Waterman Moylan
Engineering Consultants

EXTERNAL LIGHTING ANALYSIS
for
Farrankelly Development

Greystones, Co. Wicklow

August 2019

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Contents

1. Introduction 6

2. Standards & Design Criteria 7

2.1 Lighting Standards & Design Guides 7

2.2 General Design Criteria 7

2.2.1 Design Criteria related to Bats & Other Wildlife 7

2.2.2 General Recommendations for Lighting Design 7

3. Design Response & Mitigation Measures 9

3.1 Specific Mitigation Measures 9

4. Proposed Installation 10

4.1 Light Fitting Selections 10

4.2 Typical Lighting Results 12

5. Conclusion. 14

Appendix A – Lighting Calculations Report 15

1. Introduction

Waterman Moylan have been appointed by Cairn Homes to conduct an analysis of the external lighting designs for the proposed development at Farrankelly. The proposed development will consist of the construction of a residential development of 426 no. dwellings, a creche, a residential amenity building, active open space and a greenway pedestrian walkway.

This report outlines the design intent and considerations to be taken into account with regards to the lighting designs for the proposed Greenway pedestrian route and the general public lighting within the proposed development. Particular attention will be given to how the Greenway lighting designs have been tailored to minimise obtrusive light spill and to mitigate impacts on bats and other wildlife.

The report considers the lighting design provided by Sabre Electrical which has been developed with the following principal considerations:

- To preserve residential amenity of neighbouring properties and the impact of lighting on the bat's natural habitat.
- Provide adequate illumination to contribute towards the safe use of the green walkway and general public walkways.
- Contain the lighting within the site and minimise light pollution and visual glare.

The complete external lighting installation has been designed in accordance with the regulations for electrical services as ETCI National Rules for Electrical Installations ET101:2008 as well Bat Conservation Ireland (BCI) guidelines. These design criteria are outlined in Section 2.0.

Section 3 of the report details the design methodology and the specific mitigation measures that have been implemented in the design and Section 4 describes the specific light fittings proposed and the results that have been achieved by the lighting design

2. Standards & Design Criteria

2.1 Lighting Standards & Design Guides

The lighting design for the Greenway and for the public lighting is based on best practice and more importantly National & International Industry Standards, incorporating the following:

- ETCI National Rules for Electrical Installations ET101:2008 plus amendments
- Bat Conservation Ireland (BCI) guidelines
- Guide to Obtrusive lighting, The ILE guidance Notes on reduction of Obtrusive Light and CIE.
- The Institution of Lighting Professionals (ILP) and the Bat Conservation Trust Guidance note 08/18 - Bats and artificial lighting in the UK. Bats and the Built Environment series.

2.2 General Design Criteria

The lighting design parameters proposed for the development are as follows

The Public Lighting (estate roads & car parking) require 5 lux

The Greenway Pedestrian Route will require 3 lux

2.2.1 Design Criteria related to Bats & Other Wildlife

A Bat Survey was conducted by Dr Tina Aughney of Bat Eco Services (ecological consultants) on the Farrankelly site, Co. Wicklow. The findings of the report refer to bat usage of this proposed development site and the potential impact of lighting on the site.

The brief for the lighting design is to mitigate the impact of lighting on the bats natural habitat by reducing light spill from the roads, paths and carpark areas and to conform to Bat Conservation Ireland (BCI) guidelines.

2.2.2 General Recommendations for Lighting Design

The report produced on foot of the Bat Survey makes the following recommendations in relation to the design of the external lighting.

(a) *Artificial lights shining on bat roosts, their access points and the flight paths away from the roost must always be avoided. This includes alternative roosting sites such as bat boxes.*

(b) *Lighting design should be flexible and be able to fully take into account the presence of protected species. Therefore, appropriate lighting should be used within a proposed development and adjacent areas with more sensitive lighting regimes deployed in wildlife sensitive areas.*

(c) *Dark buffer zones can be used as a good way to separate habitats or features from lighting by forming a dark perimeter around them. This could be used for habitat features noted as foraging areas for bats.*

(d) *Buffer zones can be used to protect Dark buffer zones and rely on ensuring light levels (levels of illuminance measured in lux) within a certain distance of a feature do not exceed*

certain defined limits. The buffer zone can be further subdivided in to zones of increasing illuminance limit radiating away from the feature or habitat that requires to be protected.

(e) Luminaire design is extremely important to achieve an appropriate lighting regime. Luminaires come in a myriad of different styles, applications and specifications which a lighting professional can help to select.

3. Design Response & Mitigation Measures

It is intended to utilise best international practice in controlling obtrusive light in the specified outdoor playing fields and carpark area and ancillary landscape area.

The brief for the lighting design emanating from the Bat Survey conducted by Dr Tina Aughney of Bat Eco Services is to mitigate the impact of lighting on the bats natural habitat by reducing light spill from the development and BCI and to conform to Bat Conservation Ireland (BCI) guidelines.

Sabre Electrical Services have conducted light level calculations for the entire site and the required type, quantity and location of the light fittings was identified. Details of these designs and of the resulting light levels within the target design areas and surrounding areas are presented in Appendix A.

The proposed lighting scheme has been specifically designed to take account of the issues raised in the Bat Survey Report and the recommended limitations on obtrusive light are adhered to.

3.1 Specific Mitigation Measures

In response to the Bat Survey Report the following mitigation measures have been included in the design

- The design will seek to provide only the minimum required lux levels, (5 lux on public roads & pedestrian routes and 3 lux on greenway pedestrian routes) ensuring no excessive lighting levels are provided.

- Column heights, positions and the luminaire photometry have been carefully selected for each area of the site. 6m columns have been selected for general public lighting, 5m columns for pedestrian routes outside the woodland area and 4m columns for pedestrian routes in the most sensitive woodland zones.

- Market leading LED light fittings have been selected to provide the required lux levels in all areas LED light emitters have excellent directional properties and the fittings selected will provide warm white lighting with a colour temperature of 3000 Kelvin and will have peak wavelengths of 610nm in accordance with the recommendations made in the bat report.

- Where lighting is provided in areas that are close to wildlife habitats, rear louvres will be fitted to reduce rearward light spill.

- The LED fittings will be positioned with a 5 degree tilt which will reduce backward light spill while still delivering virtually zero upward light spill.

- The footpaths in the woodland section we have designed to BS5489-1:2013 category P5 with 4m columns, delivering an average illuminance of only 3 lux with the fittings dimmed to 55% to achieve this reduced lighting level. The luminaires on these footpaths will also be fitted with front and rear louvres to further minimise light spill while still delivering the required lighting levels.

- An advanced, intelligent lighting control system will be provided for all light fittings on the greenway. This will feature PIR control on each light fitting to detect pedestrians and cyclists on the pathways. Each PIR detector will then be networked to adjacent lighting columns to bring a series of lights at once. This system ensures safe light levels for all users of the paths while ensure that the lights will only be on when needed thereby greatly mitigating the impact on bats in this area.

4. Proposed Installation

4.1 Light Fitting Selections

The fittings proposed for the development are as follows:

Luminaire A Data

Supplier	Urbis-Schreder
Type	AXIA 2.1 5166 - 16 NVSL219CT 390mA W W 230V Integrated lenses
Lamp(s)	16 NVSL219CT 390mA_WW
LampFlux(klm)/Colour	2.38 WW 3000K/80
File Name	AXIA 2_1 5166 16 NVSL219CT 390mA W W 21W 383322 Integrated lenses - 230V 2...
Maintenance Factor	0.83
Imax70,80,90(cd/klm)	1056.5, 197.6, 0.0
No. in Project	68

Luminaire B Data

Supplier	Urbis-Schreder
Type	AXIA 2.1 5166 [[see details], PC, Black], [Integrated lenses]
Lamp(s)	16 NVSL219CT@390mA WW830 230V 00-14-560
LampFlux(klm)/Colour	1.93 WW 3000K/80
File Name	AXIA 2.1 5166 16 NVSL219CT 390mA WW 830 21W 392782 [[see details], PC, Black], ...
Maintenance Factor	0.83
Imax70,80,90(cd/klm)	1141.2, 252.7, 0.0
No. in Project	28

Figure 4.1 – Proposed Fittings for General Public Lighting on estate roads

Luminaire C Data

Supplier	Urbis-Schreder
Type	AXIA 2.1 5165 [[see details], PC, Black], [Integrated lenses]
Lamp(s)	4 NVSL219CT@680mA WW830 230V 00-25-501
LampFlux(klm)/Colour	0.77 WW 3000K/80
File Name	AXIA 2.1 5165 4 NVSL219CT 680mA WW830 10W 392272 [[see details], PC, Black], [...
Maintenance Factor	0.83
Imax70,80,90(cd/klm)	1166.5, 203.2, 0.0
No. in Project	28

Figure 4.2 – Proposed Fittings for pedestrian routes outside of woodland areas

Luminaire D Data

Supplier	Urbis-Schreder
Type	AXIA 2.1 5165 [[see details], PC, Black], [Integrated lenses]
Lamp(s)	4 NVSL219CT@680mA WW830 230V 00-25-501
LampFlux(klm)/Colour	0.52 WW 3000K/80
File Name	AXIA 2.1 5165 4 NVSL219CT 680mA WW830 10W 392292 [[see details], PC, Black], [...
Maintenance Factor	0.83
Imax70,80,90(cd/klm)	1364.3, 154.1, 0.0
No. in Project	38

Figure 4.3 – Proposed Fittings for pedestrian routes in woodland areas

Luminaire E Data

Supplier	Urbis-Schreder
Type	PILZEO: (335442) Lum. shape-related PC Smooth (Lexan SLX 227
Lamp(s)	16 XP-G2 500mA NW [150lm - 350mA]
Lamp Flux (klm)	3.19
File Name	PILZEO 5068 16 LED 500mA NW Lum. shape-related PC Smooth335442 EF.ldt
Maintenance Factor	0.83
Imax70,80,90(cd/klm)	354.2, 233.3, 21.0
No. in Project	24

Figure 4.4 – Proposed Fittings for public open space

4.2 Typical Lighting Results

Typical results from the lighting design are provided below. A full report on the design of the lighting is provided in Appendix A and the overall lighting plan for the site is as indicated on the Sabre Electrical Services Drawing, drawing reference SES09319.

Figures 4.5 & 4.6 show the lighting design on a typical residential streets within the scheme and also demonstrates how rearward light spill is minimised. Figures 4.7 & 4.8 demonstrate how the lighting design on the greenway provides adequate lux levels longitudinally on the path with minimal light spill into the surrounding woodland.

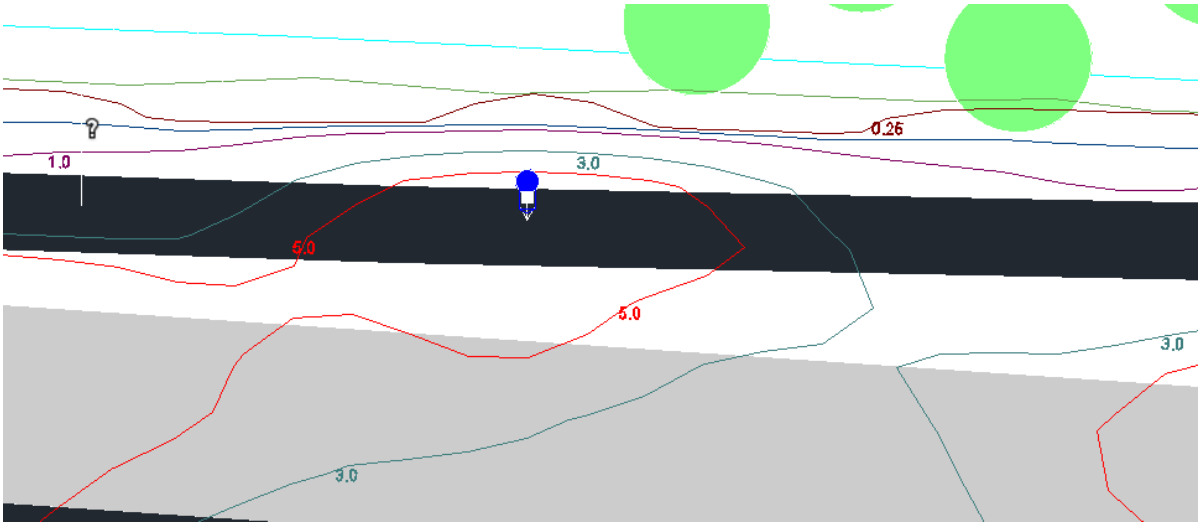

Figure 4.5 – Typical lighting results for estate roads with minimal rearward light spill

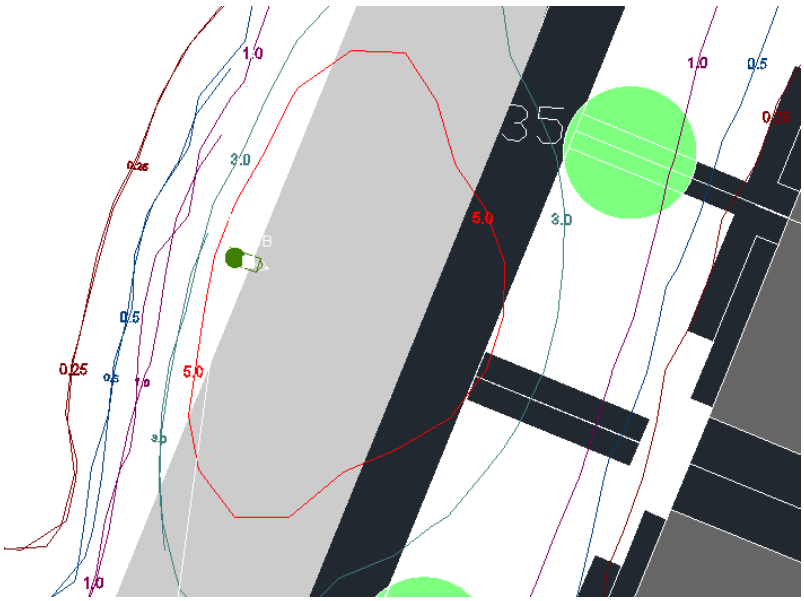

Figure 4.6 – Typical lighting results for estate roads with minimal rearward light spill

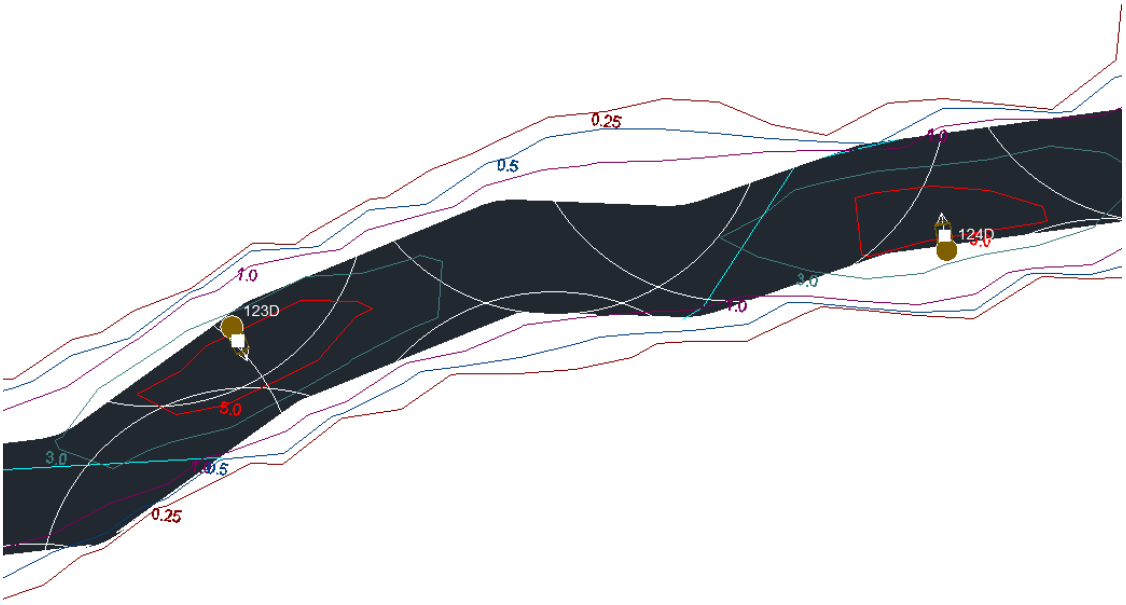

Figure 4.7 – Typical lighting results for Greenway

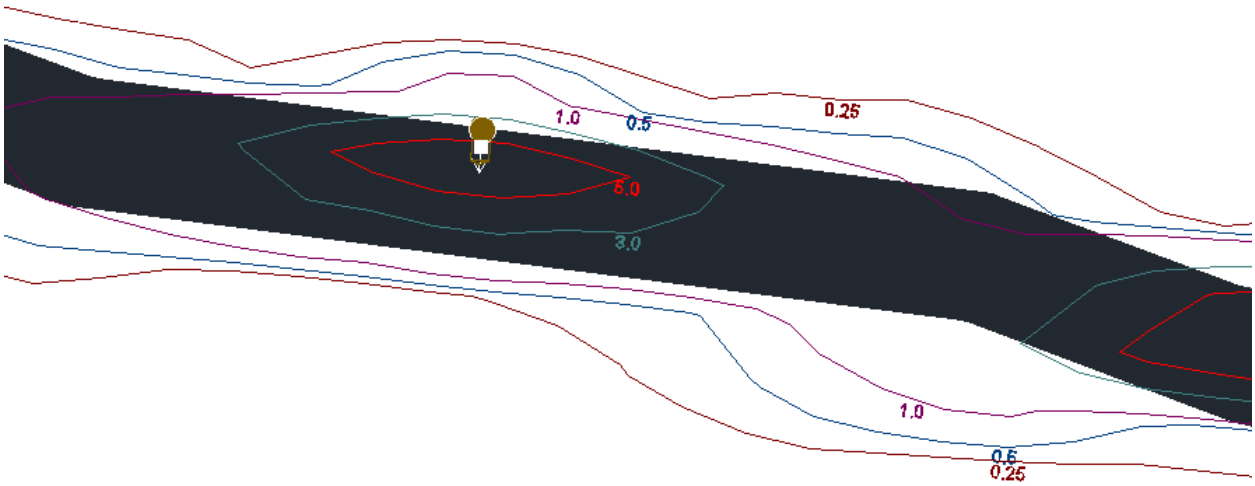

Figure 4.8 – Typical lighting results for Greenway

5. Conclusion.

The Bat Survey Report prepared by Dr Tina Aughney of Bat Eco Services for the Farrankelly site, made a series of recommendations in relation to the lighting design for the development.

The recommendations made were taken on board by lighting designers and every effort made to mitigate that impacts that might arise as a result of the lighting for the proposed development.

The key measures implemented to minimise the impact on bats are as follows

- High quality directional LED lights provided throughout
- Zero upward light spill achieved
- Column heights specifically selected to minimise impact on wildlife
- The addition of louvres on fittings in and near to the most sensitive woodland areas of the site
- Advanced lighting controls on lighting in woodland areas to ensure lighting is only provided when required

Appendix A – Lighting Calculations Report

DATE:	**19 August 2019**
DESIGNER:	**Alex Naper**
PROJECT No:	**SES 09319 Rev A**
PROJECT NAME:	**Farrankelly Greystones - Waterman Moylan**

Outdoor Lighting Report

PREPARED BY:

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Layout Report

General Data

Dimensions in Metres Angles in Degrees

Calculation Grids

ID	Grid Name	X	Y	X' Length	Y' Length	X' Spacing	Y' Spacing
1	Grid 1	728246.69	712111.24	373.00	344.18	1.50	1.50
2	Grid 2	728620.78	712203.45	365.86	246.79	1.46	1.50
3	Grid 3	728229.77	712225.34	53.87	333.00	1.10	1.50
4	Grid 4	728292.22	712542.63	371.00	150.00	1.50	1.50
5	Grid 5	728664.64	712535.10	257.93	99.00	1.50	1.50
6	Grid 6	728512.01	712433.74	113.15	96.00	1.13	1.50
7	Grid 7	728444.26	712355.08	45.00	143.00	1.50	1.49
8	Grid 8	728482.13	712265.05	184.00	142.36	1.50	1.50

Luminaires

Luminaire A Data

Supplier	Urbis-Schreder
Type	AXIA 2.1 5166 - 16 NVSL219CT 390mA W W 230V Integrated lenses
Lamp(s)	16 NVSL219CT 390mA_WW
LampFlux(klm)/Colour	2.38 WW 3000K/80
File Name	AXIA 2_1 5166 16 NVSL219CT 390mA W W 21W 383322 Integrated lenses - 230V 2...
Maintenance Factor	0.83
Imax70,80,90(cd/klm)	1056.5, 197.6, 0.0
No. in Project	67

Luminaire B Data

Supplier	Urbis-Schreder
Type	AXIA 2.1 5166 [[see details], PC, Black], [Integrated lenses]
Lamp(s)	16 NVSL219CT@390mA WW830 230V 00-14-560
LampFlux(klm)/Colour	1.93 WW 3000K/80
File Name	AXIA 2.1 5166 16 NVSL219CT 390mA WW 830 21W 392782 [[see details], PC, Black], ...
Maintenance Factor	0.83
Imax70,80,90(cd/klm)	1141.2, 252.7, 0.0
No. in Project	22

Luminaire C Data

Supplier	Urbis-Schreder
Type	AXIA 2.1 5165 [[see details], PC, Black], [Integrated lenses]
Lamp(s)	4 NVSL219CT@680mA WW830 230V 00-25-501
LampFlux(klm)/Colour	0.77 WW 3000K/80
File Name	AXIA 2.1 5165 4 NVSL219CT 680mA WW830 10W 392272 [[see details], PC, Black], [...
Maintenance Factor	0.83
Imax70,80,90(cd/klm)	1166.5, 203.2, 0.0
No. in Project	41

Luminaire D Data

Supplier	Urbis-Schreder
Type	AXIA 2.1 5165 [[see details], PC, Black], [Integrated lenses]
Lamp(s)	4 NVSL219CT@680mA WW830 230V 00-25-501
LampFlux(klm)/Colour	0.52 WW 3000K/80
File Name	AXIA 2.1 5165 4 NVSL219CT 680mA WW830 10W 392292 [[see details], PC, Black], [...
Maintenance Factor	0.83
Imax70,80,90(cd/klm)	1364.3, 154.1, 0.0
No. in Project	40

Luminaires

Luminaire E Data

Supplier	Urbis-Schreder
Type	PILZEO: (335442) Lum. shape-related PC Smooth (Lexan SLX 227
Lamp(s)	16 XP-G2 500mA NW [150lm - 350mA]
Lamp Flux (klm)	3.19
File Name	PILZEO 5068 16 LED 500mA NW Lum. shape-related PC Smooth335442 EF.ldt
Maintenance Factor	0.83
Imax70,80,90(cd/klm)	354.2, 233.3, 21.0
No. in Project	28

Layout

ID	Type	X	Y	Height	Angle	Tilt	Cant	Out-reach	Dimmed to	Target X	Target Y	Target Z
1	B	728971.63	712383.55	6.00	247.00	5.00	0.00	0.40	100%			
2	B	728968.70	712362.18	6.00	198.00	5.00	0.00	0.40	100%			
3	B	728955.39	712407.31	6.00	200.00	5.00	0.00	0.40	100%			
4	B	728933.65	712436.75	6.00	244.00	5.00	0.00	0.40	100%			
5	B	728908.22	712426.07	6.00	104.00	5.00	0.00	0.40	100%			
6	B	728871.87	712423.47	6.00	288.00	5.00	0.00	0.40	100%			
7	B	728839.39	712420.79	6.00	281.00	5.00	0.00	0.40	100%			
8	B	728809.96	712412.23	6.00	286.00	5.00	0.00	0.40	100%			
9	B	728774.50	712401.55	6.00	287.00	5.00	0.00	0.40	100%			
10	B	728740.57	712382.43	6.00	331.00	5.00	0.00	0.40	100%			
11	A	728738.40	712355.73	6.00	359.00	5.00	0.00	0.40	100%			
12	A	728742.12	712326.65	6.00	353.00	5.00	0.00	0.40	100%			
13	A	728727.83	712307.72	6.00	306.00	5.00	0.00	0.40	100%			
14	A	728703.70	712294.33	6.00	296.00	5.00	0.00	0.40	100%			
15	A	728669.07	712274.66	6.00	297.00	5.00	0.00	0.40	100%			
16	A	728669.15	712238.35	5.00	27.00	5.00	0.00	0.40	100%			
17	A	728651.29	712248.64	5.00	115.00	5.00	0.00	0.40	100%			
18	A	728625.21	712234.11	5.00	120.00	5.00	0.00	0.40	100%			
19	A	728680.02	712245.03	5.00	204.00	5.00	0.00	0.40	100%			
20	A	728808.02	712394.14	6.00	7.00	5.00	0.00	0.40	100%			
21	A	728814.33	712333.24	6.00	6.00	5.00	0.00	0.40	100%			
22	A	728811.43	712360.87	6.00	6.00	5.00	0.00	0.40	100%			
23	A	728830.28	712339.29	6.00	92.00	5.00	0.00	0.40	100%			
24	A	728865.68	712343.05	6.00	94.00	5.00	0.00	0.40	100%			
25	A	728896.58	712345.11	6.00	184.00	5.00	0.00	0.40	100%			
26	A	728892.76	712382.51	6.00	190.00	5.00	0.00	0.40	100%			
27	A	728880.47	712407.12	6.00	2.00	5.00	0.00	0.40	100%			
28	A	728652.05	712269.64	6.00	271.00	5.00	0.00	0.40	100%			
29	A	728636.51	712255.02	6.00	180.00	5.00	0.00	0.40	100%			
30	A	728654.16	712295.26	6.00	208.00	5.00	0.00	0.40	100%			
31	A	728608.61	712260.39	6.00	93.00	5.00	0.00	0.40	100%			
32	C	728688.31	712382.24	5.00	280.00	5.00	0.00	0.40	100%			
33	C	728664.62	712384.73	6.00	269.00	5.00	0.00	0.40	100%			
34	C	728638.65	712383.07	6.00	264.00	5.00	0.00	0.40	100%			
35	C	728703.83	712362.50	6.00	174.00	5.00	0.00	0.40	100%			
36	A	728596.35	712217.42	6.00	124.00	5.00	0.00	0.40	100%			

Layout Continued

ID	Type	X	Y	Height	Angle	Tilt	Cant	Out-reach	Dimmed to	Target X	Target Y	Target Z
37	A	728561.11	712196.94	6.00	120.00	5.00	0.00	0.40	100%			
38	A	728520.90	712190.56	6.00	86.00	5.00	0.00	0.40	100%			
39	A	728491.94	712192.69	6.00	82.00	5.00	0.00	0.40	100%			
40	A	728454.28	712200.98	6.00	67.00	5.00	0.00	0.40	100%			
41	A	728484.52	712169.30	6.00	166.00	5.00	0.00	0.40	100%			
42	A	728464.60	712143.82	6.00	335.00	5.00	0.00	0.40	100%			
43	A	728542.57	712213.48	6.00	4.00	5.00	0.00	0.40	100%			
44	A	728544.30	712244.42	6.00	358.00	5.00	0.00	0.40	100%			
45	A	728576.11	712262.30	6.00	90.00	5.00	0.00	0.40	100%			
46	A	728524.71	712262.51	6.00	91.00	5.00	0.00	0.40	100%			
47	A	728497.64	712266.11	6.00	86.00	5.00	0.00	0.40	100%			
48	A	728547.85	712271.36	6.00	274.00	5.00	0.00	0.40	100%			
49	A	728466.51	712268.29	6.00	94.00	5.00	0.00	0.40	100%			
50	A	728440.02	712258.61	6.00	160.00	5.00	0.00	0.40	100%			
51	A	728442.18	712293.97	6.00	355.00	5.00	0.00	0.40	100%			
52	A	728445.12	712334.49	6.00	353.00	5.00	0.00	0.40	100%			
53	B	728440.02	712349.95	6.00	268.00	5.00	0.00	0.40	100%			
54	B	728401.88	712352.69	6.00	269.00	5.00	0.00	0.40	100%			
55	B	728364.08	712355.33	6.00	266.00	5.00	0.00	0.40	100%			
56	B	728331.38	712357.55	6.00	265.00	5.00	0.00	0.40	100%			
57	B	728302.43	712348.89	6.00	348.00	5.00	0.00	0.40	100%			
58	B	728296.45	712312.99	6.00	342.00	5.00	0.00	0.40	100%			
59	A	728299.20	712285.36	6.00	69.00	5.00	0.00	0.40	100%			
60	A	728329.75	712272.55	6.00	66.00	5.00	0.00	0.40	100%			
61	A	728366.87	712253.85	6.00	62.00	5.00	0.00	0.40	100%			
62	A	728406.36	712237.42	6.00	68.00	5.00	0.00	0.40	100%			
63	A	728369.10	712278.81	6.00	157.00	5.00	0.00	0.40	100%			
64	A	728378.55	712301.75	6.00	155.00	5.00	0.00	0.40	100%			
65	A	728427.80	712216.93	6.00	158.00	5.00	0.00	0.40	100%			
66	A	728416.92	712190.31	6.00	151.00	5.00	0.00	0.40	100%			
67	A	728405.83	712162.49	6.00	154.00	5.00	0.00	0.40	100%			
68	A	728490.21	712293.49	6.00	176.00	5.00	0.00	0.40	100%			
69	A	728493.03	712333.23	6.00	177.00	5.00	0.00	0.40	100%			
70	B	728473.27	712361.23	6.00	49.00	5.00	0.00	0.40	100%			
71	A	728490.56	712381.93	6.00	339.00	5.00	0.00	0.40	100%			
72	A	728507.24	712405.84	6.00	333.00	5.00	0.00	0.40	100%			

Layout Continued

ID	Type	X	Y	Height	Angle	Tilt	Cant	Out-reach	Dimmed to	Target X	Target Y	Target Z
73	A	728514.33	712440.63	6.00	348.00	5.00	0.00	0.40	100%			
74	A	728517.58	712477.81	6.00	356.00	5.00	0.00	0.40	100%			
75	A	728538.23	712440.80	6.00	262.00	5.00	0.00	0.40	100%			
76	A	728553.42	712425.06	6.00	84.00	5.00	0.00	0.40	100%			
77	A	728571.53	712438.49	6.00	267.00	5.00	0.00	0.40	100%			
78	A	728605.65	712440.80	6.00	353.00	5.00	0.00	0.40	100%			
79	A	728588.52	712422.28	6.00	90.00	5.00	0.00	0.40	100%			
80	A	728621.95	712426.26	6.00	85.00	5.00	0.00	0.40	100%			
81	B	728464.76	712390.98	6.00	332.00	5.00	0.00	0.40	100%			
82	C	728367.09	712375.15	5.00	82.00	5.00	0.00	0.40	100%			
83	C	728337.57	712377.00	5.00	99.00	5.00	0.00	0.40	100%			
84	C	728454.83	712366.87	6.00	83.00	5.00	0.00	0.40	100%			
85	C	728422.32	712373.60	5.00	80.00	5.00	0.00	0.40	100%			
86	B	728489.11	712443.31	6.00	178.00	5.00	0.00	0.40	100%			
87	C	728397.70	712374.59	5.00	109.00	5.00	0.00	0.40	100%			
88	B	728469.34	712444.88	6.00	350.00	5.00	0.00	0.40	100%			
89	B	728486.72	712415.69	6.00	180.00	5.00	0.00	0.40	100%			
90	B	728467.30	712416.20	6.00	358.00	5.00	0.00	0.40	100%			
91	C	728305.68	712384.50	5.00	49.00	5.00	0.00	0.40	100%			
92	C	728302.18	712380.71	5.00	147.00	5.00	0.00	0.40	100%			
93	C	728444.10	712354.29	5.00	260.00	5.00	0.00	0.40	100%			
94	C	728411.30	712357.52	5.00	270.00	5.00	0.00	0.40	100%			
95	C	728379.85	712357.72	5.00	270.00	5.00	0.00	0.40	100%			
96	C	728347.10	712358.60	5.00	272.00	5.00	0.00	0.40	100%			
97	C	728315.22	712361.49	5.00	265.00	5.00	0.00	0.40	100%			
98	C	728474.48	712352.78	5.00	140.00	5.00	0.00	0.40	100%			
99	C	728461.01	712314.76	5.00	167.00	5.00	0.00	0.40	100%			
100	C	728456.77	712287.89	5.00	164.00	5.00	0.00	0.40	100%			
101	C	728525.20	712397.46	5.00	265.00	5.00	0.00	0.40	100%			
102	C	728557.48	712394.45	5.00	272.00	5.00	0.00	0.40	100%			
103	C	728586.57	712392.39	5.00	272.00	5.00	0.00	0.40	100%			
104	C	728612.11	712387.06	5.00	243.00	5.00	0.00	0.40	100%			
105	A	728463.74	712117.31	6.00	56.00	5.00	0.00	0.40	100%			
106	A	728475.92	712126.77	6.00	149.00	5.00	0.00	0.40	100%			
107	A	728522.42	712426.88	6.00	87.00	5.00	0.00	0.40	100%			
108	C	728258.62	712252.51	5.00	352.00	5.00	0.00	0.40	100%			

Layout Continued

ID	Type	X	Y	Height	Angle	Tilt	Cant	Out-reach	Dimmed to	Target X	Target Y	Target Z
109	C	728266.12	712281.25	5.00	324.00	5.00	0.00	0.40	100%			
110	C	728278.94	712309.30	5.00	346.00	5.00	0.00	0.40	100%			
111	C	728290.94	712339.71	5.00	329.00	5.00	0.00	0.40	100%			
112	C	728292.15	712368.58	5.00	9.00	5.00	0.00	0.40	100%			
113	C	728287.00	712402.04	5.00	4.00	5.00	0.00	0.40	100%			
114	C	728281.92	712430.70	5.00	7.00	5.00	0.00	0.40	100%			
115	C	728276.89	712459.39	5.00	5.00	5.00	0.00	0.40	100%			
116	C	728278.91	712489.84	5.00	352.00	5.00	0.00	0.40	100%			
117	C	728293.92	712518.55	5.00	315.00	5.00	0.00	0.40	100%			
118	D	728314.42	712531.89	4.00	307.00	5.00	0.00	0.40	55%			
119	D	728341.63	712563.38	4.00	313.00	5.00	0.00	0.40	55%			
120	C	728466.10	712339.64	5.00	169.00	5.00	0.00	0.40	100%			
121	D	728329.45	712547.51	4.00	325.00	5.00	0.00	0.40	55%			
122	D	728358.57	712572.31	4.00	283.00	5.00	0.00	0.40	55%			
123	D	728379.68	712577.35	4.00	295.00	5.00	0.00	0.40	55%			
124	D	728398.87	712579.41	4.00	99.00	5.00	0.00	0.40	55%			
125	D	728417.84	712581.80	4.00	80.00	5.00	0.00	0.40	55%			
126	D	728435.29	712578.21	4.00	270.00	5.00	0.00	0.40	55%			
127	D	728459.36	712578.10	4.00	106.00	5.00	0.00	0.40	55%			
128	D	728480.32	712589.03	4.00	130.00	5.00	0.00	0.40	55%			
129	D	728496.15	712596.89	4.00	275.00	5.00	0.00	0.40	55%			
130	D	728515.52	712592.17	4.00	262.00	5.00	0.00	0.40	55%			
131	D	728534.42	712586.00	4.00	250.00	5.00	0.00	0.40	55%			
132	D	728554.06	712584.42	4.00	268.00	5.00	0.00	0.40	55%			
133	D	728571.77	712588.23	4.00	290.00	5.00	0.00	0.40	55%			
134	D	728593.97	712586.61	4.00	266.00	5.00	0.00	0.40	55%			
135	D	728619.38	712582.81	4.00	264.00	5.00	0.00	0.40	55%			
136	D	728646.81	712580.45	4.00	267.00	5.00	0.00	0.40	55%			
137	D	728674.43	712575.50	4.00	261.00	5.00	0.00	0.40	55%			
138	D	728584.55	712577.84	4.00	115.00	5.00	0.00	0.40	55%			
139	D	728566.50	712568.04	4.00	116.00	5.00	0.00	0.40	55%			
140	D	728543.44	712556.31	4.00	121.00	5.00	0.00	0.40	55%			
141	D	728550.72	712548.55	4.00	70.00	5.00	0.00	0.40	55%			
142	D	728575.23	712538.82	4.00	72.00	5.00	0.00	0.40	55%			
143	D	728577.93	712533.70	4.00	270.00	5.00	0.00	0.40	55%			
144	D	728556.72	712533.23	4.00	274.00	5.00	0.00	0.40	55%			

Layout Continued

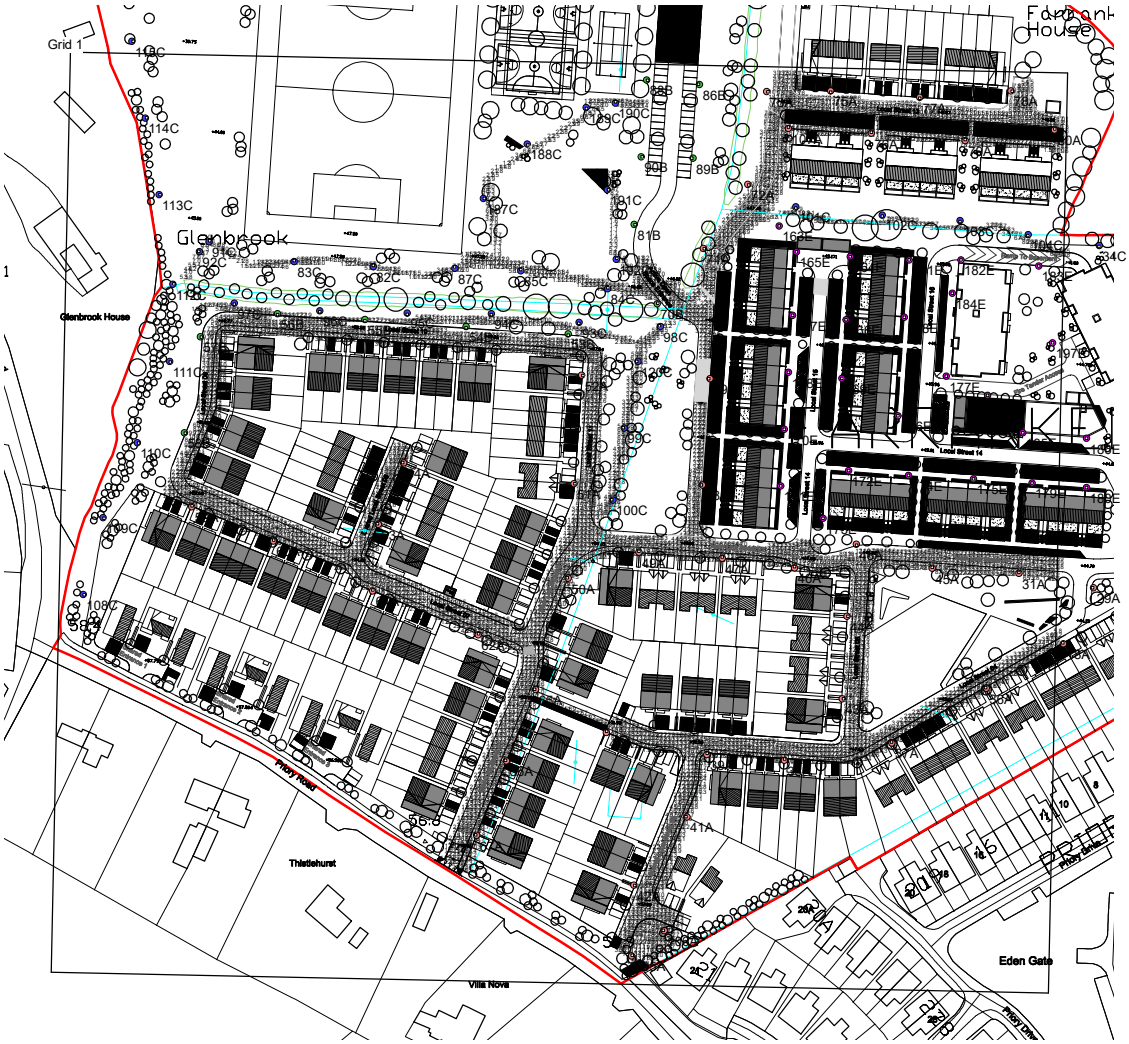
ID	Type	X	Y	Height	Angle	Tilt	Cant	Out-reach	Dimmed to	Target X	Target Y	Target Z
145	D	728535.70	712532.83	4.00	276.00	5.00	0.00	0.40	55%			
147	D	728695.43	712570.97	4.00	251.00	5.00	0.00	0.40	55%			
148	D	728707.74	712559.96	4.00	239.00	5.00	0.00	0.40	55%			
149	D	728731.78	712552.97	4.00	87.00	5.00	0.00	0.40	55%			
150	D	728755.00	712546.54	4.00	243.00	5.00	0.00	0.40	55%			
151	D	728778.01	712538.78	4.00	265.00	5.00	0.00	0.40	55%			
152	D	728796.16	712535.06	4.00	268.00	5.00	0.00	0.40	55%			
153	D	728811.32	712538.98	4.00	287.00	5.00	0.00	0.40	55%			
154	D	728832.95	712546.96	4.00	303.00	5.00	0.00	0.40	55%			
155	D	728848.97	712561.77	4.00	317.00	5.00	0.00	0.40	55%			
156	D	728865.50	712577.08	4.00	129.00	5.00	0.00	0.40	55%			
157	C	728881.11	712588.68	4.00	297.00	5.00	0.00	0.40	100%			
158	D	728897.30	712599.52	4.00	327.00	5.00	0.00	0.40	55%			
167	A	728521.01	712511.05	6.00	351.00	5.00	0.00	0.40	100%			
168	A	728543.84	712505.14	6.00	88.00	5.00	0.00	0.40	100%			
169	A	728591.54	712515.60	6.00	186.00	5.00	0.00	0.40	100%			
170	A	728571.64	712503.39	6.00	86.00	5.00	0.00	0.40	100%			
171	A	728603.65	712501.00	6.00	88.00	5.00	0.00	0.40	100%			
163	E	728518.97	712390.37	6.00	263.00	0.00	0.00	0.00	100%			
164	E	728545.51	712378.90	6.00	174.00	0.00	0.00	0.00	100%			
165	E	728525.44	712380.58	6.00	356.00	0.00	0.00	0.00	100%			
166	E	728543.94	712355.22	6.00	174.00	0.00	0.00	0.00	100%			
167	E	728524.03	712356.96	6.00	357.00	0.00	0.00	0.00	100%			
168	E	728522.40	712335.65	6.00	355.00	0.00	0.00	0.00	100%			
169	E	728542.36	712333.34	6.00	177.00	0.00	0.00	0.00	100%			
170	E	728520.82	712314.33	6.00	355.00	0.00	0.00	0.00	100%			
171	E	728519.53	712293.07	6.00	355.00	0.00	0.00	0.00	100%			
172	E	728544.90	712298.82	6.00	84.00	0.00	0.00	0.00	100%			
173	E	728535.33	712280.98	6.00	173.00	0.00	0.00	0.00	100%			
174	E	728567.32	712297.11	6.00	92.00	0.00	0.00	0.00	100%			
175	E	728591.63	712295.78	6.00	85.00	0.00	0.00	0.00	100%			
176	E	728563.40	712319.35	6.00	359.00	0.00	0.00	0.00	100%			
177	E	728581.41	712334.15	6.00	178.00	0.00	0.00	0.00	100%			
178	E	728565.76	712356.16	6.00	355.00	0.00	0.00	0.00	100%			
179	E	728613.51	712294.20	6.00	87.00	0.00	0.00	0.00	100%			
180	E	728633.83	712292.53	6.00	90.00	0.00	0.00	0.00	100%			

Layout Continued

ID	Type	X	Y	Height	Angle	Tilt	Cant	Out-reach	Dimmed to	Target X	Target Y	Target Z
181	E	728567.54	712377.68	6.00	355.00	0.00	0.00	0.00	100%			
182	E	728586.92	712377.61	6.00	83.00	0.00	0.00	0.00	100%			
183	E	728616.10	712375.37	6.00	88.00	0.00	0.00	0.00	100%			
184	E	728583.77	712365.24	6.00	177.00	0.00	0.00	0.00	100%			
185	E	728610.10	712313.02	6.00	260.00	0.00	0.00	0.00	100%			
186	E	728633.94	712310.96	6.00	268.00	0.00	0.00	0.00	100%			
187	C	728408.33	712400.65	5.00	6.00	5.00	0.00	0.40	100%			
188	C	728424.73	712420.97	5.00	301.00	5.00	0.00	0.40	100%			
189	C	728446.70	712434.67	5.00	298.00	5.00	0.00	0.40	100%			
190	C	728457.69	712436.35	5.00	87.00	5.00	0.00	0.40	100%			
191	C	728454.71	712403.82	5.00	2.00	5.00	0.00	0.40	100%			
192	C	728457.96	712377.94	5.00	49.00	5.00	0.00	0.40	100%			
193	D	728327.78	712559.26	4.00	287.00	5.00	0.00	0.40	55%			
194	D	728305.66	712553.67	4.00	286.00	5.00	0.00	0.40	55%			
195	E	728647.88	712323.34	5.00	256.00	0.00	0.00	0.00	100%			
196	E	728662.74	712331.40	5.00	205.00	0.00	0.00	0.00	100%			
197	E	728621.21	712346.69	5.00	11.00	0.00	0.00	0.00	100%			
198	E	728596.89	712327.06	6.00	84.00	0.00	0.00	0.00	100%			

Horizontal Illuminance (lux)

Grid 1



Results

Eav	4.87
Emin	0.96
Emax	13.91
Emin/Emax	0.07
Emin/Eav	0.20

Horizontal Illuminance (lux)

Grid 1

Results

Eav	4.87
Emin	0.96
Emax	13.91
Emin/Emax	0.07
Emin/Eav	0.20

Horizontal Illuminance (lux)

Grid 2

Results

Eav	4.82
Emin	1.00
Emax	15.94
Emin/Emax	0.06
Emin/Eav	0.21

Horizontal Illuminance (lux)

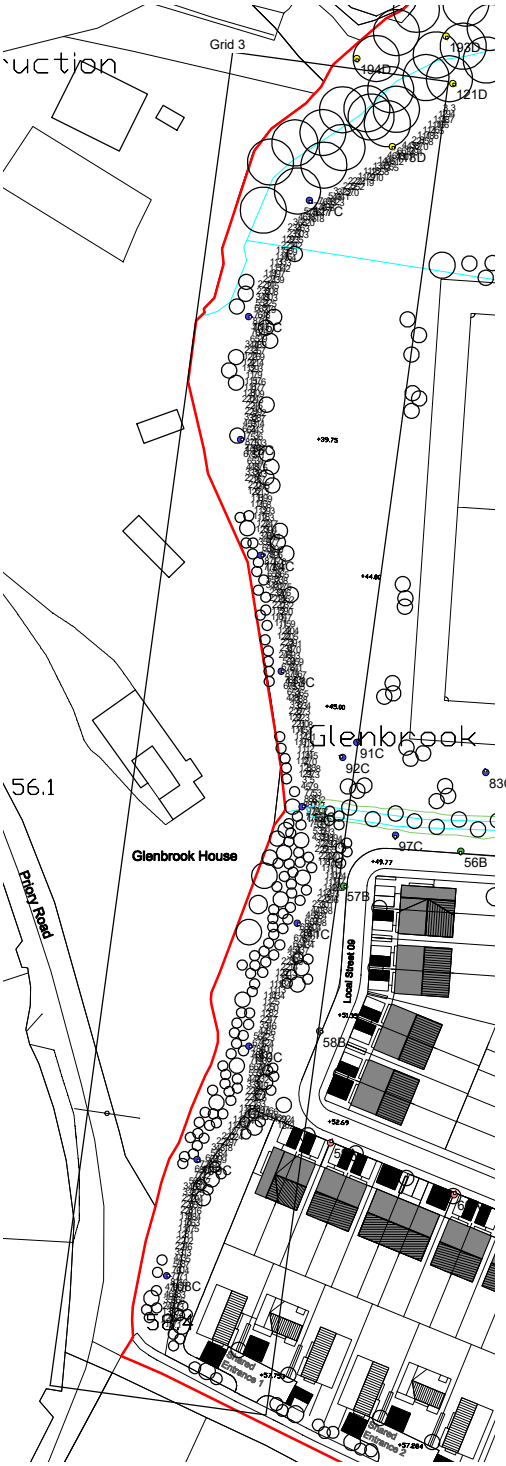
Grid 2

Results

Eav	4.82
Emin	1.00
Emax	15.94
Emin/Emax	0.06
Emin/Eav	0.21

Horizontal Illuminance (lux)

Grid 3



Results

Eav	3.60
Emin	0.96
Emax	8.98
Emin/Emax	0.11
Emin/Eav	0.27

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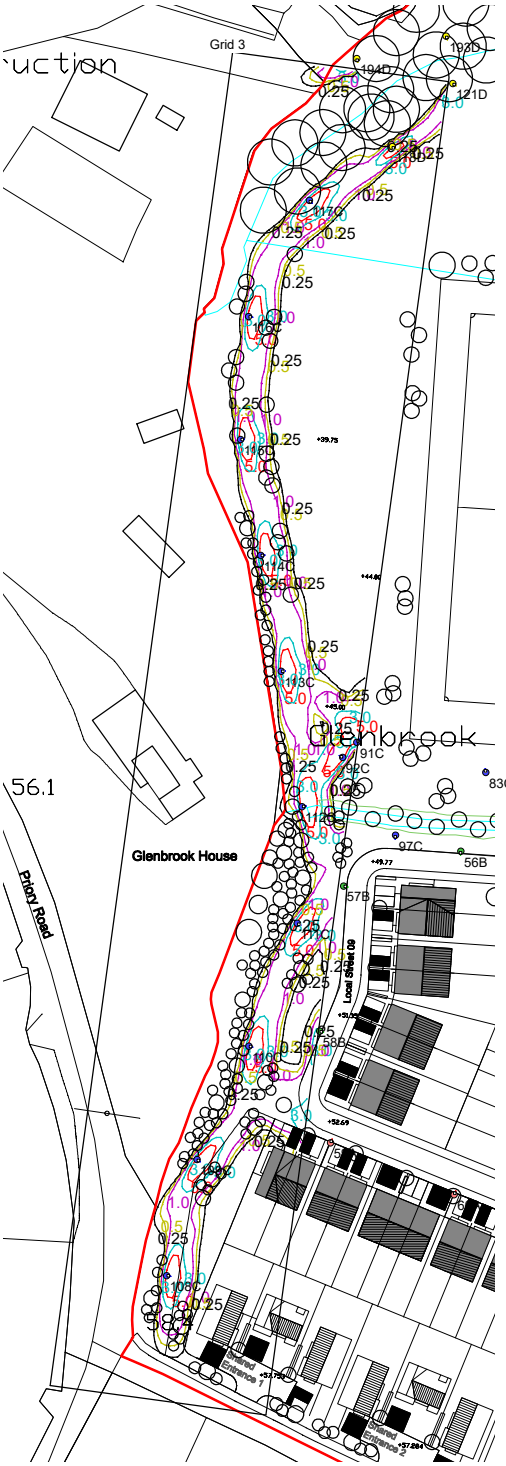
Horizontal Illuminance (lux)

Grid 3



Results

Eav	3.60
Emin	0.96
Emax	8.98
Emin/Emax	0.11
Emin/Eav	0.27

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Horizontal Illuminance (lux)

Grid 4

Results

Eav	2.83
Emin	0.49
Emax	7.19
Emin/Emax	0.07
Emin/Eav	0.17

Horizontal Illuminance (lux)

Grid 4

Results

Eav	2.83
Emin	0.49
Emax	7.19
Emin/Emax	0.07
Emin/Eav	0.17

Horizontal Illuminance (lux)

Grid 5

Results

Eav	3.09
Emin	0.47
Emax	12.66
Emin/Emax	0.04
Emin/Eav	0.15

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Horizontal Illuminance (lux)

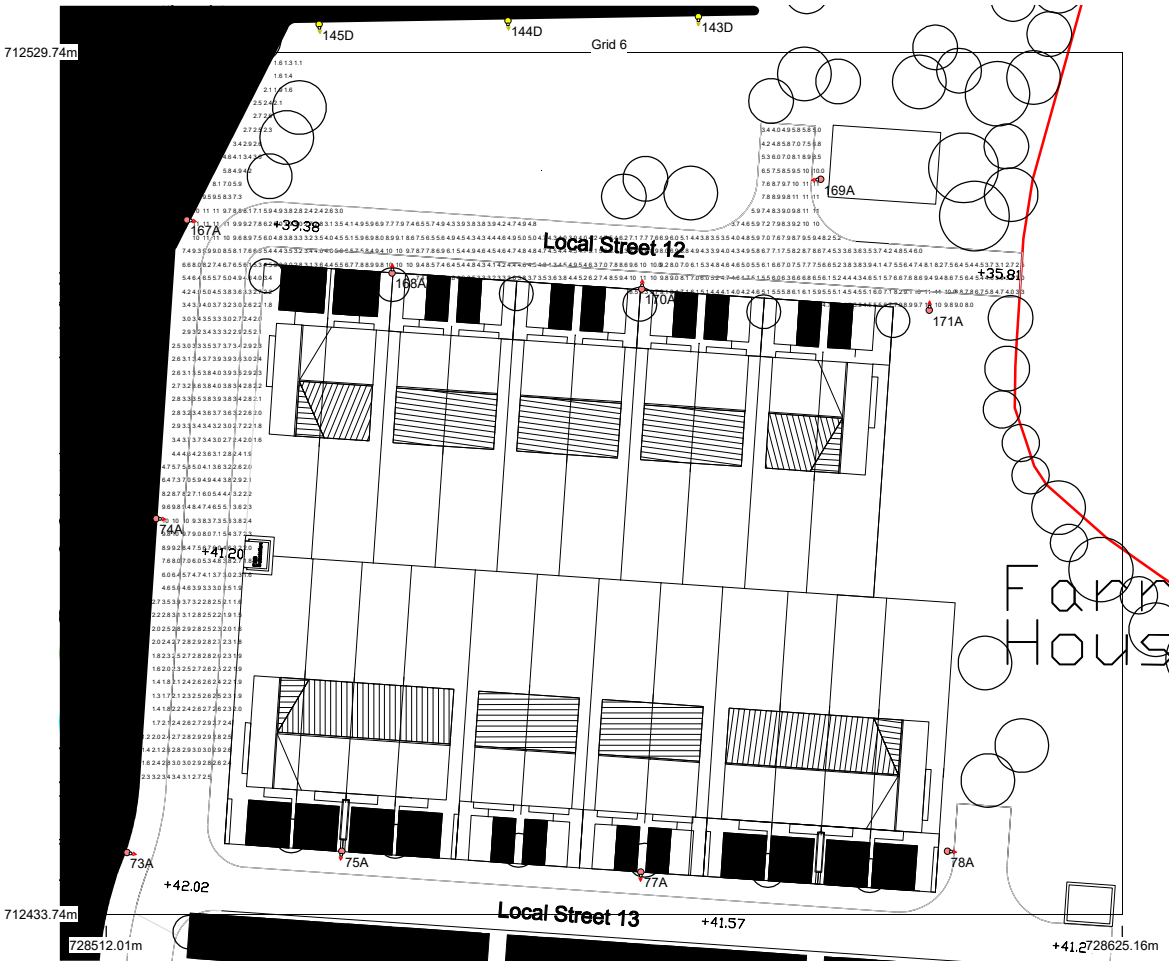
Grid 5

Results

Eav	3.09
Emin	0.47
Emax	12.66
Emin/Emax	0.04
Emin/Eav	0.15

Horizontal Illuminance (lux)

Grid 6



Results

Eav	5.11
Emin	1.07
Emax	11.47
Emin/Emax	0.09
Emin/Eav	0.21

Horizontal Illuminance (lux)

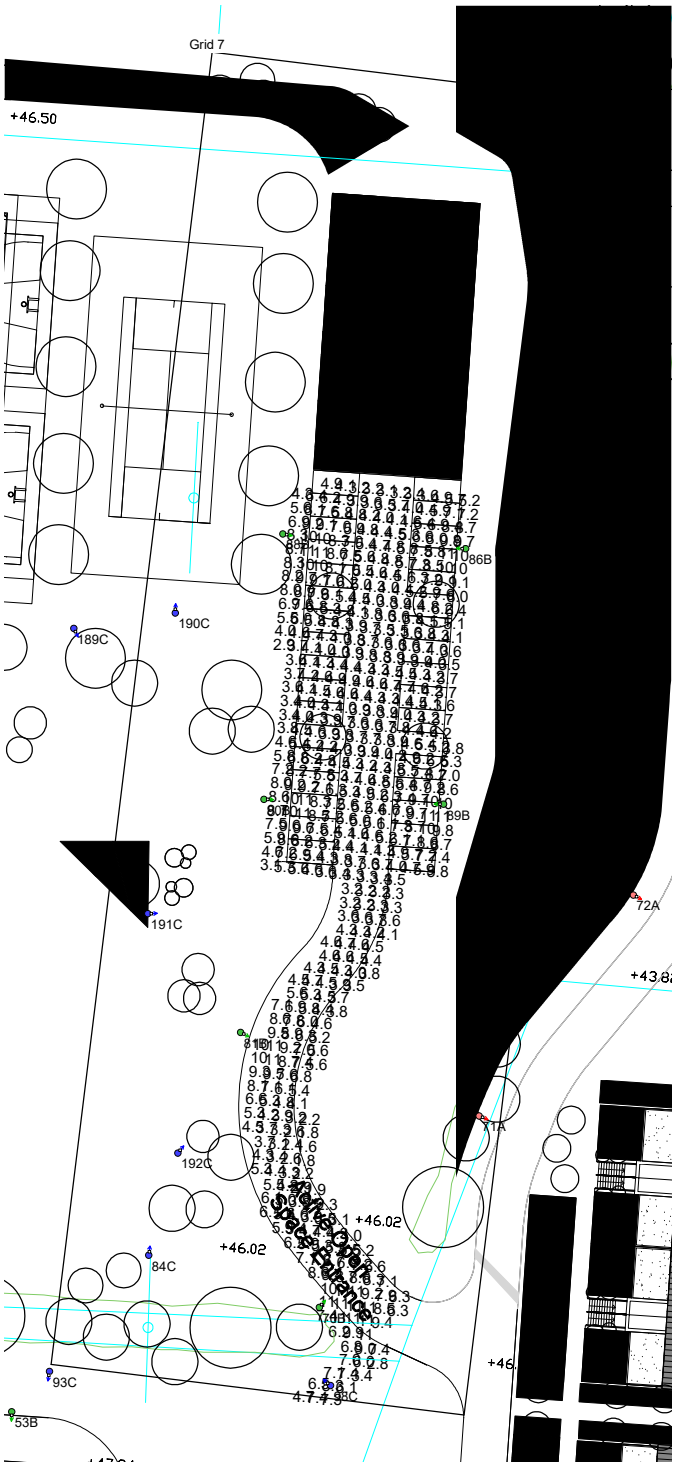
Grid 6

Results

Eav	5.11
Emin	1.07
Emax	11.47
Emin/Emax	0.09
Emin/Eav	0.21

Horizontal Illuminance (lux)

Grid 7

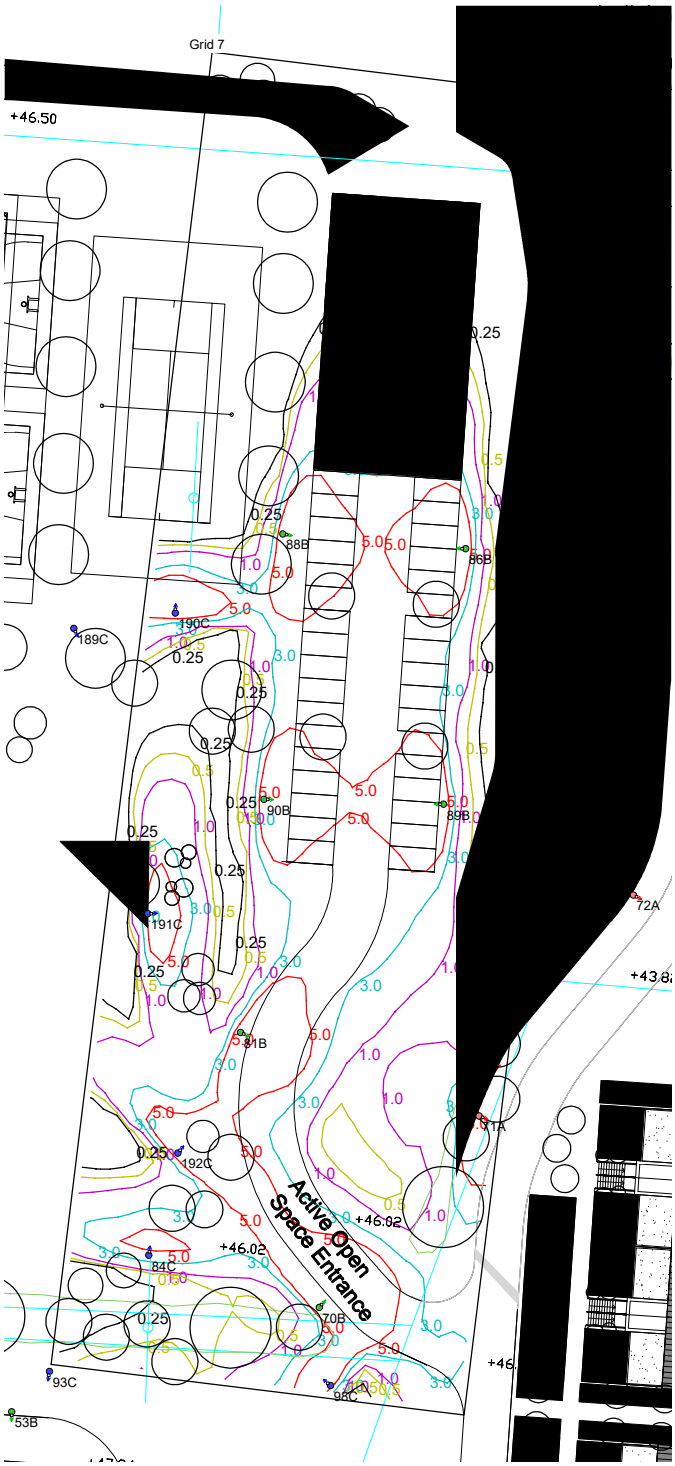


Results

Eav	5.69
Emin	1.65
Emax	11.42
Emin/Emax	0.14
Emin/Eav	0.29

Horizontal Illuminance (lux)

Grid 7



Results

Eav	5.69
Emin	1.65
Emax	11.42
Emin/Emax	0.14
Emin/Eav	0.29

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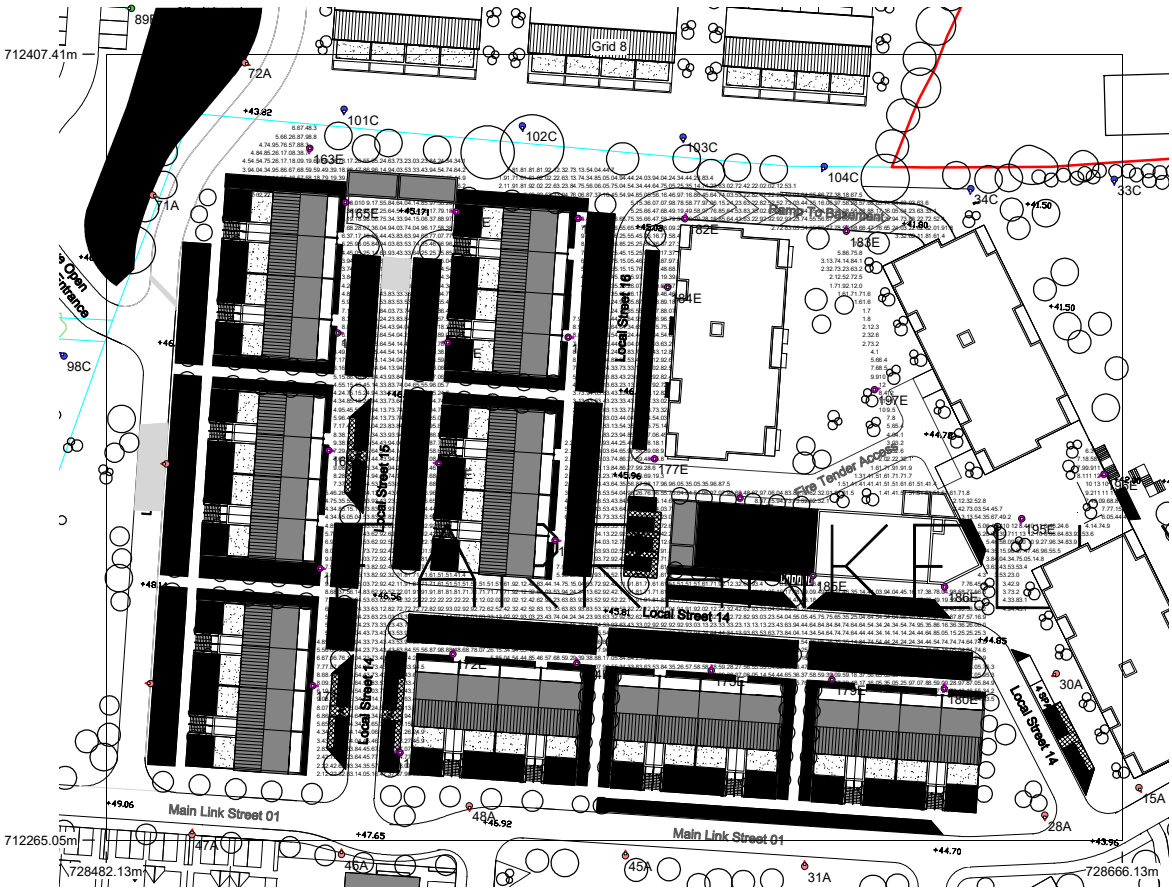
Horizontal Illuminance (lux)

Grid 8



Results

Eav	5.08
Emin	1.35
Emax	13.10
Emin/Emax	0.10
Emin/Eav	0.27

Horizontal Illuminance (lux)

Grid 8

Results

Eav	5.08
Emin	1.35
Emax	13.10
Emin/Emax	0.10
Emin/Eav	0.27

UK and Ireland Office Locations