Cardiff and Vale College - Advanced Technology Centre

ATC-ARUP-XX-XX-RP-OL-000001 | RIBA Stage 4 External Lighting Report

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Contents

Introduction

Welcome to the Cardiff and Vale College (CAVC), Advanced Technology Centre (ATC) lighting report. The objective of this report is to set out the lighting strategy, lighting considerations and limiting lighting criteria for consideration at detailed planning.

The report will cover the following:

- Site Context - a breakdown of the scope and routes around the site to determine the lighting strategy.
- Lighting Strategy - the lighting treatments for each location throughout the planned development and the reasons those treatments are selected.
- Lighting Principles - some of the key details that shall be applied when adopting the different lighting treatments.
- Design Criteria - the limiting lighting design criteria based on reference to ecological guidelines, British Standards and best practice guidelines.
- Indicative Layouts - the plans showing indicative luminaire positions and quantities.
- Lighting Schedule - a list of indicative type luminaires for specification.
- Control Strategy - lighting control considerations for development in latter design phases.

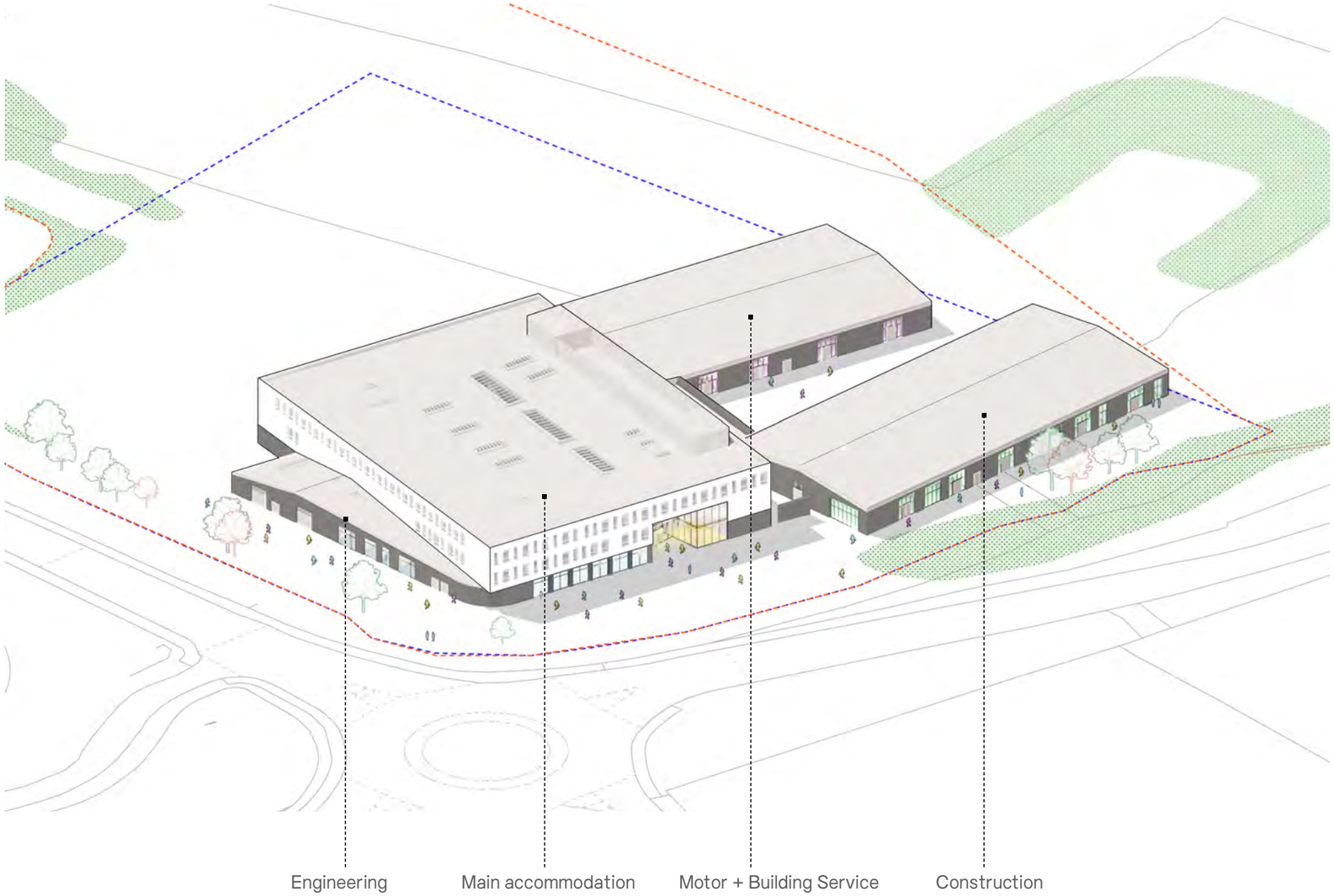


Figure 1: Visual extract of ATC by Sheppard Robson

1 Site Context

1.1 Wider Site Context

The site is adjacent to Cardiff Airport as demonstrated in Figure 2. Figure 3 identifies the prevalent surrounding features of the site:

- Cardiff Airport long stay car park to the south west.
- International Centre for Aerospace Training to the west.
- Retail and commercial units directly adjacent to the west.
- Fields to the north and east, with a residential property (farmhouse) directly across the field to the north-east.
- The site is bounded by roads to the south.

Figure 2: Site location with the proposed site highlighted in red.

Figure 3: Site context with the proposed site highlighted in red.

1.2 Sensitive Receptors

1.2.1 Obtrusive Light, Residential Properties

Obtrusive light can impede the view of the night sky and cause nuisance to people within their properties. This can be minimised by implementing good design practices as detailed in the Institute of Lighting Professional (ILP) Guidance Note 01/21(GN01) for the reduction of obtrusive light. Limiting criteria for light intrusion only apply to nearby dwellings.

There is only one residential property within proximity to the site. This is a farmhouse to the north east. It is situated a considerable distance (over 100 metres), and is obstructed from view by vegetation.

As ecological requirements to the northern and eastern boundaries impose strict limits on light spill, it is considered that any impact on the residential property will be negligible and therefore it is not considered to require further assessment. Please refer to section "3.1 The Reduction of Obtrusive Light" within this report for further details.

1.2.2 Ecology

The ecological appraisal document for the site identified the presence of bats on the site. It recommends:

'Lighting strategy to avoid disturbance of nocturnal species, in particular foraging/commuting bats.'

The ecological consultant has suggested to maintain the southern and eastern boundaries, as identified in Figure 4, as dark corridors. The consultant has recommended target light levels of no more than 0.5 lux at these features.

An attenuation break will be located within the site boundary at the north corner. This will contain wild meadow flowers that must also not be illuminated. As such, the dark corridor is continued along the boundary to the attenuation break.

For further details on the design criteria and light mitigation strategies please refer to section "3.2 Ecological Consideration" within this report.

An existing lighting base-line study to determine the existing light impact to the ecologically sensitive areas has not been conducted by Arup.

1.2.3 Aerodrome

The adjacent Cardiff Airport is a sensitive receptor. Artificial lighting can present a hazard to pilots due to the effect of lighting on the pilot's visual picture and the creation of obstacles within the flight paths around an aerodrome. Please refer to section "3.3 Aerodrome Consideration" within this report for further details.

Figure 4: Identification of ecology and residential sensitive receptors.

Figure 5: Airport sensitive receptors.

1.3 Site Movement and Activity

Access routes define the lighting approach within an exterior/public realm scheme, providing the basis for the visual lighting hierarchy and to inform the proposed illuminance levels around the site.

The access routes have been assessed and determined based on the following:

- What the route used for
- Who uses the route
- How often the route is used

The routes have been broken down into the following categories:

- Primary vehicular route
- Secondary vehicular route
- Primary pedestrian/cyclist route
- Secondary pedestrian/cyclist route

1.3.1 Primary Vehicular Route

The route is predicted have regular vehicular access, with vehicles travelling <30mph. The route is expected to be busy between peak college hours (drop off and collection) and quiet thereafter.

1.3.2 Secondary Vehicular Route

Secondary vehicular routes are situated to the south of the development for servicing and deliveries to the workshops. These routes are expected to be used infrequently (assumed 1-2 times per week) and is categorised as quiet, with vehicles travelling at <30mph.

1.3.3 Primary Pedestrian & Cyclist Route

Primary pedestrian & cyclist routes are predicted to have high foot-fall being used by students, staff and visitors. These routes are primarily to gain access to the main entrances of buildings and dwell locations.

1.3.4 Secondary Pedestrian & Cyclist Route

Secondary routes are predicted to have less foot-fall and used less frequently. The secondary routes are mainly situated around the building perimeter linking the main entrances, dwell and breakout spaces together. There is a central internal space that provides a link to the three workshops, this will likely be the main route and access to all teaching facilities.

Figure 6: Movement plan

Site Movement and Activity

In addition to the access routes, the individual spaces along those routes need to be considered holistically. This approach ensures the lighting treatments and illuminance levels blend seamlessly from area to area based on function and use. Refer to section "3.4 Lighting Treatment Plan" within this report for full details on illumination levels.

Further categories from those listed previously are as follows:

1.3.5 Building Entrances and Primary Dwell Areas

Building entrances shall be the brightest visual statement within the public realm. As the brightest point, they help guide people around the public realm and are easily identifiable landmarks. Well illuminated entrances including the space/route leading to the entrance are critical for way-finding and inclusivity for all users.

1.3.6 Secondary Dwell Areas

A dwell space is an area that is anticipated to be used for students and visitors to socialise during daytime and night-time. P3 is a lighting class categorisation within BS EN 13201-2: 2015 Road Lighting, Selection of Lighting Classes in conjunction with BS EN 12464-2 Light and lighting — Lighting of work places, Part 2: Outdoor work places that recommends the illuminance level for that area.

1.3.7 Servicing & Storage Yards

Loading/unloading areas require higher illumination levels and uniformity for manual tasks involved; moving potentially heavy equipment. Vertical illumination is critical for facial recognition for people and CCTV.

1.3.8 Car Park Spaces

Lighting to the car park areas will be functional focussing on illuminating a wide area utilising as few luminaires as possible.

1.3.9 Accessible Car Park Spaces

As above but illuminated to a higher level, following the guidance of BS 8300-1:2018. This is to assist with manual and visual tasks.

1.3.10 MUGA

The 2 court MUGA has been catergorised as a lighting class III following the guidance of BS EN 12193:2018. The illumination level has been selected based on the size of the court. The courts will only be lit when in use.

Figure 7: Area Categorisation Plan

2 Lighting Strategy

2.1 Lit Environment

The lighting strategy focuses on several key aspects:

1. Provide functional lighting - to the mixed vehicular, pedestrian and cyclist routes, car parks, loading/unloading bays, and security.

2. Promoting routes - using lighting intensity, equipment height and type to direct movement and aid way-finding around the college.

3. Provide a safe, comfortable experience - with an external ambience appropriate for the use of the site.

2. Utilise low-level lighting - in areas adjacent to sensitive ecology to mitigate upward light spill and stray light into sensitive habitats.

5. A balanced light transition - between areas to avoid extremes in contrast.

6. Encourage dwelling - and socialising in external locales.

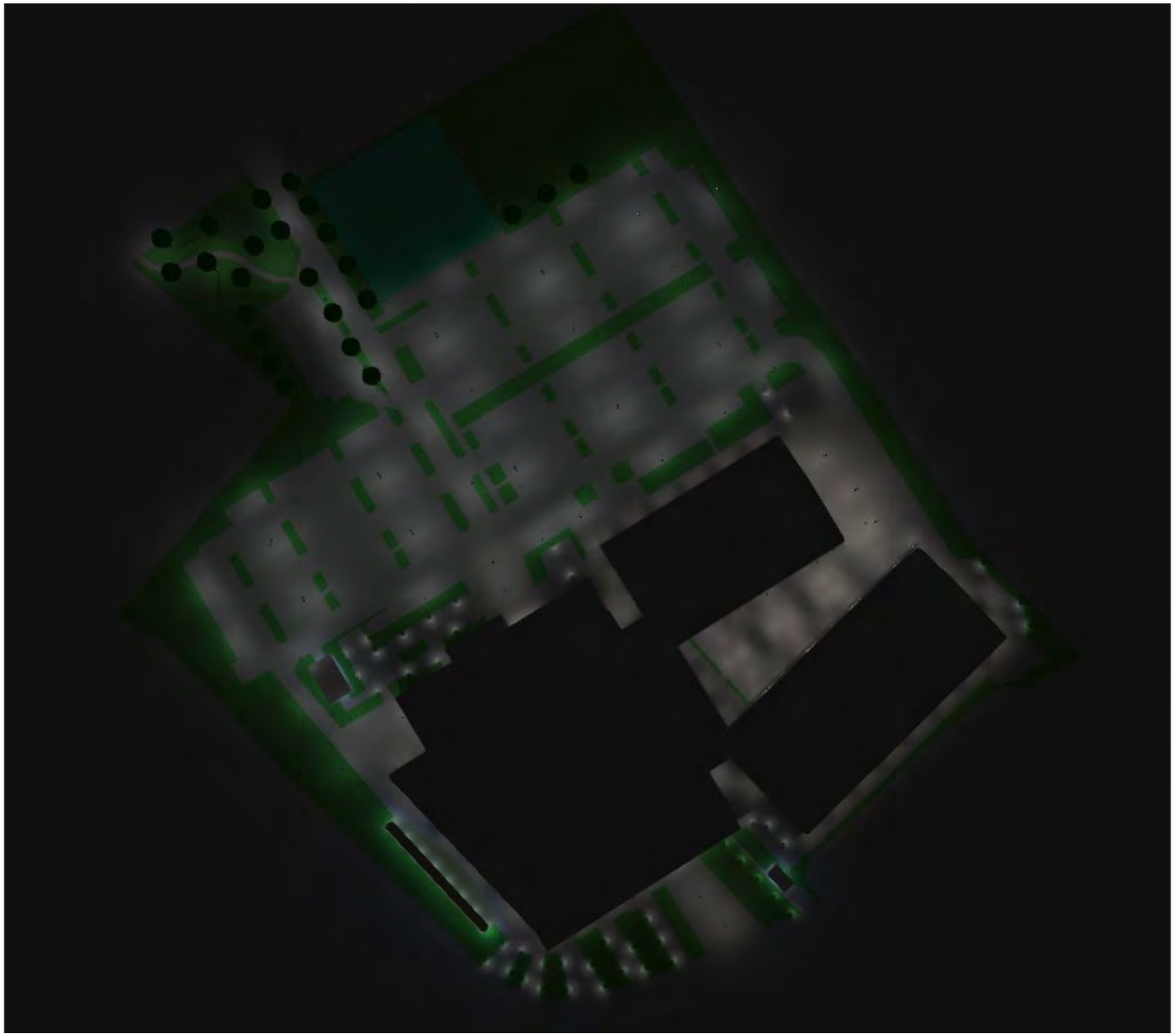


Figure 8: Lighting visualisation

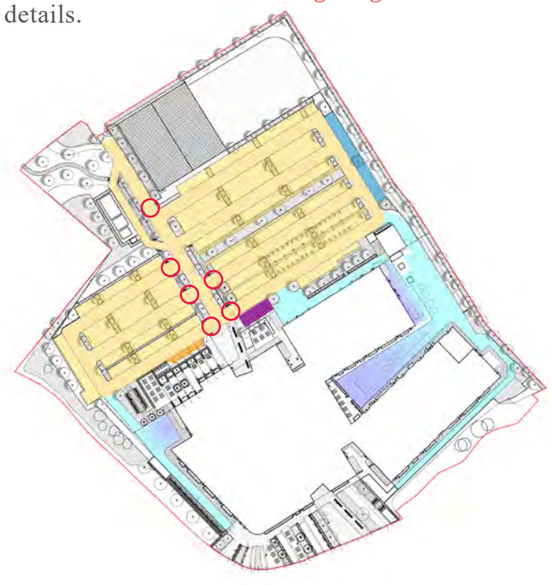
2.2 Vehicular Routes

Including Car Parks, Accessible Spaces, Conflict Areas and Service Areas

- Pole top luminaires - Pole top luminaire attached to an 8m column within the centre of the car park for better coverage and a 6m column around the perimeter of the parking area and along access roads. An area optic has been selected to provide the base lighting levels and good uniformity across site. A mixture of single and double headed fittings are proposed to decrease the number of columns required.
- Wall mounted luminaires - luminaire mounted at 6m along the workshop walls bordering the east service yard.
- Bollards - low-level bollards with an asymmetric optic along the eastern secondary vehicular route to minimise impact to the adjacent sensitive ecology.
- Please refer to section "6 Lighting Schedule" for full luminaire details.

Figure 9: Lighting concept - vehicular routes and parking areas

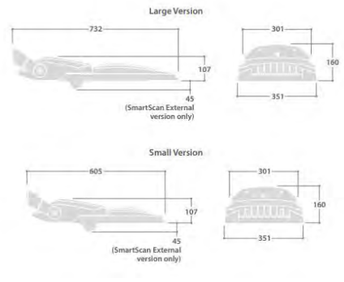
Figure 10: Lighting concept - service & storage yards



- Primary vehicular route & car parking
- Secondary vehicular route
- Accessible parking
- Drop off zone
- Servicing & storage yards
- Car park bays adjacent to sensitive ecology
- Conflict areas

Figure 13: Key Plan

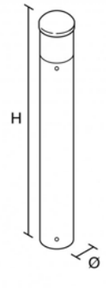
Luminaire type EXD, EXN



Large: 732mm(l) x 107mm (w) x 160mm (h)
Small: 605mm(l) x 107mm (w) x 160mm (h)

Luminaire type EXA, EXB, EXC

Luminaire type EXF



998mm(h) x 152mm(Ø)

Figure 11: Indicative luminaire image and dimensions

Figure 12: Lighting concept - bollards to sensitive areas

2.3 Pedestrian and Cyclist Routes

Including Cycle Shelters

- Pole top luminaires - Pole top luminaire attached to a 6m column with an area optic to provide the base lighting levels and good uniformity across site. Columns provide higher levels of illumination within the parking and conflict areas.
- Wall mounted luminaires - luminaire with forward throw distribution mounted at 3.8m across the building perimeter. Luminaires situated above secondary entrances to aid wayfinding.
- Linear luminaire - linear batten with a wide distribution mounted to the soffit of enclosed cycle shelters for area lighting.
- Please refer to section "6 Lighting Schedule" for full luminaire details.

Primary pedestrian route

Secondary pedestrian route

Cycle storage

Figure 18: Key Plan

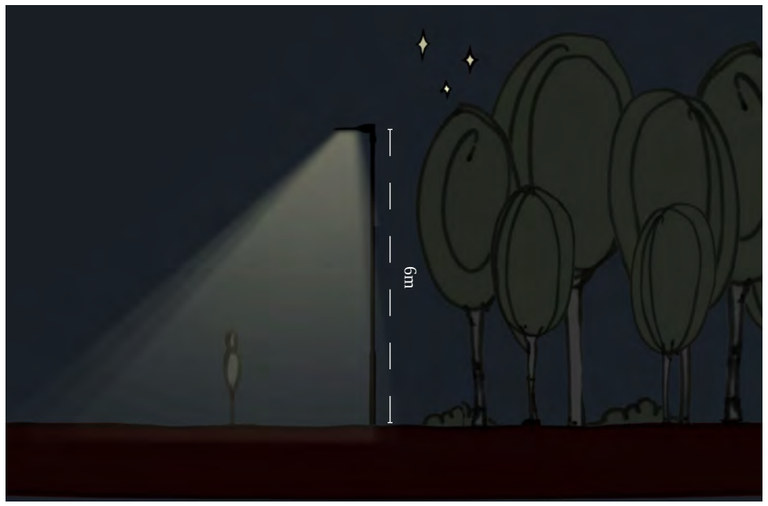


Figure 14: Lighting concept - primary routes

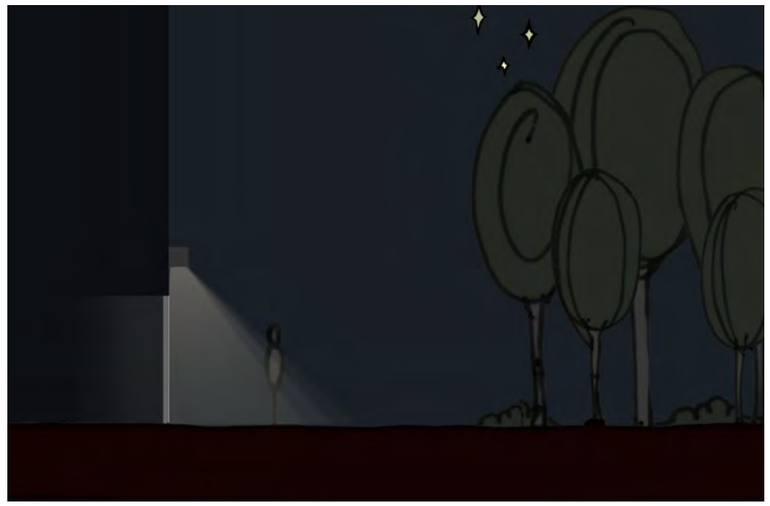
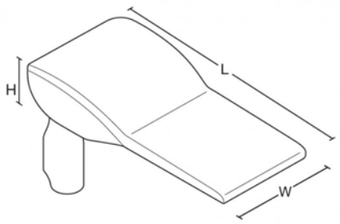


Figure 15: Lighting concept -secondary routes

Luminaire type EXA, EXB, EXC



558mm(l) x 293mm (w) x 115mm (h)

Luminaire type EXM
658mm(l) x 145mm (w) x 101mm (h)

Luminaire type EXE

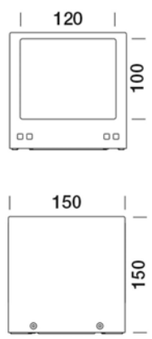


Figure 16: Indicative luminaire image and dimensions

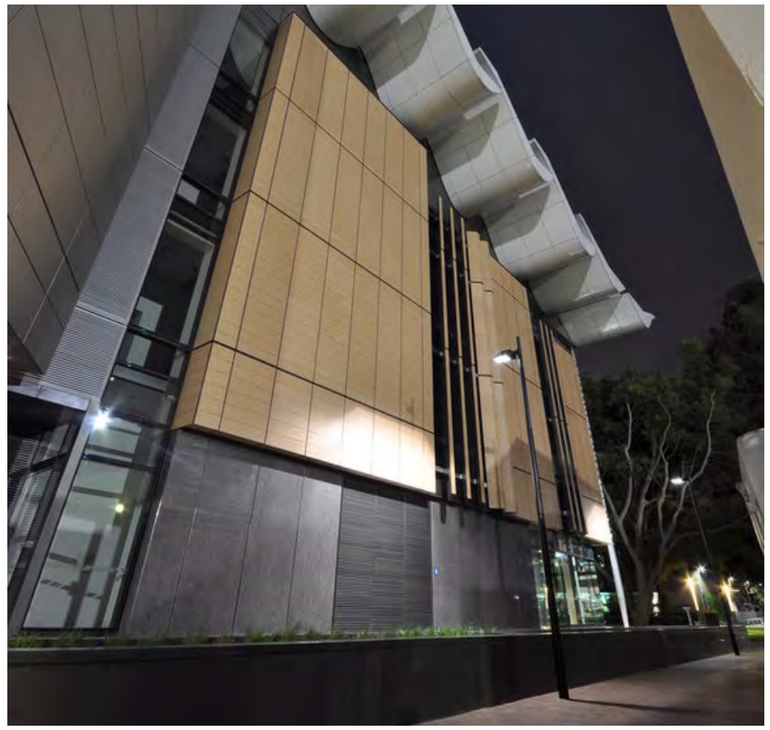
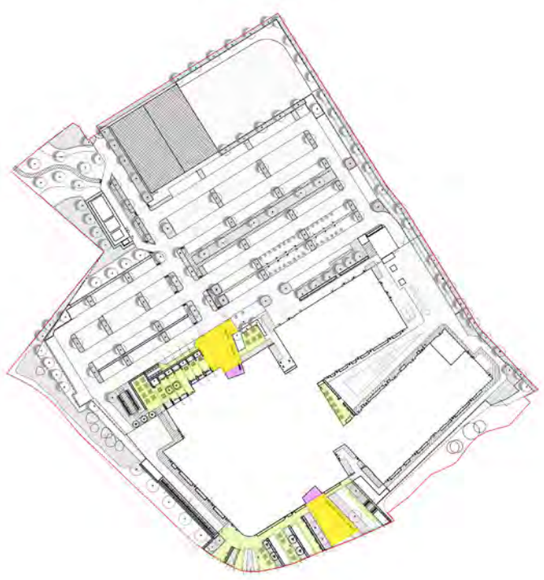


Figure 17: Column lighting reference image - Technology Building University of New South Wales © Arup

2.4 Dwell Areas and Entrances

- Pole top luminaires - Circular pole top luminaire attached to a 4m column with a symmetrical light distribution. The different aesthetic helps identify the main approach to the site and building.
- Bollards - low-level bollards located within the dwell areas among planters and benches to provide a comfortable ambience.
- Downlights - recessed downlights with a wide distribution mounted to the soffit of the main entrance canopies to provide higher levels of horizontal illuminance and good vertical illuminance above entrance doors.
- Please refer to section "6 Lighting Schedule" for full luminaire details.



Main approach

Dwell areas

Main building entrances

Figure 23: Key Plan

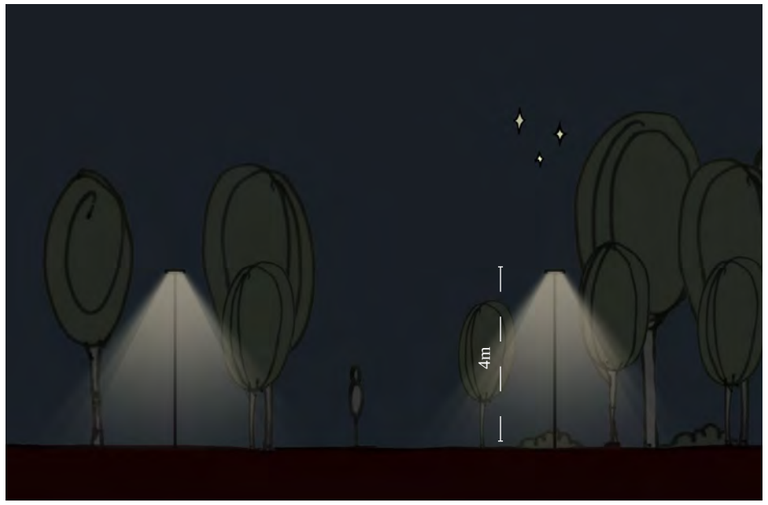


Figure 19: Lighting concept - primary routes

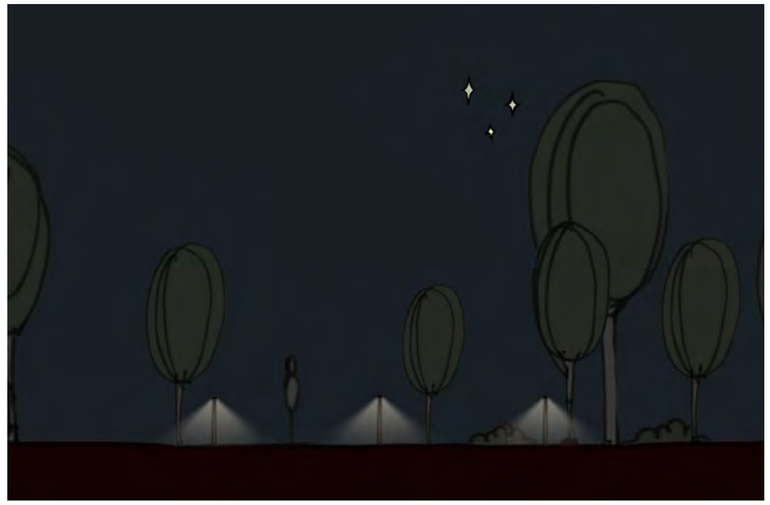
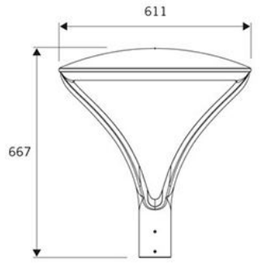


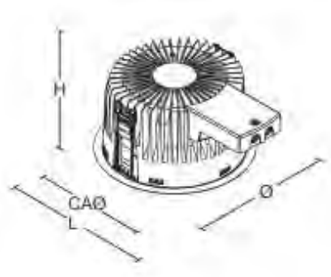
Figure 20: Lighting concept -secondary routes

Luminaire type EXH



Luminaire type EXF

Luminaire type EXG



270mm(l) x 220mm (w) x 147mm (h)

Figure 21: Indicative luminaire image and dimensions

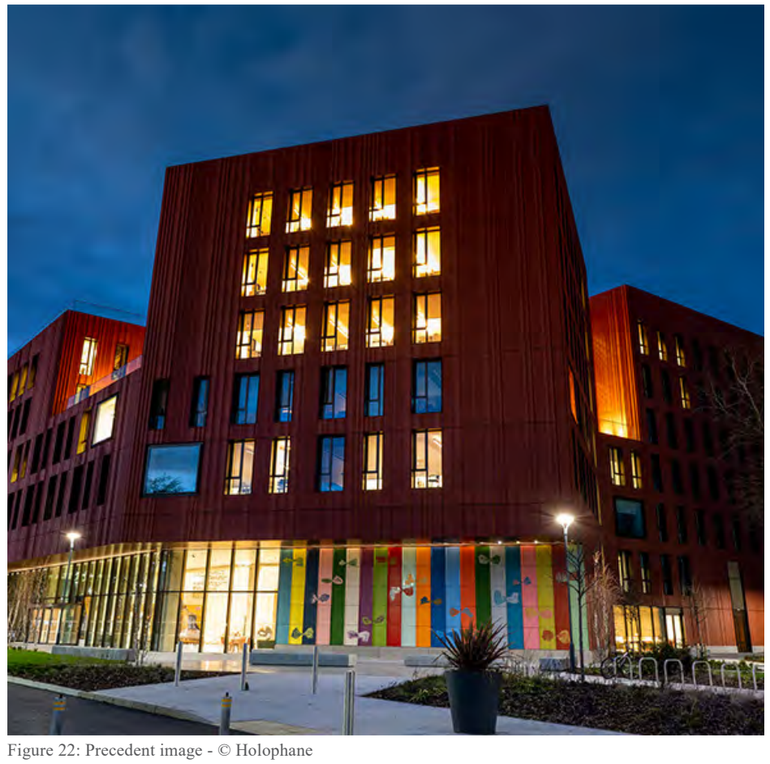
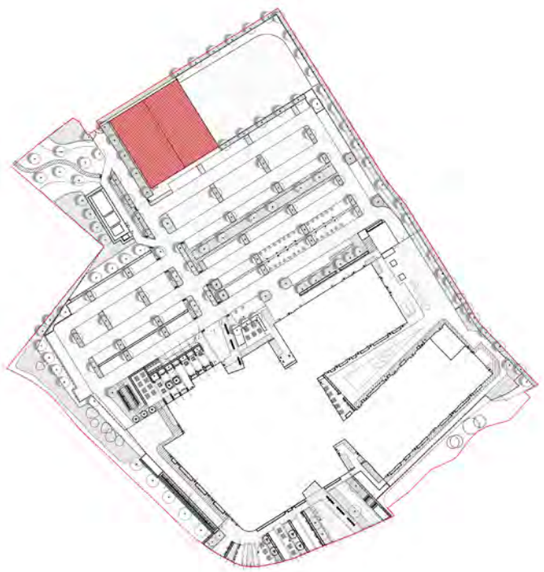


Figure 22: Precedent image - © Holophane

2.5 MUGA

- Pole top luminaires - Pole top luminaire attached to a 10m column with an area floodlight distribution to provide the base lighting levels and good uniformity across the MUGA courts. A mixture of double and triple head columns have been proposed to reduce the number of columns required.
- Please refer to section "6 Lighting Schedule" for full luminaire details.



2 Court MUGA

Figure 26: Key Plan

Figure 27: Precedent image - © Thorlux

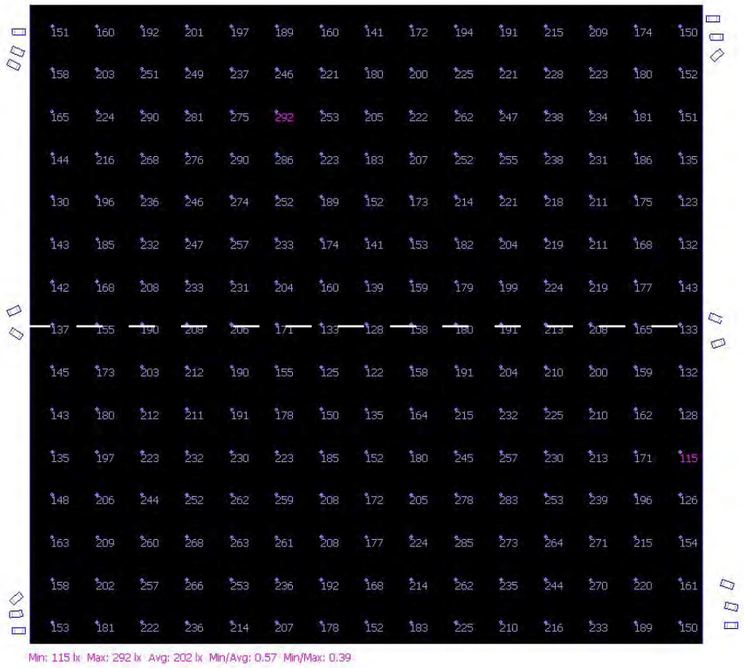


Figure 25: Calculation extract

Luminaire type EXJ & EXK

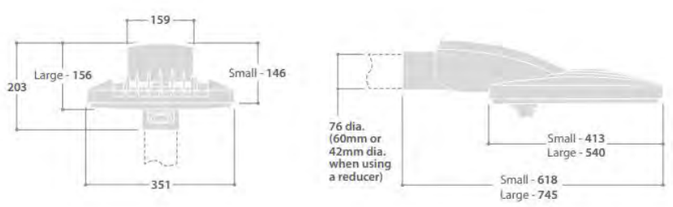


Figure 24: Indicative luminaire image and dimensions

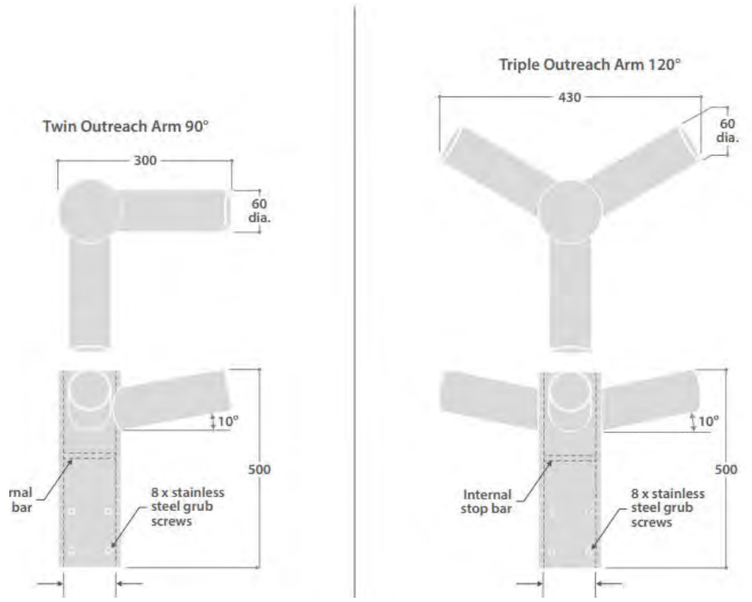


Figure 28: Indicative luminaire mounting details

3 Design Criteria

3.1 The Reduction of Obtrusive Light

The CAVC, ATC is situated in a sparsely inhabited, rural area approximately 1 mile north of the village Rhoose, Cardiff.

Despite the site being in close proximity to Cardiff airport, this document proposes that the site's existing area and context is classified as being within an E2 zone due to the site's mostly rural surrounding. While the skies may be relatively brighter around the airport, it is still important to limit light obtrusion from the surrounding areas especially within a darker zone. It is important to protect the heritage of the night sky and nocturnal environment. Furthermore, light obtrusion manifests itself as unnecessary energy waste and a contributor to climate change.

An E2 zone is defined within the Institute of Lighting Professionals (ILP) GN01: Guidance Notes for the Reduction of Obtrusive Light (GN01) as low district brightness, Table 1.

Establishing the environmental zone helps to set the limiting lighting criteria to mitigate light obtrusion. The characteristics of light obtrusion are:

- Light Intrusion: stray light beyond the task area onto neighbouring dwellings or sensitive receptors.
- Source Intensity: how bright the light source appears to an observer.
- Sky Glow: a combination of Direct Upward Light and Indirect Upward Light. This effect is often seen as a glow in the night sky. Sky glow can be quantified in terms of upward flux and upward light output ratio which is the percentage of the luminaire output emitted above the horizontal plane.

Light obtrusion characteristics are shown graphically in Figure 30.

Any future design shall consider the ILP lighting criteria associated with an E2 environmental zone and demonstrate compliance.

Figure 29: Site context

Zone	Surrounding	Lighting Environment	Examples
E0	Protected	Dark (SQM 20.5+)	Astronomical observable dark skies, UNESCO starlight reserves, IDA dark sky places.
E1	Natural	Dark (SQM 20 to 20.5)	Relatively uninhabited rural areas, National Parks, Areas of Outstanding Natural Beauty, IDA buffer zones etc.
E2	Rural	Low district brightness (SQM ~15 to 20)	Sparsely inhabited rural areas, village or relatively dark outer suburban locations.
E3	Suburban	Medium district brightness	Well inhabited rural and urban settlements, small town centres of suburban locations.
E4	Urban	High district brightness	Town/city centres with high levels of night-time activity.

Table 1: Environmental Zones

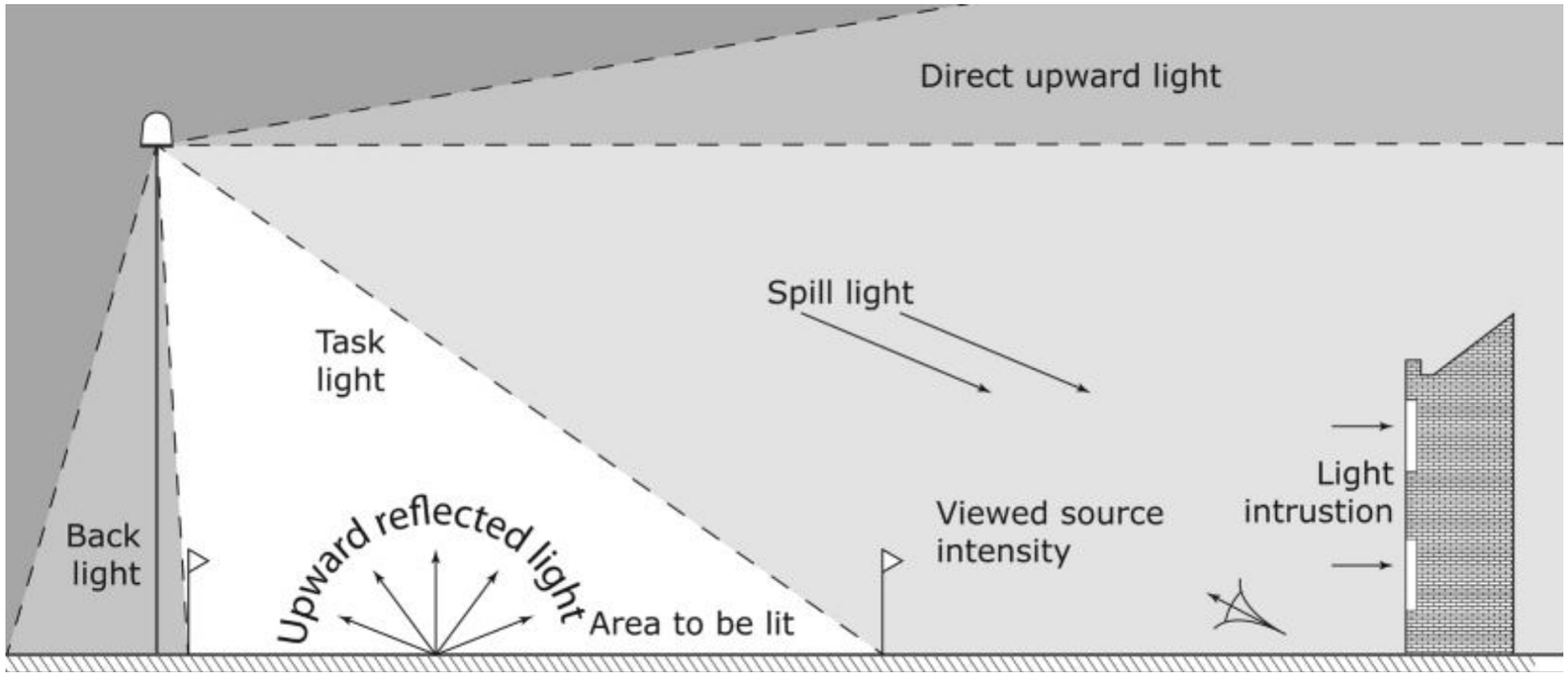


Figure 30: Light obtrusion characteristics - extract from ILP GN01

3.2 Ecological Consideration

Guidance Note 08 (GN08) Bats and Artificial Lighting (Institute of Lighting Professionals, 2023) is referred to as a benchmark for the lighting criteria to the ecologically sensitive areas. GN08 criteria includes:

- Illuminance levels should be as low as possible with 0 lux required at bat roosting locations.
- Guidance on appropriate lighting technology
- General guidance on how to minimise the impact of lighting to bats

The maximum permitted vertical illuminance level recommended by the ecologist is 0.5 lux along the proposed dark corridor as illustrated in Figure 31.

GN08 states that "*It is acknowledged that, especially for vertical calculation planes, very low levels of light (<0.5 lux) may occur even at considerable distances from the source if there is little intervening attenuation*". [4]

Vertical illuminance levels are taken at >1.5m above ground level and up to the tallest tree, to replicate the likely location of bats using the feature.

No limiting horizontal illuminance levels have been provided by the ecologist.

The maximum vertical illuminances along the proposed dark corridor have been recorded in Figure 31. The calculation has been carried out with a maintenance factor of 1 as a 'worst-case' scenario as installed on day one. The results are also unobstructed, with no objects such as trees and fences included in the model.

The highest levels recorded are adjacent to the car park. The use of back shields and a lighting control system can help mitigate light spill onto the sensitive ecological areas. Section 3.2.1 further explains the mitigation methods. The vertical illuminances along the boundary towards the south of the site are within the recommended limits.

The MUGA lighting has not been included in the calculation to assess vertical illuminances. The MUGA will have an impact on the attenuation zone and nearby ecology. However, it is assumed that the MUGA will only be lit at night for limited periods of time, and shall have the ability for scheduling via a lighting control system.

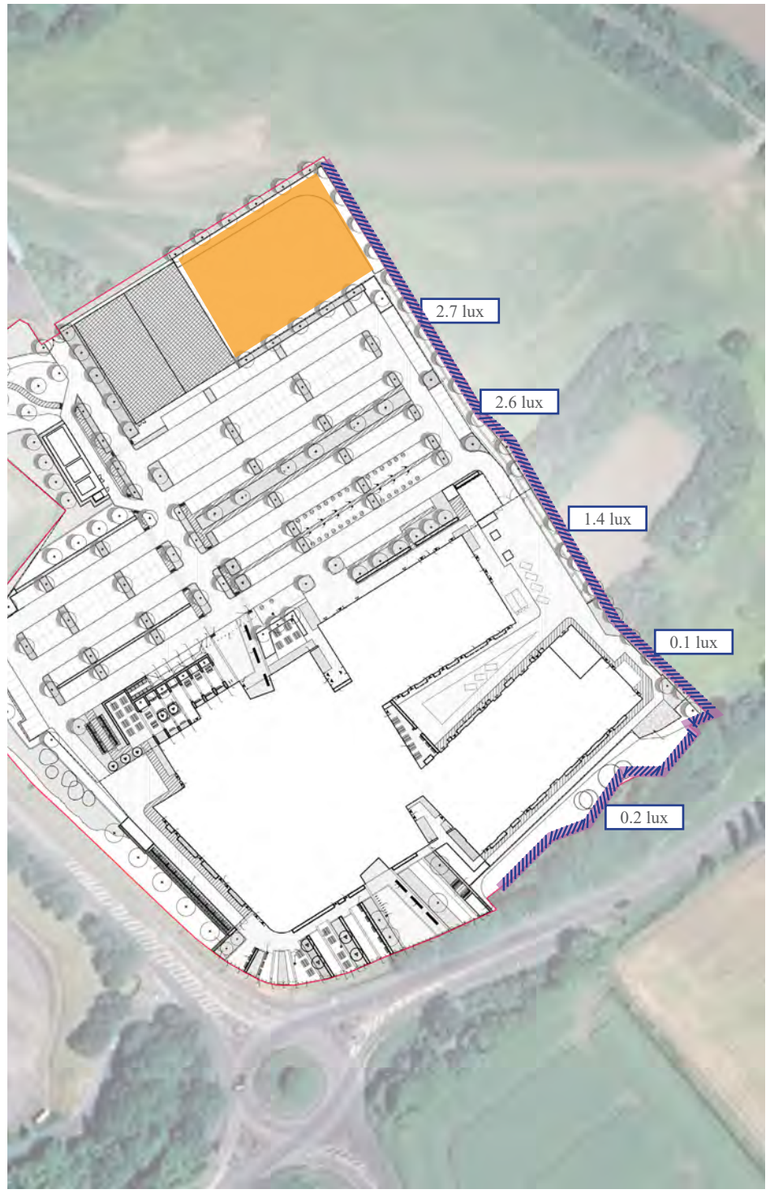


Figure 31: Vertical illuminance levels mapped on plan

4. ILP GN08 - Bats and Artificial Lighting

Ecological Consideration

3.2.1 Mitigation Methods

While adhering to the limiting vertical illuminance criteria the following mitigation methods shall be used:

- Light source - Typically an LED source is considered to be more appropriate to reduce the impact to bats as it has less UV component and good colour rendition.

- Colour temperature - GN08 recommends a warm white colour temperature should be used to reduce the amount of blue light component. It is proposed to utilise a 3,000K (warm white), LED source across the site.

- Lighting controls - Using a lighting control system ensures that lighting is only used in areas of the public realm when it is needed and limits light exposure to ecologically sensitive areas. Refer to section 8 "Lighting Control" on page 31 for more details.

- Glare control accessories - Lanterns shall have the ability to be fitted with back shields so that backward light spill can be minimised.

3.3 Aerodrome Consideration

The CAVC, ATC site is situated in close proximity to Cardiff Airport, approximately 650m north-east of the runway strip - Figure 32.

Consideration has been given to the potential effect of lighting upon the pilot within the flight paths around the aerodrome.

The following British Standards have been considered for the CAVC, ATC external lighting design:

- BS EN 5489-1:2020 Lighting of Roads and Public Amenity Areas
- BS EN 13201-2: 2015 Road Lighting, Selection of Lighting Classes

Following the guidance in the standards above and other current best practice guidelines for the reduction of obtrusive light, the following lighting principles and criteria shall be implemented within the design.

All external column mounted luminaires shall:

- have an upward light ratio (ULR) of 0
- be mounted horizontally with a 0° tilt angle
- be installed with a G*4 intensity class or higher to minimise glare
- be directed away from the site boundary to minimise spill light
- not be positioned within a pattern similar to runway lighting*

*The column mounted luminaires illuminate the car park, entrance road and MUGA courts only. The luminaires are positioned within a grid formation. The site does not contain a singular, continuous row of luminaires and is considerably smaller than the length of the runway strip, therefore it should not be confused with approach or runway lighting. Refer to section "5 Proposed Lighting Layout" for further details.

Consideration has also been given to the safeguarded obstacle limitation surfaces to ensure the external lighting columns will not affect safe use of an aerodrome. Figure 33 illustrates the extent of the obstacle limitation surfaces (OLS) surrounding the aerodrome, generally the OLS varies between 10-15km depending on the length and type of runway.

All external lighting columns within the scheme are below the height of the CAVC,ATC building (≤10m) therefore no further analysis will be carried out.

Figure 32: CAVC, ATC - Surrounding site context. Source: Google Earth

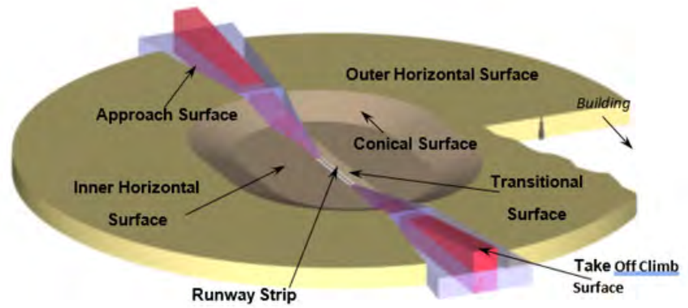


Figure 33: Obstacle Limitation Surfaces (OLS) - Illustration

3.4 Lighting Treatment Plan

The following British Standards, codes and best practice guidelines have been considered for the development of the external illuminance level criteria at CAVC, ATC:

- BS EN 5489-1:2020 Lighting of Roads and Public Amenity Areas
- BS EN 13201-2: 2015 Road Lighting, Selection of Lighting Classes
- BS EN 13201-3:2015 Road Lighting, Performance Requirements
- CIBSE/SLL Lighting Guide 6 - Lighting of the Outdoor Environment
- CIBSE/SLL Lighting Guide 16 - Lighting for stairs
- BS 12464-2:2014 - Lighting of Work Places, Outdoor Work Places
- BS 8300-1:2018 Design of an accessible and inclusive built environment
- ILP GN01: Guidance Note 1 for the Reduction of Obtrusive Light
- ILP GN08: Bats and Artificial Lighting

Type		Lighting classification	Maintained Horizontal Illuminance			Additional Requirements			Additional Notes
			Average in Lux (Ēa)	Minimum in Lux (Emin)	Uniformity (Uo)	Vertical min Lux (Ev, min)	Cylindrical min Lux (Esc, min)	Glare (R_{GL})	
	Car Park and entrance road	-	10	-	0.25	-	-	<50	BS EN 5489: Medium traffic BS EN 12464
	Vehicular conflict areas	C4	10	-	0.4	-	-	<50	BS EN 13201-2
	Vehicular access	P4	5	1	-	-	-	<50	BS EN 5489: Quiet, vehicles <30mph (within an E2 zone) and BS EN 13201-2. Increased from P5 to P4 to reduce contrast to adjacent areas.
	Secondary route (Pedestrian & cyclists)	P4	5	1	-	-	-	<50	BS EN 13201-2 BS EN 12464
	Entrance approach	P2	10	2	-	3	2	<50	BS EN 13201-2
	Service/storage areas (criteria only required temporarily during times of use).	-	20	-	0.25	-	-	<55	BS EN 12464 : Table 5.7
	Dwell areas (Pedestrians & cyclists)	P3	7.5	1.5	-	-	-	<50	BS EN 13201-2
	MUGA	-	200	-	0.6	-	-	<55	BS EN 12193 : Lighting Class III, Table A.16
	Main entrances to buildings	-	-	100	-	-	-	<50	BS 8300-1
	Drop off zone	C3	15	-	0.4	-	-	<50	BS EN 13201-2
	Accessible car park spaces	-	20	-	0.4	5	5	<50	BS EN 5489 & BS 8300-1
	Bicycle parking	-	100	-	0.25	-	-	-	BS EN 5489
	Sensitive ecology	-	-	-	-	-	-	-	Area not lit.

Table 2: Illuminance level criteria per location

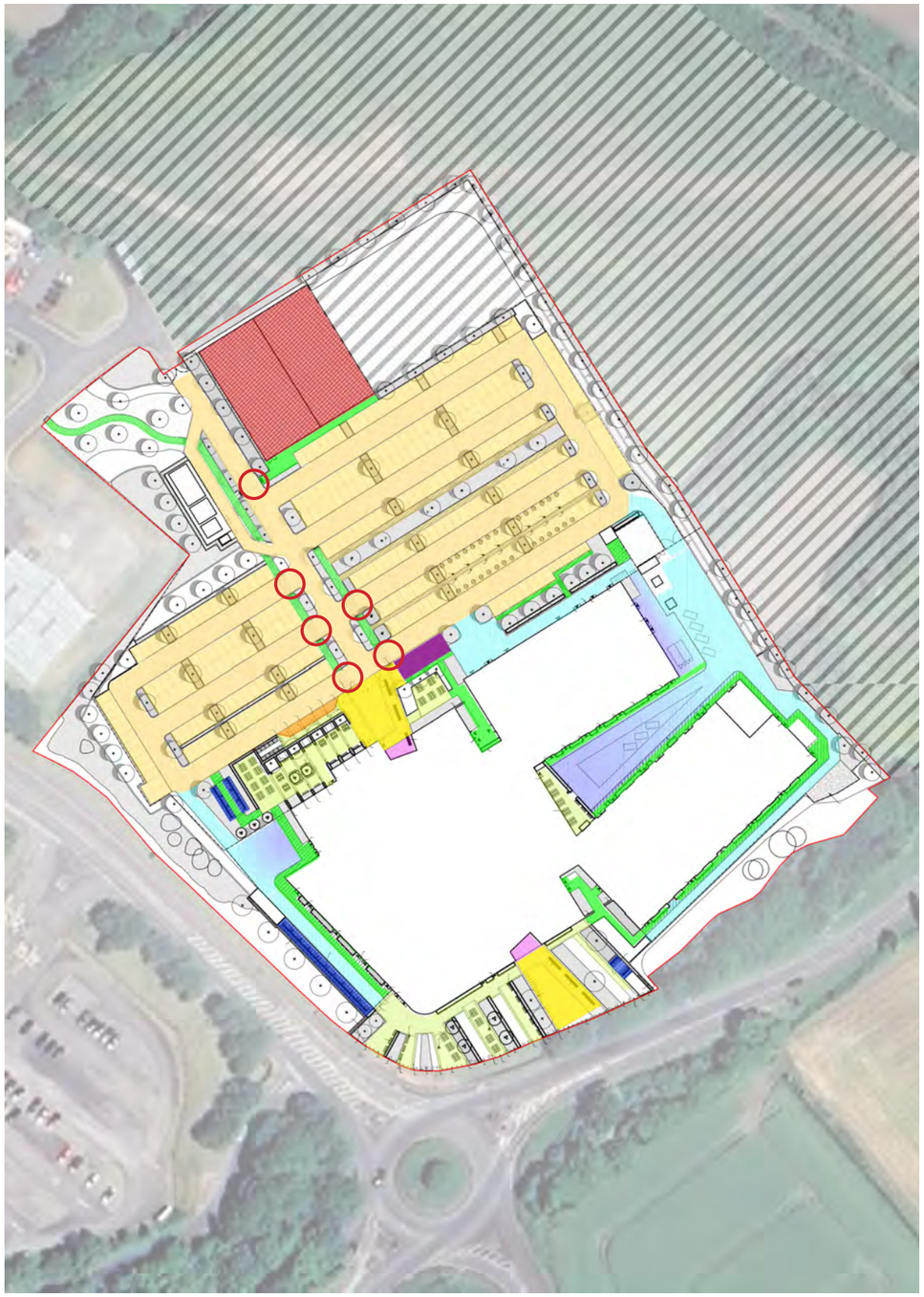


Figure 34: Lighting treatment plan

4 Lighting Principles

4.1 Column Mounted Lighting

4.1.1 Luminaire Selection

The luminaire selection for column mounted lighting have been carefully selected considering the following criteria:

- Optical control - beam angles/beam shaping
- Tilt - only 0° is acceptable to prevent impact to ecology. Refer to Figure 35.
- Glare control - back shields on street lights to limit light spill onto sensitive ecological areas. Please refer to Figure 36.
- Column height - 6-8m is recommended to limit visual impact while providing a wide distribution of lighting using fewer luminaires.

Figure 35: Luminaire with 0° tilt to prevent upward light spill

Figure 36: Use of back shields to prevent stray light to woodland areas

4.2 Bollard Lighting

The vehicular route adjacent to the south-east boundary of the site Figure 39 utilises bollard lighting.

Bollards that utilise the following performance requirements are selected because of the proximity to ecologically sensitive habitats.

- 180° distribution - to illuminate roads that are adjacent to woodlands with potential of light sensitive habitats. The light is thrown forwards and downward to illuminate the road/path while limiting light spill.
- >1m height - keep the lighting at low-level so that upward light spill is mitigated and is lower than common flying height of a bat[2].

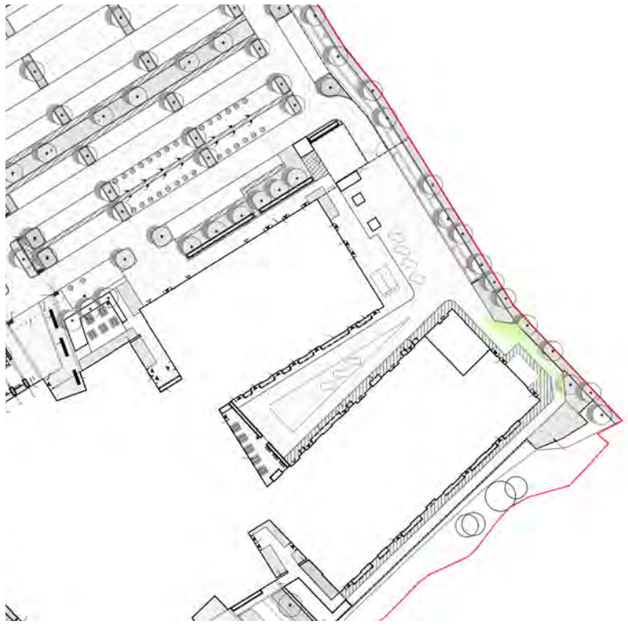


Figure 39: Location of bollard lighting on site

Figure 37: 180° distribution

Figure 38: Indicative luminaire type with asymmetrical distribution

Figure 40: Low-level luminaire with no direct upward light emission

2. ILP GN08 - Bats and Artificial Lighting

4.3 Light Colour

4.3.1 Colour temperature

The colour of light; be it warm light or a cool light is described as colour temperature and is measured in Kelvin (K). The lower the number, the warmer the light. The higher the number, the cooler the light. Please refer to Figure 41 as a guide.

The choice of colour temperature is a matter of aesthetics, ambience and function of the space. Typically, warmer colour temperatures are used in environments that promote relaxation, while intermediate and cooler colour temperatures are functional.

The use of 3,000K (warm white) is recommended for use across the CAVC, ATC site with 4,000K (neutral white) used across the MUGA courts only.

A 4,000K colour temperature provides functional illumination. 3,000K is recommended for areas that are in proximity to sensitive ecology.

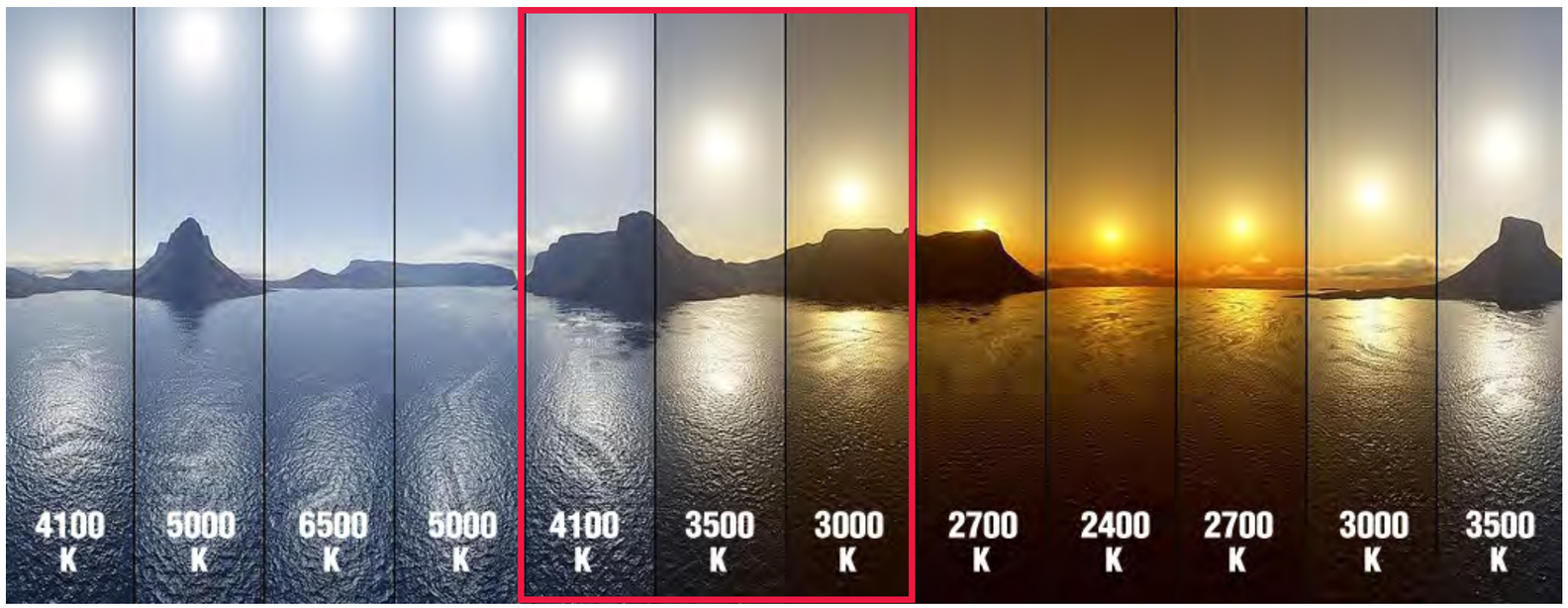


Figure 41: Colour temperature guide

4.3.2 Colour rendering

Not to be confused with colour temperature; colour rendering is how well the light makes the colour of an object appear to the human eye and how well subtle variations in colour shades are revealed.

The Colour Rendering Index (CRI) is a scale from 0 to 100 indicating how accurate a light source is at rendering colour when compared to a reference light source. Please refer to Figure 42. Good colour rendering enables users of a space to appreciate its context; textures, colours and materials.

The use of CRI ≥80 is recommended throughout the external areas/ public realm of the site.

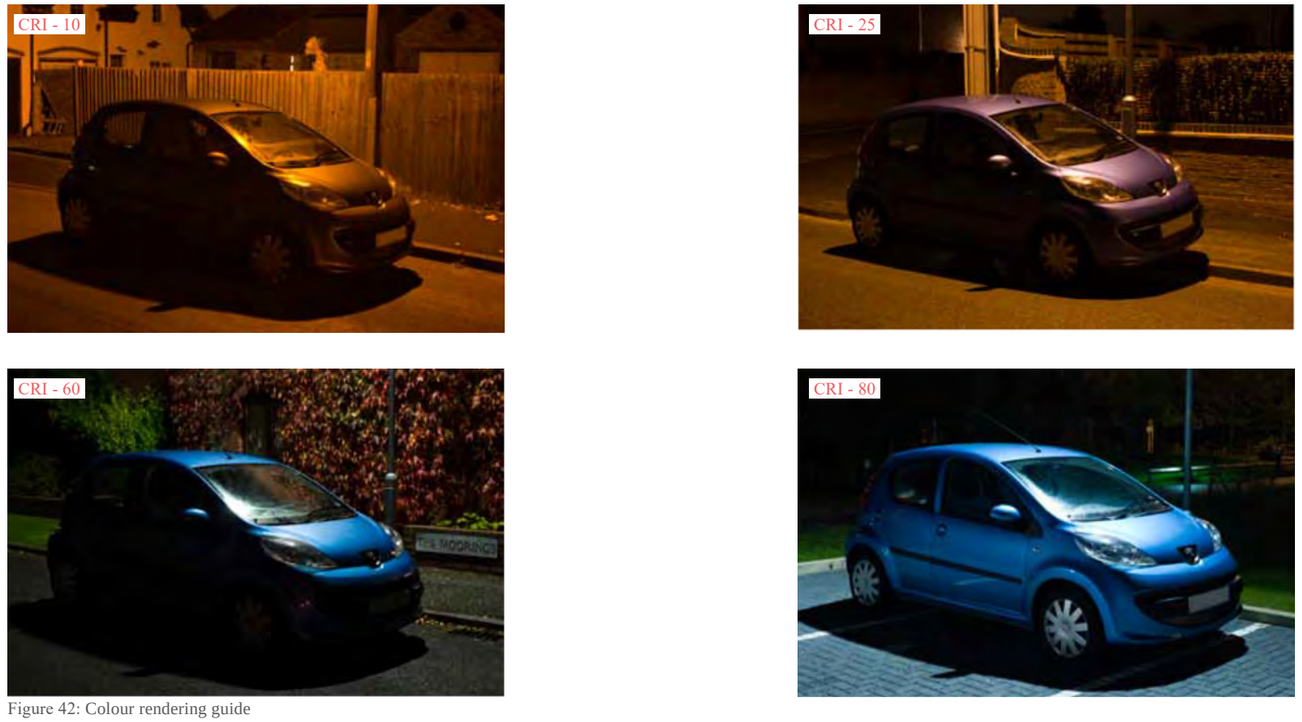


Figure 42: Colour rendering guide

5 Proposed Lighting Layout

Proposed Lighting Layout

Luminaire Symbol	Luminaire Reference	Description	Image	Wattage
	EXA	Single head 8m column		34W
	EXB	Double head 8m column		
	EXC	Single head 6m column		
	EXD	Wall-mounted at 6m		35W
	EXE	Wall-mounted at 3.8m		16W
	EXF	Bollard		5W
	EXG	Recessed downlight		35W
	EXH	Symmetrical 4m column		25W
	EXJ	Triple head column 10m		297W
	EXK	Double head column 10m		
	EXM	Surface mounted linear batten to bike shelter soffit		35W
	EXN	Double head 6m column		35W

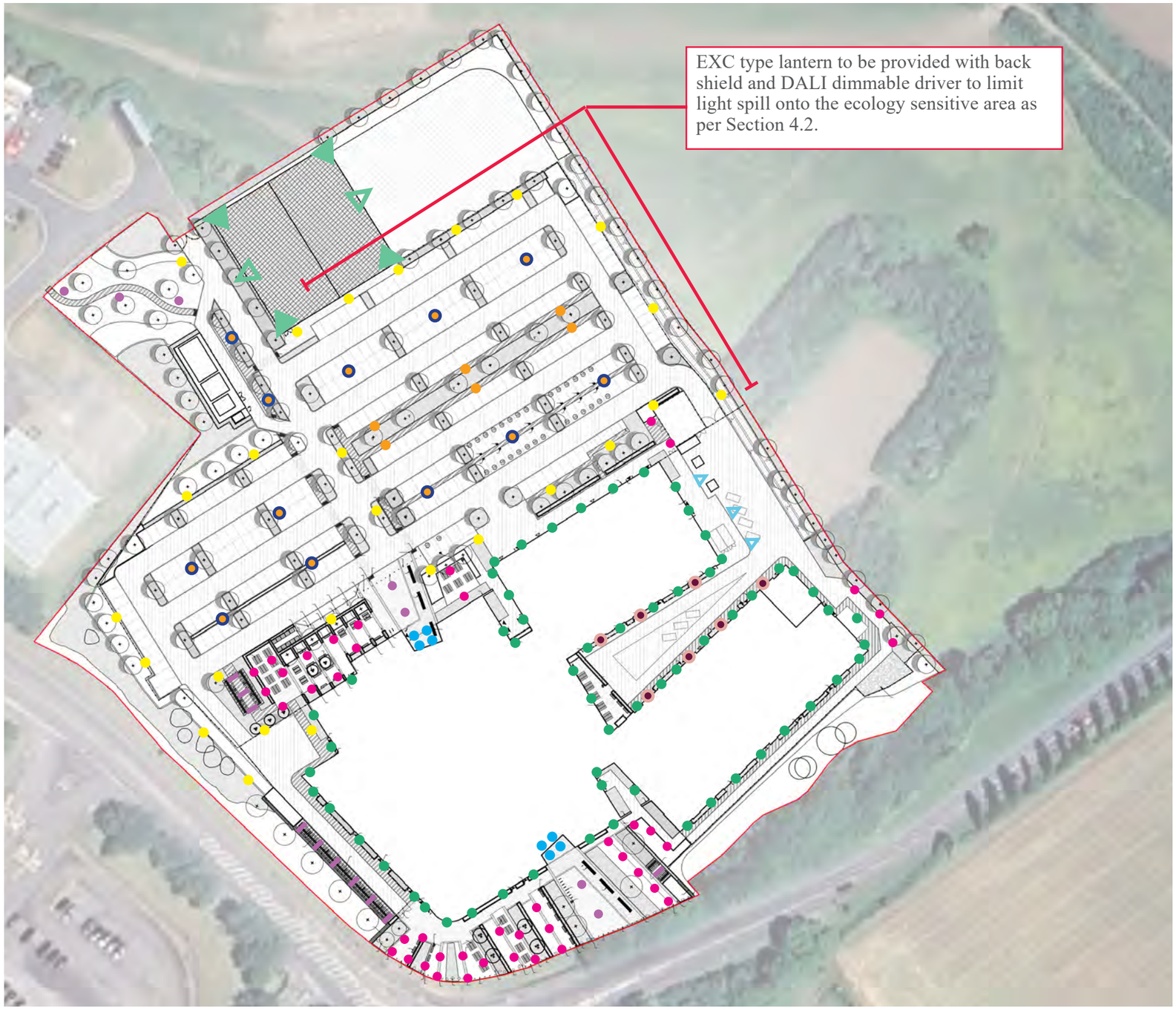


Figure 43: Indicative lighting layout

6 Lighting Schedule

Lighting Schedule

Luminaire Reference	Location	Image	Indicative Manufacturer	Model	Mounting Type	Optic/Beam Angle	Light Source	Dimming Protocol	Wattage (W)	Rated Luminous Flux (Lm)	Colour Temp (K)	Colour Rendering Index	Colour Deviation (SDCM)	IP / IK rating	Lifetime basis	Luminous intensity class (G*)	Comments
EXA	Car Park		Whitecroft	Sirocco Midi	Pole Top	Area	LED	DALI	34W	4500 lm	3,000	70	3	66 / 08	L90 at 100K hrs	G*4	1. Column/pole height 8m 2. Column/pole allows for a Ø46 to Ø76mm post top or side entry spigot 3. To be supplied with root or flange plate mounting accessories
EXB (double head)	Car Park		Whitecroft	Sirocco Midi	Pole Top	Area	LED	DALI	34W	4500 lm	3,000	70	3	66 / 08	L90 at 100K hrs	G*4	
EXC	Car Park perimeter & access roads		Whitecroft	Sirocco Midi	Pole Top	Area	LED	DALI	34W	4500 lm	3,000	70	3	66 / 08	L90 at 100K hrs	G*4	1. Column/pole height 6m 2. Column/pole allows for a Ø46 to Ø76mm post top or side entry spigot 3. To be supplied with root or flange plate mounting accessories 4. Dimmable DALI driver required for identified areas 5. To be supplied with backsheilds.
EXD	East service yard		Thorlux	Starbeam Plus	Wall mounted	Flood	LED	DALI	31W	3975 lm	3,000	70	3	66 / 08	L90 at 100K hrs	G*6	1. Mounted at 6m
EXE	Building perimeter		Holophane	one 2.0	Wall mounted	Asymmetrical	LED	DALI	17W	1200 lm	3,000	80	3	65 / 08	L90 at 100K hrs	G*6	1. Mounted at 3.8m
EXF	Dwell areas		Whitecroft	Kolo Bollard	Root	180 degree	LED	DALI	5.2W	410 lm	3,000	80	3	66 / 10	L80 at 54k hrs	N/A	1. To be supplied with root mounting accessories 2. Finish TBC by Architect
EXG	Building main entrances		Whitecroft	Mirage 3	Recessed	Symmetric wide beam distribution	LED	DALI	35W	3359 lm	3,000	80	3	65 /10	L90 at 100K hrs	N/A	1. Provided with integral DALI dimming driver, contained within body.
EXH	Building approach and north entrance		Holophane	Signature	Pole Top	Symmetrical	LED	DALI	25W	3200 lm	3,000	80	3	65	L70 at 100K hrs	G*6	1. Column height 4m

Lighting Schedule

Luminaire Reference	Location	Image	Indicative Manufacturer	Model	Mounting Type	Optic/Beam Angle	Light Source	Dimming Protocol	Wattage (W)	Rated Luminous Flux (Lm)	Colour Temp (K)	Colour Rendering Index	Colour Deviation (SDCM)	IP / IK rating	Lifetime basis	Luminous intensity class (G*)	Comments
EXJ (triple head)	MUGA		Thorlux	Starbeam Plus	Pole Top (special mounting bracket)	Flood	LED	DALI	297W (per head)	37000 lm (per head)	4,000	70	3	66 / 08	L90 at 100K hrs	G*6	1. Column height 10m 2. To be supplied with manufacturer's propriety triple floodlight bracket 3. To be supplied with root or flange plate mounting accessories
EXK (double head)	MUGA		Thorlux	Starbeam Plus	Pole Top (special mounting bracket)	Flood	LED	DALI	297W (per head)	37000 lm (per head)	4,000	70	3	66 / 08	L90 at 100K hrs	G*6	1. Column height 10m 2. To be supplied with manufacturer's propriety twin floodlight bracket 3. To be supplied with root or flange plate mounting accessories
EXM	Bike shelters		Whitecroft	ACL Extreme	Surface	Diffuse	LED	DALI	35W	4006 lm	3,000	80	3	65	L80 at 54k hrs	N/A	1. Mounted to bike shelter soffit
EXN (double head)	East storage yard and access road		Thorlux	Starbeam Plus	Pole Top (special mounting bracket)	Area	LED	DALI	35W	3800 lm	3,000	70	3	66 / 08	L90 at 100K hrs	G*6	1. Column height 6m 2. To be supplied with manufacturer's propriety twin floodlight bracket 3. To be mounted with luminaire type EXN 4. To be supplied with root or flange plate mounting accessories
EXP (double head)	East storage yard and access road		Thorlux	Starbeam Plus	Pole Top (special mounting bracket)	Area	LED	DALI	35W	3800 lm	3,000	70	3	66 / 08	L90 at 100K hrs	G*6	1. Column height 6m 2. To be supplied with manufacturer's propriety twin floodlight bracket 3. To be mounted with luminaire type EXN 4. To be supplied with root or flange plate mounting accessories

7 Lighting Control Strategy

Lighting Control

The Contractor shall provide, install and commission a lighting control system to ensure lighting is only on during hours of darkness and ensure the level/amount of light meets the usage and requirements of the public realm at that time. Correct commissioning and utilisation of a lighting control system shall deliver the following:

- Energy saving
- Reduced carbon impact
- Reduce impact on residence and ecology (sensitive receptors)
- Reduction in obtrusive light
- Monitoring of luminaires for maintenance

As a minimum, the lighting control system shall provide the following functionality:

- Switch on the electric lighting at night via a photocell or time clock control.
- The control system is capable of night-time dimming to key lighting areas.
- Capability to schedule groups of columns/lanterns/luminaires to dim and turn on/off in response to the anticipated activities at night to further reduce obtrusive light.

Figure 44 suggests a lighting control strategy for areas across the site that require a greater level of control to minimise impact on local surroundings. Refer to Table 4 for details on each lighting control group. Specifically, the lighting columns along the ecologically-sensitive east boundary shall be dimmed to reduce output; this requires dimming of luminaires to 45% of the standard output.

The MUGA shall have local manual controls with time delay to ensure lighting is not in operation when the area is not in use.

The enhanced lighting for the service yard will have manual controls to facilitate local management for the lighting as needed.

Further lighting control requirements shall be co-ordinated with the Client and building operator during the detailed design phase.

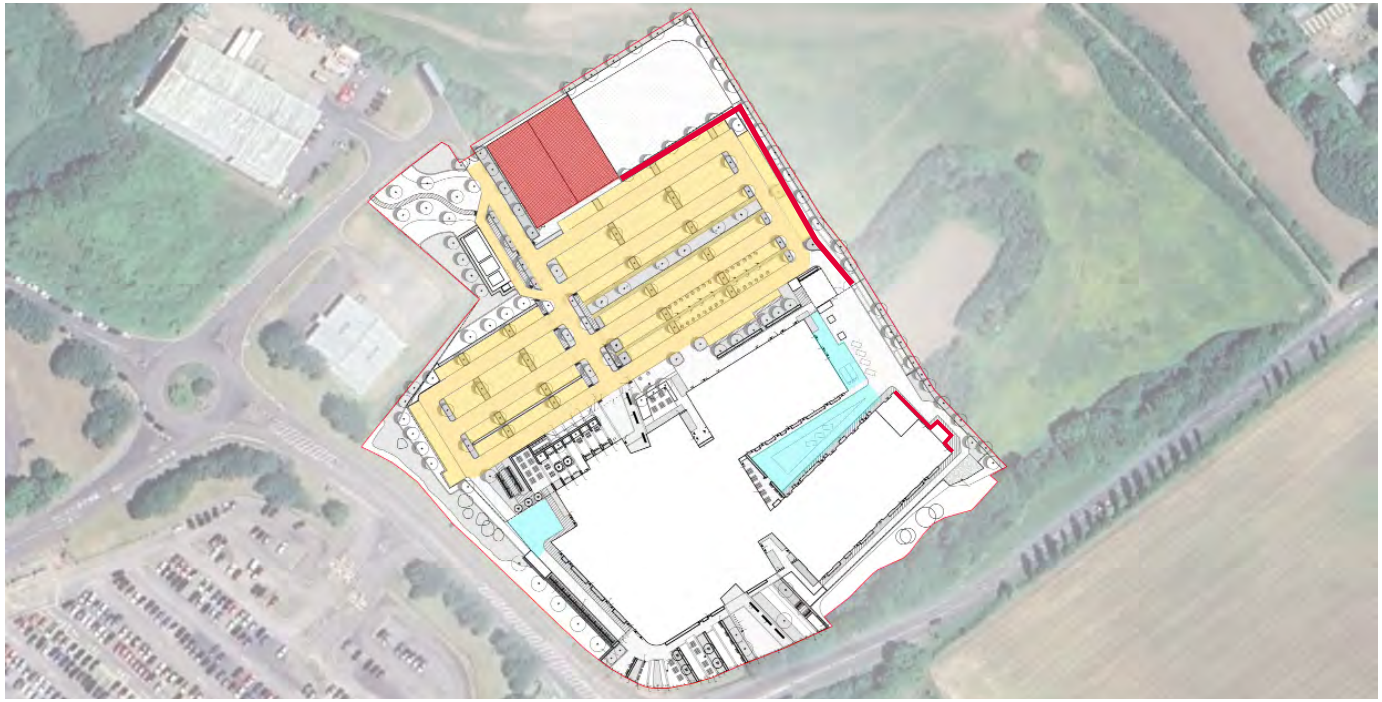


Figure 44: Lighting control strategy plan

Key:	Location:	Control Protocol:	Sensing/Functionality:	Luminaire Types:	Notes:
	Car park & entrance road	DALI	Time clock & photocell	EXA, EXB, EXC	Controlled via a central time clock and photocell arrangement. Lighting to dim from 10 lux to 5 lux after a pre-determined time during the hours that are anticipated to be quiet.
	MUGA	Switched & timed switch	Manually operated	EXJ, EXK	The lighting shall be manually switched on when the courts are in use. Switches to be located locally to each court. A time-clock shall prevent the operation of the lighting system during curfew time (cerfew time to be agreed but recomended to be between 10:00pm and 06:00am.) After 45 minutes of the lights being switched on, or at 10:00pm, the lights shall dim to 10% output for 15 minutes to allow user to reactivate or leave the area, before switching off.
	Service/storage yards	Switched & timed switch	Manually operated	EXC, EXD, EXN	The lighting shall be manually switched on/off when the service yards are in use for loading/unloading. Switches to be located internally within the admin area of the college. Photocell to switch the lighting off when ambient light levels achieve target light values each day. Switing of of lighting via the photocell shall reset the system requiring manual activation to turn lighting back on.
	Ecological boundary hting control criteria	DALI	Time clock & photocell	EXC, EXE	Controlled via a central time clock and photocell arrangement. Lighting to be programmed to 45% of the rest of the car park and entrance road, and wall lighting.

Appendix A - Calculations

Normal operation, MUGA lighting assumed OFF

DIALux

(Light scene 1)

Calculation objects

(Light scene 1)

Calculation objects

Calculation surfaces

Properties	$\bar{E}$	E_{min}	E_{max}	U_o (g_1)	g_2	Index
Pedestrian Perpendicular illuminance Height: 0.000 m	9.56 lx	4.04 lx	14.3 lx	0.42	0.28	CG1
Pedestrian Perpendicular illuminance Height: -0.000 m	20.0 lx	4.55 lx	33.5 lx	0.23	0.14	CG2
Conflict Perpendicular illuminance Height: -0.000 m	13.0 lx	11.7 lx	14.6 lx	0.90	0.80	CG3
Pedestrian Perpendicular illuminance Height: -0.000 m	7.77 lx	3.82 lx	13.2 lx	0.49	0.29	CG4
Pedestrian Perpendicular illuminance Height: -0.000 m	12.4 lx	11.0 lx	13.5 lx	0.89	0.81	CG5
Pedestrian Perpendicular illuminance Height: -0.000 m	11.7 lx	9.22 lx	13.0 lx	0.79	0.71	CG6
Pedestrian Perpendicular illuminance Height: -0.000 m	11.6 lx	10.9 lx	12.5 lx	0.94	0.87	CG7
Conflict Perpendicular illuminance Height: -0.000 m	10.4 lx	9.84 lx	11.2 lx	0.95	0.88	CG8
Conflict Perpendicular illuminance Height: -0.000 m	11.1 lx	10.8 lx	11.6 lx	0.97	0.93	CG9
Conflict Perpendicular illuminance Height: -0.000 m	10.2 lx	9.56 lx	11.9 lx	0.94	0.80	CG10
Conflict Perpendicular illuminance Height: -0.000 m	10.5 lx	8.90 lx	12.5 lx	0.85	0.71	CG11

(Light scene 1)

Calculation objects

Conflict Perpendicular illuminance Height: -0.000 m	13.5 lx	12.2 lx	15.8 lx	0.90	0.77	CG12
Parking Perpendicular illuminance Height: -0.000 m	16.4 lx	8.89 lx	26.2 lx	0.54	0.34	CG13
Accessible Parking Perpendicular illuminance Height: 0.000 m	22.0 lx	13.1 lx	29.0 lx	0.60	0.45	CG14
Drop off Perpendicular illuminance Height: -0.000 m	16.2 lx	8.32 lx	24.5 lx	0.51	0.34	CG15
Dwell Perpendicular illuminance Height: -0.000 m	17.1 lx	4.94 lx	28.5 lx	0.29	0.17	CG16
Main Entrance Perpendicular illuminance Height: 0.000 m	104 lx	102 lx	106 lx	0.98	0.96	CG17
Entrance Road Perpendicular illuminance Height: 0.000 m	15.0 lx	4.44 lx	33.7 lx	0.30	0.13	CG18
Dwell Perpendicular illuminance Height: -0.000 m	10.9 lx	4.56 lx	15.0 lx	0.42	0.30	CG19
Service Yard Perpendicular illuminance Height: -0.000 m	27.3 lx	7.38 lx	56.5 lx	0.27	0.13	CG20
Pedestrian Perpendicular illuminance Height: -0.000 m	15.5 lx	5.31 lx	26.2 lx	0.34	0.20	CG21
Service Yard Perpendicular illuminance Height: -0.000 m	19.8 lx	15.6 lx	26.9 lx	0.79	0.58	CG22
Vehicular Perpendicular illuminance Height: -0.000 m	9.59 lx	5.23 lx	24.5 lx	0.55	0.21	CG23

(Light scene 1)

Calculation objects

Vehicular Perpendicular illuminance Height: -0.000 m	16.0 lx	10.5 lx	22.1 lx	0.66	0.48	CG24
Pedestrian Perpendicular illuminance Height: 0.050 m	17.2 lx	4.86 lx	55.0 lx	0.28	0.088	CG25
Pedestrian Perpendicular illuminance Height: -0.000 m	12.0 lx	2.62 lx	24.5 lx	0.22	0.11	CG26
Pedestrian Perpendicular illuminance Height: -0.000 m	11.6 lx	2.78 lx	32.2 lx	0.24	0.086	CG27
Cycle Storage Perpendicular illuminance Height: -0.000 m	113 lx	58.8 lx	201 lx	0.52	0.29	CG28
Main Entrance Perpendicular illuminance Height: 0.000 m	109 lx	109 lx	109 lx	1.00	1.00	CG29
Pedestrian Perpendicular illuminance Height: -0.000 m	16.2 lx	5.30 lx	34.2 lx	0.33	0.15	CG30
Cycle Storage Perpendicular illuminance Height: 0.100 m	120 lx	37.0 lx	258 lx	0.31	0.14	CG31
Pedestrian Perpendicular illuminance Height: -0.000 m	20.2 lx	7.20 lx	29.4 lx	0.36	0.24	CG32
Service Yard Perpendicular illuminance Height: -0.000 m	36.7 lx	15.2 lx	60.6 lx	0.41	0.25	CG33
Dwell Perpendicular illuminance Height: -0.000 m	8.79 lx	2.15 lx	35.3 lx	0.24	0.061	CG34
Pedestrian Perpendicular illuminance Height: -0.000 m	14.4 lx	5.06 lx	24.6 lx	0.35	0.21	CG35

(Light scene 1)

Calculation objects

Vehicular Perpendicular illuminance Height: -0.000 m	12.1 lx	5.88 lx	23.6 lx	0.49	0.25	CG36
Entrance approach Perpendicular illuminance Height: -0.000 m	20.8 lx	4.83 lx	100 lx	0.23	0.048	CG37
Entrance approach Perpendicular illuminance Height: 0.000 m	21.4 lx	3.31 lx	103 lx	0.15	0.032	CG38
Vehicular Perpendicular illuminance Height: 0.000 m	6.88 lx	3.83 lx	12.8 lx	0.56	0.30	CG39
Pedestrian Perpendicular illuminance Height: 0.000 m	8.80 lx	3.48 lx	16.3 lx	0.40	0.21	CG40
Vehicular Perpendicular illuminance Height: -0.000 m	18.8 lx	6.98 lx	54.8 lx	0.37	0.13	CG41
Vehicular & service yard Perpendicular illuminance Height: -0.000 m	15.3 lx	3.84 lx	51.8 lx	0.25	0.074	CG42
Vehicular Perpendicular illuminance Height: -0.000 m	8.75 lx	1.36 lx	32.9 lx	0.16	0.041	CG43
Pedestrian Perpendicular illuminance Height: 0.500 m	10.3 lx	2.37 lx	28.5 lx	0.23	0.083	CG44
Cycle Storage Perpendicular illuminance Height: 0.500 m	123 lx	35.5 lx	300 lx	0.29	0.12	CG45
Car park Perpendicular illuminance Height: -0.000 m	12.1 lx	3.44 lx	27.8 lx	0.28	0.12	CG46
Car park Perpendicular illuminance Height: 0.050 m	10.9 lx	2.79 lx	27.8 lx	0.26	0.10	CG47

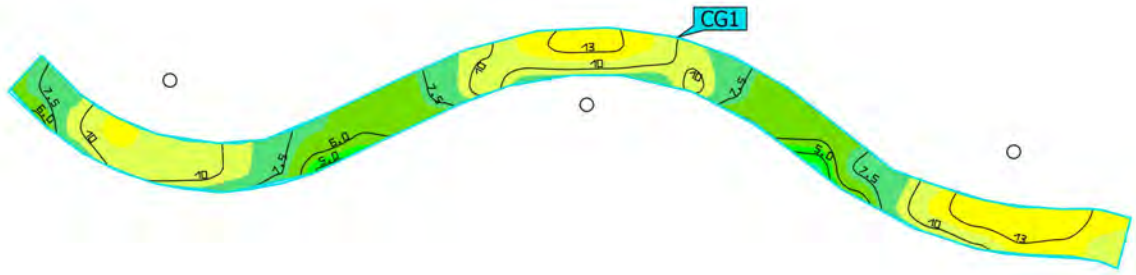
(Light scene 1)

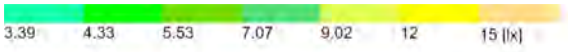
Calculation objects

Dwell Perpendicular illuminance Height: -0.000 m	7.46 lx	1.51 lx	20.7 lx	0.20	0.073	CG48

(Light scene 1)

Pedestrian

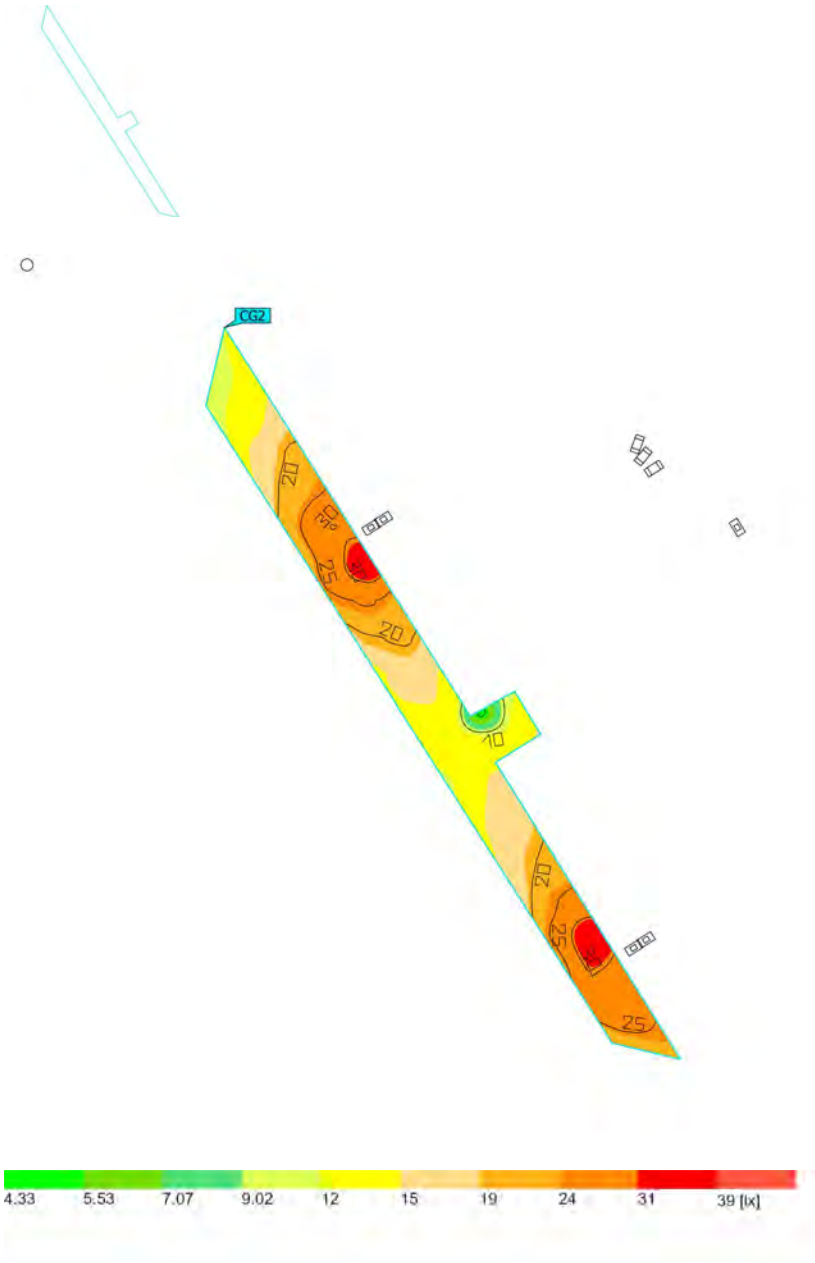




Properties	Ē	E_{min}	E_{max}	U_o (g_1)	g_2	Index
Pedestrian Perpendicular illuminance Height: 0.000 m	9.56 lx	4.04 lx	14.3 lx	0.42	0.28	CG1

(Light scene 1)

Pedestrian

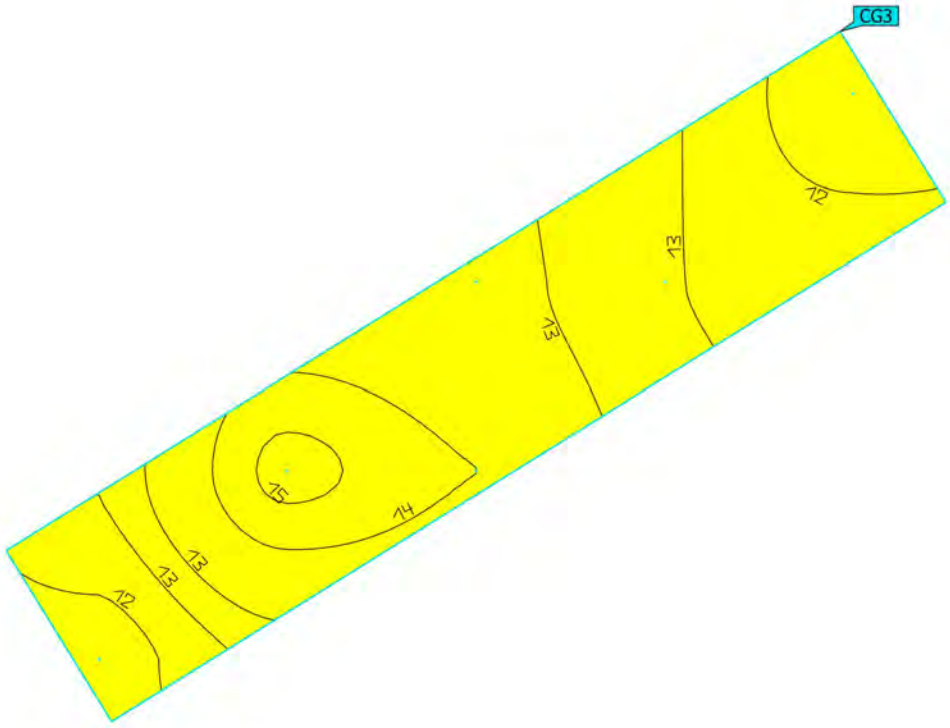


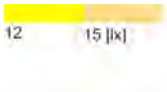
Properties	Ē	E_{min}	E_{max}	U_o (g_1)	g_2	Index
Pedestrian Perpendicular illuminance Height: -0.000 m	20.0 lx	4.55 lx	33.5 lx	0.23	0.14	CG2

DIALux

(Light scene 1)

Conflict



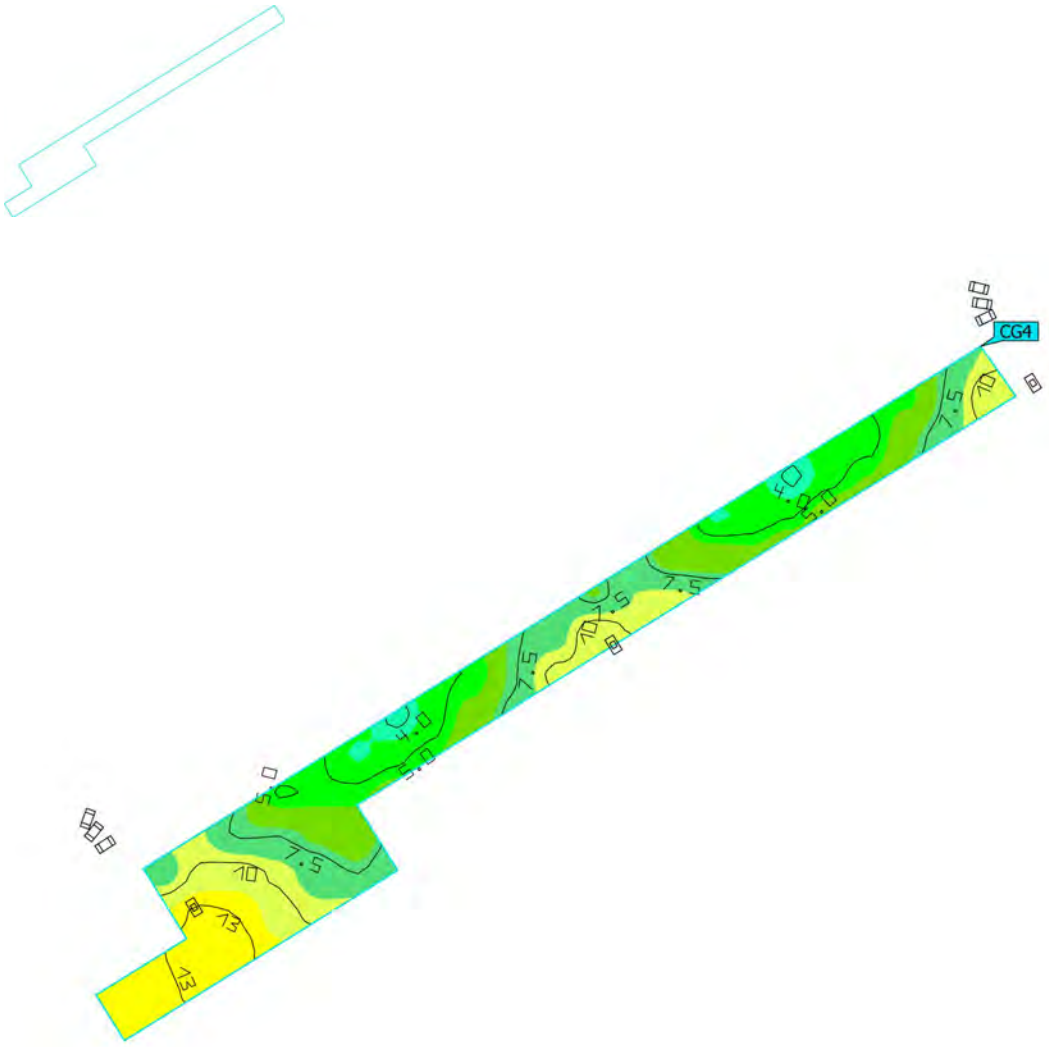


Properties	Ē	E_{min}	E_{max}	U_o (g_1)	g_2	Index
Conflict Perpendicular illuminance Height: -0.000 m	13.0 lx	11.7 lx	14.6 lx	0.90	0.80	CG3

DIALux

(Light scene 1)

Pedestrian

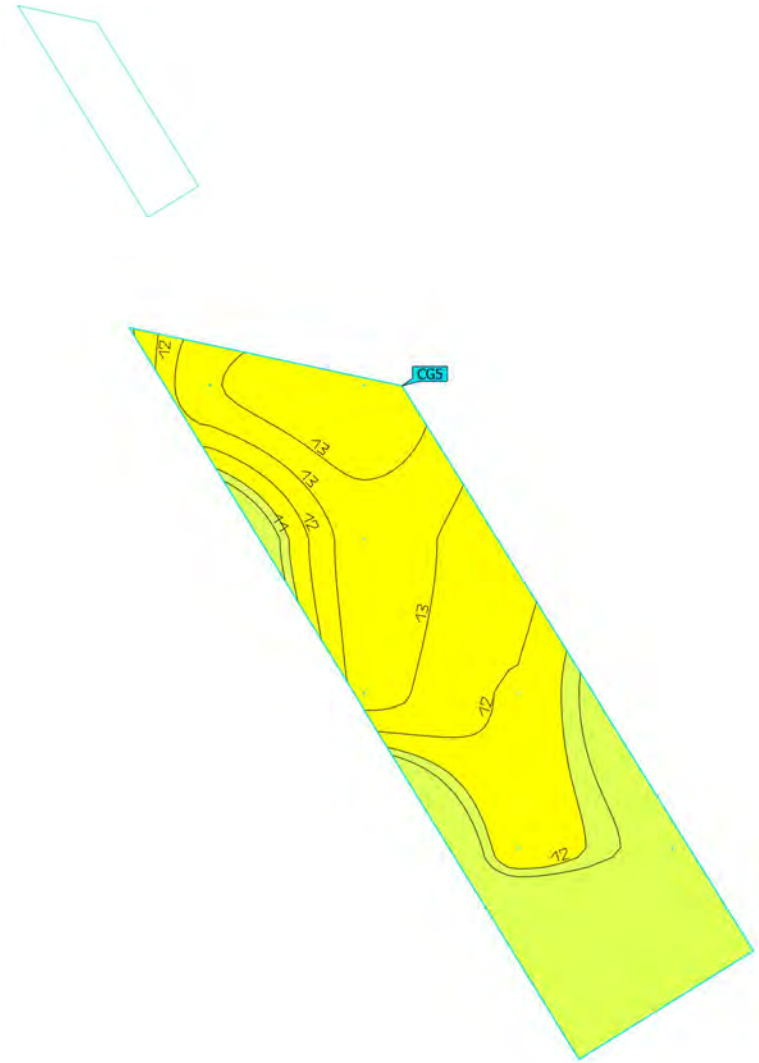


Properties	Ē	E_{min}	E_{max}	U_o (g_1)	g_2	Index
Pedestrian Perpendicular illuminance Height: -0.000 m	7.77 lx	3.82 lx	13.2 lx	0.49	0.29	CG4

DIALux

(Light scene 1)

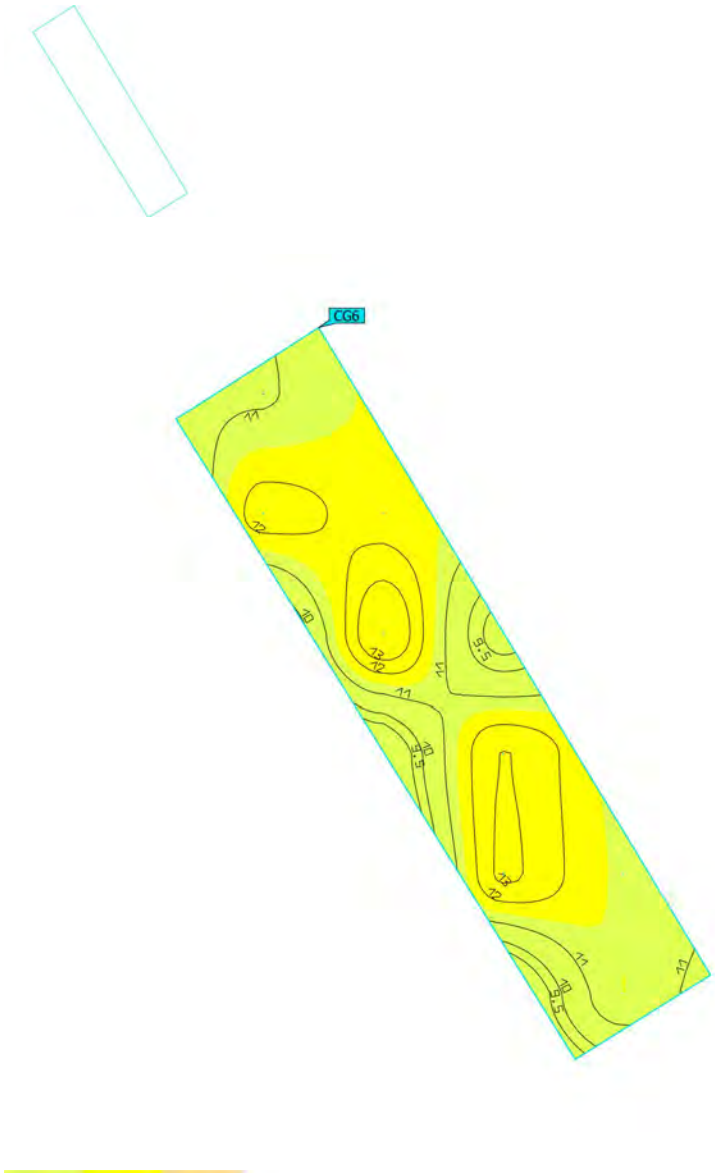
Pedestrian



Properties	Ē	E_{min}	E_{max}	U_o (g_1)	g_2	Index
Pedestrian Perpendicular illuminance Height: -0.000 m	12.4 lx	11.0 lx	13.5 lx	0.89	0.81	CG5

(Light scene 1)

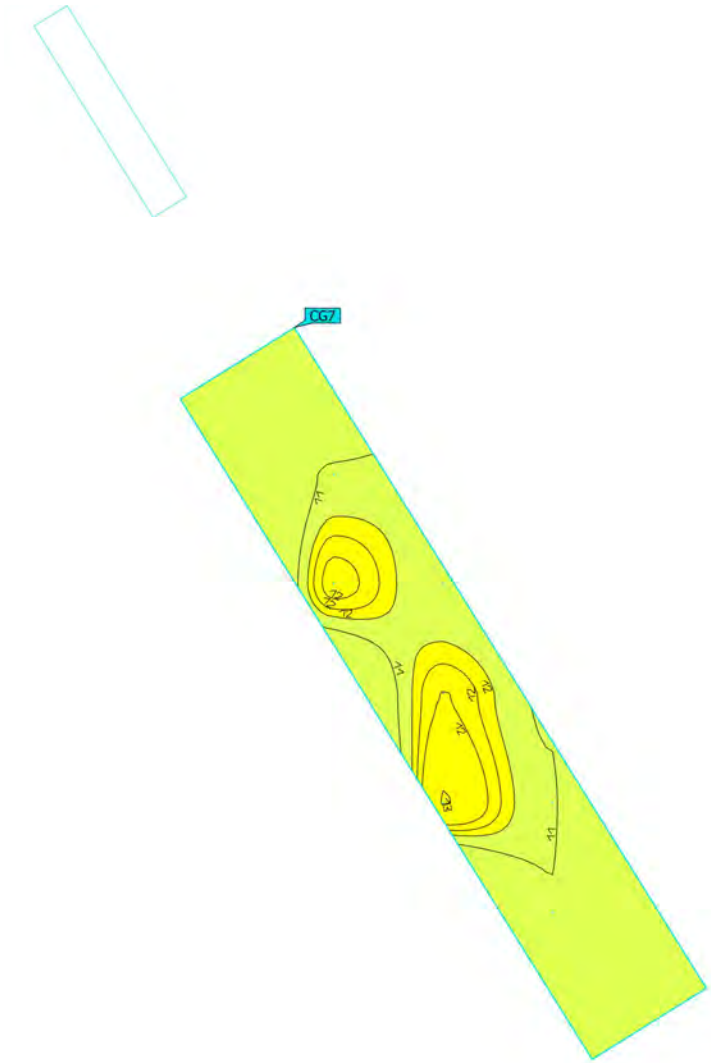
Pedestrian



Properties	Ē	E_{min}	E_{max}	U_o (g_1)	g_2	Index
Pedestrian Perpendicular illuminance Height: -0.000 m	11.7 lx	9.22 lx	13.0 lx	0.79	0.71	CG6

(Light scene 1)

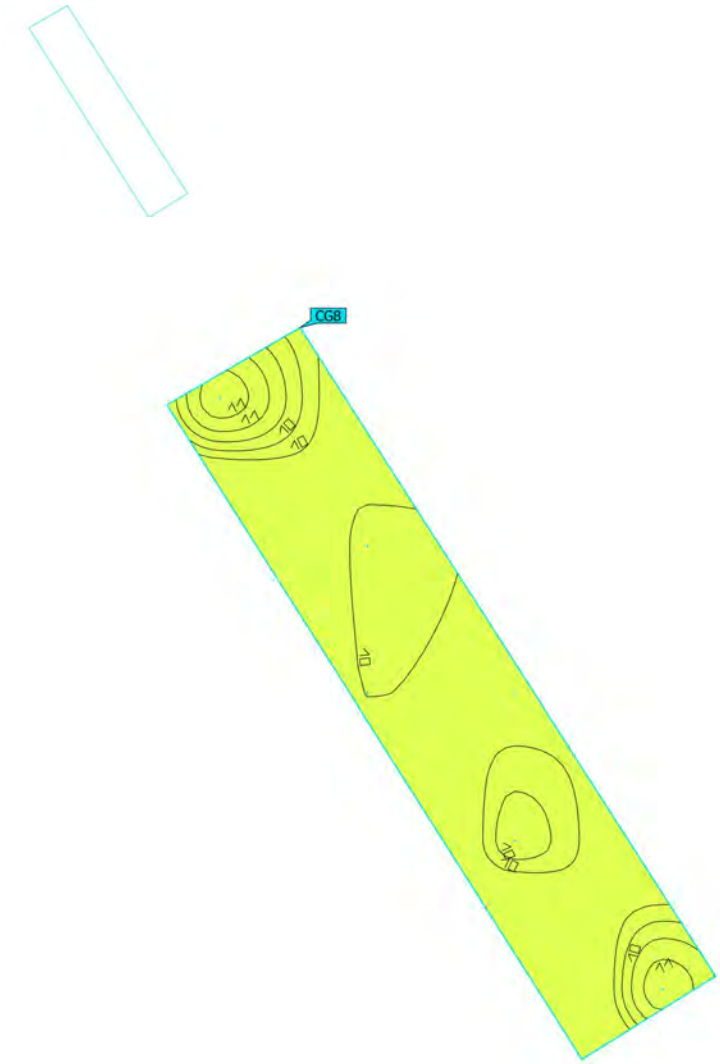
Pedestrian



Properties	Ē	E_{min}	E_{max}	U_o (g_1)	g_2	Index
Pedestrian Perpendicular illuminance Height: -0.000 m	11.6 lx	10.9 lx	12.5 lx	0.94	0.87	CG7

(Light scene 1)

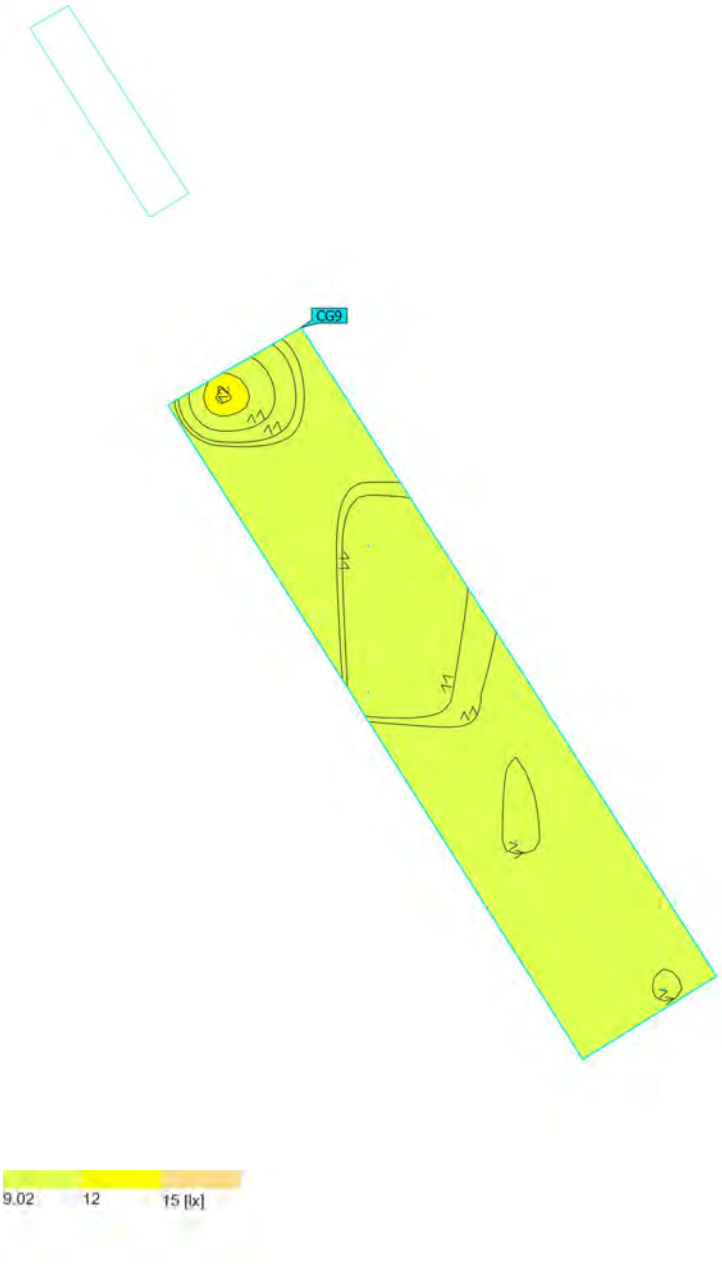
Conflict



Properties	Ē	E_{min}	E_{max}	U_o (g_1)	g_2	Index
Conflict Perpendicular illuminance Height: -0.000 m	10.4 lx	9.84 lx	11.2 lx	0.95	0.88	CG8

(Light scene 1)

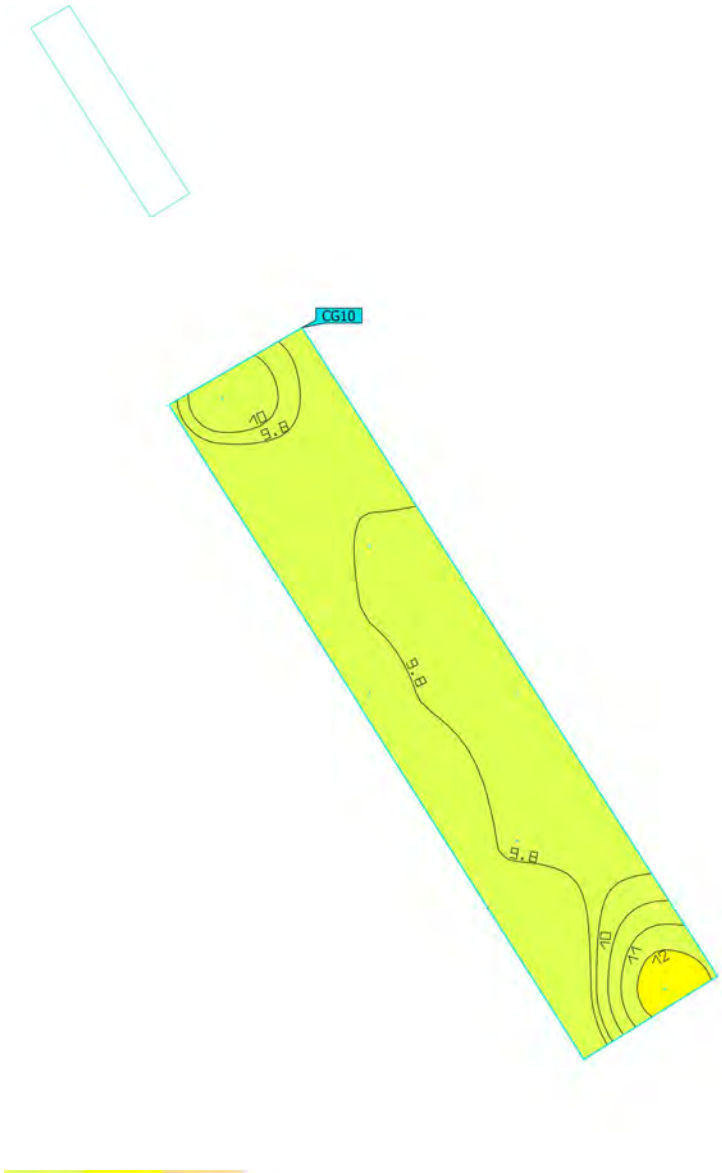
Conflict



Properties	Ē	E_{min}	E_{max}	U_o (g_1)	g_2	Index
Conflict Perpendicular illuminance Height: -0.000 m	11.1 lx	10.8 lx	11.6 lx	0.97	0.93	CG9

(Light scene 1)

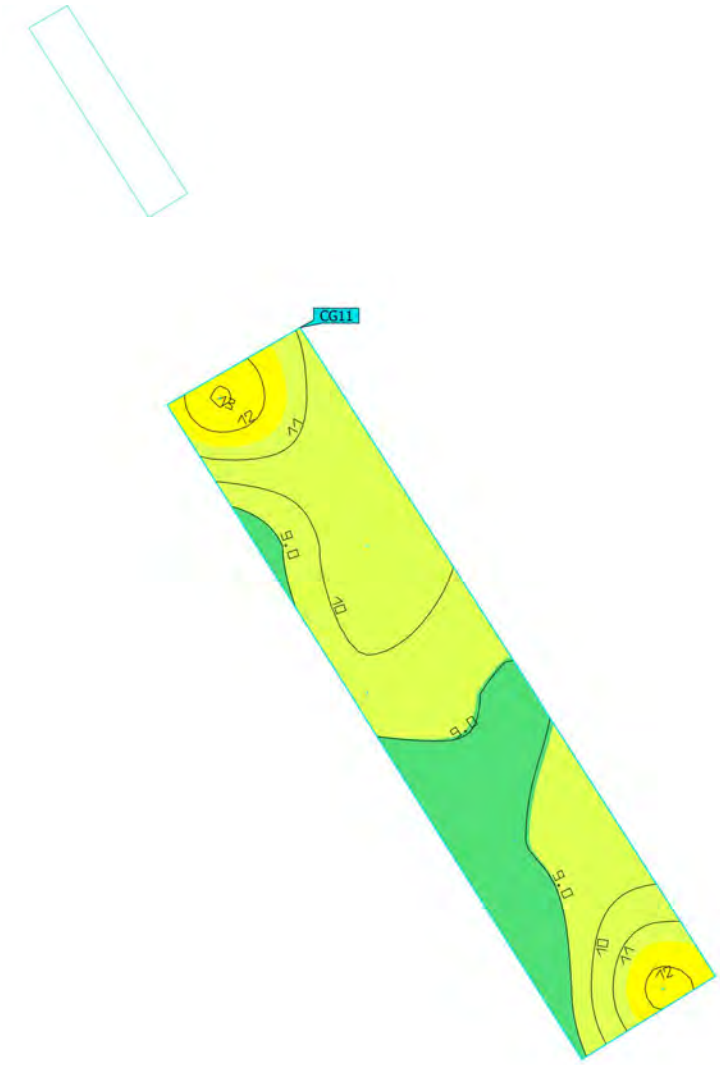
Conflict



Properties	Ē	E_{min}	E_{max}	U_o (g_1)	g_2	Index
Conflict Perpendicular illuminance Height: -0.000 m	10.2 lx	9.56 lx	11.9 lx	0.94	0.80	CG10

(Light scene 1)

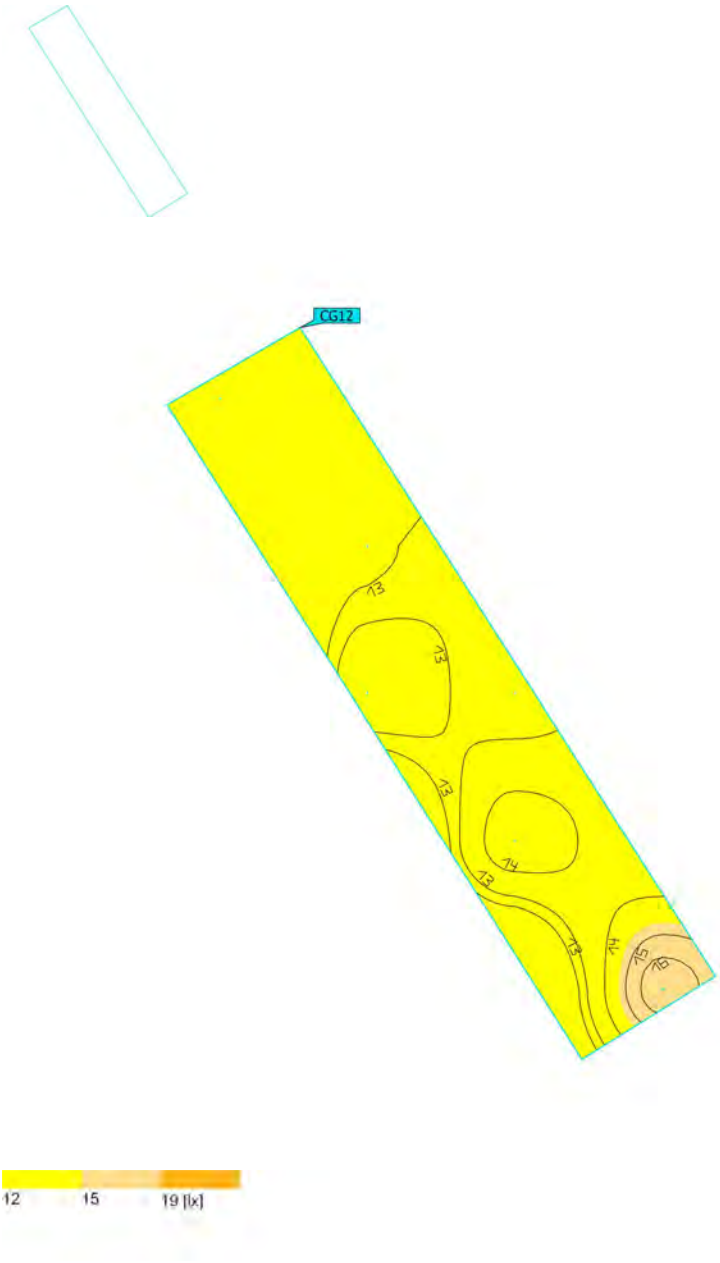
Conflict



Properties	Ē	E_{min}	E_{max}	U_o (g_1)	g_2	Index
Conflict Perpendicular illuminance Height: -0.000 m	10.5 lx	8.90 lx	12.5 lx	0.85	0.71	CG11

(Light scene 1)

Conflict

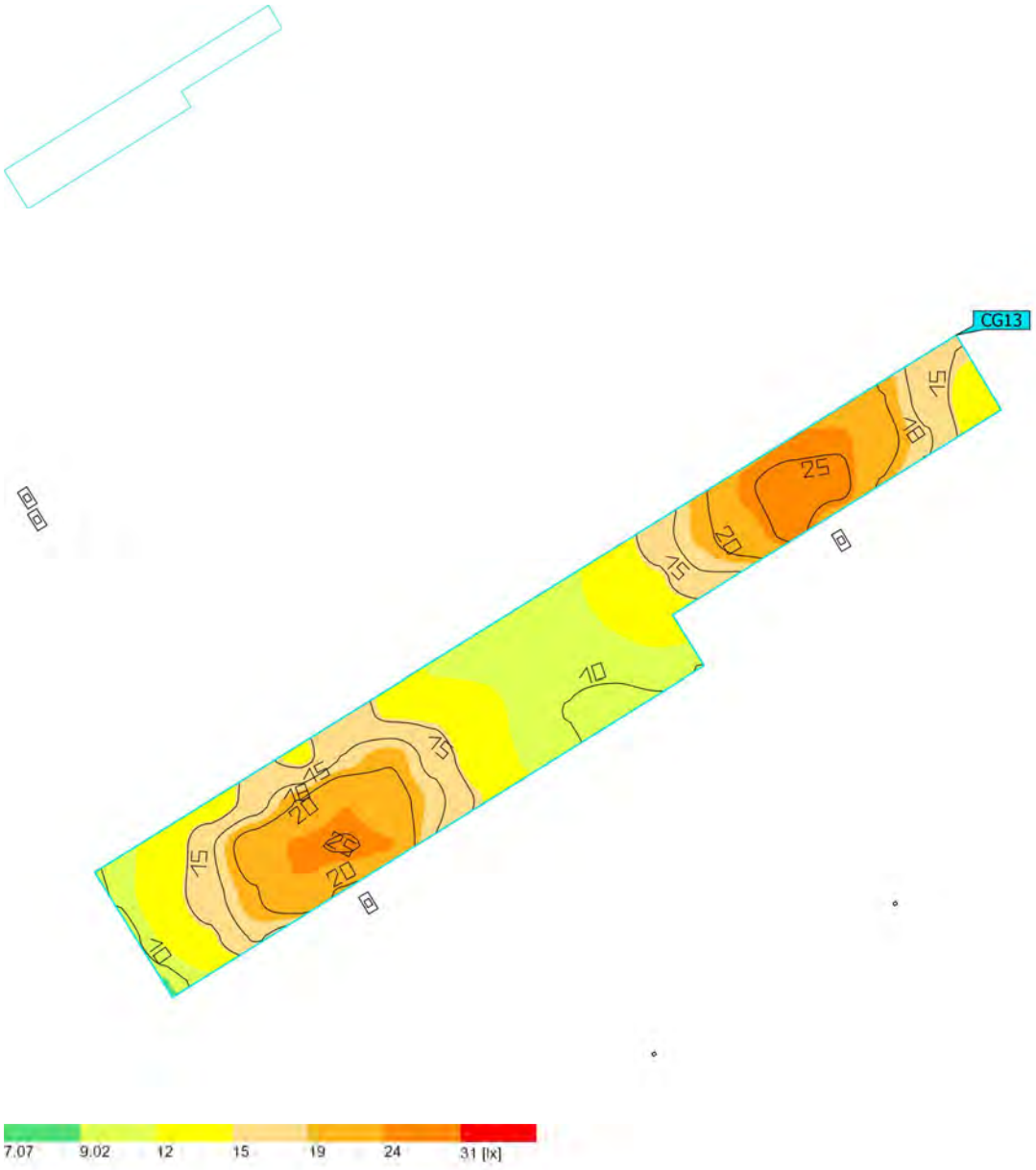


Properties	Ē	E_{min}	E_{max}	U_o (g_1)	g_2	Index
Conflict Perpendicular illuminance Height: -0.000 m	13.5 lx	12.2 lx	15.8 lx	0.90	0.77	CG12

DIALux

(Light scene 1)

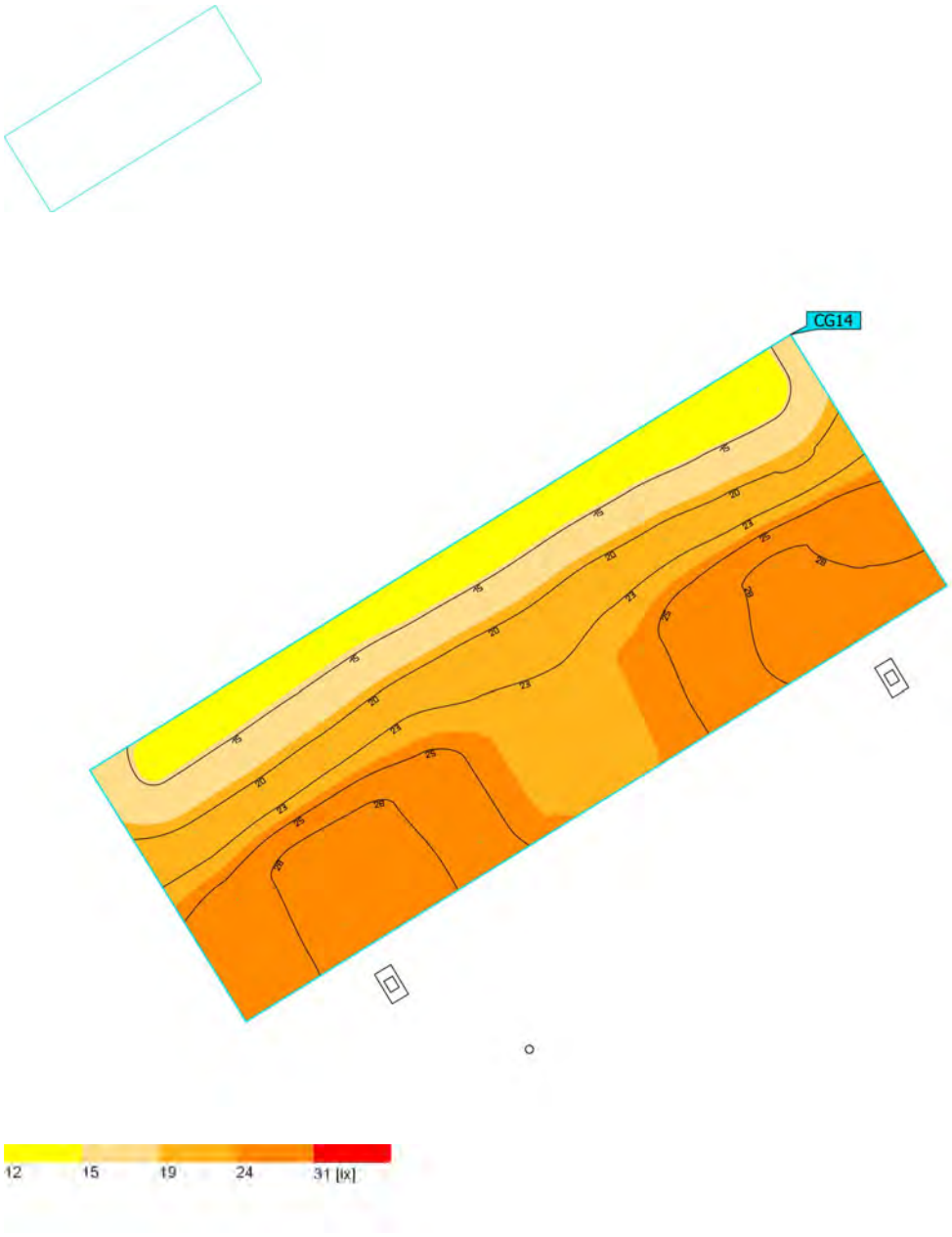
Parking



Properties	Ē	E_{min}	E_{max}	U_o (g_1)	g_2	Index
Parking Perpendicular illuminance Height: -0.000 m	16.4 lx	8.89 lx	26.2 lx	0.54	0.34	CG13

(Light scene 1)

Accessible Parking

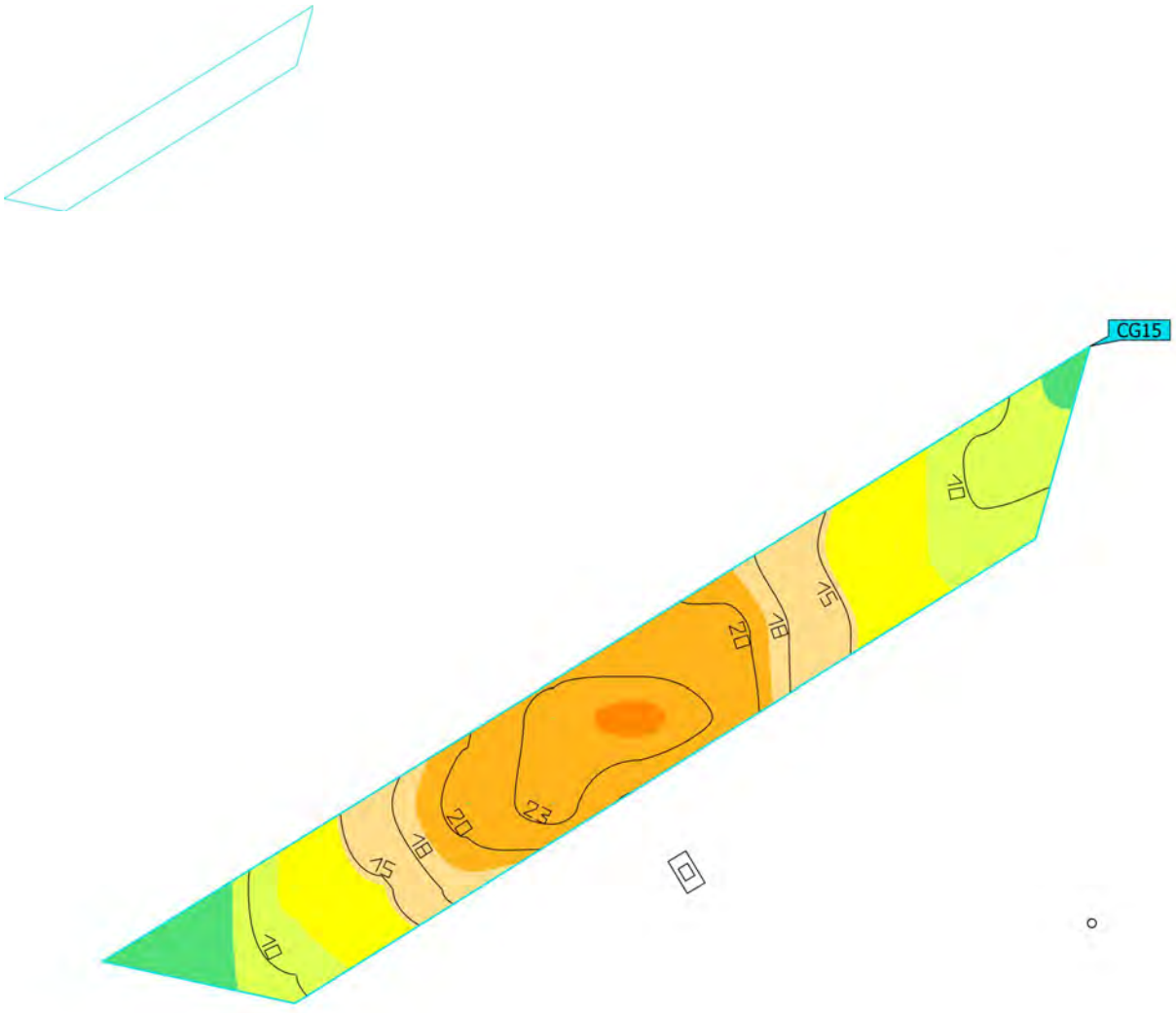


Properties	Ē	E_{min}	E_{max}	U_o (g_1)	g_2	Index
Accessible Parking Perpendicular illuminance Height: 0.000 m	22.0 lx	13.1 lx	29.0 lx	0.60	0.45	CG14

DIALux

(Light scene 1)

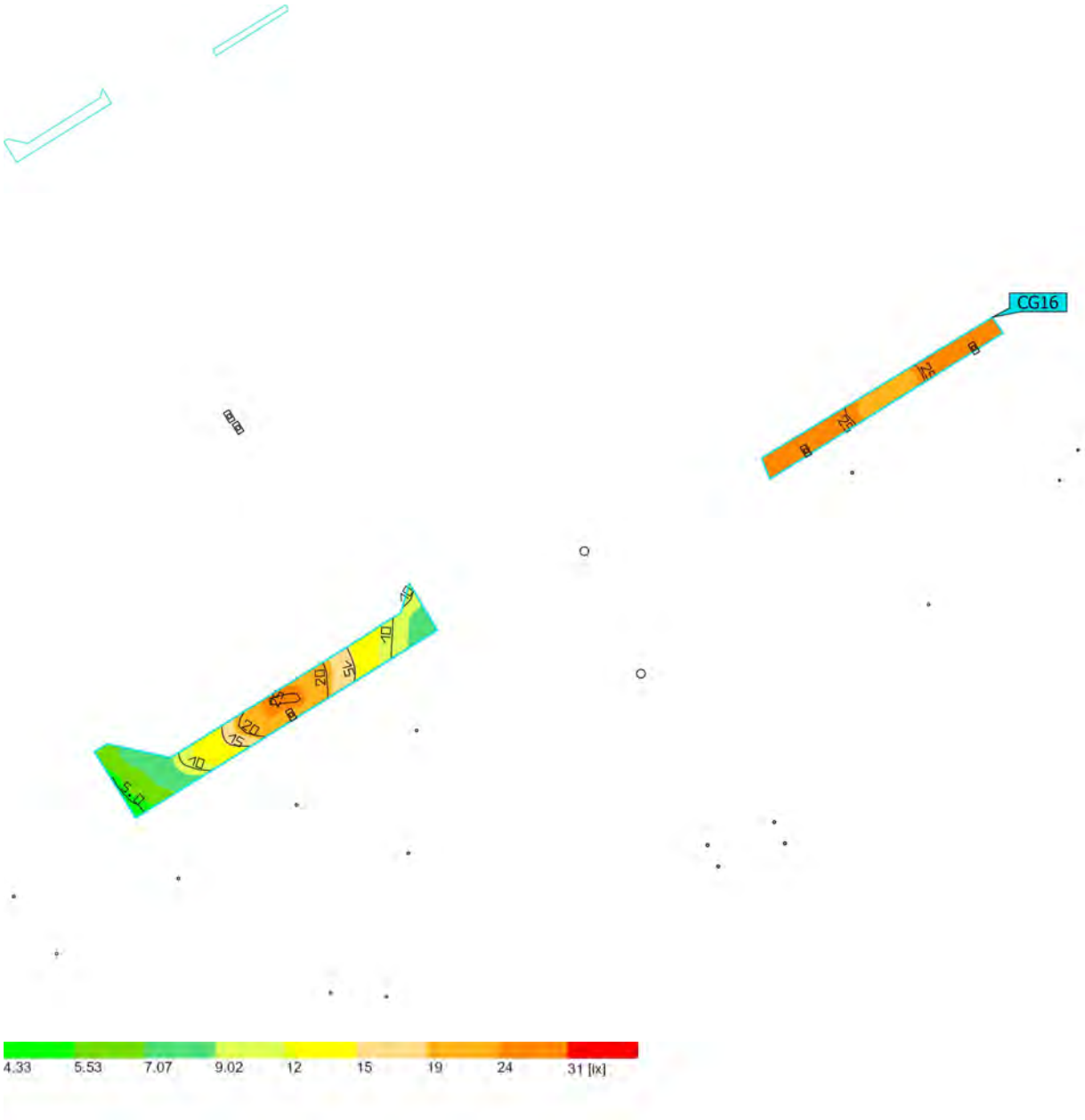
Drop off



Properties	Ē	E_{min}	E_{max}	U_o (g_1)	g_2	Index
Drop off Perpendicular illuminance Height: -0.000 m	16.2 lx	8.32 lx	24.5 lx	0.51	0.34	CG15

(Light scene 1)

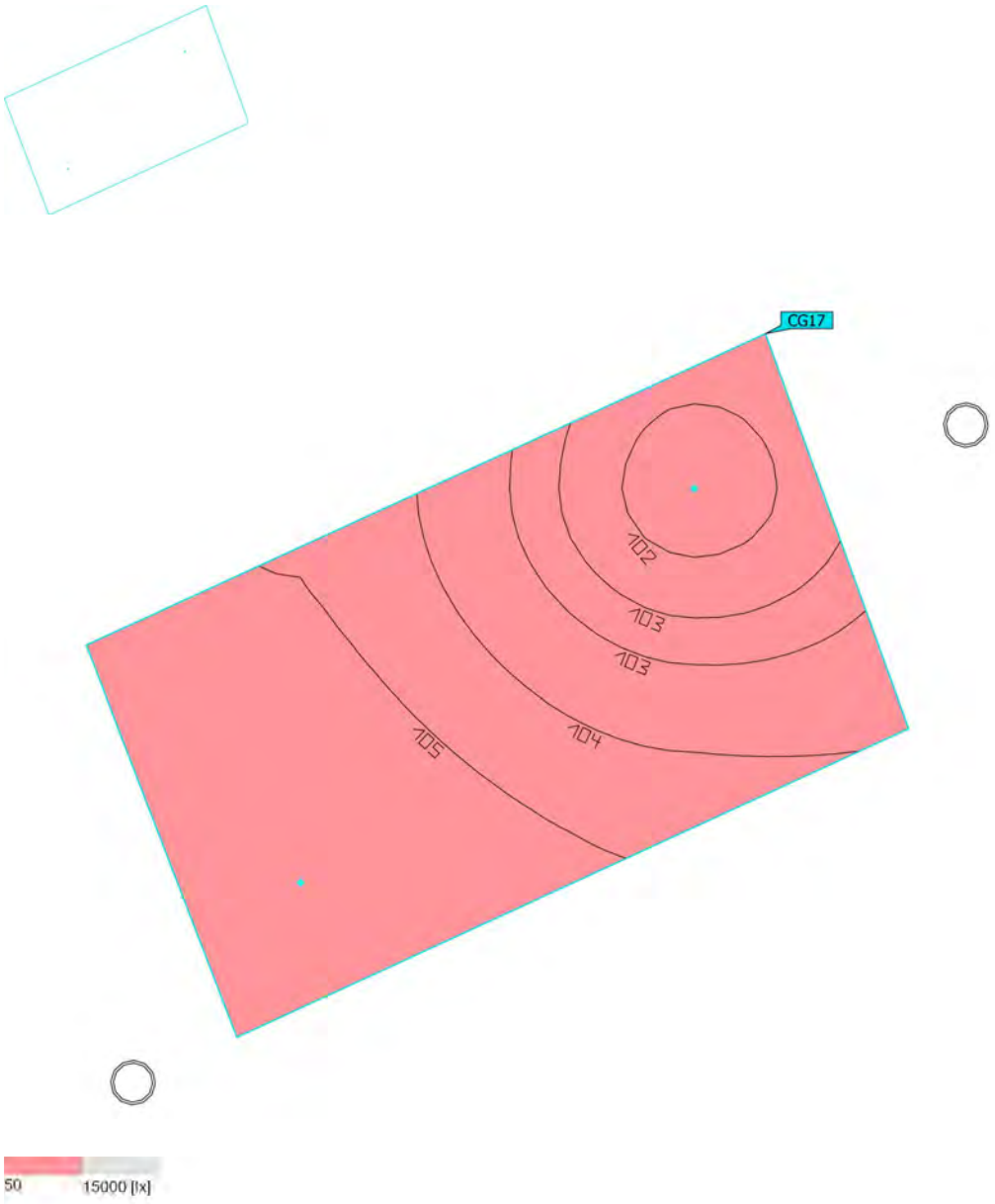
Dwell



Properties	Ē	E_{min}	E_{max}	U_o (g_1)	g_2	Index
Dwell Perpendicular illuminance Height: -0.000 m	17.1 lx	4.94 lx	28.5 lx	0.29	0.17	CG16

(Light scene 1)

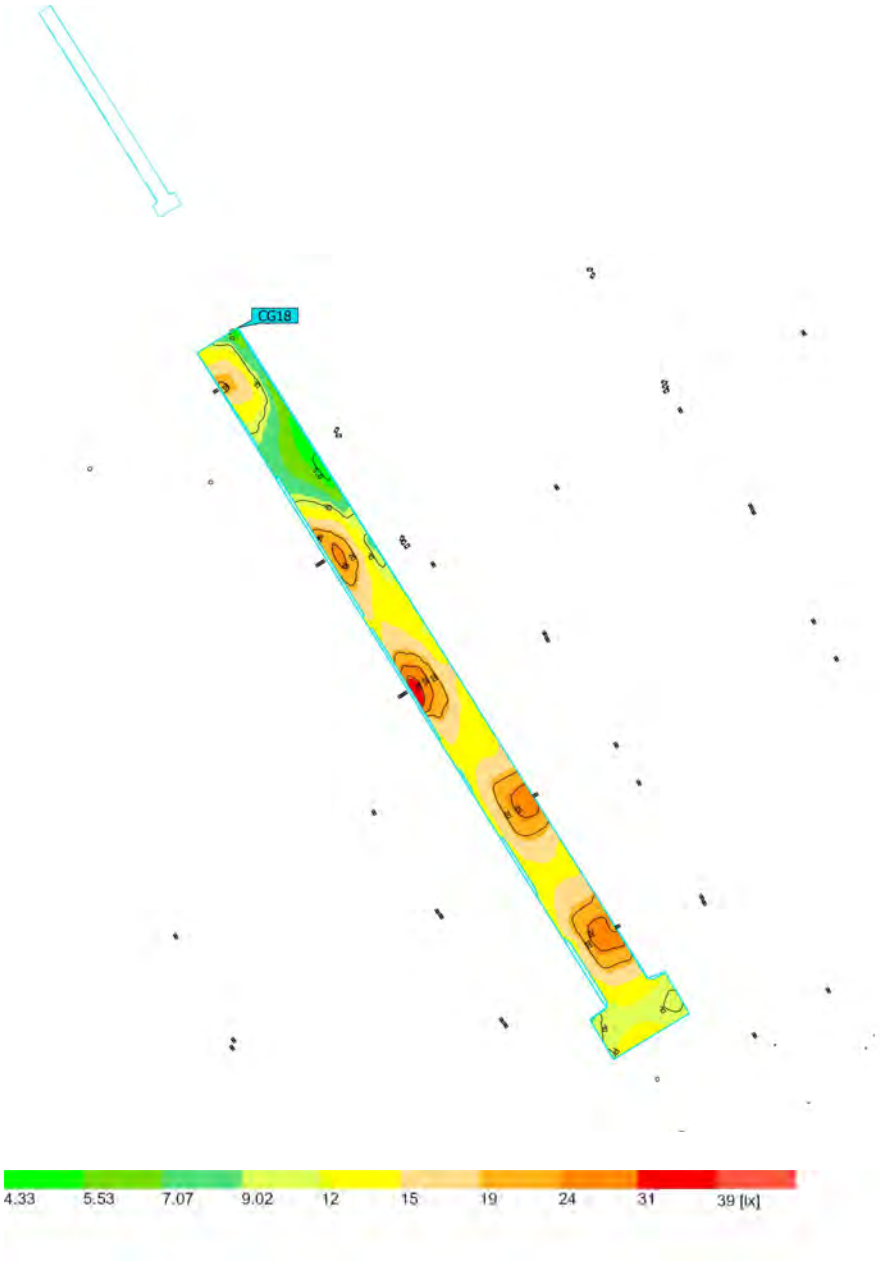
Main Entrance



Properties	Ē	E_{min}	E_{max}	U_o (g_1)	g_2	Index
Main Entrance Perpendicular illuminance Height: 0.000 m	104 lx	102 lx	106 lx	0.98	0.96	CG17

(Light scene 1)

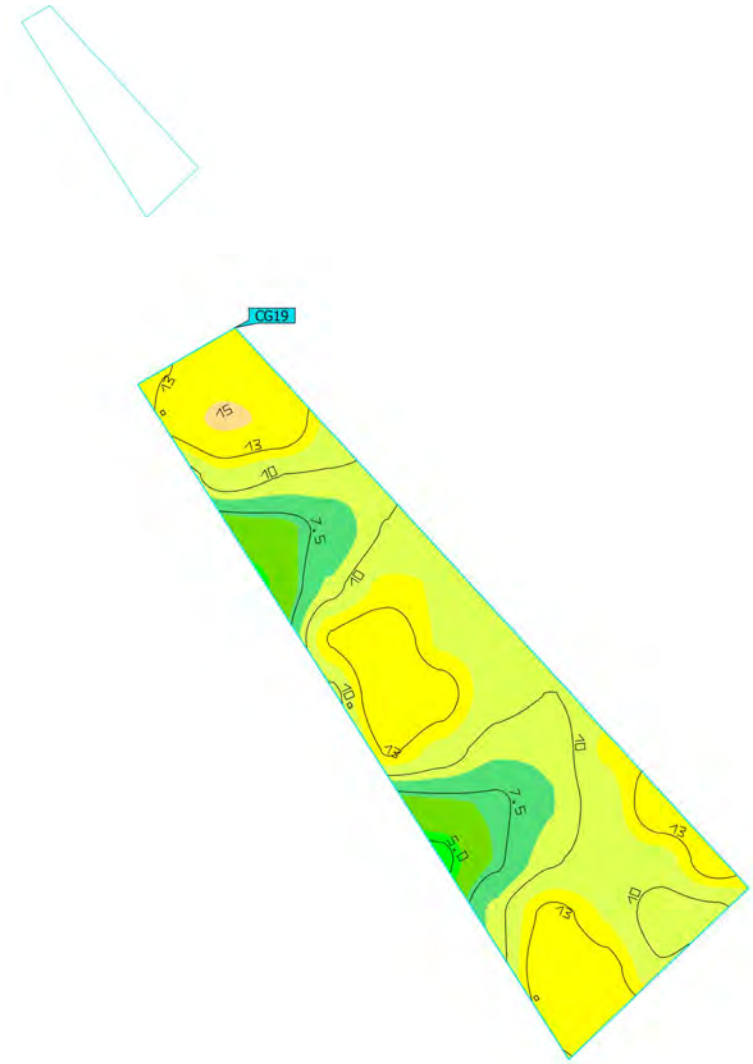
Entrance Road



Properties	Ē	E_{min}	E_{max}	U_o (g_1)	g_2	Index
Entrance Road Perpendicular illuminance Height: 0.000 m	15.0 lx	4.44 lx	33.7 lx	0.30	0.13	CG18

(Light scene 1)

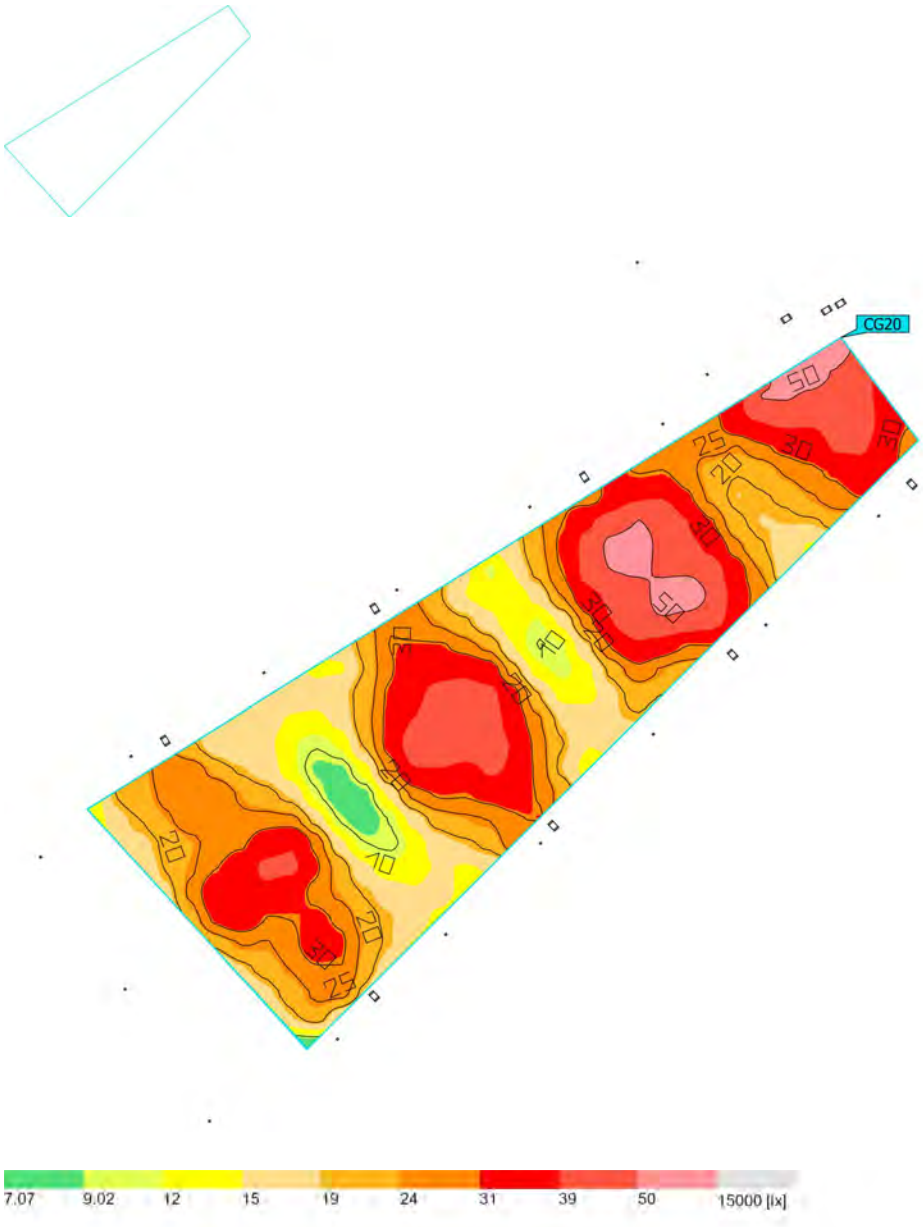
Dwell



Properties	Ē	E_{min}	E_{max}	U_o (g_1)	g_2	Index
Dwell Perpendicular illuminance Height: -0.000 m	10.9 lx	4.56 lx	15.0 lx	0.42	0.30	CG19

(Light scene 1)

Service Yard

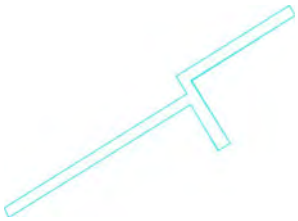


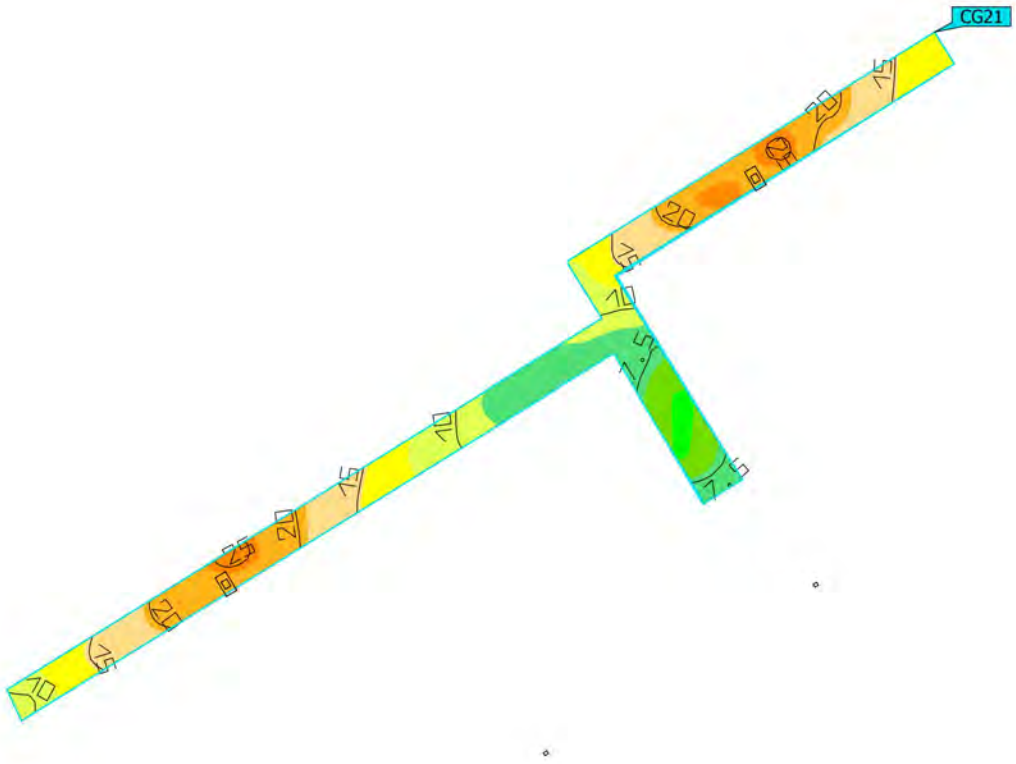
Properties	Ē	E_{min}	E_{max}	U_o (g_1)	g_2	Index
Service Yard Perpendicular illuminance Height: -0.000 m	27.3 lx	7.38 lx	56.5 lx	0.27	0.13	CG20

DIALux

(Light scene 1)

Pedestrian





Properties	Ē	E_{min}	E_{max}	U_o (g_1)	g_2	Index
Pedestrian Perpendicular illuminance Height: -0.000 m	15.5 lx	5.31 lx	26.2 lx	0.34	0.20	CG21

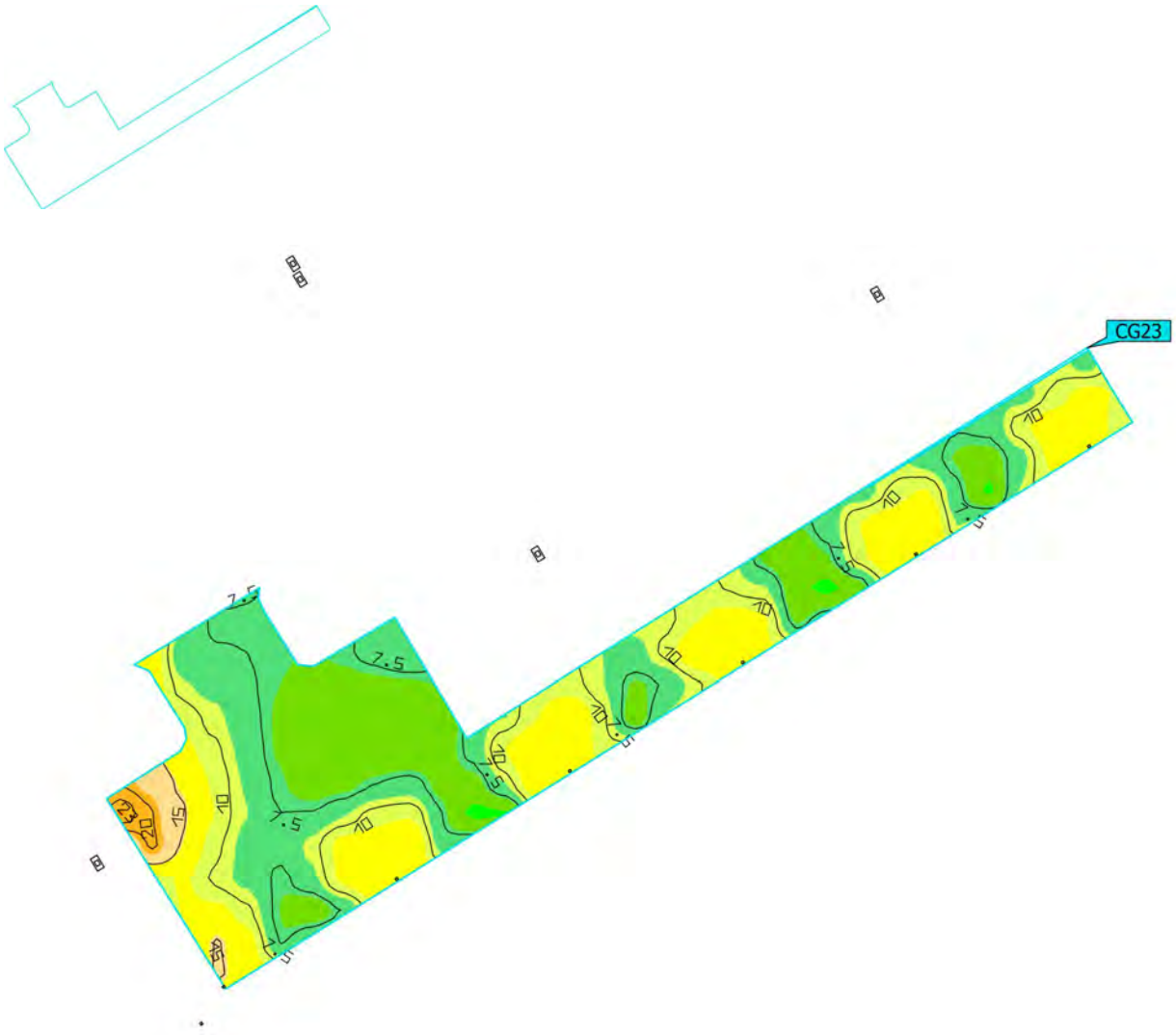
(Light scene 1)

Service Yard

Properties	Ē	E_{min}	E_{max}	U_o (g_1)	g_2	Index
Service Yard Perpendicular illuminance Height: -0.000 m	19.8 lx	15.6 lx	26.9 lx	0.79	0.58	CG22

(Light scene 1)

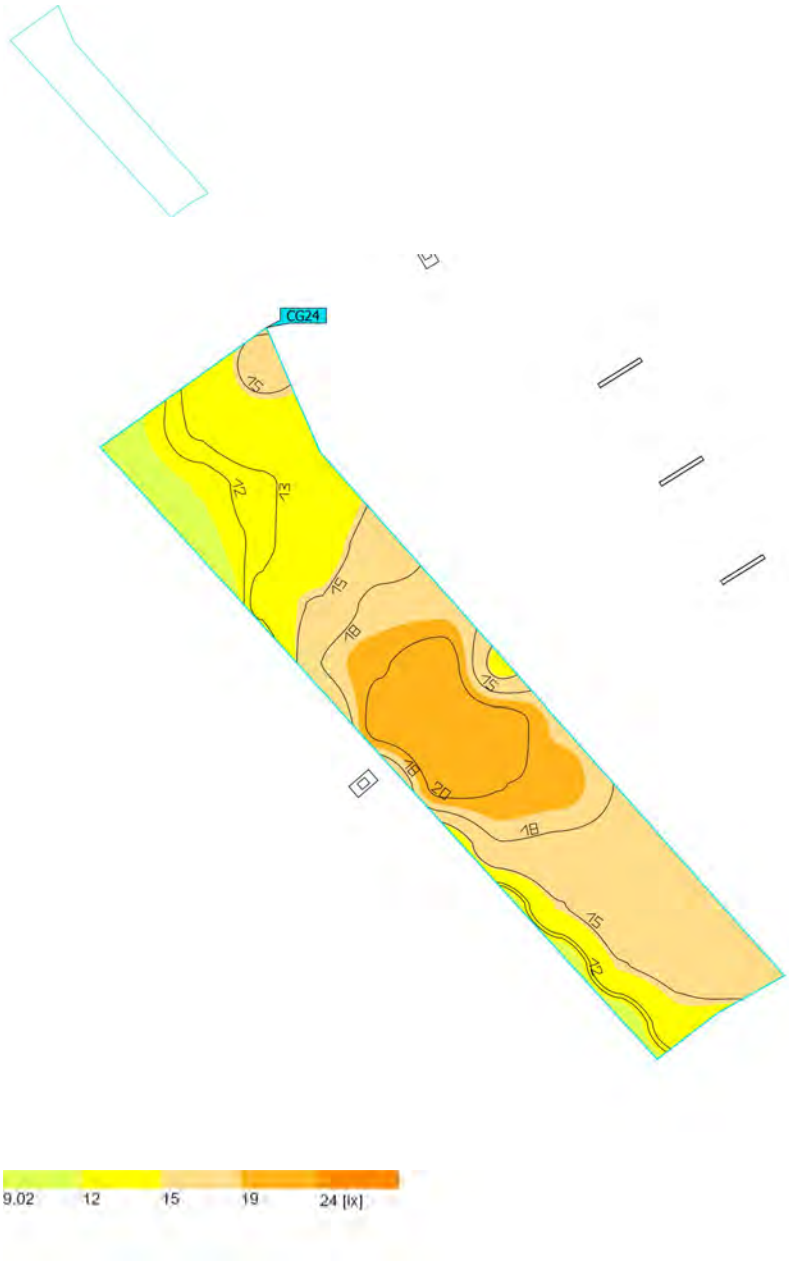
Vehicular



Properties	Ē	E_{min}	E_{max}	U_o (g_1)	g_2	Index
Vehicular Perpendicular illuminance Height: -0.000 m	9.59 lx	5.23 lx	24.5 lx	0.55	0.21	CG23

(Light scene 1)

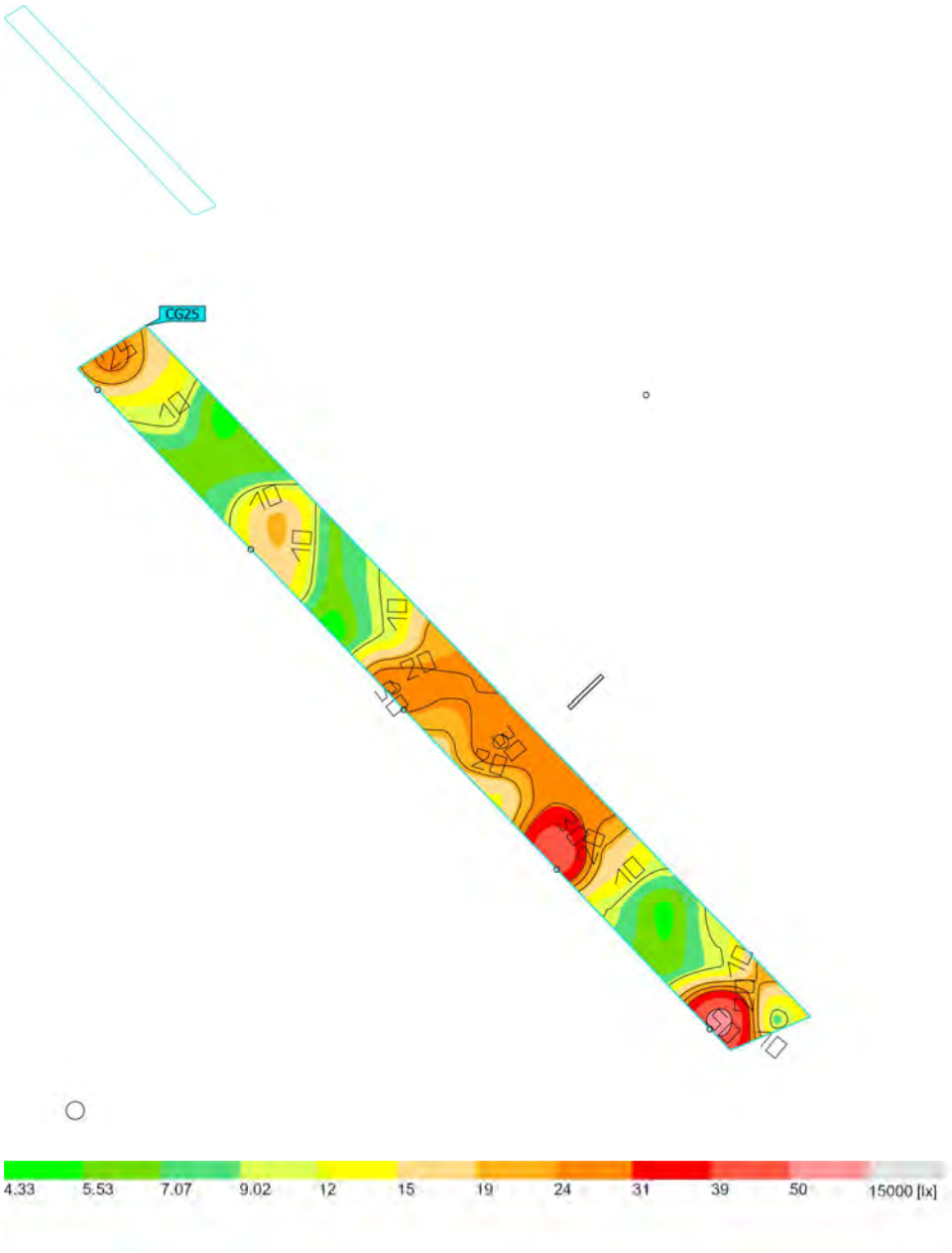
Vehicular



Properties	Ē	E_{min}	E_{max}	U_o (g_1)	g_2	Index
Vehicular Perpendicular illuminance Height: -0.000 m	16.0 lx	10.5 lx	22.1 lx	0.66	0.48	CG24

(Light scene 1)

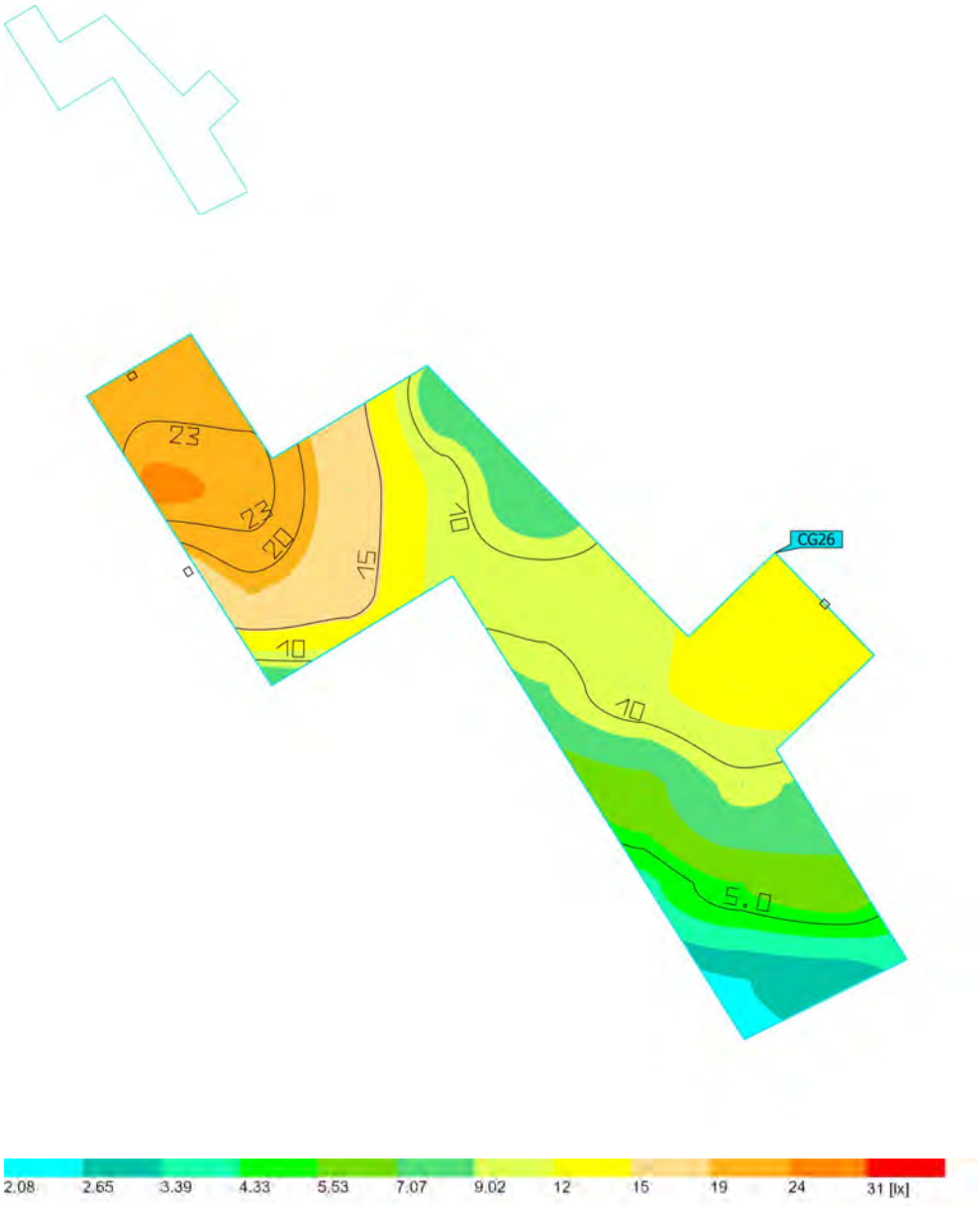
Pedestrian



Properties	Ē	E_{min}	E_{max}	U_o (g_1)	g_2	Index
Pedestrian Perpendicular illuminance Height: 0.050 m	17.2 lx	4.86 lx	55.0 lx	0.28	0.088	CG25

(Light scene 1)

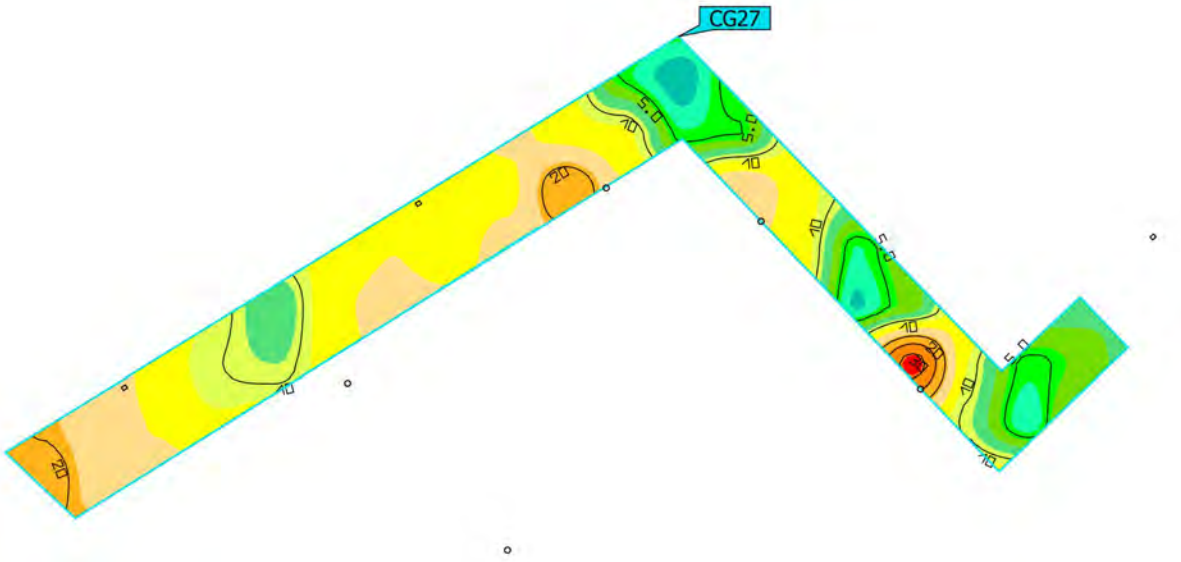
Pedestrian



Properties	Ē	E_{min}	E_{max}	U_o (g_1)	g_2	Index
Pedestrian Perpendicular illuminance Height: -0.000 m	12.0 lx	2.62 lx	24.5 lx	0.22	0.11	CG26

(Light scene 1)

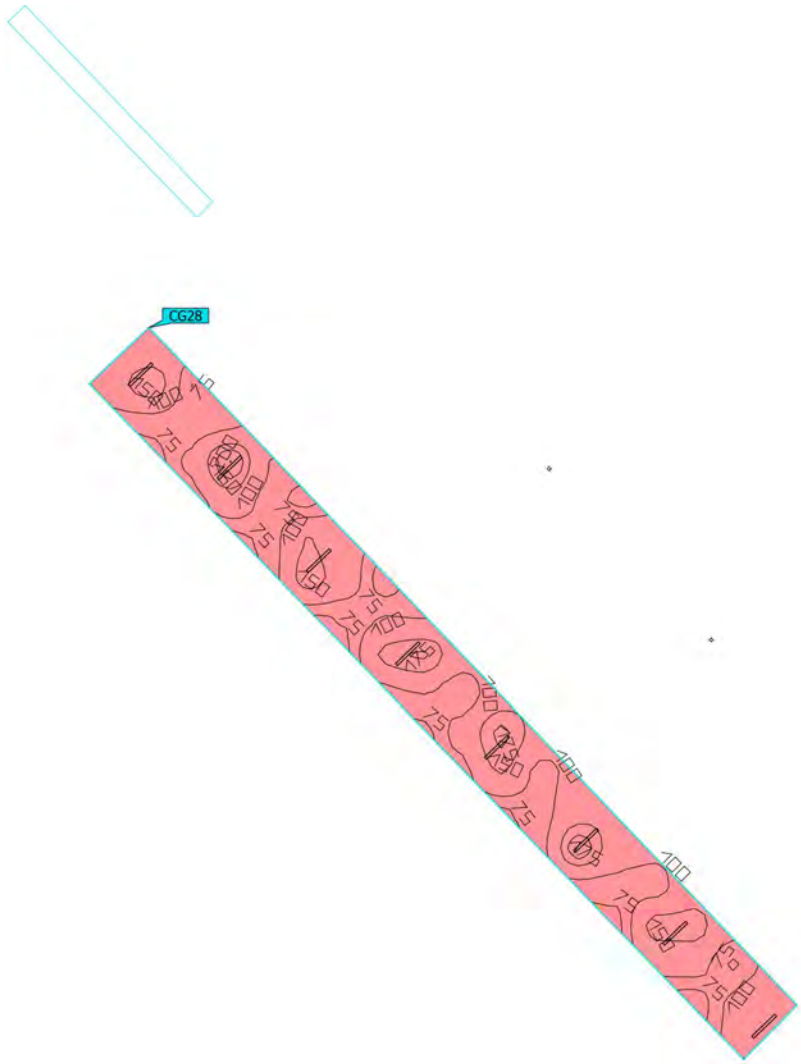
Pedestrian



Properties	Ē	E_{min}	E_{max}	U_o (g_1)	g_2	Index
Pedestrian Perpendicular illuminance Height: -0.000 m	11.6 lx	2.78 lx	32.2 lx	0.24	0.086	CG27

(Light scene 1)

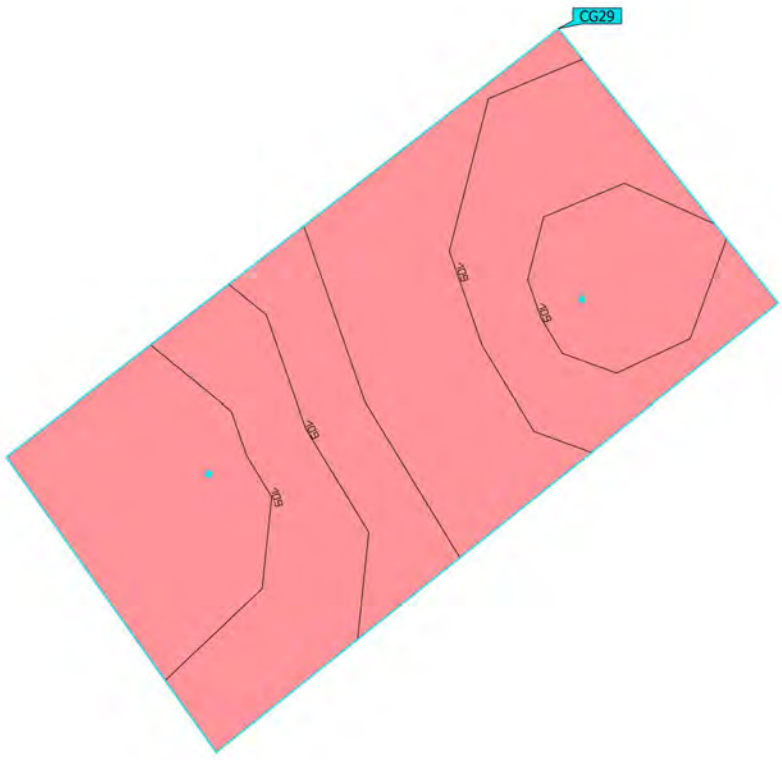
Cycle Storage

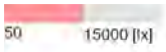


Properties	Ē	E_{min}	E_{max}	U_o (g_1)	g_2	Index
Cycle Storage Perpendicular illuminance Height: -0.000 m	113 lx	58.8 lx	201 lx	0.52	0.29	CG28

(Light scene 1)

Main Entrance

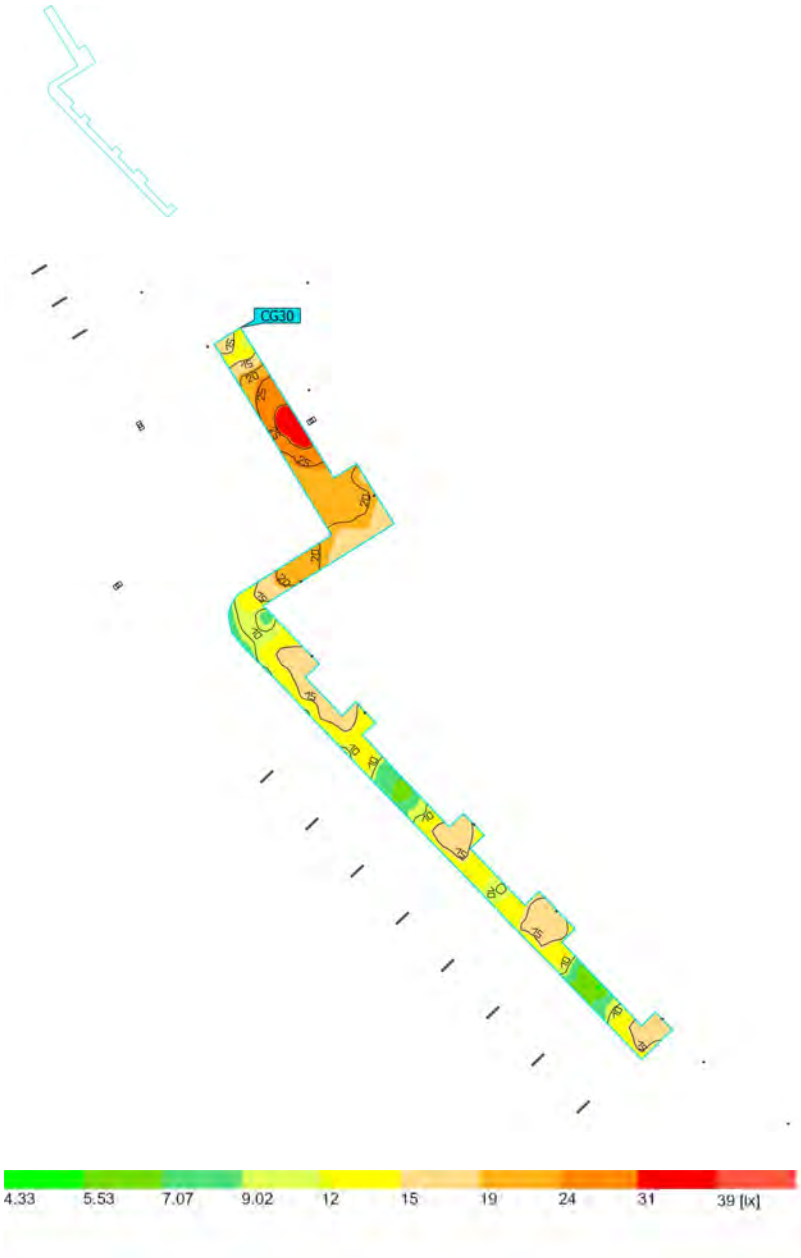




Properties	Ē	E_{min}	E_{max}	U_o (g_1)	g_2	Index
Main Entrance Perpendicular illuminance Height: 0.000 m	109 lx	109 lx	109 lx	1.00	1.00	CG29

(Light scene 1)

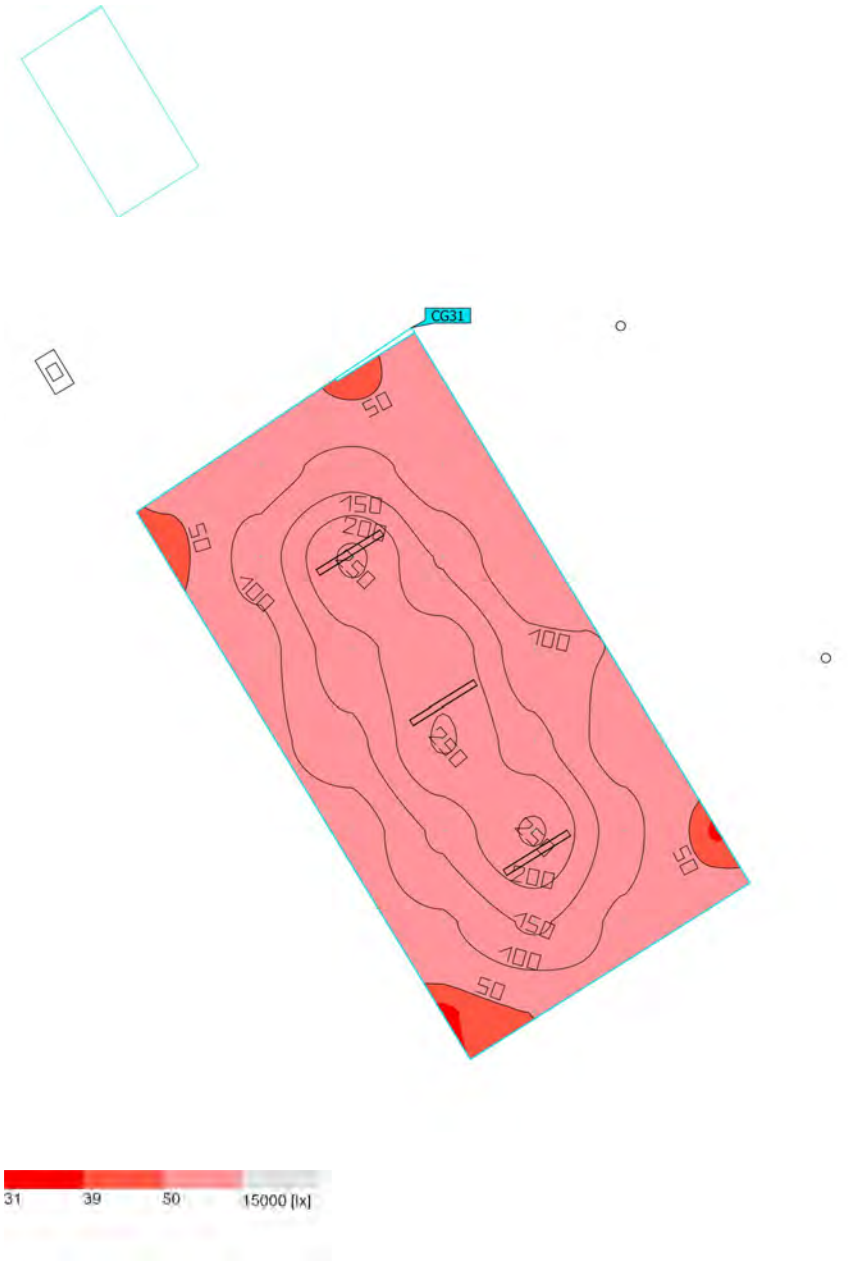
Pedestrian



Properties	Ē	E_{min}	E_{max}	U_o (g_1)	g_2	Index
Pedestrian Perpendicular illuminance Height: -0.000 m	16.2 lx	5.30 lx	34.2 lx	0.33	0.15	CG30

(Light scene 1)

Cycle Storage



Properties	Ē	E_{min}	E_{max}	U_o (g_1)	g_2	Index
Cycle Storage Perpendicular illuminance Height: 0.100 m	120 lx	37.0 lx	258 lx	0.31	0.14	CG31