

UOR Health and Life Sciences

Lighting Design Strategy for Biodiversity for Light Sensitive Species

1. INTRODUCTION

Background

- 1.1 This lighting strategy has been prepared by Ecological Planning & Research Ltd (EPR) in conjunction with AECOM on behalf of the University of Reading to discharge planning conditions in relation to lighting of the Health and Life Science Building at the University of Reading's Whiteknights campus, Reading.
- 1.2 It has been produced to discharge Planning Condition 4 of the Wokingham Borough Council decision notice (Ref.:163325) and Condition 13 of Reading Borough Council's decision notice (Ref.: 162219).
- 1.3 Both conditions require the design of a lighting strategy for biodiversity of bats and other light sensitive species.
- 1.4 The site of the Health and Life Sciences Building formed part of a site of four buildings and was subject to an Ecological Appraisal and External and Internal Inspection for Bats in February 2016 (EPR 2016a). Following the recommendation of the building inspection, a bat activity survey was completed on the former Engineering building in September 2016 and the habitat surrounding the building was described as "sub-optimal and well-lit" (EPR 2016b).

Ecological Context

- 1.5 The University of Reading, Whiteknights Campus is subject to moderate-high levels of baseline lighting from various sources including security lighting associated with the car parks, footpaths and University buildings. As only low levels of bat activity were recorded around the former Engineering building, it is not thought to be a regularly used commuting route for bats, but is used by low numbers of foraging bats, such as Common Pipistrelles *Pipistrellus pipistrellus*.
- 1.6 The largest concern of light-spill is onto the Harris Gardens to the East of the Site which has been identified as an important foraging and commuting route for common species of bats. The other areas which have been highlighted as appropriate for low impact lighting include the locations of the newly installed wildlife boxes (bird and bat boxes) and the new planted areas. With the addition of artificial lighting, bats could become confused, have reduced foraging opportunities, alter their commuting paths or even abandon a roost altogether, depending on the light sensitivity of the species. Increasing artificial light so much that a bat abandons a roost could constitute as an offence (Garland and Markham, 2007), therefore it is important that use of an area by bats is thoroughly assessed prior to the addition of artificial lighting (BCT, 2018). Other studies have shown that bats are also more prone to predation in artificially lit areas, and that they modify their behaviour in response to this threat.
- 1.7 Stone (2013) developed a matrix which identified which species are most sensitive to light pollution. The species most frequently recorded at The University of Reading (including Common and Soprano Pipistrelles *Pipistrellus pygmaeus* and Noctule bat (*Nyctalus noctula*))

are all listed as “Low Impact” species with regards to the addition of artificial light whilst foraging or commuting. Other species are more sensitive to light pollution, these include the Horseshoe bats (*Rhinolophus.sp*), Long-eared bats (*Plectotus sp.*) and Barbastelle *Barbastella barbastellus* bats, but none of which were recorded on Site (RCEP, 2012).

- 1.8 On this basis, methods to reduce light-spill have been suggested in order to avoid illuminating the “Low lighting corridors” at the same time as provide a safe environment for students, staff and visitors and provide accessibility around the University Campus.

No other important ecological features, in addition to bats were identified during the surveys, however the measures identified to reduce the impacts from lighting for bats will be beneficial to other light sensitive species.

2. LIGHTING STRATEGY

Aims and Objectives

- 2.1 The lighting strategy has three principal elements:

- External lighting will be minimised to the extent required for safety and orientation;
- Direct lighting of key areas of bat foraging, commuting and roosting habitat will be avoided; and
- Where lighting is required, its obtrusiveness will be minimised through the application of best practice measures undertaken in accordance with technical guidance issued by the Bat Conservation Trust (2016) and the Institution of Lighting Professionals (2018).

Type of Luminaries

- 2.2 Following relevant guidance, luminaries have been chosen to minimise impacts on bats and other light sensitive species, including the use of LED lights lacking light in the UV spectrum (Bat Conservation Trust, 2018; Stone, 2018).
- 2.3 The luminaries being used have a LED light source (Holophane Europe Ltd. DSX1.2.Lao54.FW D-Series 4784 lm and 3500 lm) (**Appendix 1**). They do not emit any UV or Infra-red (IR) and are a sharp cut off in the photometric output and minimal backward light spill.
- 2.4 LED lights have been selected as they produce a more directional and narrow light, thereby minimising light spill. LED lights are recommended by the Bat Conservation Trust “*due to their sharp cut-off, lower intensity, good colour rendition and dimming capability*” (Bat Conservation Trust, 2018).
- 2.5 The wavelength of the lights will be between 400nm – 750nm. The warmer light ranges (>550nm) are considered to have a lower impact on bats (Bat Conservation Trust, 2018). Invertebrates meanwhile are less attracted to lights between the 590nm – 660nm (Bruce-White & Shardlow, 2011).
- 2.6 Invertebrates are drawn to UV light, and therefore by eliminating this light spectrum from the lighting plans, potential impacts on the local invertebrate assemblage are minimised (Bruce-White & Shardlow, 2011).

Light Spill

- 2.7 To minimise light spill into the wider area, all lights will be directed downwards. The luminaries specified have a 60-degree optic tilted at 30 degrees. The extent and direction of light spill is demonstrated on **Maps 1 & 2**.
- 2.8 As described above, the design of the luminaries results in minimal backward spill and no upward spill, thereby limiting light spill to the immediate vicinity and reducing sky glow.
- 2.9 LED units are the equivalent to a convention flat glass luminaire, which minimises any upward light so reducing sky glow and further unnecessary light spill.
- 2.10 Hoods and cowls should be used as a last means resort of minimising light spill (Bat Conservation Trust, 2018). Due to the design of the luminaries, with minimal backward spill and no upward spill, neither cowls nor hoods are required.

Lux Levels and Enhancement Features

- 2.11 Lux levels at ground level and at a height of 3m above ground are shown in **Map 1 & 2** respectively.
- 2.12 Ecological enhancements at ground level include Hedgehog *Erinaceus europaeus* boxes. Although nocturnal, Hedgehogs are not known to be significantly negatively impacted by the presence of artificial light (Finch *et al*, 2020). Nevertheless, the Hedgehog box is located within an area subject to light levels of just 1.0 lux thereby minimising potential impacts of artificial light (**Map 1**).
- 2.13 Bat boxes are generally positioned, where possible, at a height of greater than 3m. Enhancement boxes will therefore be subject to lux levels of 1.0 or less (**Map 2**). Should it not be possible to position the boxes at such height, the location of the boxes and the lighting strategy means that all bat boxes will still be subject to no more than 1.0 lux.
- 2.14 1.0 lux is equivalent to lighting levels at twilight (Bat Conservation Trust, 2018), during which both bats and hedgehogs may be active. With the implementation of the lighting strategy, lighting levels therefore are not considered likely to impact upon these species.

Summary

- 2.15 Following the implementation of the lighting strategy it is considered that impacts on light sensitive species will be minimised as a result of the development at the Health & Life Sciences Building and conditions 4 and 13 can be discharged.

3. REFERENCES

Bat Conservation Trust (2009) Bats and the Built Environment Series: Bats and Lighting in the UK

Bat Conservation Trust (2014) Interim Guidance: Artificial lighting and wildlife – Recommendations to help minimise the impact of artificial lighting

Bat Conservation Trust (2018): Guidance Note on Bats and Artificial Lighting in the UK (Guidance Note 08/18)

Bruce-White, C. & Shardlow, M. 2011. A review of the impact of artificial light on invertebrates. Buglife.

CIEEM (2018) *Guidelines for Ecological Impact Assessment in the UK and Ireland*.

EPR (2016a) University of Reading Health & Life Sciences: Ecological Appraisal and External and Internal Inspection for Bats, Ecological Planning & Research Ltd. April 2016

EPR (2016b) Engineering Building, UOR Whiteknights Campus - Phase 2 Bat Survey Report Ecological Planning & Research Ltd. September 2016

EPR Ecological Management Plan Report Ecological Planning & Research Ltd, April, 2018

Finch, D., Smith, B.R., Marshall, C., Coomber, F.G., Kubasiewicz, L.M., Anderson, M., Wright, P.G. and Mathews, F., (2020). Effects of Artificial Light at Night (ALAN) on European Hedgehog Activity at Supplementary Feeding Stations. *Animals*, 10(5), p.768.

RCEP Report on Artificial Light in the Environment – 23/04/12 RCEP report summarising environmental impacts of artificial lighting

Stone, E.L. (2013) Bats and lighting: Overview of current evidence and mitigation

MAP 1 Isoline at Ground Level & Locations of Biodiversity Enhancements

KEY

-  Sparrow Terrace (1SP)
-  Bird Nesting Box (1B)
-  Hedgehog Box Location
-  Bat Box (2F)

-  Beehives & insect garden
-  Minimal lighting corridor

1: Holophane Europe Ltd DSX1.2.LA054.FW D-Series 1 Luminaire (4784 lm; 36.0 W)
2: Holophane Europe Ltd DSX1.2.LA054.FW D-Series 1 Luminaire (3500 lm; 36.0 W)

- Isolines
-  1.0 lx
 -  6.0 lx
 -  11.0 lx
 -  21.0 lx
 -  31.0 lx
 -  50.0 lx

SCALE: 1:425 at A3

0 5 10 15 20 Metres



Ecological Planning & Research

CLIENT: University of Reading

PROJECT: UoR Health and Life Sciences

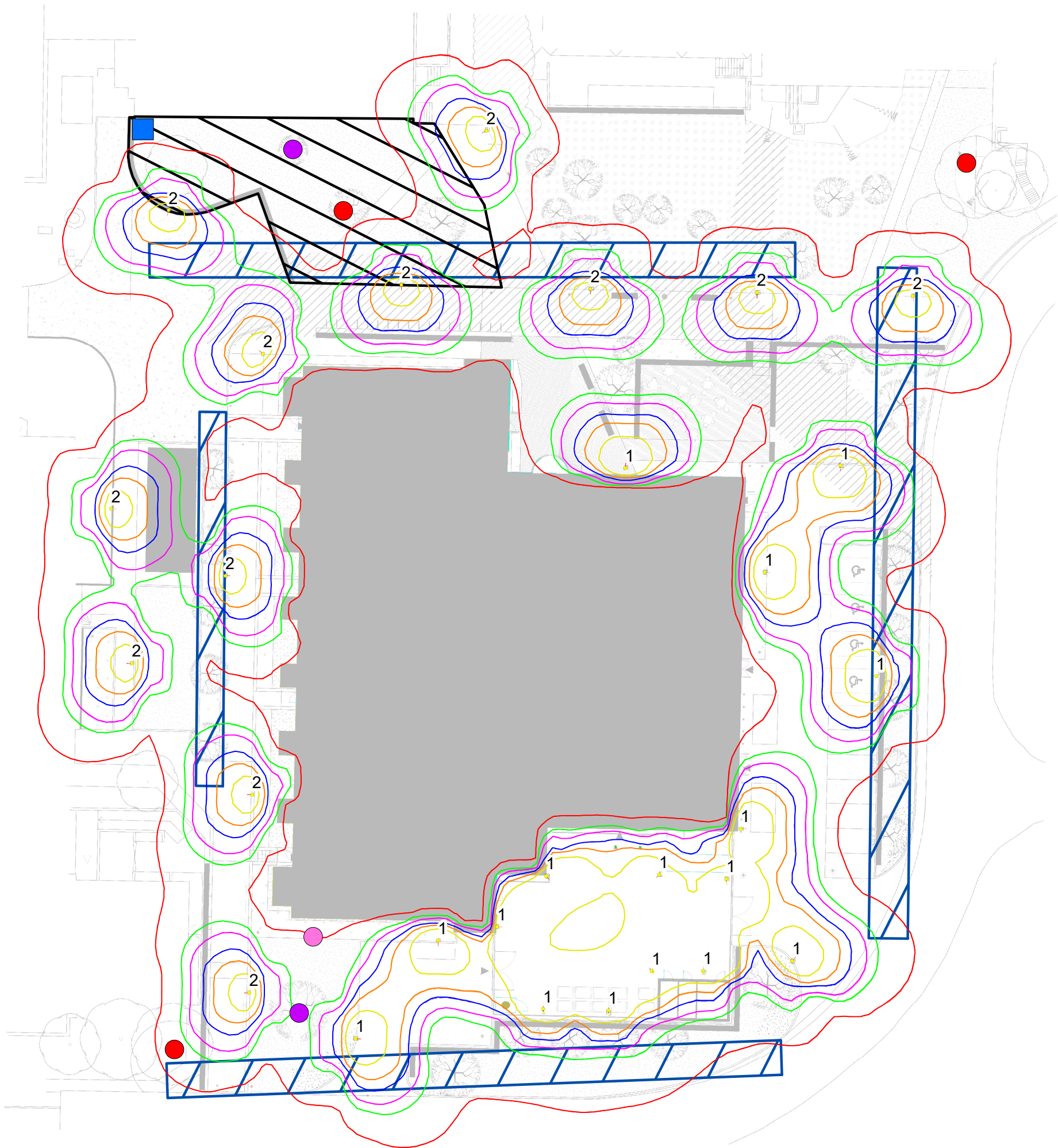
DATE: May 2020

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200506 External Isoline At Ground Level

MAP 2 Isolines at 3m Above Ground Level & Locations of Biodiversity Enhancements



KEY

- Sparrow Terrace (1SP)
- Bird Nesting Box (1B)
- Hedgehog Box Location
- Bat Box (2F)

- Beehives & insect garden
- Minimal lighting corridor

1: Holophane Europe Ltd DSX1.2.LA054.FW D-Series 1 Luminaire (4784 lm; 36.0 W)
2: Holophane Europe Ltd DSX1.2.LA054.FW D-Series 1 Luminaire (3500 lm; 36.0 W)

Isolines

- 1.0 lx
- 6.0 lx
- 11.0 lx
- 21.0 lx
- 31.0 lx
- 50.0 lx

SCALE: 1:425 at A3

0 5 10 15 20 Metres



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DATE: May 2020

Appendix 1

Luminary Data Sheet.

OUTDOOR PHOTOMETRIC REPORT

CATALOG: DSX1.2.LA054.FW

TEST #: LTL22428P4003
TEST LAB: ACUITY BRANDS LIGHTING CONYERS LAB
TEST DATE: 10/29/2015
CATALOG: DSX1.2.LA054.FW
DESCRIPTION: D-SERIES 1 LUMINAIRE
SERIES: DSX1
LAMP CATALOG: LA054
LAMP: LED C.5000LM-4000K
LAMP OUTPUT: TOTAL LUMINAIRE LUMENS: 4784.3, **ABSOLUTE PHOTOMETRY ***

INPUT WATTAGE: 36

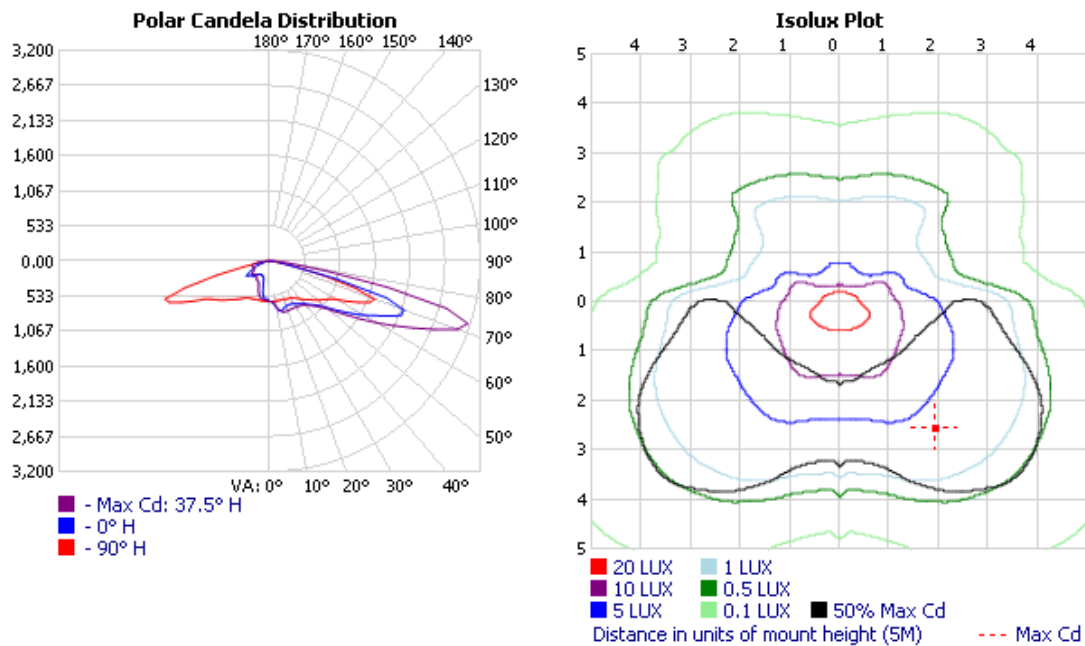
LUMINOUS OPENING: RECTANGLE (L: 0.28M, W: 0.25M)

MAX CD: 3,157.0 AT HORIZONTAL: 37.5°, VERTICAL: 72.5°

ROADWAY CLASS: SHORT, TYPE IV

AcuityBrands.

HOLOPHANE®



***TEST BASED ON ABSOLUTE PHOTOMETRY WHERE LAMP LUMENS=LUMENS TOTAL.**

***CUTOFF CLASSIFICATION AND EFFICIENCY CANNOT BE PROPERLY CALCULATED FOR ABSOLUTE PHOTOMETRY.**

VISUAL PHOTOMETRIC TOOL 1.2.46 COPYRIGHT 2020, ACUITY BRANDS LIGHTING.

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LTL22428P4003
VISUAL PHOTOMETRIC TOOL

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PAGE 1 OF 4

ZONAL LUMEN SUMMARY

ZONE	LUMENS	% LUMINAIRE
0-30	506.3	10.6%
0-40	887.4	18.5%
0-60	2,272.5	47.5%
60-90	2,511.8	52.5%
70-100	1,239.3	25.9%
90-120	0.000	0%
0-90	4,784.3	100%
90-180	0.000	0%
0-180	4,784.3	100%

LUMENS PER ZONE

ZONE	LUMENS	% TOTAL	ZONE	LUMENS	% TOTAL
0-10	60.0	1.3%	90-100	0.000	0%
10-20	176.8	3.7%	100-110	0.000	0%
20-30	269.5	5.6%	110-120	0.000	0%
30-40	381.1	8.0%	120-130	0.000	0%
40-50	549.8	11.5%	130-140	0.000	0%
50-60	835.3	17.5%	140-150	0.000	0%
60-70	1,272.5	26.6%	150-160	0.000	0%
70-80	1,073.9	22.4%	160-170	0.000	0%
80-90	165.4	3.5%	170-180	0.000	0%

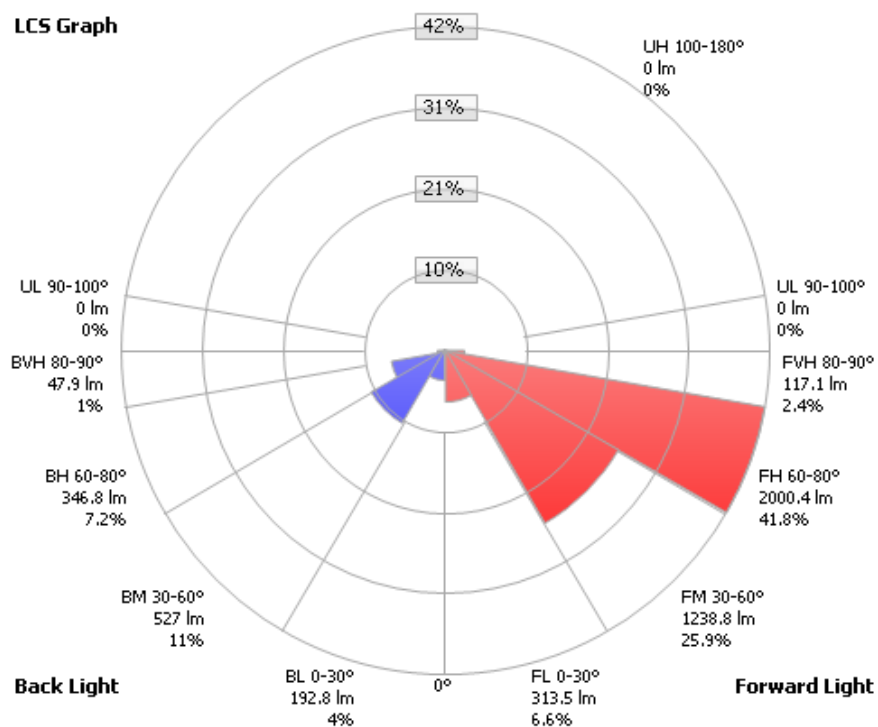
ROADWAY SUMMARY

DISTRIBUTION:	TYPE IV, SHORT	
MAX CD, 90 DEG VERT:	0.000	
MAX CD, 80 TO <90 DEG:	1,138.0	
	LUMENS	% LAMP
DOWNWARD STREET SIDE:	3,669.8	76.7%
DOWNWARD HOUSE SIDE:	1,114.5	23.3%
DOWNWARD TOTAL:	4,784.3	100%
UPWARD STREET SIDE:	0.000	0%
UPWARD HOUSE SIDE:	0.000	0%
UPWARD TOTAL:	0.000	0%
TOTAL LUMENS:	4,784.3	100%

LCS TABLE

BUG RATING	B1 - U0 - G2	
FORWARD LIGHT	LUMENS	LUMENS %
LOW(0-30):	313.5	6.6%
MEDIUM(30-60):	1,238.8	25.9%
HIGH(60-80):	2,000.4	41.8%
VERY HIGH(80-90):	117.1	2.4%
BACK LIGHT		
LOW(0-30):	192.8	4%
MEDIUM(30-60):	527.0	11%
HIGH(60-80):	346.8	7.2%
VERY HIGH(80-90):	47.9	1%
UPLIGHT		
LOW(90-100):	0.000	0%
HIGH(100-180):	0.000	0%
TRAPPED LIGHT:	0.0	0%

LCS Graph



Back Light

Forward Light

Scale = Max LCS %

Trapped Light: 0lm, 0%

CANDELA TABLE - TYPE C

	0	10	20	30	40	50	60	70	80	90	100	110	120	130	140	150	160	170	180
0	610	610	610	610	610	610	610	610	610	610	610	610	610	610	610	610	610	610	610
5	646	660	656	651	646	638	630	624	618	614	609	604	601	597	594	591	590	589	587
10	756	763	760	749	730	701	670	643	625	614	606	599	594	589	584	575	569	564	552
15	766	763	779	796	802	779	726	673	634	616	604	594	583	560	525	485	453	431	393
20	727	733	755	782	811	827	797	715	653	623	605	588	546	470	384	321	292	283	275
25	724	735	755	779	811	841	846	768	680	633	607	571	488	364	289	269	255	249	246
30	746	757	770	790	814	841	862	818	716	648	612	572	470	327	266	242	243	246	245
35	793	799	808	817	830	844	865	853	770	688	648	642	490	307	243	235	237	239	243
40	851	850	862	876	877	876	892	899	837	758	702	726	505	275	239	252	272	272	266
45	941	934	950	970	968	951	958	967	909	831	750	730	497	268	284	334	343	325	323
50	1079	1114	1135	1150	1125	1092	1079	1071	999	920	788	689	486	316	393	439	438	384	328
55	1337	1390	1460	1468	1425	1358	1310	1262	1140	1023	759	538	355	359	485	495	478	423	387
60	1643	1693	1863	1937	1853	1754	1665	1551	1343	1167	639	321	265	319	494	578	531	446	375
65	1974	2035	2307	2480	2365	2235	2136	2021	1731	1486	453	245	237	286	539	525	415	325	274
70	2166	2176	2697	3072	3002	2843	2756	2533	2041	1694	293	209	242	298	466	385	317	248	202
75	1049	960	1655	2501	2829	2782	2585	1957	1189	835	176	163	224	313	310	269	200	150	120
80	187	198	385	637	1004	1102	919	594	308	194	109	134	196	216	222	181	130	88	65
85	74	79	151	177	240	293	270	204	105	60	65	105	139	141	140	112	78	38	26
90	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
95	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
100	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
105	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
110	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
115	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
120	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
125	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
130	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
135	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
140	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
145	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
150	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
155	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
160	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
165	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
170	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
175	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
180	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0