Daylight and Sunlight Report

On

The Former Mercedes Benz Garage
Blackburn Road
West Hampstead
LondonNW6

For

Loftus Family Property

November 2009

WATERSLADE

5 Thames Street, Eynsham, Oxford, OX29 4HF
t: 01865 881882 f: 01865 881891 @: www.waterslade.com

1.0 Introduction and Methodology

1.1 Generally

We have considered the proposed development at Blackburn Road in relation to its Daylight and Sunlight amenity.

It is usual to assess Daylight/Sunlight in relation to the guidelines set out in the Building Research Establishment (BRE) report 'Site layout planning for daylight and sunlight - A guide to good practice' by P. J. Littlefair. We shall refer to this report throughout as the 'BRE'. One of the primary sources for the BRE document is the more detailed guidance contained within 'British Standard 8206 Part 2', and we shall also refer to this document.

Daylight and sunlight is one of a number of factors to be considered in designing a building. Often it needs to be balanced with energy efficiency considerations, or the provision of external balcony space. In the introduction, the BRE guide itself urges that the guidelines be interpreted flexibly:

" *The advice given here is not mandatory……Although it gives numerical guidelines these should be interpreted flexibly……For example in an historic city centre a higher degree of obstruction may be unavoidable….*".

We examine three measures of diffuse daylight in this study – namely Vertical Sky Component (VSC), No-Sky Line (NSL), and Average Daylight Factor (ADF). In terms of Sunlight, we examine the BRE Annual Probable Sunlight Hours (APSH). These measures of Daylight and Sunlight are discussed in the following paragraphs.

1.2 Diffuse Daylight

1.2.1 Vertical Sky Component (VSC)

VSC is a measure of the skylight reaching a point from an overcast sky. For Existing buildings, the BRE guideline is based on the loss of VSC at a point at the centre of a window, on the outer plane of the wall. The BRE guidelines state that if the VSC at the centre of a window is less than 27%, and it is less than 0.8 times its former value, then the diffuse daylighting of the existing building may be adversely affected. For new build, the guidelines are based on achieving a target value of 27%, in order to retain the potential for good interior diffuse daylighting. However, the actual daylight levels within each room are more appropriately represented by the Average Daylight Factor and this is the most appropriate means by which to judge the acceptably of light within a proposed scheme.

1.2.2 Average Daylight Factor (ADF)

ADF is a measure of the daylight within a room, and accounts for factors such as the number of windows and their size in relation to the size of the room. Clearly a small room with a large window will be better illuminated by daylight than a large room with a small window. It also accounts for window transmittance and the reflectance of the internal walls, floor and ceiling. The general idea is that the daylight which reaches each of the windows is first calculated. Then, allowing for the window size, the daylight which then enters the room through the windows is determined. The light is then imagined to bounce around within the room, controlled by the reflectance of the internal surfaces. The ADF is detailed in British Standard 8206 Part 2. As for the BRE report, it provides guidance for acceptable values in the presence of supplementary electric lighting, depending on the room use. These are 1.0% for a bedroom, 1.5% for a living room and 2.0% for a kitchen.

1.2.3 No-Sky Line (NSL)

No-Sky Line (NSL) is a measure of the distribution of daylight within a room. As it maps out the region within a room where light can penetrate directly from the sky, it therefore accounts for the size of and number of windows by simple geometry. The BRE suggest the area of the working plane within a room that can receive direct skylight should not be reduced to less than 0.8 times its former value. We refer to Appendix B for more detail.

1.3 Sunlight

1.3.1 Annual Probable Sunlight Hours (APSH)

In relation to sunlight, the BRE recommends that the Annual Probable Sunlight Hours (APSH) received at a given window in the proposed case should be at least 25% of the total available including at least 5% in winter. Where the proposed values fall short of these, then the proposed values should not be less than 0.8 times their previous value in each period. For new build, the guidelines are based on achieving a target value of 25% of the total available, and 5% in winter. We also note that the BRE guidelines state that *'..all main living rooms of dwellings .. should be checked if they have a window facing within 90 degrees of due south. Kitchens and bedrooms are less important, although care should be taken not to block out too much sun'*. We refer to Appendix B for more detail.

2.0 Calculations and assumptions

In order to calculate the various measures of daylight and sunlight it is necessary to construct a 3D computer model. The 3D model was created so as to reproduce the massing of the buildings both on and surrounding the site, at a level of detail appropriate to the calculations performed. The model was set out to measured survey data. The proposed scheme was modelled from the architects plans, elevations and sections. We understand that all windows are double glazed with a window transmittance of 0.7. In accordance with British Standard a

8% reduction in transmittance has been applied to allow for the effect of dirty glass, and we have applied a glazing bar correction factor of 0.9. This gives an overall window transmittance of 0.58. We understand that the internal décor consists of light coloured walls, white ceilings and light wood veneered floors or carpet. Accordingly the following reflectance values have been used; 0.81 for internal walls, 0.85 for ceilings and 0.4 for floors. VSC values were calculated on the outer plane of the windows, while for ADF, the required VSC values were calculated on the inner plane. APSH values are generally calculated on the inner plane of the wall.

3.0 Results and Discussion

3.1 Generally

We refer to drawings 590/01-03, which illustrate the proposed scheme both in plan and 3d.

A word of explanation about labelling of windows is required. Every window is given a unique reference. This is necessary to track the windows through the various calculations, and these labels appear in the tables of results. An example of a window label is W3/101. The label begins with W, meaning it is a window. The number after the slash represents the floor of the building – here the number 101 represents the 1st floor. The number 3 after the W simply means it is the 3rd window on that floor.

We refer to the drawings 590/04-09 showing the layouts and drawings 590/WM/01-03 showing the window labels.

3.2 Daylight and Sunlight – Surrounding Properties

We understand that there are no neighbouring residential buildings nearby.

3.3 Daylight/Sunlight – Within the Proposed Development

Since the proposed development is for student accommodation, the majority of rooms are study bedrooms.

In drawings 590/04-09, we show the ADF values obtained. These show that all rooms comply with the BRE and British Standard criteria for ADF. Furthermore, it can be seen that most living rooms will enjoy around double the required minimum levels of daylight.

The No-sky line results show that most rooms will have a very high proportion of their area with access to direct skylight and therefore the distribution of daylight within these rooms will be very good.

In relation to sunlight we have calculated the APSH figure for each window that faces within 90 degrees of south. The resulting APSH figures indicate very high levels of sunlight on most façades of the building, with typical values around double the BRE suggested levels.

The west facing facades face slightly south of west and are therefore on the limit of having a requirement, or expectation, of good sunlight. Even so, most windows will have high levels of sunlight availability, typically significantly in excess of the BRE target figures. There are a few windows near the lower corners of the façade where the adjacent return façade obscures their view to the south and this reduces sunlight levels in these localised regions. However, even here, the resulting values are not unusual in an urban location. In relation to sunlight, the BRE guidelines state that sunlight to kitchens and bedrooms is less important than for living rooms. Arguably student study bedrooms have a lesser requirement than conventional living rooms due to the likely pattern of use and to the transient nature of the accommodation. Furthermore, even in a wholly residential scheme, commonly some regions will not fully meet a strict interpretation of the BRE guidelines. In this case, given that the majority of windows assessed will have exceptionally high levels of daylight and sunlight availability, that the issue is localised, and bearing in mind the location and use the accommodation, it is our view the development would provide good levels of amenity for the occupiers.

We have also considered overshadowing within the proposed amenity areas. Section 3.3 of the BRE guidelines describes the method of assessment of the availability of sunlight within garden/amenity space. This relates to the proportion of permanent shadow on March 21st. Any point that receives no sun on March 21st will be permanently in shade all winter. Likewise, if it can receive some sun on March 21st, it will receive some sunlight all summer.

The BRE criterion for garden or amenity areas is as follows:

'*It is suggested that, for it to appear adequately sunlit throughout the year, no more than two-fifths, and preferably no more than a quarter, of any garden or amenity area should be prevented by buildings from receiving any sunlight at all on 21 March*.'

Drawing 590/10 shows that the extent of permanent shadow on 21 March is very localised and covers less than 5 % of the area. Therefore the extent of shadowing within the amenity space is minimal and accords with the BRE guidelines.

4.0 Summary and Conclusions

We have considered the proposed development in relation to the BRE guidelines on daylight and sunlight. We understand that the buildings in the immediate vicinity have commercial uses and therefore do not need to be considered.

The level and distribution of daylight within the principal habitable rooms will be very good and generally substantially in excess of the BRE and British Standard recommended values.

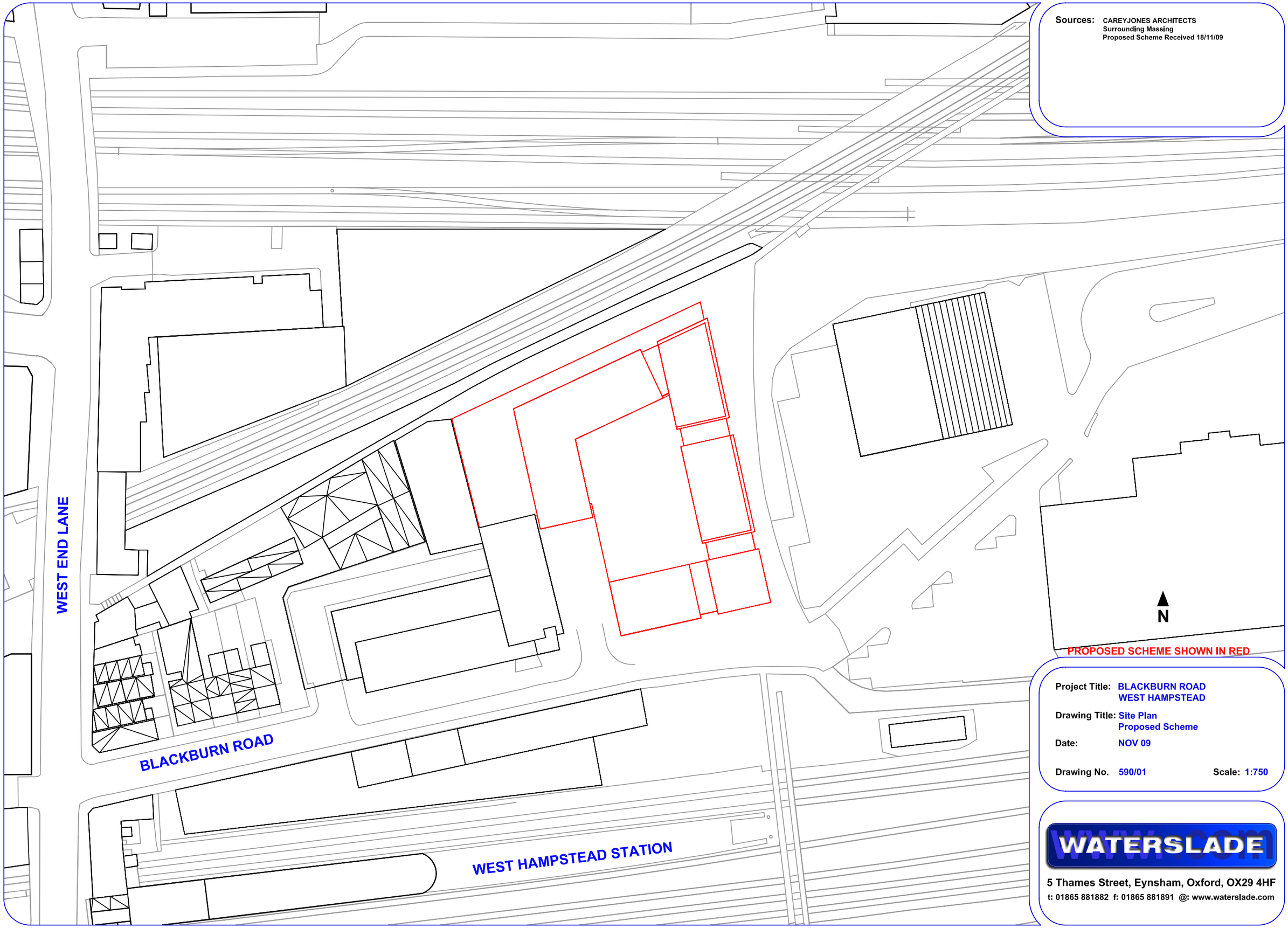
The sunlight levels will be largely very good and substantially in excess of the BRE recommended values. There are localised exceptions which, although near the limit of being

considered for sunlight due to their largely west facing orientation, nevertheless achieve sunlight levels not substantially below the guideline figure.

The BRE advises that its guidelines should be interpreted flexibly and that different target values may be appropriate in certain urban areas. The BRE guidelines originate from 1991 and since that time development policies have increased the densities required, and commonly achieved, in urban areas. It unusual for a modern development in a central urban location to fully adhere to the guidelines and therefore, in such areas, a flexible approach to their interpretation is necessary.

We therefore conclude that the scheme will achieve good levels of daylight and sunlight which accord with the BRE guidelines and therefore should be considered acceptable.

Waterslade Ltd



Sources: CAREYJONES ARCHITECTS
Surrounding Massing
Proposed Scheme Received 18/11/09

PROPOSED SCHEME SHOWN IN RED

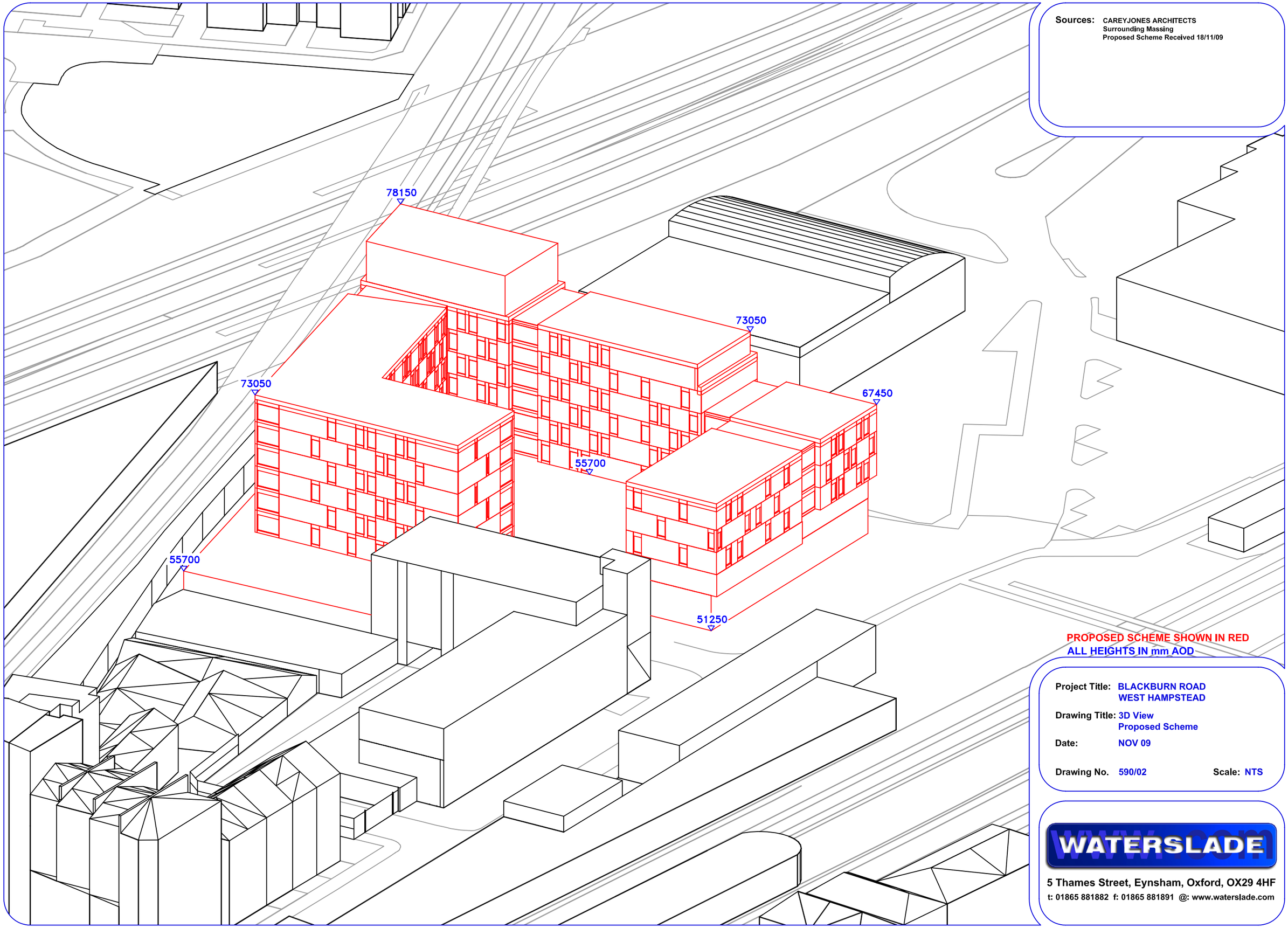
Project Title: BLACKBURN ROAD
WEST HAMPSTEAD

Drawing Title: Site Plan
Proposed Scheme

Date: NOV 09

Drawing No. 590/01 **Scale:** 1:750

WATERSLADE
5 Thames Street, Eynsham, Oxford, OX29 4HF
t: 01865 881882 f: 01865 881891 @: www.waterslade.com



Sources: CAREYJONES ARCHITECTS
Surrounding Massing
Proposed Scheme Received 18/11/09

PROPOSED SCHEME SHOWN IN RED
ALL HEIGHTS IN mm AOD

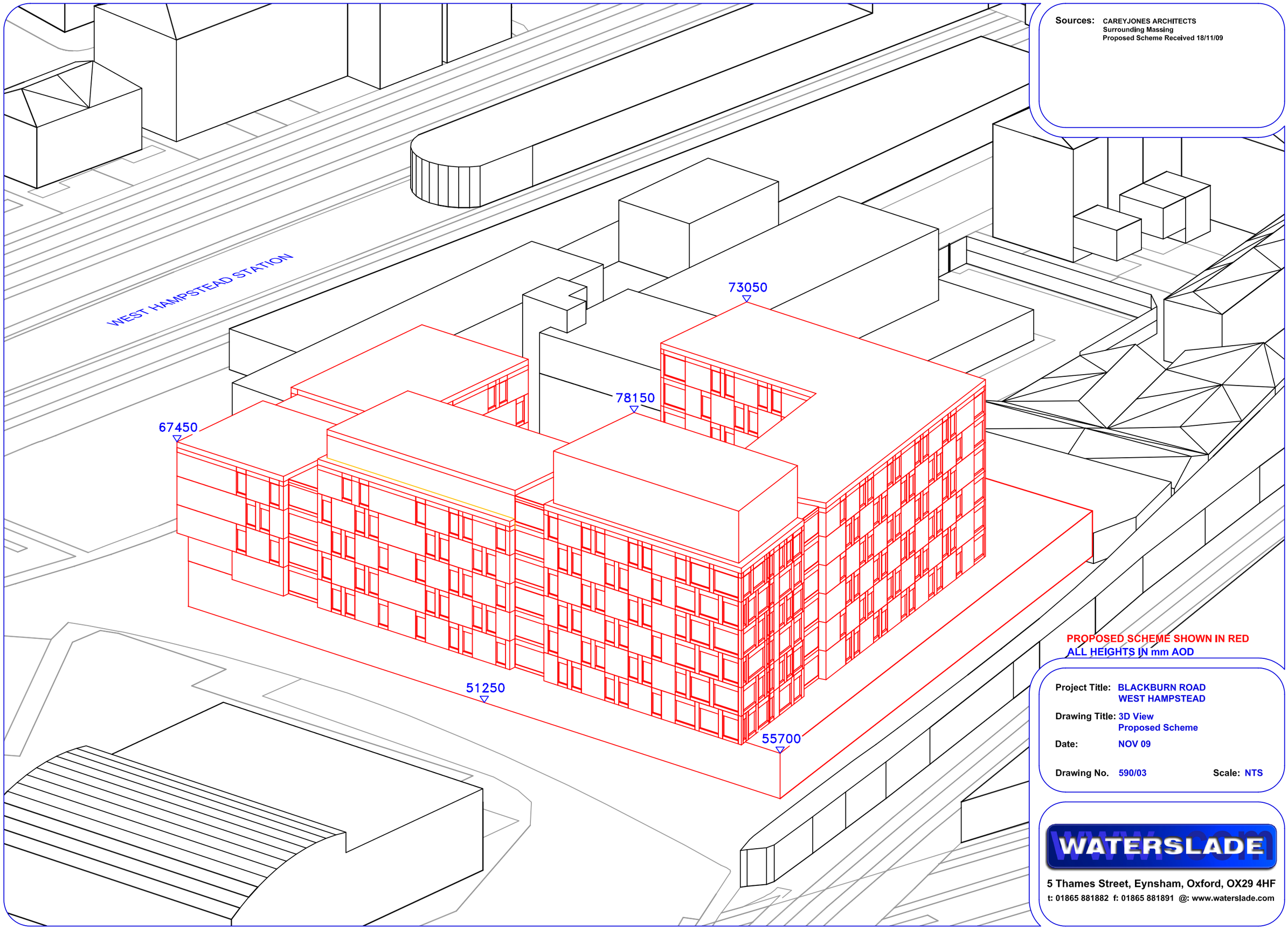
Project Title: BLACKBURN ROAD
WEST HAMPSTEAD

Drawing Title: 3D View
Proposed Scheme

Date: NOV 09

Drawing No. 590/02 **Scale:** NTS

WATERSLADE
5 Thames Street, Eynsham, Oxford, OX29 4HF
t: 01865 881882 f: 01865 881891 @: www.waterslade.com



Sources: CAREYJONES ARCHITECTS
Surrounding Massing
Proposed Scheme Received 18/11/09

PROPOSED SCHEME SHOWN IN RED
ALL HEIGHTS IN mm AOD

Project Title: BLACKBURN ROAD
WEST HAMPSTEAD

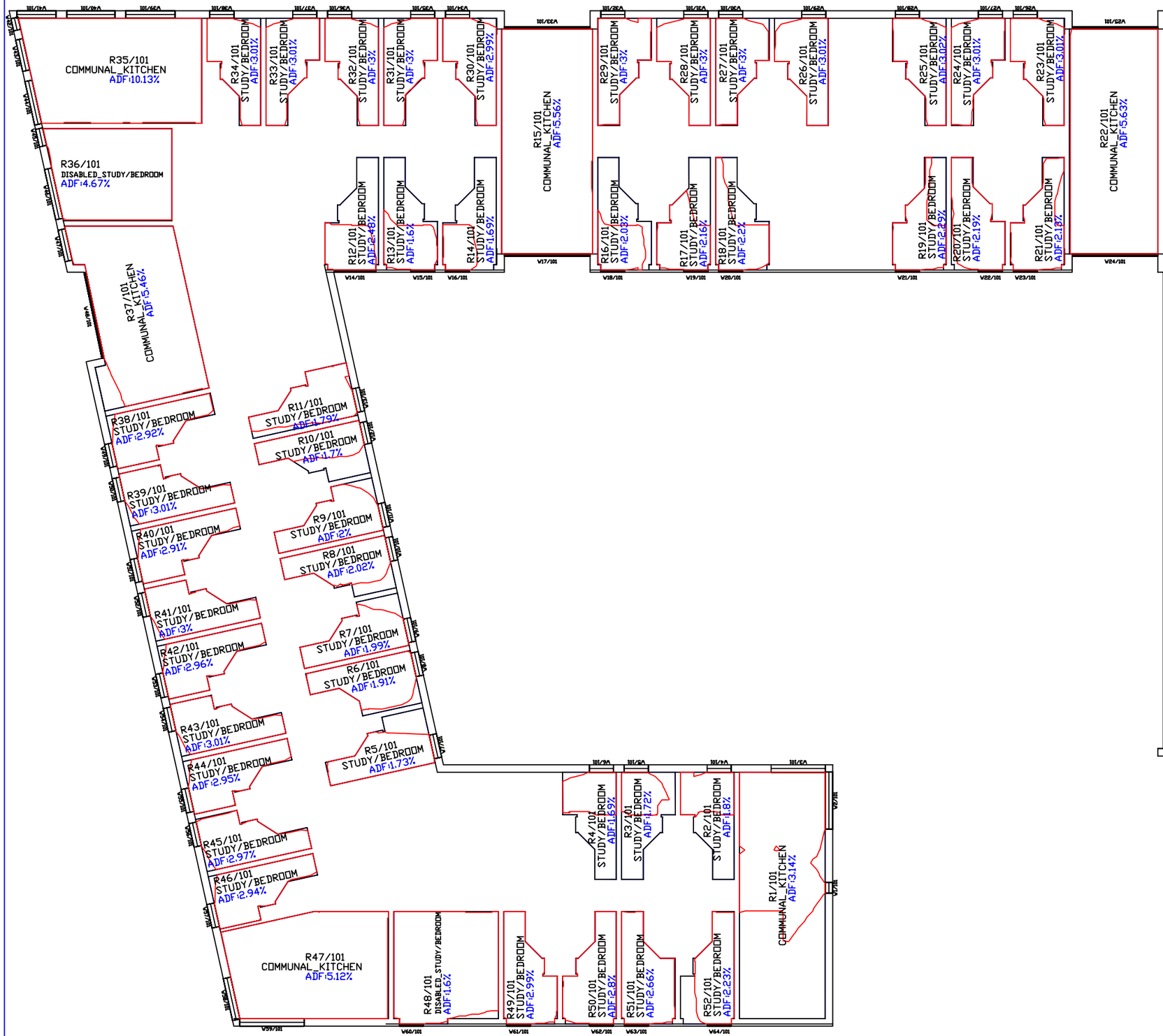
Drawing Title: 3D View
Proposed Scheme

Date: NOV 09

Drawing No. 590/03 Scale: NTS

WATERSLADE
5 Thames Street, Eynsham, Oxford, OX29 4HF
t: 01865 881882 f: 01865 881891 @: www.waterslade.com

Sources: CAREYJONES ARCHITECTS
Surrounding Massing
Proposed Scheme Received 18/11/09



FIRST FLOOR

Project Title: BLACKBURN ROAD
WEST HAMPSTEAD

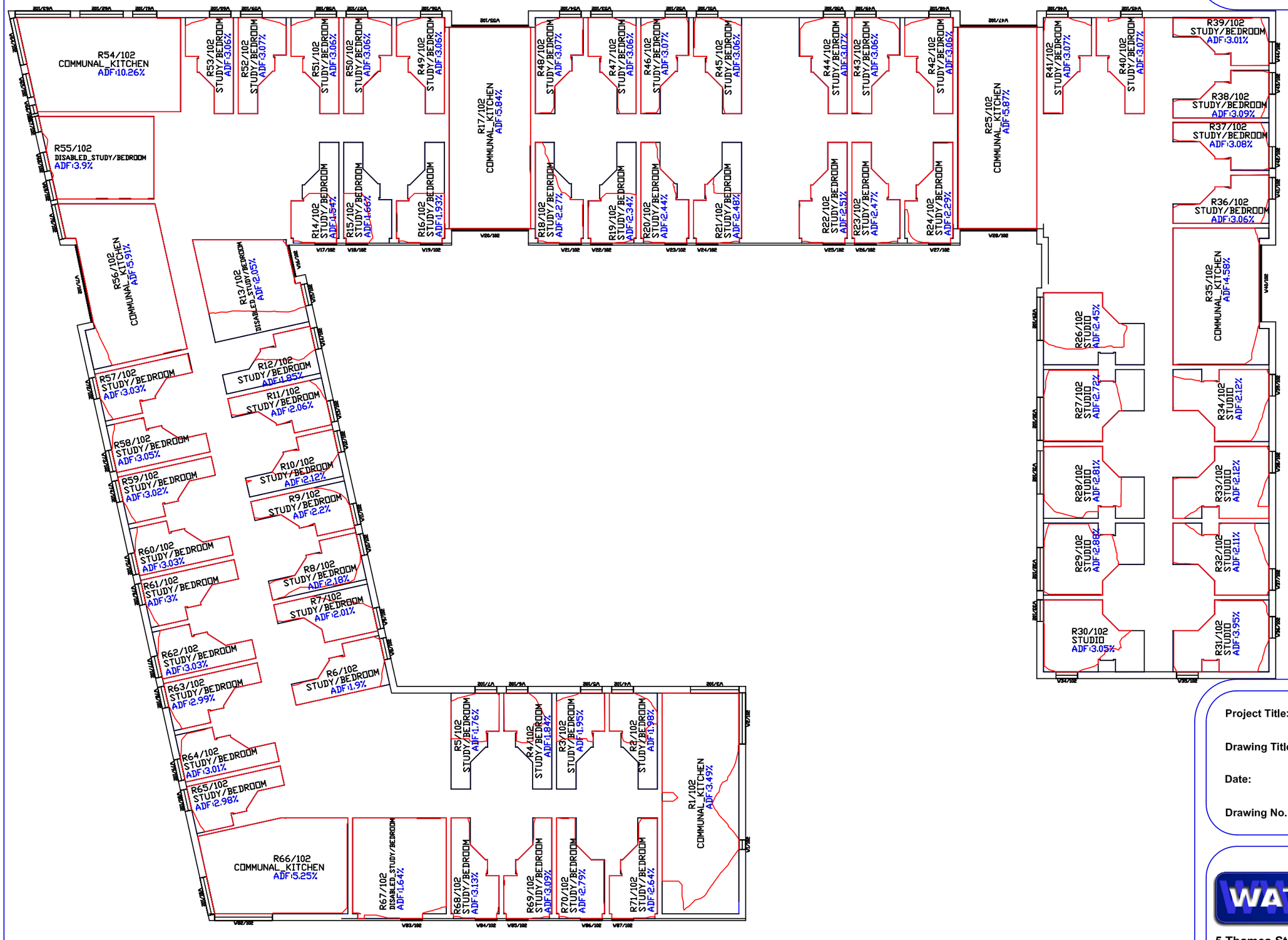
Drawing Title: Internal ADF Results and Daylight Distribution Contours

Date: NOV 09

Drawing No. 590/04 **Scale:** 1:200

WATERSLADE
5 Thames Street, Eynsham, Oxford, OX29 4HF
t: 01865 881882 f: 01865 881891 @: www.waterslade.com

Sources: CAREYJONES ARCHITECTS
Surrounding Massing
Proposed Scheme Received 18/11/09



SECOND FLOOR

Project Title: BLACKBURN ROAD
WEST HAMPSTEAD

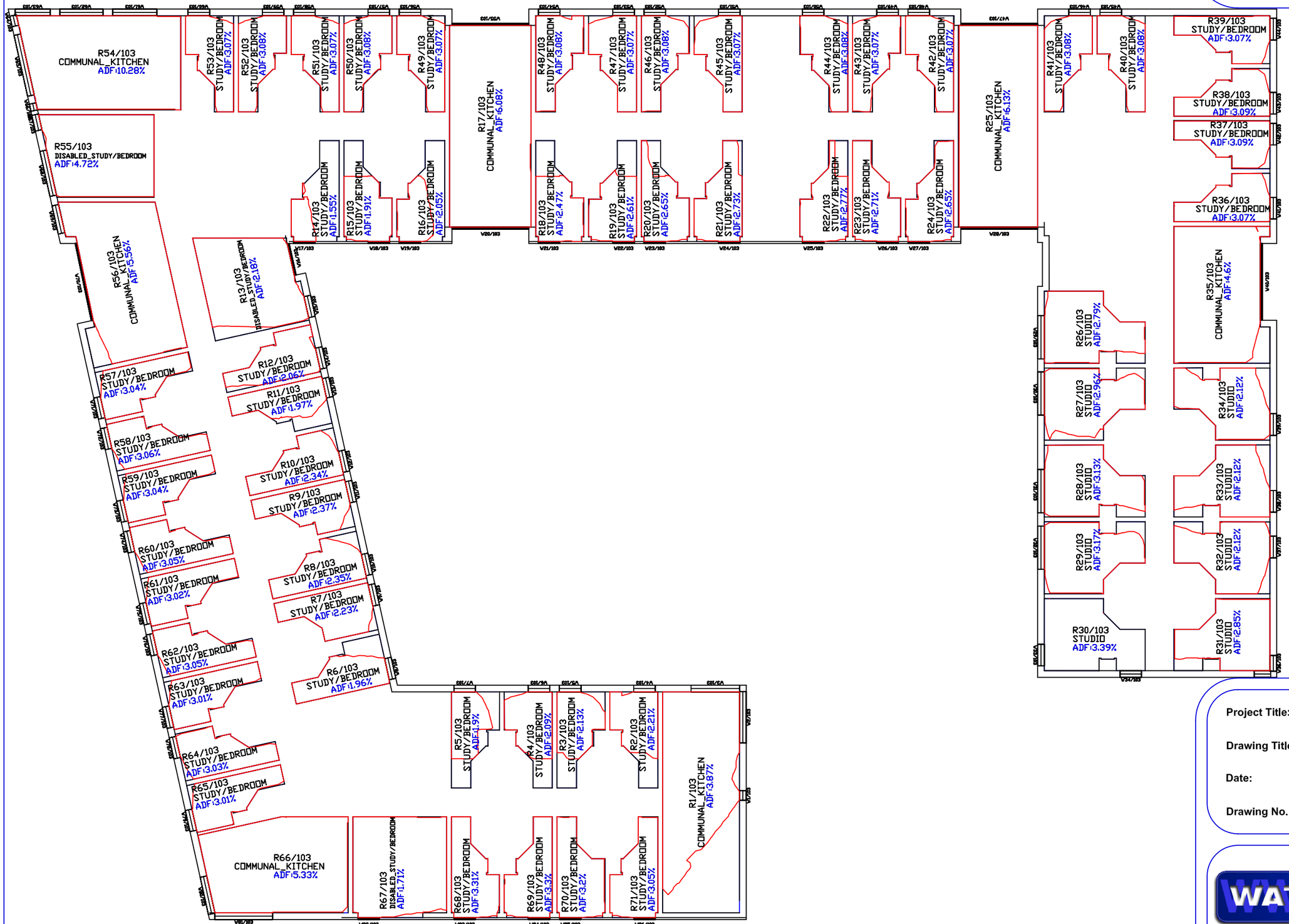
Drawing Title: Internal ADF Results and
Daylight Distribution Contours

Date: NOV 09

Drawing No. 590/05 Scale: 1:200

WATERSLADE
5 Thames Street, Eynsham, Oxford, OX29 4HF
t: 01865 881882 f: 01865 881891 @: www.waterslade.com

Sources: CAREYJONES ARCHITECTS
Surrounding Massing
Proposed Scheme Received 18/11/09



THIRD FLOOR

Project Title: BLACKBURN ROAD
WEST HAMPSTEAD

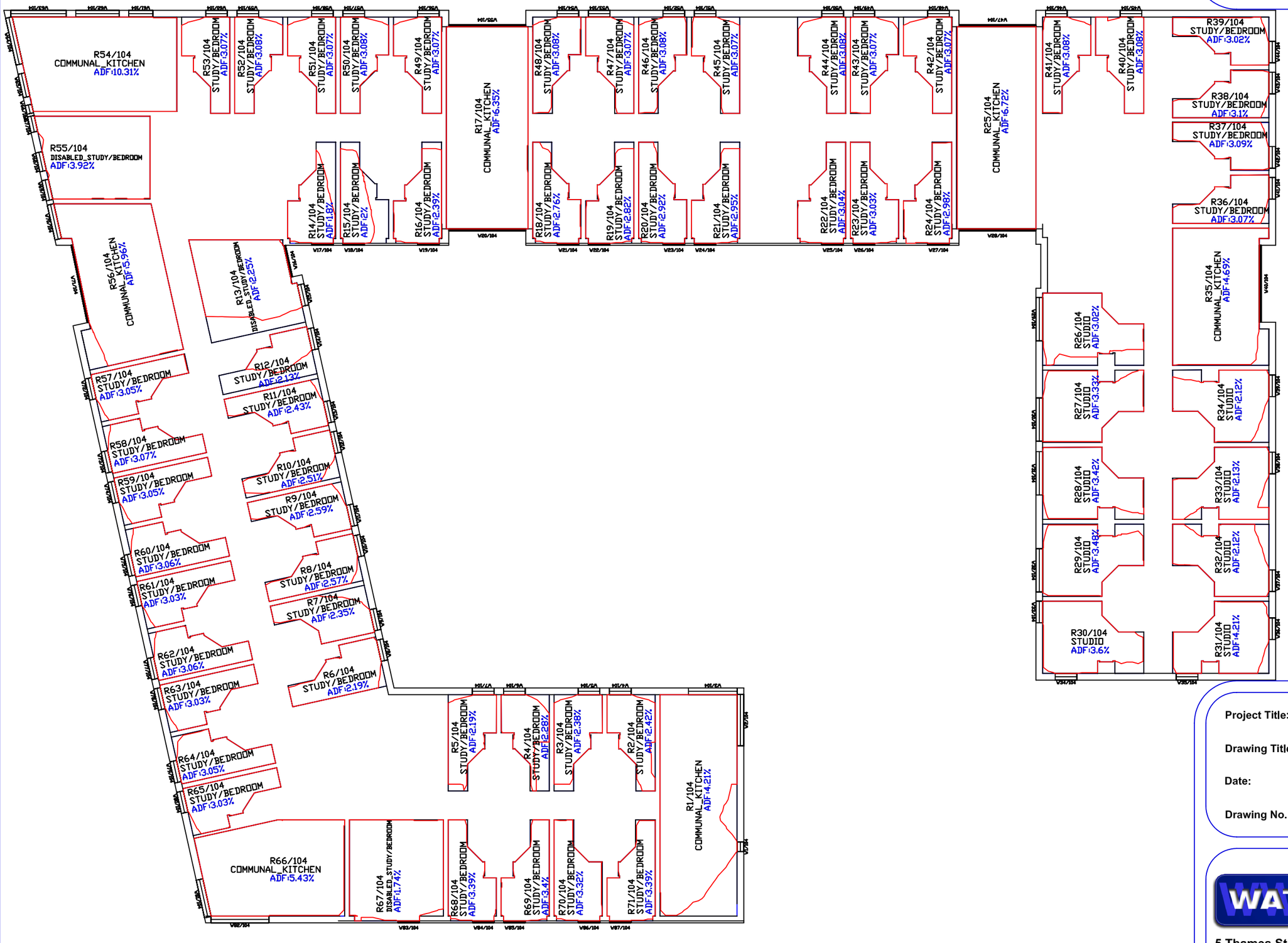
Drawing Title: Internal ADF Results and
Daylight Distribution Contours

Date: NOV 09

Drawing No. 590/06 Scale: 1:200

WATERSLADE
5 Thames Street, Eynsham, Oxford, OX29 4HF
t: 01865 881882 f: 01865 881891 @: www.waterslade.com

Sources: CAREYJONES ARCHITECTS
Surrounding Massing
Proposed Scheme Received 18/11/09



FOURTH FLOOR

Project Title: BLACKBURN ROAD
WEST HAMPSTEAD

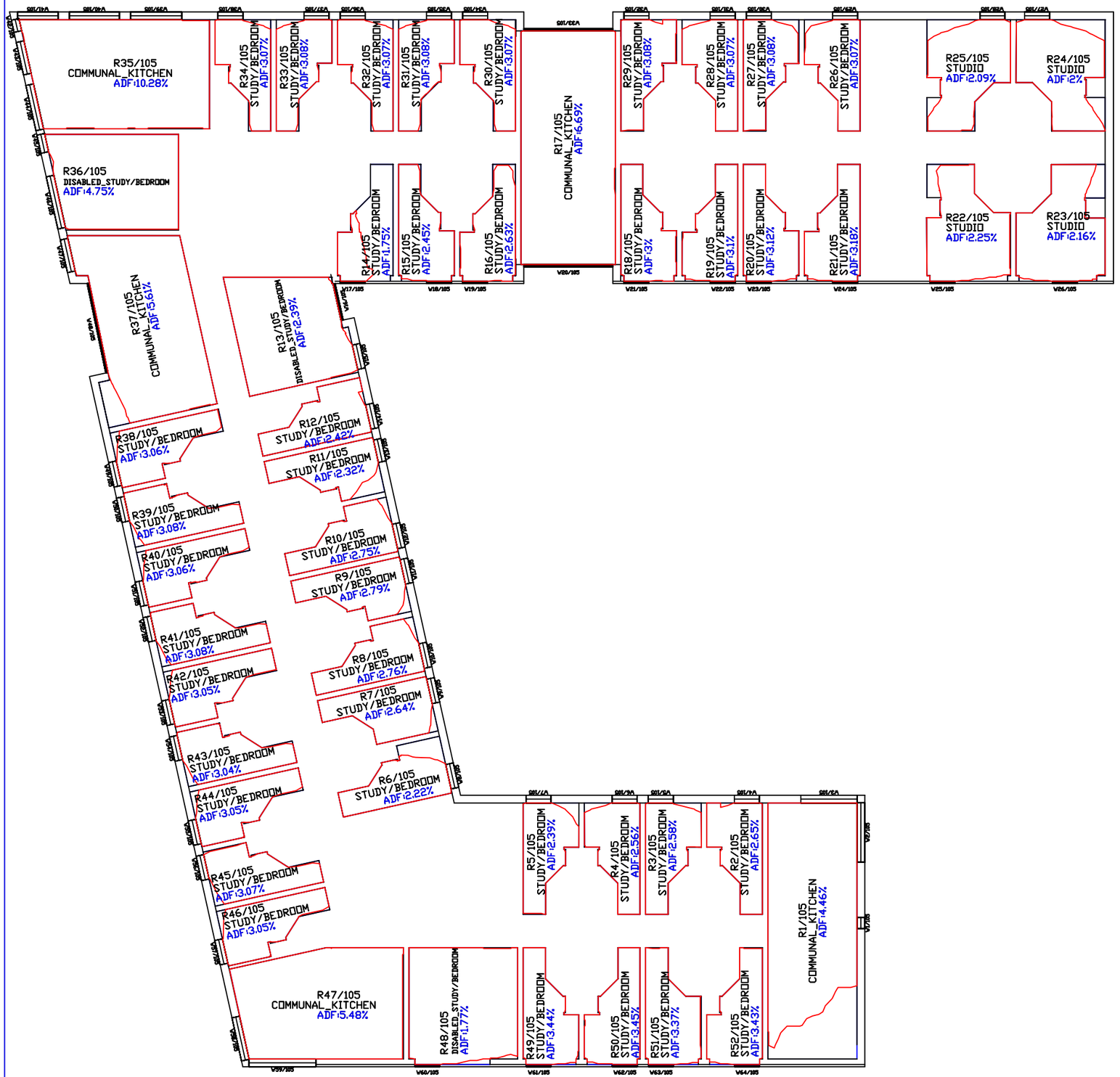
Drawing Title: Internal ADF Results and
Daylight Distribution Contours

Date: NOV 09

Drawing No. 590/07 Scale: 1:200

WATERSLADE
5 Thames Street, Eynsham, Oxford, OX29 4HF
t: 01865 881882 f: 01865 881891 @: www.waterslade.com

Sources: CAREYJONES ARCHITECTS
Surrounding Massing
Proposed Scheme Received 18/11/09



N

FIFTH FLOOR

Project Title: BLACKBURN ROAD
WEST HAMPSTEAD

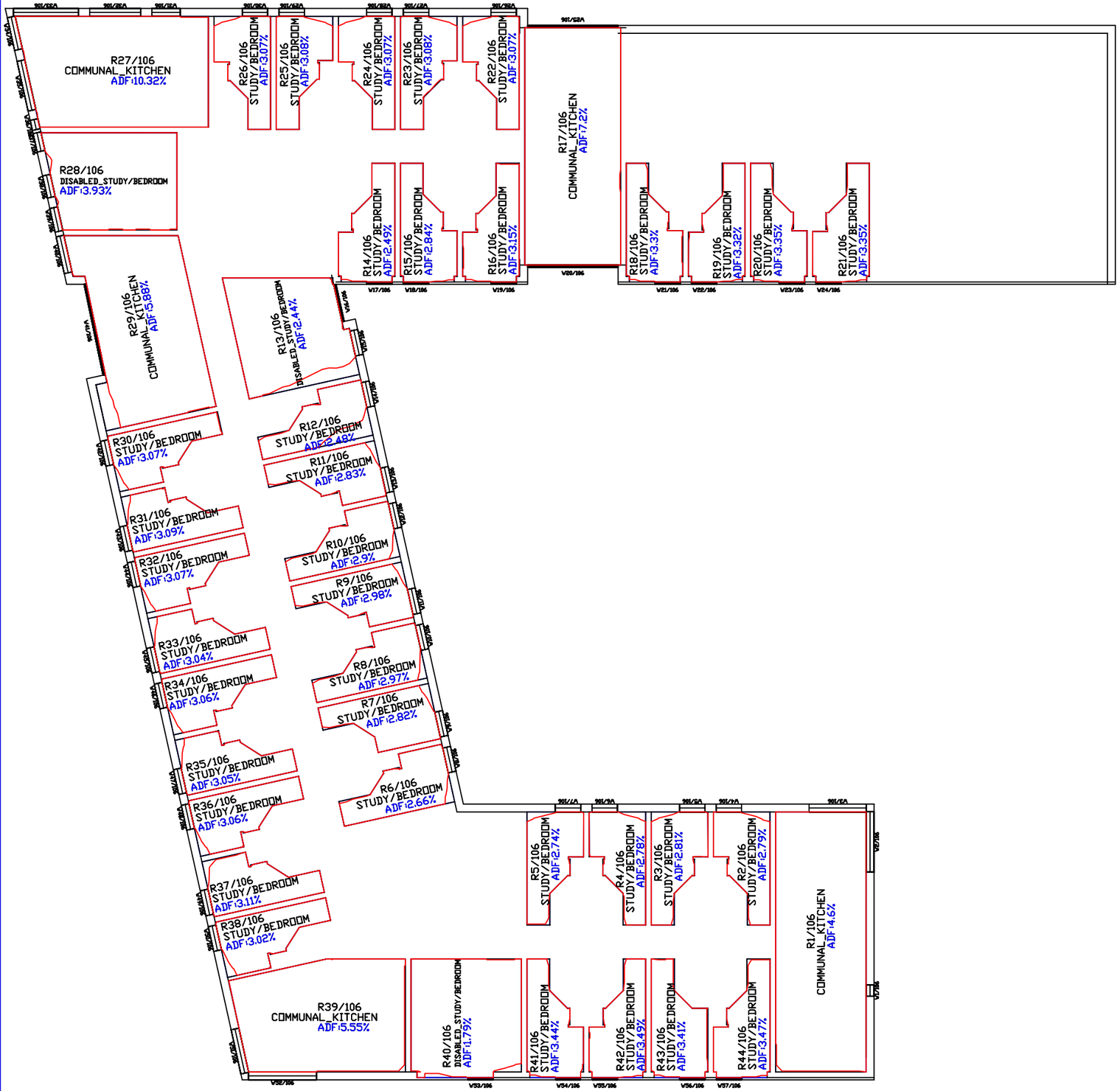
Drawing Title: Internal ADF Results and
Daylight Distribution Contours

Date: NOV 09

Drawing No. 590/08 Scale: 1:200

WATERSLADE
5 Thames Street, Eynsham, Oxford, OX29 4HF
t: 01865 881882 f: 01865 881891 @: www.waterslade.com

Sources: CAREYJONES ARCHITECTS
Surrounding Massing
Proposed Scheme Received 18/11/09



N

SIXTH FLOOR

Project Title: BLACKBURN ROAD
WEST HAMPSTEAD

Drawing Title: Internal ADF Results and
Daylight Distribution Contours

Date: NOV 09

Drawing No. 590/09 Scale: 1:200

WATERSLADE
5 Thames Street, Eynsham, Oxford, OX29 4HF
t: 01865 881882 f: 01865 881891 @: www.waterslade.com

Sources: CAREYJONES ARCHITECTS
Surrounding Massing
Proposed Scheme Received 18/11/09

AREA 2
PROPORTION IN
SHADE: 1.1%

AREA 1
PROPORTION IN
SHADE: 4.9%

N

AREA OF AMENITY SPACE
PERMANENT OVERSHADOW
REGION IN SUN

Project Title: BLACKBURN ROAD
WEST HAMPSTEAD

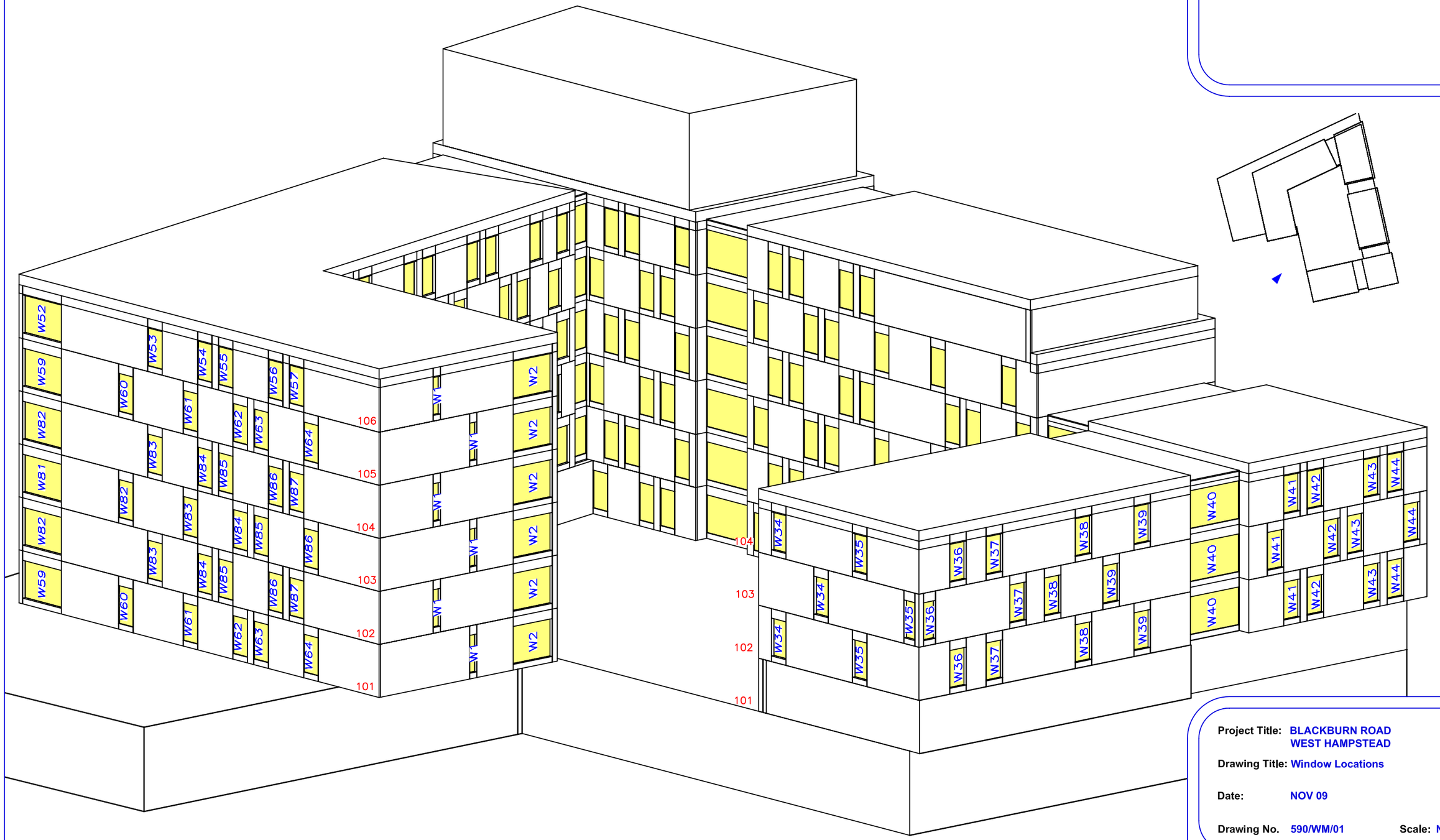
Drawing Title: Permanent Overshadowing
March 21st

Date: NOV 09

Drawing No. 590/10 **Scale:** 1:500

WATERSLADE
5 Thames Street, Eynsham, Oxford, OX29 4HF
t: 01865 881882 f: 01865 881891 @: www.waterslade.com

Sources: CAREYJONES ARCHITECTS
Surrounding Massing
Proposed Scheme Received 18/11/09



Project Title: BLACKBURN ROAD
WEST HAMPSTEAD

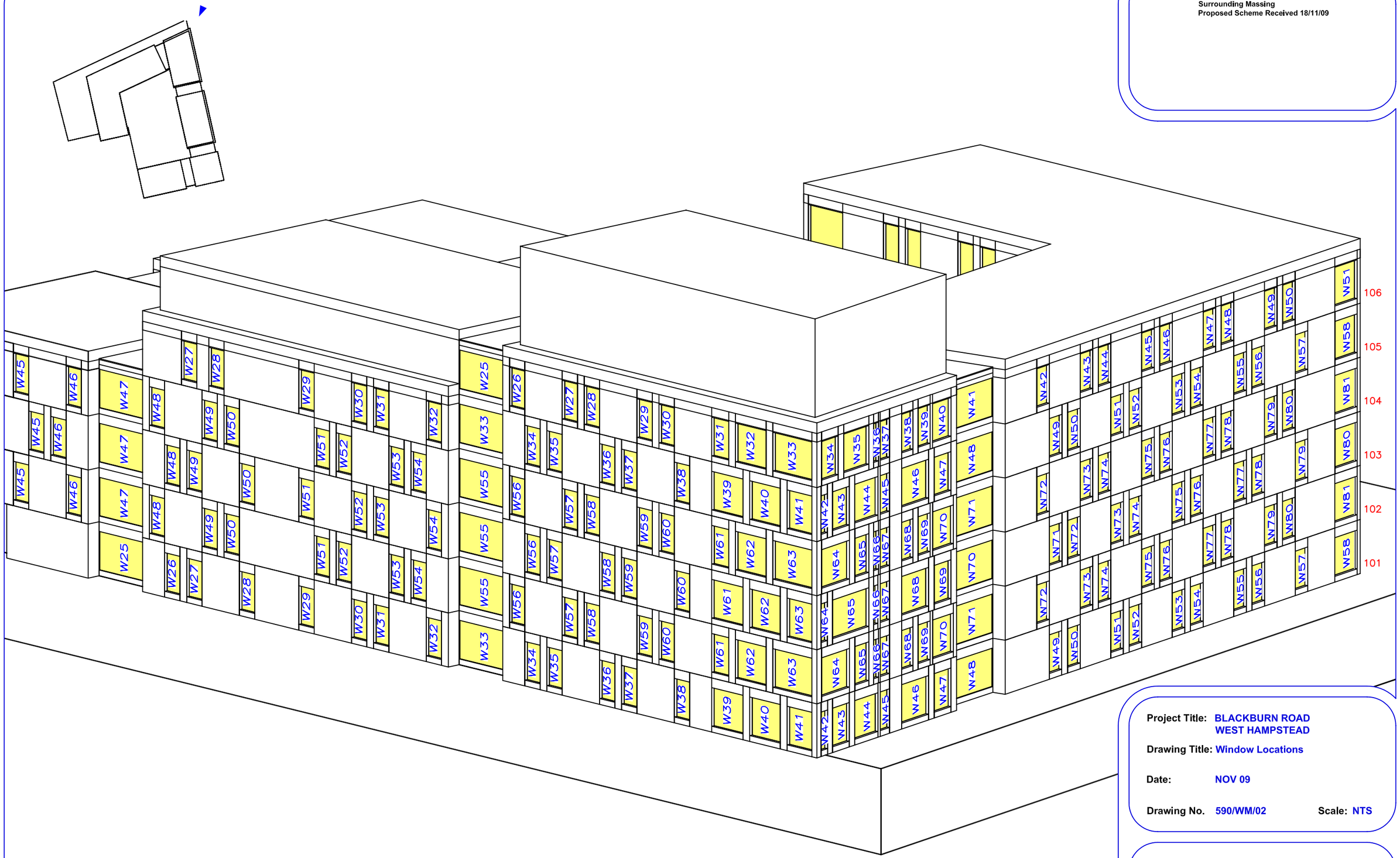
Drawing Title: Window Locations

Date: NOV 09

Drawing No. 590/WM/01 Scale: NTS

WATERSLADE
5 Thames Street, Eynsham, Oxford, OX29 4HF
t: 01865 881882 f: 01865 881891 @: www.waterslade.com

Sources: CAREYJONES ARCHITECTS
Surrounding Massing
Proposed Scheme Received 18/11/09



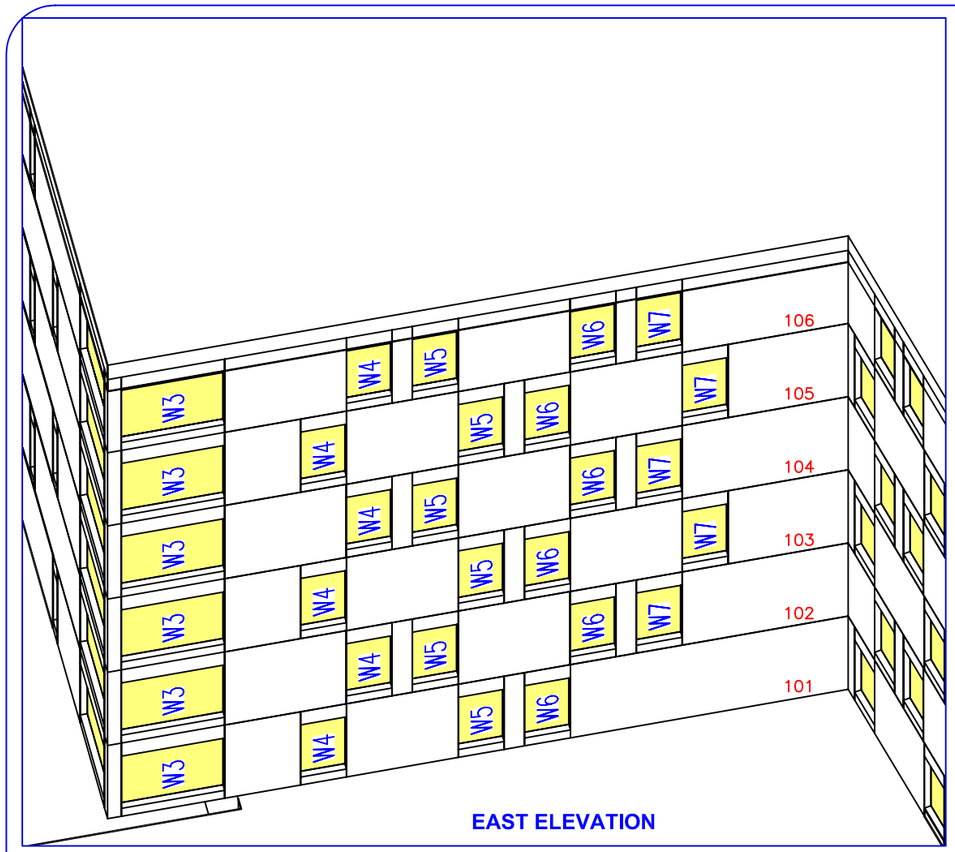
Project Title: BLACKBURN ROAD
WEST HAMPSTEAD

Drawing Title: Window Locations

Date: NOV 09

Drawing No. 590/WM/02 Scale: NTS

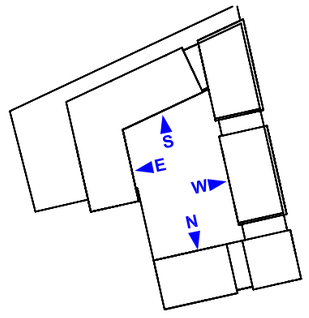
WATERSLADE
5 Thames Street, Eynsham, Oxford, OX29 4HF
t: 01865 881882 f: 01865 881891 @: www.waterslade.com

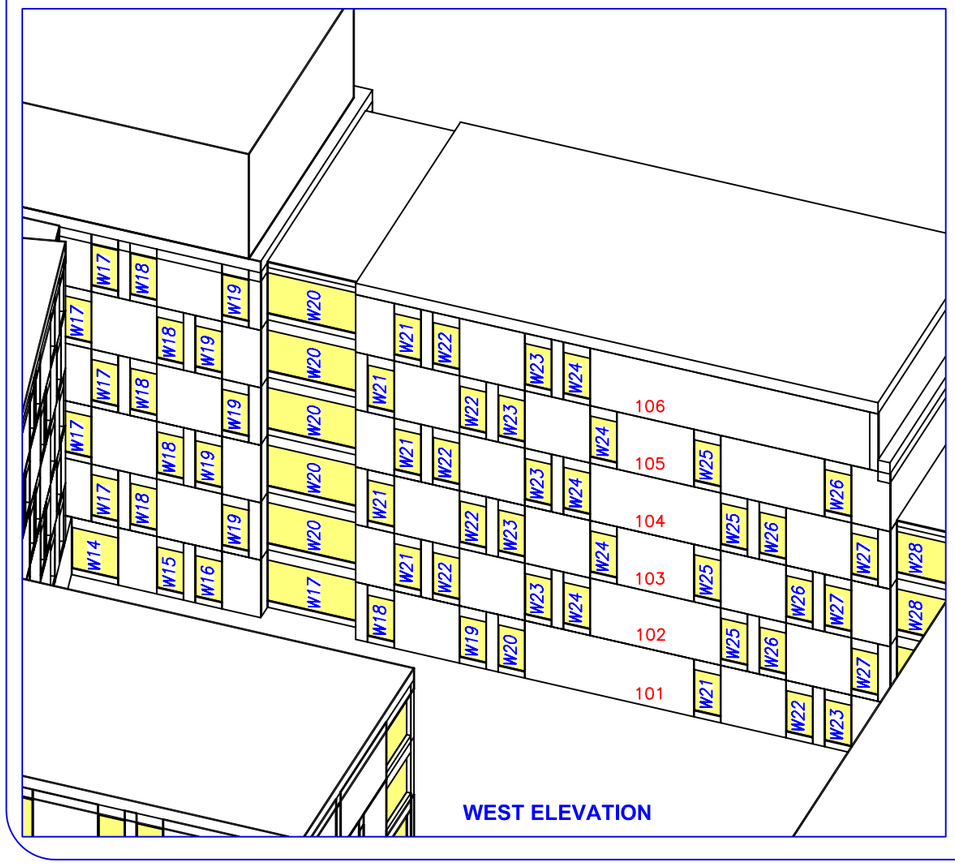


EAST ELEVATION

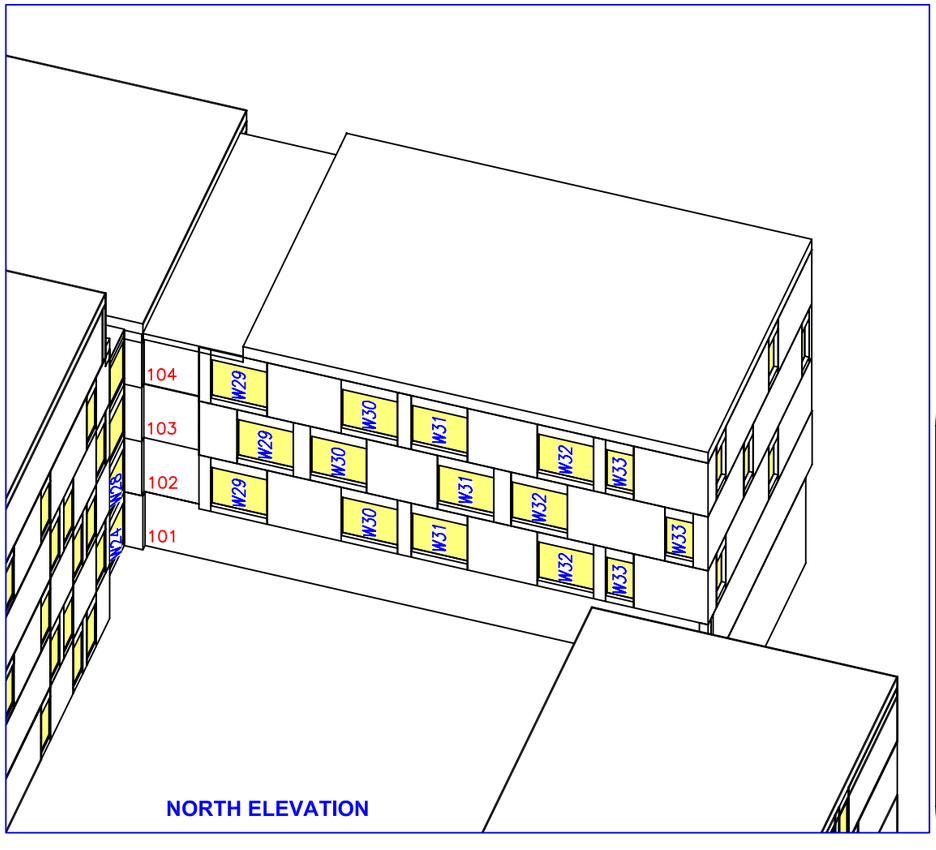
SOUTH ELEVATION

Sources: CAREYJONES ARCHITECTS
Surrounding Massing
Proposed Scheme Received 18/11/09





WEST ELEVATION



NORTH ELEVATION

Project Title: BLACKBURN ROAD
WEST HAMPSTEAD

Drawing Title: Window Locations

Date: NOV 09

Drawing No. 590/WM/03 **Scale:** NTS

WATERSLADE
5 Thames Street, Eynsham, Oxford, OX29 4HF
t: 01865 881882 f: 01865 881891 @: www.waterslade.com

Appendix A

Room	Roomuse	Window	VSC(%)	ADF(%)	TOTAL ADF(%)		Summer %	Winter %	Total %
PROPOSED SCHEME									
R1/101	COMMUNAL_KITCHEN	W1/101	25.61	0.25			20	11	**31**
R1/101	COMMUNAL_KITCHEN	W2/101	26.57	1.66			42	11	**53**
R1/101	COMMUNAL_KITCHEN	W3/101	18.76	1.23	**3.14**				
R2/101	STUDY/BEDROOM	W4/101	18.17	1.80	**1.80**				
R3/101	STUDY/BEDROOM	W5/101	16.97	1.72	**1.72**				
R4/101	STUDY/BEDROOM	W6/101	16.28	1.69	**1.69**				
R5/101	STUDY/BEDROOM	W7/101	16.24	1.73	**1.73**		23	8	**31**
R6/101	STUDY/BEDROOM	W8/101	18.86	1.91	**1.91**		22	9	**31**
R7/101	STUDY/BEDROOM	W9/101	19.41	1.99	**1.99**		23	8	**31**
R8/101	STUDY/BEDROOM	W10/101	19.68	2.02	**2.02**		23	10	**33**
R9/101	STUDY/BEDROOM	W11/101	19.36	2.00	**2.00**		23	12	**35**
R10/101	STUDY/BEDROOM	W12/101	17.64	1.70	**1.70**		21	13	**34**
R11/101	STUDY/BEDROOM	W13/101	16.58	1.79	**1.79**		17	12	**29**
R12/101	STUDY/BEDROOM	W14/101	10.45	2.48	**2.48**		20	9	**29**
R13/101	STUDY/BEDROOM	W15/101	13.10	1.60	**1.60**		22	8	**30**
R14/101	STUDY/BEDROOM	W16/101	14.37	1.69	**1.69**		22	7	**29**
R15/101	COMMUNAL_KITCHEN	W17/101	16.78	2.06			17	7	**24**
R15/101	COMMUNAL_KITCHEN	W33/101	36.07	3.50	**5.56**				
R16/101	STUDY/BEDROOM	W18/101	19.31	2.03	**2.03**		22	8	**30**
R17/101	STUDY/BEDROOM	W19/101	21.31	2.16	**2.16**		23	8	**31**
R18/101	STUDY/BEDROOM	W20/101	22.00	2.20	**2.20**		23	7	**30**
R19/101	STUDY/BEDROOM	W21/101	23.24	2.29	**2.29**		27	2	**29**
R20/101	STUDY/BEDROOM	W22/101	21.89	2.19	**2.19**		22	1	**23**
R21/101	STUDY/BEDROOM	W23/101	20.84	2.13	**2.13**		17	1	**18**
R22/101	COMMUNAL_KITCHEN	W24/101	15.79	2.03			8	0	**8**
R22/101	COMMUNAL_KITCHEN	W25/101	36.41	3.61	**5.63**				
R23/101	STUDY/BEDROOM	W26/101	38.80	3.01	**3.01**				
R24/101	STUDY/BEDROOM	W27/101	38.78	3.01	**3.01**				
R25/101	STUDY/BEDROOM	W28/101	38.74	3.02	**3.02**				
R26/101	STUDY/BEDROOM	W29/101	38.68	3.01	**3.01**				
R27/101	STUDY/BEDROOM	W30/101	38.59	3.00	**3.00**				
R28/101	STUDY/BEDROOM	W31/101	38.56	3.00	**3.00**				
R29/101	STUDY/BEDROOM	W32/101	38.52	3.00	**3.00**				
R30/101	STUDY/BEDROOM	W34/101	38.53	2.99	**2.99**				
R31/101	STUDY/BEDROOM	W35/101	38.54	3.00	**3.00**				
R32/101	STUDY/BEDROOM	W36/101	38.60	3.00	**3.00**				
R33/101	STUDY/BEDROOM	W37/101	38.63	3.01	**3.01**				
R34/101	STUDY/BEDROOM	W38/101	38.73	3.01	**3.01**				
R35/101	COMMUNAL_KITCHEN	W39/101	38.80	2.26					
R35/101	COMMUNAL_KITCHEN	W40/101	38.83	2.21					
R35/101	COMMUNAL_KITCHEN	W41/101	38.86	1.77					
R35/101	COMMUNAL_KITCHEN	W42/101	38.60	0.44					
R35/101	COMMUNAL_KITCHEN	W43/101	38.58	1.42					
R35/101	COMMUNAL_KITCHEN	W44/101	38.54	2.03	**10.13**				

Room	Roomuse	Window	VSC(%)	ADF(%)	TOTAL ADF(%)		Summer %	Winter %	Total %
R36/101	DISABLED_STUDY/BEDROOM	W45/101	38.54	1.07					
R36/101	DISABLED_STUDY/BEDROOM	W46/101	38.51	3.60	**4.67**				
R37/101	COMMUNAL_KITCHEN	W47/101	38.46	1.40					
R37/101	COMMUNAL_KITCHEN	W48/101	36.25	4.06	**5.46**				
R38/101	STUDY/BEDROOM	W49/101	38.29	2.92	**2.92**				
R39/101	STUDY/BEDROOM	W50/101	38.27	3.01	**3.01**				
R40/101	STUDY/BEDROOM	W51/101	38.16	2.91	**2.91**				
R41/101	STUDY/BEDROOM	W52/101	38.10	3.00	**3.00**				
R42/101	STUDY/BEDROOM	W53/101	38.02	2.96	**2.96**				
R43/101	STUDY/BEDROOM	W54/101	37.96	3.01	**3.01**				
R44/101	STUDY/BEDROOM	W55/101	37.80	2.95	**2.95**				
R45/101	STUDY/BEDROOM	W56/101	37.73	2.97	**2.97**				
R46/101	STUDY/BEDROOM	W57/101	37.55	2.94	**2.94**				
R47/101	COMMUNAL_KITCHEN	W58/101	37.34	2.07					
R47/101	COMMUNAL_KITCHEN	W59/101	35.59	3.04	**5.12**		29	14	**43**
R48/101	DISABLED_STUDY/BEDROOM	W60/101	35.02	1.60	**1.60**		34	11	**45**
R49/101	STUDY/BEDROOM	W61/101	33.65	2.99	**2.99**		34	9	**43**
R50/101	STUDY/BEDROOM	W62/101	31.23	2.80	**2.80**		34	3	**37**
R51/101	STUDY/BEDROOM	W63/101	29.51	2.66	**2.66**		31	1	**32**
R52/101	STUDY/BEDROOM	W64/101	22.63	2.23	**2.23**		14	0	**14**
R1/102	COMMUNAL_KITCHEN	W1/102	28.72	0.26			20	13	**33**
R1/102	COMMUNAL_KITCHEN	W2/102	30.70	1.85			46	19	**65**
R1/102	COMMUNAL_KITCHEN	W3/102	22.28	1.39	**3.49**				
R2/102	STUDY/BEDROOM	W4/102	21.17	1.98	**1.98**				
R3/102	STUDY/BEDROOM	W5/102	20.59	1.95	**1.95**				
R4/102	STUDY/BEDROOM	W6/102	18.67	1.84	**1.84**				
R5/102	STUDY/BEDROOM	W7/102	17.61	1.76	**1.76**				
R6/102	STUDY/BEDROOM	W8/102	19.23	1.90	**1.90**		24	11	**35**
R7/102	STUDY/BEDROOM	W9/102	20.68	2.01	**2.01**		26	12	**38**
R8/102	STUDY/BEDROOM	W10/102	22.52	2.18	**2.18**		27	12	**39**
R9/102	STUDY/BEDROOM	W11/102	22.54	2.20	**2.20**		27	12	**39**
R10/102	STUDY/BEDROOM	W12/102	21.60	2.12	**2.12**		24	14	**38**
R11/102	STUDY/BEDROOM	W13/102	20.73	2.06	**2.06**		24	15	**39**
R12/102	STUDY/BEDROOM	W14/102	17.69	1.85	**1.85**		17	14	**31**
R13/102	DISABLED_STUDY/BEDROOM	W15/102	15.41	0.86			16	13	**29**
R13/102	DISABLED_STUDY/BEDROOM	W16/102	12.00	1.19	**2.05**		13	13	**26**
R14/102	STUDY/BEDROOM	W17/102	12.23	1.54	**1.54**		21	8	**29**
R15/102	STUDY/BEDROOM	W18/102	13.93	1.66	**1.66**		23	9	**32**
R16/102	STUDY/BEDROOM	W19/102	17.80	1.93	**1.93**		23	10	**33**
R17/102	COMMUNAL_KITCHEN	W20/102	19.54	2.25			20	8	**28**
R17/102	COMMUNAL_KITCHEN	W55/102	36.96	3.58	**5.84**				
R18/102	STUDY/BEDROOM	W21/102	23.20	2.27	**2.27**		24	11	**35**
R19/102	STUDY/BEDROOM	W22/102	24.00	2.34	**2.34**		24	11	**35**
R20/102	STUDY/BEDROOM	W23/102	25.79	2.44	**2.44**		25	9	**34**

Room	Roomuse	Window	VSC(%)	ADF(%)	TOTAL ADF(%)		Summer %	Winter %	Total %
R21/102	STUDY/BEDROOM	W24/102	26.37	2.48	**2.48**		26	10	**36**
R22/102	STUDY/BEDROOM	W25/102	26.69	2.51	**2.51**		28	4	**32**
R23/102	STUDY/BEDROOM	W26/102	26.19	2.47	**2.47**		29	2	**31**
R24/102	STUDY/BEDROOM	W27/102	23.41	2.29	**2.29**		22	1	**23**
R25/102	COMMUNAL_KITCHEN	W28/102	18.20	2.21			9	0	**9**
R25/102	COMMUNAL_KITCHEN	W47/102	37.03	3.66	**5.87**				
R26/102	STUDIO	W29/102	18.06	2.45	**2.45**				
R27/102	STUDIO	W30/102	21.42	2.72	**2.72**				
R28/102	STUDIO	W31/102	22.41	2.81	**2.81**				
R29/102	STUDIO	W32/102	23.15	2.88	**2.88**				
R30/102	STUDIO	W33/102	23.25	1.36					
R30/102	STUDIO	W34/102	30.76	1.69	**3.05**		26	6	**32**
R31/102	STUDIO	W35/102	32.72	1.84			25	8	**33**
R31/102	STUDIO	W36/102	39.43	2.11	**3.95**		36	25	**61**
R32/102	STUDIO	W37/102	39.44	2.11	**2.11**		36	25	**61**
R33/102	STUDIO	W38/102	39.45	2.12	**2.12**		36	25	**61**
R34/102	STUDIO	W39/102	39.45	2.12	**2.12**		36	25	**61**
R35/102	COMMUNAL_KITCHEN	W40/102	36.98	4.58	**4.58**		40	28	**68**
R36/102	STUDY/BEDROOM	W41/102	39.46	3.06	**3.06**		36	25	**61**
R37/102	STUDY/BEDROOM	W42/102	39.46	3.08	**3.08**		36	25	**61**
R38/102	STUDY/BEDROOM	W43/102	39.46	3.09	**3.09**		36	25	**61**
R39/102	STUDY/BEDROOM	W44/102	39.46	3.01	**3.01**		35	25	**60**
R40/102	STUDY/BEDROOM	W45/102	39.51	3.07	**3.07**				
R41/102	STUDY/BEDROOM	W46/102	39.51	3.07	**3.07**				
R42/102	STUDY/BEDROOM	W48/102	39.49	3.06	**3.06**				
R43/102	STUDY/BEDROOM	W49/102	39.48	3.06	**3.06**				
R44/102	STUDY/BEDROOM	W50/102	39.48	3.07	**3.07**				
R45/102	STUDY/BEDROOM	W51/102	39.46	3.06	**3.06**				
R46/102	STUDY/BEDROOM	W52/102	39.46	3.07	**3.07**				
R47/102	STUDY/BEDROOM	W53/102	39.45	3.06	**3.06**				
R48/102	STUDY/BEDROOM	W54/102	39.45	3.07	**3.07**				
R49/102	STUDY/BEDROOM	W56/102	39.45	3.06	**3.06**				
R50/102	STUDY/BEDROOM	W57/102	39.45	3.06	**3.06**				
R51/102	STUDY/BEDROOM	W58/102	39.45	3.06	**3.06**				
R52/102	STUDY/BEDROOM	W59/102	39.46	3.07	**3.07**				
R53/102	STUDY/BEDROOM	W60/102	39.46	3.06	**3.06**				
R54/102	COMMUNAL_KITCHEN	W61/102	39.47	1.17					
R54/102	COMMUNAL_KITCHEN	W62/102	39.48	2.25					
R54/102	COMMUNAL_KITCHEN	W63/102	39.49	2.90					
R54/102	COMMUNAL_KITCHEN	W64/102	39.06	2.48					
R54/102	COMMUNAL_KITCHEN	W65/102	39.05	1.16					
R54/102	COMMUNAL_KITCHEN	W66/102	39.03	0.31	**10.26**				
R55/102	DISABLED_STUDY/BEDROOM	W67/102	39.02	1.08					
R55/102	DISABLED_STUDY/BEDROOM	W68/102	39.00	1.36					
R55/102	DISABLED_STUDY/BEDROOM	W69/102	38.99	1.47	**3.90**				
R56/102	COMMUNAL_KITCHEN	W70/102	38.95	1.78					

Room	Roomuse	Window	VSC(%)	ADF(%)	TOTAL ADF(%)		Summer %	Winter %	Total %
R56/102	COMMUNAL_KITCHEN	W71/102	36.84	4.13	**5.91**				
R57/102	STUDY/BEDROOM	W72/102	38.82	3.03	**3.03**				
R58/102	STUDY/BEDROOM	W73/102	38.77	3.05	**3.05**				
R59/102	STUDY/BEDROOM	W74/102	38.73	3.02	**3.02**				
R60/102	STUDY/BEDROOM	W75/102	38.66	3.03	**3.03**				
R61/102	STUDY/BEDROOM	W76/102	38.60	3.00	**3.00**				
R62/102	STUDY/BEDROOM	W77/102	38.50	3.03	**3.03**				
R63/102	STUDY/BEDROOM	W78/102	38.44	2.99	**2.99**				
R64/102	STUDY/BEDROOM	W79/102	38.32	3.01	**3.01**				
R65/102	STUDY/BEDROOM	W80/102	38.25	2.98	**2.98**				
R66/102	COMMUNAL_KITCHEN	W81/102	38.04	2.11					
R66/102	COMMUNAL_KITCHEN	W82/102	36.84	3.14	**5.25**		29	14	**43**
R67/102	DISABLED_STUDY/BEDROOM	W83/102	36.32	1.64	**1.64**		34	14	**48**
R68/102	STUDY/BEDROOM	W84/102	35.50	3.13	**3.13**		35	11	**46**
R69/102	STUDY/BEDROOM	W85/102	34.90	3.09	**3.09**		35	10	**45**
R70/102	STUDY/BEDROOM	W86/102	31.75	2.79	**2.79**		35	3	**38**
R71/102	STUDY/BEDROOM	W87/102	28.87	2.64	**2.64**		30	1	**31**
R1/103	COMMUNAL_KITCHEN	W1/103	35.46	0.28			20	17	**37**
R1/103	COMMUNAL_KITCHEN	W2/103	34.84	2.04			47	26	**73**
R1/103	COMMUNAL_KITCHEN	W3/103	26.13	1.55	**3.87**				
R2/103	STUDY/BEDROOM	W4/103	25.24	2.21	**2.21**				
R3/103	STUDY/BEDROOM	W5/103	23.72	2.13	**2.13**				
R4/103	STUDY/BEDROOM	W6/103	22.81	2.09	**2.09**				
R5/103	STUDY/BEDROOM	W7/103	19.78	1.90	**1.90**				
R6/103	STUDY/BEDROOM	W8/103	20.30	1.96	**1.96**		25	9	**34**
R7/103	STUDY/BEDROOM	W9/103	24.29	2.23	**2.23**		31	12	**43**
R8/103	STUDY/BEDROOM	W10/103	25.17	2.35	**2.35**		33	13	**46**
R9/103	STUDY/BEDROOM	W11/103	25.60	2.37	**2.37**		31	12	**43**
R10/103	STUDY/BEDROOM	W12/103	25.16	2.34	**2.34**		29	15	**44**
R11/103	STUDY/BEDROOM	W13/103	22.74	1.97	**1.97**		26	16	**42**
R12/103	STUDY/BEDROOM	W14/103	21.20	2.06	**2.06**		22	16	**38**
R13/103	DISABLED_STUDY/BEDROOM	W15/103	18.00	0.94			17	13	**30**
R13/103	DISABLED_STUDY/BEDROOM	W16/103	12.88	1.24	**2.18**		14	13	**27**
R14/103	STUDY/BEDROOM	W17/103	12.29	1.55	**1.55**		21	9	**30**
R15/103	STUDY/BEDROOM	W18/103	17.68	1.91	**1.91**		24	10	**34**
R16/103	STUDY/BEDROOM	W19/103	19.68	2.05	**2.05**		26	10	**36**
R17/103	COMMUNAL_KITCHEN	W20/103	22.81	2.49			23	9	**32**
R17/103	COMMUNAL_KITCHEN	W55/103	37.13	3.60	**6.08**				
R18/103	STUDY/BEDROOM	W21/103	26.04	2.47	**2.47**		28	13	**41**
R19/103	STUDY/BEDROOM	W22/103	28.17	2.61	**2.61**		28	13	**41**
R20/103	STUDY/BEDROOM	W23/103	28.88	2.65	**2.65**		28	13	**41**
R21/103	STUDY/BEDROOM	W24/103	30.10	2.73	**2.73**		29	13	**42**
R22/103	STUDY/BEDROOM	W25/103	30.56	2.77	**2.77**		29	11	**40**

Room	Roomuse	Window	VSC(%)	ADF(%)	TOTAL ADF(%)	Summer %	Winter %	Total %
R23/103	STUDY/BEDROOM	W26/103	29.82	2.71	**2.71**	29	8	**37**
R24/103	STUDY/BEDROOM	W27/103	28.90	2.65	**2.65**	29	5	**34**
R25/103	COMMUNAL_KITCHEN	W28/103	21.65	2.46		15	0	**15**
R25/103	COMMUNAL_KITCHEN	W47/103	37.18	3.68	**6.13**			
R26/103	STUDIO	W29/103	22.07	2.79	**2.79**			
R27/103	STUDIO	W30/103	24.14	2.96	**2.96**			
R28/103	STUDIO	W31/103	26.10	3.13	**3.13**			
R29/103	STUDIO	W32/103	26.58	3.17	**3.17**			
R30/103	STUDIO	W33/103	26.84	1.49				
R30/103	STUDIO	W34/103	36.13	1.89	**3.39**	29	9	**38**
R31/103	STUDIO	W35/103	37.15	1.43		26	8	**34**
R31/103	STUDIO	W36/103	39.59	1.42	**2.85**	28	22	**50**
R32/103	STUDIO	W37/103	39.59	2.12	**2.12**	36	25	**61**
R33/103	STUDIO	W38/103	39.59	2.12	**2.12**	36	25	**61**
R34/103	STUDIO	W39/103	39.59	2.12	**2.12**	36	25	**61**
R35/103	COMMUNAL_KITCHEN	W40/103	37.18	4.60	**4.60**	40	28	**68**
R36/103	STUDY/BEDROOM	W41/103	39.58	3.07	**3.07**	36	25	**61**
R37/103	STUDY/BEDROOM	W42/103	39.58	3.09	**3.09**	36	25	**61**
R38/103	STUDY/BEDROOM	W43/103	39.58	3.09	**3.09**	36	25	**61**
R39/103	STUDY/BEDROOM	W44/103	39.58	3.07	**3.07**	36	25	**61**
R40/103	STUDY/BEDROOM	W45/103	39.61	3.08	**3.08**			
R41/103	STUDY/BEDROOM	W46/103	39.61	3.08	**3.08**			
R42/103	STUDY/BEDROOM	W48/103	39.61	3.07	**3.07**			
R43/103	STUDY/BEDROOM	W49/103	39.61	3.07	**3.07**			
R44/103	STUDY/BEDROOM	W50/103	39.61	3.08	**3.08**			
R45/103	STUDY/BEDROOM	W51/103	39.61	3.07	**3.07**			
R46/103	STUDY/BEDROOM	W52/103	39.62	3.08	**3.08**			
R47/103	STUDY/BEDROOM	W53/103	39.62	3.07	**3.07**			
R48/103	STUDY/BEDROOM	W54/103	39.62	3.08	**3.08**			
R49/103	STUDY/BEDROOM	W56/103	39.62	3.07	**3.07**			
R50/103	STUDY/BEDROOM	W57/103	39.62	3.08	**3.08**			
R51/103	STUDY/BEDROOM	W58/103	39.62	3.07	**3.07**			
R52/103	STUDY/BEDROOM	W59/103	39.62	3.08	**3.08**			
R53/103	STUDY/BEDROOM	W60/103	39.62	3.07	**3.07**			
R54/103	COMMUNAL_KITCHEN	W61/103	39.62	2.31				
R54/103	COMMUNAL_KITCHEN	W62/103	39.62	2.25				
R54/103	COMMUNAL_KITCHEN	W63/103	39.62	1.80				
R54/103	COMMUNAL_KITCHEN	W64/103	39.23	0.41				
R54/103	COMMUNAL_KITCHEN	W65/103	39.21	3.27				
R54/103	COMMUNAL_KITCHEN	W66/103	39.19	0.24	**10.28**			
R55/103	DISABLED_STUDY/BEDROOM	W67/103	39.19	1.08				
R55/103	DISABLED_STUDY/BEDROOM	W68/103	39.17	3.64	**4.72**			
R56/103	COMMUNAL_KITCHEN	W69/103	39.15	1.42				
R56/103	COMMUNAL_KITCHEN	W70/103	37.02	4.15	**5.56**			
R57/103	STUDY/BEDROOM	W71/103	39.04	3.04	**3.04**			
R58/103	STUDY/BEDROOM	W72/103	39.02	3.06	**3.06**			

Room	Roomuse	Window	VSC(%)	ADF(%)	TOTAL ADF(%)		Summer %	Winter %	Total %
R59/103	STUDY/BEDROOM	W73/103	38.96	3.04	**3.04**				
R60/103	STUDY/BEDROOM	W74/103	38.92	3.05	**3.05**				
R61/103	STUDY/BEDROOM	W75/103	38.88	3.02	**3.02**				
R62/103	STUDY/BEDROOM	W76/103	38.84	3.05	**3.05**				
R63/103	STUDY/BEDROOM	W77/103	38.76	3.01	**3.01**				
R64/103	STUDY/BEDROOM	W78/103	38.71	3.03	**3.03**				
R65/103	STUDY/BEDROOM	W79/103	38.62	3.01	**3.01**				
R66/103	COMMUNAL_KITCHEN	W80/103	38.49	2.12					
R66/103	COMMUNAL_KITCHEN	W81/103	37.83	3.21	**5.33**		30	15	**45**
R67/103	DISABLED_STUDY/BEDROOM	W82/103	37.82	1.71	**1.71**		35	15	**50**
R68/103	STUDY/BEDROOM	W83/103	37.69	3.31	**3.31**		35	14	**49**
R69/103	STUDY/BEDROOM	W84/103	37.43	3.30	**3.30**		35	14	**49**
R70/103	STUDY/BEDROOM	W85/103	37.16	3.20	**3.20**		35	14	**49**
R71/103	STUDY/BEDROOM	W86/103	34.64	3.05	**3.05**		35	9	**44**
R1/104	COMMUNAL_KITCHEN	W1/104	38.48	0.30			20	17	**37**
R1/104	COMMUNAL_KITCHEN	W2/104	37.79	2.20			48	28	**76**
R1/104	COMMUNAL_KITCHEN	W3/104	30.13	1.72	**4.21**				
R2/104	STUDY/BEDROOM	W4/104	28.83	2.42	**2.42**				
R3/104	STUDY/BEDROOM	W5/104	28.21	2.38	**2.38**				
R4/104	STUDY/BEDROOM	W6/104	26.03	2.28	**2.28**				
R5/104	STUDY/BEDROOM	W7/104	24.59	2.19	**2.19**				
R6/104	STUDY/BEDROOM	W8/104	24.42	2.19	**2.19**		28	11	**39**
R7/104	STUDY/BEDROOM	W9/104	26.64	2.35	**2.35**		32	12	**44**
R8/104	STUDY/BEDROOM	W10/104	29.26	2.57	**2.57**		35	15	**50**
R9/104	STUDY/BEDROOM	W11/104	29.38	2.59	**2.59**		35	17	**52**
R10/104	STUDY/BEDROOM	W12/104	28.21	2.51	**2.51**		33	18	**51**
R11/104	STUDY/BEDROOM	W13/104	27.05	2.43	**2.43**		29	17	**46**
R12/104	STUDY/BEDROOM	W14/104	22.60	2.13	**2.13**		23	16	**39**
R13/104	DISABLED_STUDY/BEDROOM	W15/104	18.92	0.96			17	13	**30**
R13/104	DISABLED_STUDY/BEDROOM	W16/104	13.77	1.29	**2.25**		14	13	**27**
R14/104	STUDY/BEDROOM	W17/104	15.87	1.80	**1.80**		23	11	**34**
R15/104	STUDY/BEDROOM	W18/104	19.00	2.00	**2.00**		25	12	**37**
R16/104	STUDY/BEDROOM	W19/104	24.93	2.39	**2.39**		29	12	**41**
R17/104	COMMUNAL_KITCHEN	W20/104	26.54	2.75			24	9	**33**
R17/104	COMMUNAL_KITCHEN	W55/104	37.18	3.60	**6.35**				
R18/104	STUDY/BEDROOM	W21/104	30.54	2.76	**2.76**		31	13	**44**
R19/104	STUDY/BEDROOM	W22/104	31.24	2.82	**2.82**		31	13	**44**
R20/104	STUDY/BEDROOM	W23/104	32.73	2.92	**2.92**		31	13	**44**
R21/104	STUDY/BEDROOM	W24/104	33.22	2.95	**2.95**		31	15	**46**
R22/104	STUDY/BEDROOM	W25/104	34.21	3.04	**3.04**		31	15	**46**
R23/104	STUDY/BEDROOM	W26/104	34.27	3.03	**3.03**		31	14	**45**
R24/104	STUDY/BEDROOM	W27/104	33.60	2.98	**2.98**		33	12	**45**
R25/104	COMMUNAL_KITCHEN	W28/104	29.05	3.01			31	3	**34**

Room	Roomuse	Window	VSC(%)	ADF(%)	TOTAL ADF(%)	Summer %	Winter %	Total %
R25/104	COMMUNAL_KITCHEN	W47/104	37.49	3.71	**6.72**			
R26/104	STUDIO	W29/104	24.93	3.02	**3.02**			
R27/104	STUDIO	W30/104	28.55	3.33	**3.33**			
R28/104	STUDIO	W31/104	29.44	3.42	**3.42**			
R29/104	STUDIO	W32/104	30.06	3.48	**3.48**			
R30/104	STUDIO	W33/104	30.16	1.63				
R30/104	STUDIO	W34/104	37.61	1.98	**3.60**	29	10	**39**
R31/104	STUDIO	W35/104	38.33	2.09		29	10	**39**
R31/104	STUDIO	W36/104	39.62	2.12	**4.21**	36	25	**61**
R32/104	STUDIO	W37/104	39.62	2.12	**2.12**	36	25	**61**
R33/104	STUDIO	W38/104	39.62	2.13	**2.13**	36	25	**61**
R34/104	STUDIO	W39/104	39.62	2.12	**2.12**	36	25	**61**
R35/104	COMMUNAL_KITCHEN	W40/104	37.77	4.69	**4.69**	41	28	**69**
R36/104	STUDY/BEDROOM	W41/104	39.62	3.07	**3.07**	36	25	**61**
R37/104	STUDY/BEDROOM	W42/104	39.62	3.09	**3.09**	36	25	**61**
R38/104	STUDY/BEDROOM	W43/104	39.62	3.10	**3.10**	36	25	**61**
R39/104	STUDY/BEDROOM	W44/104	39.62	3.02	**3.02**	35	25	**60**
R40/104	STUDY/BEDROOM	W45/104	39.62	3.08	**3.08**			
R41/104	STUDY/BEDROOM	W46/104	39.62	3.08	**3.08**			
R42/104	STUDY/BEDROOM	W48/104	39.62	3.07	**3.07**			
R43/104	STUDY/BEDROOM	W49/104	39.62	3.07	**3.07**			
R44/104	STUDY/BEDROOM	W50/104	39.62	3.08	**3.08**			
R45/104	STUDY/BEDROOM	W51/104	39.62	3.07	**3.07**			
R46/104	STUDY/BEDROOM	W52/104	39.62	3.08	**3.08**			
R47/104	STUDY/BEDROOM	W53/104	39.62	3.07	**3.07**			
R48/104	STUDY/BEDROOM	W54/104	39.62	3.08	**3.08**			
R49/104	STUDY/BEDROOM	W56/104	39.62	3.07	**3.07**			
R50/104	STUDY/BEDROOM	W57/104	39.62	3.08	**3.08**			
R51/104	STUDY/BEDROOM	W58/104	39.62	3.07	**3.07**			
R52/104	STUDY/BEDROOM	W59/104	39.62	3.08	**3.08**			
R53/104	STUDY/BEDROOM	W60/104	39.62	3.07	**3.07**			
R54/104	COMMUNAL_KITCHEN	W61/104	39.62	1.17				
R54/104	COMMUNAL_KITCHEN	W62/104	39.62	2.25				
R54/104	COMMUNAL_KITCHEN	W63/104	39.62	2.91				
R54/104	COMMUNAL_KITCHEN	W64/104	39.35	2.50				
R54/104	COMMUNAL_KITCHEN	W65/104	39.35	1.16				
R54/104	COMMUNAL_KITCHEN	W66/104	39.34	0.31	**10.31**			
R55/104	DISABLED_STUDY/BEDROOM	W67/104	39.34	1.08				
R55/104	DISABLED_STUDY/BEDROOM	W68/104	39.32	1.36				
R55/104	DISABLED_STUDY/BEDROOM	W69/104	39.32	1.48	**3.92**			
R56/104	COMMUNAL_KITCHEN	W70/104	39.30	1.80				
R56/104	COMMUNAL_KITCHEN	W71/104	37.19	4.17	**5.96**			
R57/104	STUDY/BEDROOM	W72/104	39.24	3.05	**3.05**			
R58/104	STUDY/BEDROOM	W73/104	39.22	3.07	**3.07**			
R59/104	STUDY/BEDROOM	W74/104	39.20	3.05	**3.05**			
R60/104	STUDY/BEDROOM	W75/104	39.17	3.06	**3.06**			

Room	Roomuse	Window	VSC(%)	ADF(%)	TOTAL ADF(%)		Summer %	Winter %	Total %
R61/104	STUDY/BEDROOM	W76/104	39.14	3.03	**3.03**				
R62/104	STUDY/BEDROOM	W77/104	39.10	3.06	**3.06**				
R63/104	STUDY/BEDROOM	W78/104	39.07	3.03	**3.03**				
R64/104	STUDY/BEDROOM	W79/104	39.02	3.05	**3.05**				
R65/104	STUDY/BEDROOM	W80/104	38.98	3.03	**3.03**				
R66/104	COMMUNAL_KITCHEN	W81/104	38.89	2.15					
R66/104	COMMUNAL_KITCHEN	W82/104	38.53	3.27	**5.43**		30	15	**45**
R67/104	DISABLED_STUDY/BEDROOM	W83/104	38.58	1.74	**1.74**		35	15	**50**
R68/104	STUDY/BEDROOM	W84/104	38.61	3.39	**3.39**		35	15	**50**
R69/104	STUDY/BEDROOM	W85/104	38.62	3.40	**3.40**		35	15	**50**
R70/104	STUDY/BEDROOM	W86/104	38.64	3.32	**3.32**		35	15	**50**
R71/104	STUDY/BEDROOM	W87/104	38.66	3.39	**3.39**		35	15	**50**
R1/105	COMMUNAL_KITCHEN	W1/105	39.44	0.30			20	17	**37**
R1/105	COMMUNAL_KITCHEN	W2/105	39.35	2.28			48	28	**76**
R1/105	COMMUNAL_KITCHEN	W3/105	33.80	1.88	**4.46**				
R2/105	STUDY/BEDROOM	W4/105	32.97	2.65	**2.65**				
R3/105	STUDY/BEDROOM	W5/105	31.81	2.58	**2.58**				
R4/105	STUDY/BEDROOM	W6/105	31.10	2.56	**2.56**				
R5/105	STUDY/BEDROOM	W7/105	27.76	2.39	**2.39**				
R6/105	STUDY/BEDROOM	W8/105	25.08	2.22	**2.22**		27	11	**38**
R7/105	STUDY/BEDROOM	W9/105	31.74	2.64	**2.64**		37	15	**52**
R8/105	STUDY/BEDROOM	W10/105	32.74	2.76	**2.76**		38	19	**57**
R9/105	STUDY/BEDROOM	W11/105	32.99	2.79	**2.79**		37	20	**57**
R10/105	STUDY/BEDROOM	W12/105	32.48	2.75	**2.75**		33	20	**53**
R11/105	STUDY/BEDROOM	W13/105	29.53	2.32	**2.32**		29	20	**49**
R12/105	STUDY/BEDROOM	W14/105	27.46	2.42	**2.42**		25	19	**44**
R13/105	DISABLED_STUDY/BEDROOM	W15/105	22.49	1.07			19	16	**35**
R13/105	DISABLED_STUDY/BEDROOM	W16/105	14.54	1.33	**2.39**		14	13	**27**
R14/105	STUDY/BEDROOM	W17/105	15.18	1.75	**1.75**		21	12	**33**
R15/105	STUDY/BEDROOM	W18/105	25.85	2.45	**2.45**		28	13	**41**
R16/105	STUDY/BEDROOM	W19/105	28.53	2.63	**2.63**		29	13	**42**
R17/105	COMMUNAL_KITCHEN	W20/105	30.64	3.06			26	10	**36**
R17/105	COMMUNAL_KITCHEN	W33/105	37.49	3.63	**6.69**				
R18/105	STUDY/BEDROOM	W21/105	33.80	3.00	**3.00**		33	14	**47**
R19/105	STUDY/BEDROOM	W22/105	35.05	3.10	**3.10**		33	14	**47**
R20/105	STUDY/BEDROOM	W23/105	35.47	3.12	**3.12**		33	14	**47**
R21/105	STUDY/BEDROOM	W24/105	36.26	3.18	**3.18**		33	15	**48**
R22/105	STUDIO	W25/105	36.91	2.25	**2.25**		33	15	**48**
R23/105	STUDIO	W26/105	37.58	2.16	**2.16**		34	15	**49**
R24/105	STUDIO	W27/105	39.62	2.00	**2.00**				
R25/105	STUDIO	W28/105	39.62	2.09	**2.09**				
R26/105	STUDY/BEDROOM	W29/105	39.62	3.07	**3.07**				
R27/105	STUDY/BEDROOM	W30/105	39.62	3.08	**3.08**				

Room	Roomuse	Window	VSC(%)	ADF(%)	TOTAL ADF(%)		Summer %	Winter %	Total %
R28/105	STUDY/BEDROOM	W31/105	39.62	3.07	**3.07**				
R29/105	STUDY/BEDROOM	W32/105	39.62	3.08	**3.08**				
R30/105	STUDY/BEDROOM	W34/105	39.62	3.07	**3.07**				
R31/105	STUDY/BEDROOM	W35/105	39.62	3.08	**3.08**				
R32/105	STUDY/BEDROOM	W36/105	39.62	3.07	**3.07**				
R33/105	STUDY/BEDROOM	W37/105	39.62	3.08	**3.08**				
R34/105	STUDY/BEDROOM	W38/105	39.62	3.07	**3.07**				
R35/105	COMMUNAL_KITCHEN	W39/105	39.62	2.31					
R35/105	COMMUNAL_KITCHEN	W40/105	39.62	2.25					
R35/105	COMMUNAL_KITCHEN	W41/105	39.62	1.80					
R35/105	COMMUNAL_KITCHEN	W42/105	39.48	0.41					
R35/105	COMMUNAL_KITCHEN	W43/105	39.47	1.44					
R35/105	COMMUNAL_KITCHEN	W44/105	39.47	2.07	**10.28**				
R36/105	DISABLED_STUDY/BEDROOM	W45/105	39.46	1.09					
R36/105	DISABLED_STUDY/BEDROOM	W46/105	39.46	3.66	**4.75**				
R37/105	COMMUNAL_KITCHEN	W47/105	39.45	1.42					
R37/105	COMMUNAL_KITCHEN	W48/105	37.40	4.19	**5.61**				
R38/105	STUDY/BEDROOM	W49/105	39.42	3.06	**3.06**				
R39/105	STUDY/BEDROOM	W50/105	39.41	3.08	**3.08**				
R40/105	STUDY/BEDROOM	W51/105	39.40	3.06	**3.06**				
R41/105	STUDY/BEDROOM	W52/105	39.38	3.08	**3.08**				
R42/105	STUDY/BEDROOM	W53/105	39.37	3.05	**3.05**				
R43/105	STUDY/BEDROOM	W54/105	39.36	3.04	**3.04**				
R44/105	STUDY/BEDROOM	W55/105	39.34	3.05	**3.05**				
R45/105	STUDY/BEDROOM	W56/105	39.32	3.07	**3.07**				
R46/105	STUDY/BEDROOM	W57/105	39.30	3.05	**3.05**				
R47/105	COMMUNAL_KITCHEN	W58/105	39.26	2.16					
R47/105	COMMUNAL_KITCHEN	W59/105	39.09	3.32	**5.48**		30	15	**45**
R48/105	DISABLED_STUDY/BEDROOM	W60/105	39.10	1.77	**1.77**		35	15	**50**
R49/105	STUDY/BEDROOM	W61/105	39.11	3.44	**3.44**		35	15	**50**
R50/105	STUDY/BEDROOM	W62/105	39.13	3.45	**3.45**		35	15	**50**
R51/105	STUDY/BEDROOM	W63/105	39.12	3.37	**3.37**		35	15	**50**
R52/105	STUDY/BEDROOM	W64/105	39.13	3.43	**3.43**		35	15	**50**
R1/106	COMMUNAL_KITCHEN	W1/106	39.57	0.30			20	17	**37**
R1/106	COMMUNAL_KITCHEN	W2/106	39.52	2.29			48	28	**76**
R1/106	COMMUNAL_KITCHEN	W3/106	36.64	2.01	**4.60**				
R2/106	STUDY/BEDROOM	W4/106	36.01	2.79	**2.79**				
R3/106	STUDY/BEDROOM	W5/106	35.73	2.81	**2.81**				
R4/106	STUDY/BEDROOM	W6/106	34.86	2.78	**2.78**				
R5/106	STUDY/BEDROOM	W7/106	34.18	2.74	**2.74**				
R6/106	STUDY/BEDROOM	W8/106	33.08	2.66	**2.66**		37	17	**54**
R7/106	STUDY/BEDROOM	W9/106	35.44	2.82	**2.82**		37	22	**59**
R8/106	STUDY/BEDROOM	W10/106	36.71	2.97	**2.97**		38	23	**61**
R9/106	STUDY/BEDROOM	W11/106	36.61	2.98	**2.98**		38	23	**61**
R10/106	STUDY/BEDROOM	W12/106	35.38	2.90	**2.90**		34	22	**56**

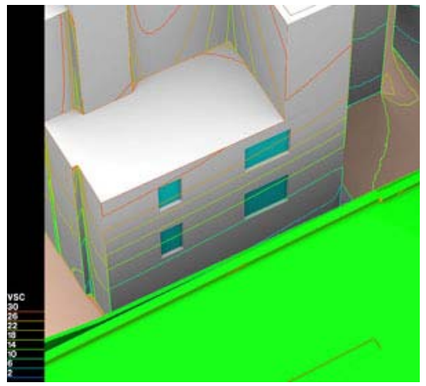
Room	Roomuse	Window	VSC(%)	ADF(%)	TOTAL ADF(%)	Summer %	Winter %	Total %
R11/106	STUDY/BEDROOM	W13/106	34.25	2.83	**2.83**	32	22	**54**
R12/106	STUDY/BEDROOM	W14/106	28.84	2.48	**2.48**	25	19	**44**
R13/106	DISABLED_STUDY/BEDROOM	W15/106	23.01	1.08		18	17	**35**
R13/106	DISABLED_STUDY/BEDROOM	W16/106	15.28	1.36	**2.44**	14	13	**27**
R14/106	STUDY/BEDROOM	W17/106	26.32	2.49	**2.49**	27	14	**41**
R15/106	STUDY/BEDROOM	W18/106	31.56	2.84	**2.84**	29	15	**44**
R16/106	STUDY/BEDROOM	W19/106	35.72	3.15	**3.15**	34	15	**49**
R17/106	COMMUNAL_KITCHEN	W20/106	35.02	3.42		33	12	**45**
R17/106	COMMUNAL_KITCHEN	W25/106	38.69	3.79	**7.20**			
R18/106	STUDY/BEDROOM	W21/106	37.52	3.30	**3.30**	35	15	**50**
R19/106	STUDY/BEDROOM	W22/106	37.71	3.32	**3.32**	35	15	**50**
R20/106	STUDY/BEDROOM	W23/106	38.11	3.35	**3.35**	35	15	**50**
R21/106	STUDY/BEDROOM	W24/106	38.25	3.35	**3.35**	35	15	**50**
R22/106	STUDY/BEDROOM	W26/106	39.62	3.07	**3.07**			
R23/106	STUDY/BEDROOM	W27/106	39.62	3.08	**3.08**			
R24/106	STUDY/BEDROOM	W28/106	39.62	3.07	**3.07**			
R25/106	STUDY/BEDROOM	W29/106	39.62	3.08	**3.08**			
R26/106	STUDY/BEDROOM	W30/106	39.62	3.07	**3.07**			
R27/106	COMMUNAL_KITCHEN	W31/106	39.62	1.17				
R27/106	COMMUNAL_KITCHEN	W32/106	39.62	2.25				
R27/106	COMMUNAL_KITCHEN	W33/106	39.62	2.91				
R27/106	COMMUNAL_KITCHEN	W34/106	39.58	1.42				
R27/106	COMMUNAL_KITCHEN	W35/106	39.58	2.25				
R27/106	COMMUNAL_KITCHEN	W36/106	39.58	0.31	**10.32**			
R28/106	DISABLED_STUDY/BEDROOM	W37/106	39.58	1.09				
R28/106	DISABLED_STUDY/BEDROOM	W38/106	39.58	1.37				
R28/106	DISABLED_STUDY/BEDROOM	W39/106	39.58	1.48	**3.93**			
R29/106	COMMUNAL_KITCHEN	W40/106	39.58	1.61				
R29/106	COMMUNAL_KITCHEN	W41/106	38.03	4.27	**5.88**			
R30/106	STUDY/BEDROOM	W42/106	39.57	3.07	**3.07**			
R31/106	STUDY/BEDROOM	W43/106	39.57	3.09	**3.09**			
R32/106	STUDY/BEDROOM	W44/106	39.57	3.07	**3.07**			
R33/106	STUDY/BEDROOM	W45/106	39.57	3.04	**3.04**			
R34/106	STUDY/BEDROOM	W46/106	39.57	3.06	**3.06**			
R35/106	STUDY/BEDROOM	W47/106	39.57	3.05	**3.05**			
R36/106	STUDY/BEDROOM	W48/106	39.57	3.06	**3.06**			
R37/106	STUDY/BEDROOM	W49/106	39.57	3.11	**3.11**			
R38/106	STUDY/BEDROOM	W50/106	39.57	3.02	**3.02**			
R39/106	COMMUNAL_KITCHEN	W51/106	39.56	2.19				
R39/106	COMMUNAL_KITCHEN	W52/106	39.54	3.36	**5.55**	30	15	**45**
R40/106	DISABLED_STUDY/BEDROOM	W53/106	39.53	1.79	**1.79**	35	15	**50**
R41/106	STUDY/BEDROOM	W54/106	39.53	3.44	**3.44**	35	15	**50**
R42/106	STUDY/BEDROOM	W55/106	39.52	3.49	**3.49**	35	15	**50**
R43/106	STUDY/BEDROOM	W56/106	39.53	3.41	**3.41**	35	15	**50**
R44/106	STUDY/BEDROOM	W57/106	39.53	3.47	**3.47**	35	15	**50**

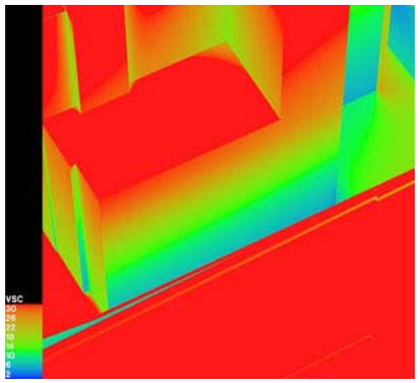
Appendix B

Vertical Sky Component (1)

WATERSLADE
5 Thames Street, Eynsham, Oxford, OX29 4HF
t: 01865 881882 f: 01865 881891 @: www.waterslade.com

The Vertical Sky Component is a measure of the amount of skylight incident on a vertical plane (i.e. the sky factor on a Vertical Plane). It is most commonly applied to the light incident at the centre of a window and in this sense is a measure of the potential for good daylighting. The VSC is calculated by taking the ratio of the skylight incident at a point to the unobstructed skylight available on a horizontal plane. For a uniform sky, the maximum value is 50% (since the point is on a vertical plane, clearly only the half of the hemisphere which is in front of the plane can contribute). For a CIE sky, the maximum value is 39.6%.





Clearly in this case, the further down the windows are, the less light they receive, and therefore the lower the value of the VSC.

BRE Criterion

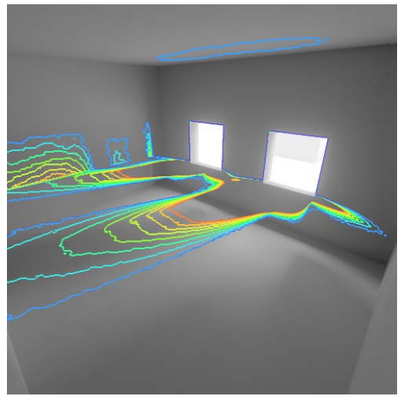
The guidelines state that if the VSC at the centre of a window is less than 27% and less than 0.8 times its former value, the diffuse daylighting of the existing building will be adversely affected. A value of 27% corresponds to an obstruction angle of 25 degrees over an infinite extent in plan.

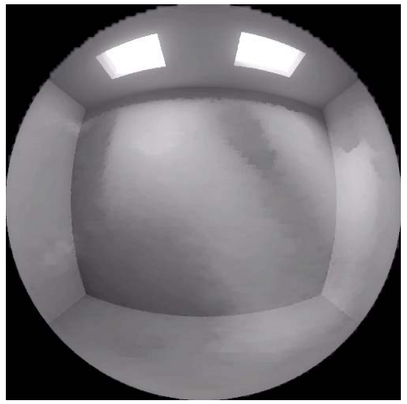
This guideline (as with all the BRE guidelines) can be interpreted flexibly. The above criterion was developed in the case of suburban development where existing development was 2 storeys across an average street width. In city centre locations, the target VSC can be reduced to allow proposed buildings to match the height of other buildings in the neighbourhood.

Average Daylight Factor (1)

WATERSLADE
5 Thames Street, Eynsham, Oxford, OX29 4HF
t: 01865 881882 f: 01865 881891 @: www.waterslade.com

The Average Daylight Factor (ADF) is a measure of interior daylight. It can be used to establish whether a room will have a predominantly daylit appearance and if not, it can provide levels below which a room should not fall even if supplementary electric lighting is provided.





ADF values can be calculated for rooms within a proposed development, and checked against the recommended value. Existing and Proposed ADF values can also be calculated for properties which overlook a site.

Factors on which the ADF depend are: VSC at the face of each window, the Total Window Area, Total Wall Area, Wall Reflectivity and Window Transmission.

There are no specific BRE criteria for reduction in ADF if a proposed development were to be implemented, but since the ADF is related to the VSC via the obstruction angle, a reduction in VSC leads to a reduction in ADF.

BRE Criterion

The BRE states that for a predominantly daylit appearance the ADF should be 5% or more if there is no supplementary electric lighting, or 2% or more if there is supplementary electric lighting. There are additional recommendations for dwellings. These are

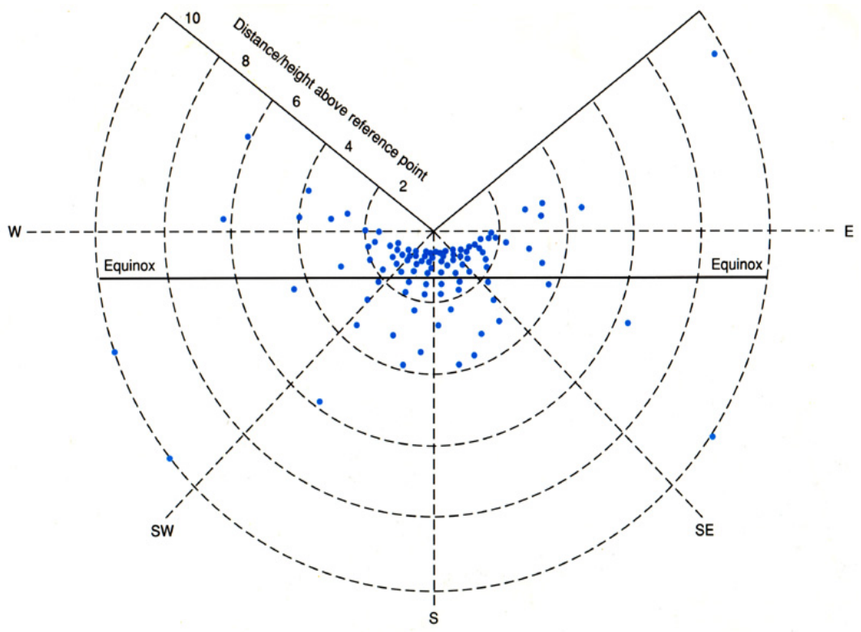
- 2.0% - Kitchens
- 1.5% - Living Rooms
- 1.0% - Bedrooms

These figures are also recommended in BS 8206 Part 2 1992 entitled 'Code of Practice for Daylighting'.

Sunlight Availability

WATERSLADE
5 Thames Street, Eynsham, Oxford, OX29 4HF
t: 01865 881882 f: 01865 881891 @: www.waterslade.com

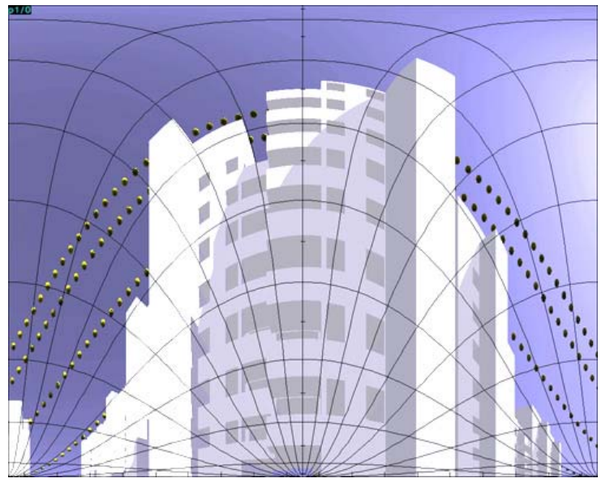
Sunlight Availability is a measure of the average number of hours of sunlight one would expect to receive at a given position, as a fraction of the unobstructed total number of hours at the same location. The BRE have compiled data sets consisting of a statistical sample of solar positions convolved with local meteorological data. Using these to calculate Sunlight Availability, one would simply calculate the number of solar positions visible from a point, compared to the total number, expressed as a percentage. The diagram below, taken from the BRE report, shows the solar positions, relative to a reference point, used to calculate Sunlight Availability for London (51.5°N).



The BRE report states that for windows within a new development, if a point at the centre of a window on the plane of the inside surface of the wall "...*can receive more than one quarter of annual probable sunlight hours, including at least 5% of annual probable hours during the winter months between 21st September and 21st March, then the room should still receive enough sunlight."*

For windows in surrounding properties which experience a change in sulight availability, it goes on to say that, "*Any reduction in sunlight access below this level should be kept to a minimum. If the available sunlight hours are both less than the amount given and less than 0.8 times their former value, either over the whole year or just during the winter months, then the occupants will notice the loss of sunlight."*

Subjective Assessment



It is often useful to visualise solar paths as viewed from a particular position. The above example shows solar paths plotted onto a Waldram Diagram. This provides a snapshot of times and dates showing when a window will receive direct sunlight. It also shows which part of a building is responsible for causing a shadow. Another method of subjective assessment involves producing shadow animations to compare the existing and proposed scenarios.

No-Sky Line (1)

The No-Sky Line is a measure of the impact of development on the daylight distribution in a room. The No-Sky Line can be determined by examining a grid of points on the working plane of the room. Those from which the sky is visible lie within the No-Sky Line, and those from which it is not, lie outside. For a fine enough grid, the boundary between the two is the No-Sky Line. The BRE state that for residential properties, the working plane is to be taken at 850mm above floor level, and for commercial properties, 700mm above floor level.

The BRE state the following for the criterion to be used in comparing the No-Sky Line for the existing buildings with that for proposed development:

'*If, following construction of a new development, the no-sky line moves so that the area of the existing room which does receive direct skylight is reduced to less than 0.8 times its former value, then this will be noticeable to the occupants, and more of the room will appear poorly lit. This is also true if the no-sky line encroaches on key areas like kitchen sinks and worktops.'*

The BRE guide goes on to state that the guidelines need to be applied sensibly and flexibly. For instance, there is no point designing a proposed scheme with tiny gaps in it in order to safeguard the No-Sky line.

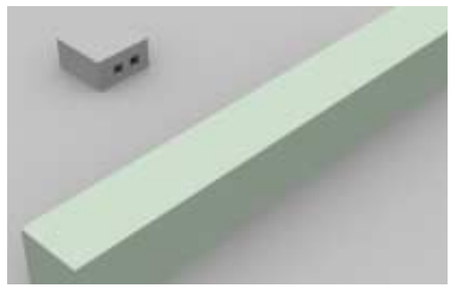
The above highlights a potential weakness in the method—in principle a point lies within the No-Sky Line no matter how small a patch of sky it can see—even if for instance there is only a keyhole allowing light in to the room. Clearly the method is intended to map out areas within a room which receive a significant amount of direct daylight from the sky, so that it would be better if a small but finite amount of direct daylight were used to divide the two regions. This would also reduce the tendency for the No-Sky Line position to vary wildly at the rear of a room, rather like when small variations in tidal height cause the tide line to move by large distances on a virtually level beach.

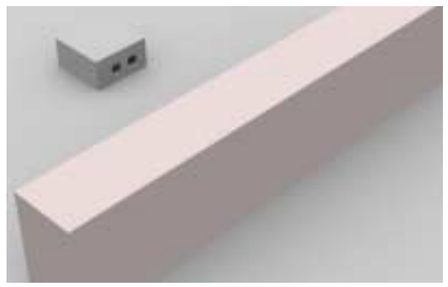
That said, the No-Sky line takes into account multiple windows serving the same room, which the VSC criterion does not. It also takes account of the size of the windows, and the size and layout of the room being served by the window(s). These two factors are also not accounted for in a VSC analysis.

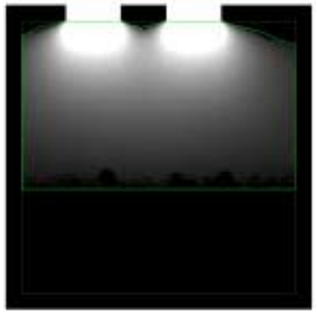
WATERSLADE
1 Ashurst Court, London Road, Wheatley, Oxford OX33 1ER
t: 01865 875800 f: 01865 875000 @: www.waterslade.com

VSC and No-Sky Line are in a sense complementary. VSC is a measure of the potential for good daylighting—does the front face of a window receive adequate daylight and by how much is it reduced? No-Sky Line on the other hand, by examining what happens to daylight when it enters a room through the windows serving it, attempts to answer the question, how is the daylight and its distribution impacted within a room?

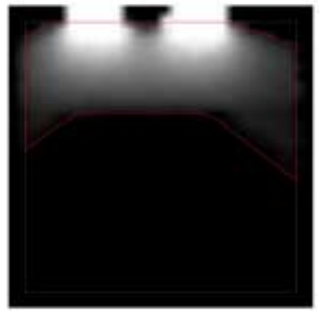
Simple Example







EXISTING



PROPOSED

In the example above, we show a room served by 2 windows, in front of which a two storey building is having an additional storey added. The area of the room is 25 sq m, the area enclosed by the existing No-Sky Line is 15 sq m, and that enclosed by the proposed No-Sky Line is 9.4 sq m. The proposed area is 0.63 times its former value (37% reduction), and therefore this room would fail the BRE No-Sky Line test.