Waterman Moylan
Engineering Consultants

Daylight / Sunlight Assessment

Strategic Housing Development at Auburn SHD 2, Malahide, Co. Dublin

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1. Introduction

Waterman Moylan have been appointed to complete the sunlight and daylight analysis for the proposed residential development in lands around Auburn House in Malahide, Co. Dublin. The purpose of this analysis is to determine if the various parameters associated with sunlight and daylight meet the recommendations of BRE document 'Site Layout Planning for Daylight and Sunlight: a Guide to Good Practice' Second Edition 2018.

The parameters assessed will include the following

- daylight factors within dwellings,
- sunlight to communal amenity areas and pocket parks within the proposed development,
- overshadowing caused by the proposed development within the subject site and existing adjacent properties,
- overshadowing caused by the proposed development on existing adjacent properties,
- vertical sky component to existing properties
- sunlight to existing property gardens

The proposed development has been analysed using a number of qualitative and quantitative methods to identify the areas of the development which were likely to receive the least daylight and to identify measures that could be taken to improve the daylight penetration. IES Virtual Environment simulation software was used to build a model of the proposed development to enable the necessary analysis to be completed.

This Daylight Analysis Report presents the requirements set out in the relevant guidance documents, describes the methodologies employed to complete the analysis and details the results that were achieved.

2. Site Overview and Nature of Proposed Development

2.1 Site Location & Description

The proposed development will consist of the preservation and protection of the existing Protected Structure of Auburn House and its stables as 1 no. residential dwelling; the conversion of the existing stables of Auburn House to provide for storage space for the main Auburn House and the construction of 368 no. new residential dwelling units (comprising 87 no. houses, 239 no. apartments & 42 no. duplex units) for an overall total of 369 no. residential units, including Auburn House. The development shall consist of 135 no. 1-bedroom apartments and duplex apartments, 138 no. 2-bedroom apartments and duplex apartments, 8 no. 3-bedroom apartments and duplex apartments, 47 no. 3-bedroom houses, 34 no. 4-bedroom houses, 6 no. 5-bedroom houses and the existing 11-bedroom Auburn House along with 1 no. childcare facility and 1 no. ancillary resident facility. The proposed development shall also provide landscaped public open space, car parking and all associated ancillary site development infrastructure including foul and surface water drainage, internal roads, cycle paths and footpaths, and boundary walls and fences. Vehicular access to the proposed development is to be via a new entrance at the R107 Malahide Road/Dublin Road entrance, with the existing entrance to Auburn House acting as a pedestrian/cyclist entrance and access to existing properties outside the application site, there will be a secondary entrance comprising modifications of the existing vehicular entrance off Carey's Lane to the south west of the development, the closure of the existing vehicular entrance to Little Auburn, the provision of 4 no. ESB substations, 1 no. new foul pumping station, public lighting; proposed foul sewer works along Back Road and Kinsealy Lane and all associated engineering and site works necessary to facilitate the development. The building heights range from 2 storey to 5 storey buildings with balconies or terraces being provided to the apartments and duplex units.

Figure 1 – *Proposed development site.*

Figure 2 – *Proposed arrangement of Blocks 1, 2 & 3*

Figure 3 - *Proposed arrangement of Blocks 4 & 5 and Duplex Block 2A, 2B, 2C & 2D and adjacent housing units*

Figure 4 – *Proposed arrangement of Duplex Block 1 and Apartment Blocks 6 & 7 and adjacent housing units*

Figure 5 – *Typical Elevations Blocks 1, 2 & 3*

The elevations of the scheme have been developed with a view to increasing daylight penetration by maximising window sizes and arranging balconies such that they minimise shading on the units below.

2.2 Design Development Process

The daylight modelling results presented in Section 4 of this report have been achieved following a design development process between the Architect, Conroy Crowe Kelly and Waterman Moylan. Preliminary drawings were analysed for compliance and feedback was given to the Architect.

In areas where non compliances were identified, the Architect looked to improve the access to daylight by increasing window sizes where possible and by modifying the position of the balconies to minimise the over-shading of the living areas. These changes had a positive impact on the daylight levels achieved and these improved results are reported in Section 4.

2.3 Schedule of Accommodation – Apartments & Duplexes

The Backfield - Apartment Block 1 – 46 Units					
	1 Bed	2 Bed (3P)	2 Bed (4P)	3 Bed	Total
Level 0 / Ground Floor	8	0	4	0	12
Level 1	6	0	6	0	12
Level 2	6	0	6	0	12
Level 3	6	0	4	0	10
Total	26	0	20	2	46

The Backfield – Apartment Block 2 – 49 Units					
	1 Bed	2 Bed (3P)	2 Bed (4P)	3 Bed	Total
Level 0 / Ground Floor	7	0	3	0	10
Level 1	6	0	6	0	12
Level 2	6	0	6	0	12
Level 3	6	0	4	0	10
Level 4 Penthouse	1	0	2	2	5
Total	29	0	21	2	49

The Backfield – Apartment Block 3 – 42 Units					
	1 Bed	2 Bed (3P)	2 Bed (4P)	3 Bed	Total
Level 0 / Ground Floor	7	0	4	0	11
Level 1	5	0	6	0	11
Level 2	5	0	6	0	11
Level 3	5	0	4	0	9
Total	22	0	20	0	42

The Avenue – Apartment Block 4 – 28 Units					
	1 Bed	2 Bed (3P)	2 Bed (4P)	3 Bed	Total
Level 0 / Ground Floor*	3	0	2	0	5
Level 1 / Podium	4	0	6	0	10
Level 2	3	2	5	0	10
Level 3	0	0	2	1	3
Level 4 Penthouse	0	0	0	0	0
Total	9	2	15	1	28

The Avenue – Apartment Block 5 – 28 Units					
	1 Bed	2 Bed (3P)	2 Bed (4P)	3 Bed	Total
Level 0/Ground Floor	2	0	2	0	4
Level 1 / Podium	2	0	6	0	8
Level 2	1	1	6	0	8
Level 3	1	1	4	0	6
Level 4 Penthouse	0	0	2	1	2
Total	6	2	20	0	28

Streamstown – Apartment Block 6 – 21 Units					
	1 Bed	2 Bed (3P)	2 Bed (4P)	3 Bed	Total
Level 0 / Ground Floor	1	0	4	0	5
Level 1	1	0	5	0	6
Level 2	1	0	5	0	6
Level 3 Penthouse	2	0	0	2	4

Total	5	0	14	2	21

Streamstown – Apartment Block 7 – 25 Units					
	1 Bed	2 Bed (3P)	2 Bed (4P)	3 Bed	Total
Level 0 / Ground Floor	3	0	2	0	5
Level 1	3	0	3	0	6
Level 2	3	0	3	0	6
Level 3	3	0	1	1	5
Level 4 Penthouse	2	0	1	0	3
Total	14	0	10	1	25

Streamstown - Duplex Apartment Block 1 – 6 Units					
Unit mix by floor	1 Bed	2 Bed (3P)	2 Bed (4P)	3 Bed	Total
Level 0 / Ground Floor	0	0	2	2	4
Level 1	0	0	0	0	0
Level 2	1	0	1	0	2
Total	1	0	3	2	6

The Avenue - Duplex Apartment Block 2A – 8 Units					
Unit mix by floor	1 Bed	2 Bed (3P)	2 Bed (4P)	3 Bed	Total
Level 0 / Ground Floor	4	0	0	0	4
Level 1	2	0	2	0	4
Total	6	0	2	0	8

The Avenue - Duplex Apartment Block 2B – 11 Units					
Unit mix by floor	1 Bed	2 Bed (3P)	2 Bed (4P)	3 Bed	Total
Level 0 / Ground Floor	5	0	0	0	5
Level 1	3	0	3	0	6
Total	8	0	3	0	11

The Avenue - Duplex Apartment Block 2C – 9 Units					
Unit mix by floor	1 Bed	2 Bed (3P)	2 Bed (4P)	3 Bed	Total
Level 0 / Ground Floor	5	0	0	0	5
Level 1	2	0	2	0	4
Total	7	0	2	0	9

The Avenue - Duplex Apartment Block 2D – 8 Units					
Unit mix by floor	1 Bed	2 Bed (3P)	2 Bed (4P)	3 Bed	Total
Level 0 / Ground Floor	4	0	1	0	5
Level 1	1	0	3	0	4
Total	5	0	4	0	9

3. Relevant Standards and Assessment Approach

This Daylight and Sunlight Assessment follows the methodologies set out in the Building Research Establishment's (BRE) publication entitled "***Site Layout Planning for Daylight and Sunlight. A Guide to Good Practice*** (Building Research Establishment Report, 2018). This document is considered to be one of the primary sources of guidance on the subject of daylight and sunlight in residential developments and BS 8206-2008 – 'Lighting for Buildings – Part 2: Code of Practice for Daylight'.

Guidance on daylight levels in residential buildings is also provided in ***British Standard (BS) 8206: Part 2 – Code of Practice for Daylighting.*** Both the BRE document and BS 8206 describe similar approaches to assessing daylight levels in residential buildings and set the same minimum performance levels for daylighting. The BRE document refers to BS 8206 and provides more practical advice and greater clarity around the assessment methodologies and will therefore form the basis for the assessment described in this report.

It is noted that BS 8206-2:2008: Lighting for buildings - Part 2: Code of practice for daylighting was replaced with BS EN 17037:2018 Daylight in Buildings. However, given that the Sustainable Urban Housing: Design Standards for New Apartments Guidelines for Planning Authorities refer to the BS 8206-2:2008 and not to BS EN 17037:2018, BS 8206:2008 has been referenced in the preparation of this report.

The BRE "Site Layout Planning for Daylight and Sunlight. A Guidance to Good Practice" sets out a number of key parameters and assessment methodologies that should be measured in order to assess the sunlight & daylight penetration into the buildings within a proposed development and also sets out the analysis that should be carried out to assess the impact of a proposed development might have on existing adjacent properties.

3.1 Assessment Methodologies

The BRE report identifies a number of metrics that can be used to assess the levels of daylight that can be expected in a dwelling

3.1.1 Angle of Visible Sky

The Angle of Visible Sky can be used to provide a qualitative assessment of the amount of daylight that can be expected based on the angle between the mid pane of the window a continuous obstruction opposite to it.

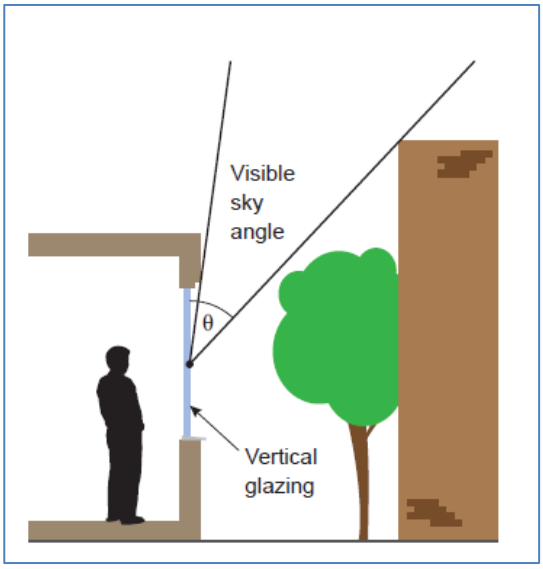

Figure 6 – *Angle of Visible Sky (Θ)*

3.1.2 Vertical Sky Component (VSC)

The Vertical Sky Component (VSC) is the ratio of direct sky illuminance that falls on a vertical wall at a particular reference point to the simultaneous horizontal illuminance under an unobstructed sky. The maximum VSC is typically 40% for an unobstructed wall. The assessment of VSC assumes that the sky is completely overcast (CIE Overcast Sky), with no direct sunlight. As the sky model brightness is assumed unidirectional, there is therefore no difference in calculation for VSC for different orientations: i.e., Northerly aspect facades will receive identical natural light potential to Southerly, etc.

The Angle of Visible Sky and the VSC are effectively different ways of representing the same information, both will allow an assessment to be made of the day light available at a point on a building façade, and by extension the likelihood of adequate daylight being available within the rooms of a building, however they do not provide a method for measuring the specific internal daylight levels.

3.1.3 Average Daylight Factor (ADF)

The ADF is the ratio of illuminance at a point on a given plane due to light received from a sky of known or assumed luminance distribution, to illuminance on a horizontal plane due to an unobstructed hemisphere of this sky. Similar to the measurement of VSC, the assessment of ADF is also based on the CIE Overcast Sky.

The Average Daylight Factor does provide a method for making a quantitative assessment of the daylight that will be achieved internally. The ADF is assessed using numerical modelling which takes account of the external factors (such as shading from balconies or other buildings), the size and shape of the windows and the internal room layouts.

BS 8206-2 Code of Practice for daylighting, states that below 2% the room will look dull and electric lighting is likely to be turned on. In residential developments, both the BRE guidance and BS 8206-2 also give minimum value of ADF of 2% for kitchens, 1.5% for living rooms and 1% for bedrooms."

In assessing a scheme of the size that proposed for the Auburn site, the most effective way to assess the overall daylight levels in the scheme is to use a combination of the methods described above. Sectional views of apartments will be assessed to determine which apartments will have the lowest value for the Angle of Visible Sky, then, once these apartments have been identified, ADF calculations will be carried on these units to confirm the actual level of daylight that will be achieved.

3.1.4 Sunlight to Amenity

The BRE guidelines recommend that for external amenity spaces to appear adequately sunlit throughout the year, at least 50% of the amenity space should receive at least two hours of sunlight on March 21st. In order to prove that sunlight levels to amenity spaces achieve compliance a dynamic simulation was carried out using IES VE Suncast.

The amenity spaces were accurately imported to IES VE via Auto CAD dxf files, and the footprint of the amenity area was traced and the geometry (position, bulk and height) of all proposed building structures were included in order to perform accurate IES VE Suncast simulations.

3.1.5 Annual Probable Sunlight Hours

Annual probable sunlight hours (APSH) are a measure of sunlight a given window may expect over the period of a one year. The BRE guidance recognises that sunlight is heavily influenced by orientation with north facing windows receiving significantly less sunlight than south facing windows throughout the year with eastwards or westwards windows receiving sunlight at certain points of each day.

If the assessment point of a window can receive more than 25% of APSH, including at least 5% of APSH in the winter months, then the room should receive enough sunlight.

To determine the impact the proposed development may have on the existing properties a dynamic simulation was carried out using IES VE software. In order to calculate and objectively determine the impact to the existing properties, simulations were performed modelling the existing properties before introducing the proposed development to establish a baseline.

3.1.6 Vertical Sky Component – Existing Adjacent Properties

This assessment used receptors on the existing properties surrounding the proposed development in order to analyse the impact the proposed development may have on these existing dwellings.

A visual survey of the existing properties was carried out using 'Google – Earth' to identify windows (receptors) which look onto the proposed development to determine if there was a significant drop in illuminance due to obstructions from the auburn site.

4. Daylight Assessment of Dwellings

As discussed in Section 3, a combination of methods was used to make an assessment of the daylight levels that will be achieved within the various apartments within the development. This assessment systematically identified the apartments that will have the most restricted access to daylight based on BRE recommended Vertical Sky Angle obstruction angle of between 25° - 45°.

4.1 Angle of Visible Sky Assessment

In order to use the Angle of Visible Sky method to critically assess the scheme, a series of sections through the buildings were analysed to determine which apartments had the least advantageous “Angle of Visible Sky” as these are the apartments that are likely to perform the worst in terms of Average Daylight Factor.

Due to the low-rise nature of the scheme overall and the fact that the apartment blocks are generally well spaced out, the majority of apartments have a favourable Angle of Visible Sky. This analysis did however highlight the fact that the apartments on the lower levels of Blocks 1, 2 and 3 had the least favourable value due to the fact that the blocks were located next to each other and due to the geometry of some of the balconies.

As such, these units were the focus of the initial Average Daylight Factor ADF analysis. This initial analysis identified rooms where the ADF did not meet the required minimum standards and where changes needed to be made. Waterman Moylan liaised with CCK to identify the required changes and to remodel the performance of the changes made. Once satisfied that these changes had the desired effect, they were implemented. ADF modelling was then completed for all units in apartment blocks 1 to 7 and duplex blocks 1, 2A, 2B, 2C & 2D, starting at ground level and working up through the floors.

4.2 Average Daylight Factor Assessment

Having analysed the scheme as described in Section 4.1 above to identify the apartments that were not achieving the minimum standard and to work with the architect to make the necessary changes, a systematic ADF modelling approach was then undertaken to work through all apartments in the scheme.

This involved the use of ***IES Virtual Environment program Radiance*** *to* systematically model apartments at through each level in Blocks 1 – 7 and Duplex Blocks 1 & 2A – 2D to determine compliance with the required standards.

The results of this modelling exercise are shown in Tables 1 to 12 in Section 4.2.2 for every living area and bedroom in all apartments in Apartment Blocks 1-7 and kitchen/living/dining rooms & bedrooms in the Duplex Blocks.

The average daylight factor results are visually represented using daylight mapping images for each area, as indicated in the examples in Figures 7, 8 & 9. The daylight mapping images indicate the daylight levels in a space each space. They are represented through coloured bands which indicate the level of daylight in each part of the room.

The average daylight factor generate in Figure 7 to 9 shows the level daylight received ranging from 14.25% (red band) to 0.75% (blue band). These images show how the level of daylight reduces as the distance from the window increases. The average daylight factor in each space is an average of each of

the varying levels of daylight throughout the room. Figures 7-9 are examples of 3 typical rooms. Full mapping for each floor of each of the assessed buildings is provided in Appendix A.

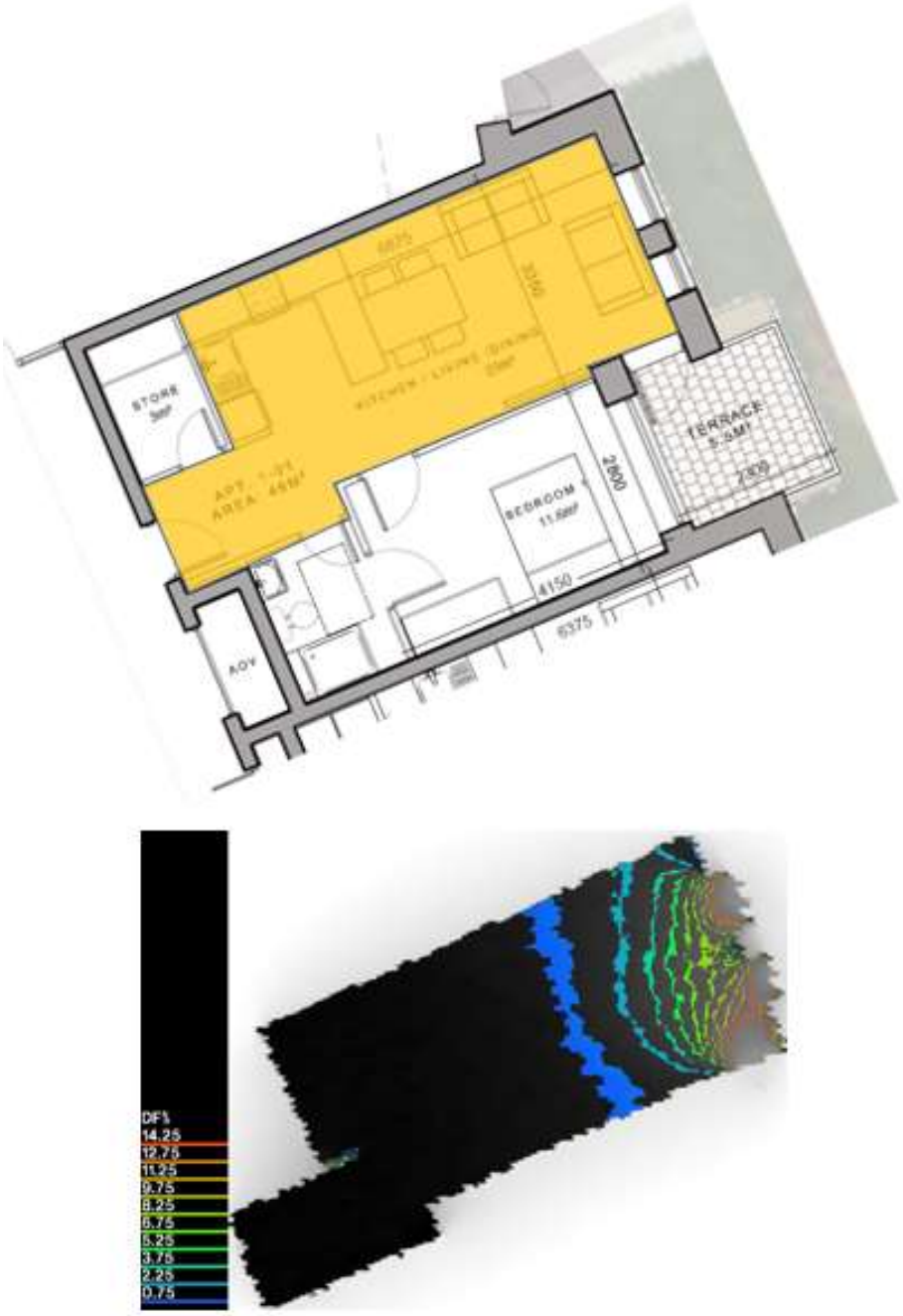

Figure 7 – *Block 1 Apartment 1.01 (K/L/D) Daylight Mapping*

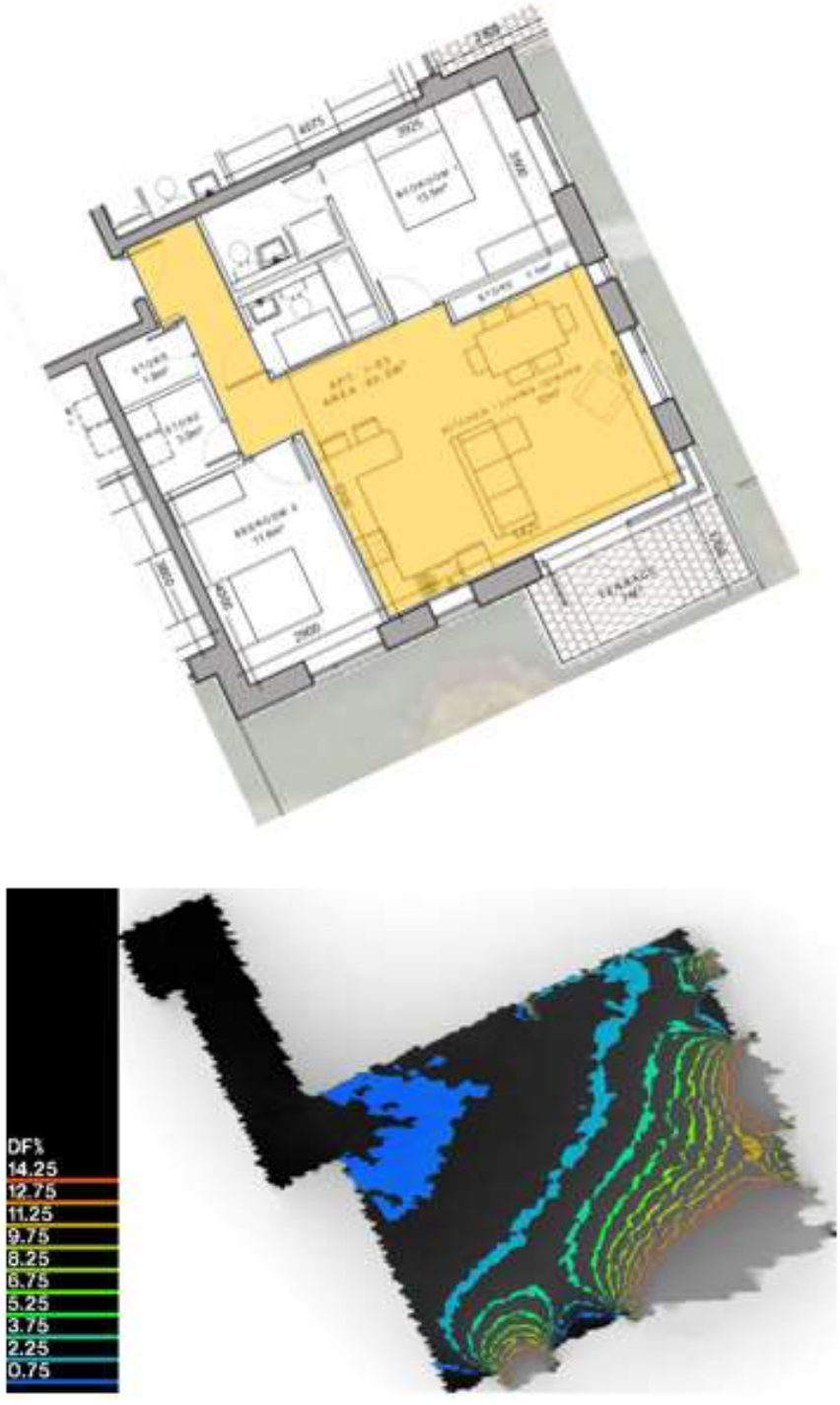

Figure 8 – *Block 1 Apartment 1.03 (K/L/D) Daylight Mapping*

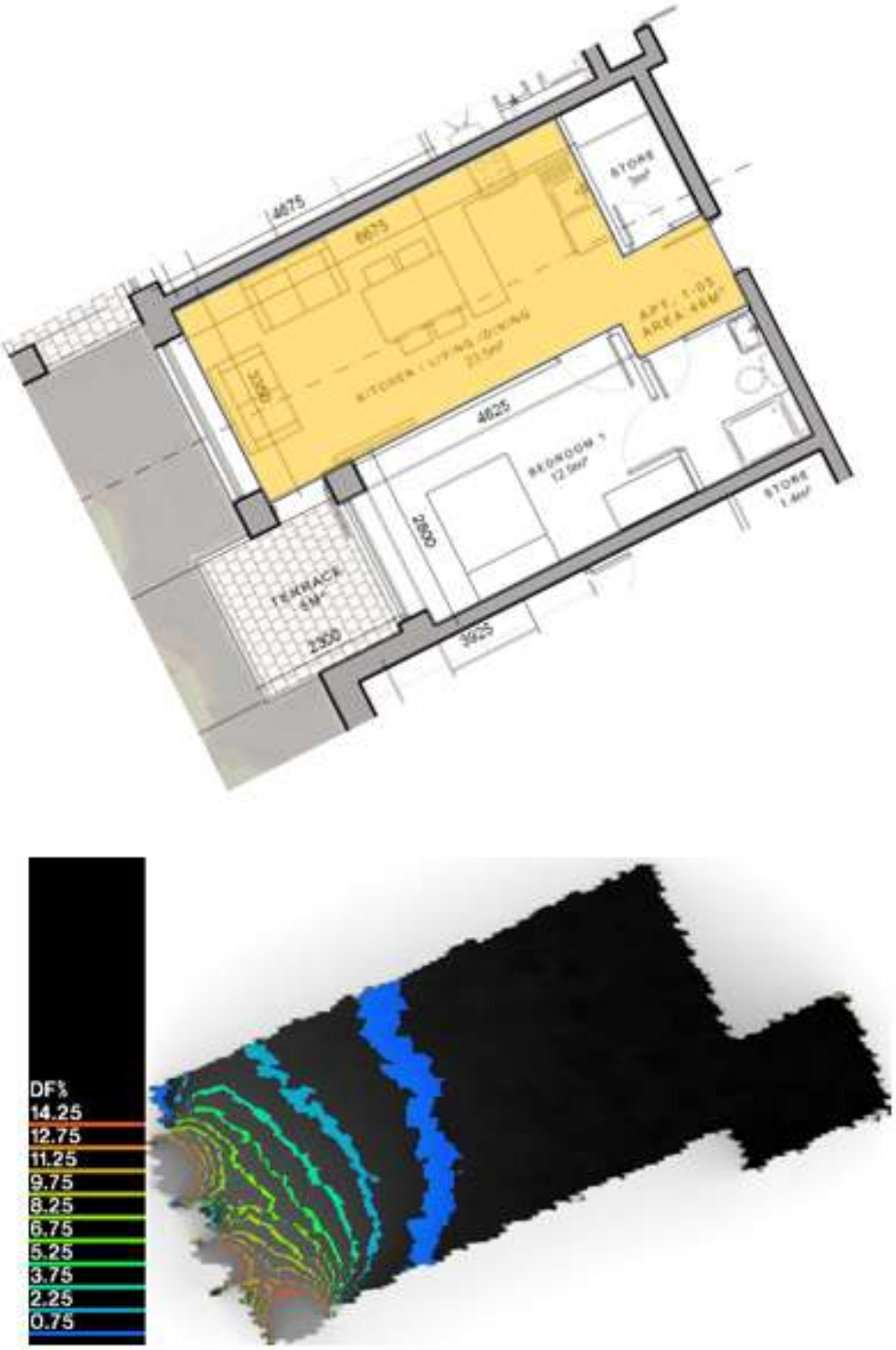

Figure 9 – *Block 1 Apartment 1.05 (K/L/D) Daylight Mapping*

4.2.1 IES Model Data

The model was built in accordance with architectural Auto CAD layouts issued by CCK Architects which included all blocks in the proposed development. Images of the model are presented below

The following assumptions were made when modelling the ADF in each of the apartments selected

- The CIE Overcast Sky was used in accordance with CIBSE and BRE Guidance
- The following material properties were assigned in the model:
    - Glazing Visible Light Transmittance - 0.70
    - Internal Wall Reflectance - 0.80
    - Ceiling Reflectance - 0.80
    - Internal Floor Reflectance - 0.68
- Working Plane Height

  The working plane height in the model was taken as 0.85m. This is a typical value for domestic applications based on guidance within the BRE Guide "Site Layout Planning for Daylight and Sunlight" Second Edition 2018.

4.2.2 Average Daylight Factor Results

The BRE guidelines suggest a daylight level of 2% for kitchen/living/Dining areas, 1.5% Living areas and 1% for bedrooms as an adequate performance in terms of access to daylight. The tables 1 to 12 below indicate rooms assessed achieved daylight levels in compliance with the minimum standards.

The BRE "Site Layout Planning for Daylight and Sunlight. A Guidance to Good Practice states, *"2.1.8 Daylight provision in new rooms may be checked using the average daylight factor (ADF). The ADF is a measure of the overall amount of daylight in a space... BS 8206-2 Code of practice for daylighting" states that below 2% the room will look dull and electric lighting is likely to be turned on. In housing BS 8206-2 also gives minimum value of ADF of 2% for kitchens, 1.5% for living rooms and 1% for bedrooms."*

In all cases adequate glazing areas have been designed into all units of the proposed development with dual aspect facades incorporated where possible.

Block 1 ADF Results				
Block	Unit	Type	ADF Required (%)	ADF Results (%)
1	APT.1-01	K/L/D	2	2.30
1	APT.1-01	Bed 1	1	1.03
1	APT.1-02	K/L/D	2	2.42
1	APT.1-02	Bed 1	1	1.01

1	APT.1-03	Bed 1	1	2.24
1	APT.1-03	K/L/D	2	3.75
1	APT.1-03	Bed 2	1	3.54
1	APT.1-04	Bed 2	1	3.93
1	APT.1-04	K/L/D	2	4.20
1	APT.1-04	Bed 1	1	3.73
1	APT.1-05	Bed 1	1	1.17
1	APT.1-05	K/L/D	2	2.16
1	APT.1-06	Bed 1	1	1.54
1	APT.1-06	K/L/D	2	2.35
1	APT.1-07	K/L/D	2	2.22
1	APT.1-07	Bed 1	1	2.47
1	APT.1-08	Bed 1	1	1.13
1	APT.1-08	K/L/D	2	2.12
1	APT.1-09	Bed 1	1	3.01
1	APT.1-09	K/L/D	2	3.30
1	APT.1-09	Bed 2	1	2.37
1	APT.1-10	Bed 2	1	2.23
1	APT.1-10	K/L/D	2	2.85
1	APT.1-10	Bed 1	1	2.55
1	APT.1-11	K/L/D	2	2.08
1	APT.1-11	Bed 1	1	1.19
1	APT.1-12	K/L/D	2	2.01
1	APT.1-12	Bed 1	1	1.18
1	APT.1-13	K/L/D	2	2.65
1	APT.1-13	Bed 1	1	1.18
1	APT.1-14	K/L/D	2	2.78
1	APT.1-14	Bed 1	1	1.16
1	APT.1-15	Bed 1	1	2.57
1	APT.1-15	K/L/D	2	4.31
1	APT.1-15	Bed 2	1	4.08
1	APT.1-16	Bed 2	1	4.49
1	APT.1-16	K/L/D	2	4.84
1	APT.1-16	Bed 1	1	4.26
1	APT.1-17	Bed 1	1	1.35
1	APT.1-17	K/L/D	2	2.44
1	APT.1-18	Bed 2	1	1.78
1	APT.1-18	K/L/D	2	2.68
1	APT.1-18	Bed 1	1	1.36

1	APT.1-19	Bed 1	1	1.43
1	APT.1-19	K/L/D	2	2.56
1	APT.1-19	Bed 2	1	2.84
1	APT.1-20	Bed 1	1	1.32
1	APT.1-20	K/L/D	2	3.03
1	APT.1-21	Bed 1	1	3.44
1	APT.1-21	K/L/D	2	3.76
1	APT.1-21	Bed 2	1	2.84
1	APT.1-22	Bed 2	1	2.56
1	APT.1-22	K/L/D	2	3.22
1	APT.1-22	Bed 1	1	2.98
1	APT.1-23	K/L/D	2	2.33
1	APT.1-23	Bed 1	1	1.35
1	APT.1-24	K/L/D	2	2.34
1	APT.1-24	Bed 1	1	1.35
1	APT.1-25	K/L/D	2	3.91
1	APT.1-25	Bed 1	1	1.74
1	APT.1-26	K/L/D	2	4.10
1	APT.1-26	Bed 1	1	1.72
1	APT.1-27	Bed 1	1	3.79
1	APT.1-27	K/L/D	2	6.36
1	APT.1-27	Bed 2	1	6.02
1	APT.1-28	Bed 2	1	6.62
1	APT.1-28	K/L/D	2	5.89
1	APT.1-28	Bed 1	1	5.76
1	APT.1-29	Bed 1	1	1.99
1	APT.1-29	K/L/D	2	3.52
1	APT.1-30	Bed 2	1	2.63
1	APT.1-30	K/L/D	2	3.96
1	APT.1-30	Bed 1	1	2.02
1	APT.1-31	Bed 1	1	2.11
1	APT.1-31	K/L/D	2	3.78
1	APT.1-31	Bed 2	1	4.19
1	APT.1-32	Bed 1	1	1.96
1	APT.1-32	K/L/D	2	4.58
1	APT.1-33	Bed 1	1	4.65
1	APT.1-33	K/L/D	2	5.54
1	APT.1-33	Bed 2	1	4.19
1	APT.1-34	Bed 2	1	3.78

1	APT.1-34	K/L/D	2	4.75
1	APT.1-34	Bed 1	1	4.40
1	APT.1-35	K/L/D	2	3.44
1	APT.1-35	Bed 1	1	1.99
1	APT.1-36	K/L/D	2	3.46
1	APT.1-36	Bed 1	1	1.96
1	APT.1-37	K/L/D	2	4.54
1	APT.1-37	Bed 1	1	2.02
1	APT.1-38	K/L/D	2	4.76
1	APT.1-38	Bed 1	1	1.99
1	APT.1-39	Bed 1	1	4.40
1	APT.1-39	K/L/D	2	7.38
1	APT.1-39	Bed 2	1	6.99
1	APT.1-40	Bed 2	1	7.68
1	APT.1-40	K/L/D	2	6.83
1	APT.1-40	Bed 1	1	6.69
1	APT.1-41	Bed 1	1	2.31
1	APT.1-41	K/L/D	2	4.08
1	APT.1-42	Bed 2	1	3.05
1	APT.1-42	K/L/D	2	4.59
1	APT.1-42	Bed 1	1	2.34
1	APT.1-43	Bed 1	1	2.45
1	APT.1-43	K/L/D	2	4.38
1	APT.1-43	Bed 2	1	4.86
1	APT.1-44	Bed 1	1	2.27
1	APT.1-44	K/L/D	2	5.32
1	APT.1-45	K/L/D	2	4.00
1	APT.1-45	Bed 1	1	2.31
1	APT.1-46	K/L/D	2	4.01
1	APT.1-46	Bed 1	1	2.27

Table 1 – *Block 1 ADF Results*

Block 2 ADF Results				
Block	Unit	Type	ADF Required (%)	ADF Results (%)
2	APT.2-01	K/L/D	2	2.43
2	APT.2-01	Bed 1	1	1.08
2	APT.2-02	K/L/D	2	2.52
2	APT.2-02	Bed 1	1	1.03
2	APT.2-03	Bed 1	1	2.53
2	APT.2-03	K/L/D	2	3.65
2	APT.2-03	Bed 2	1	3.48
2	APT.2-04	Bed 2	1	3.98
2	APT.2-04	K/L/D	2	4.29
2	APT.2-04	Bed 1	1	2.85
2	APT.2-05	Bed 1	1	1.07
2	APT.2-05	K/L/D	2	2.03
2	APT.2-06	Bed 1	1	1.31
2	APT.2-06	K/L/D	2	2.15
2	APT.2-06	Bed 2	1	1.43
2	APT.2-07	Bed 1	1	1.31
2	APT.2-07	K/L/D	2	2.23
2	APT.2-07	Bed 2	1	1.53
2	APT.2-08	Bed 1	1	1.10
2	APT.2-08	K/L/D	2	2.02
2	APT.2-09	K/L/D	2	2.13
2	APT.2-09	Bed 1	1	1.23
2	APT.2-10	K/L/D	2	2.11
2	APT.2-10	Bed 1	1	1.26
2	APT.2-11	K/L/D	2	2.77
2	APT.2-11	Bed 1	1	1.24
2	APT.2-12	K/L/D	2	2.89
2	APT.2-12	Bed 1	1	1.17
2	APT.2-13	Bed 1	1	2.86
2	APT.2-13	K/L/D	2	4.16
2	APT.2-13	Bed 2	1	3.98
2	APT.2-14	Bed 2	1	4.56
2	APT.2-14	K/L/D	2	4.91
2	APT.2-14	Bed 1	1	3.23
2	APT.2-15	Bed 1	1	1.22

2	APT.2-15	K/L/D	2	2.36
2	APT.2-16	Bed 1	1	1.48
2	APT.2-16	K/L/D	2	2.49
2	APT.2-16	Bed 2	1	1.63
2	APT.2-17	Bed 1	1	1.52
2	APT.2-17	K/L/D	2	2.54
2	APT.2-17	Bed 2	1	1.75
2	APT.2-18	Bed 1	1	1.22
2	APT.2-18	K/L/D	2	2.33
2	APT.2-19	Bed 1	1	3.52
2	APT.2-19	K/L/D	2	3.78
2	APT.2-19	Bed 2	1	2.92
2	APT.2-20	Bed 2	1	2.53
2	APT.2-20	K/L/D	2	3.36
2	APT.2-20	Bed 1	1	3.02
2	APT.2-21	K/L/D	2	2.42
2	APT.2-21	Bed 1	1	1.39
2	APT.2-22	K/L/D	2	2.04
2	APT.2-22	Bed 1	1	1.42
2	APT.2-23	K/L/D	2	4.43
2	APT.2-23	Bed 1	1	1.99
2	APT.2-24	K/L/D	2	4.62
2	APT.2-24	Bed 1	1	1.87
2	APT.2-25	Bed 1	1	4.58
2	APT.2-25	K/L/D	2	5.63
2	APT.2-25	Bed 2	1	5.88
2	APT.2-26	Bed 2	1	6.17
2	APT.2-26	K/L/D	2	6.64
2	APT.2-26	Bed 1	1	5.16
2	APT.2-27	Bed 1	1	1.88
2	APT.2-27	K/L/D	2	3.75
2	APT.2-28	Bed 1	1	2.05
2	APT.2-28	K/L/D	2	3.67
2	APT.2-28	Bed 2	1	2.65
2	APT.2-29	Bed 1	1	2.09
2	APT.2-29	K/L/D	2	3.76
2	APT.2-29	Bed 2	1	2.47
2	APT.2-30	Bed 1	1	1.81
2	APT.2-30	K/L/D	2	3.63

2	APT.2-31	Bed 1	1	5.63
2	APT.2-31	K/L/D	2	5.39
2	APT.2-31	Bed 2	1	4.31
2	APT.2-32	Bed 2	1	3.83
2	APT.2-32	K/L/D	2	4.97
2	APT.2-32	Bed 1	1	4.46
2	APT.2-33	K/L/D	2	3.67
2	APT.2-33	Bed 1	1	2.22
2	APT.2-34	K/L/D	2	3.26
2	APT.2-34	Bed 1	1	2.29
2	APT.2-35	K/L/D	2	5.45
2	APT.2-35	Bed 1	1	2.45
2	APT.2-36	K/L/D	2	5.68
2	APT.2-36	Bed 1	1	2.30
2	APT.2-37	Bed 1	1	5.63
2	APT.2-37	K/L/D	2	6.93
2	APT.2-37	Bed 2	1	7.23
2	APT.2-38	Bed 2	1	7.59
2	APT.2-38	K/L/D	2	8.17
2	APT.2-38	Bed 1	1	6.35
2	APT.2-39	Bed 1	1	2.31
2	APT.2-39	K/L/D	2	4.61
2	APT.2-40	Bed 1	1	2.52
2	APT.2-40	K/L/D	2	4.52
2	APT.2-40	Bed 2	1	3.26
2	APT.2-41	Bed 1	1	2.58
2	APT.2-41	K/L/D	2	4.62
2	APT.2-41	Bed 2	1	3.04
2	APT.2-42	Bed 1	1	2.23
2	APT.2-42	K/L/D	2	4.46
2	APT.2-43	K/L/D	2	4.47
2	APT.2-43	Bed 1	1	2.71
2	APT.2-44	K/L/D	2	3.98
2	APT.2-44	Bed 1	1	2.79
2	APT.2-45	Bed 1	1	4.57
2	APT.2-45	Bed 2	1	4.56
2	APT.2-45	K/L/D	2	6.59
2	APT.2-46	Bed 1	1	4.44
2	APT.2-46	Bed 2	1	4.32

2	APT.2-46	K/L/D	2	7.09
2	APT.2-47	Bed 3	1	4.68
2	APT.2-47	Bed 2	1	4.92
2	APT.2-47	Bed 1	1	4.56
2	APT.2-47	K/L/D	2	6.65
2	APT.2-48	Bed 3	1	4.08
2	APT.2-48	Bed 2	1	4.20
2	APT.2-48	Bed 1	1	3.96
2	APT.2-48	K/L/D	2	6.70
2	APT.2-49	K/L/D	2	6.54
2	APT.2-49	Bed 1	1	4.20

Table 2 – *Block 2 ADF Results*

Block 3 ADF Results				
Block	Unit	Type	ADF Required (%)	ADF Results (%)
3	APT.3-01	K/L/D	2	2.37
3	APT.3-01	Bed 1	1	1.08
3	APT.3-02	K/L/D	2	2.49
3	APT.3-02	Bed 1	1	1.04
3	APT.3-03	Bed 1	1	2.31
3	APT.3-03	K/L/D	2	3.86
3	APT.3-03	Bed 2	1	3.65
3	APT.3-04	Bed 2	1	3.78
3	APT.3-04	Bed 1	1	2.54
3	APT.3-04	K/L/D	2	4.02
3	APT.3-05	K/L/D	2	2.42
3	APT.3-05	Bed 1	1	1.09
3	APT.3-06	K/L/D	2	2.29
3	APT.3-07	Bed 1	1	1.16
3	APT.3-07	K/L/D	2	2.04
3	APT.3-08	Bed 1	1	3.10
3	APT.3-08	K/L/D	2	3.40
3	APT.3-09	K/L/D	2	2.94
3	APT.3-09	Bed 1	1	2.13
3	APT.3-09	Bed 2	1	2.63

3	APT.3-10	K/L/D	2	2.14
3	APT.3-10	Bed 1	1	1.21
3	APT.3-11	K/L/D	2	2.07
3	APT.3-11	Bed 1	1	1.22
3	APT.3-12	K/L/D	2	2.71
3	APT.3-12	Bed 1	1	1.26
3	APT.3-13	K/L/D	2	2.91
3	APT.3-13	Bed 1	1	1.22
3	APT.3-14	Bed 1	1	2.70
3	APT.3-14	K/L/D	2	4.52
3	APT.3-14	Bed 2	1	4.27
3	APT.3-15	Bed 2	1	4.52
3	APT.3-15	Bed 1	1	2.92
3	APT.3-15	K/L/D	2	5.63
3	APT.3-16	Bed 2	1	1.86
3	APT.3-16	K/L/D	2	2.83
3	APT.3-16	Bed 1	1	1.28
3	APT.3-17	Bed 1	1	1.39
3	APT.3-17	K/L/D	2	2.68
3	APT.3-17	Bed 2	1	1.72
3	APT.3-18	Bed 1	1	1.37
3	APT.3-18	K/L/D	2	2.39
3	APT.3-19	Bed 1	1	3.63
3	APT.3-19	K/L/D	2	3.99
3	APT.3-19	Bed 2	1	2.84
3	APT.3-20	K/L/D	2	3.44
3	APT.3-20	Bed 1	1	2.34
3	APT.3-20	Bed 2	1	3.08
3	APT.3-21	K/L/D	2	2.50
3	APT.3-21	Bed 1	1	1.42
3	APT.3-22	K/L/D	2	2.42
3	APT.3-22	Bed 1	1	1.43
3	APT.3-23	K/L/D	2	4.30
3	APT.3-23	Bed 1	1	1.54
3	APT.3-24	K/L/D	2	3.55
3	APT.3-24	Bed 1	1	1.49
3	APT.3-25	Bed 1	1	3.29
3	APT.3-25	K/L/D	2	5.54
3	APT.3-25	Bed 2	1	5.21

3	APT.3-26	Bed 2	1	6.41
3	APT.3-26	Bed 1	1	3.82
3	APT.3-26	K/L/D	2	6.45
3	APT.3-27	Bed 2	1	2.27
3	APT.3-27	K/L/D	2	3.45
3	APT.3-27	Bed 1	1	1.56
3	APT.3-28	Bed 1	1	1.70
3	APT.3-28	K/L/D	2	3.27
3	APT.3-28	Bed 2	1	2.98
3	APT.3-29	Bed 1	1	1.68
3	APT.3-29	K/L/D	2	2.92
3	APT.3-30	Bed 1	1	4.48
3	APT.3-30	K/L/D	2	4.87
3	APT.3-30	Bed 2	1	3.98
3	APT.3-31	K/L/D	2	5.05
3	APT.3-31	Bed 1	1	2.82
3	APT.3-31	Bed 2	1	4.14
3	APT.3-32	K/L/D	2	3.98
3	APT.3-32	Bed 1	1	2.08
3	APT.3-33	K/L/D	2	3.20
3	APT.3-33	Bed 1	1	2.12
3	APT.3-34	K/L/D	2	5.34
3	APT.3-34	Bed 1	1	1.91
3	APT.3-35	K/L/D	2	4.40
3	APT.3-35	Bed 1	1	1.85
3	APT.3-36	Bed 1	1	4.08
3	APT.3-36	K/L/D	2	6.87
3	APT.3-36	Bed 2	1	6.46
3	APT.3-37	Bed 2	1	7.95
3	APT.3-37	Bed 1	1	4.74
3	APT.3-37	K/L/D	2	8.00
3	APT.3-38	Bed 2	1	2.81
3	APT.3-38	K/L/D	2	4.28
3	APT.3-38	Bed 1	1	1.93
3	APT.3-39	Bed 1	1	2.11
3	APT.3-39	K/L/D	2	4.05
3	APT.3-39	Bed 2	1	3.70
3	APT.3-40	Bed 1	1	2.08
3	APT.3-40	K/L/D	2	3.62

3	APT.3-41	K/L/D	2	4.93
3	APT.3-41	Bed 1	1	2.57
3	APT.3-42	K/L/D	2	3.97
3	APT.3-42	Bed 1	1	2.63

Table 3 – *Block 3 ADF Results*

Block 4 ADF Results				
Block	Unit	Type	ADF Required (%)	ADF Required (%)
4	APT.4-01	Bed 1	1	1.07
4	APT.4-01	K/L/D	2	2.78
4	APT.4-01	Bed 2	1	5.94
4	APT.4-02	K/L/D	2	3.99
4	APT.4-02	Bed 1	1	1.46
4	APT.4-03	K/L/D	2	4.08
4	APT.4-03	Bed 1	1	1.47
4	APT.4-04	Bed 1	1	3.72
4	APT.4-04	K/L/D	2	2.65
4	APT.4-04	Bed 2	1	3.97
4	APT.4-05	Bed 2	1	3.63
4	APT.4-05	K/L/D	2	2.56
4	APT.4-05	Bed 1	1	1.16
4	APT.4-06	Bed 2	1	5.51
4	APT.4-06	K/L/D	2	2.36
4	APT.4-06	Bed 1	1	5.45
4	APT.4-07	Bed 1	1	6.89
4	APT.4-07	K/L/D	2	3.44
4	APT.4-07	Bed 2	1	3.56
4	APT.4-08	Bed 1	1	1.15
4	APT.4-08	K/L/D	2	4.37
4	APT.4-08	Bed 2	1	7.46
4	APT.4-09	K/L/D	2	3.91
4	APT.4-09	Bed 1	1	1.25
4	APT.4-10	K/L/D	2	3.85
4	APT.4-10	Bed 1	1	1.31
4	APT.4-11	Bed 2	1	3.95

4	APT.4-11	K/L/D	2	2.7
4	APT.4-11	Bed 1	1	2.74
4	APT.4-12	Bed 1	1	2.86
4	APT.4-12	K/L/D	2	2.91
4	APT.4-12	Bed 2	1	6.78
4	APT.4-13	Bed 1	1	1.03
4	APT.4-13	K/L/D	2	3.99
4	APT.4-14	Bed 1	1	1.23
4	APT.4-14	K/L/D	2	2.93
4	APT.4-15	Bed 2	1	4.50
4	APT.4-15	K/L/D	2	3.17
4	APT.4-15	Bed 1	1	1.44
4	APT.4-16	Bed 2	1	6.83
4	APT.4-16	K/L/D	2	2.93
4	APT.4-16	Bed 1	1	6.76
4	APT.4-17	Bed 1	1	8.54
4	APT.4-17	K/L/D	2	4.27
4	APT.4-17	Bed 2	1	4.41
4	APT.4-18	Bed 1	1	1.43
4	APT.4-18	K/L/D	2	5.42
4	APT.4-18	Bed 2	1	9.25
4	APT.4-19	K/L/D	2	4.85
4	APT.4-19	Bed 1	1	1.55
4	APT.4-20	K/L/D	2	4.77
4	APT.4-20	Bed 1	1	1.62
4	APT.4-21	Bed 2	1	4.90
4	APT.4-21	K/L/D	2	3.35
4	APT.4-21	Bed 1	1	3.40
4	APT.4-22	Bed 1	1	3.55
4	APT.4-22	K/L/D	2	3.61
4	APT.4-22	Bed 2	1	8.41
4	APT.4-23	Bed 1	1	1.28
4	APT.4-23	K/L/D	2	4.95
4	APT.4-24	Bed 1	1	1.53
4	APT.4-24	K/L/D	2	3.63
4	APT.4-25	Bed 1	1	7.83
4	APT.4-25	Bed 2	1	11.58
4	APT.4-25	K/L/D	2	8.65
4	APT.4-26	Bed 1	1	10.46

4	APT.4-26	Bed 2	1	9.16
4	APT.4-26	K/L/D	2	10.46
4	APT.4-27	Bed 1	1	12.74
4	APT.4-27	Bed 2	1	7.49
4	APT.4-27	Bed 3	1	8.41
4	APT.4-27	K/L/D	2	13.01

Table 4 – *Block 4 ADF Results*

Block 5 ADF Results				
Block	Unit	Type	ADF Required (%)	ADF Results (%)
5	APT.5-01	Bed 1	1	5.07
5	APT.5-01	K/L/D	2	3.92
5	APT.5-01	Bed 2	1	3.68
5	APT.5-02	Bed 1	1	1.62
5	APT.5-02	K/L/D	2	4.43
5	APT.5-03	Bed 2	1	5.71
5	APT.5-03	K/L/D	2	4.58
5	APT.5-03	Bed 1	1	1.15
5	APT.5-04	K/L/D	2	3.75
5	APT.5-04	Bed 1	1	1.12
5	APT.5-05	Bed 1	1	4.40
5	APT.5-05	K/L/D	2	3.61
5	APT.5-05	Bed 2	1	4.64
5	APT.5-06	Bed 1	1	1.32
5	APT.5-06	K/L/D	2	5.25
5	APT.5-07	Bed 2	1	7.08
5	APT.5-07	K/L/D	2	4.64
5	APT.5-07	Bed 1	1	1.31
5	APT.5-08	Bed 2	1	4.58
5	APT.5-08	K/L/D	2	2.45
5	APT.5-08	Bed 1	1	7.73
5	APT.5-09	Bed 1	1	3.44
5	APT.5-09	K/L/D	2	3.27
5	APT.5-09	Bed 2	1	5.88
5	APT.5-10	Bed 1	1	1.03

5	APT.5-10	K/L/D	2	3.90
5	APT.5-10	Bed 2	1	4.98
5	APT.5-11	K/L/D	2	3.58
5	APT.5-11	Bed 1	1	1.31
5	APT.5-12	Bed 2	1	7.64
5	APT.5-12	K/L/D	2	3.30
5	APT.5-12	Bed 1	1	5.21
5	APT.5-13	Bed 1	1	5.32
5	APT.5-13	K/L/D	2	4.37
5	APT.5-13	Bed 2	1	5.61
5	APT.5-14	Bed 1	1	1.60
5	APT.5-14	K/L/D	2	6.35
5	APT.5-15	Bed 2	1	8.57
5	APT.5-15	K/L/D	1	5.61
5	APT.5-15	Bed 1	2	1.59
5	APT.5-16	Bed 2	1	5.54
5	APT.5-16	K/L/D	1	2.96
5	APT.5-16	Bed 1	2	9.35
5	APT.5-17	Bed 1	1	4.16
5	APT.5-17	K/L/D	1	3.96
5	APT.5-17	Bed 2	2	7.11
5	APT.5-18	Bed 1	1	1.25
5	APT.5-18	K/L/D	1	4.72
5	APT.5-18	Bed 2	2	6.03
5	APT.5-19	K/L/D	2	4.33
5	APT.5-19	Bed 1	1	1.59
5	APT.5-19	Bed 2	1	9.24
5	APT.5-20	K/L/D	2	3.99
5	APT.5-20	Bed 1	1	6.30
5	APT.5-20	Bed 2	1	4.22
5	APT.5-21	K/L/D	2	5.74
5	APT.5-21	Bed 1	1	3.98
5	APT.5-21	Bed 2	1	5.30
5	APT.5-22	K/L/D	2	4.47
5	APT.5-22	Bed 1	1	6.89
5	APT.5-23	K/L/D	1	5.02
5	APT.5-23	Bed 1	1	5.45
5	APT.5-23	Bed 2	1	8.25
5	APT.5-24	K/L/D	2	5.57

5	APT.5-24	Bed 1	1	2.39
5	APT.5-24	Bed 2	1	5.09
5	APT.5-25	K/L/D	2	9.37
5	APT.5-25	Bed 1	1	5.07
5	APT.5-25	Bed 2	1	3.98
5	APT.5-26	K/L/D	2	9.20
5	APT.5-26	Bed 1	1	5.57
5	APT.5-26	Bed 2	1	4.20
5	APT.5-27	Bed 1	1	11.71
5	APT.5-27	Bed 2	1	6.34
5	APT.5-27	K/L/D	2	4.98
5	APT.5-28	Bed 1	1	12.09
5	APT.5-28	Bed 2	1	6.54
5	APT.5-28	K/L/D	2	5.13

Table 5 – *Block 5 ADF Results*

Block 6 ADF Results				
Block	Unit	Type	ADF Required (%)	ADF Required (%)
6	APT.6-01	Bed 2	1	2.23
6	APT.6-01	K/L/D	2	3.67
6	APT.6-01	Bed 1	1	1.76
6	APT.6-02	Bed 1	1	1.04
6	APT.6-02	K/L/D	2	2.08
6	APT.6-02	Bed 2	1	2.18
6	APT.6-03	Bed 1	1	1.89
6	APT.6-03	K/L/D	2	1.93
6	APT.6-04	Bed 2	1	1.84
6	APT.6-04	K/L/D	2	4.09
6	APT.6-04	Bed 1	1	1.79
6	APT.6-05	Bed 1	1	1.23

6	APT.6-05	K/L/D	2	3.53
6	APT.6-05	Bed 2	1	2.1
6	APT.6-06	Bed 1	1	1.46
6	APT.6-06	K/L/D	2	3.15
6	APT.6-07	Bed 1	1	1.85
6	APT.6-07	K/L/D	2	4.20
6	APT.6-07	Bed 2	1	2.15
6	APT.6-08	Bed 1	1	2.17
6	APT.6-08	K/L/D	2	3.94
6	APT.6-08	Bed 2	1	1.84
6	APT.6-09	Bed 1	1	1.08
6	APT.6-09	K/L/D	2	2.33
6	APT.6-09	Bed 2	1	2.65
6	APT.6-10	Bed 1	1	1.75
6	APT.6-10	K/L/D	2	4.22
6	APT.6-10	Bed 2	1	2.65
6	APT.6-11	Bed 1	1	2.22
6	APT.6-11	K/L/D	2	4.89
6	APT.6-11	Bed 2	1	2.13
6	APT.6-12	Bed 1	1	1.76
6	APT.6-12	K/L/D	2	3.19
6	APT.6-13	Bed 1	1	2.17
6	APT.6-13	K/L/D	2	5.13
6	APT.6-13	Bed 2	1	3.89
6	APT.6-14	Bed 1	1	2.18
6	APT.6-14	K/L/D	2	5.13
6	APT.6-14	Bed 2	1	1.86
6	APT.6-15	Bed 1	1	1.34
6	APT.6-15	K/L/D	2	2.92
6	APT.6-15	Bed 2	1	4.05
6	APT.6-16	Bed 1	1	1.84
6	APT.6-16	K/L/D	2	5.05
6	APT.6-16	Bed 2	1	2.66
6	APT.6-17	Bed 1	1	2.64
6	APT.6-17	K/L/D	2	5.82
6	APT.6-17	Bed 2	1	2.56
6	APT.6-18	Bed 1	1	2.64
6	APT.6-18	K/L/D	2	3.72
6	APT.6-19	Bed 1	1	1.76

6	APT.6-19	Bed 2	1	1.23
6	APT.6-19	Bed 3	1	2.00
6	APT.6-19	K/L/D	2	6.99
6	APT.6-20	Bed 1	1	2.33
6	APT.6-20	K/L/D	2	2.79
6	APT.6-21	Bed 1	1	2.48
6	APT.6-21	Bed 2	1	1.49
6	APT.6-21	Bed 3	1	2.94
6	APT.6-21	K/L/D	2	5.93

Table 6 – *Block 6 ADF Results*

Block 7 ADF Results				
Block	Unit	Type	ADF Required (%)	ADF Required (%)
7	APT.7-01	Bed 1	1	1.67
7	APT.7-01	K/L/D	2	3.46
7	APT.7-02	Bed 1	1	4.22
7	APT.7-02	K/L/D	2	4.68
7	APT.7-03	Bed 1	1	4.49
7	APT.7-03	K/L/D	2	4.72
7	APT.7-04	Bed 1	1	2.29
7	APT.7-04	Bed 2	1	2.13
7	APT.7-04	K/L/D	2	3.78
7	APT.7-05	Bed 1	1	3.15
7	APT.7-05	Bed 2	1	4.71
7	APT.7-05	K/L/D	2	3.35
7	APT.7-06	Bed 1	1	1.98
7	APT.7-06	K/L/D	2	4.25
7	APT.7-07	Bed 1	1	3.98
7	APT.7-07	K/L/D	2	3.85
7	APT.7-08	Bed 1	1	3.42
7	APT.7-08	K/L/D	2	4.03
7	APT.7-09	Bed 1	1	3.01
7	APT.7-09	K/L/D	2	5.15
7	APT.7-09	Bed 2	1	2.48
7	APT.7-10	Bed 1	1	2.73

7	APT.7-10	Bed 2	1	2.91
7	APT.7-10	K/L/D	2	3.82
7	APT.7-11	Bed 1	1	3.73
7	APT.7-11	Bed 2	1	5.03
7	APT.7-11	K/L/D	2	3.51
7	APT.7-12	Bed 1	1	2.55
7	APT.7-12	K/L/D	2	5.48
7	APT.7-13	Bed 1	1	5.13
7	APT.7-13	K/L/D	2	4.97
7	APT.7-14	Bed 1	1	4.41
7	APT.7-14	K/L/D	2	5.20
7	APT.7-15	Bed 1	1	3.88
7	APT.7-15	K/L/D	2	6.64
7	APT.7-15	Bed 2	1	3.20
7	APT.7-16	Bed 1	1	3.52
7	APT.7-16	Bed 2	1	3.75
7	APT.7-16	K/L/D	2	4.93
7	APT.7-17	Bed 1	1	4.81
7	APT.7-17	Bed 2	1	6.49
7	APT.7-17	K/L/D	2	4.53
7	APT.7-18	Bed 1	1	3.09
7	APT.7-18	K/L/D	2	6.63
7	APT.7-19	Bed 1	1	6.21
7	APT.7-19	K/L/D	2	6.01
7	APT.7-20	Bed 1	1	5.34
7	APT.7-20	K/L/D	2	6.29
7	APT.7-21	Bed 1	1	4.70
7	APT.7-21	K/L/D	2	8.04
7	APT.7-21	Bed 2	1	3.87
7	APT.7-22	Bed 1	1	2.09
7	APT.7-22	Bed 2	1	1.49
7	APT.7-22	Bed 3	1	1.72
7	APT.7-22	K/L/D	2	5.96
7	APT.7-23	Bed 1	1	2.47
7	APT.7-23	K/L/D	2	4.87
7	APT.7-24	Bed 1	1	3.01
7	APT.7-24	Bed 2	1	5.43
7	APT.7-24	K/L/D	2	6.38
7	APT.7-25	Bed 1	1	2.48

7	APT.7-25	K/L/D	2	4.82

Table 7 – *Block 7 ADF Results*

Duplex Block 1 ADF Results				
Block	Unit	Type	ADF Required (%)	ADF Results (%)
DB1	APT 1	K/L/D	2	7.15
DB1	APT 1	Bed 1	1	2.80
DB1	APT 1	Bed 2	1	2.93
DB1	APT 2	K/L/D	2	8.61
DB1	APT 2	Bed 1	1	3.44
DB1	APT 2	Bed 2	1	2.56
DB1	APT 2	Bed 3	1	5.62
DB1	APT 3	K/L/D	2	5.36
DB1	APT 3	Bed 1	1	3.12
DB1	APT 3	Bed 2	1	2.02
DB1	APT 3	Bed 3	1	1.88
DB1	APT 4	K/L/D	2	8.03
DB1	APT 4	Bed 1	1	2.49
DB1	APT 4	Bed 2	1	3.71
DB1	APT 5	K/L/D	2	9.45
DB1	APT 5	Bed 1	1	2.57
DB1	APT 5	Bed 2	1	3.75
DB1	APT 6	K/L/D	2	9.86
DB1	APT 6	Bed 1	1	2.22

Table 8 – *Duplex Apartment Block 1 ADF Results*

Duplex Block 2A ADF Results				
Block	Unit	Type	ADF Required (%)	ADF Results (%)
DB2A	2A-01	K/L/D	2	7.37
DB2A	2A-01	Bed 1	1	5.79
DB2A	2A-02	K/L/D	2	5.08
DB2A	2A-02	Bed 1	1	4.12
DB2A	2A-03	K/L/D	2	6.45

DB2A	2A-03	Bed 1	1	4.12
DB2A	2A-04	K/L/D	2	5.34
DB2A	2A-04	Bed 1	1	4.10
DB2A	2A-05	K/L/D	2	6.32
DB2A	2A-05	Bed 1	1	6.02
DB2A	2A-05	Bed 2	1	3.39
DB2A	2A-06	K/L/D	2	5.61
DB2A	2A-06	Bed 1	1	4.57
DB2A	2A-07	K/L/D	2	5.94
DB2A	2A-07	Bed 1	1	6.04
DB2A	2A-07	Bed 2	1	3.68
DB2A	2A-08	K/L/D	2	5.58
DB2A	2A-08	Bed 1	1	4.57

Table 9 – *Duplex Apartment Block 2A ADF Results*

Duplex Block 2B ADF Results				
Block	Unit	Type	ADF Required (%)	ADF Results (%)
DB2B	2B-01	K/L/D	2	6.09
DB2B	2B-01	Bed 1	1	3.90
DB2B	2B-02	K/L/D	2	4.53
DB2B	2B-02	Bed 1	1	3.91
DB2B	2B-03	K/L/D	2	6.54
DB2B	2B-03	Bed 1	1	4.95
DB2B	2B-04	K/L/D	2	6.22
DB2B	2B-04	Bed 1	1	4.11
DB2B	2B-05	K/L/D	2	6.22
DB2B	2B-05	Bed 1	1	4.12
DB2B	2B-06	K/L/D	2	10.92
DB2B	2B-06	Bed 1	1	5.60
DB2B	2B-06	Bed 2	1	4.42
DB2B	2B-07	K/L/D	2	5.46
DB2B	2B-07	Bed 1	1	4.67
DB2B	2B-08	K/L/D	2	5.55
DB2B	2B-08	Bed 1	1	5.50
DB2B	2B-08	Bed 2	1	4.14
DB2B	2B-09	K/L/D	2	7.67

DB2B	2B-09	Bed 1	1	4.67
DB2B	2B-10	K/L/D	2	7.93
DB2B	2B-10	Bed 1	1	5.54
DB2B	2B-10	Bed 2	1	3.78
DB2B	2B-11	K/L/D	2	6.78
DB2B	2B-11	Bed 1	1	5.73

Table 10 – *Duplex Apartment Block 2B ADF Results*

Duplex Block 2C ADF Results				
Block	Unit	Type	ADF Required (%)	ADF Results (%)
DB2C	2C-01	K/L/D	2	4.49
DB2C	2C-01	Bed 1	1	2.78
DB2C	2C-02	K/L/D	2	3.04
DB2C	2C-02	Bed 1	1	2.41
DB2C	2C-03	K/L/D	2	3.04
DB2C	2C-03	Bed 1	1	2.41
DB2C	2C-04	K/L/D	2	3.04
DB2C	2C-04	Bed 1	1	2.41
DB2C	2C-05	K/L/D	2	3.14
DB2C	2C-05	Bed 1	1	2.46
DB2C	2C-06	K/L/D	2	6.78
DB2C	2C-06	Bed 1	1	5.73
DB2C	2C-07	K/L/D	2	7.93
DB2C	2C-07	Bed 1	1	5.54
DB2C	2C-07	Bed 2	1	3.78
DB2C	2C-08	K/L/D	2	6.78
DB2C	2C-08	Bed 1	1	5.73
DB2C	2C-09	K/L/D	2	7.93
DB2C	2C-09	Bed 1	1	5.54
DB2C	2C-09	Bed 2	1	3.78

Table 11 – *Duplex Apartment Block 2C ADF Results*

Duplex Block 2D ADF Results				
Block	Unit	Type	ADF Required (%)	ADF Results (%)
DB2D	2D-01	K/L/D	2	6.38
DB2D	2D-01	Bed 1	1	4.19
DB2D	2D-02	K/L/D	2	5.18
DB2D	2D-02	Bed 1	1	3.09
DB2D	2D-02	Bed 2	1	4.11
DB2D	2D-03	K/L/D	2	4.89
DB2D	2D-03	Bed 1	1	2.89
DB2D	2D-04	K/L/D	2	6.68
DB2D	2D-04	Bed 1	1	2.91
DB2D	2D-05	K/L/D	2	5.22
DB2D	2D-05	Bed 1	1	2.92
DB2D	2D-06	K/L/D	2	7.38
DB2D	2D-06	Bed 1	1	6.65
DB2D	2D-06	Bed 2	1	6.90
DB2D	2D-07	K/L/D	2	5.01
DB2D	2D-07	Bed 1	1	5.89
DB2D	2D-07	Bed 2	1	2.89
DB2D	2D-08	K/L/D	2	6.82
DB2D	2D-08	Bed 1	1	6.68
DB2D	2D-08	Bed 2	1	3.82
DB2D	2D-09	K/L/D	2	6.67
DB2D	2D-09	Bed 1	1	3.03

Table 12 – *Duplex Apartment Block 2D ADF Results*

5. Sunlight on the Proposed Amenity Areas and Existing Gardens

BRE Guidelines recommend that for external amenity spaces to appear adequately sunlit throughout the year, at 50% of the garden or amenity space should receive a minimum two hours of sunlight on March 21st.

A sunlight study has been carried out using IES VE SunCast which is based on a model of the entire site, including all proposed building structures and the proposed communal amenity areas. The communal amenity areas and pocket parks are identified in Figure 10. The IES model and SunCast simulation was used to assess the sunlight that each of these communal amenity spaces will receive, the results of which are presented in Figures 11 – 13.

A similar exercise can then also be completed to assess the impact of the proposed development on the gardens of the existing properties which are adjacent to the existing development. The results of this assessment are presented in Section 5.2 and in Figures 15 – 24.

5.1 Sunlight on Amenity Areas – Proposed Development

Figures 10 – 13 show the high-resolution grid with 5m^2 sections to identify the direct sunlight hours for each proposed amenity space. The colour coding transitions from blue (0 hours) to red (12 hours) signifying varying hourly totals of direct sunlight for a particular 5m^2 section.

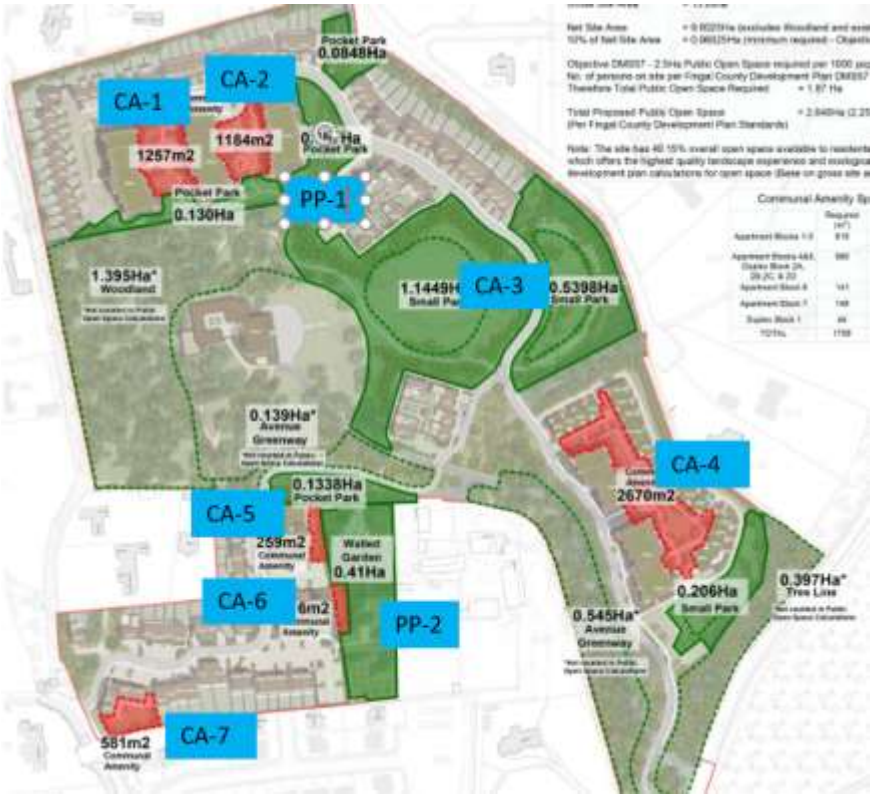

Figure 10 – *Proposed Communal Amenity Spaces & Pocket Parks indicated in green and red with associated references*

Figure 11 – *Sunlight to Amenity Areas*

Area A-1 - Blocks 1 & 2 Communal Amenity - 82% > 2 hours

Area A-2 - Block 2 & 3 Communal Amenity - 84% > 2 hours

Area A-3 - Small Park - 100%,

Area A-4 - Block 4 & 5 Communal Amenity - 91%;

Area A-5 - Block 6 Communal Amenity – 100% > 2 hours

Area A-6 - Block 7 Communal Amenity – 100% > 2 hours

Area A-7 - Duplex Block 1 Communal Amenity – 100% > 2 hours

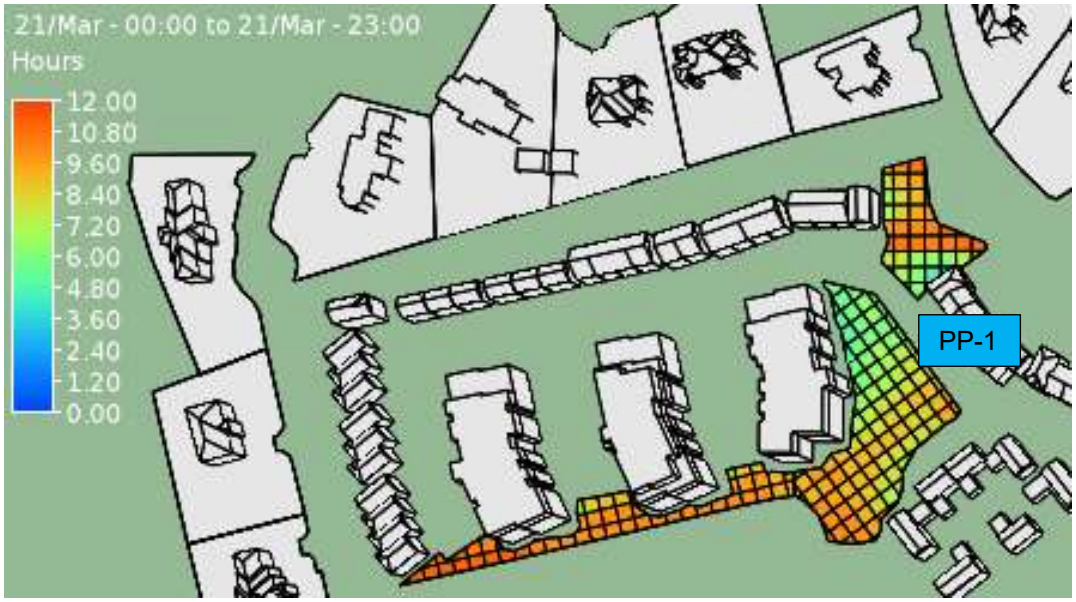

Figure 12 – *Sunlight to Proposed Pocket Park*
Area PP-1 - Blocks 1, 2 & 3 Pocket Park - 100% > 2 hours

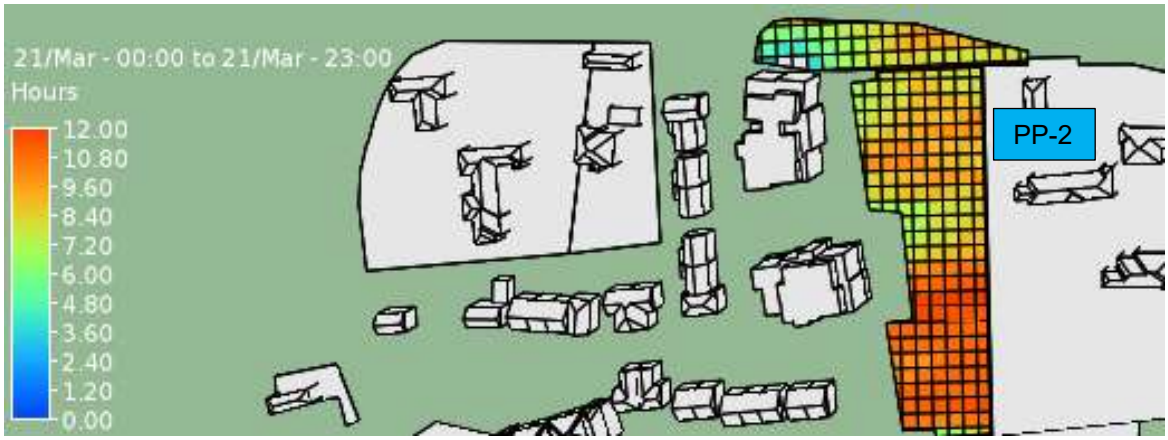

Figure 13 – *Sunlight to Proposed Pocket Park*
Area PP-2 - Blocks 6 & 7 Pocket Park - 100% > 2 hours

5.2 Sunlight to Existing Properties Gardens

The sunlight to existing properties is an important aspect of this report as it aims to quantify the hours of direct sunlight each existing gardens receive for the surrounding properties. The existing gardens have been identified and a dynamic model for each garden was created. Using IES VE Suncast an accurate visual depiction of the sunlight hours for existing garden has been determined and are presented in Figures 15 to 24.

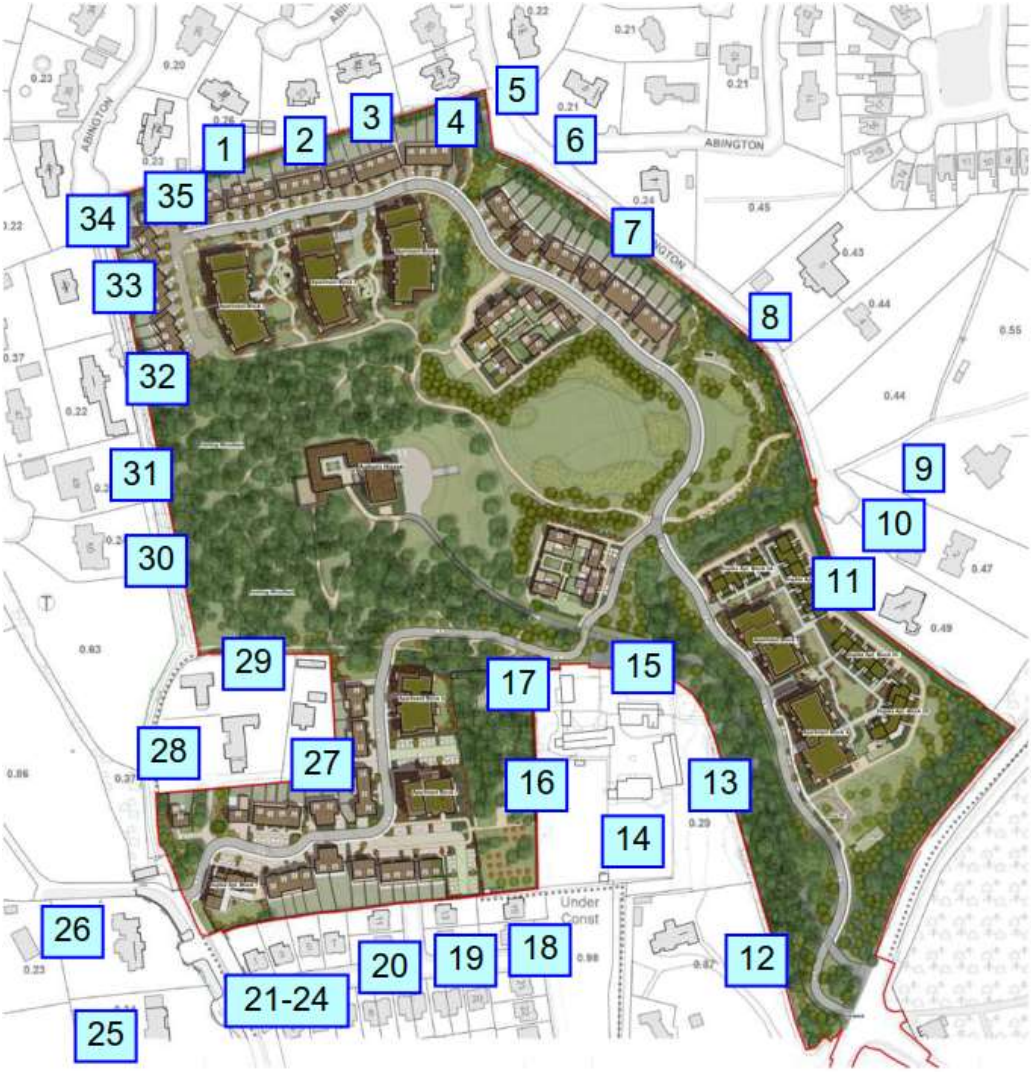

Figure 14 *Overview of Existing Gardens and Numeric References*

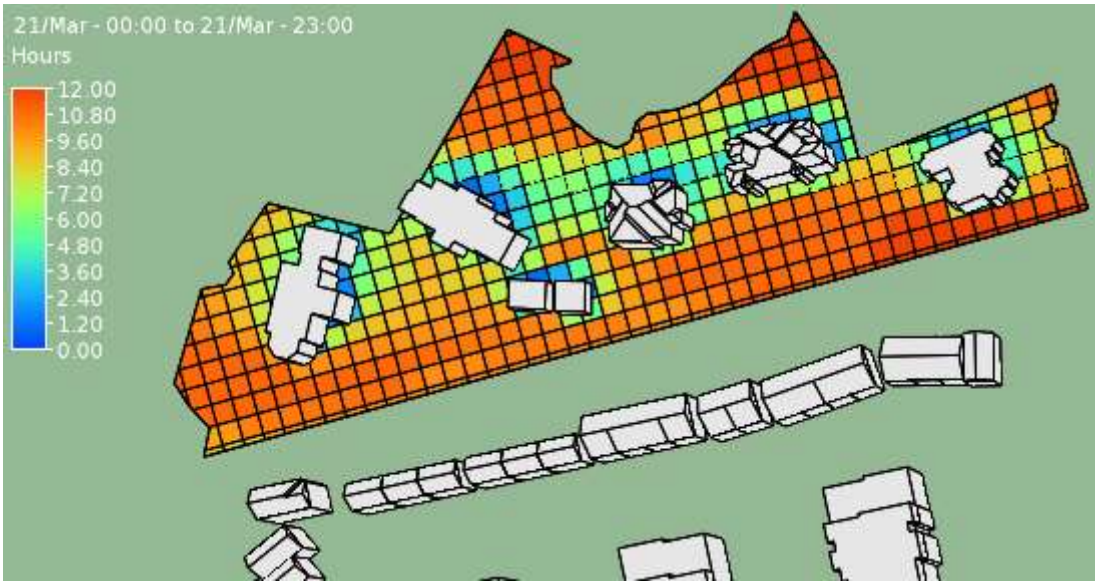

Figure 15 – *Sunlight to Existing Property Gardens (unit 1 – 92%, unit 2 – 97%, unit 3 – 95% and unit 4 – 98% >2 hours)*

Figure 16 – *Sunlight to Existing Property Gardens (unit 5 – 100% and unit 6 – 98% >2 hours)*

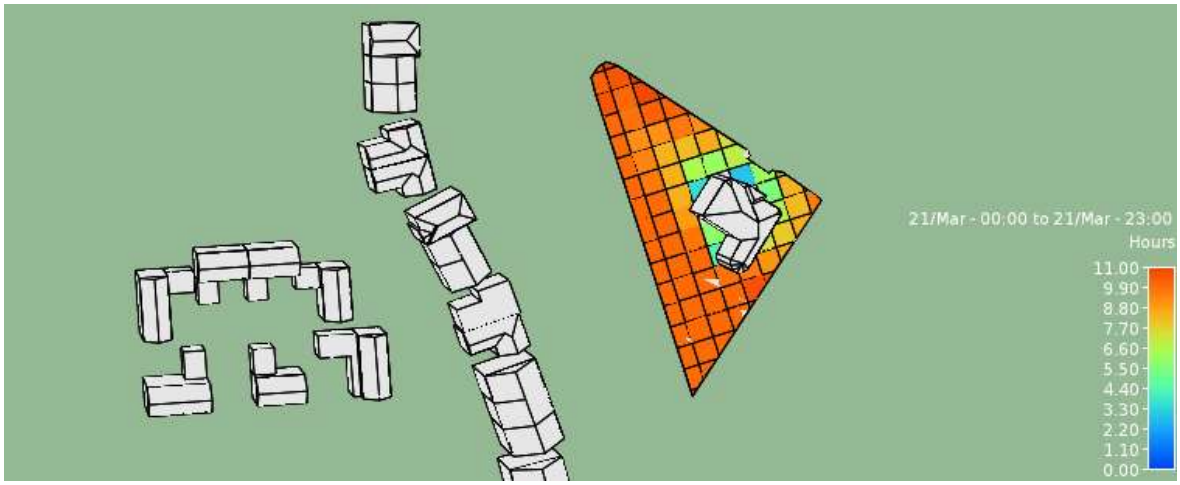

Figure 17 – *Sunlight to Existing Property Gardens (unit 7 – 100% >2 hours)*

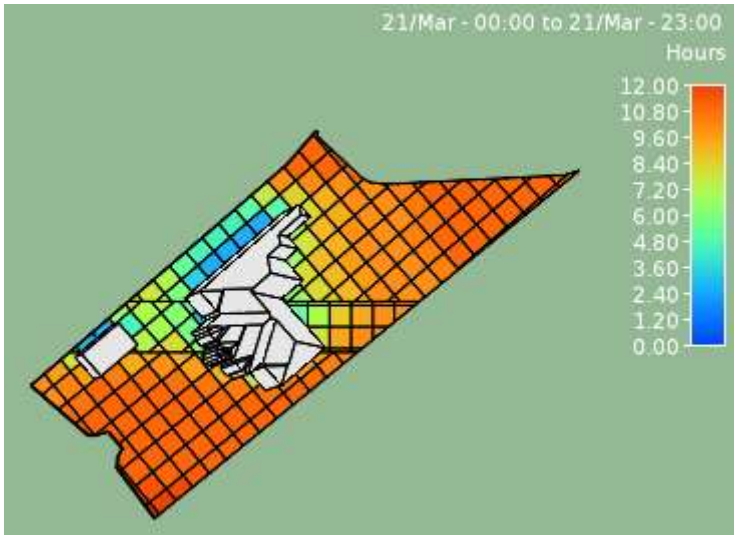

Figure 18 – *Sunlight to Existing Property Gardens (unit 8 – 96% >2 hours)*

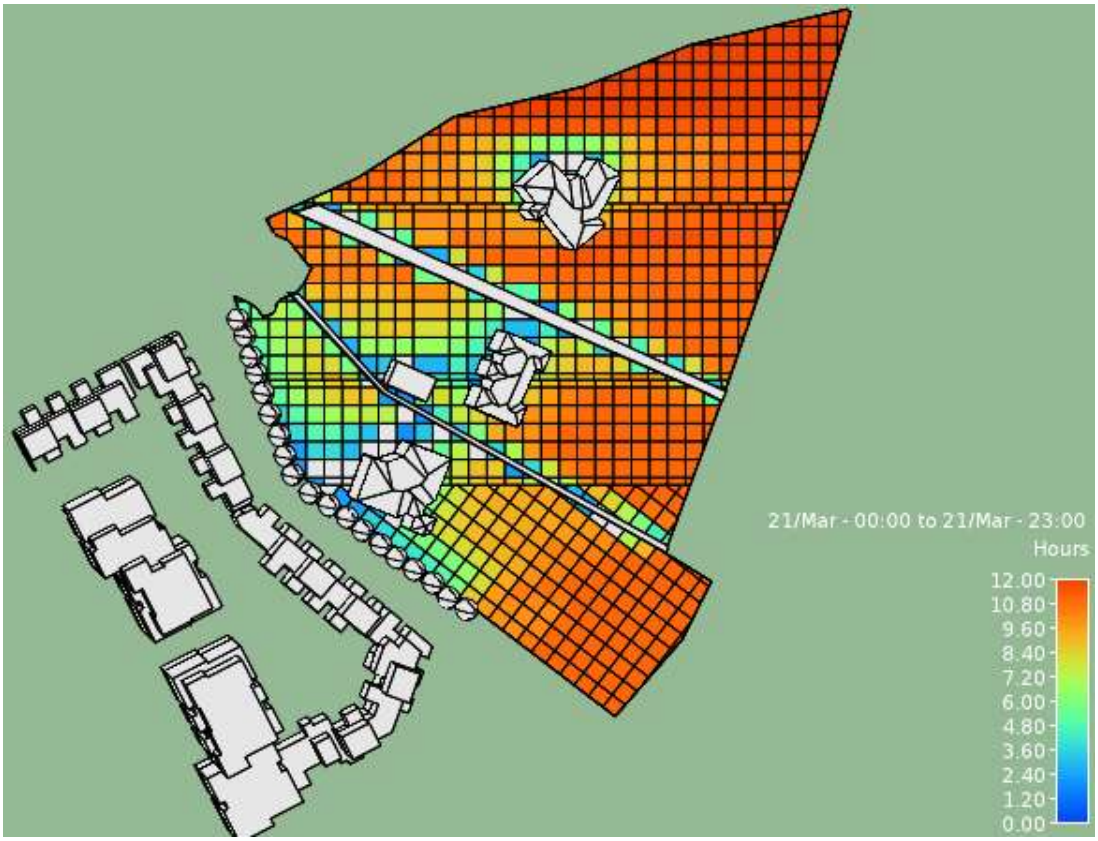

Figure 19 – *Sunlight to Existing Property Gardens (unit 9 – 98%, unit 10 – 88% and unit 11 – 94% >2 hours)*

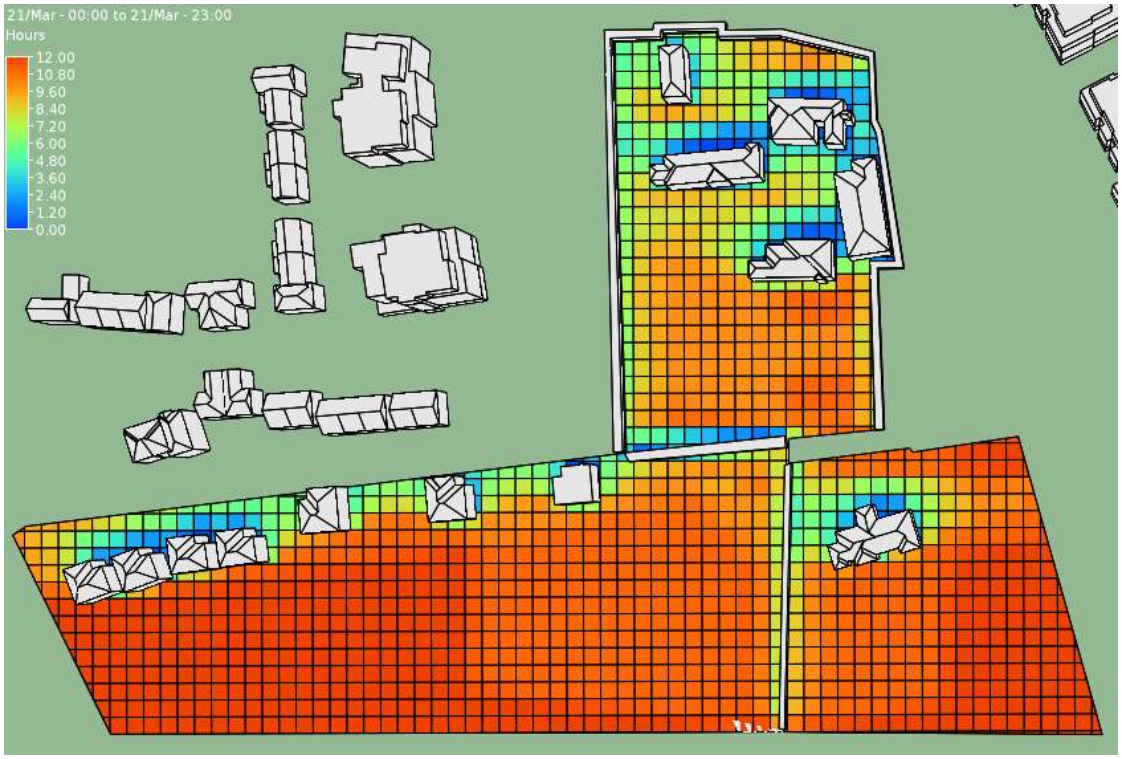

Figure 20 – *Sunlight to Existing Property Gardens (unit 12 – 98%, unit 13 – 72%, unit 14 – 95%, unit 15 – 85%, unit 16 – 90%, unit 17 – 100%, unit 18 to 20 – 100% and units 21 to 24 – 98% >2 hours)*

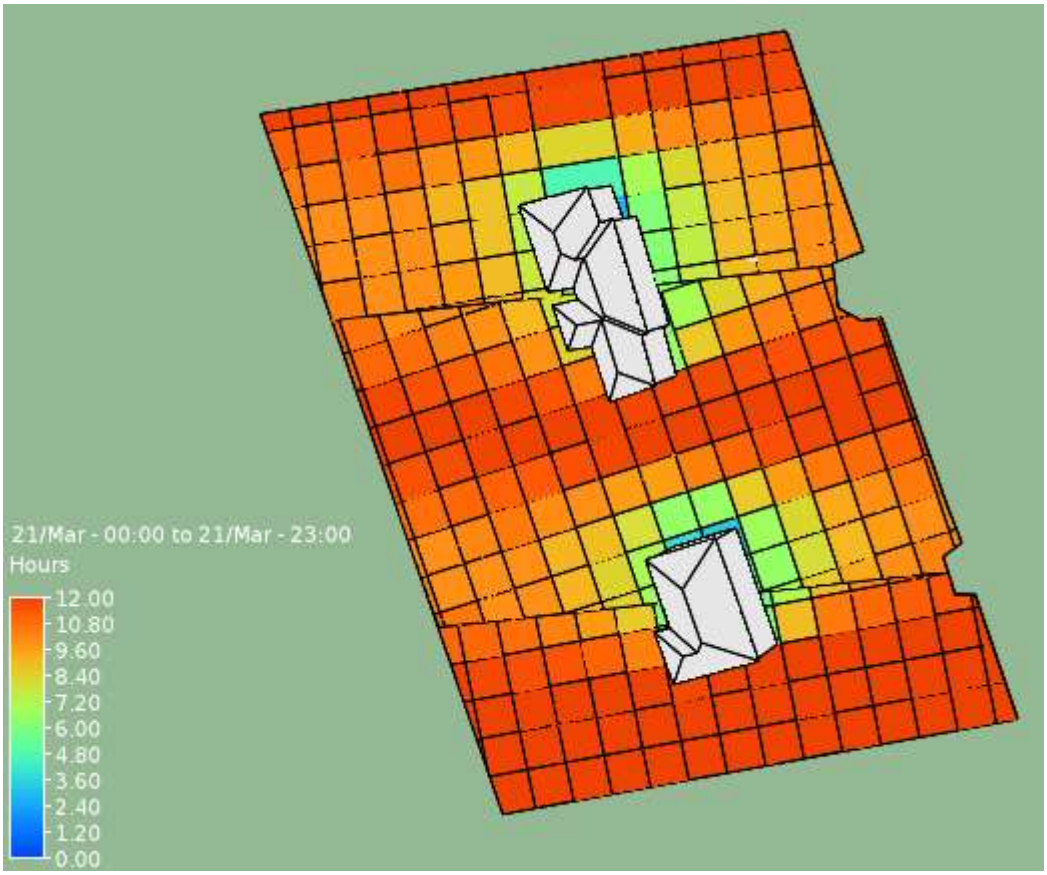

Figure 21– *Sunlight to Existing Property Gardens (unit 25- 100%, unit 26 – 100% >2 hours)*

Figure 22– *Sunlight to Existing Property Gardens (unit 27- 89%, unit 28 – 100% and unit 29 – 100% >2 hours)*

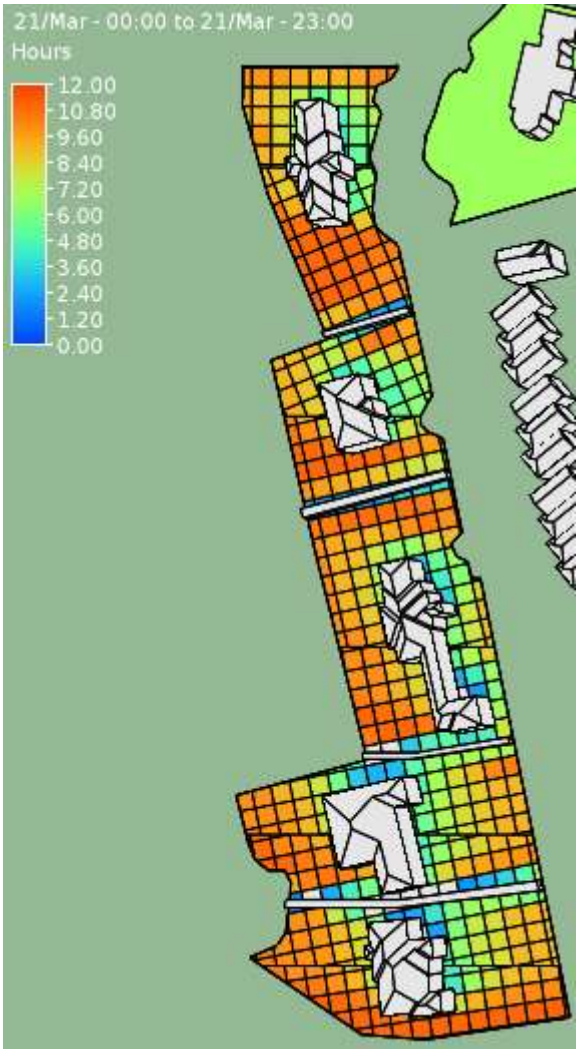

Figure 23 – *Sunlight to Existing Property Gardens (unit 30 – 92%, unit 31 – 98%, unit 32 – 99%, unit 33 – 100% and unit 34 -100% >2 hours)*

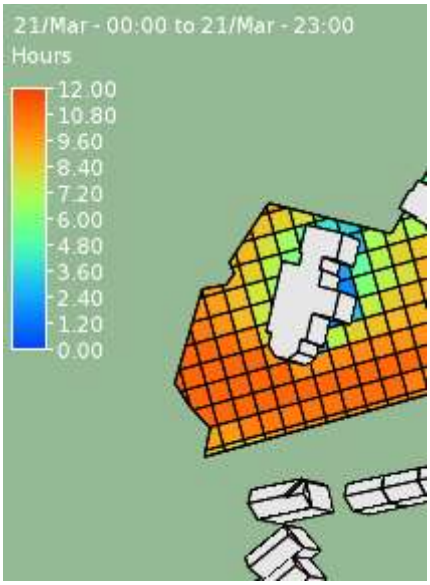

Figure 24 – *Sunlight to Existing Property Gardens (unit 35 – 98%)*

6. Impact on Adjacent Existing Buildings

The BRE guidance report suggests that analyses of the impact of new developments on existing adjacent properties should be considered. In order to assess the potential impacts of a new structure or structures the report identifies a number of conditions that can be assessed, to determine if further detailed numerical daylight analysis is required.

The guidance suggests that if either of the following criteria are met that the development can be deemed to have no discernible impact on the daylight levels of the existing building.

- If the distance of each part of the new development is three or more times greater than its height above the midpoint of the of a window in the existing property or
- If the angle from the horizontal between the mid pane of a window of the existing dwelling and the highest point of the new structure is less than 25 degrees

All the apartment buildings on the site are a considerable distance from the site boundary and the from the neighbouring properties and the 25 degree criteria referred to above is likely to be met in most cases. This would give confidence that the proposed development will have a negligible impact on the neighbouring properties. Nonetheless, a modelling exercise has still been undertaken to confirm that the impact of the proposed development is indeed negligible.

Each of the adjacent properties, labelled 1 to 35 on the map below have been assessed to determine the impacts of the proposed development. The following metrics were used

- Visible Sky Component
- Annual Probable Sunlight Hours

Figure 25 – *Overview of Existing Properties and Numeric Reference*

6.1 Daylight/Sunlight Impact on Surrounding Properties

Due to the general low-rise nature of the development the impact on the surrounding existing dwellings is expected to be minimal.

However, on review of the local topography, a significant variation in levels was identified and it was decided that further analysis was warranted. Since it was not possible to gather accurate information on the internal layouts of the neighbouring properties or on the extent of glazing on the relevant elevations of these properties, glazing was added to the model of these buildings based on reasonable assumptions. This glazing is then used as a "receptor" within the model to measure the amount of daylight and/or sunlight that is incident on the elevation of the existing dwelling in both the "before" and "after" scenario

6.1.1 Vertical Sky Component (VSC) > 80% of its former value

The VSC assessment for each existing dwelling and the impact of the proposed development was carried out. All selected windows (receptors) show compliance with the VSC method by achieving ≥80% of its former value, therefore no further impact will be perceived over the permitted development.

Note: Glazing geometry to the rear of the existing dwelling were assumed for the purpose generating the results indicated below.

Property	IES Receptor Index Reference	VSC of Receptor		Impact of Proposed development on baseline VSC (Target <20%)	Meets BRE Guidelines
		Baseline	Proposed		
1	1	35.44%	33.87%	4.64%	Yes
	2	38.95%	36.68%	6.19%	Yes
2	3	39.85%	36.79%	8.32%	Yes
	4	37.92%	34.60%	9.60%	Yes
3	5	39.24%	36.62%	7.15%	Yes
4	6	38.89%	36.90%	5.39%	Yes
5	7	39.12%	38.25%	2.27%	Yes
6	8	38.53%	36.99%	4.16%	Yes
	9	38.66%	37.38%	3.42%	Yes
7	10	39.63%	38.26%	3.58%	Yes
	11	36.65%	34.85%	5.16%	Yes
8	12	38.69%	37.81%	2.33%	Yes

9	13	38.30%	37.65%	1.73%	Yes
10	14	39.15%	38.14%	2.65%	Yes
11	15	39.68%	33.59%	18.13%	Yes
	16	40.00%	36.00%	11.11%	Yes
12	17	36.97%	36.17%	2.21%	Yes
13	18	35.20%	34.05%	3.38%	Yes
	19	39.92%	37.56%	6.28%	Yes
14	20	35.91%	35.85%	0.17%	Yes
	21	39.23%	38.20%	2.70%	Yes
15	22	39.84%	38.61%	3.19%	Yes
	23	34.35%	31.78%	8.09%	Yes
16	24	38.23%	37.31%	2.47%	Yes
	25	39.62%	37.74%	4.98%	Yes
17	26	38.78%	38.52%	0.67%	Yes
	27	39.93%	37.92%	5.30%	Yes
	28	39.69%	37.60%	5.56%	Yes
18	29	39.80%	37.95%	4.87%	Yes
19	30	39.61%	34.85%	13.66%	Yes
20	31	39.80%	34.38%	15.76%	Yes
21	32	39.74%	36.65%	8.43%	Yes
22	33	39.81%	36.81%	8.15%	Yes
23	34	39.67%	37.92%	4.61%	Yes
24	35	39.77%	38.83%	2.42%	Yes
25	36	39.68%	39.67%	0.03%	Yes
26	37	39.60%	39.05%	1.41%	Yes
	38	39.87%	39.55%	0.81%	Yes
27	39	39.39%	39.15%	0.61%	Yes

	40	39.76%	34.98%	13.66%	Yes
	41	39.84%	37.59%	5.99%	Yes
28	42	38.75%	38.41%	0.89%	Yes
	43	37.23%	35.60%	4.58%	Yes
	44	39.71%	35.47%	11.95%	Yes
29	45	39.79%	39.43	0.91%	Yes
	46	39.23%	38.35%	2.29%	Yes
	47	38.26%	37.92%	0.90%	Yes
30	48	39.83%	38.98%	2.18%	Yes
31	49	38.66%	37.65%	2.68%	Yes
32	50	39.90%	38.37%	3.99%	Yes
	51	37.36%	35.20%	6.14%	Yes
33	52	38.61%	36.57%	5.58%	Yes
34	53	39.58%	38.85%	1.88%	Yes
	54	36.11%	35.19%	2.61%	Yes
35	55	39.73%	36.89%	7.70%	Yes

Table 13 – *Vertical Sky Component Results (Existing Properties)*

6.1.2 Annual Probable Sunlight Hours

The existing adjacent dwellings have a mixture of northerly and southerly glazing. The table 14 below identifies each existing dwellings APSH prior to the development and the subsequent impact of the development.

If the assessment point of a window can receive more than 25% of APSH, including at least 5% of APSH in the winter months, then the room should receive enough sunlight.

When measuring the effect a proposed development will have on the APSH of an existing window, the APSH value should not drop below the absolute values of 25% annually or winter 5% during winter months. If the available sunlight the available sunlight hours are both less than the annual and winter BRE guidelines and less than 0.8 times their former value then the occupants of the existing dwelling will notice a loss of sunlight or if the overall annual loss is greater than 4% of ASPH, the room may appear colder and less pleasant.

Property	IES Receptor	APSH of Receptor				Impact of Proposed Development on existing ASPH (Target <25%)		Impact of Proposed Development meet BRE Guidelines
		Annual APSH (Target >25%)		Winter APSH (Target <5%)				
		Baseline	Proposed	Baseline	Propose	Annual	Winter	
1	1	65.43	63.16	32.18	32.18	3.60%	0%	Yes
	2	50.28	47.77	19.98	19.98	5.26%	0%	Yes
2	3	43.31	42.14	14.97	14.97	2.77%	0%	Yes
	4	74.23	71.82	30.89	30.89	3.36%	0%	Yes
3	5	65.28	62.50	29.99	29.99	4.45%	0%	Yes
4	6	69.86	66.80	32.18	32.18	4.58%	0%	Yes
5	7	74.17	71.46	30.82	30.82	3.79%	0%	Yes
6	8	67.18	63.30	29.01	29.01	6.13%	0%	Yes
	9	73.57	69.18	31.61	31.61	6.35%	0%	Yes
7	10	66.76	63.90	30.24	30.24	4.48%	0%	Yes
	11	40.69	38.20	16.12	16.12	6.52%	0%	Yes
8	12	65.91	61.40	30.07	30.07	7.35%	0%	Yes
9	13	66.33	63.70	27.99	27.99	4.13%	0%	Yes
10	14	29.10	28.10	5.39	5.39	3.56%	0%	Yes
11	15	25.06	23.20	3.50	3.50	8.02%	0%	Yes
	16	61.19	58.77	21.67	21.67	4.12%	0%	Yes
12	17	16.08	15.90	0.70	0.70	1.13%	0%	Yes
13	18	7.54	6.98	0.00	0.00	8.02%	0%	Yes
	19	42.81	41.22	16.08	16.08	3.86%	0%	Yes
14	20	42.65	41.60	19.58	19.58	2.52%	0%	Yes
	21	45.22	42.78	17.40	17.40	5.70%	0%	Yes
15	22	11.44	11.23	0.00	0.00	1.87%	0%	Yes
	23	34.21	32.63	6.94	6.94	4.84%	0%	Yes

16	24	11.15	10.71	0.00	0.00	4.11%	0%	Yes
	25	42.91	40.28	13.99	13.99	6.53%	0%	Yes
17	26	40.02	38.34	10.97	10.97	4.38%	0%	Yes
	27	15.56	14.92	0.00	0.00	4.29%	0%	Yes
	28	45.92	43.78	16.09	16.09	4.89%	0%	Yes
18	29	12.16	11.54	0.00	0.00	5.37%	0%	Yes
19	30	11.66	11.28	0.00	0.00	3.37%	0%	Yes
20	31	12.02	11.93	0.00	0.00	0.75%	0%	Yes
21	32	13.55	12.87	0.00	0.00	5.26%	0%	Yes
22	33	14.69	13.89	0.00	0.00	5.76%	0%	Yes
23	34	15.33	14.72	0.00	0.00	4.14%	0%	Yes
24	35	16.63	15.89	0.70	0.70	4.66%	0%	Yes
25	36	46.15	43.93	17.48	17.48	5.05%	0%	Yes
26	37	44.72	42.36	15.35	15.35	5.57%	0%	Yes
	38	44.43	42.29	15.03	15.03	5.06%	0%	Yes
27	39	37.04	36.19	13.36	13.36	2.35%	0%	Yes
	40	70.91	67.90	29.15	29.15	4.43%	0%	Yes
	41	42.02	40.12	13.32	13.32	4.74%	0%	Yes
28	42	12.12	11.78	0.00	0.00	2.89%	0%	Yes
	43	37.00	35.95	17.16	17.16	2.92%	0%	Yes
	44	67.60	64.34	25.64	25.64	5.07%	0%	Yes
29	45	18.88	17.78	0.00	0.00	6.19%	0%	Yes
	46	40.77	38.65	10.70	10.70	5.49%	0%	Yes
	47	71.95	68.45	30.19	30.19	5.11%	0%	Yes
30	48	44.97	42.68	14.20	14.20	5.37%	0%	Yes
31	49	38.61	36.60	13.29	13.29	5.49%	0%	Yes
32	50	37.76	35.93	13.61	13.61	5.09%	0%	Yes

	51	36.68	34.81	13.29	13.29	5.37%	0%	Yes
33	52	35.63	33.20	13.25	13.25	7.32%	0%	Yes
34	53	78.32	74.11	35.66	35.66	5.68%	0%	Yes
	54	43.23	40.89	14.29	14.29	5.72%	0%	Yes
35	55	67.86	64.21	28.00	28.00	5.68%	0%	Yes

Table 14 – *Annual Probable Sunlight Hours Results (Existing Properties)*

7. Overshadowing on the Proposed Development & Existing Dwellings

The overshadowing impact within the proposed development and to existing dwellings has been analysed.

7.1 Proposed Development & Existing Dwellings

The overshadowing images illustrate the impact on the proposed development and adjacent existing dwellings during the Spring Equinox - March 21st, Summer Solstice – June 21st, Autumn Equinox - September 21st and Winter Solstice - December 21st at 7am, 10am, 2pm and 6pm.

Note: Further overshadowing assessments of Duplex Blocks 1, 2B & 2C have been carried out. Refer to Appendix for illustrations.

Figure 26 – Proposed Development & Existing Dwellings Overview (Source IES VE model)

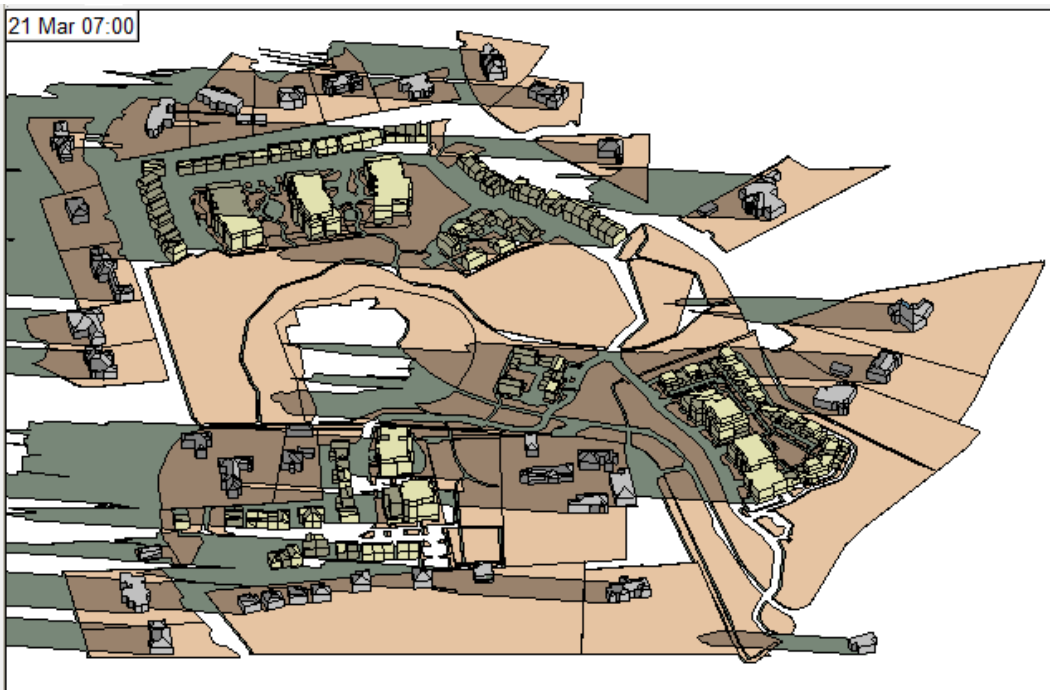

Figure 27 – Overshadowing image on March 21st at 7am (Source IES VE model)

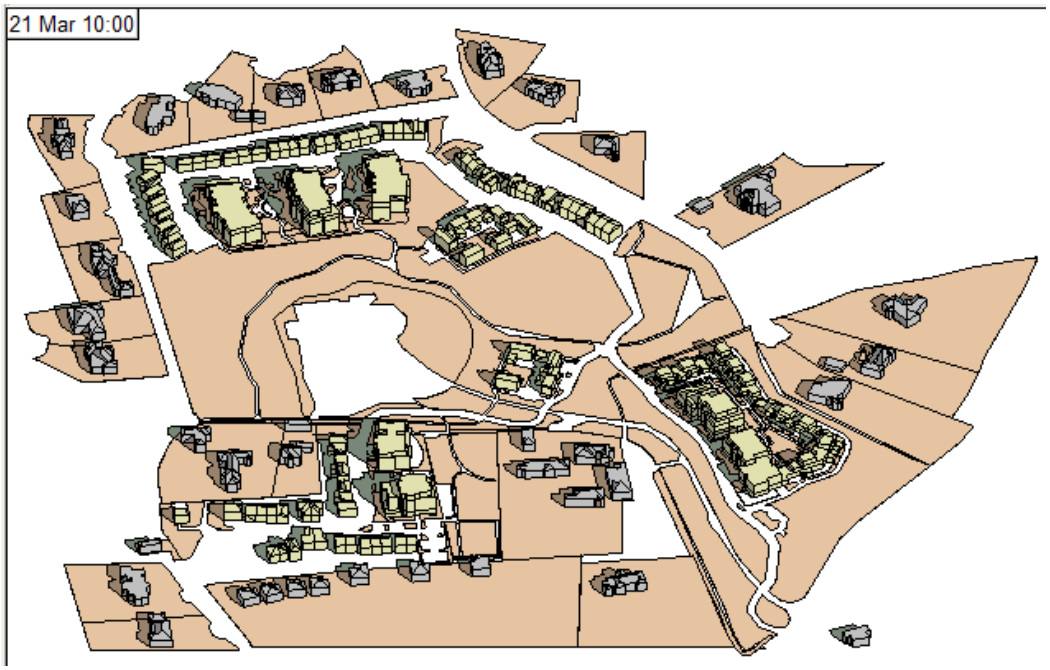

Figure 28 –Overshadowing image on March 21st at 10am (Source IES VE model)

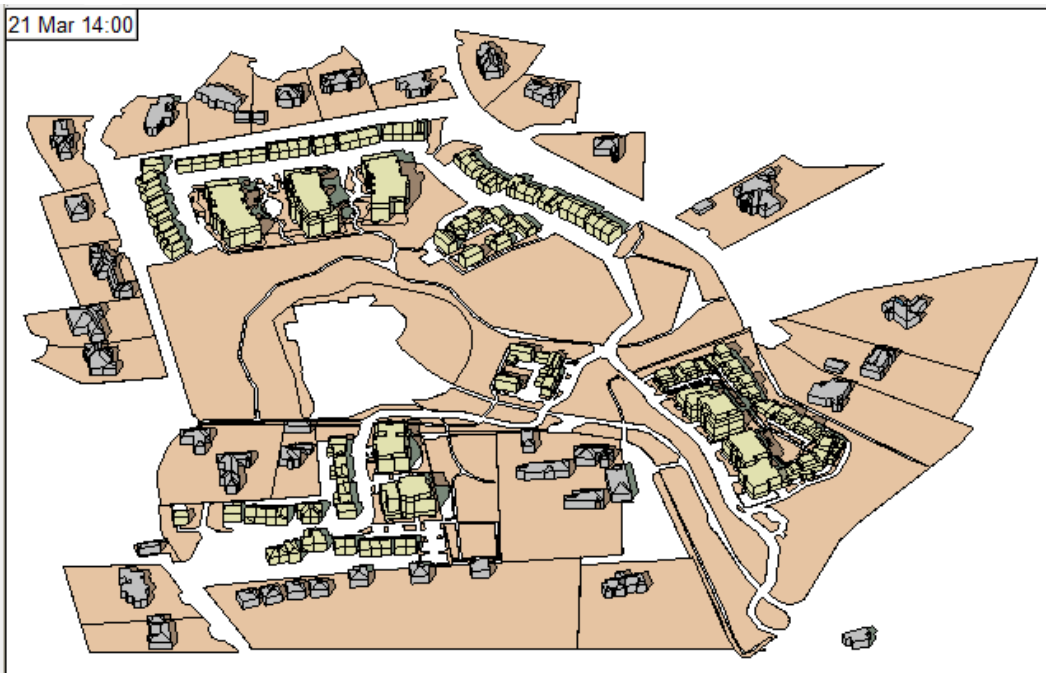

Figure 29 - Overshadowing image on March 21st at 2pm (Source IES VE model)

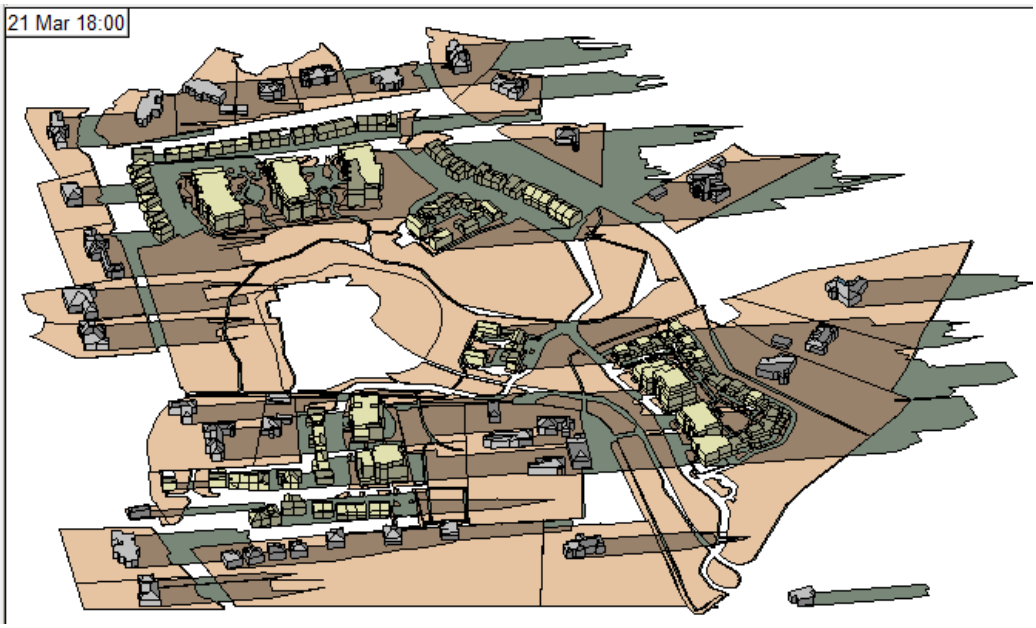

Figure 30 – Overshadowing image on March 21st at 6pm (Source IES VE model)

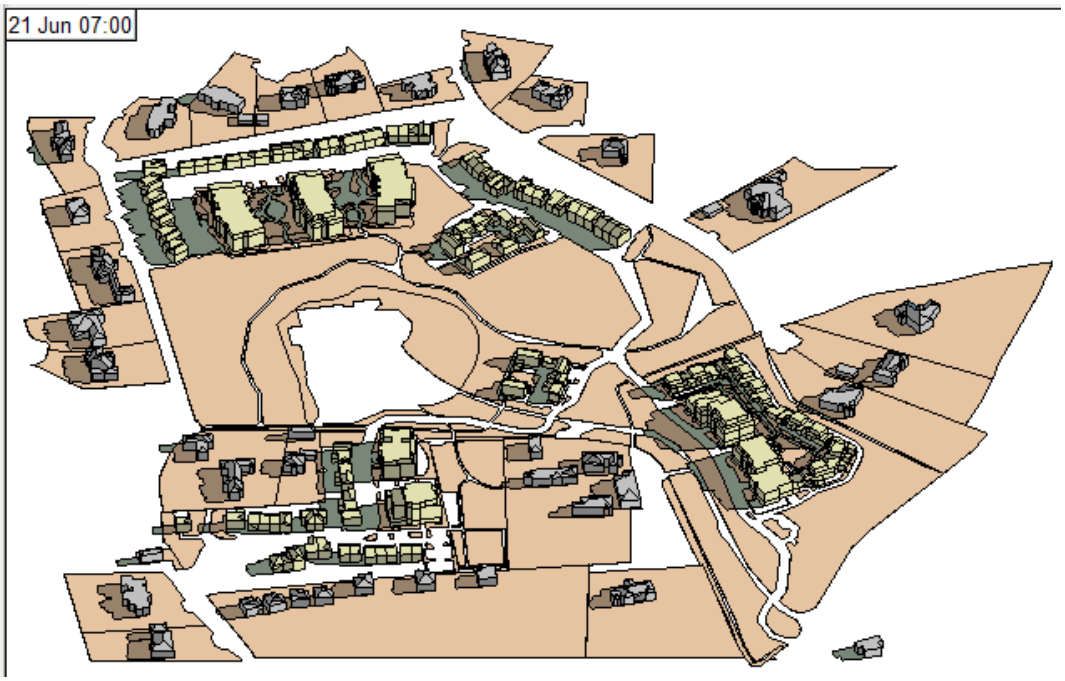

Figure 31 – Overshadowing image on June 21st at 7am (Source IES VE model)

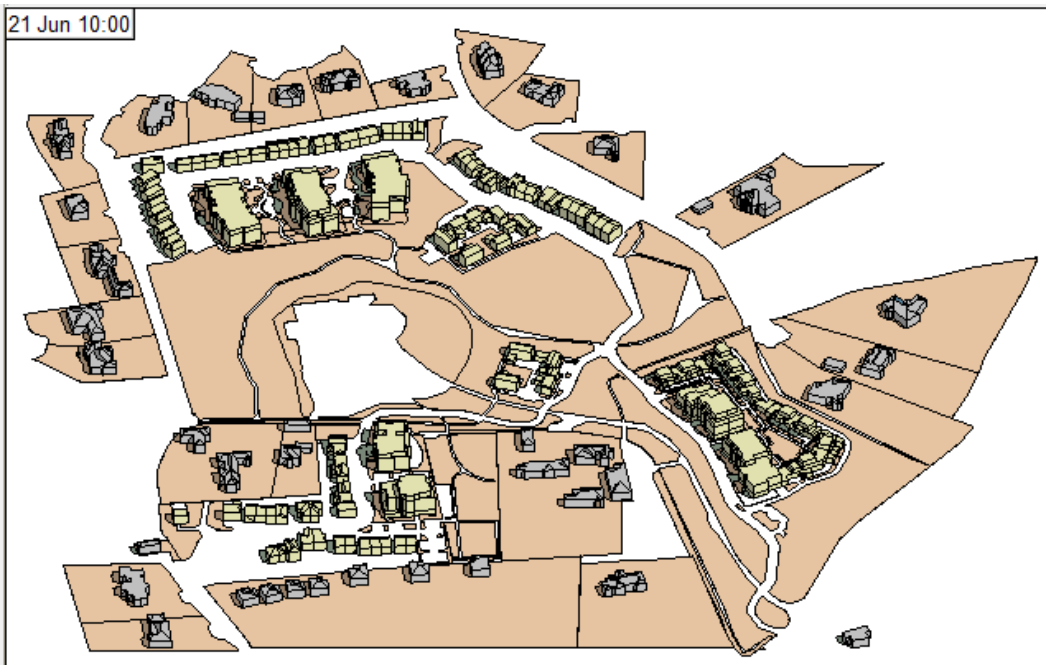

Figure 32 – Overshadowing image on June 21st at 10am (Source IES VE model)

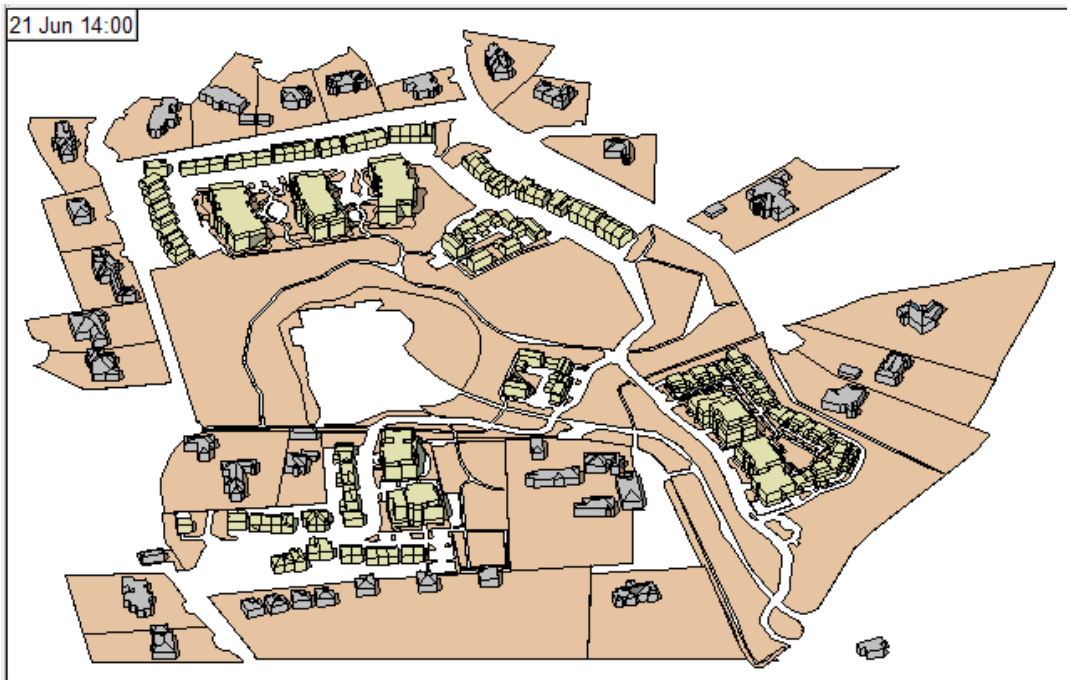

Figure 33 – Overshadowing image on June 21st at 2pm (Source IES VE model)

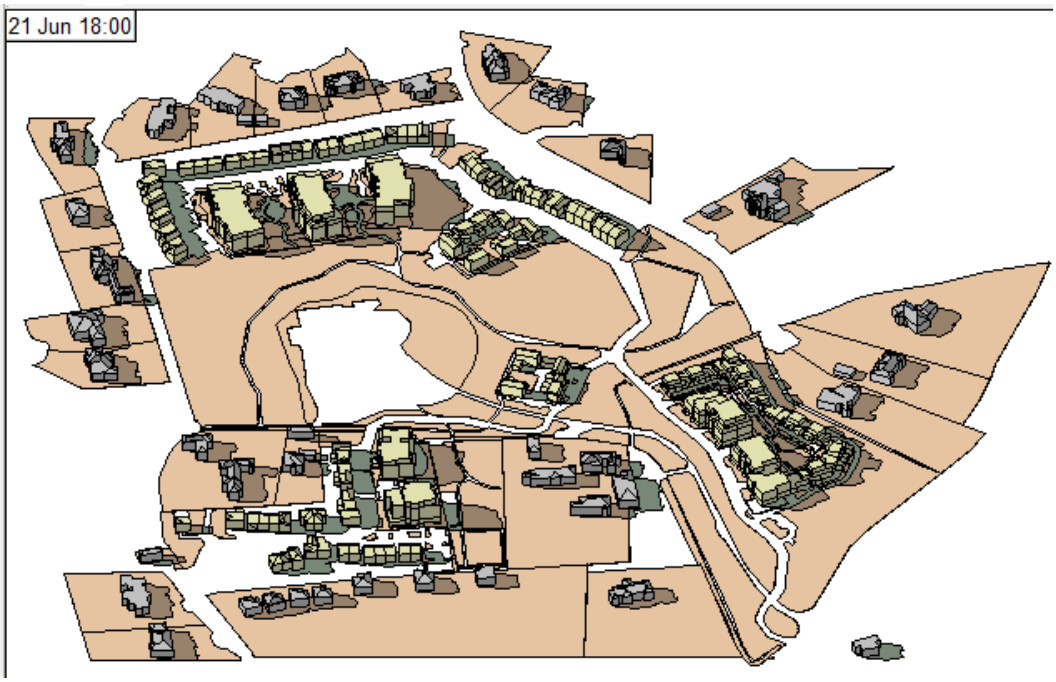

Figure 34 – Overshadowing image on June 21st at 6pm (Source IES VE model)

Figure 35 – Overshadowing image on September 21st at 7am (Source IES VE model)

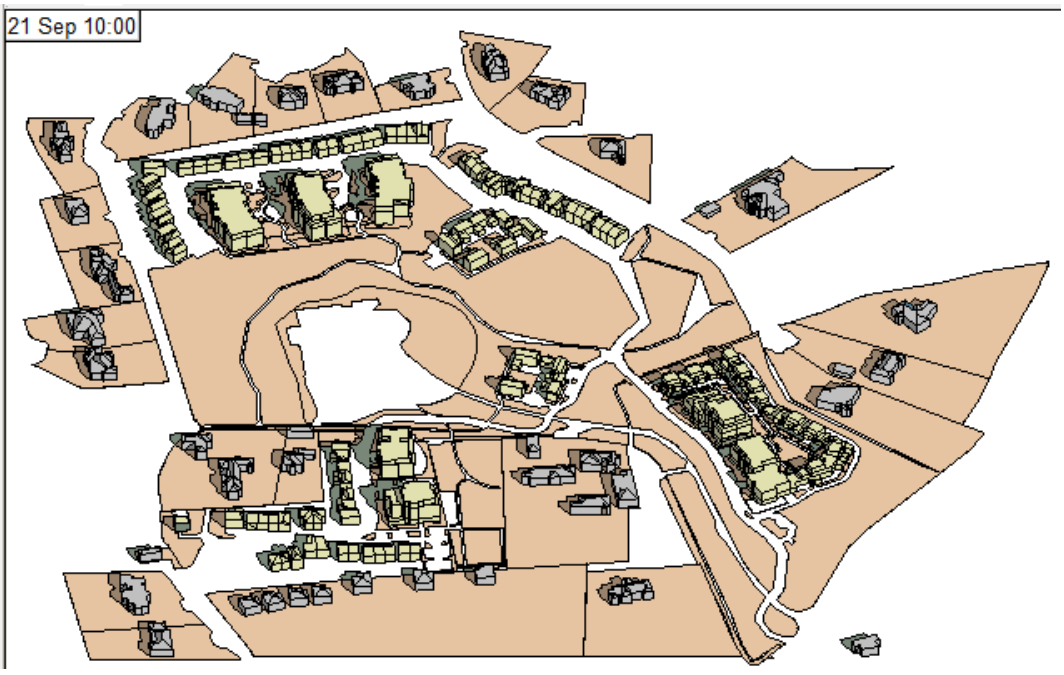

Figure 36 – Overshadowing image on September 21st at 10am (Source IES VE model)

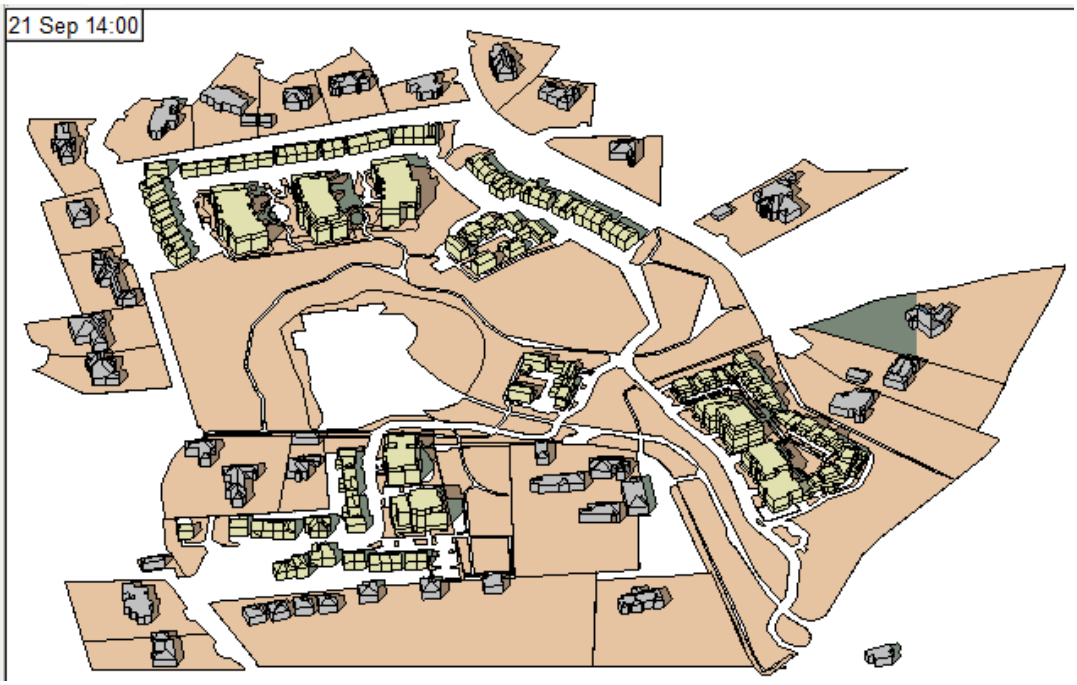

Figure 37 – Overshadowing image on September 21st at 2pm (Source IES VE model)

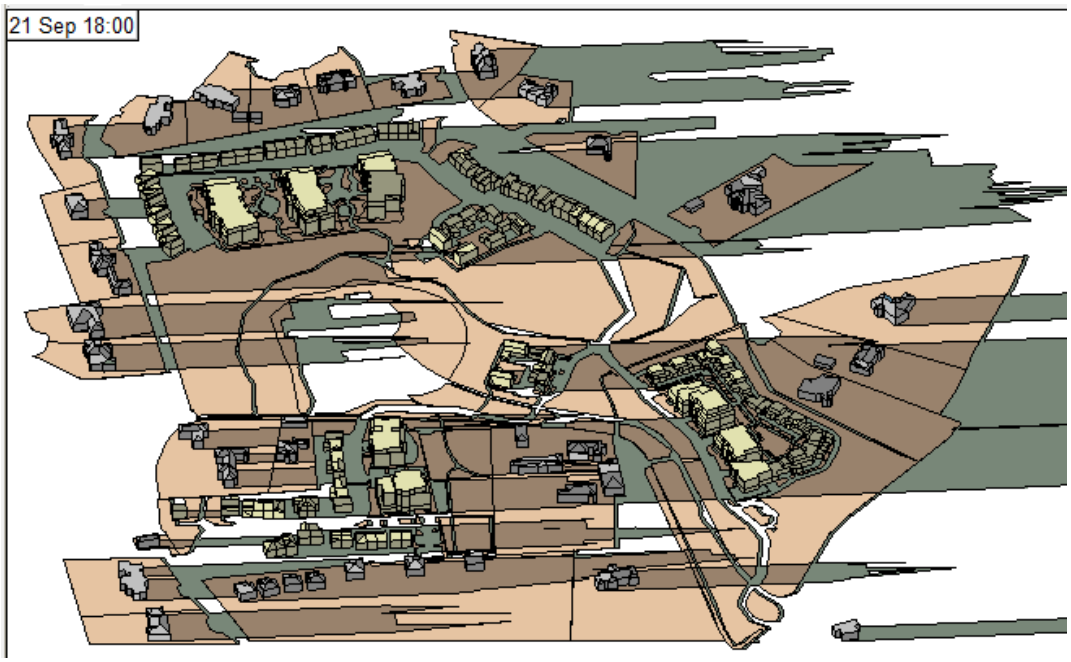

Figure 38 – Overshadowing image on September 21st at 6pm (Source IES VE model)

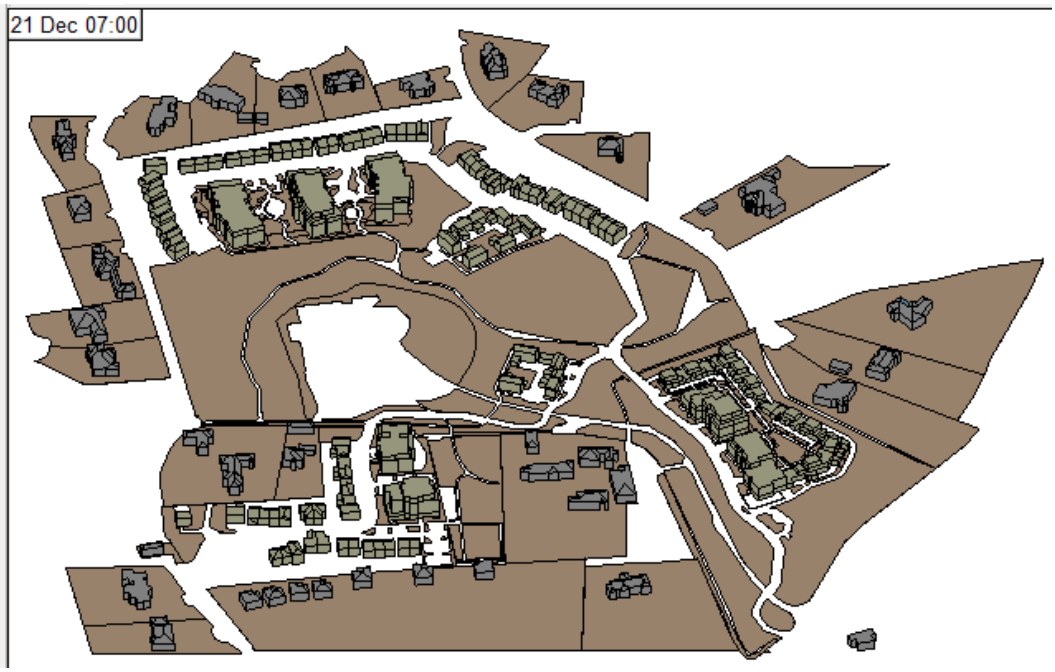

Figure 39 – Overshadowing image on December 21st at 7am (Source IES VE model)

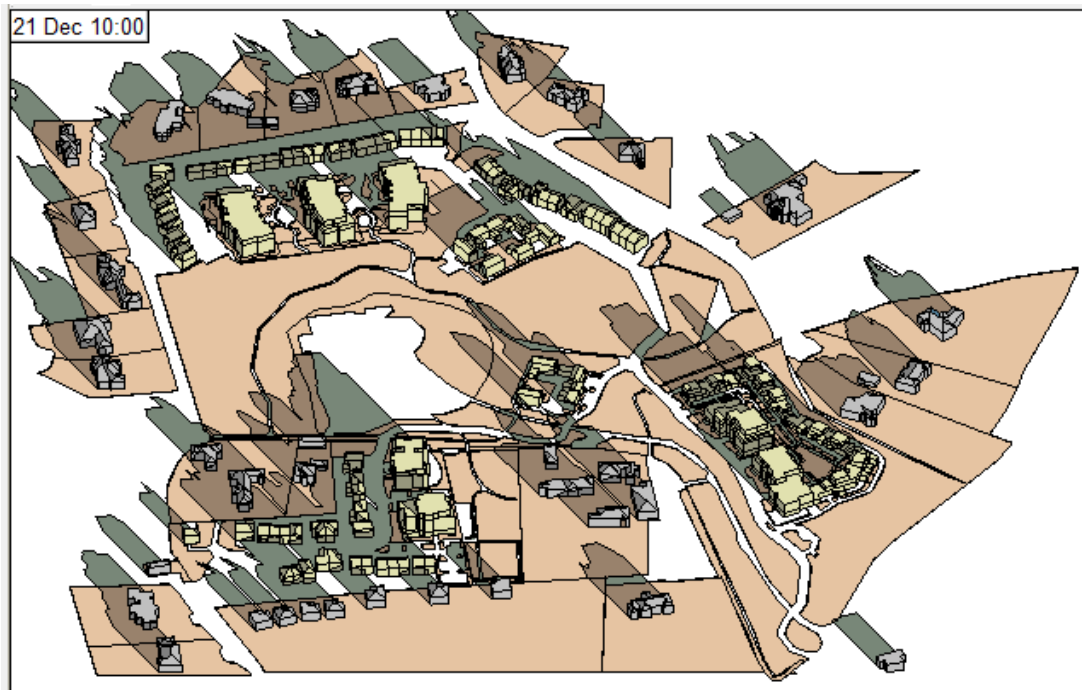

Figure 40 – Overshadowing image on December 21st at 10am (Source IES VE model)

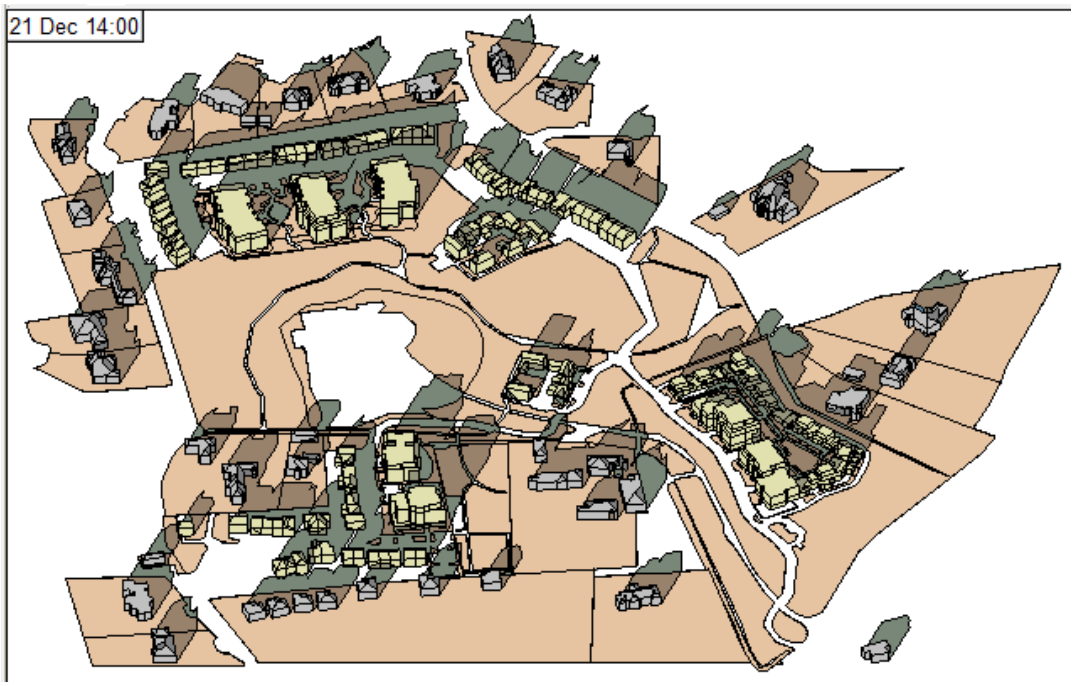

Figure 41 – Overshadowing image on December 21st at 2pm (Source IES VE model)

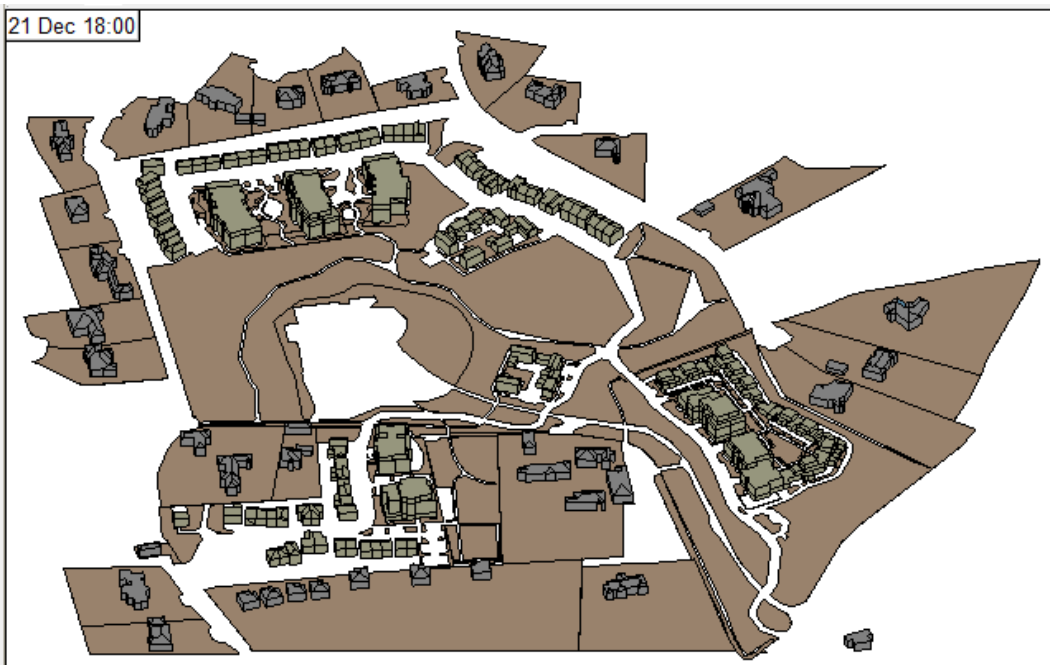

Figure 42 – Overshadowing image on December 21st at 6pm (Source IES VE model)

8. Results & Conclusions

Average Daylight Factor – Proposed Development

The average daylight analysis for the proposed the development evaluated the living/kitchen/dining space and bedrooms across all apartment blocks 1 to 7 and duplex blocks 1, 2A, 2B, 2C & 2D.

The results of the ADF analysis demonstrate the following:

- The combined living/kitchen/dining areas across the scheme demonstrate levels of daylight above the BRE recommended 2% average daylight factor with 100% of the kitchen/living/dining spaces achieving compliance.
- The bedrooms across the entire scheme demonstrate levels of daylight above the BRE recommended 1% average daylight factor with 100% of the bedrooms achieving compliance.
- Overall, across the scheme, 100% of the spaces analysed demonstrate compliance with the BRE average daylighting levels.

Sunlight to Proposed Communal Spaces & Pocket Parks

The results of the sunlight analysis to the communal amenity areas and pocket parks are as follows.

- The communal amenity areas between Blocks 1 & 2 and Blocks 2 & 3 demonstrate levels of sunlight above the recommend 2 hours over 50% of the area on the design test day 21st March. The communal amenity areas between blocks 1, 2 & 3 were deemed to be the worst performing spaces due to their proximity to the apartment blocks and due to the fact that that they are shaded on two sides, however these spaces are shown to be fully compliant with the BRE requirements.
- All other communal amenity areas and pocket parks identified receive significantly more direct sunlight due to their positioning within the development and less obtrusive shading from surrounding apartment blocks.

Sunlight to Existing Property Gardens

The sunlight analysis on the impact the proposed development to the existing gardens have been identified and modelled using IES VE SunCast. The results of this assessment are illustrated in Figures 15 to 24 and have shown that on the 21st March all gardens will receive a 2 hours sunlight over 50% over its area in accordance with the BRE guidelines.

Impact on surrounding properties

The Visible Sky Component (VSC) and Annual Probable Sunlight Hours (APSH) analysis that was completed for all existing adjacent properties demonstrated full compliance with the BRE guidance.

- The VSC analysis demonstrates that the proposed development has no significant daylight impact to existing adjacent dwellings.
- The APSH analysis demonstrates that the loss of sunlight will not be noticeable as both the annual and winter results (when the modelled with the proposed development included) will meet the recommended BRE Guidelines.

Overshadowing impact on Existing Properties

- The overshadowing analysis of the existing properties illustrates the various shadows cast at four key dates (March 21st, June 21st, September 21st and December 21st) and the impact the proposed development may have on these properties at particular times of the day illustrated in Figures 27 to 42.
- Further overshadowing analysis has been carried out on the impact of retaining circa 13-15 metre evergreen hedge may pose on Duplex Blocks 2B & 2C and the Duplex Blocks 2B & 2C on the adjacent existing properties. This has shown that while the evergreen trees overshadow Duplex Blocks 2B & 2C at morning times of the four key dates, the impact is not significant throughout the day. The analysis also identified that the impact the evergreen trees bare over the existing properties outweigh the potential impact of overshadowing from Duplex Block 2B & 2C.
- The overall shadowing analysis identifies negligible impact on the adjacent properties nearest to the proposed development.

A. Appendix

Figures 43 to 72 below provide visual representations using IES VE Radiance of daylight factor mapping for kitchen/Living/Dining and bedrooms in Blocks 1 -7.

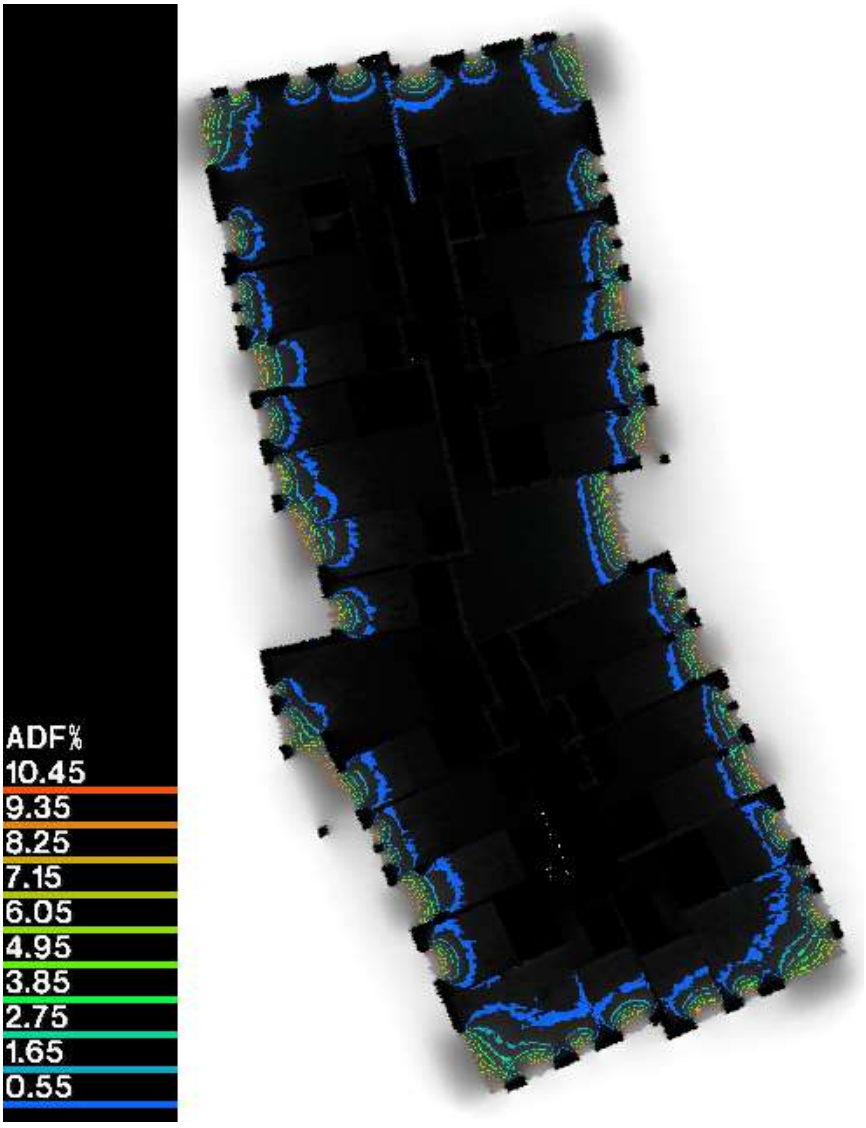

Figure 43 – *Block 1 Ground Floor Daylight Factor Mapping*

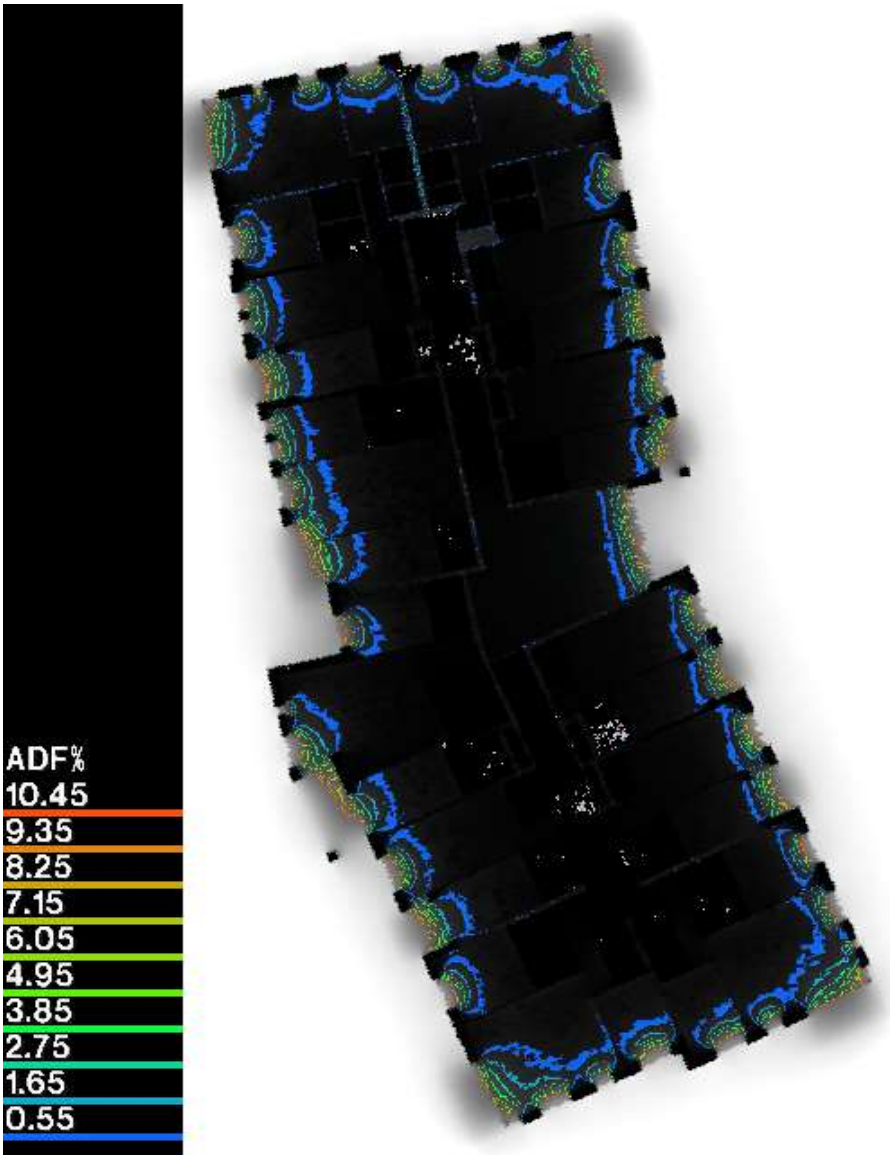

Figure 44 – *Block 1 First Floor Daylight Factor Mapping*

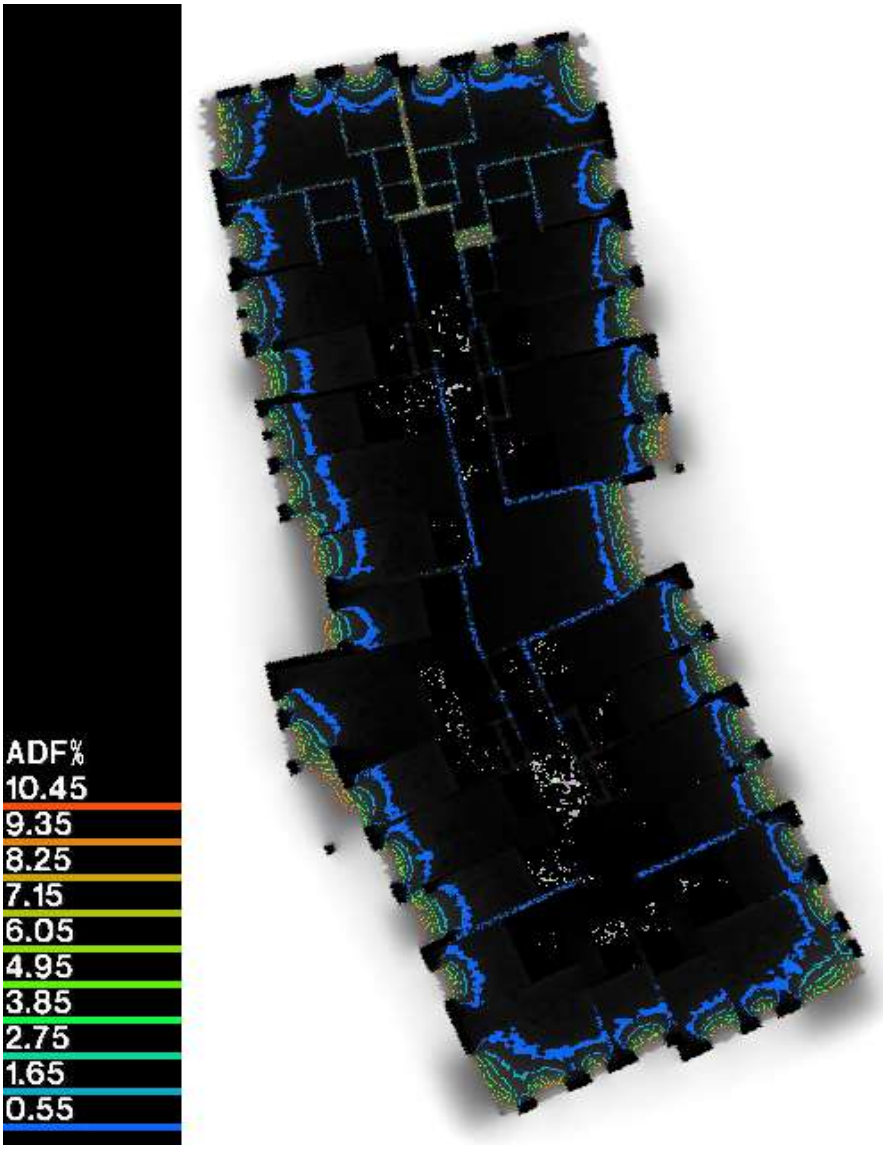

Figure 45 – *Block 1 Second Floor Daylight Factor Mapping*

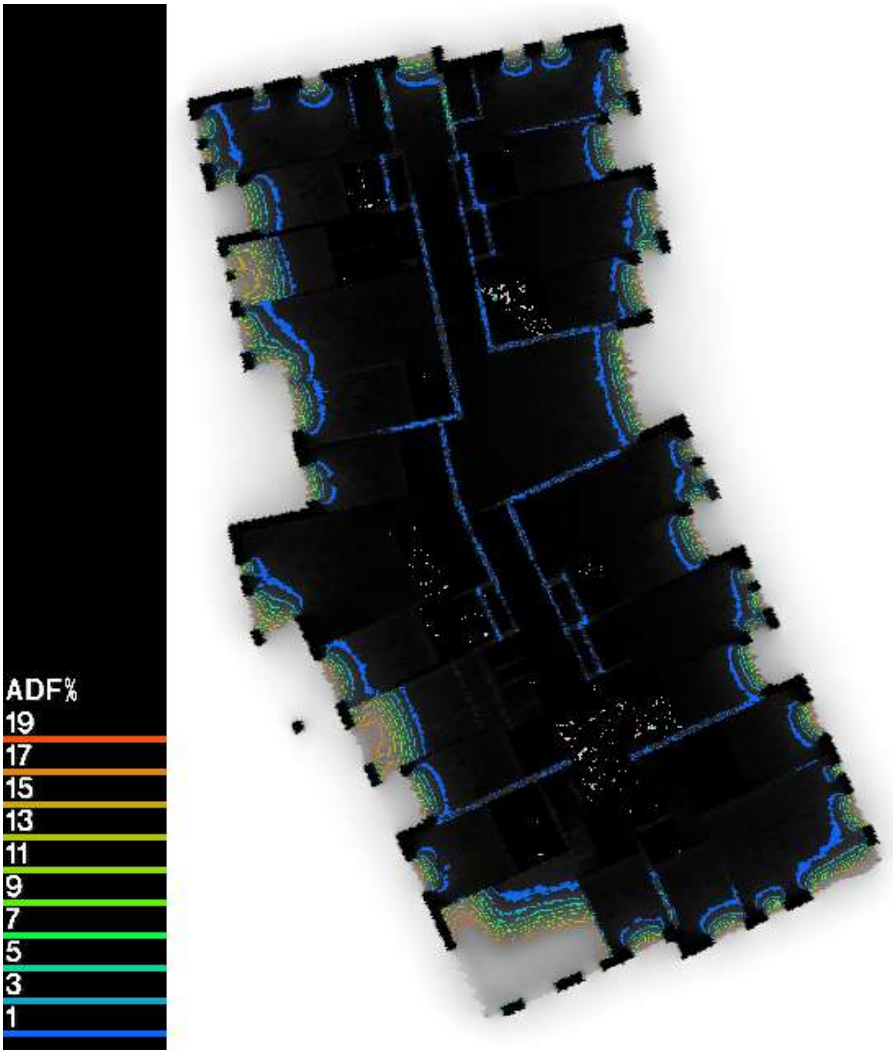

Figure 46 – *Block 1 Third Floor Daylight Factor Mapping*

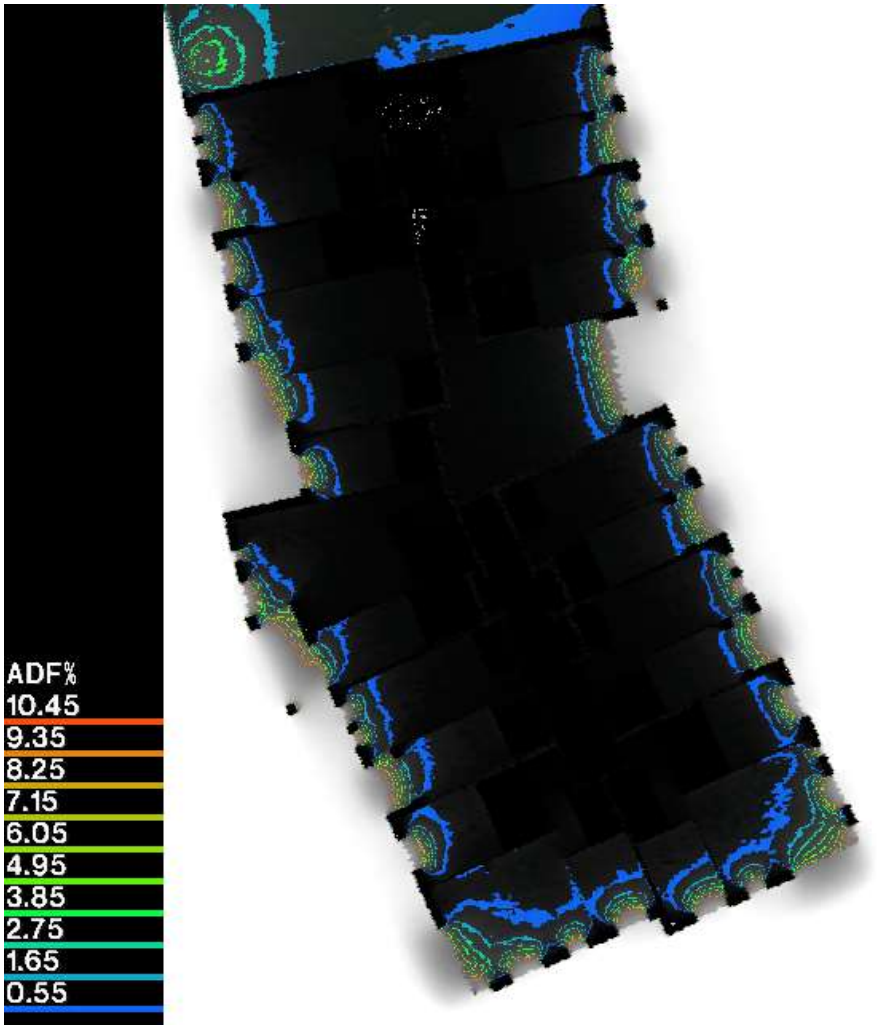

Figure 47 – *Block 2 Ground Floor Daylight Factor Mapping*

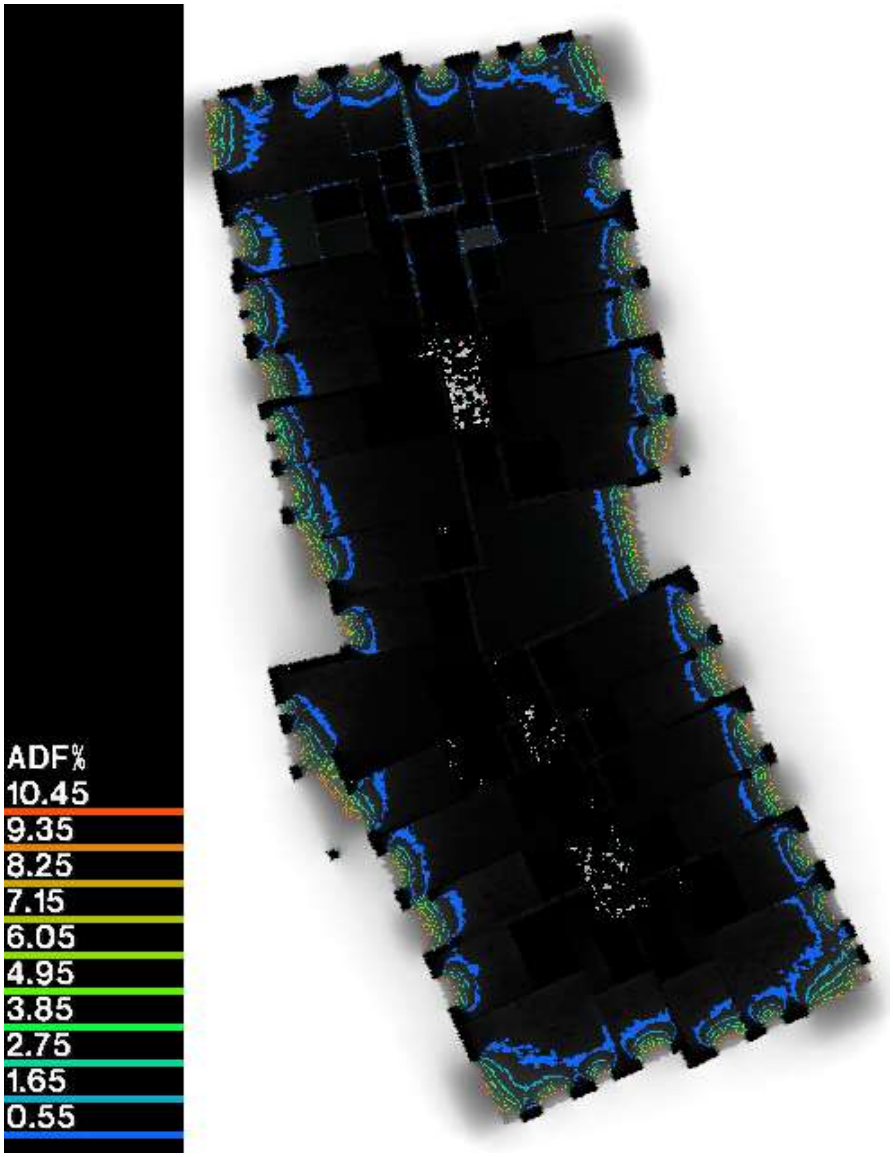

Figure 48 – *Block 2 First Floor Daylight Factor Mapping*

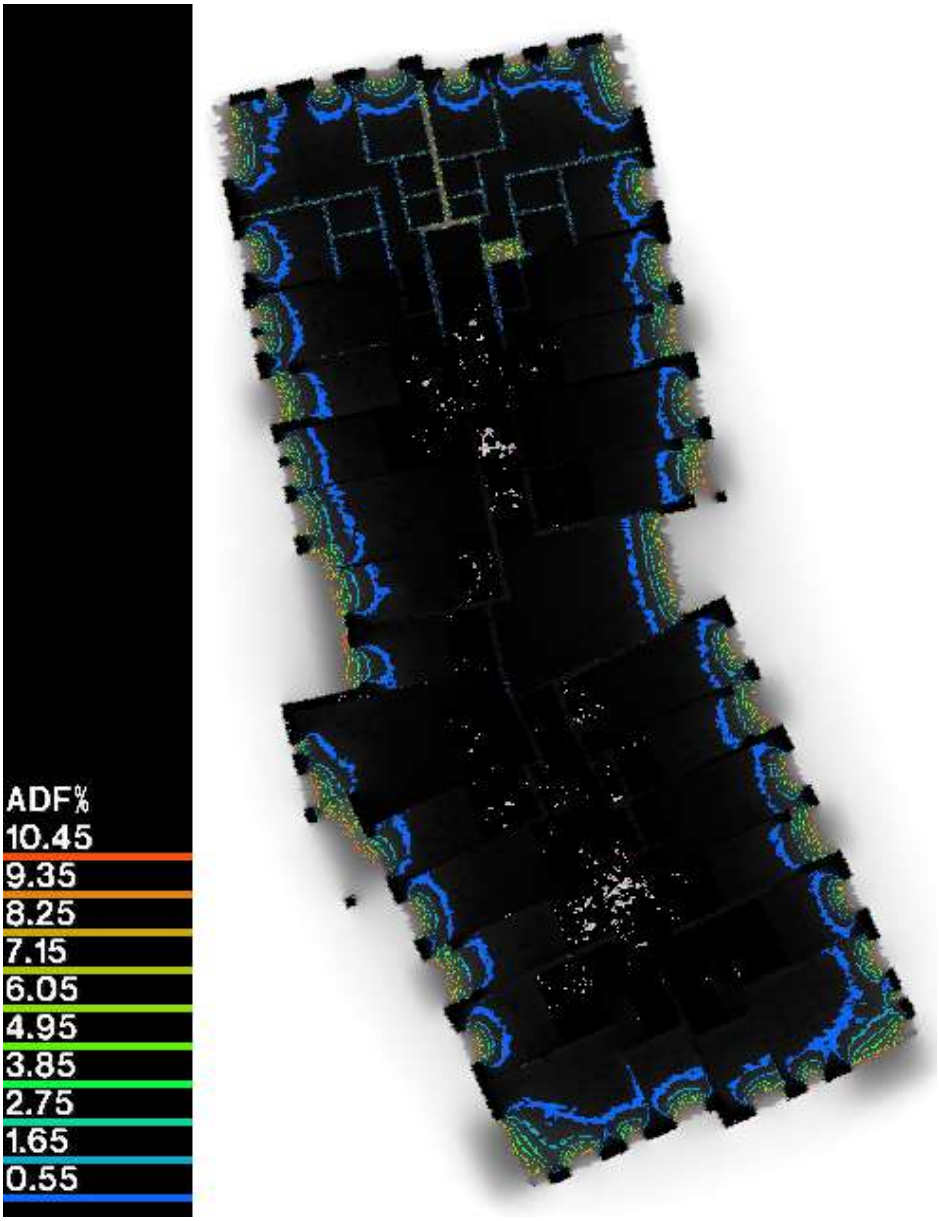

Figure 49 – *Block 2 Second Floor Daylight Factor Mapping*

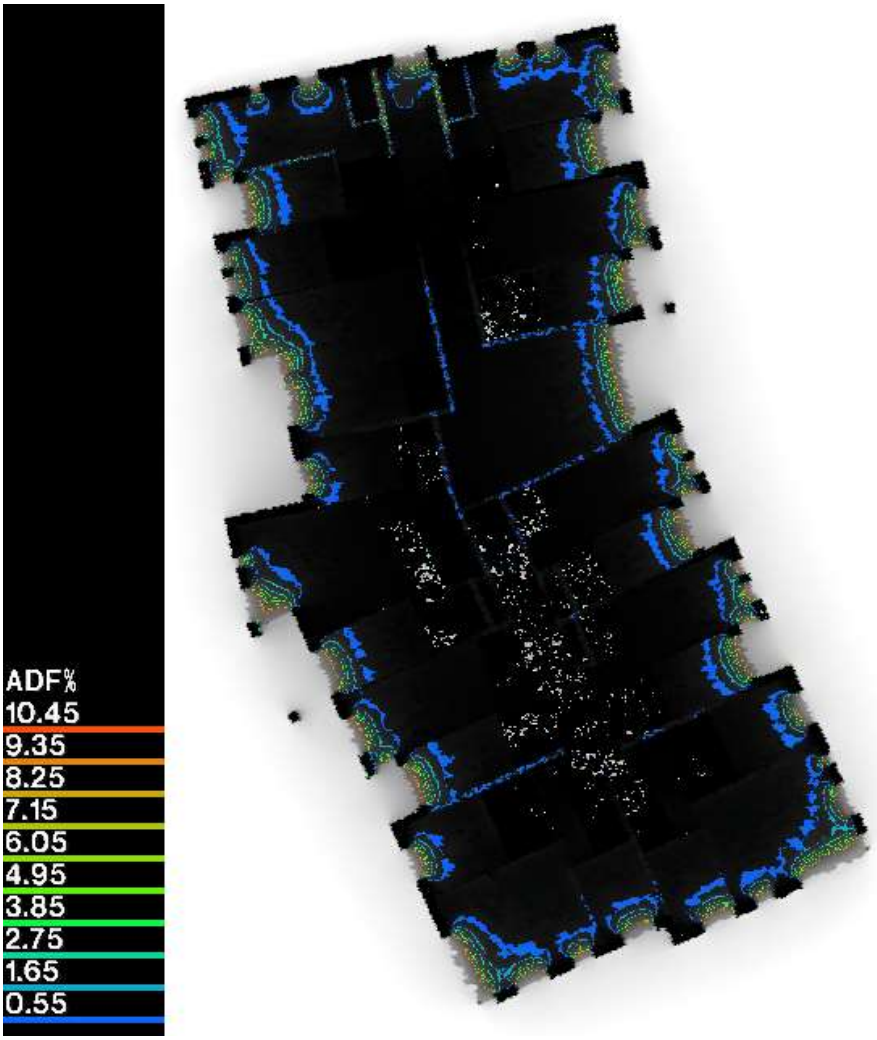

Figure 50 – *Block 2 Third Floor Daylight Factor Mapping*

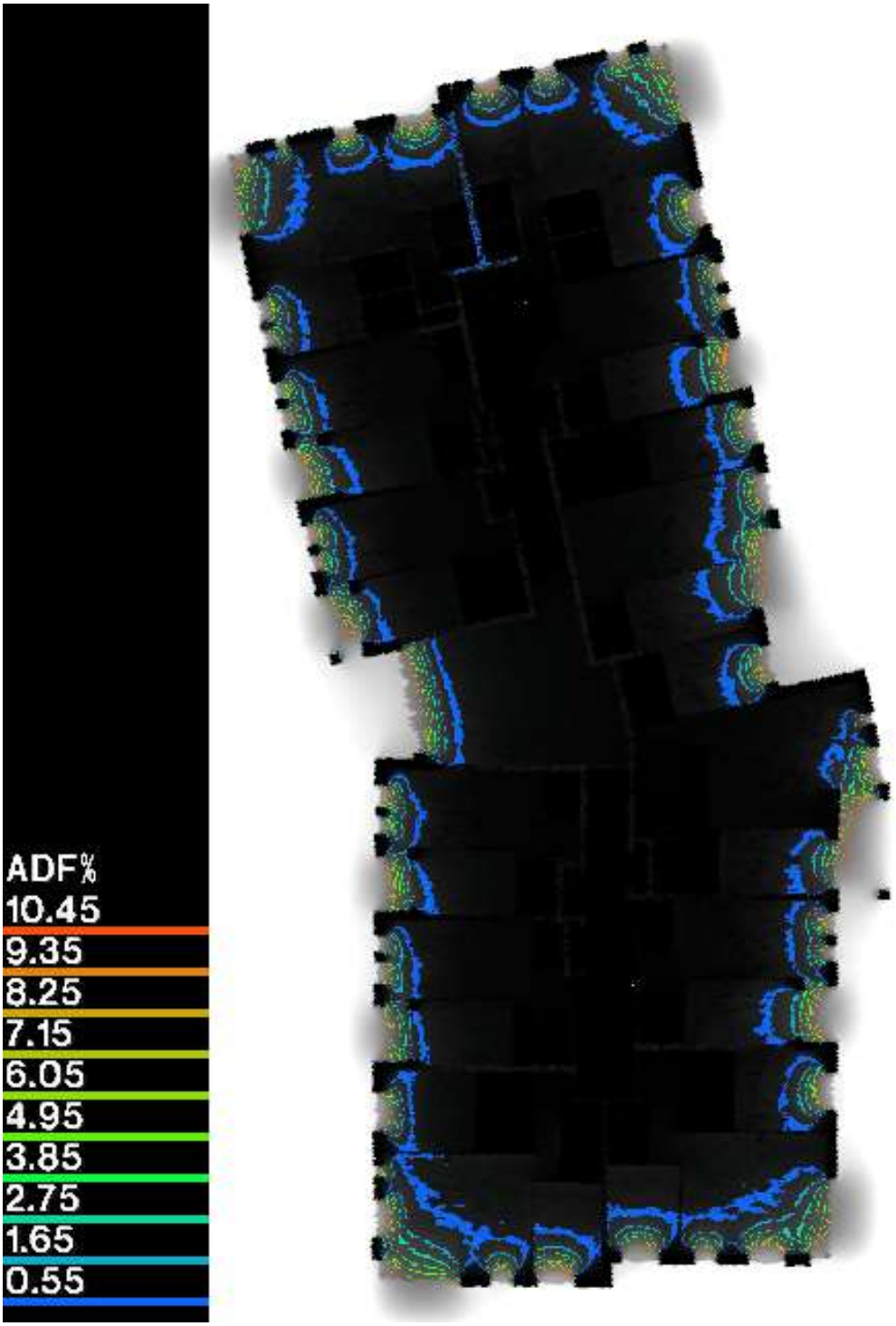

Figure 51 - *Block 3 Ground Floor Daylight Factor Mapping*

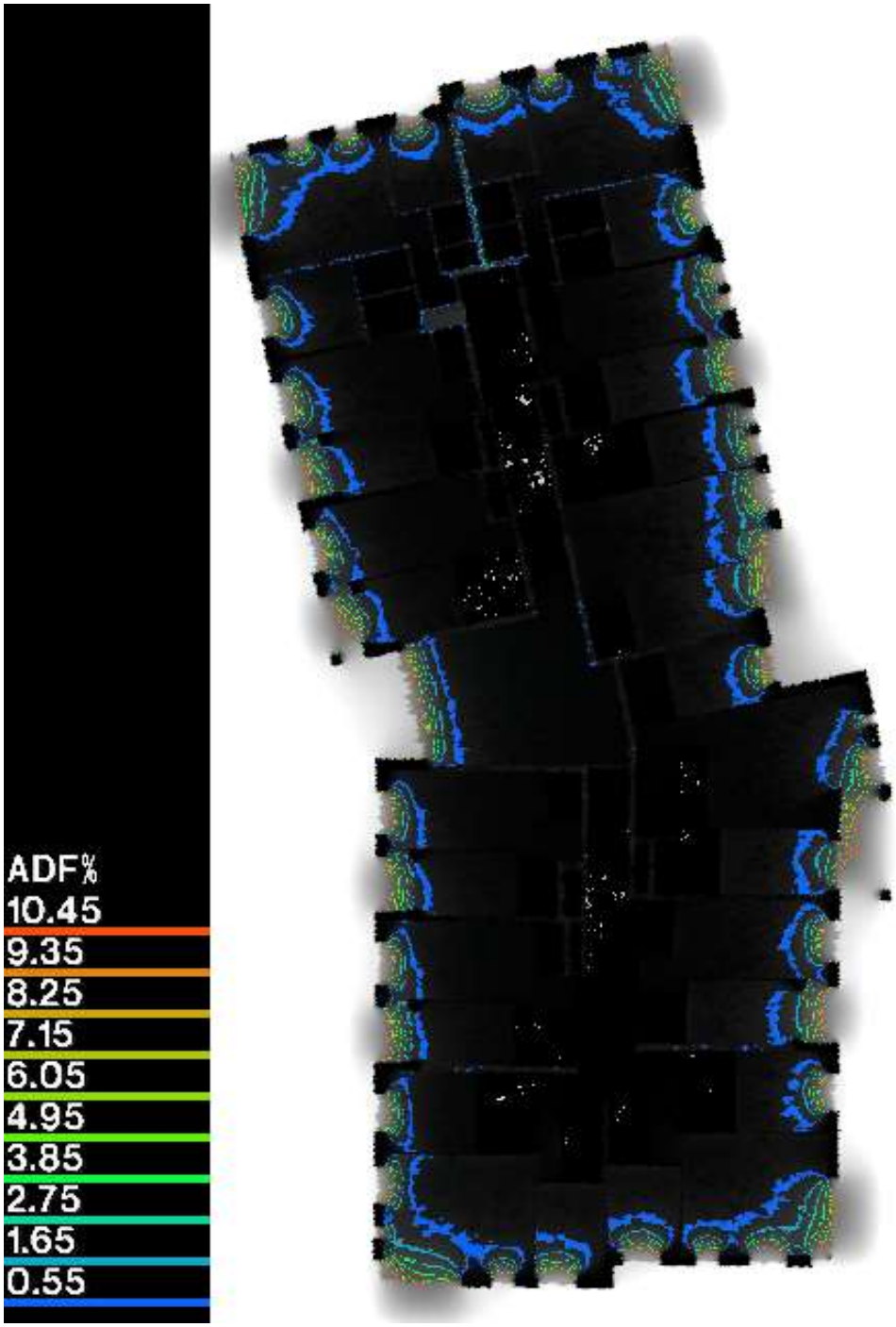

Figure 52 - *Block 3 First Floor Daylight Factor Mapping*

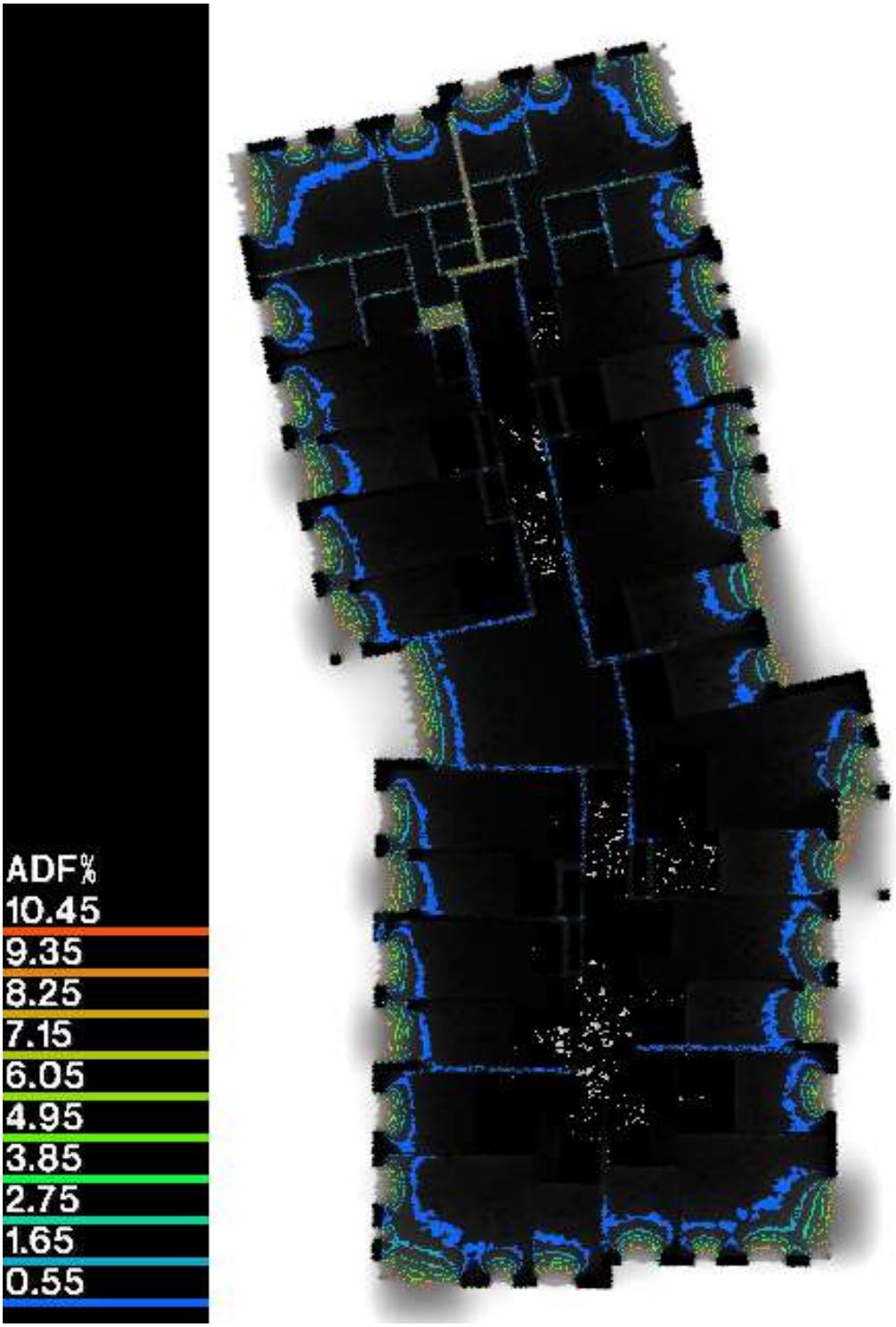

Figure 53 - *Block 3 Second Floor Daylight Factor Mapping*

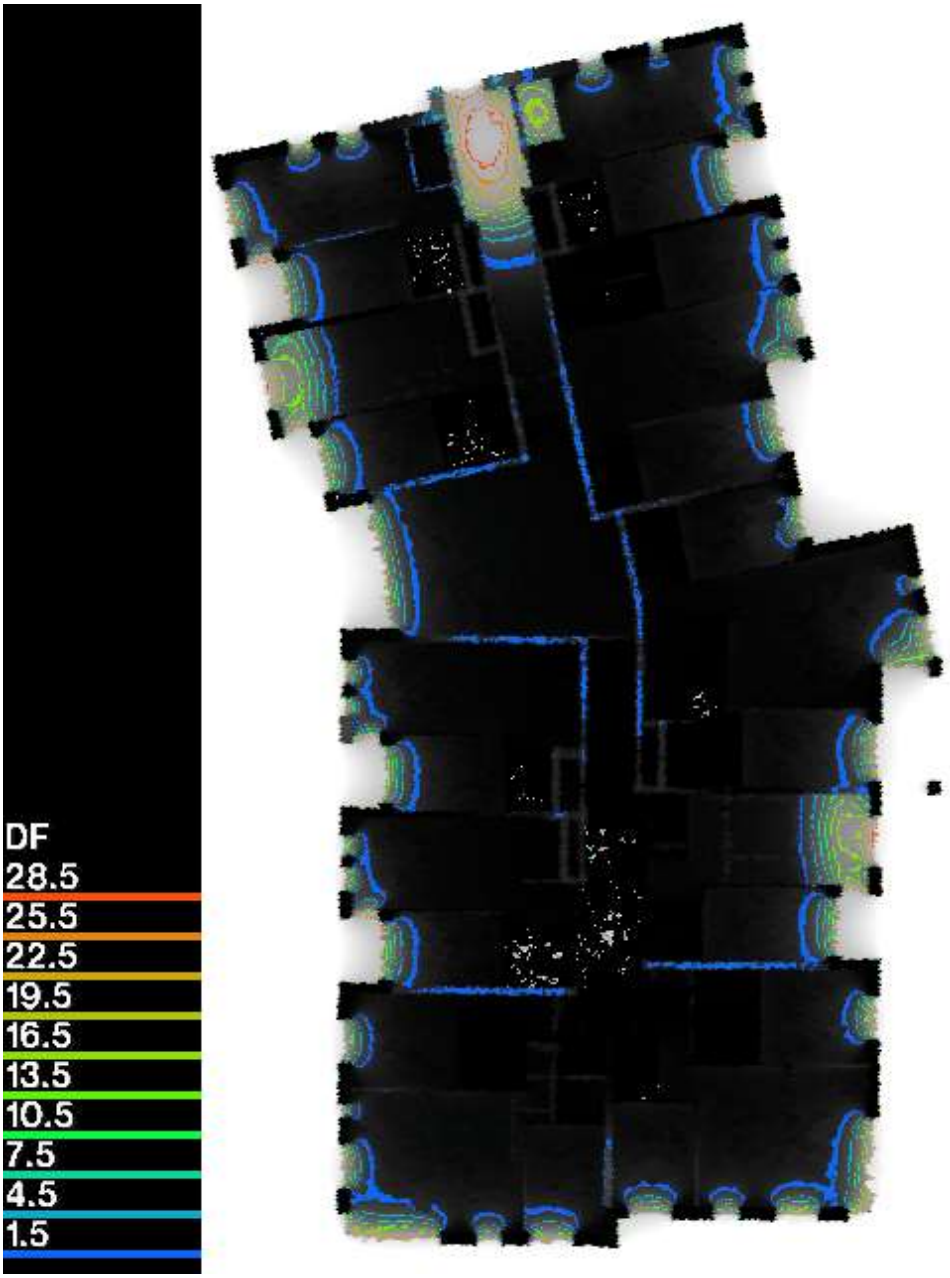

Figure 54 - *Block 3 Third Floor Daylight Factor Mapping*

Figure 55 - *Block 4 Ground Floor Daylight Factor Mapping*

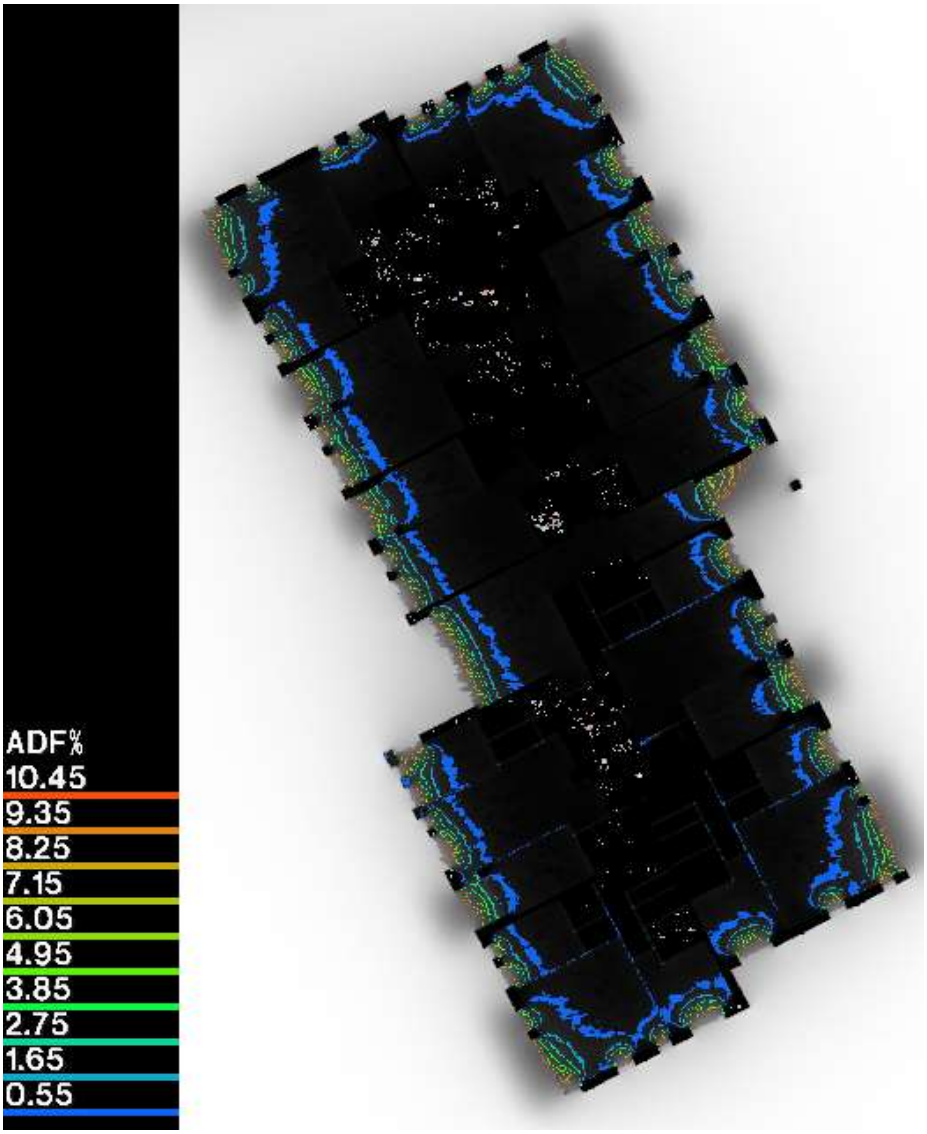

Figure 56 - Block 4 First Floor Daylight Factor Mapping

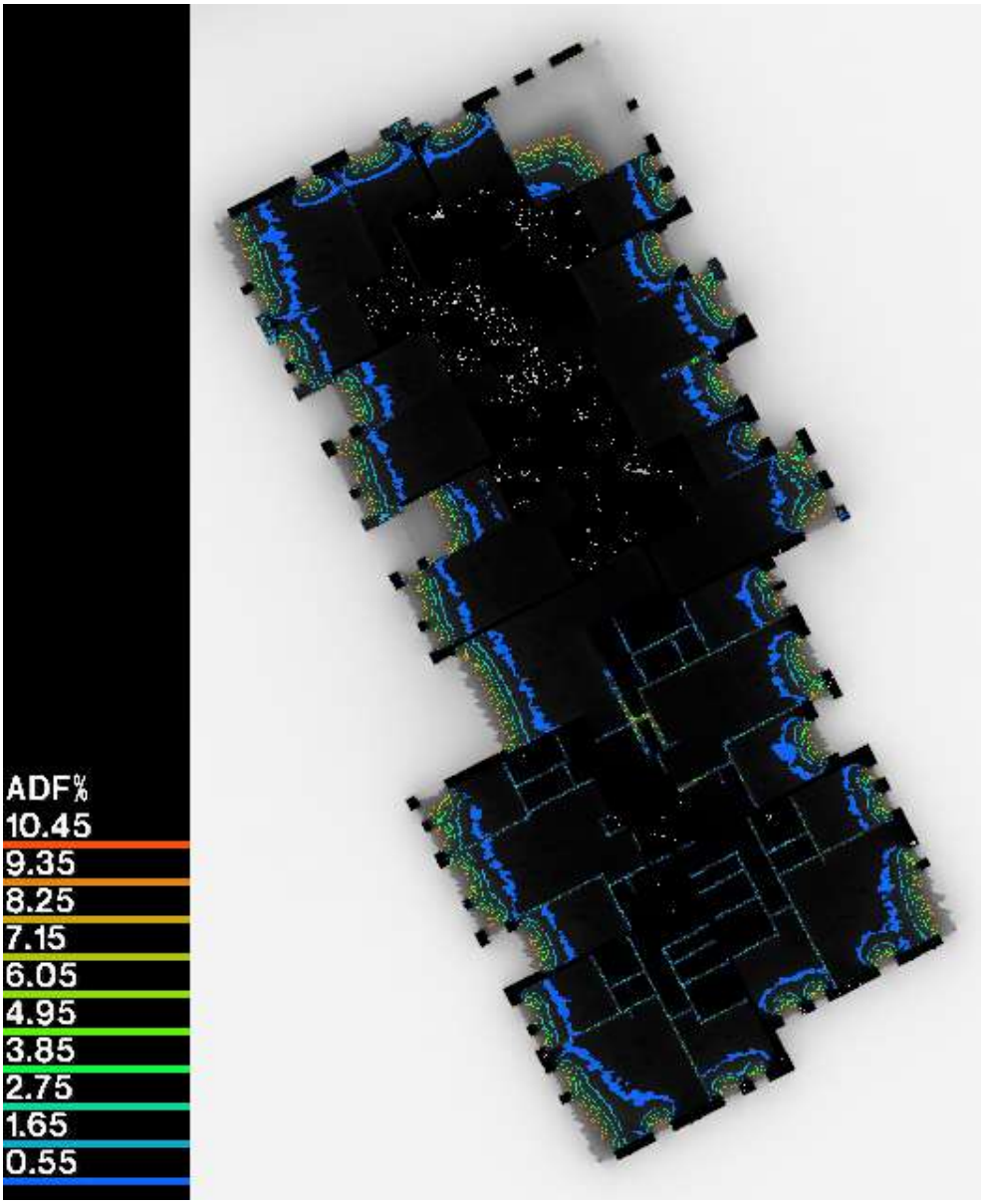

Figure 57 - *Block 4 Second Floor Daylight Factor Mapping*

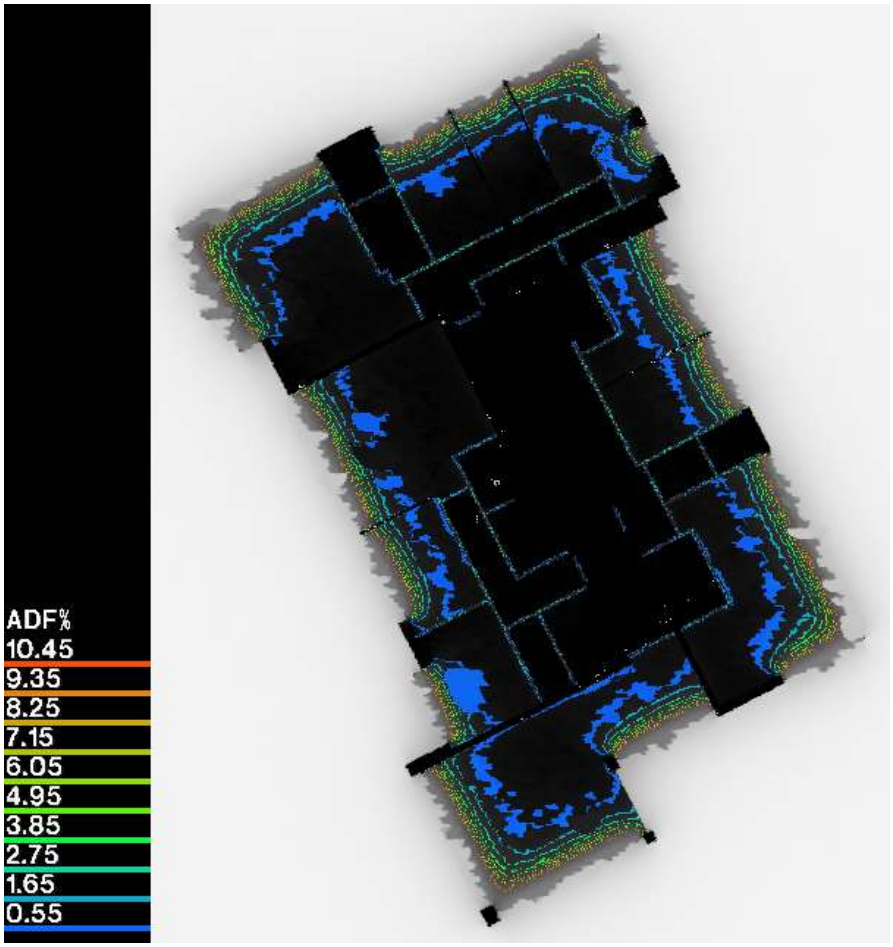

Figure 58 - *Block 4 Third Floor Daylight Factor Mapping*

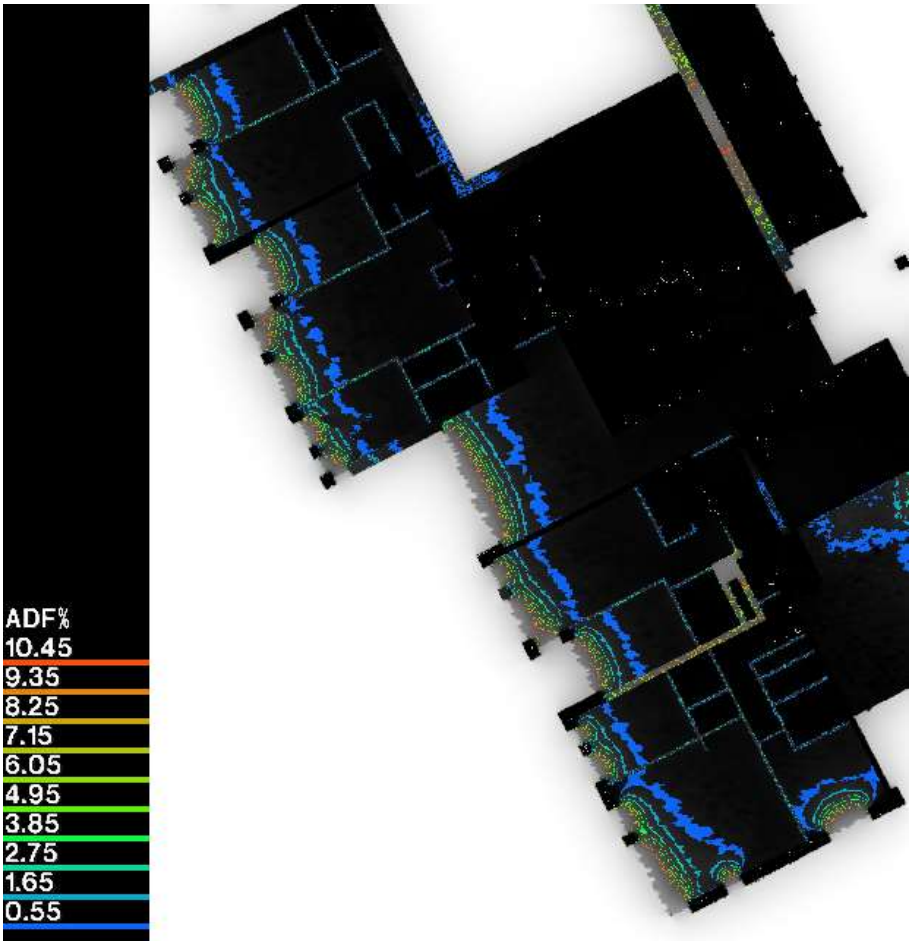

Figure 59 - *Block 5 Ground Floor Daylight Factor Mapping*

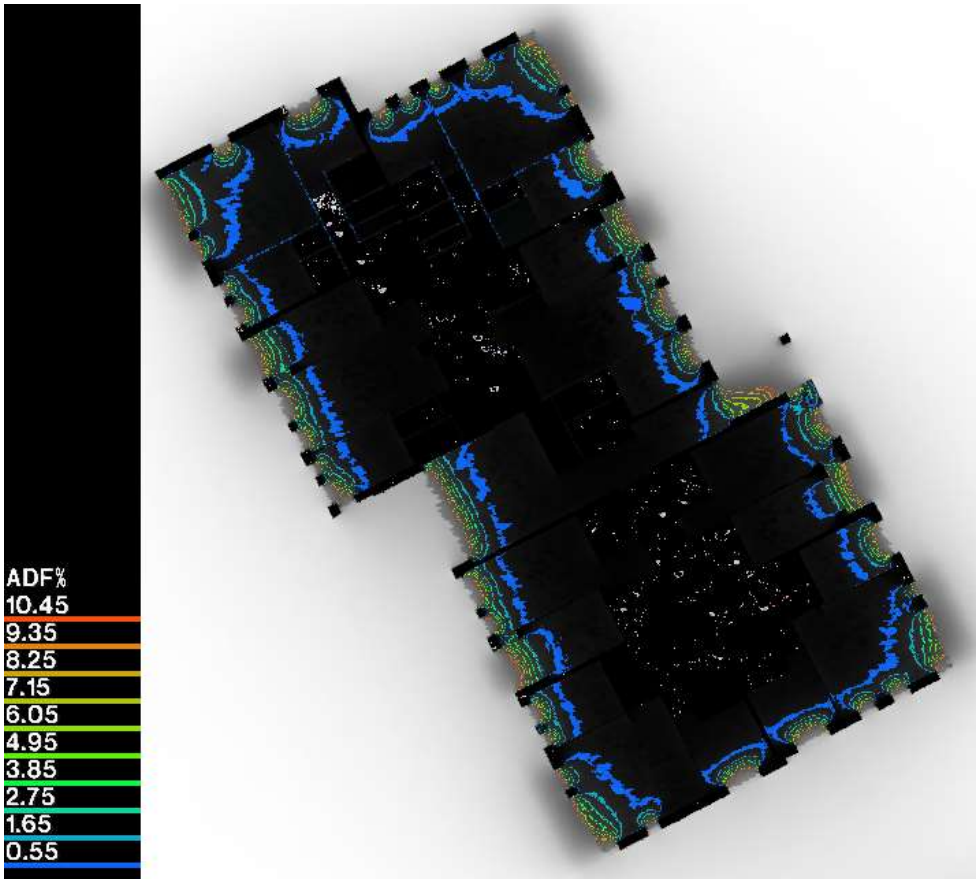

Figure 60 - *Block 5 First Floor Daylight Factor Mapping*

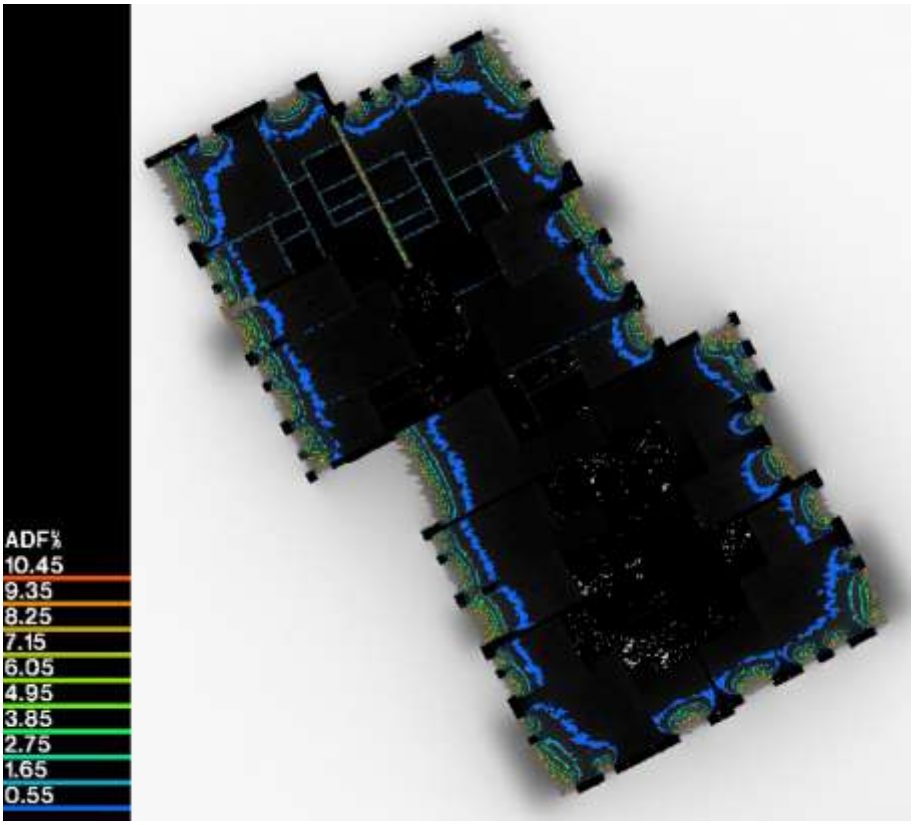

Figure 61 - *Block 5 Second Floor Daylight Factor Mapping*

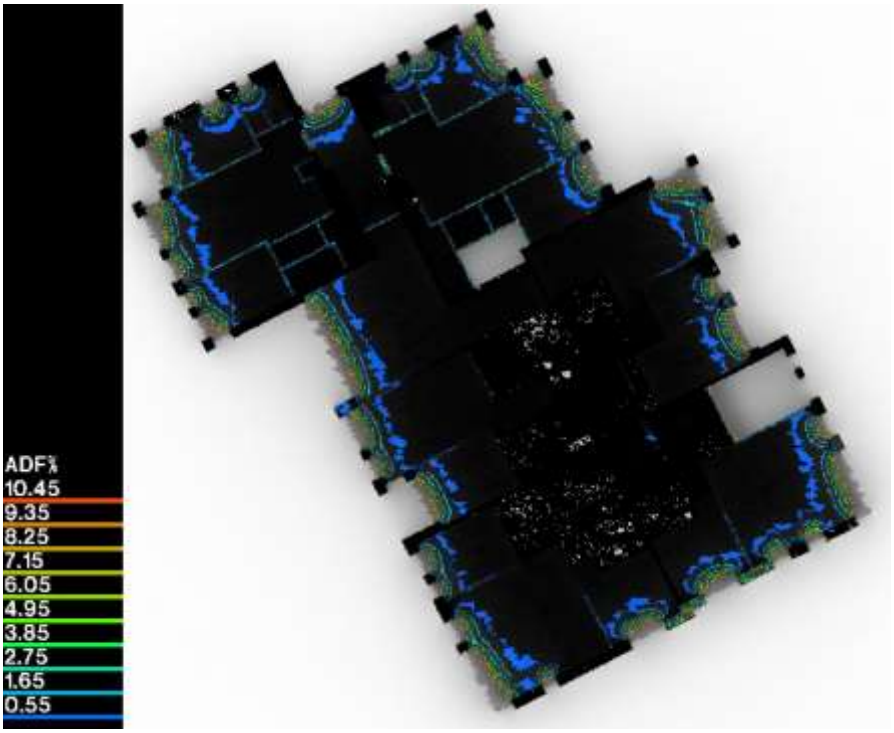

Figure 62 - *Block 5 Third Floor Daylight Factor Mapping*

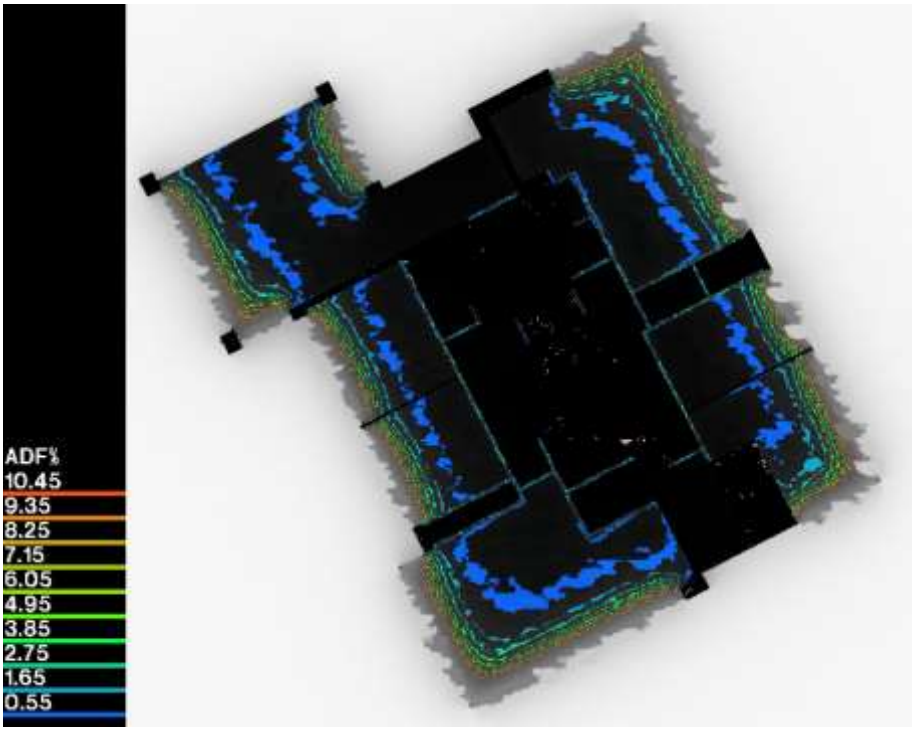

Figure 63 - *Block 5 Fourth Floor Daylight Factor Mapping*

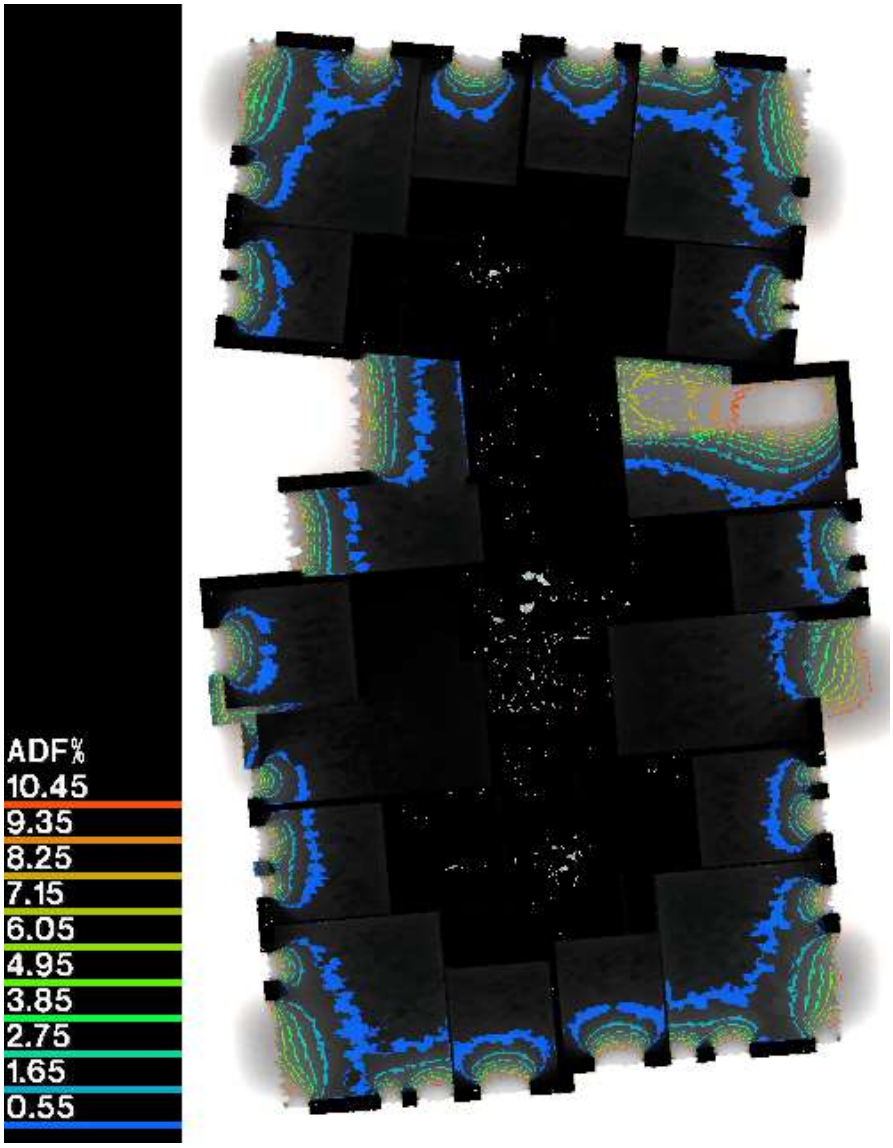

Figure 64 - *Block 6 Ground Floor Daylight Factor Mapping*

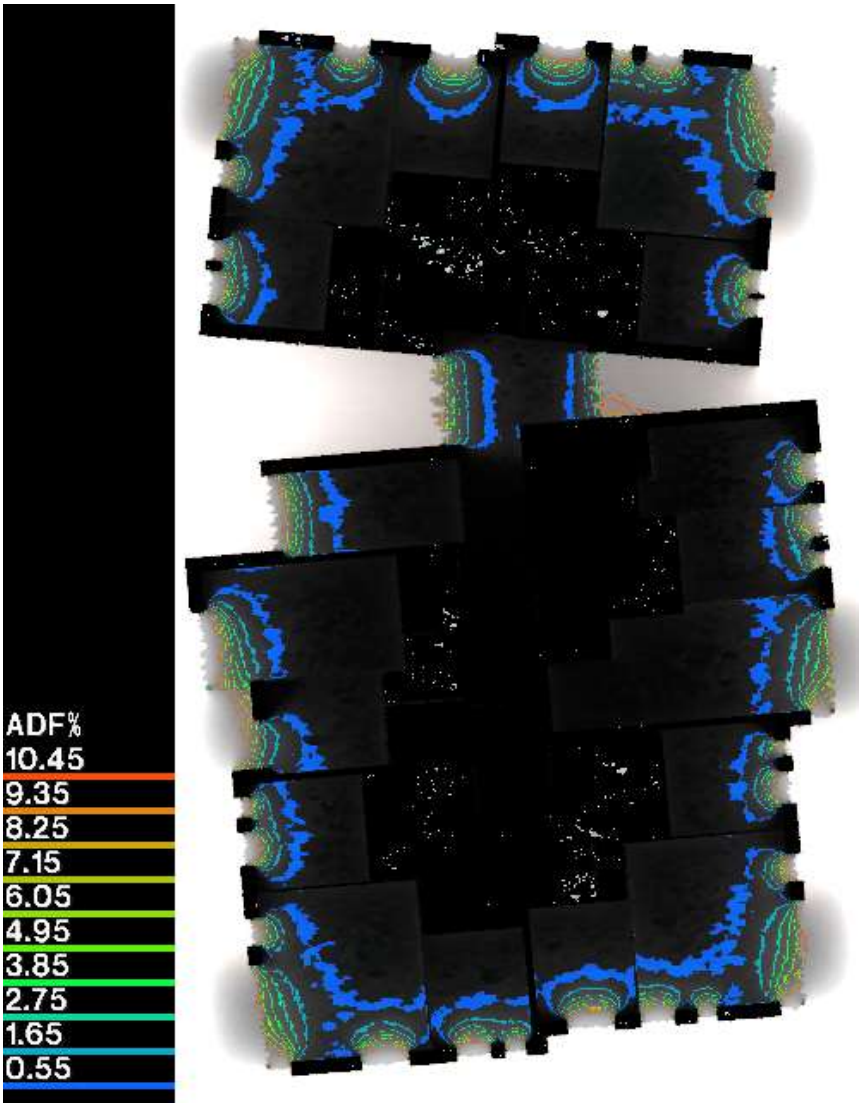

Figure 65 - *Block 6 First Floor Daylight Factor Mapping*

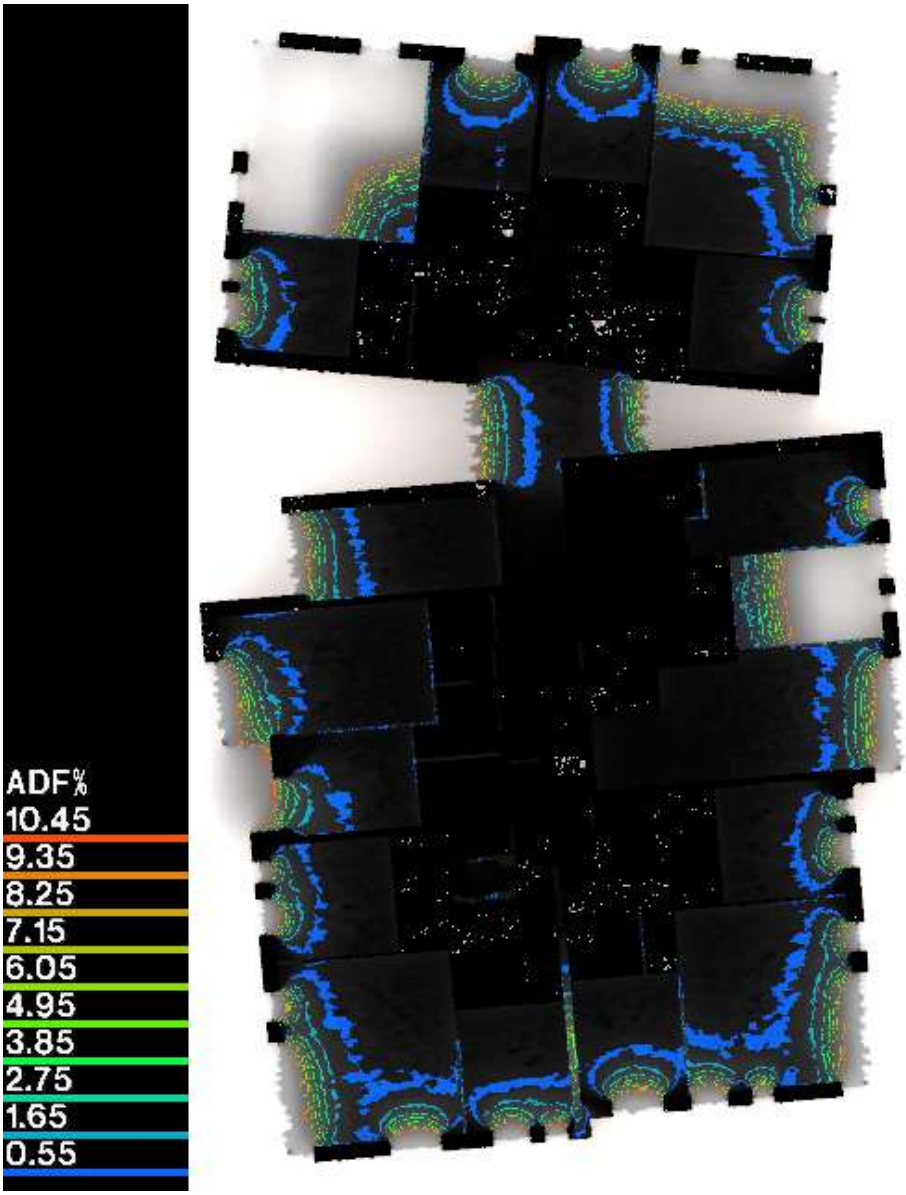

Figure 66 - *Block 6 Second Floor Daylight Factor Mapping*

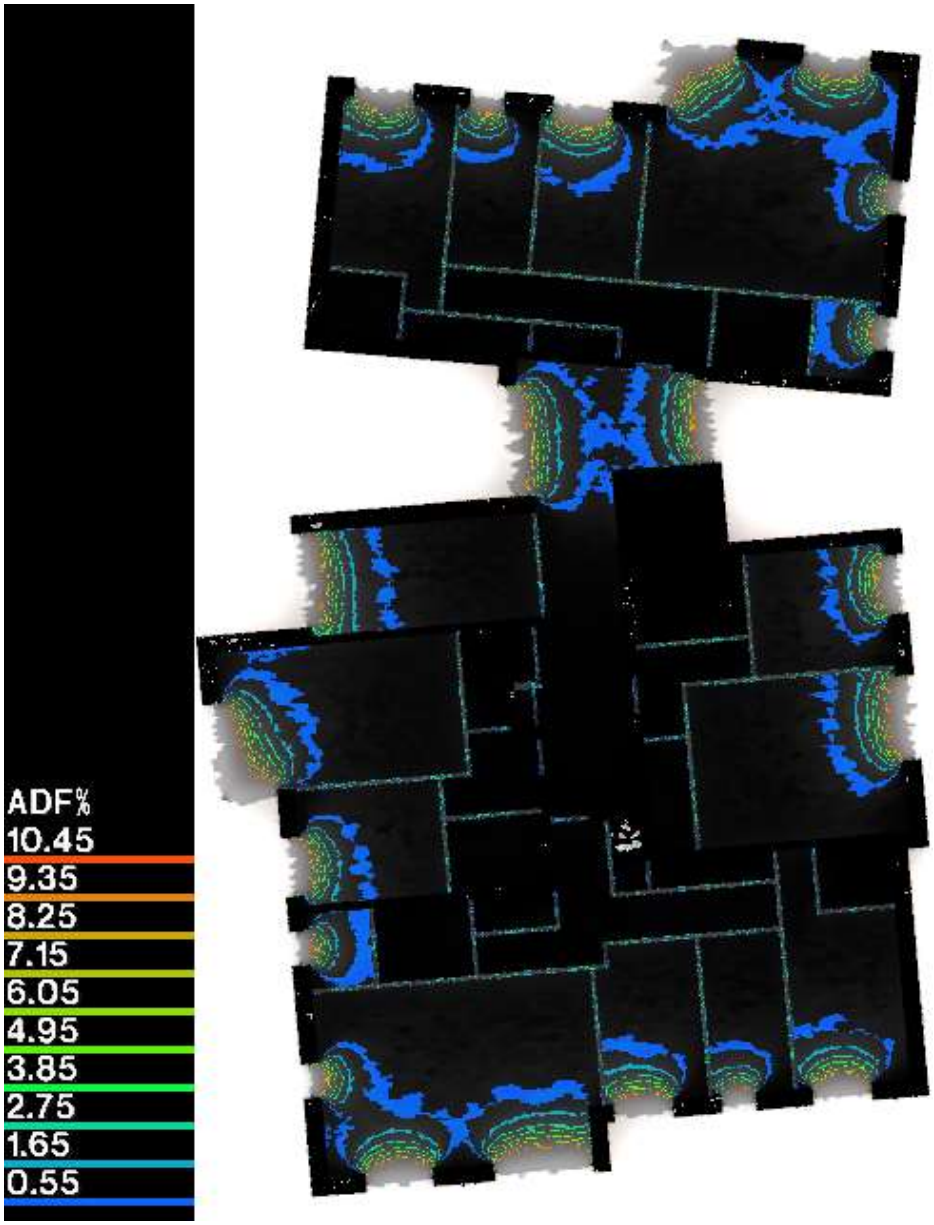

Figure 67 - *Block 6 Third Floor Daylight Factor Mapping*

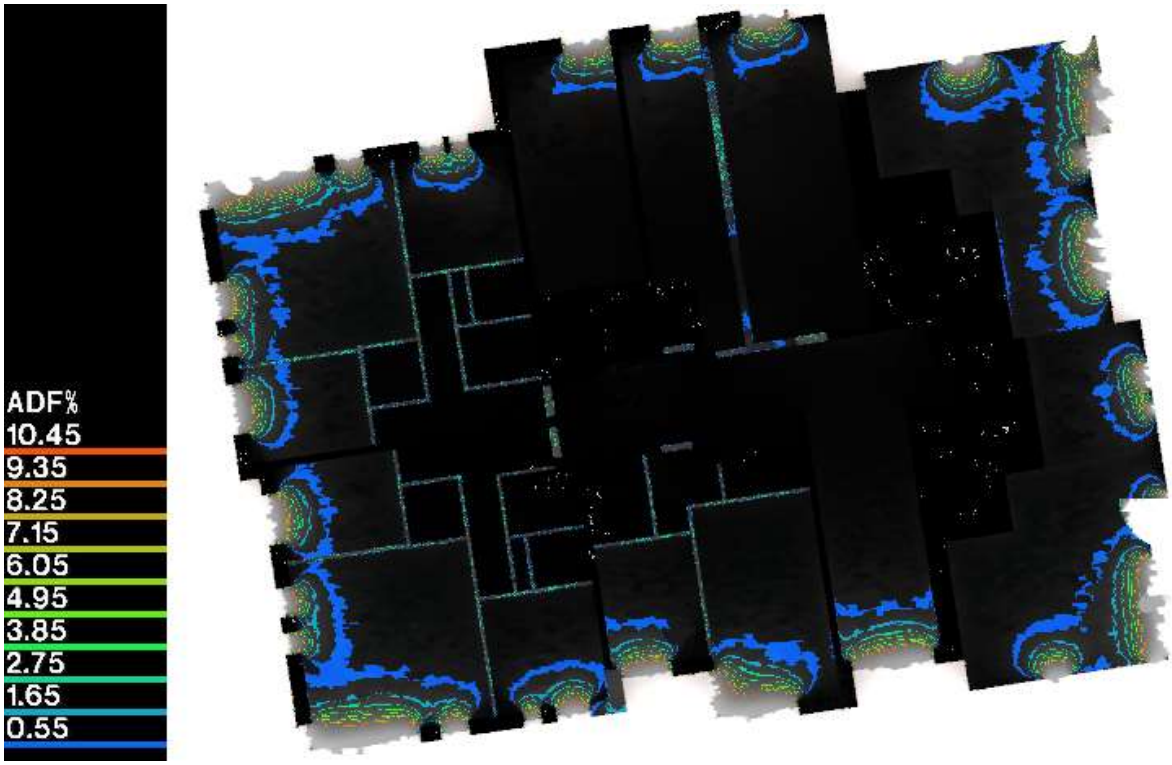

Figure 68 - *Block 7 Ground Floor Daylight Factor Mapping*

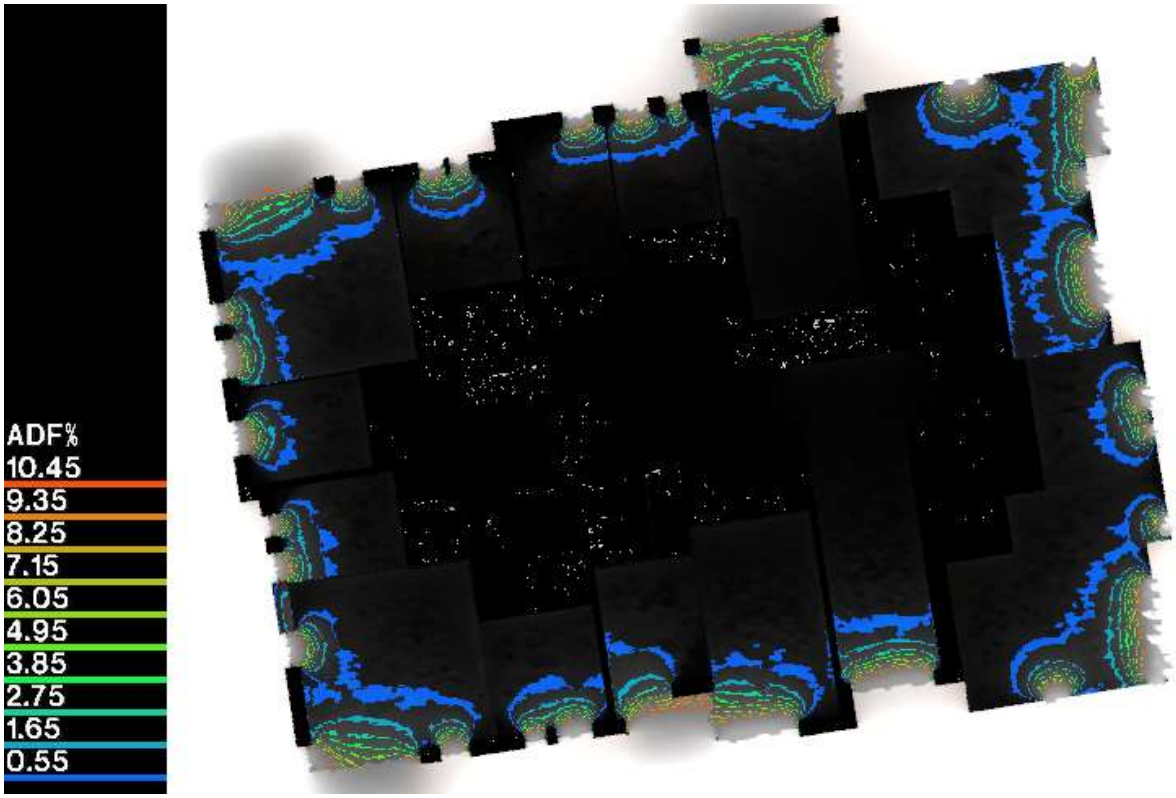

Figure 69 - *Block 7 First Floor Daylight Factor Mapping*

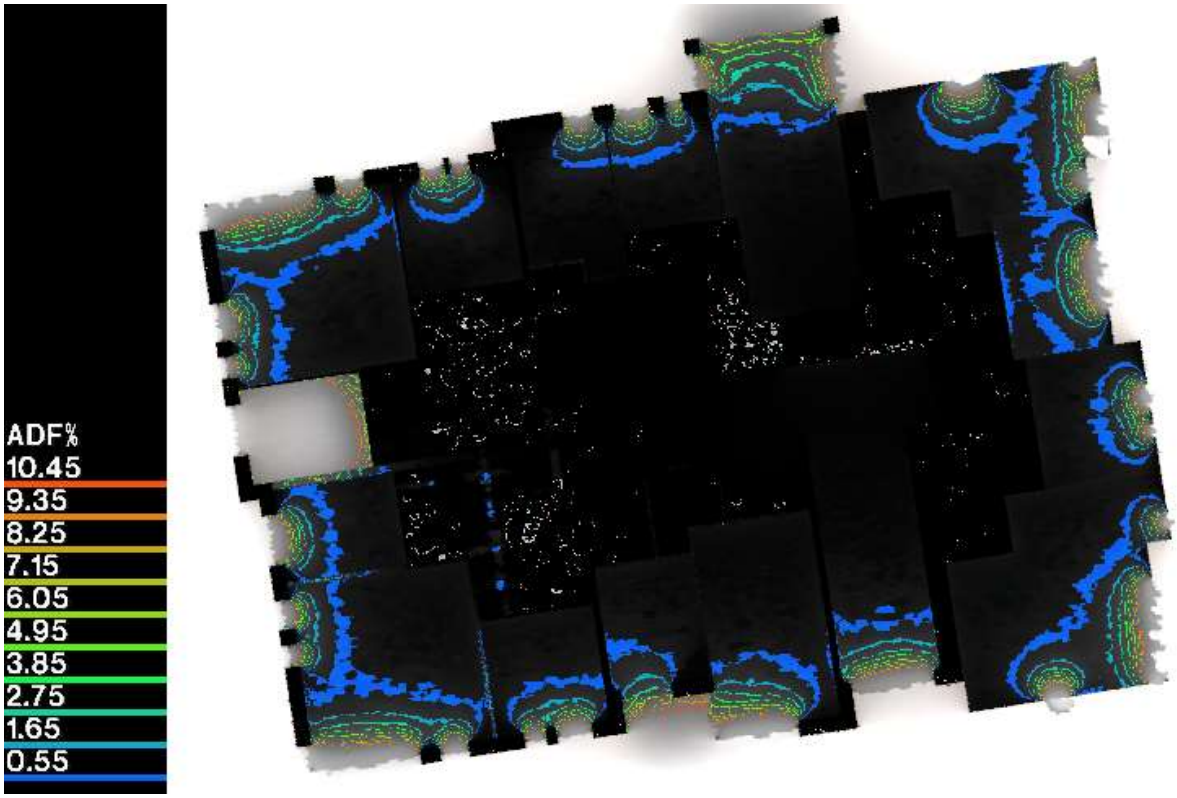

Figure 70 - *Block 7 Second Floor Daylight Factor Mapping*

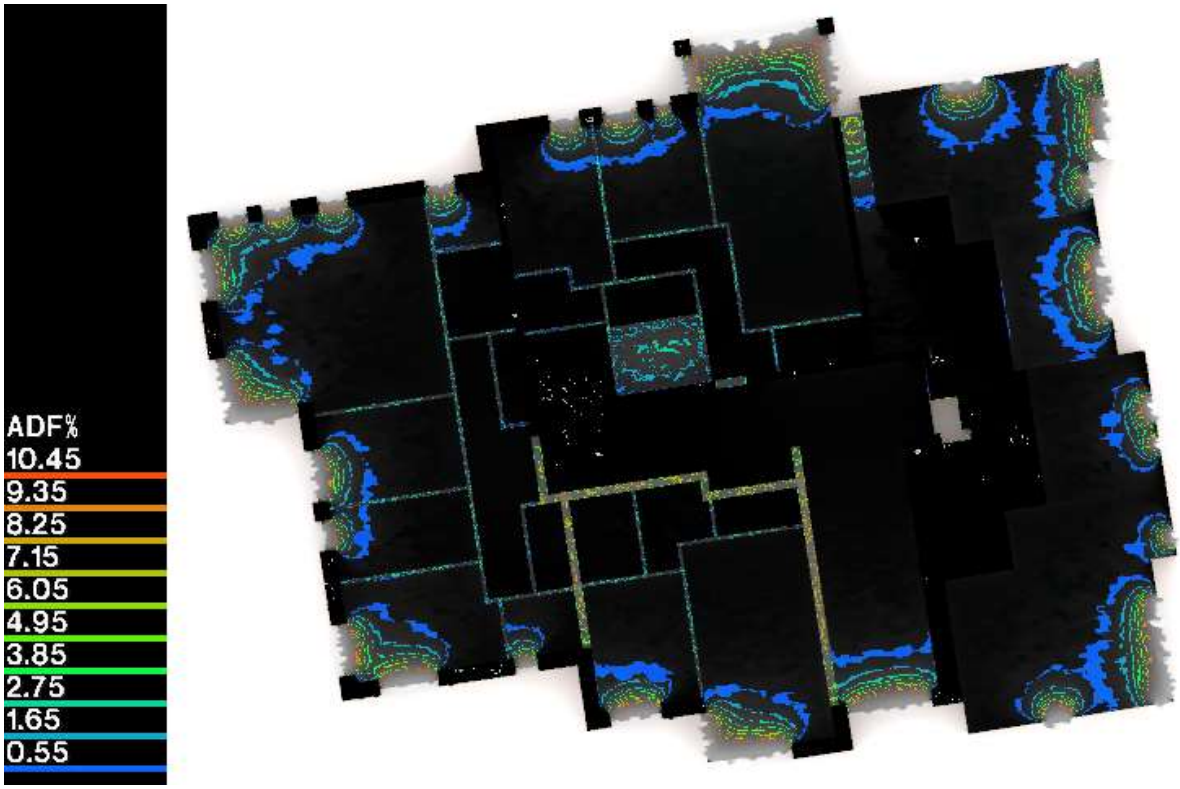

Figure 71 - *Block 7 Third Floor Daylight Factor Mapping*

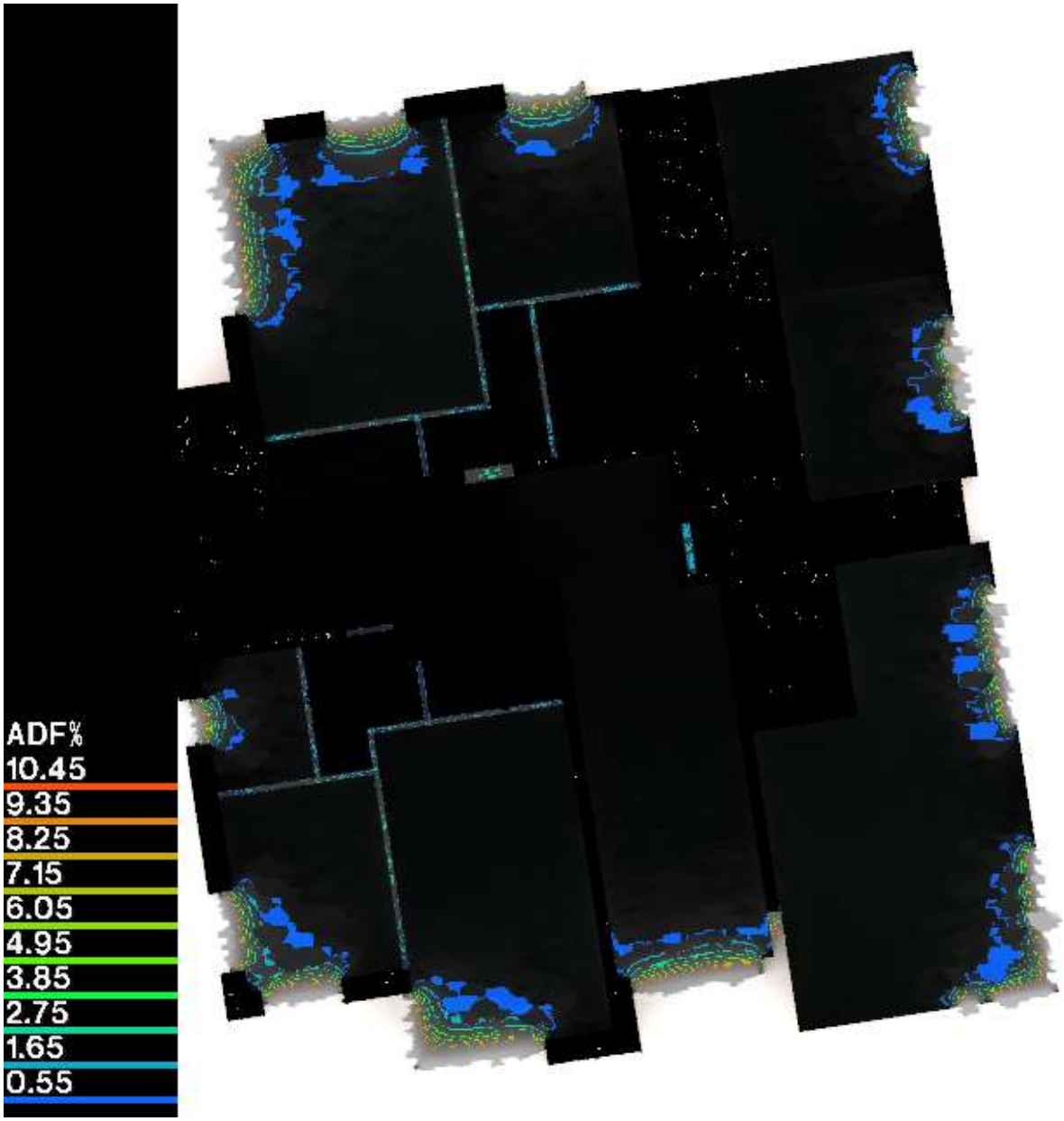

Figure 72 - *Block 7 Fourth Floor Daylight Factor Mapping*

Figures 73 to 89 below provide visual representations of the expecting overshadowing caused by the existing mature tree line to the east of Duplex Blocks 2B & 2C.

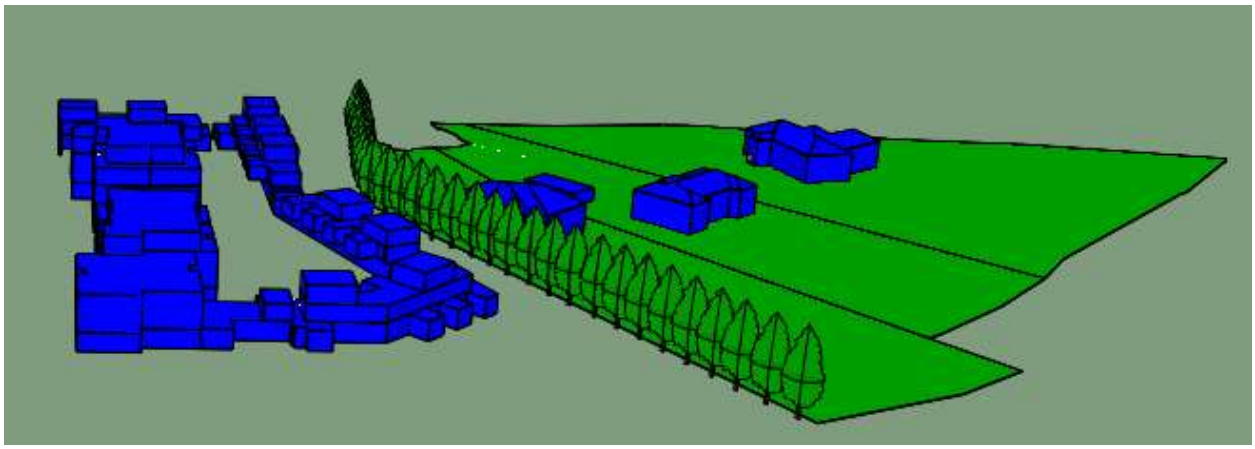

Figure 73 – Duplex Block 2B & 2C and adjacent properties (Source IES VE model)

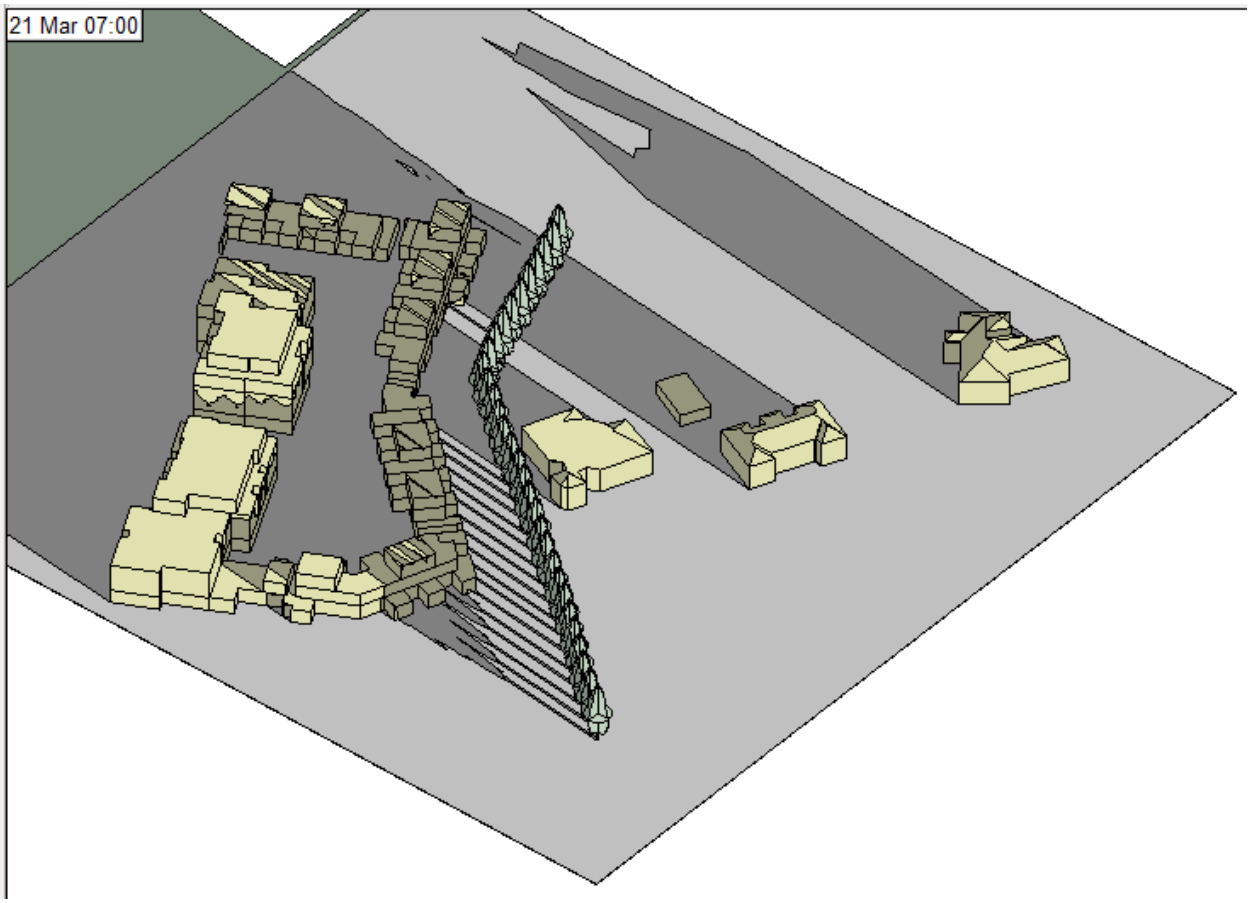

Figure 74 –Overshadowing to Duplex Block 2A – 2D & Existing Properties image on March 21st at 7am (Source IES VE model)

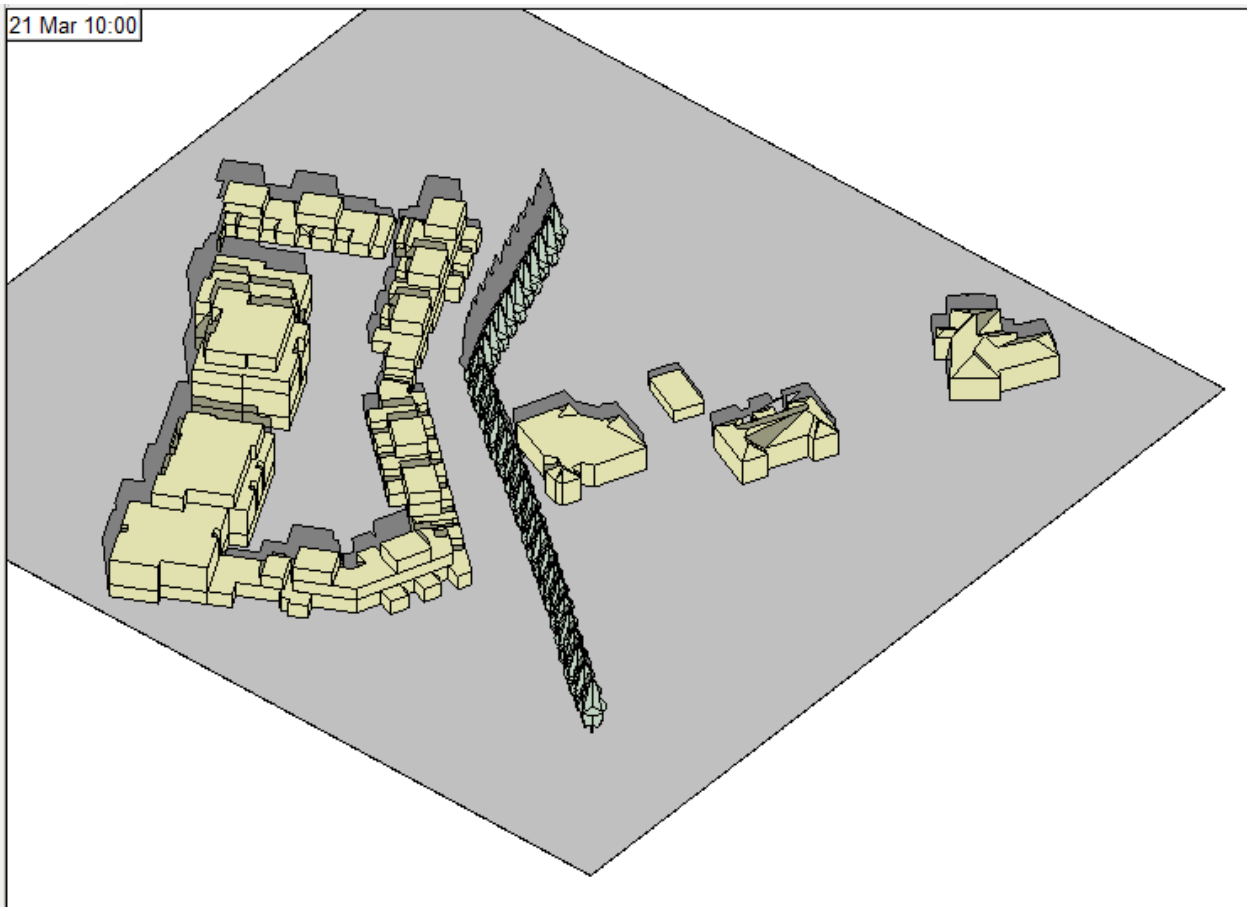

Figure 75 –Overshadowing to Duplex Block 2A – 2D & Existing Properties image on March 21st at 10am (Source IES VE model)

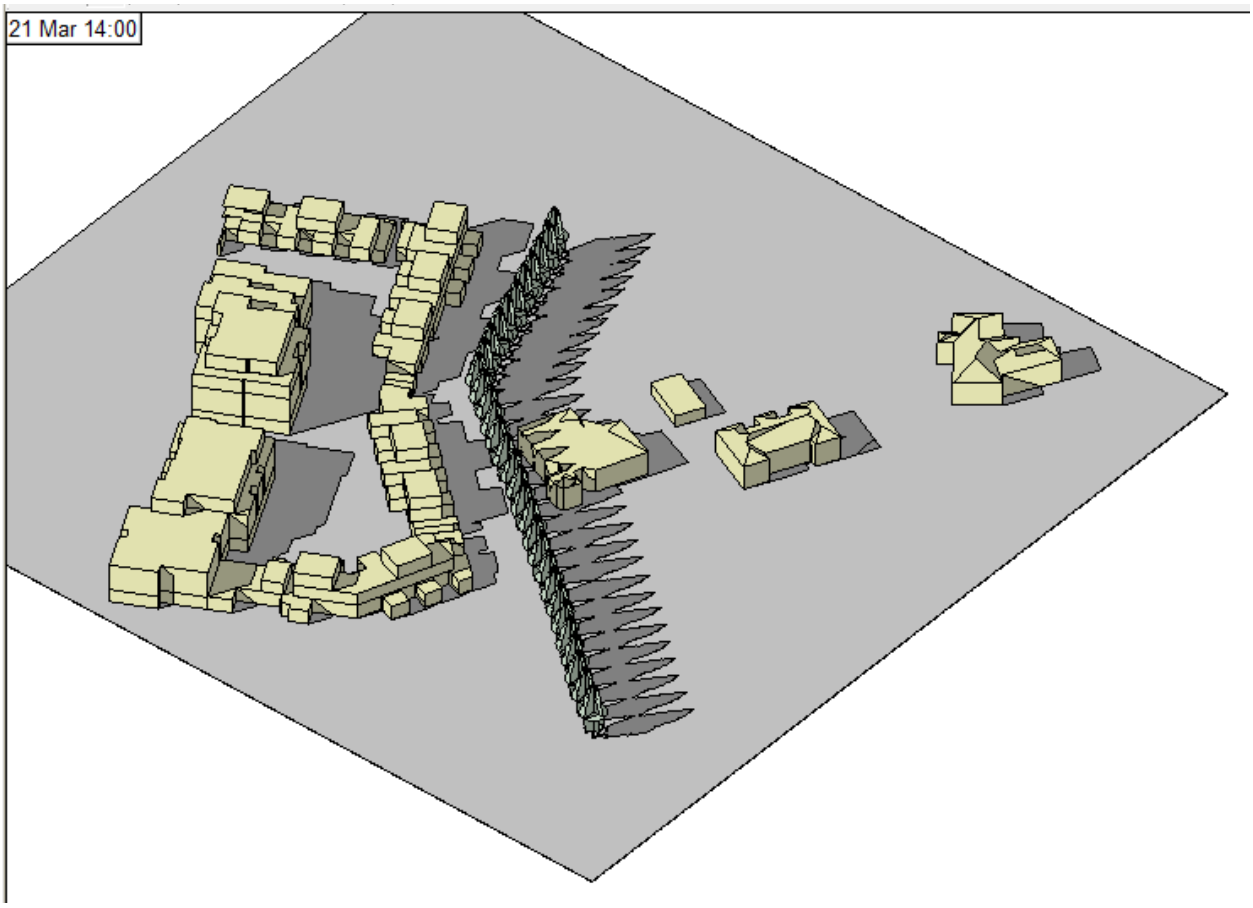

Figure 76 – Overshadowing to Duplex Block 2A – 2D & Existing Properties image on March 21st at 2pm (Source IES VE model)

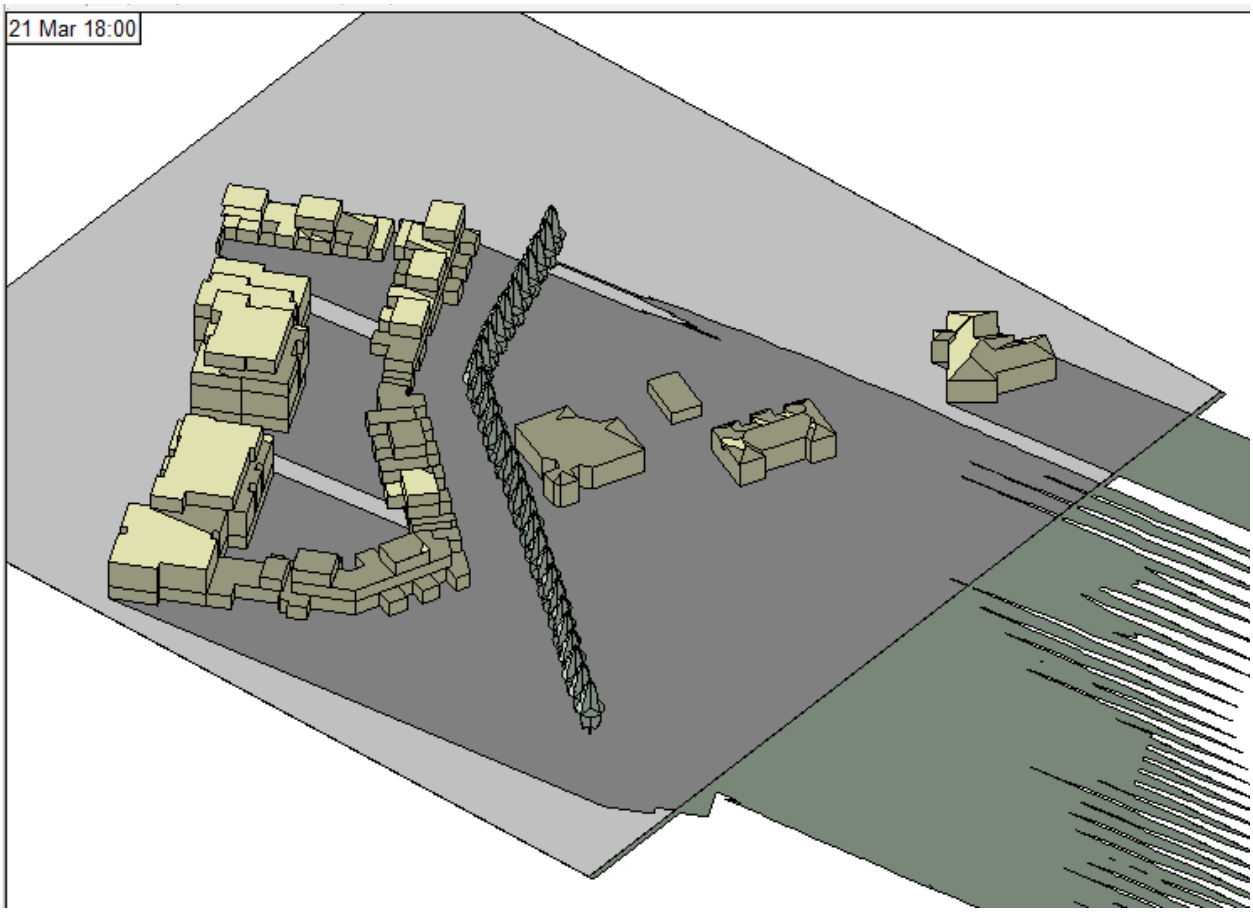

Figure 77 – Overshadowing to Duplex Block 2A – 2D & Existing Properties image on March 21st at 6pm (Source IES VE model)

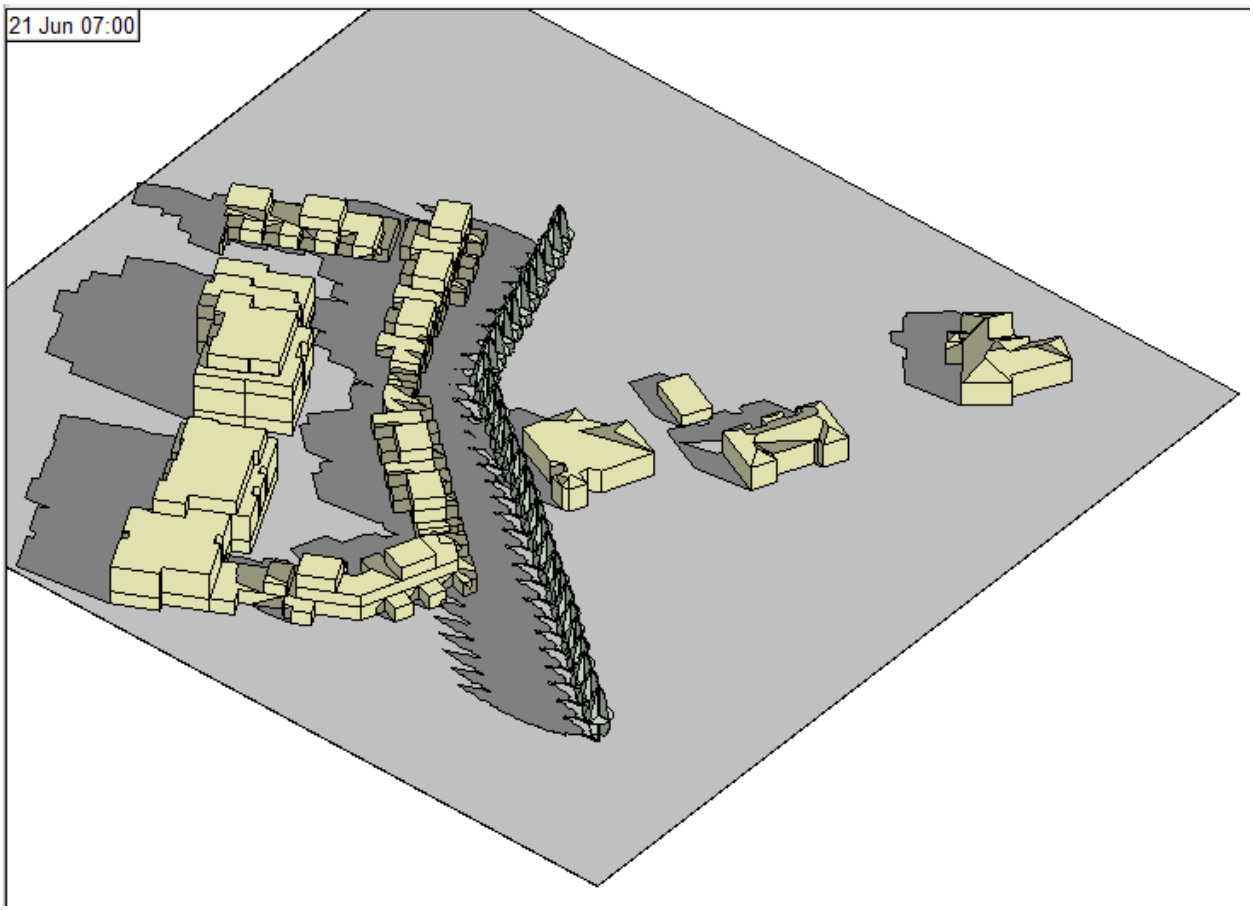

Figure 78 – Overshadowing to Duplex Block 2A – 2D & Existing Properties image on June 21st at 7am (Source IES VE model)

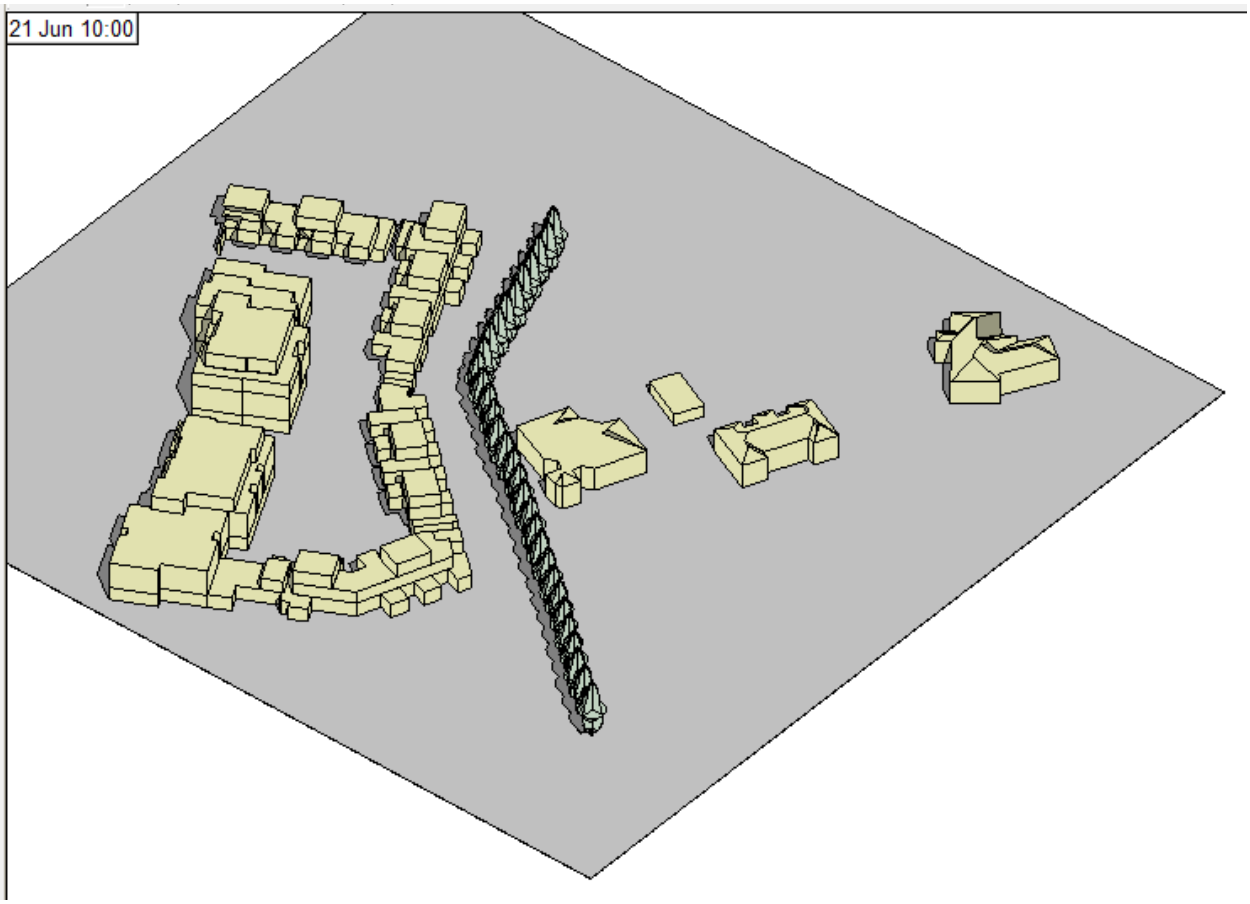

Figure 79 – Overshadowing to Duplex Block 2A – 2D & Existing Properties image on June 21st at 10am (Source IES VE model)

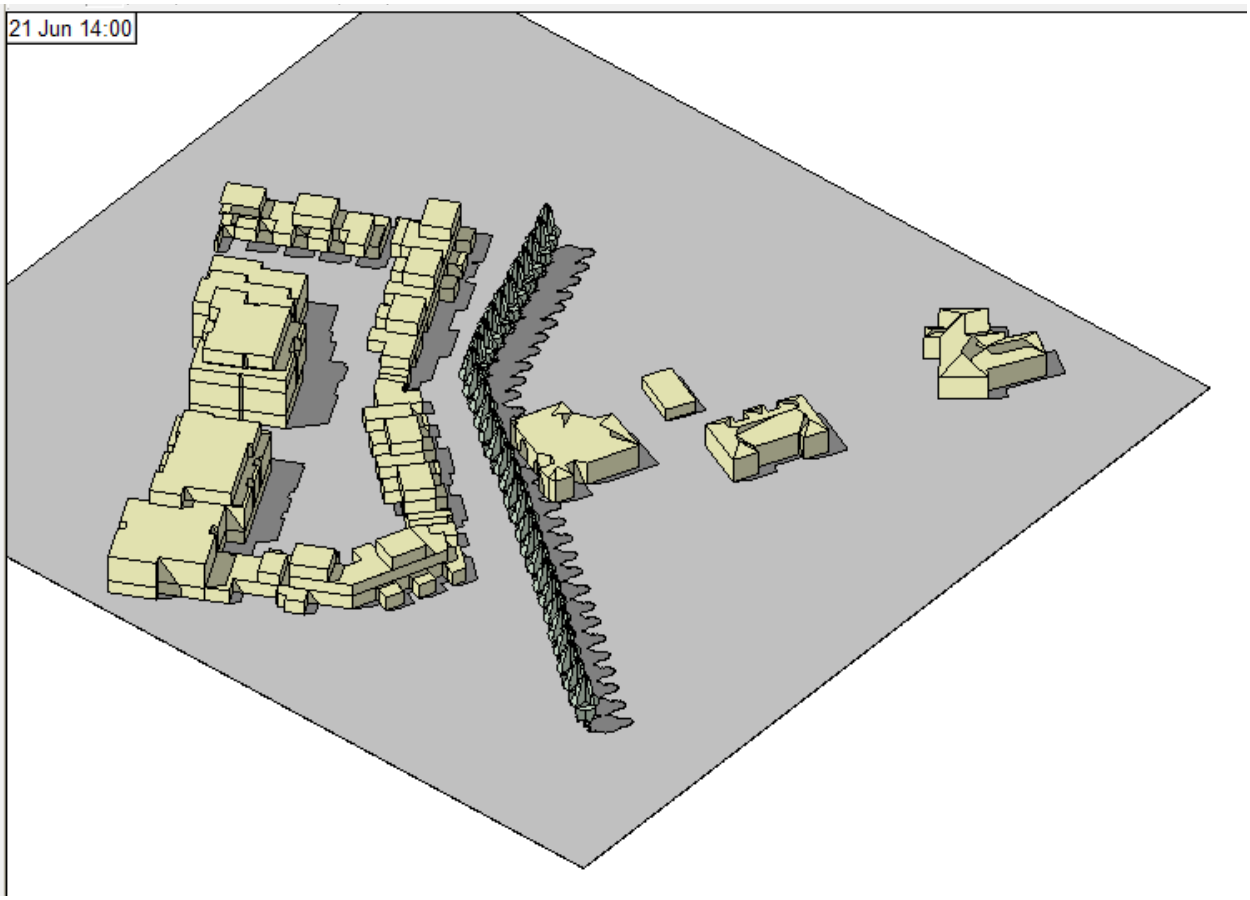

Figure 80 – Overshadowing to Duplex Block 2A – 2D & Existing Properties image on June 21st at 2pm (Source IES VE model)

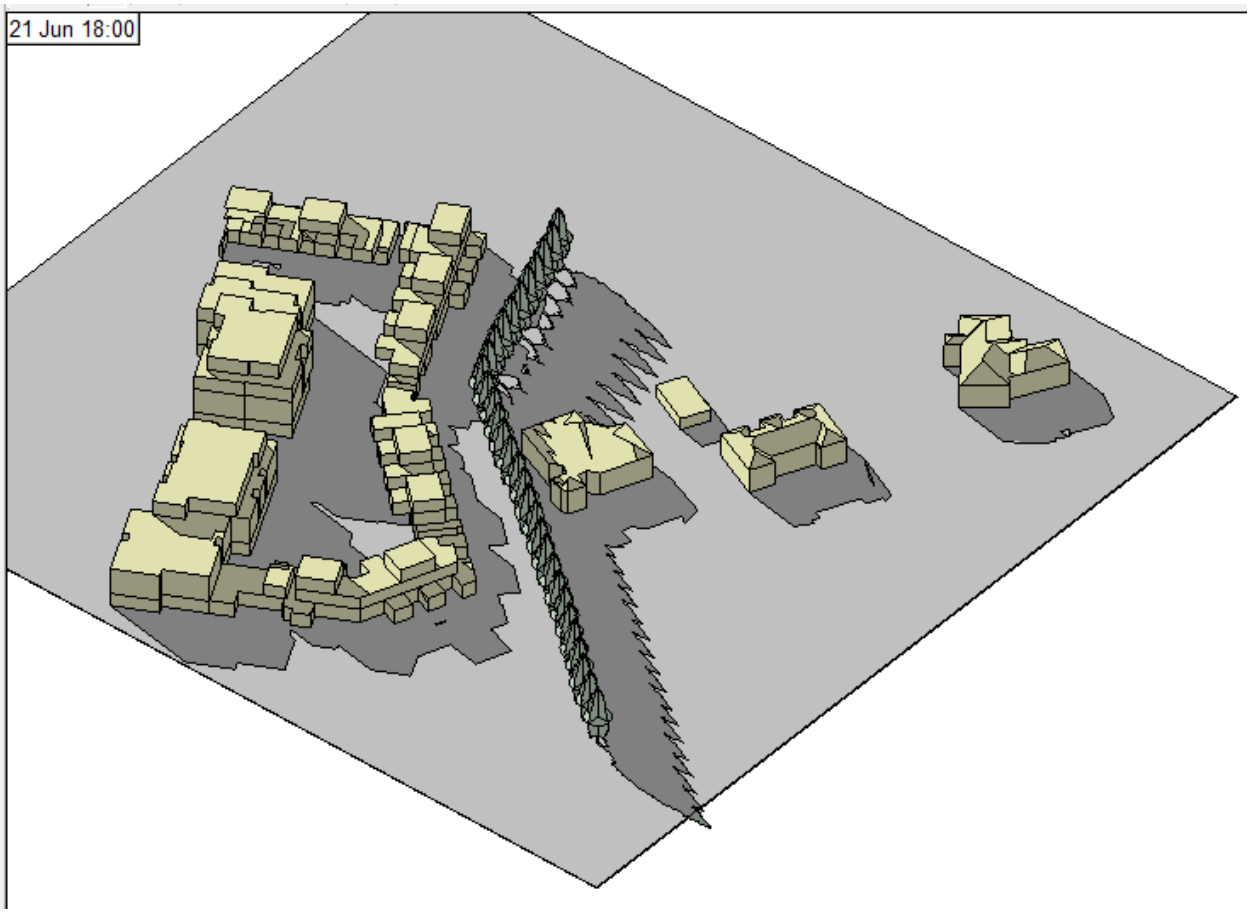

Figure 81 – Overshadowing to Duplex Block 2A – 2D & Existing Properties image on June 21st at 6pm (Source IES VE model)

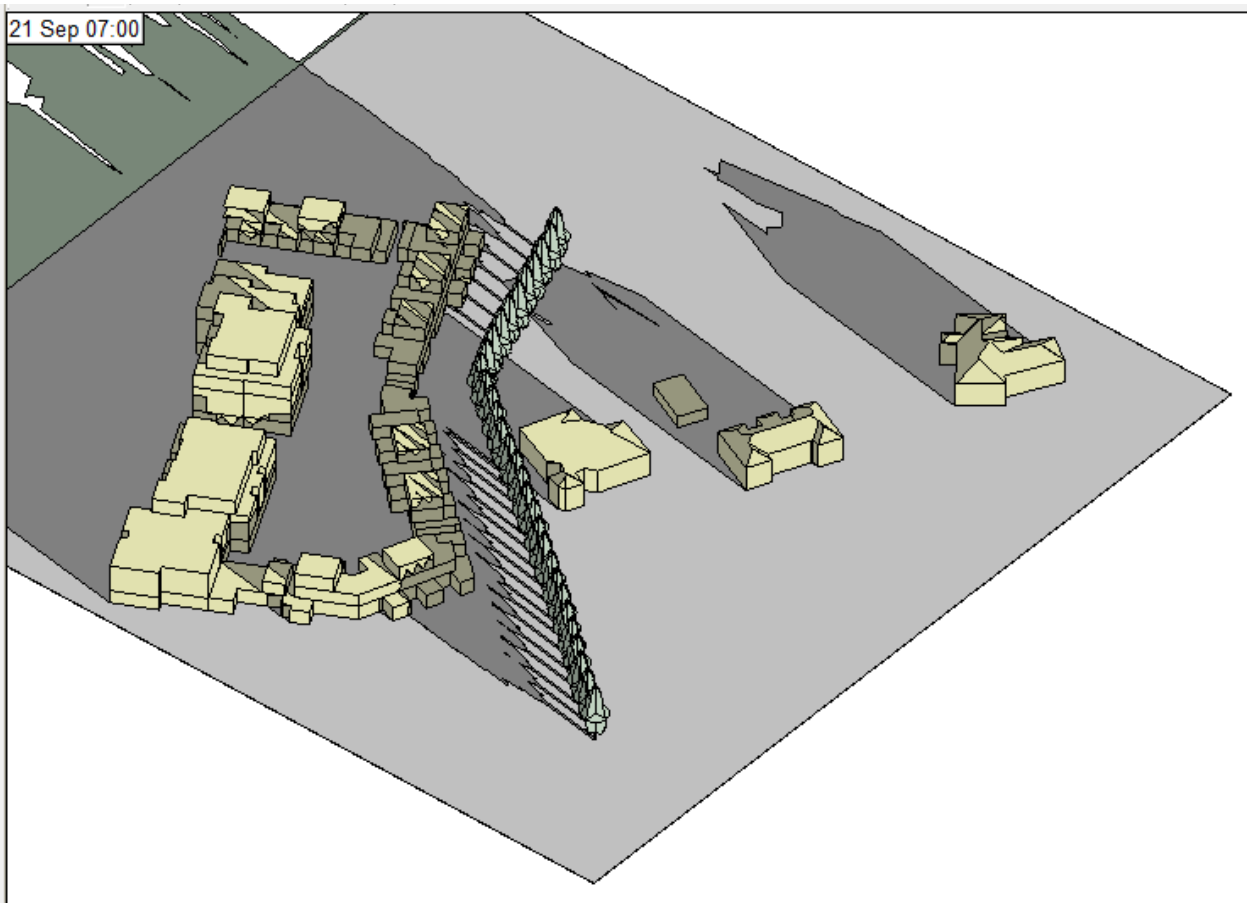

Figure 82 – Overshadowing to Duplex Block 2A – 2D & Existing Properties image on September 21st at 7am (Source IES VE model)

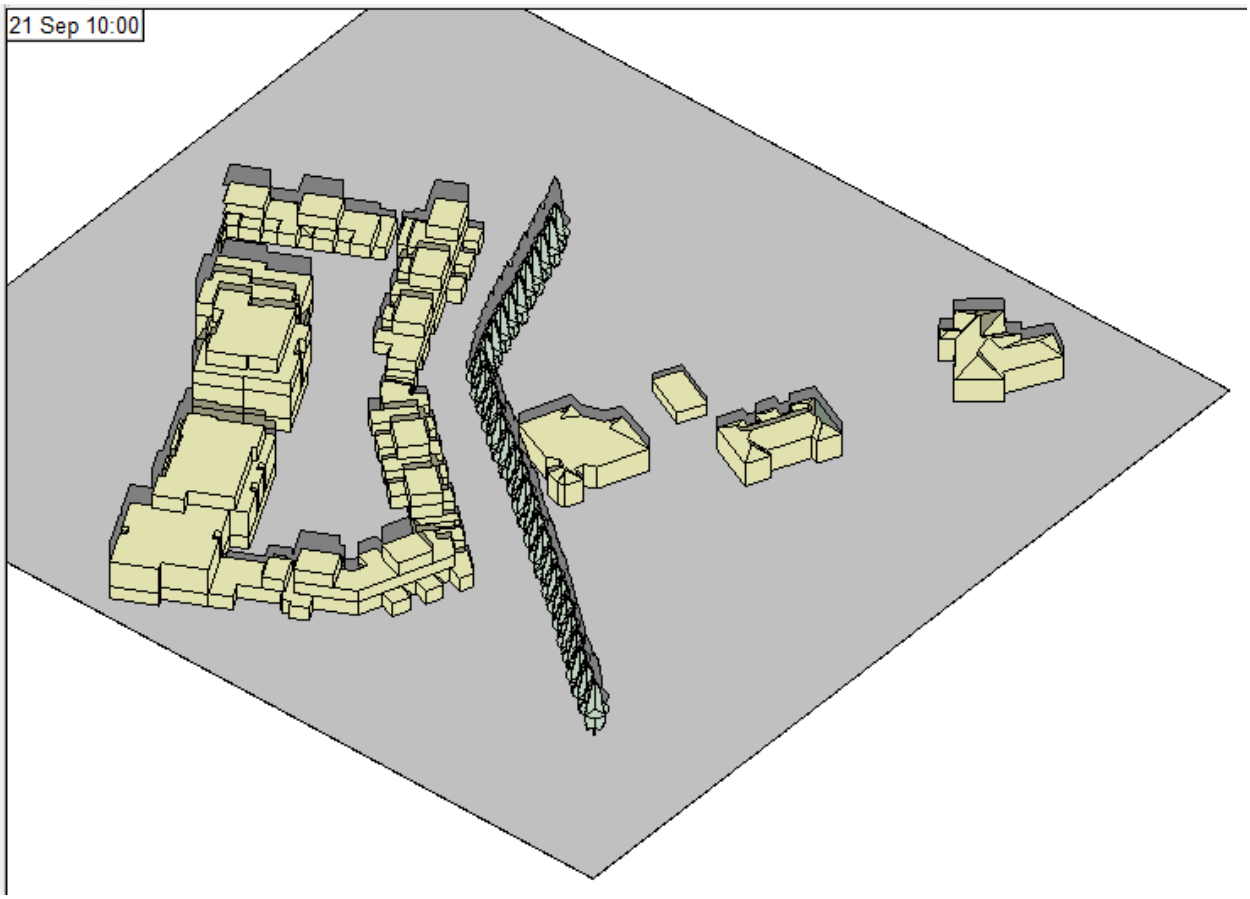

Figure 83 – Overshadowing to Duplex Block 2A – 2D & Existing Properties image on September 21st at 10am (Source IES VE model)

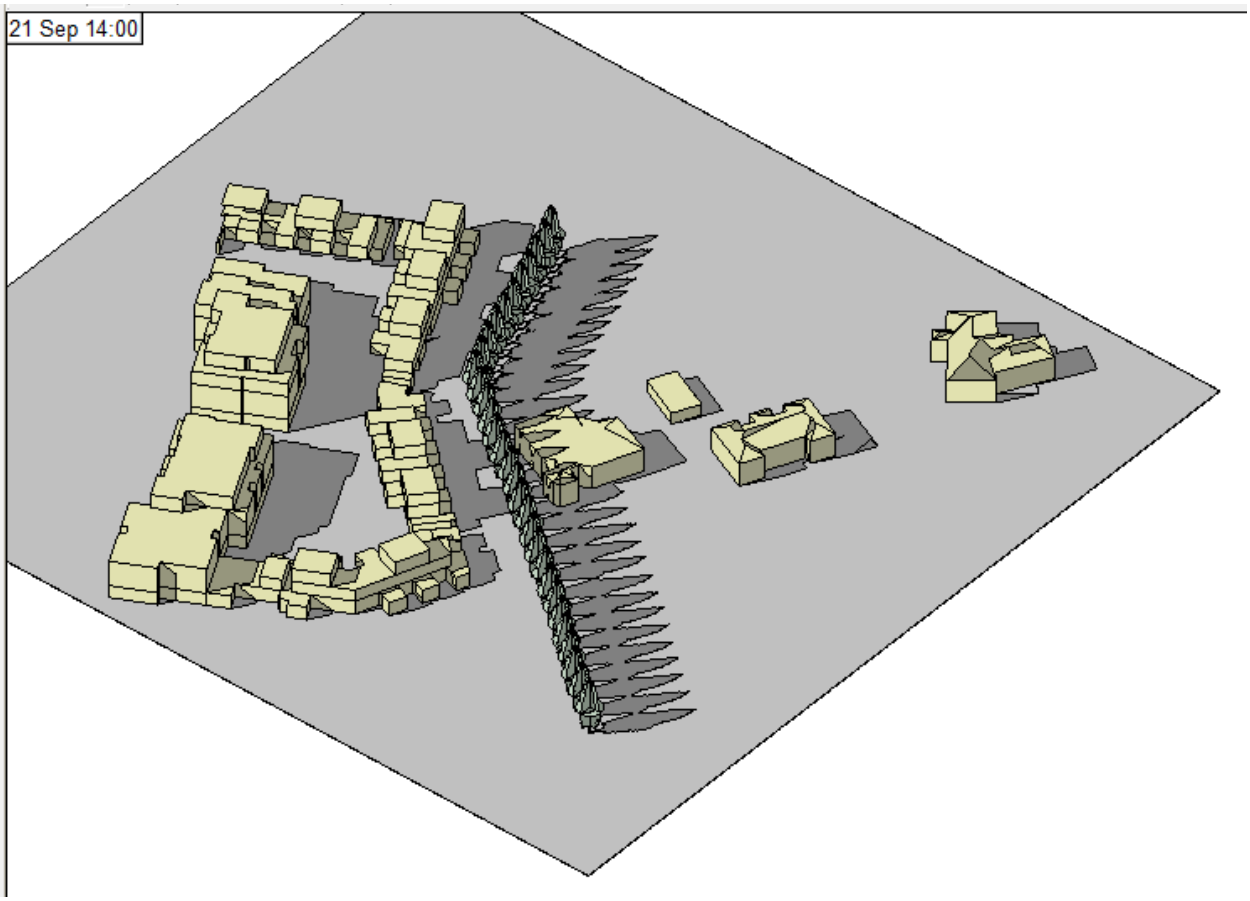

Figure 84 – Overshadowing to Duplex Block 2A – 2D & Existing Properties image on September 21st at 2pm (Source IES VE model)

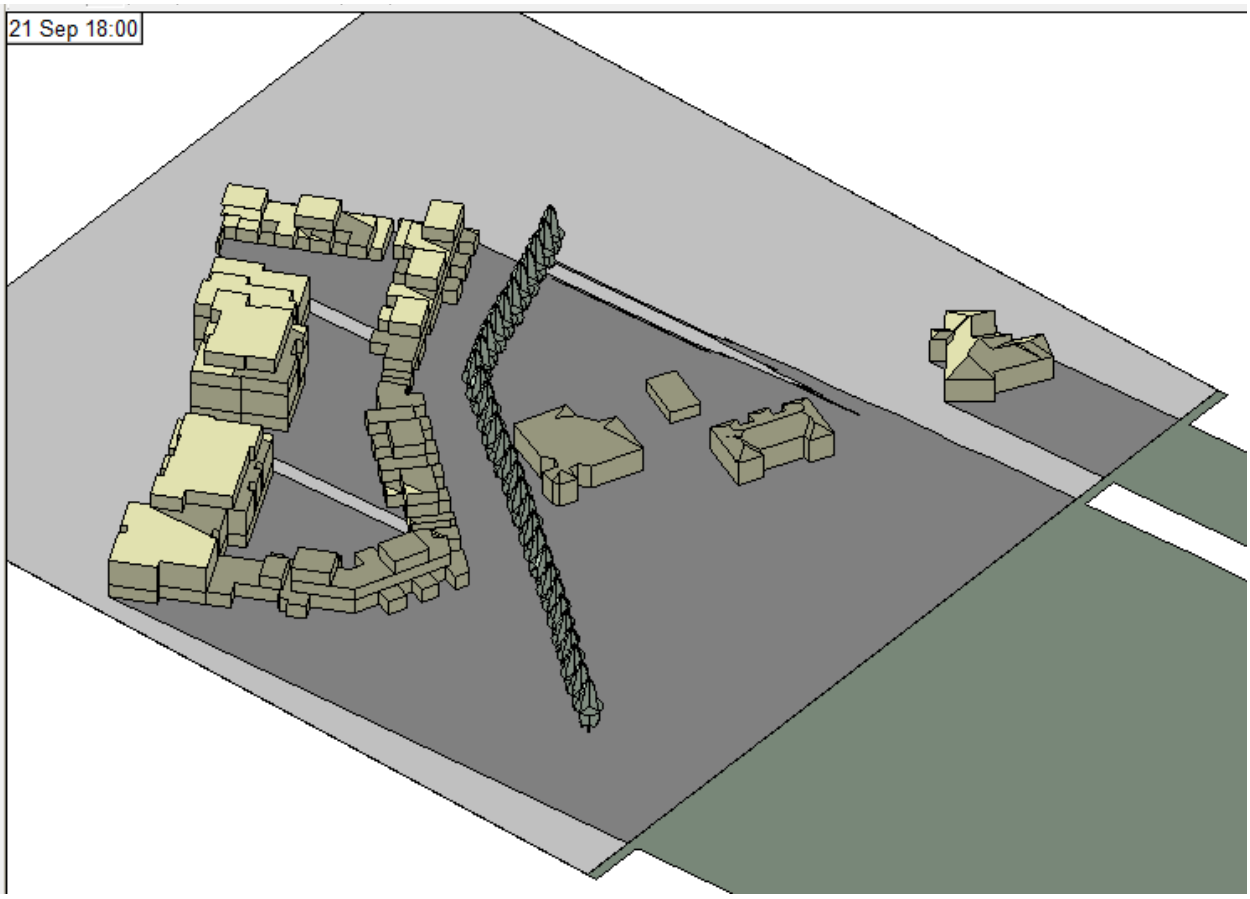

Figure 85 – Overshadowing to Duplex Block 2A – 2D & Existing Properties image on September 21st at 6pm (Source IES VE model)

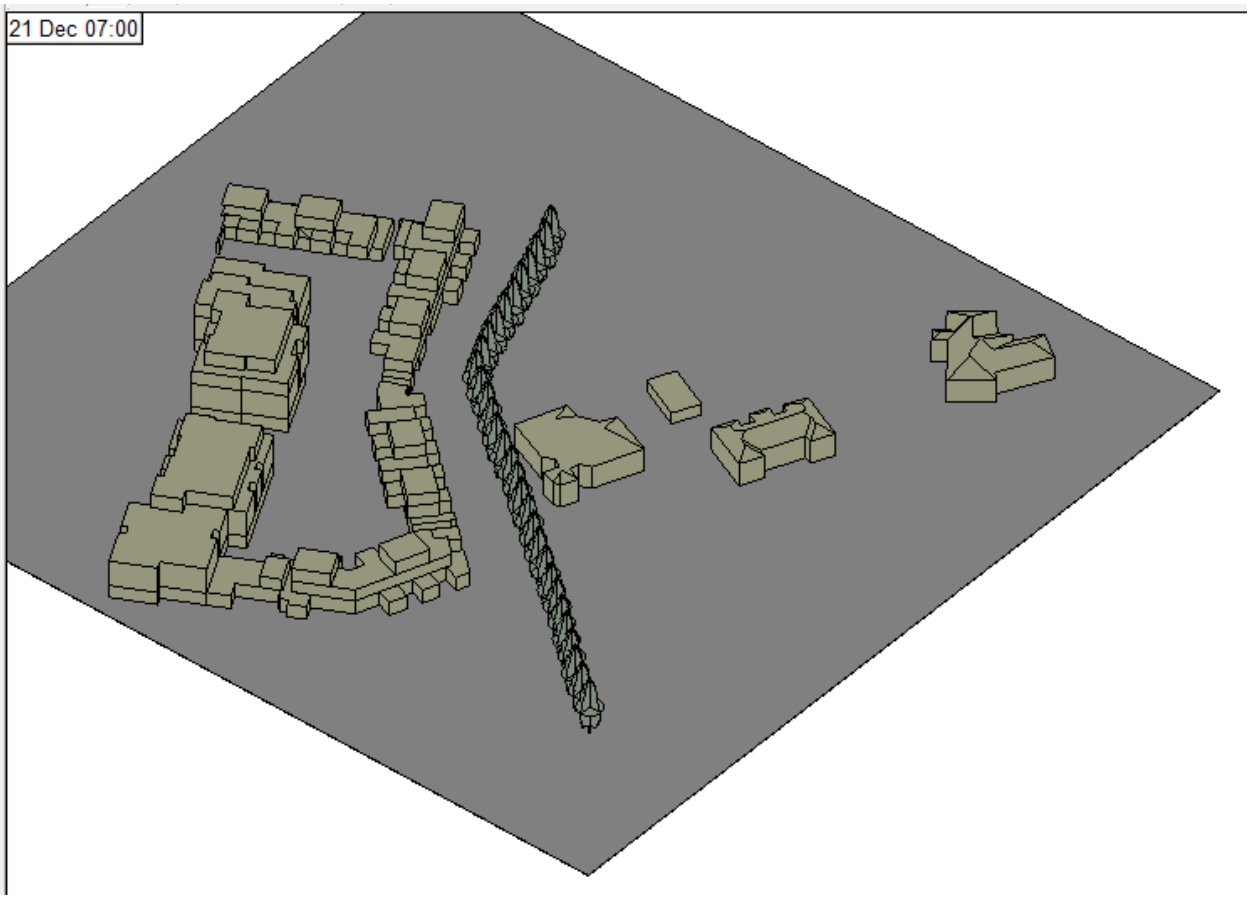

Figure 86 – Overshadowing to Duplex Block 2A – 2D & Existing Properties image on December 21st at 7am (Source IES VE model)

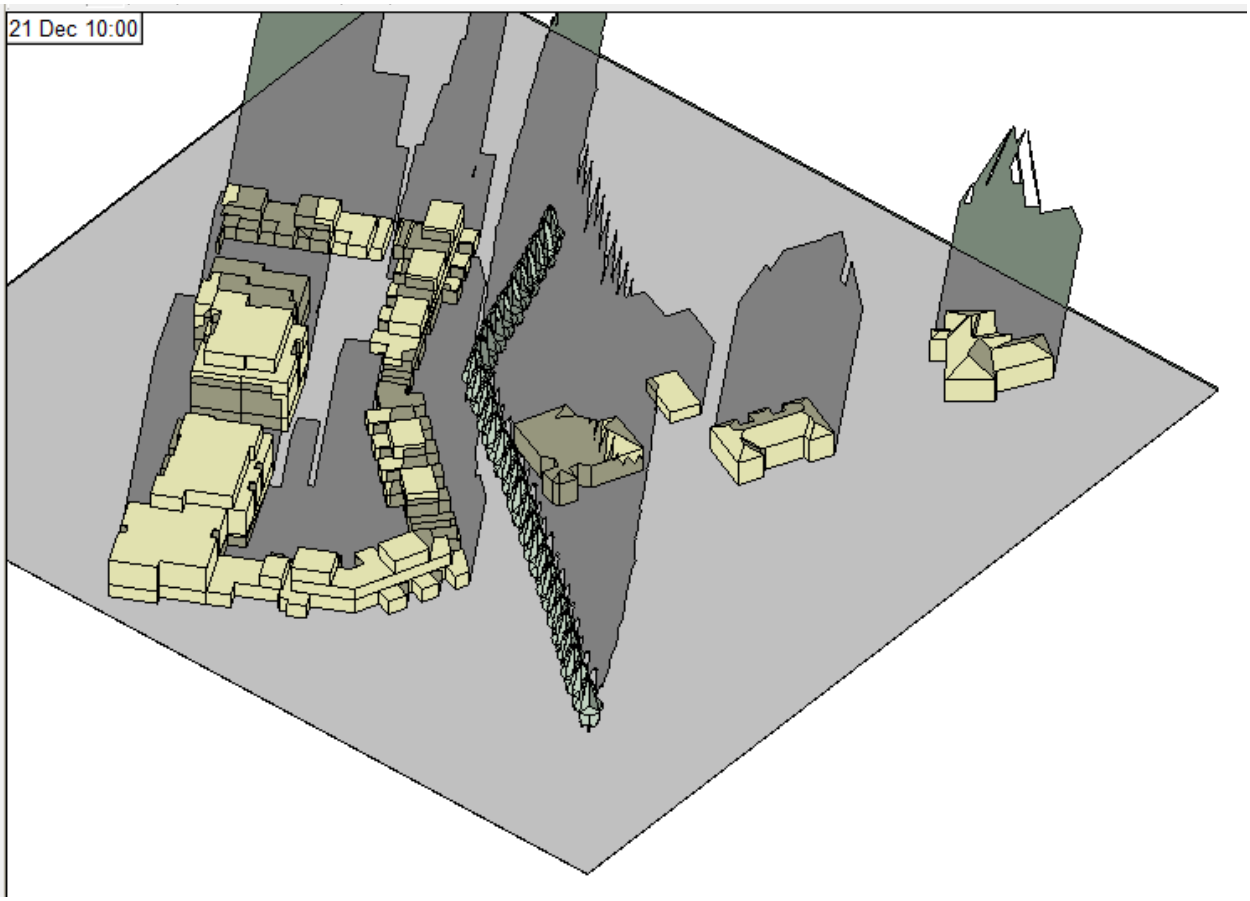

Figure 87 – Overshadowing to Duplex Block 2A – 2D & Existing Properties image on December 21st at 10am (Source IES VE model)

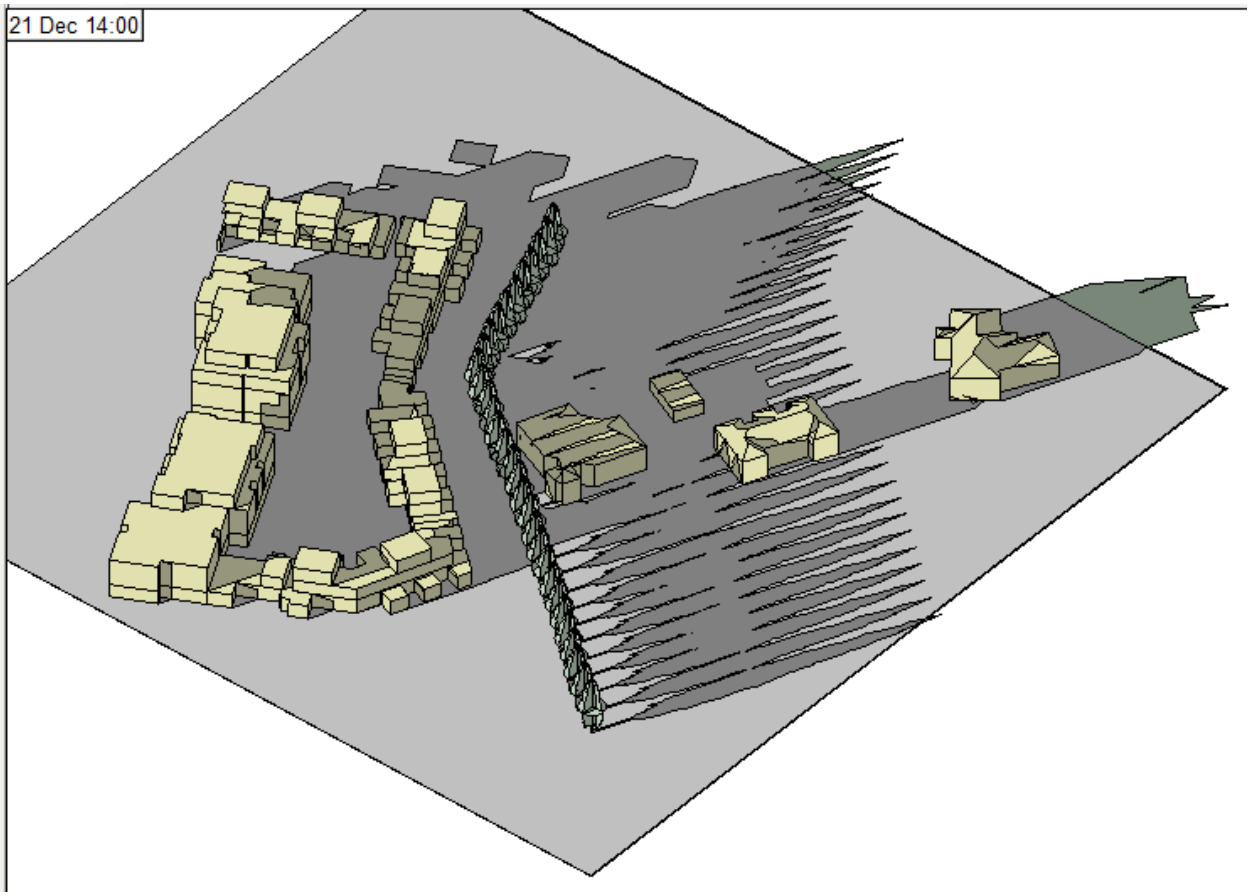

Figure 88 – Overshadowing to Duplex Block 2A – 2D & Existing Properties image on December 21st at 2pm (Source IES VE model)

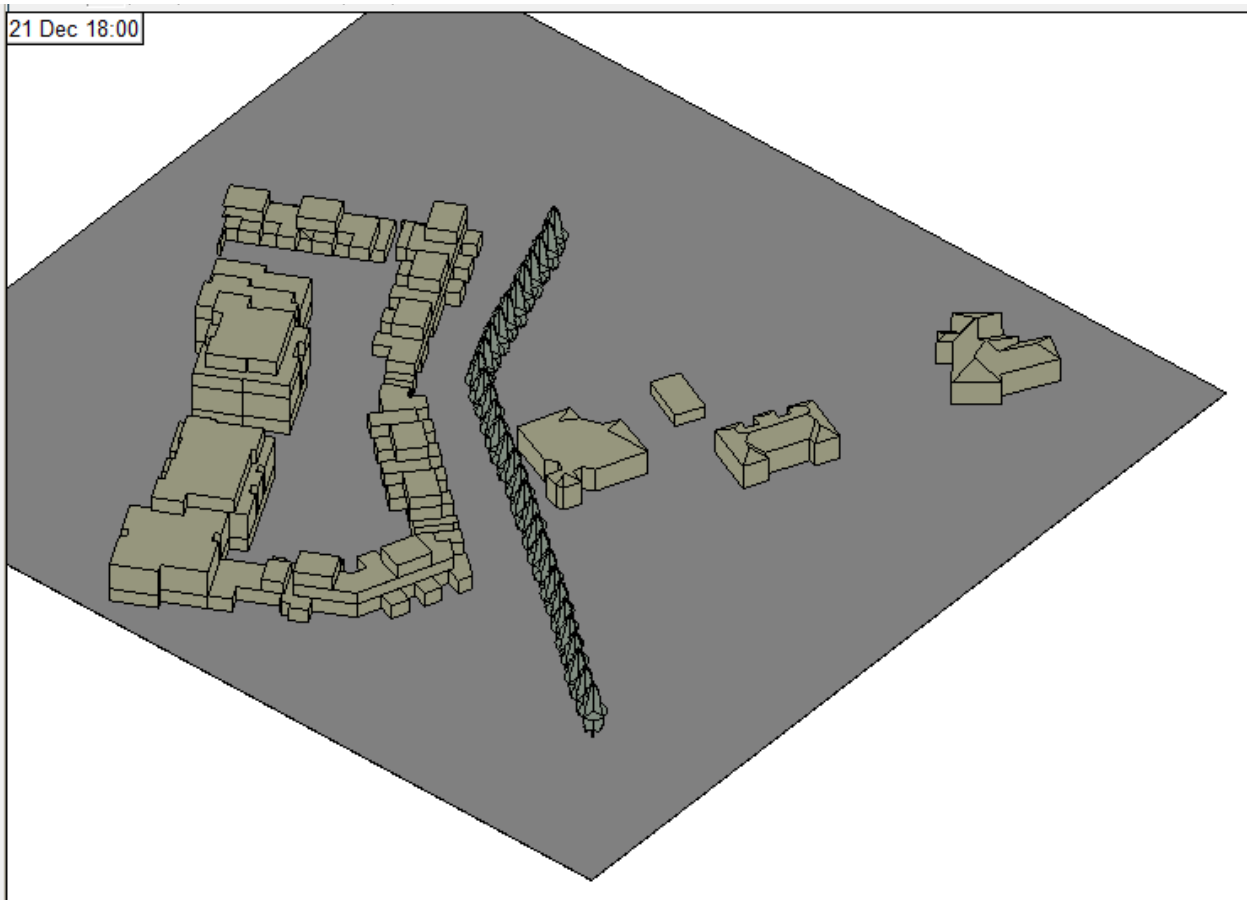

Figure 89 – Overshadowing to Duplex Block 2A – 2D & Existing Properties image on December 21st at 6pm (Source IES VE model)

Figures 90 to 106 provide visual representation of the expecting overshadowing from Duplex Block 1 on existing properties. Generally, the overshadowing from Duplex 1 on existing properties is minimal.

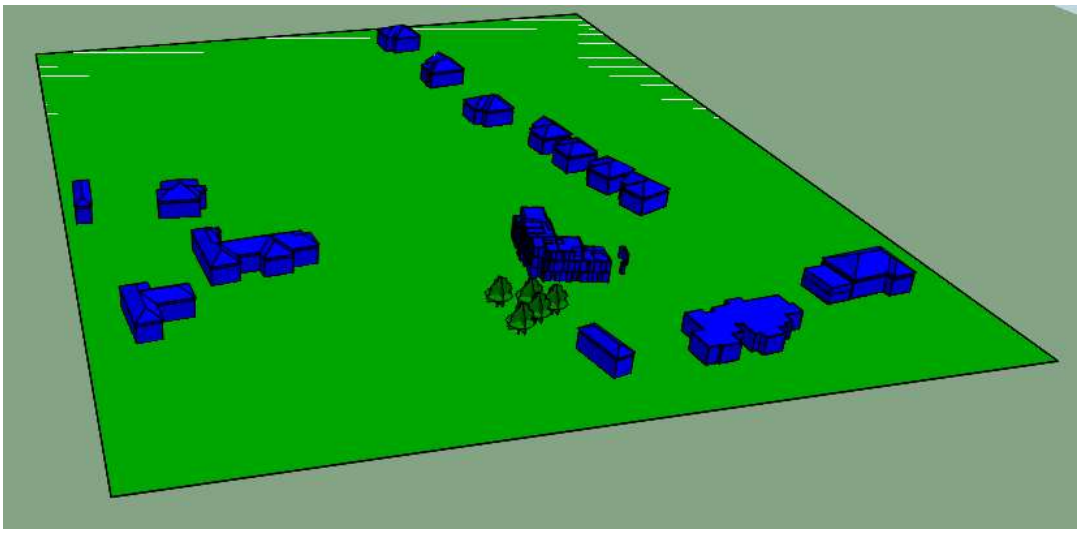

Figure 90 – Duplex Block 1 and adjacent properties (Source IES VE model)

Figure 91 –Overshadowing to Duplex Block 1 & Existing Properties image on March 21st at 7am (Source IES VE model)

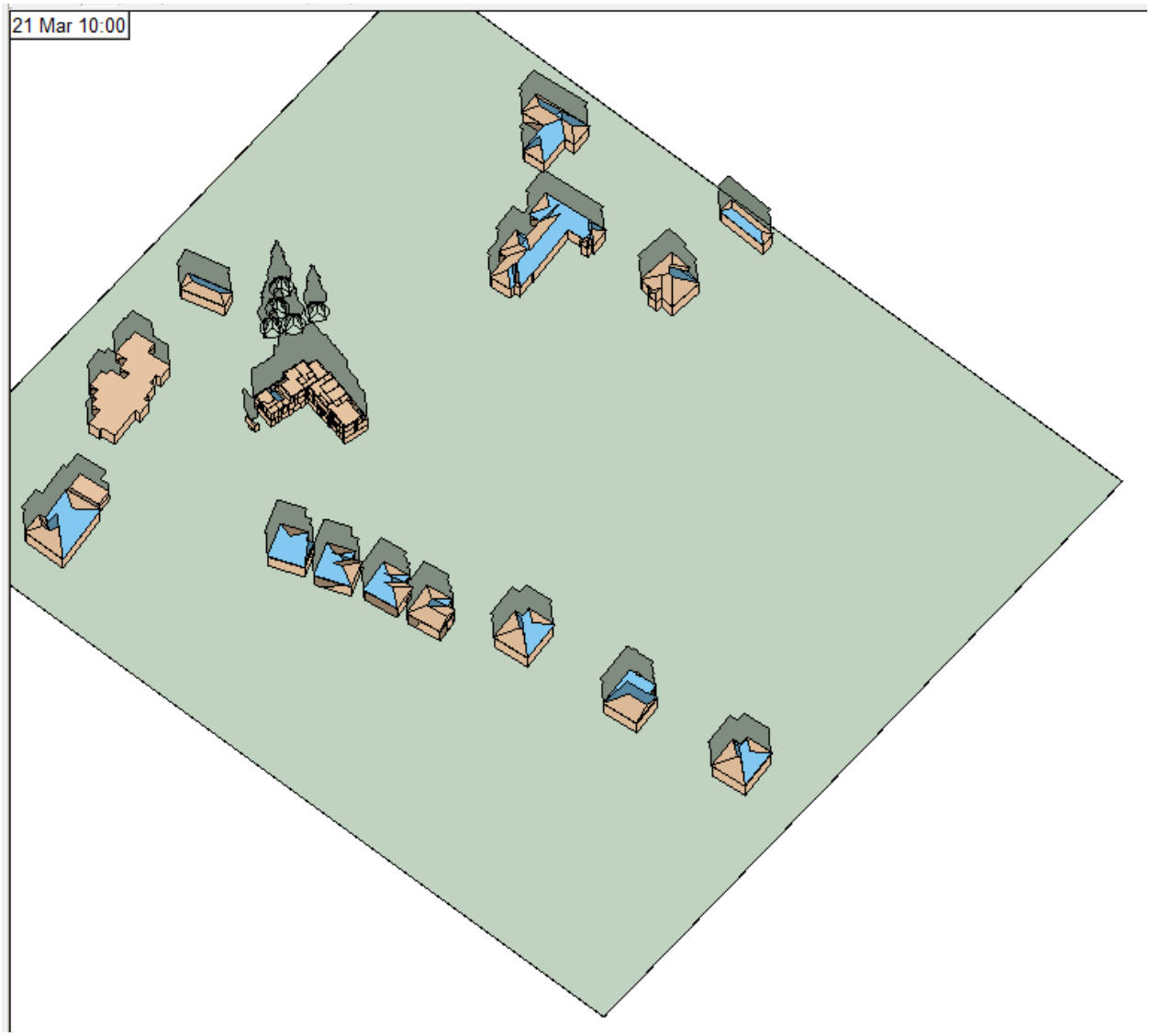

Figure 92 –Overshadowing to Duplex Block 1 & Existing Properties image on March 21st at 10am (Source IES VE model)

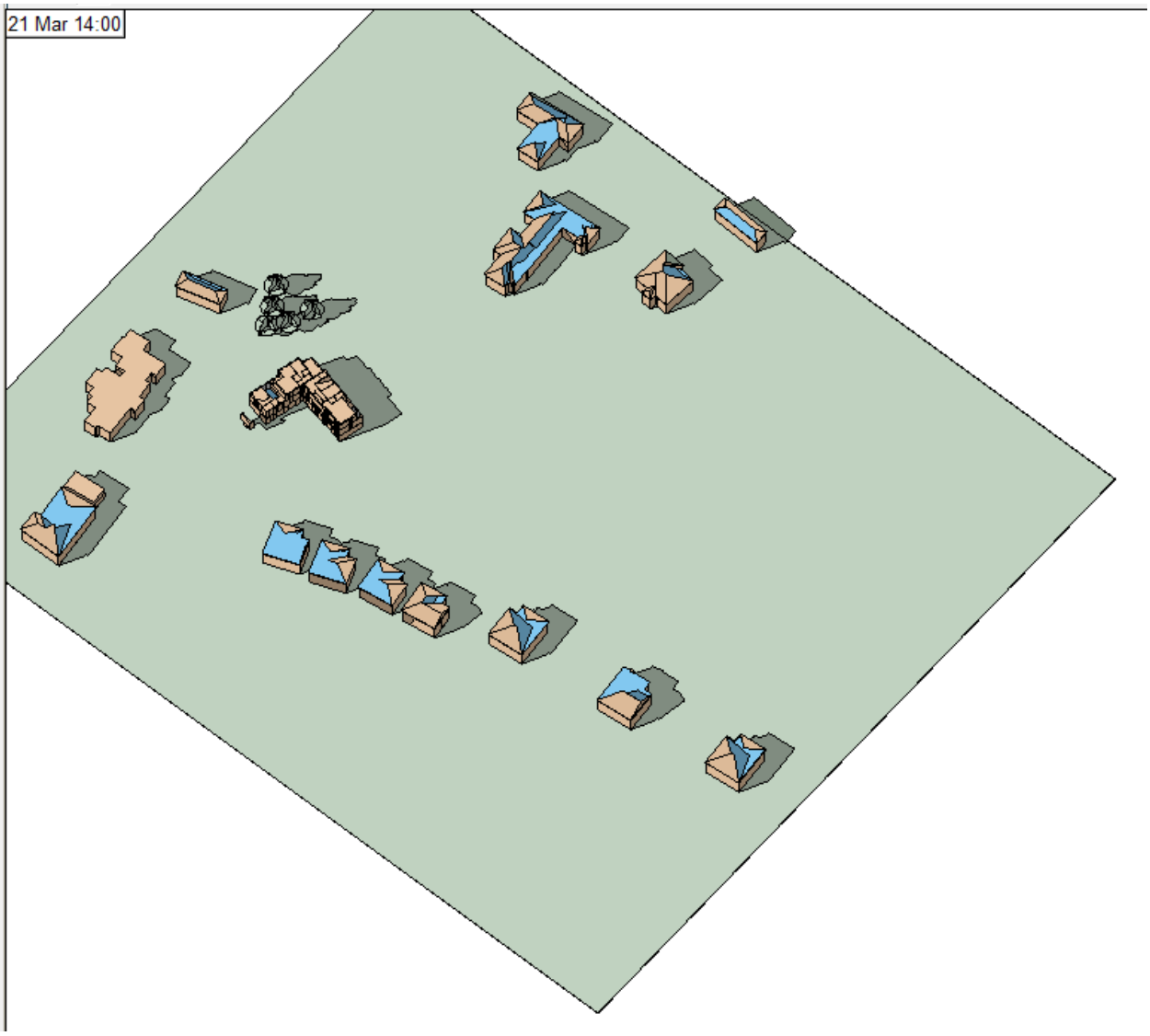

Figure 93 – Overshadowing to Duplex Block 1 & Existing Properties image on March 21st at 2pm (Source IES VE model)

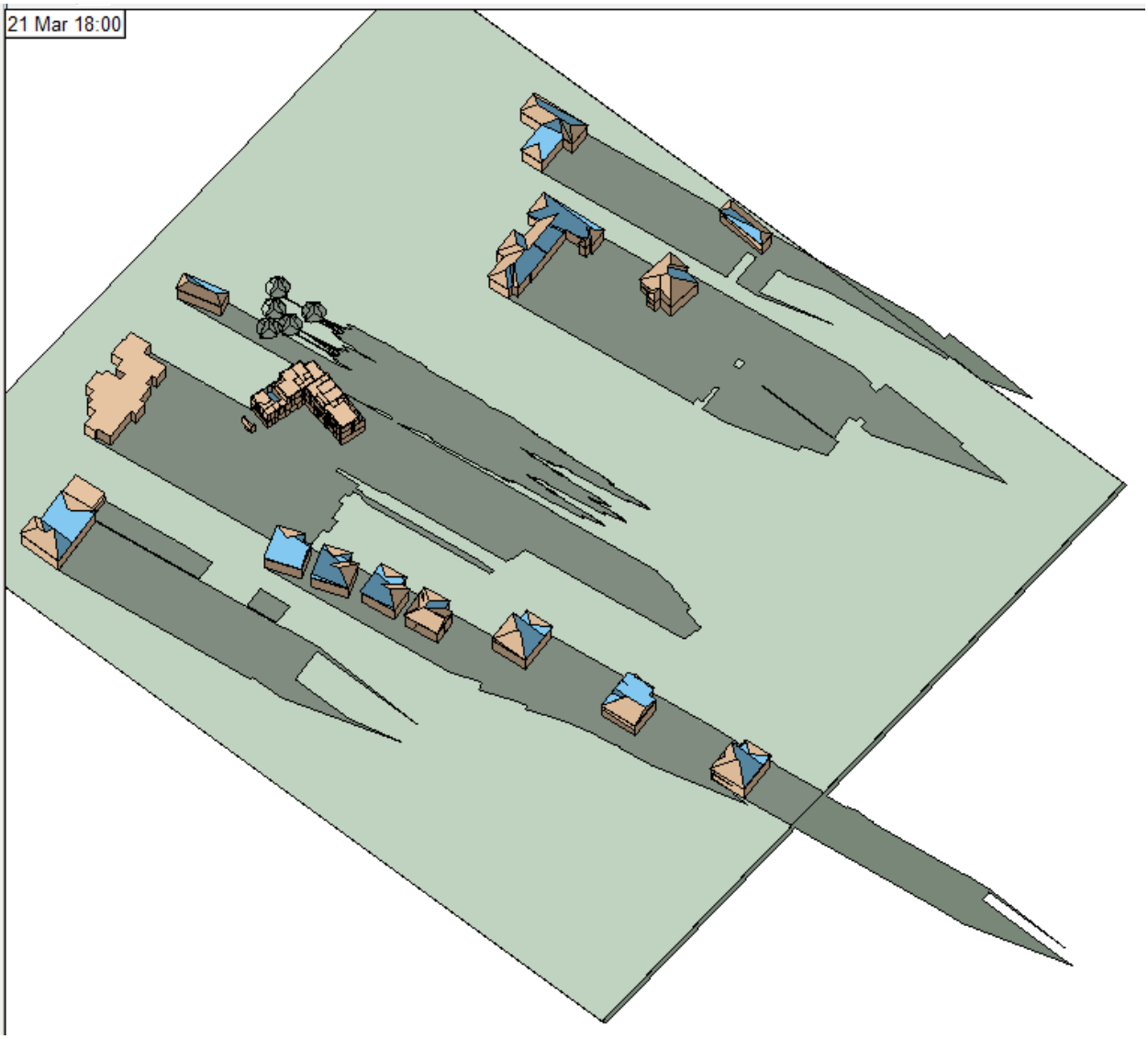

Figure 94– Overshadowing to Duplex Block 1 & Existing Properties image on March 21st at 6pm (Source IES VE model)

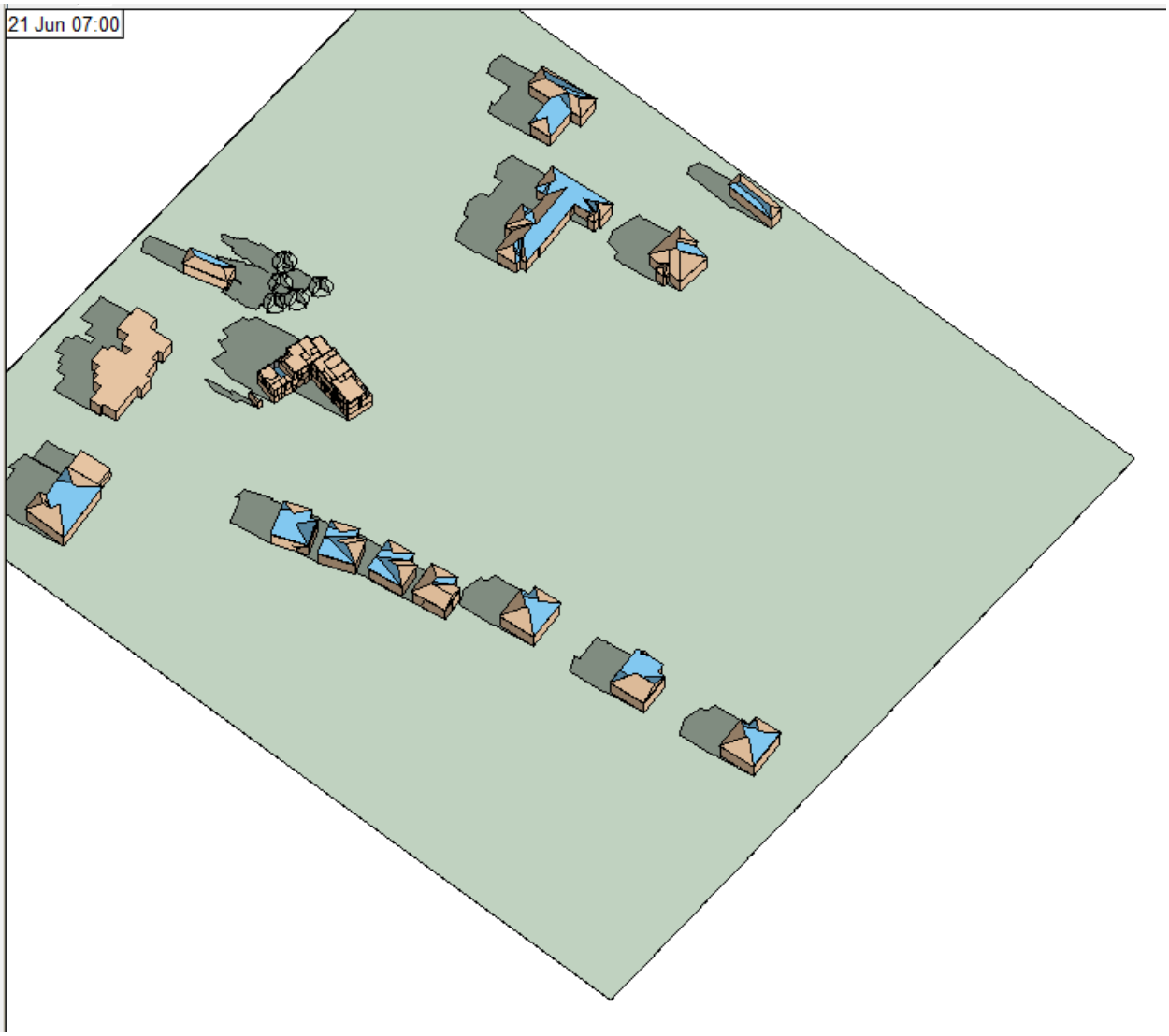

Figure 95 – Overshadowing to Duplex Block 1 & Existing Properties image on June 21st at 7am (Source IES VE model)

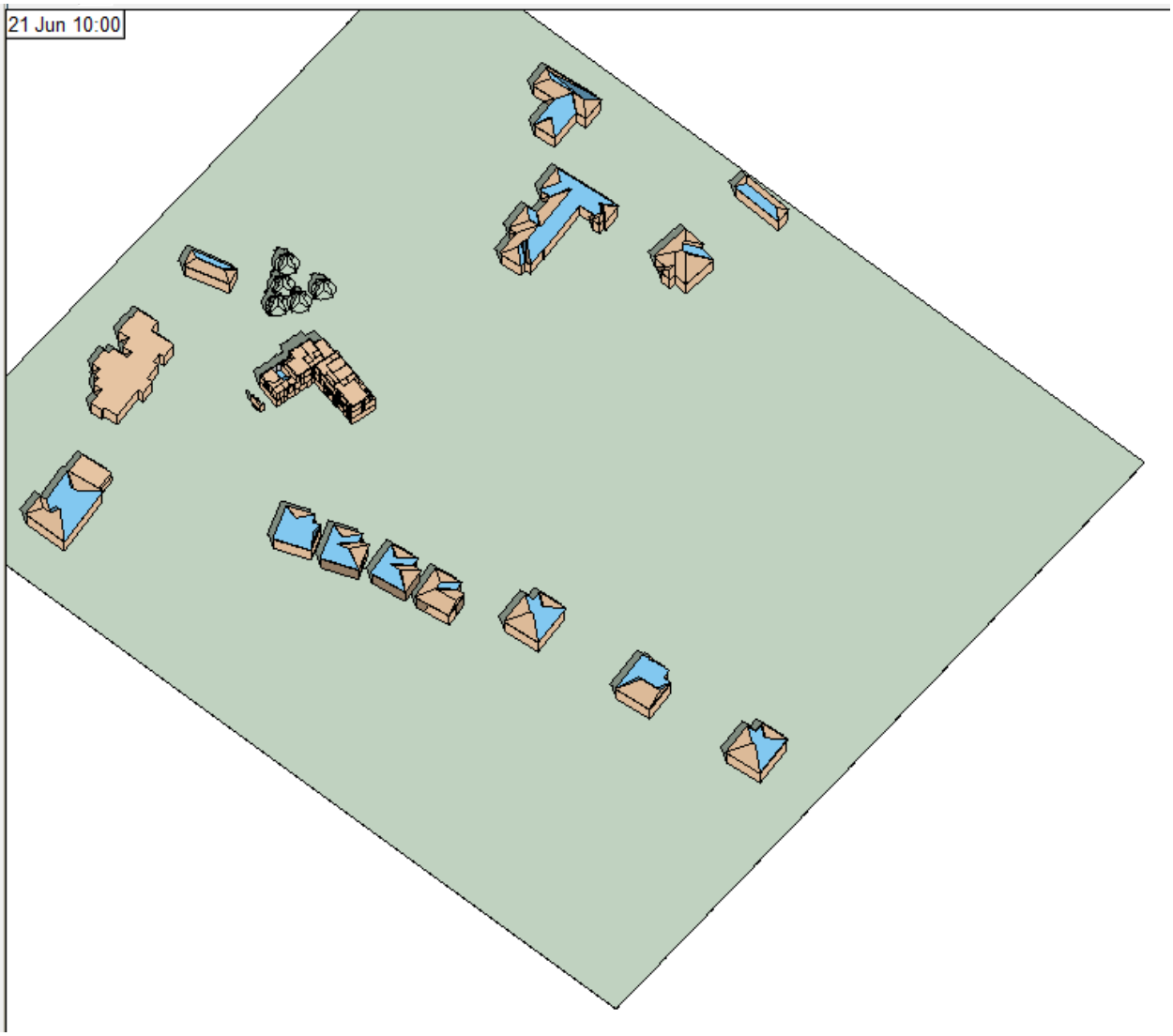

Figure 96 – Overshadowing to Duplex Block 1 & Existing Properties image on June 21st at 10am (Source IES VE model)

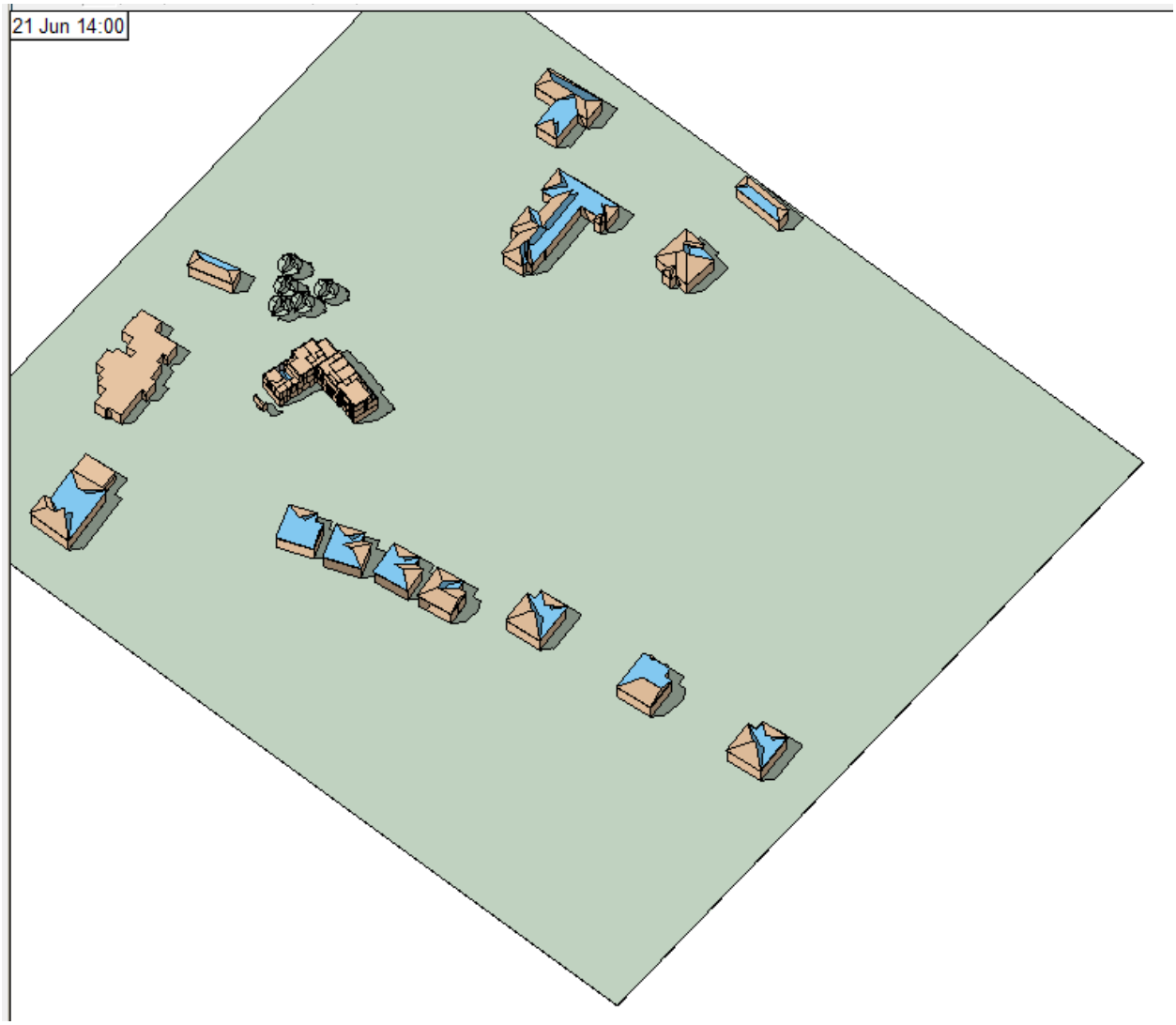

Figure 97 – Overshadowing to Duplex Block 1 & Existing Properties image on June 21st at 2pm (Source IES VE model)

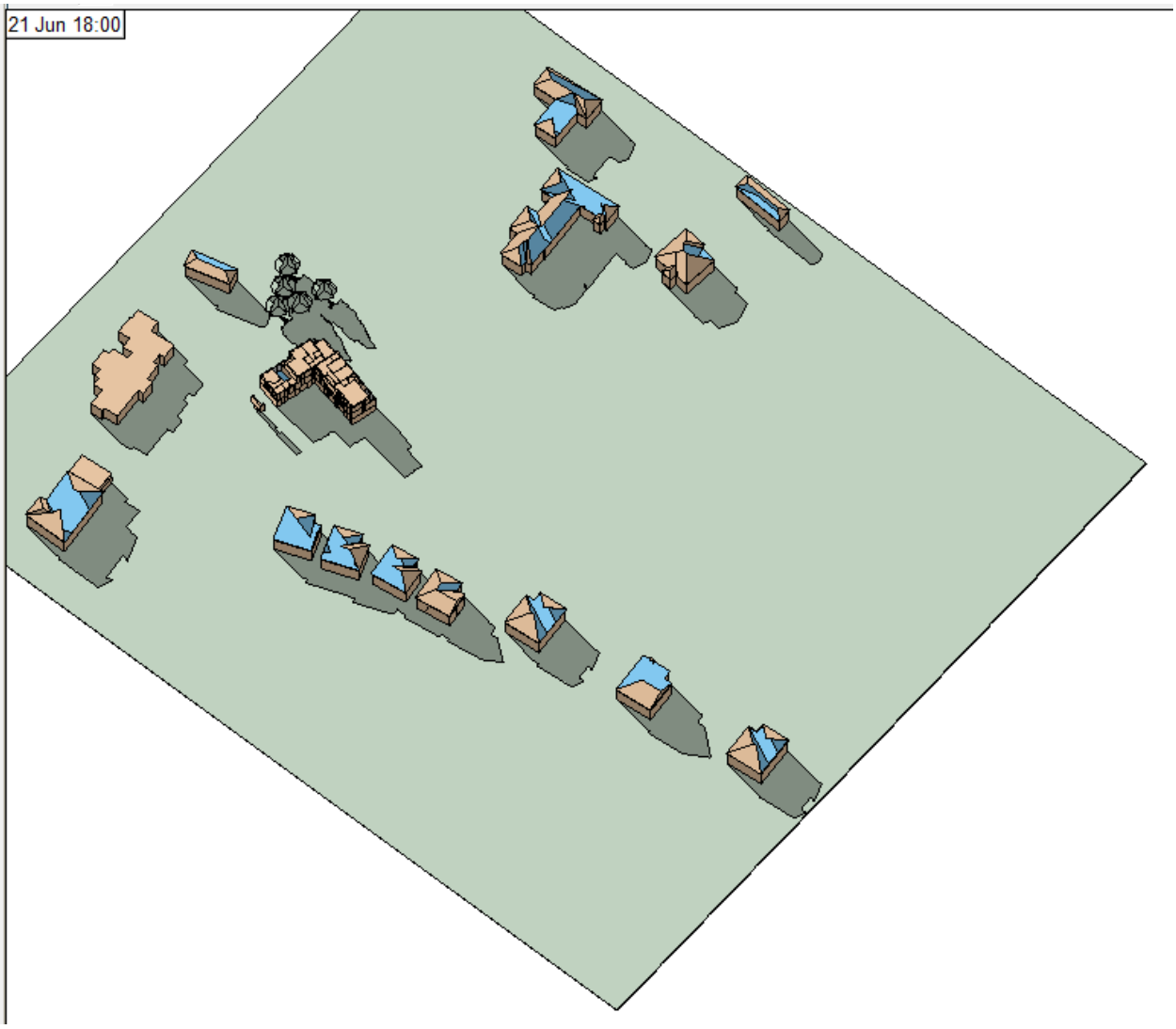

Figure 98 – Overshadowing to Duplex Block 1 & Existing Properties image on June 21st at 6pm (Source IES VE model)

Figure 99 – Overshadowing to Duplex Block 1 & Existing Properties image on September 21st at 7am (Source IES VE model)

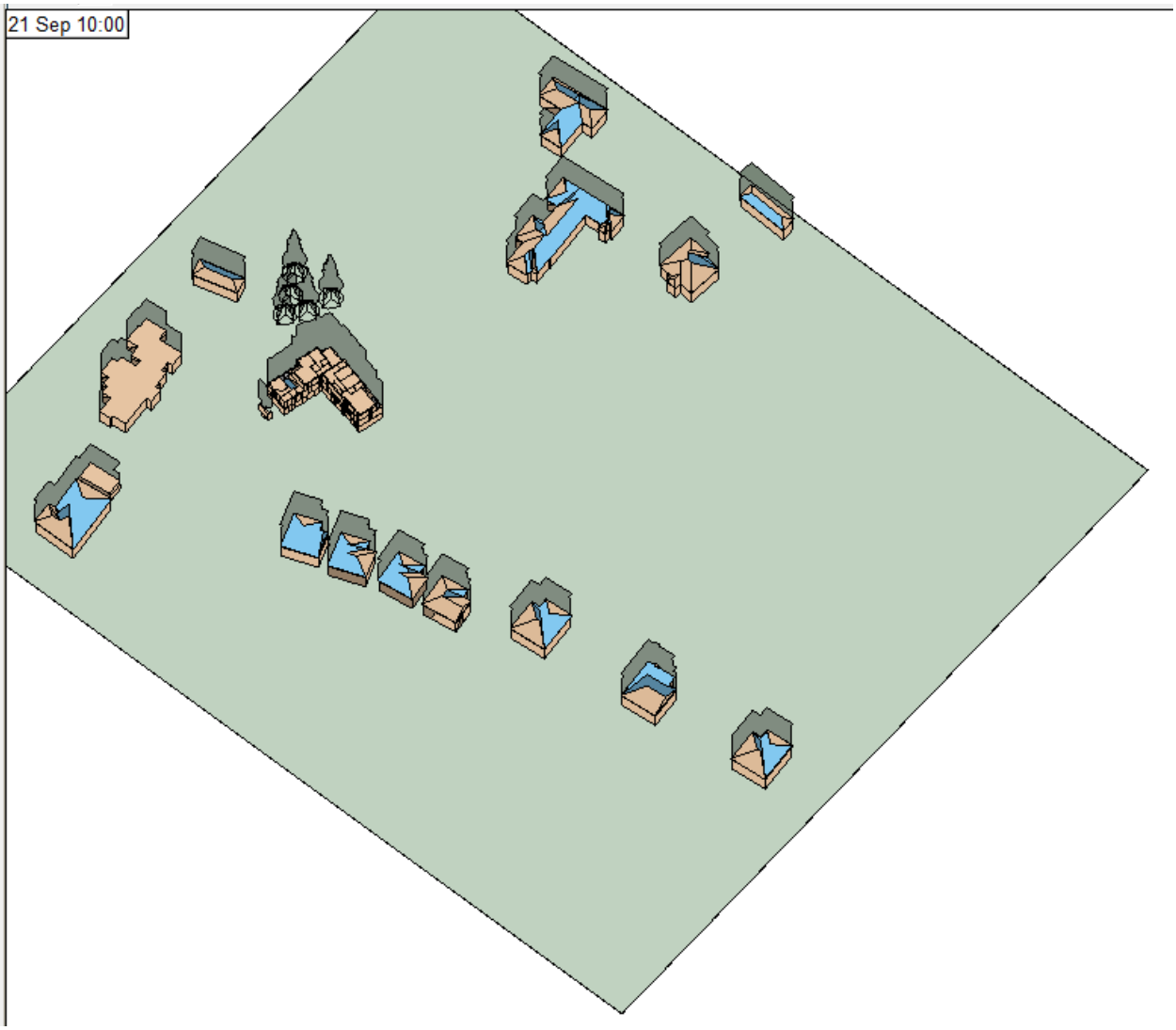

Figure 100 – Overshadowing to Duplex Block 1 & Existing Properties image on September 21st at 10am (Source IES VE model)

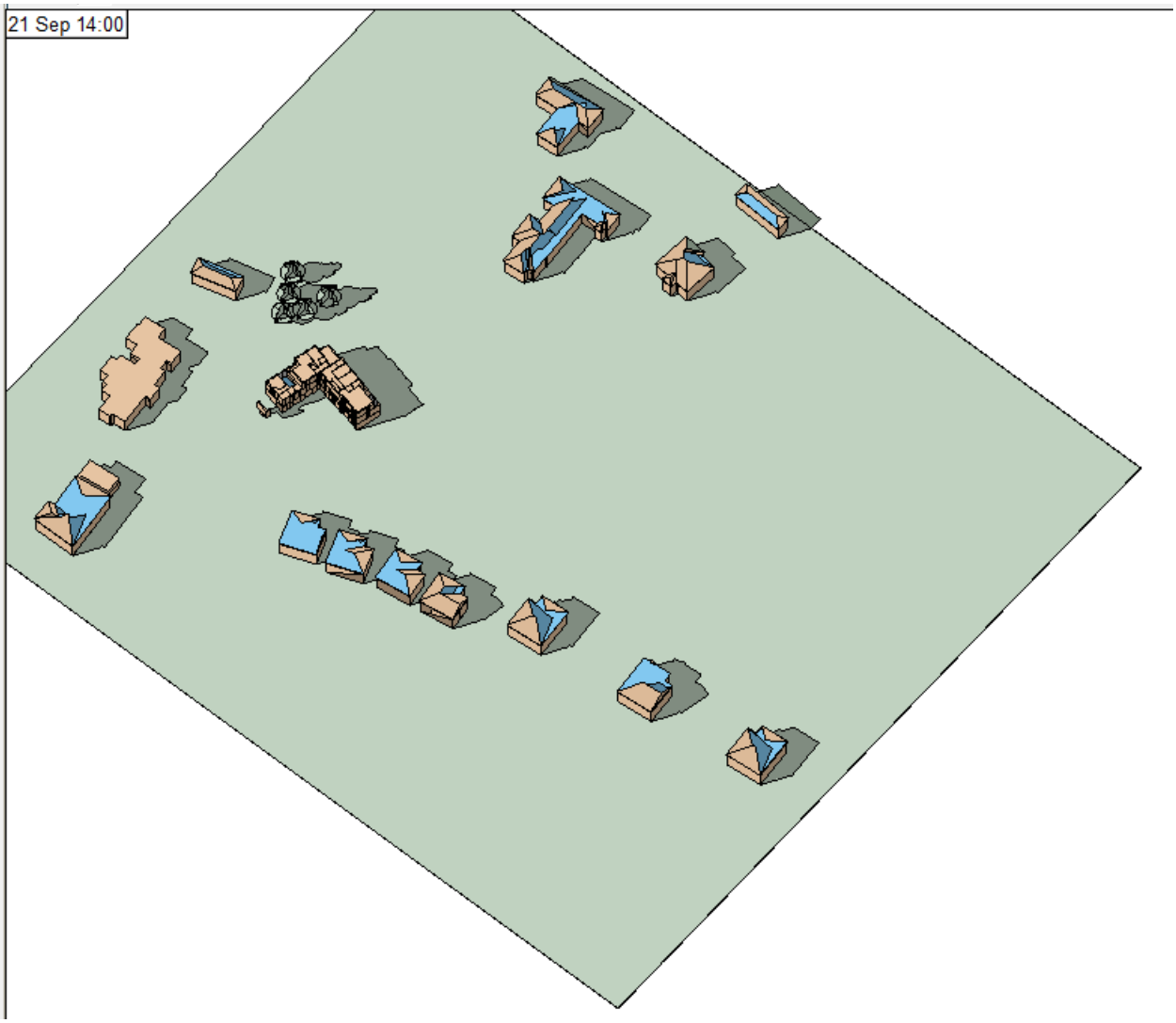

Figure 101 – Overshadowing to Duplex Block 1 & Existing Properties image on September 21st at 2pm (Source IES VE model)

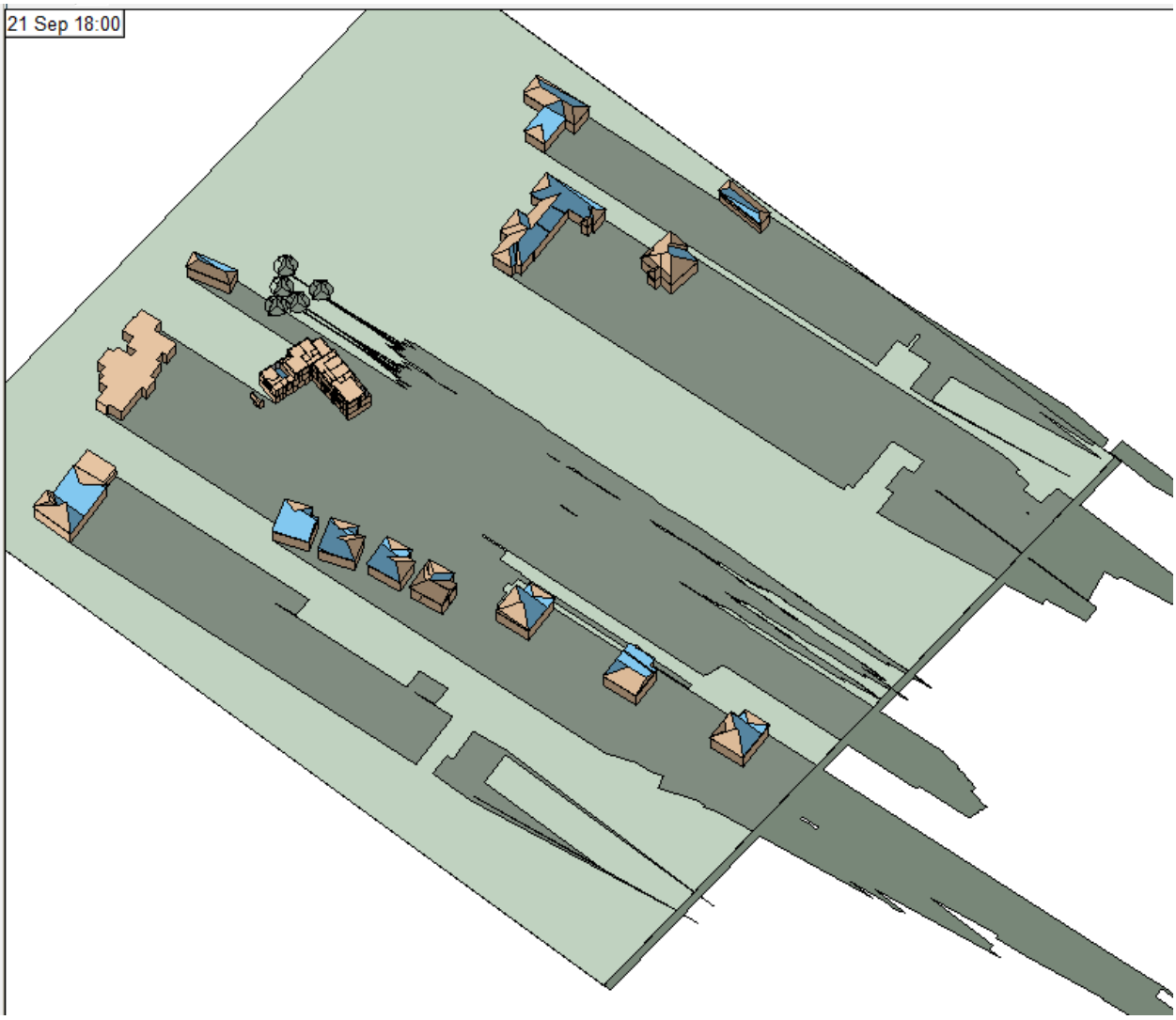

Figure 102 – Overshadowing to Duplex Block 1 & Existing Properties image on September 21st at 6pm (Source IES VE model)

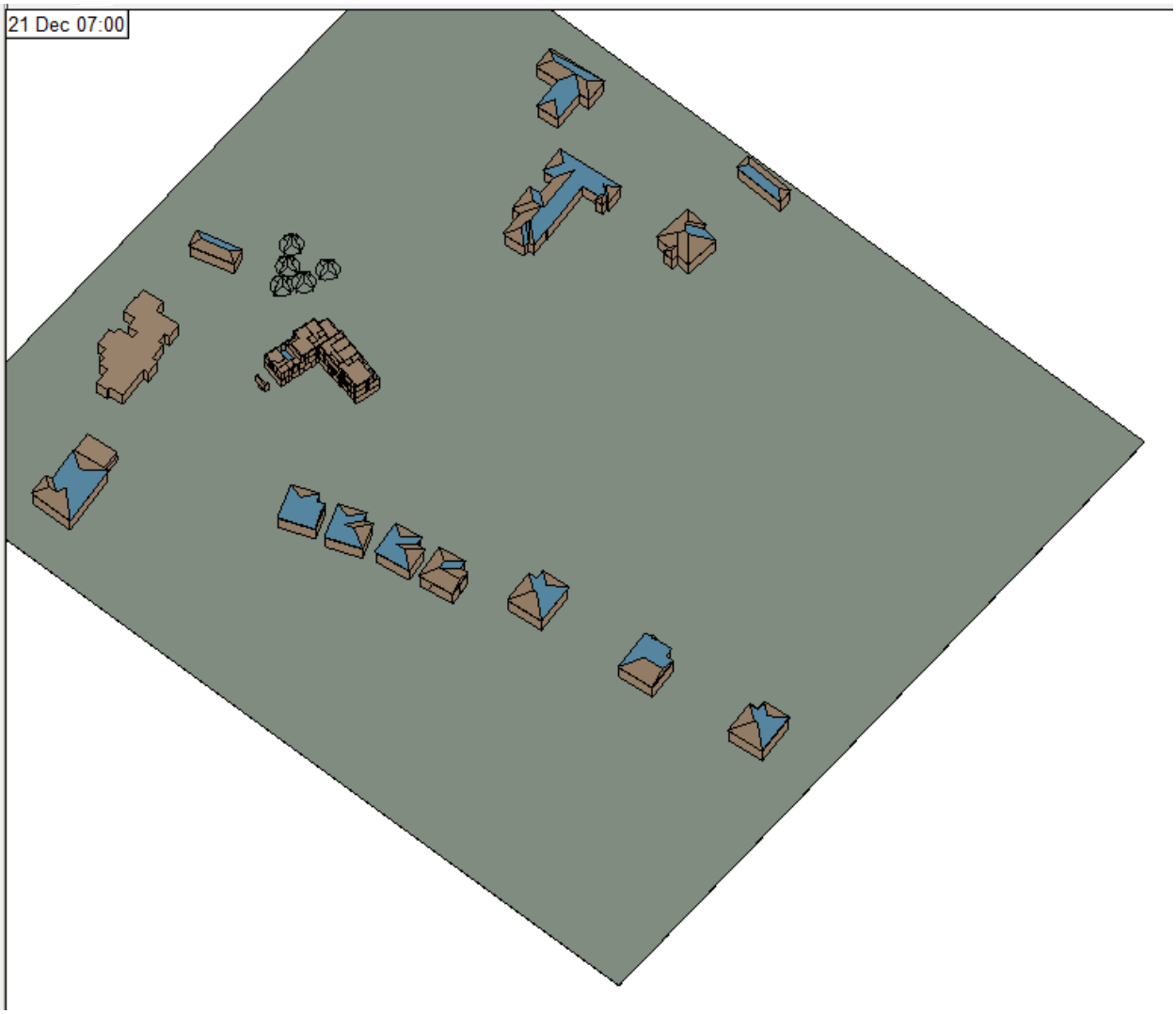

Figure 103 – Overshadowing to Duplex Block 1 & Existing Properties image on December 21st at 7am (Source IES VE model)

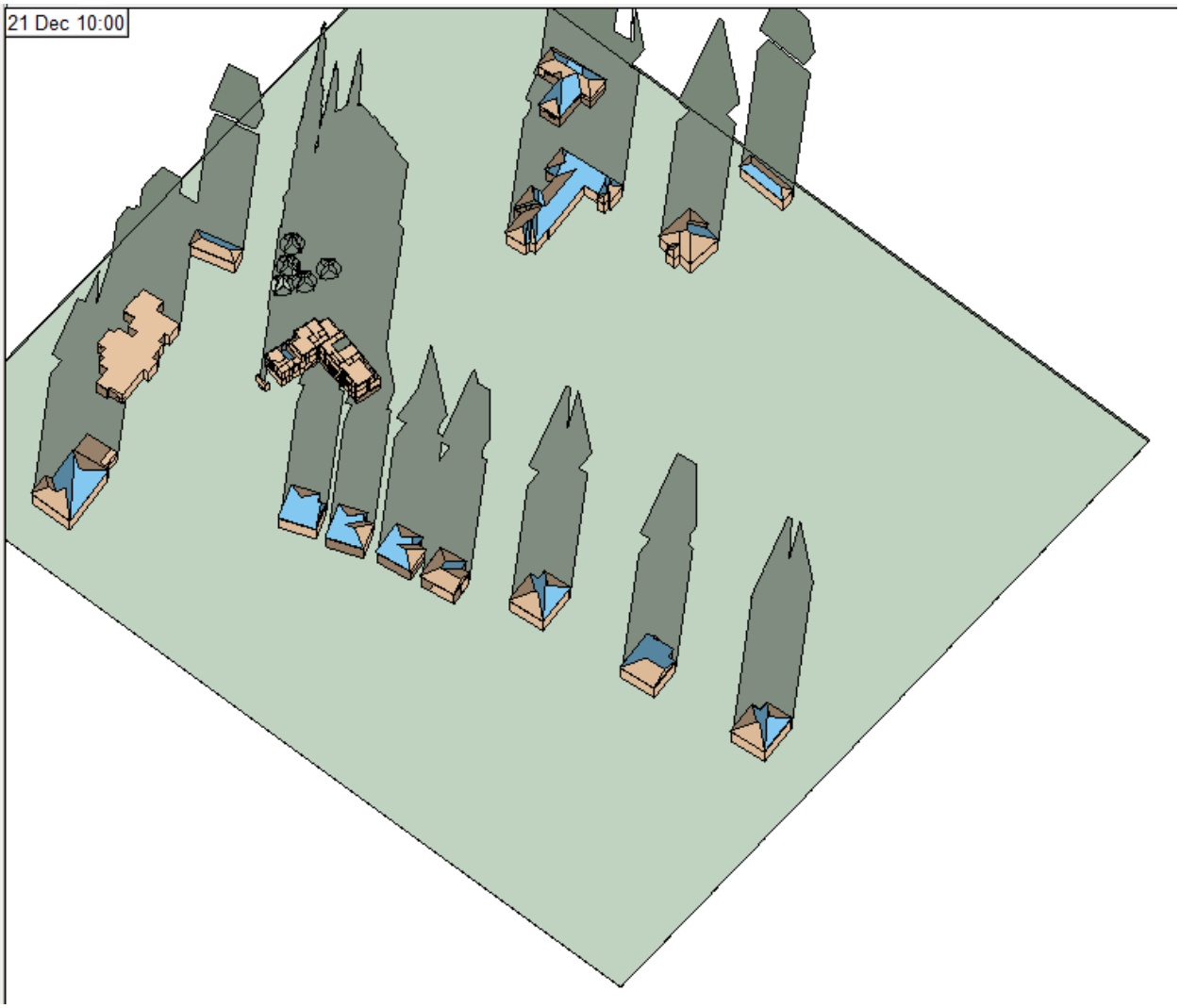

Figure 104 – Overshadowing to Duplex Block 1 & Existing Properties image on December 21st at 10am (Source IES VE model)

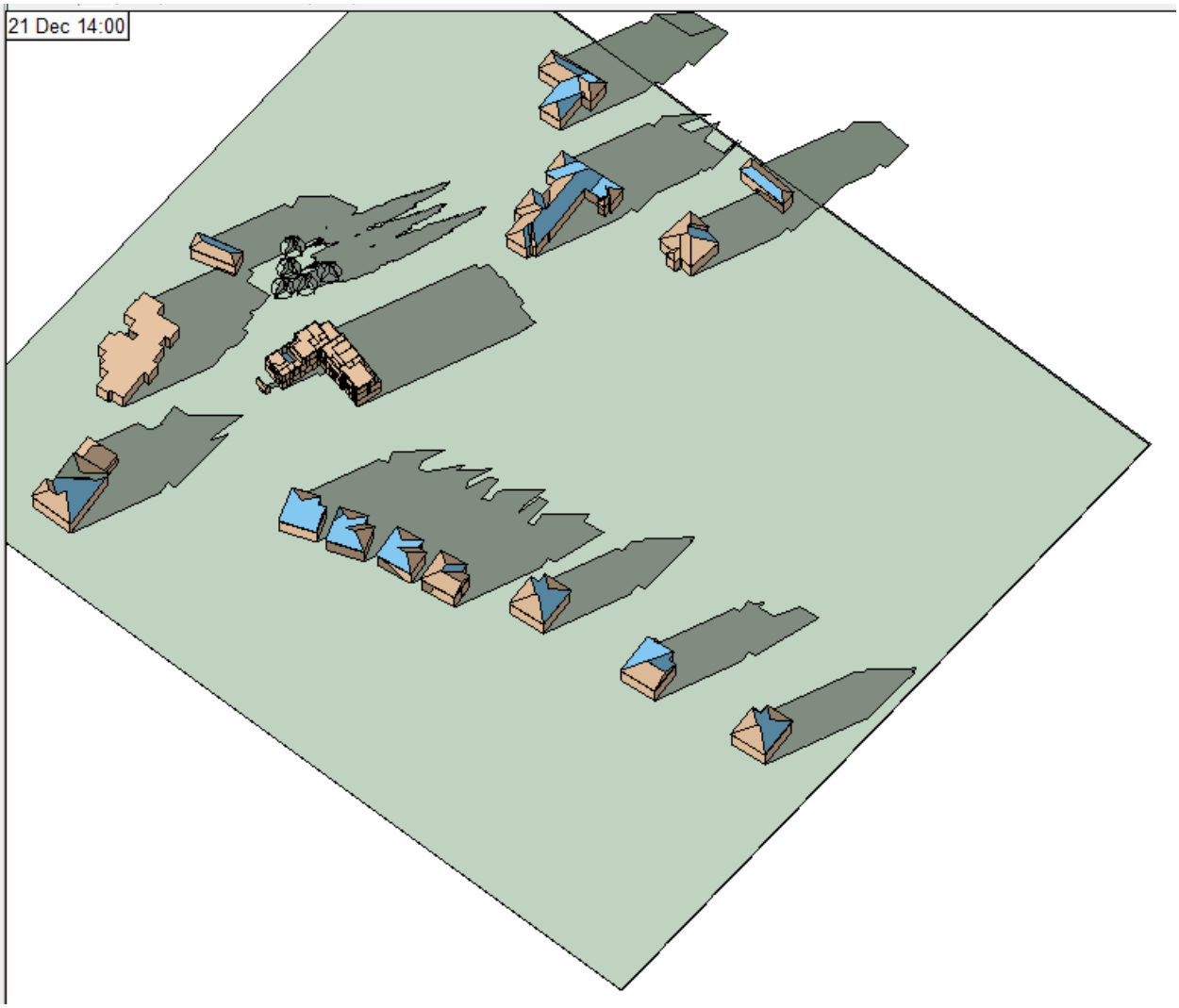

Figure 105 – Overshadowing to Duplex Block 1 & Existing Properties image on December 21st at 2pm (Source IES VE model)

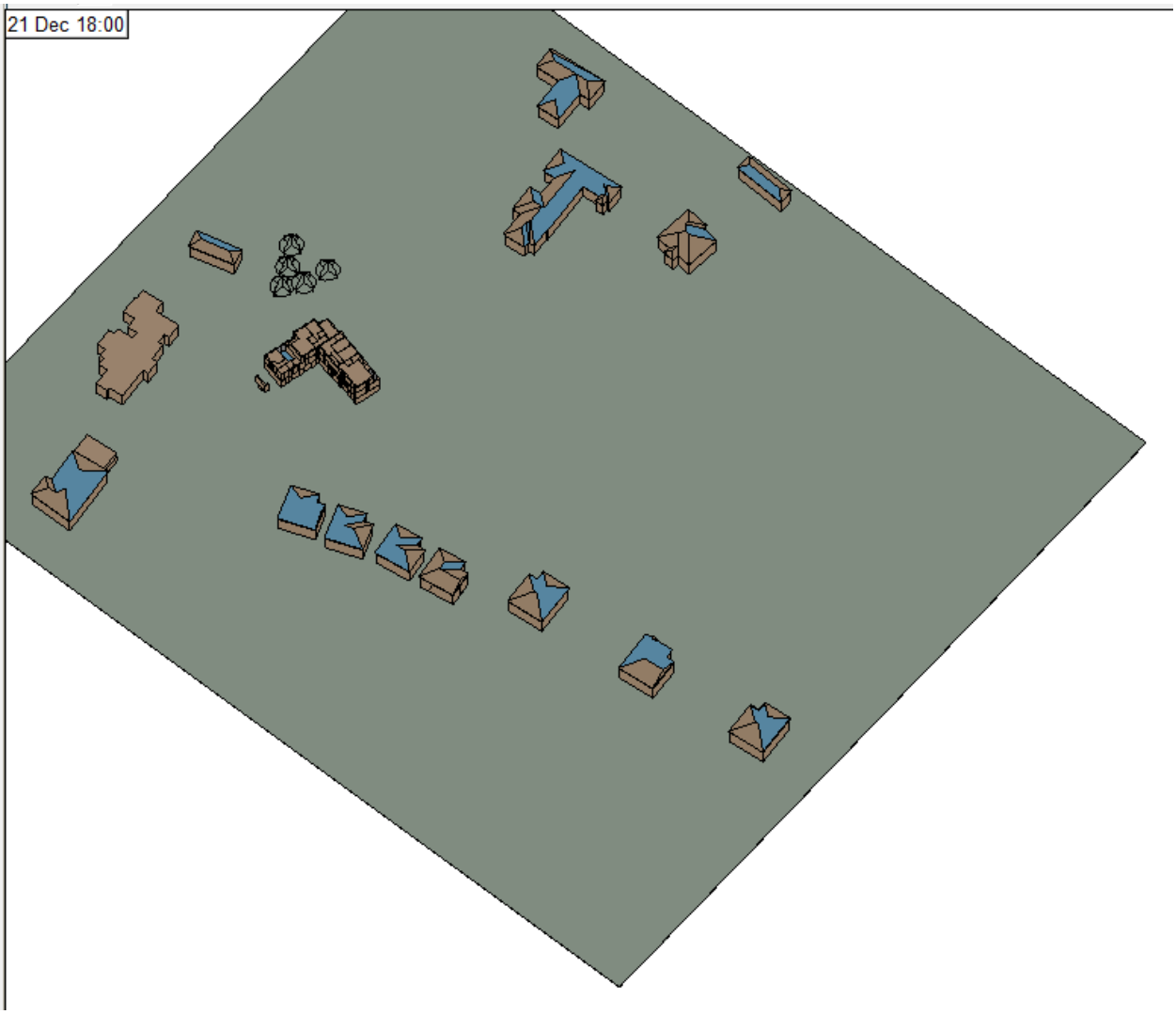

Figure 106 – Overshadowing to Duplex Block 1 & Existing Properties image on December 21st at 6pm (Source IES VE model)

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