Cambridge Waste Water Treatment Plant Relocation Project
Anglian Water Services Limited

Appendix 15.3: Lighting Assessment Report

Application Document Reference: 5.4.15.3
PINS Project Reference: WW010003
APFP Regulation No. 5(2)a

Revision No. 02
September 2023

Document Control

Document title	Lighting Assessment Report
Version No.	02
Date Approved	27.01.23
Date 1st Issued	30.01.23

Version History

Version	Date	Author	Description of change
01	30.01.23	-	DCO Submission
02	14.07.23	-	Updated formatting

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Summary

This Environmental Lighting Impact Assessment (herein 'the ELIA') has been prepared to assess the potential effects from artificial lighting on sensitive receptors and the surrounding environment for both the construction, operational and maintenance phases of the Proposed Development.

The ELIA has been informed by the Lighting Design Strategy (Appendix 2.5, App Doc Ref 5.4.2.5), Chapter 2 of the Environmental Statement - Project Description (App Doc Ref 5.2.2) and the Code of Construction Practice (Appendix 2.1, App Doc Ref 5.4.2.1).

The ELIA has been undertaken utilising a desk based study to inform the baseline conditions. To ensure the desk based study results are realist and reasonable, the receptor locations identified during the desk based study will be surveyed in the future to record the baseline conditions and measure the existing lighting levels.

The Table below provides the overall predicted effects of obtrusive light on human receptors for the operation, maintenance and construction phases of Proposed Development. The assessment includes light intrusion, luminous intensity, sky glow and glare.

Summary of Overall Predicted Effects of Obtrusive Light

ILP Guidance	Guidance criteria		Operational and maintenance assessment summary of predicted effects		Construction assessment summary of predicted effects		Summary of overall predicted effects
	Pre-curfew	Post-curfew	Pre-curfew	Post-curfew	Pre-curfew	Post-curfew	
Light Intrusion E2 Zone	5 Lux	1 Lux	None/ Negligible	None/ Negligible	None/ Negligible	None/ Negligible	None/ Negligible
Light Intrusion E3 Zone	10 Lux	2 Lux	None/ Negligible	None/ Negligible	None/ Negligible	None/ Negligible	None/ Negligible
Luminous Intensity E2 Zone	7,500	500	None/ Negligible	None/ Negligible	None/ Negligible	None/ Negligible	None/ Negligible
Luminous Intensity E3 Zone	10,000	1,000	None/ Negligible	None/ Negligible	None/ Negligible	None/ Negligible	None/ Negligible
Sky Glow E2 Zone	2.5%		None/ Negligible	None/ Negligible	None/ Negligible	None/ Negligible	None/ Negligible
Sky Glow E3 Zone	5%		None/ Negligible	None/ Negligible	None/ Negligible	None/ Negligible	None/ Negligible
Glare	Limits defined per design area		None/ Negligible	None/ Negligible	None/ Negligible	None/ Negligible	None/ Negligible

1 Introduction

1.1 Introduction

1.1.1 The Environmental Lighting Impact Assessment (ELIA) is provided as a technical appendix to the Environmental Statement (ES) and presents information to enable statutory consultees, members of the public, and the Secretary of State to understand, identify, and assess the likely significant effects of obtrusive light from Cambridge Waste Water Treatment Plant Relocation ("CWWTPR") on human receptors. This ELIA needs to be read in conjunction with Chapter 2 of the ES which set out the context of the project (App Doc Reference 5.2.2).

1.1.2 The following documents have been utilised to inform the ELIA: -

- Lighting Design Strategy (Appendix 2.5, App Doc Ref 5.4.2.5)
- Code of Construction Practice Part A (Appendix 2.1, App Doc Ref 5.4.2.1)
- The Proposed Development is shown on the Works Plans (App Doc Ref 4.3.0 to 4.3.11), General Arrangement Plans (App Doc Ref 4.2) and Design Plans (App Doc Ref 4.9 – 4.14), together with the other plans contained in Volume 4 of the application.

1.1.3 This ELIA:

- Summarises the proposed lighting elements of CWWTPR.
- Identifies the relevant legal and policy framework that has informed the undertaking of this assessment.
- Describes the methodology used to identify and assess likely significant effects.
- Describes the baseline environmental conditions against which the effects of CWWTPR are predicted.
- Describes the proposed lighting elements and equipment use for CWWTPR.
- Describes the measures that have been adopted as part of CWWTPR (primary mitigation, best practice and tertiary mitigation).
- Assesses the likely significant effects that could result from the CWWTPR during the construction, operation, and maintenance of CWWTPR taking into account the primary mitigation, best practice and tertiary mitigation).
- Describes the measures to be adopted as part of the CWWTPR (secondary mitigation).
- Assesses residual effects following the taking into account of the secondary mitigation.
- Provides a summary of residual effects for the mitigated CWWTPR.

1.2 Anglian Water Services Limited

1.2.1 Anglian Water Services Limited (the 'Applicant') is the largest regulated water and water recycling company in England and Wales by geographic area, supplying water and water recycling services to almost seven million people in the East of England and Hartlepool.

1.2.2 The Applicant is committed to bringing environmental and social prosperity to the region they serve, through their commitment to Love Every Drop. As a purpose-led business, The Applicant seeks to contribute to the environmental and social wellbeing of the communities within which they operate. As one of the largest energy users in the East of England, they are also committed to reaching net zero carbon emissions by 2030.

1.3 Introduction to the relocation project

1.3.1 Anglian Water's Cambridge Waste Water Treatment Plant Relocation project (CWWTPRP) ("the Proposed Development") is funded by Homes England, the Government's housing accelerator which seeks to improve neighbourhoods and grow communities by releasing land for development.

1.3.2 The Proposed Development involves the relocation of the existing Cambridge Waste Water Treatment Plant (WWTP) currently operating at Cowley Road, Cambridge, to a new site between Horningsea, Fen Ditton and Stow cum Quy, adjacent to the A14 in Cambridgeshire.

1.3.3 The relocation would make the site of the existing WWTP available to form part of the development of a new low-carbon city district, known as North East Cambridge. The site at Cowley Road, is Cambridge's last major brownfield site, and the wider North East Cambridge district proposals envisage creating around 8,350 homes and 15,000 jobs over the next 20 years.

1.3.4 North East Cambridge is a highly sustainable location for housing. In addition to the Homes England funding, the area has benefitted from Transport Infrastructure Fund (TIF) funding for Park & Ride, the completion of Cambridge Guided Bus public transport infrastructure, the delivery of the Cambridge North rail station and the Chisholm Trail.

1.3.5 North East Cambridge is one of three key strategic sites which will form "*central building blocks of any future strategy for development*" in the proposed Greater Cambridge Local Plan being jointly prepared by Cambridge City Council and South Cambridgeshire District Council that will be subject to public consultation in Autumn 2023. The North East Cambridge Area Action Plan (AAP), currently in "Proposed Submission" form, will be the planning policy framework which ultimately guides the development of North East Cambridge city district.

1.3.6 The importance of the Proposed Development, both regionally and nationally, was recognised by the Secretary of State for Environment, Food and Rural Affairs (DEFRA) in January 2021, who directed that the Proposed Development is nationally significant and is to be treated as a development for which a Development Consent

Order (DCO) is required (see Appendix 1-3 of the Planning Statement, App Doc Ref 7.5).

1.3.7 The policy context of the Proposed Development is described in more detail in the Planning Statement (Application Document Reference 7.5)

1.4 The relocation site

1.4.1 The relocation site was selected following comprehensive study and public consultation. The site selection process and consideration of alternatives is described in more detail in Chapter 3: Alternatives of the Environmental Statement (App Doc Ref 5.2.3).

1.4.2 The current environmental conditions at the existing Cambridge WWTP site and at the relocation site are described in Chapter 2: Project Description of the Environmental Statement (App Doc Ref 5.2.2). The site is located to the north-east of Cambridge and 2km to the east of the existing Cambridge WWTP, as shown on the Works Plans (App Doc Ref 4.3.1). It is situated on arable farmland immediately north of the A14 and east of the B1047 Horningsea Road in the green belt between the villages of Horningsea to the north, Stow cum Quy to the east and Fen Ditton to the south west. Two overhead lines of pylons cross the northern and eastern edges of the main development site and come together with a third line at the north eastern corner of the site. The topography is fairly flat with an approximately 4m fall across the site south west to north east.

1.5 Purpose of the Proposed Development

1.5.1 The Proposed Development for which the DCO is being sought will deliver all the functions of the existing Cambridge WWTP at Cowley Road, treating all waste water from the Cambridge catchment and wet sludge from the wider region.

1.5.2 In addition, it will have an increased capacity, being intended to treat the waste water from the Waterbeach catchment and anticipated housing growth in the combined Cambridge and Waterbeach catchment area.

1.5.3 The infrastructure provided as part of the main works will have a design life to at least 2090, and the supporting infrastructure (i.e. the transfer tunnel, pipelines and outfall) will have a designed capacity sufficient to meet population growth projections plus an allowance for climate change into the 2080s. Furthermore, there is capability for expansion in space that has been provided within the earth bank and by modification, enhancement and optimisation of the design to accommodate anticipated flows into the early 2100s.`

1.6 Outline description of the Proposed Development

1.6.1 The DCO application is seeking approval for the following main elements of the Proposed Development:

- an integrated waste water and sludge treatment plant.

- a shaft to intercept waste water at the existing Cambridge WWTP on Cowley Road and a tunnel/ pipeline to transfer it to the proposed WWTP and terminal pumping station. Temporary intermediate shafts to launch and recover the micro-tunnel boring machine.
- a gravity pipeline transferring treated waste water from the proposed WWTP to a discharge point on the River Cam and a pipeline for storm water overflows.
- a twin pipeline transferring waste water from Waterbeach to the existing Cambridge WWTP, with the option of a connection direct in to the proposed WWTP when the existing works is decommissioned.
- on-site buildings, including - a Gateway Building with incorporated Discovery Centre, substation building, workshop, vehicle parking including electrical vehicle charging points, fencing and lighting.
- environmental mitigation and enhancements including substantial biodiversity net gain, improved habitats for wildlife, extensive landscaping, a landscaped earth bank enclosing the proposed WWTP, climate resilient drainage system and improved recreational access and connectivity.
- renewable energy generation via anaerobic digestion which is part of the sludge treatment process that produces biogas designed to be able to feed directly into the local gas network to heat homes, or as an alternative potential future option burnt in combined heat and power engines.
- renewable energy generation via solar photovoltaic and associated battery energy storage system.
- other ancillary development such as internal site access, utilities, including gas, electricity and communications and connection to the site drainage system.
- a new vehicle access from Horningsea Road including for Heavy Goods Vehicles (HGV's) bringing sludge onto the site for treatment and other site traffic.
- Temporary construction works including compounds, temporary highway controls, accesses and signage, fencing and gates, security and safety measures, lighting, welfare facilities, communication control and telemetry infrastructure.
- Decommissioning works to the existing Cambridge WWTP to cease its existing operational function and to facilitate the surrender of its operational permits including removal of pumps, isolation of plant, electrical connections and pipework, filling and capping of pipework, cleaning of tanks, pipes, screens and other structures, plant and machinery, works to decommission the potable water supply and works to restrict access to walkways, plant and machinery.

1.6.2 Additional elements, together with more information on the above features are provided in Chapter 2: Project Description of the Environmental Statement (App Doc Ref 5.2.2). Principles of Good Design have been used to inform the development of the project, which has been guided by the National Infrastructure Commission's Design Principles, advice from the Design Council and review by the Cambridgeshire Quality Panel, as described in the Design and Access Statement (App Doc Ref 7.6).

1.6.3 Construction activities, likely to take 3-4 years, will include the creation of a shaft to intercept waste water at the existing Cambridge WWTP and temporary intermediate shafts between the existing Cambridge WWTP and the proposed WWTP to launch and recover a micro-tunnel boring machine. The sequence and location of construction activities are also detailed in Chapter 2: Project Description of the Environmental Statement (App Doc Ref 5.2.2).

1.6.4 Towards the end of the construction period, commissioning of the Proposed Development will commence, lasting for between 6 months and 1 year.

1.6.5 The Proposed Development will also involve the decommissioning of the existing Cambridge WWTP at Cowley Road. This is secured by the Development Consent Order and the Outline Decommissioning Plan (Appendix 2.3, App Doc Ref 5.4.2.3) and involves activities necessary to take the existing plant out of operational use and to surrender its current operational permits.

1.6.6 Following decommissioning, the site of the existing plant will be made available in accordance with agreements already in place with Homes England and with the master developer appointed to deliver the redevelopment of North East Cambridge

1.6.7 Consent is not sought under the Development Consent Order for the subsequent demolition or redevelopment of the Cowley Road site, which, as described in Chapter 2: Project Description of the Environmental Statement (App Doc Ref 5.2.2) will be consented under a separate and future planning permission, by master developers, U+I and TOWN, appointed under the agreements described above.

1.6.8 The relationship between the Proposed Development, the scope of the draft DCO and the future demolition and redevelopment of the site at Cowley Road is set out in figure 1.1.

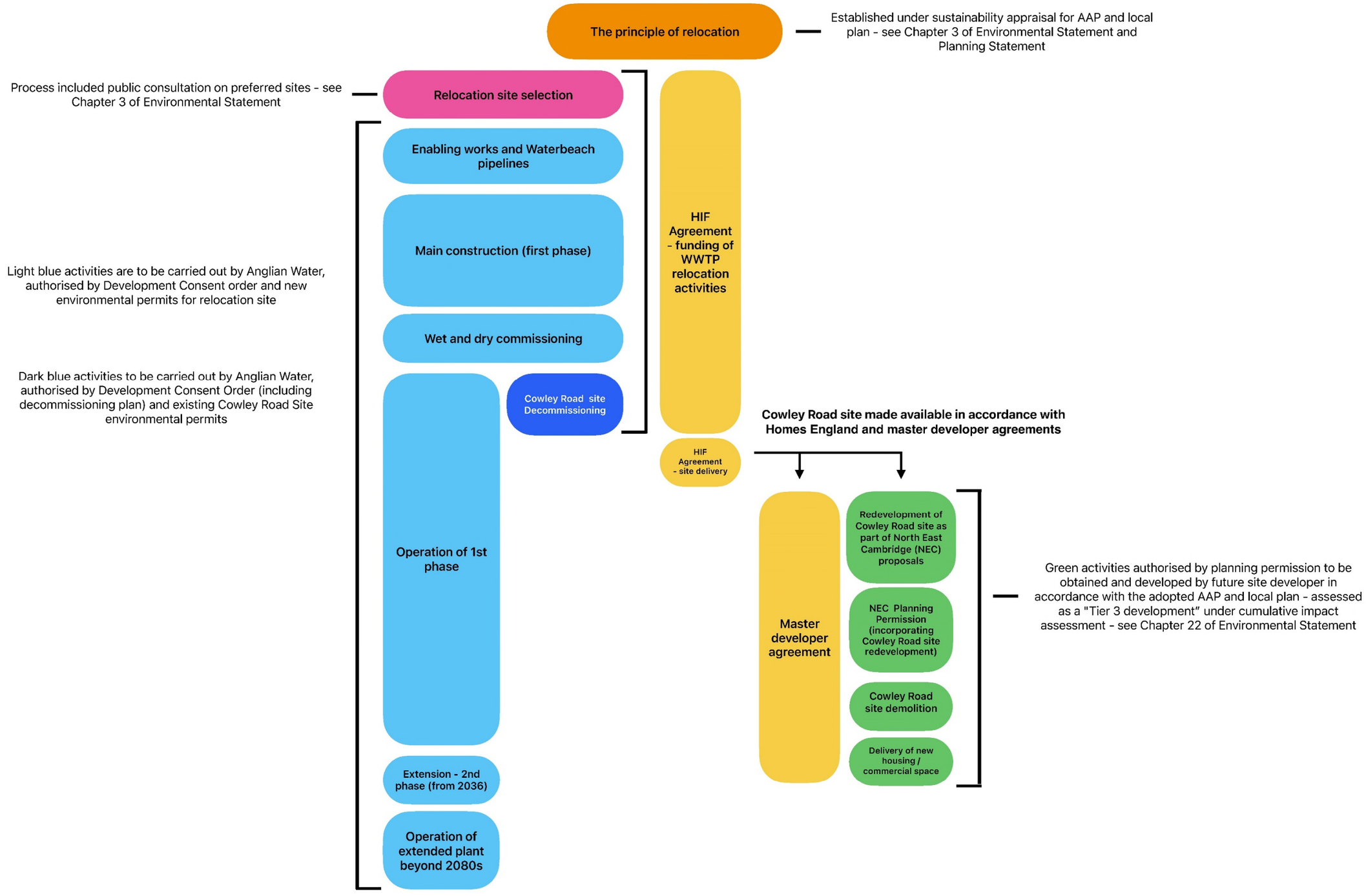

Figure 1.1: Scope of the draft DCO and the future demolition and redevelopment of the site at Cowley Road

1.7 Environmental mitigation

1.7.1 Through the environmental impact assessment process and community and technical stakeholder engagement the Proposed Development has incorporated comprehensive environmental mitigation, secured through the Development Consent Order.

1.7.2 This mitigation includes a Landscape, Ecological and Recreational Management Plan ("LERMP", Appendix 8.14, App Doc Ref 5.4.8.14) has been developed to complement regional and local initiatives, including the Wicken Fen Vision and the Cambridge Nature Network. The 22-hectare footprint of the plant is encircled by a landscaped and planted earth bank situated within the broader LERMP area of around 70-hectares,

1.8 Additional project benefits

1.8.1 In addition to enabling housing growth and future economic development of the Greater Cambridge area the project will also give rise to a number of additional benefits including:

- significantly reduced carbon emissions compared to the existing Cambridge WWTP, being operationally net zero and energy neutral, contributing to Anglian Water's ambition of being operationally net zero as a business by 2030.
- greater resilience and improved storm management, meaning storm overflows and Combined Sewer Overflows (CSOs) are far less likely to occur. This means that, as Greater Cambridge continues to grow, the facility will be able to treat a greater volume of storm flows to a higher standard than would be the case at today's facility.
- The proposed WWTP is being designed to reduce concentration in final treated effluent discharges of phosphorus, ammonia, total suspended solids and biological oxygen demand (BOD), compared to the existing Cambridge WWTP. This means that when the new facility starts to operate, water quality in the River Cam will improve.

1.9 Proposed lighting

1.9.1 Certain activities during the construction, operation and maintenance of the Proposed Development would operate 24 hours a day, therefore lighting would be required during the hours of darkness to fulfil health and safety requirements.

1.9.2 During construction of the Proposed Development there will be temporary lighting required to facilitate construction including:

- Lighting of temporary compounds.
- Lighting on plant and equipment i.e. cranes.
- Vehicle lighting.
- Lighting within buildings remaining under construction.

- Temporary lighting structures to illuminate working areas.

1.9.3 The likely sources of lighting during the operation and maintenance of the Proposed Development are:

- Operational and maintenance lighting within the earth bank of the proposed WWTP.
- Lighting of the Gateway Building and the car park external to the proposed WWTP earth bank.
- Additional Lighting along Horningsea Road associated with the road access option.
- Lighting within the Gateway Building with incorporated Discovery Centre, substation building, and workshop that is external to the proposed WWTP earth bank.
- The Gateway Building vehicle parking including electrical vehicle charging points that are external to the proposed WWTP earth bank.

1.10 Competency statement

1.10.1 The qualifications and experience of the ELIA assessors are set out in the competency statement (Table 1-1).

Table 1-1: Competency statement

Name	Years of experience	Role	Qualifications	Experience summary
JM	26	ELIA Author	HND electrical and electronic engineering	Over 15 years' experience producing and checking ELIA's and obtrusive light studies
RP	4	ELIA Technical Checker	Certificate of higher education in electrical and electronic engineering	4 years' experience producing and checking ELIA's and obtrusive light studies

1.11 Consultation

1.11.1 Table 1-2 provides a summary of points raised during engagement with stakeholders in relation to the ELIA.

1.11.2 Consultation details relating to lighting and landscape and visual amenity are provided in Chapter 15 (App Doc Reference 5.2.15), to the Historic Environment in Chapter 13 (App Doc Reference 5.2.13).

Table 1-2: Consultation record

Date	Consultee	Consultation mechanism	Issues raised	Outcome
14th July 2022	Greater Cambridge Shared Planning (GCSP)	Teams meeting	Approach to assessment Baseline Receptors and inclusion of residences and ecological receptors	Agreement that the baseline assessment could be undertaken via a desktop study. Proposed receptors list provided for review.
10th August 2022	Cambridgeshire County Council's (CCC) Street lighting team	e-mail	Requests for lighting standards and associated lighting inventory information.	Standards confirmed and inventory information provided for use in assessment.

2 Legislation, Policy and Guidance

2.1 Introduction

2.1.1 The following section identifies legislation, national and local planning policies along with guidance relevant to lighting for the Proposed Development.

2.2 Legislation

2.2.1 The Clean Neighbourhoods and Environmental Act (CNEA) 2005 amended Section 79 of the Environmental Protection Act 1990 to include "*artificial light emitted from premises so as to be prejudicial to health or a nuisance*".

2.2.2 The CNEA states that this does not apply to defence infrastructure, airports, harbour premises, railway premises, tramway premises, bus stations and any associated facilities, public service vehicle operating centres, lighthouses and prisons. Additional guidance is provided by the government website GOV.UK, Guidance on "Artificial light nuisances: how councils deal with complaints", and states that street lighting is also excluded.

2.2.3 Local Authorities are provided with powers to serve abatement notices to premises with artificial lighting installations deemed to be causing a nuisance. There is however no definition provided on the levels of artificial lighting which could be considered as a statutory nuisance.

2.2.4 Section 103 of CNEA allows the defence of best practicable means where artificial lighting is emitted from industrial, trade or business premises or where lighting is used for an outdoor relevant sports facility.

2.3 National policies

National Policy Statement for Waste Water, March 2012

2.3.1 Paragraph 4.7.4 requires the assessment supporting the DCO application to: "*…include the visibility and conspicuousness of the project during construction and of the presence and operation of the project and potential impacts on views and visual amenity. This should include any light pollution effects including on local amenity and nature conservation."*

2.3.2 Paragraph 4.12.1 acknowledges that "*During the construction, operation and decommissioning of waste water infrastructure there is potential for the release of a range of emissions such as dust, steam, smoke, artificial light and for infestation of insects. All have the potential to have a detrimental impact on amenity or cause a common law nuisance or statutory nuisance under Part III, Environmental Protection Act 1990.*"

2.3.3 Paragraph 4.12.4 requires The Applicant to: *"…assess the potential for insect infestation and emissions of dust, steam, smoke and artificial light to have a detrimental impact on amenity, as part of the Environmental Statement.*"

2.3.4 Paragraph 4.12.7 advises that: "*The decision maker should satisfy itself that all reasonable steps have been taken, and will be taken, to minimise any detrimental impact on amenity from insect infestation and emissions of dust, steam, smoke, and artificial light.*"

2.3.5 Paragraph 4.12.9 advises that "*…the decision maker may consider attaching requirements to the development consent, in order to secure mitigation measures proposed by an applicant, in particular for the management and mitigation concerning insect infestation and emissions of dust, steam, smoke and artificial light from the development.*"

National Planning Policy Framework 2019

2.3.6 The Ministry of Housing, Communities and Local Government (MHCLG), 2021), National Planning Policy Framework (NPPF), provides guidance on the Government's national planning policies and how they are expected to be applied. With regards to light pollution, Section 15 Paragraph 185 states:

2.3.7 "Planning policies and decisions should also ensure that new development is appropriate for its location taking into account the likely effects (including cumulative effects) of pollution on health, living conditions and the natural environment, as well as the potential sensitivity of the site or the wider area to impacts that could arise from the development. In doing so they should: …

2.3.8 c) limit the impact of light pollution from artificial light on local amenity, intrinsically dark landscapes and nature conservation."

2.4 National guidance

2.4.1 The MHCLG Planning Practice Guidance (2019) sets out planning policies and the governments expectations of how these should be applied. The guidance provides a section on Light Pollution (2019) and provides guidance on the following:

- What light pollution considerations does planning need to address?
- What factors can be considered when assessing whether a development proposal might have implications for light pollution?
- What factors are relevant when considering where light shines?
- What factors are relevant when considering when light shines?
- What factors are relevant when considering how much light shines?
- What factors are relevant when considering possible ecological impacts of lighting?
- What other information is available that could inform approaches to lighting and help reduce light pollution?

2.5 Local policies

Table 2-1: Summary of relevant policies within the South Cambridgeshire Local Plan (2018)

Policy Number	Title	Policy Summary
SC/9: Lighting Proposals	Lighting Proposals	Development proposals which include new external lighting will only be permitted where it can be demonstrated that: a. The proposed lighting scheme and levels are the minimum required for reasons of public safety, crime prevention / security, and living, working and recreational purposes; b. Light spillage and glare are minimised; c. There is no unacceptable adverse impact on the local amenity of neighbouring or nearby properties, or on the surrounding countryside; d. There is no dazzling or distraction to road users including cyclists, equestrians and pedestrians; e. Road and footway lighting meets the County Council's adopted standards. Proposed development that is adversely affected by existing artificial lighting outside the development site will not be permitted unless any significant impact can be mitigated to an acceptable level.

Source: South Cambridgeshire Local Plan (2018)

Table 2-2: Summary of relevant policies within Cambridge Local Plan (2018)

Policy Number	Title	Policy Summary
Policy 34	Light pollution control	Development proposals that include new external lighting or changes to existing external lighting will be permitted where it can be demonstrated that: a. it is the minimum required to undertake the task, taking into account public safety and crime prevention; b. upwards or intrusive light spillage is minimised; c. it minimises impact to local residential amenity; and d. it minimises impact to wildlife and landscape character, particularly at sites on the edge of Cambridge.

Source: Cambridge Local Plan (2018)

2.6 Local guidance

Table 2-3: Summary of relevant guidance within Greater Cambridgeshire Supplementary Planning Document (SPD) (2020)

Policy Number	Title	Policy Summary
Policy 3.6	Light Pollution	Section 3.6 of the SPD provides guidance to inform the design of lighting installations and the reduction of obtrusive light to ensure that minimum policy requirements are met and where possible exceeded. Detailed guidance is provided on the preferred approach

Policy Number	Title	Policy Summary
		to obtrusive light assessments and requirements for mitigation, including the following key elements: - a. Obtrusive light; b. Potential impacts of obtrusive light to avoid; c. Planning guidance relating to lighting; d. Submission requirements; e. General lighting requirements; f. Limitations of obtrusive light; g. Guidance on the approach of the ELIA; h. The role of planning conditions relating to lighting; and i. Information on further guidance related to lighting and obtrusive light.

Source: Greater Cambridgeshire Supplementary Planning Document (2020)

2.7 Design standards and guidance documents

2.7.1 The proposed lighting will be designed in accordance with but not limited to the following European and British standards and guidance documents.

- BS 5266-1:2016, Emergency lighting Part 1: Code of practice for the emergency lighting of premises (2016)
- BS EN 1838:2013, Lighting application – Emergency Lighting (2013)
- BS 5489-1:2020, Code of practice for the design of road lighting Part 1: Lighting of roads and public amenity areas (2020)
- BS 8300-1:2018, Design of an accessible and inclusive built environment – Part 1: External environment – Code of practice (2018)
- BS EN 12464-1:2021, Light and Lighting – Lighting of workplaces Part 1: Indoor work places (2021)
- BS EN 12464-2:2014, Light and Lighting – Lighting of workplaces Part 2: Outdoor work places (2014)
- BS EN 13201-2:2015, Road lighting – Part 2: Performance requirements (2015)
- BS EN 17037:2018+A1:2021 Daylight of buildings (2021)
- CIE 115:2010 International Commission on Illumination, Lighting of Roads for Motor and Pedestrian Traffic, 2nd Edition (2010)
- CIE 150:2017 International Commission on Illumination, Guide on the Limitation of the Effects of Obtrusive Light from Outdoor Lighting Installations, 2nd Edition (2017)
- Institution of Lighting Professionals (ILP) Guidance Note 01: Reduction of Obtrusive Light, GN01 (2021)

- ILP and Bat Conservation Trust Guidance Note 08/18 Bats and Artificial Lighting in the UK, Bats and the Built Environment series (2018)
- ILP – Professional Lighting Guide 02: The application of conflict areas on the highway, PLG02 (2013)
- ILP – Professional Lighting Guide 04: Guidance on Undertaking Environmental Lighting Impact Assessments, PLG04 (2013)
- ILP – Professional Lighting Guide 05: The Brightness of Illuminated Advertisements, PLG05 (2014)
- ILP – Professional Lighting Guide 23: Lighting for Cycle Infrastructure, PLG23 (2020)
- ILP – Technical Report 12: Lighting of Pedestrian Crossings, TR12 (2007)
- Water Industry Mechanical and Electrical Specification (WIMES) 3.02(E) incorporating Anglian Water amendments and additions – entitled 'Lighting Installation'. (2020)
- All-Party Parliamentary Group for Dark Skies (APPG) Ten Dark Sky policies for the government (2020)
- Bats and Lighting – Overview of Current Evidence and Mitigation. Stone, Emma (2014)
- BREEAM UK New Construction – Non-domestic buildings (All UK), Technical Manual SD5078 (2018)
- CIBSE LG1 Lighting Guide 1 – The Industrial Environment (2018)
- CIBSE LG6 Lighting Guide 6 – The Exterior Environment (2016)
- CIBSE LG7 Lighting Guide 7 – Offices (2015)
- CIBSE LG10 Lighting Guide 10 – Daylighting - A Guide for Designers (2014)
- CIBSE LG12 Lighting Guide 12 – Emergency Lighting - Lighting for the built Environment (2022)
- The Society of Light and Lighting (SLL) Code for Lighting (2012)
- Guidance Note HSG 38 (1997) – Lighting at Work

2.7.2 The remainder of this report considers that these documents are current. These documents should be verified as current and, if superseded, the standards and lighting levels discussed in this report should be reassessed.

3 Methodology

3.1 Introduction

3.1.1 This section outlines the methodology adopted in undertaking the ELIA.

3.2 Scope of assessment

3.2.1 CWWTPR will incorporate various elements of artificial lighting. The ELIA evaluates the impacts of the proposed lighting installation and:

- Identifies and describe the artificial light currently affecting the area of land required for the Proposed Development and surrounding identified receptors.
- Provides a description of the proposed lighting standards and associated lighting design information that will be utilised to inform the assessment of obtrusive light (sometimes referred to as light pollution).
- Provides the limitations of obtrusive light for the environmental zone in accordance with the guidance provided in ILP GN01:2021 (ILP, 2021).
- Identifies predicted impacts of obtrusive light using a qualitative assessment technique.
- Identifies design interventions and provide guidance on mitigation measures, with a view to reducing potential impacts to a negligible magnitude.

3.2.2 The guidance provided in the ILP PLG04:2013 (ILP, 2013)has been used to undertake the lighting assessment in conjunction with ILP GN01:2021 (ILP, 2021).

3.3 Baseline assessment methodology

3.3.1 Receptors in the vicinity of CWWTPR were identified through an initial desk based study of the area, this involved a review of ordnance survey maps, plans, aerial photography, street view photography, Campaign for the Protection of Rural England (CPRE) Night Blight interactive mapping (CPRE, 2016) and GIS datasets (Residential properties, statutory designations, local environmental designations, biodiversity, heritage, community and design data) to identify likely receptor locations. This was further informed by a study of potential lighting receptors, for example residential properties, rail lines, and road users that are in proximity to areas identified as being lit as part of either the construction, operational or maintenance phase of the project. Receptor sites were then chosen to allow the identification of baseline lighting conditions, and an assessment of potential impacts on people and the environment in which they live, work or travel.

3.3.2 During the consultation meeting with Greater Cambridge Shared Planning (GCSP) that took place on 14th July 2022, it was agreed that the baseline assessment could be undertaken via a desktop study, as part of this study a number of street lit areas have been identified. To inform the baseline lighting conditions queries were raised

with identified as the asset owner, in this case Cambridgeshire County Council's (CCC) Street lighting team. The information from CCC will further inform the desktop study by providing lighting standards and associated lighting inventory information for the afore mentioned street lit areas.

3.3.3 The location of each receptor was discussed with GCSP during the consultation meeting. During this consultation further receptor locations were raised by GCSP as areas that may be impacted by obtrusive light.

3.3.4 Following consultation with GCSP collaborative meetings were held with ES chapter discipline leads for biodiversity, landscape and visual impact, historic environment and health and community. These meeting reviewed the additional areas raised by GCSP and identified additional receptors that were subsequently added to the Lighting Receptor and Environmental Zone Plan within Appendix A (drawing number WW01003-CAMEST-MOT-05-XX-DR-X-1001). The updated environmental lighting zone and receptor plan was then issued to GCSP for confirmation and comment and was subsequently discussed and acknowledged within the Statement of Common Ground round table/workshop in August 2022.

3.3.5 The receptor locations identified during the desk based study will be surveyed in the future to record the baseline conditions and measure the existing lighting levels.

3.4 Summary of receptor locations

3.4.1 A summary of the locations and a description of each lighting survey receptor are shown in Table 3-1. These locations include a quantity advised by biodiversity and landscape visual for inclusion, refer to Lighting Receptor and Environmental Zone Plan (drawing number WW01003-CAMEST-MOT-05-XX-DR-X-1001) included in Appendix A of this report for further details.

Table 3-1: Summary of qualitative lighting survey receptor locations

Viewpoint No.	Eastings	Northings	Description
LR1	549809	261581	On Low Fen Drove Way by a disused building
LR2	550019	260800	In a field West of Low Fen Drove Way (confirmed bat roost)
LR3	550464	260969	On the edge of a field near a residential property on Low Fen Drove Way, 'The Old Gatehouse'
LR4	551006	259903	In a field East of Best Western Premier Collection Quy Mill Hotel & Spa
LR5	549664	259826	High Ditch Road near some residential properties
LR6	549153	260988	On the carriageway of the A14
LR7	548799	260862	In the field North of number 82 Horningsea Road
LR8	548961	261217	On Horningsea Road bridge over the A14
LR9	548753	261112	In a field West of Horningsea Road

Viewpoint No.	Eastings	Northings	Description
LR10	548351	261058	Opposite number 38 Green End (confirmed bat roost to Northeast)
LR11	548410	261253	In a field Southeast of Red House Close
LR12	547917	261491	West of the Cambridge to King's Lynn railway line within the existing Cambridge Wastewater Treatment Plant
LR13	548415	261611	In a field East of the River Cam and North of the A14
LR14	548820	261609	In a field Southwest of Biggin Abbey Cottages, Biggin Lane
LR15	549258	262173	On Horningsea Road outside a residential property, 'The Lays'
LR16	550176	263642	In a field East of Cambridge Country Cottages.
LR17	550410	264482	In a field North of Clayhithe Farm
LR18	550538	264875	In a field South of the River Cam opposite the Cam Sailing Club
LR19	550418	265049	In a field North of the River Cam near Cam Sailing Club
LR20	550506	265829	In a field East of the Cambridge to King's Lynn railway line and North of Bannold Road.
LR21	550592	266179	In a field East of the Cambridge to King's Lynn railway line and West of Long Drove
LR22	550455	266234	In a field East of Bannold Drove and West of the Cambridge to King's Lynn railway line

3.5 Environmental zones

3.5.1 To define the maximum permissible levels of obtrusive light an objective appraisal has been carried out to classify the Proposed Development in terms of its 'environmental zone', which equates to the district brightness of the surroundings (see Table 3-2 for further information). The appraisal of the environmental zones is based on the nature of the area in general and not the presence of various types and levels of lighting within it.

3.5.2 In the case of a site being between two possible environmental zones, ILP guidance recommends that the most difficult environmental zone of the two options to achieve is assigned for assessment purposes.

3.5.3 In this case there are two different environmental zones, E2 and E3 zone have been identified. The E2 zone location is in the vicinity of Cambridge City and Milton village. All other locations have been deemed to be an E3 environmental zone, refer to Lighting Receptor and Environmental Zone Plan (drawing number WW01003-CAMEST-MOT-05-XX-DR-X-1001), included in Appendix A of this report for further details.

Table 3-2: Environmental zones

Zone	Surrounding	Lighting environment	Examples
E0	Protected	Dark (SQM 20.5+)	Astronomical Observed 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 or suburban locations
E4	Urban	High district brightness	Town/city centres with high levels of night time activity

Source: ILP GN01:2021

Note 1 – Where an area to be lit lies close to the boundary of two zones the obtrusive light limitation values used should be those applicable to the most rigorous zone.

Note 2 – Rural zones under protected designations should use a higher standard of policy.

Note 3 – Zone E0 must always be surrounded by an E1 Zone.

Note 4 – Zoning should be agreed with the local planning authority. Due to local requirements a more stringent zone classification may be applied to protect special / specific areas.

Note 5 – SQM (Sky Quality Meter) is referenced by the International Dark Skies Association (IDA). SQM is an instrument used to measure the luminance of the night sky. It is typically used by astronomers to quantify sky glow, using units of magnitudes per square arcsecond. the scale is between 16:00 (a bright night sky) and 22:00 (the least light pollution). The criteria for zone E0 was revised in mid 2019, with the new requirements not being made retrospective.

Note 6 – Astronomical Observable Dark Skies will offer clearer views of the Milky Way and of other objects such as the Andromeda Galaxy and the Orion Nebula.

Note 7 – Although values of SQM 20 to 20.5 may not offer clear views of astronomical dark sky objects such as the Milky Way, these skies will have their own relative intrinsic value in the UK.

3.6 Obtrusive light limitations

3.6.1 It can be seen from Table 3-2 that a lighting installation located in an area deemed to be more sensitive will understandably equate to greater constraints with regards to

obtrusive light. Table 3-3, Table 3-4, Table 3-5, Table 3-6, and Table 3-7 detail maximum permissible levels of obtrusive light associated with an E2 and E3 zone.

Table 3-3: Limits for upward light ratio and spill light

Environmental zones	Maximum values of upward light ratio (ULR)/% of luminaires*1	Illuminance in the vertical plane (E_v) (Lux)*2	
		Pre-curfew	Post-curfew
E2	2.5	5	1
E3	5	10	2

Source: ILP GN01:2021

*1 Table 5 CIE 150:2017

Note 1 (ULR) – This is the primary approach to limit sky glow and is suitable to compare different single luminaires and mitigate the contribution of each luminaire within an installation.

Note 2 (ULR) – This does not take into account the effect of light reflected upwards from ground that also contributes to sky glow.

Note 3 (ULR) – Some lighting schemes will require the deliberate and careful use of upward light, e.g. ground recessed luminaires, ground mounted floodlights and festive lighting, to which these limits cannot apply. However, care should always be taken to minimise any upward waste light by the proper application of suitably directional luminaires and light controlling attachments.

*2 Table 2 CIE 150:2017

Note 1 (Spill light) – Limits apply to nearby dwellings / premises or potential dwellings / premises and specifically windows. The values are the summation of all lighting installations.

Note 2 (Spill light) – Curfew refers to the time after which stricter requirements (for the control of obtrusive light) will apply; often a condition of use of lighting applied the local planning department. Depending upon application curfew times often commence between 21:00 to 23:00 and may run until 07:00. However, exact curfew hours should be carefully applied to ensure the reduction of obtrusive light is prioritised within the immediate environment and towards sensitive human as well as fauna and flora receptors.

Table 3-4: Limits for the luminous intensity of bright luminaires

Light technical parameter *1	Applicable conditions	Luminaire group (projected area A_p in m^2)					
		0<Ap ≤0.002	0.002<Ap ≤0.01	0.01<Ap ≤0.03	0.03<Ap ≤0.13	0.13<Ap ≤0.50	Ap > 0.5
Maximum luminous	E2 Pre-curfew	0.57 *d*	1.3 *d*	2.5 *d*	5.0 *d*	10 *d*	7,500

Light technical parameter *1	Applicable conditions	Luminaire group (projected area A_p in m^2)					
		0<Ap ≤0.002	0.002<Ap ≤0.01	0.01<Ap ≤0.03	0.03<Ap ≤0.13	0.13<Ap ≤0.50	Ap > 0.5
intensity emitted by luminaire (I in cd)	E2 Post-curfew	0.29 *d*	0.63 *d*	1.3 *d*	2.5 *d*	5.1 *d*	500
	E3 Pre-curfew	0.86 *d*	1.9 *d*	3.8 *d*	7.5 *d*	15 *d*	10,000
	E3 Post-curfew	0.29 *d*	0.63 *d*	1.3 *d*	2.5 *d*	5.1 *d*	1,000

Source: ILP GN01:2021

*1 Table 3 CIE 150 2017

Note 1 – d is the distance between the observer and the glare source in metres.

Note 2 – A luminous intensity of 0 cd can only be realised by a luminaire with a complete cut-off in the designated directions.

Note 3 – A_p is the apparent surface of the light source seen from the observer position.

Note 4 – For further information refer to Annex C of CIE 150:2017.

Note 5 – Upper limits for each zone shall be taken as those with column Ap>0.5.

Table 3-5: Maximum values of threshold increment and veiling luminance

Light technical parameter*1	Road classification			
	No road lighting	M6/M5	M4/M3	M2/M1
Veiling luminance (L_v)	0.037 cd/m^2	0.23 cd/m^2	0.40 cd/m^2	0.84 cd/m^2
Threshold increment (TI)	15% based on adaption luminance of 0.1 cd/m^2	15% based on adaption luminance of 1.0 cd/m^2	15% based on adaption luminance of 2.0 cd/m^2	15% based on adaption luminance of 5 cd/m^2

Source: ILP GN01:2021

*1 Table 4 CIE 150:2017

Note 1 – Road classifications as given in CIE 115:2010.

Note 2 – The veiling luminance values specified in this table are based upon permissible TI value of 15%.

Table 3-6: Maximum values of threshold increment for residential roads

Light technical parameter	Road classification						
	P7	P6	P5	P4	P3	P2	P1
Threshold increment	Not Determined	35	30	30	25	25	20

Source: BS EN 13201-2:2015

Table 3-7: Maximum permitted values of average surface luminance (cd/m^2).

Light technical parameter*[1]	Application conditions	Average surface luminance (cd/m^2)
Sign luminance (L_s)	Taken as the product of the design average illuminance and reflectance divided by π (pi), or for self-luminous signs, its average luminance.	400 (E2 Zone) 800 (E3 Zone)

Source: ILP GN01:2021

*[1] Table 7 CIE 150:2017

Note 1 – The values apply to both pre- and post-curfew, except that in Zones 0 and 1 the values shall be zero post curfew. The values for signs do not apply to signs for traffic control purposes.

For illuminated advertising signs the aim should be to achieve the limits advised in ILP PLG05 (2014).

3.7 Assessment methodology

3.7.1 The ELIA has considered each identified receptor and the potential impacts from the lighting associated with CWWTPR and evaluates whether the limitations detailed in Table 3-3, Table 3-4, Table 3-5, Table 3-6, and Table 3-7 and visualised in **Figure 3.1** below and are exceeded in terms of the following:

- Sky Glow – The brightening of the sky at night by artificial light sources including light emitted directly upward from the light source and reflected from the ground or surface.
- Spill Light – Light that falls beyond the boundary of the area being lit.
- Luminous Intensity - The measure of the amount of light that a source radiates in a given direction.
- Discomfort/Disability Glare – The measure of the uncomfortable brightness of a light source when viewed against a darker background for highway users.

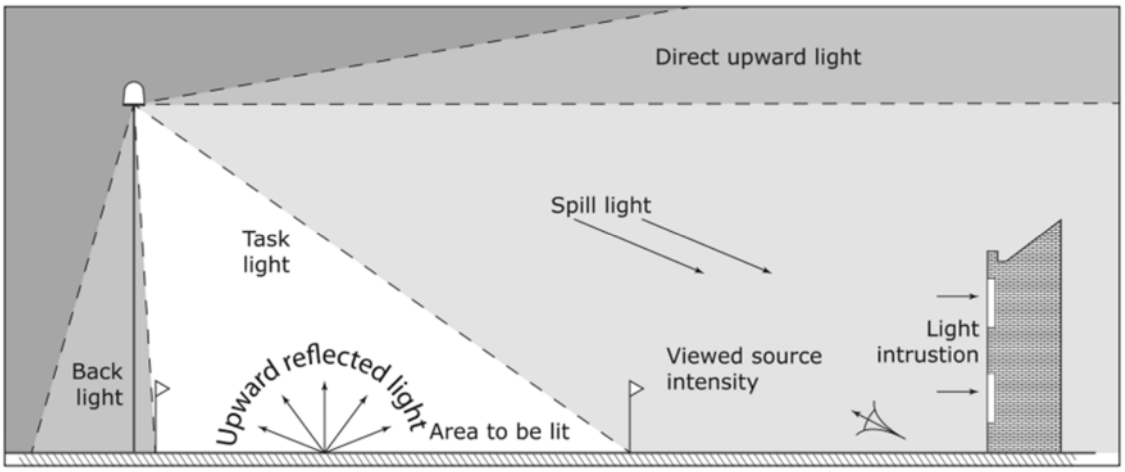

Figure 3.1: Types of obtrusive light

Source: ILP GN01:2021

3.7.2 Projects in the earlier stages of design often do not have fixed lighting designs for all elements of the proposal; this is the case with elements of CWWTPR with no detail of locations, lamp types, mounting heights, orientations, mounting angles, photometry etc. available. Therefore, a qualitative assessment of the predicted impacts has been provided.

3.7.3 The qualitative assessment considers the baseline lighting conditions identified during the desk based study at each identified receptor and review these against the potential lighting impacts from the CWWTPR as a whole. The assumed lighting requirements for the Proposed Development are detailed further in Section 4, and the assessment considers the likely impacts from these areas taking into account the primary mitigation, best practice and tertiary mitigation applied. Should they be required, secondary mitigation measures are identified following this assessment, these are provided within Section 7 of the report. The summary of residual effects for the mitigated CWWTPR is then be provided with Section 8.

3.7.4 Qualitative assessment techniques have been used to predict the likely levels of obtrusive light and whether the obtrusive light limitations detailed in this section of the ELIA are exceeded based upon professional judgement and experience.

3.7.5 It should be noted that ILP GN01:2021, states that building luminance is applicable only to buildings which are directly illuminated as a decorative night time feature and not buildings which are illuminated as a result of spill light from adjacent luminaries or luminaires fixed to the building but used to light an adjacent area.

3.7.6 A maintenance factor is a luminaire and lamp specific de-rating factor applied to lighting calculations to allow for lumen depreciation of a light source over time and a predicted amount of dirt build up on the glazing of the lantern given its height and the pollution category of the area. Maintenance factors are utilised within the design calculations to prove that an installation will have compliant lighting levels on a worst-case basis. In these situations, worst case would be at the end of the maintenance cycle when the light source has depreciated the most and the glazing of the lantern is the dirtiest.

3.7.7 To inform the baseline assessment lighting calculations have been undertaken to model lighting levels for receptors with existing street lighting provisions. These calculations have been produced with an industry standard lighting design package, Lighting Reality Area Pro (Version 2.1.1). It should be noted that this design package is a 2-dimensional design tool and therefore do not take account of changes in gradient or the blocking effect of 3-dimensional objects such as trees or buildings. For the purpose of obtrusive light assessments, a maintenance factor of 1 (no de-rating) has been utilised within these calculations as this accounts for the worst-case scenario for obtrusive light, this will show the impacts of the installation on the first day of its use or immediately after it has been maintained.

3.7.8 The curfew time (refers to the time after which stricter requirements for the control of obtrusive light will apply) of 23:00 hours has been utilised within the ELIA to inform the post curfew element of the ELIA assessment.

3.7.9 The effects of artificial lighting for the Proposed Development will have varying levels of significance and have been assessed based on the magnitude experienced by each identified receptor. The level of change is presented on a scale of minor, moderate, major or none/negligible. The resulting overall impacts can be described as positive, neutral or negative.

Magnitude of impacts and effects

3.7.10 ILP PLG04:2013 provides no methodology for assessing the environmental value (or sensitivity) or receptors in terms of lighting and therefore the magnitude of the effect evaluated from the criteria above will be assessed using the matrix as provided in ILP PLG04:2013 and outlined in Table 3-8.

Table 3-8: Evaluation table

Nature	Ref	Level	Description	Remedial needs
Positive	1	Major / substantial beneficial impacts	Significant improvements in night environment and / or reductions in glare, spill light and sky glow etc.	No remedial / mitigation measures required.
	2	Moderate beneficial impacts	Noticeable improvements in night environment and / or reductions in glare, spill light and sky glow etc.	
	3	Minor beneficial impacts	Slight improvements in night environment and / or reductions in glare, spill light and sky glow etc.	
Neutral	4	None / negligible	No significant impacts or overall impacts balancing out.	No remedial / mitigation measures required.
Negative	5	Minor adverse impacts	Slight increase in visibility of site, glare, and sky glow etc.	Develop appropriate levels and type of mitigation

Nature	Ref	Level	Description	Remedial needs
	6	Moderate adverse impacts	Noticeable increase in visibility of site, glare and sky glow etc.	
	7	Major adverse impacts	Significant problems with increase in visibility of site, glare, and sky glow etc.	

Source: (ILP, 2013)

Duration of effects

3.7.11 Timescales associated with these effects, regardless of phase are as follows:

- **Short-term** – endures for up to 12 months after construction or decommissioning
- **Medium-term** – endures for 1-5 years
- **Long-term** – endures for 5-15 years
- **Permanent effects** – endures for more than 15 years and / or effects which cannot be reversed (e.g. where buried archaeology is permanently removed during construction)

3.7.12 Changes in levels of artificial lighting can affect ecological, landscape character, visual amenity, health and social, and historical environment receptors. The lighting assessment will evaluate baseline levels for the receptors within Table 3-1 and the predicted change to levels of artificial lighting at each location. The effects of the predicted change upon each receptor has been factored into assessment of the overall effects as detailed in the discipline specific chapters of the ELIA.

4 Performance Objectives

4.1 Introduction

4.1.1 The following sections describe applications for external lighting which are required in various areas of CWWTPR, the information provided is for the operation, maintenance and construction phase of the Proposed Development.

4.1.2 Lighting will be designed in operation, maintenance and construction phases to satisfy minimum light requirements to ensure the safety of people, while avoiding light pollution, sky glow and minimising light spill and glare. The principles that will be adopted as part of the detailed design, which will be developed having regard to ILP, CIBSE guidance and British Standards on lighting in industrial environments, lighting in the exterior environment and lighting for the protection of bats.

4.1.3 The lighting design will aim to:

- Be sensitive to the setting while creating high quality and efficient lighting, which creates an attractive and safe environment for users and workers alike.
- Create a lighting solution that aspires to make use of modern luminaire and lamp technology to provide an energy efficient and flexible lighting scheme with increased equipment longevity.
- Pay attention to the sensitive nature of the surrounding ecology and local amenity in order to preserve the landscape, minimise environmental impact and minimise cost.
- Provide a lighting installation that minimises sky glow, spill light and the luminous intensity that can be experienced from luminaires.
- Provide clear key routes during the evening for users and workers.

4.2 Operational and maintenance phase lighting

4.2.1 As a water industry facility, the minimum light design provision required to operate and maintain the Proposed Development are defined by the Water Industry Mechanical and Electrical Specifications (WIMES) 3.02(E), which is a recognised industry standard. Realistic worst case lighting requirements are provided in

4.2.2 Table **4-1** with full details presented in the Lighting Design Strategy (Appendix 2.5, App Doc Ref 5.4.2.5).

4.2.3 All lighting levels cited within

4.2.4 Table **4-1** are Em (maintained illuminance) levels, which are the values below which the average illuminance (in lux) on the specified surface is not allowed to fall. A maintenance factor, comprising a luminaire and lamp specific de-rating factor, is applied to lighting calculations to allow for lumen depreciation of a light source over time and a predicted amount of dirt build up on the glazing of the lantern given its height and the pollution category of the area.

4.2.5 Applying the maintenance factor within the design calculations ensures an installation will have compliant lighting levels at the end of the maintenance cycle when the light source has depreciated the most and the glazing of the lantern is the dirtiest. The maintenance factor for the Proposed Development's lighting will be designed in line with the recommended guidance BS 5489-1 2020, with the appropriate maintenance factor formula applied based on AW completing annual maintenance intervals.

Table 4-1: Worst case lighting requirements summary

Plant area	Main lighting requirements	Other lighting requirements
Lighting on Horningsea Road	Directional, downward facing and consistent with highway authority requirements for new lighting, including retrofit of adjacent light columns if appropriate. Based on their 'Street Lighting Development Specification' lighting columns would be 10m high, but final design to be agreed with Highway Authority.	To balance road and pedestrian safety with light spillage, including potential effect on bats.
Visitors car park at proposed WWTP	20 Lux [1] at car visitor park. Car park lights would be on 5m high lighting columns or mounted on the gateway building as necessary with downward pointing Light Emitting Diode (LED) lights using warm white LEDs. Lighting around the visitor car park, outside the proposed WWTP earth bank, will be on during office hours between 08:00 and 18:00 Monday to Friday. Outside office hours lighting will operate using Passive Infrared (PIR) sensor sensors with manual override in the Gateway Building. Access road from Horningsea Road to the proposed WWTP entrance is not lit.	20 Lux at office/workshop building entry points. Mounted on building at 5m above ground level PIR sensor with manual override
Staff car park at proposed WWTP	20 Lux [2] at staff car park. Lights would be 5m high lighting columns or mounted on the building at 5m above ground level as necessary with downward pointing LED lights using warm white LEDs.	20 Lux at office/workshop building entry points. Mounted on building at 5m above ground level PIR sensor with manual override Operations staff would travel around the site after dark guided by their vehicle headlights.

1 The lux levels stated are the minimum levels allowing for degradation prior to maintenance. Initial levels may be slightly higher than the levels stated in the table to allow for degradation before units are maintained or replaced. Modern LED lighting has minimal degradation.
2 The lux levels stated are the minimum levels allowing for degradation prior to maintenance. Initial levels may be slightly higher than the levels stated in the table to allow for degradation before units are maintained or replaced. Modern LED lighting has minimal degradation.

Plant area	Main lighting requirements	Other lighting requirements
	Lighting around the staff car park, within the proposed WWTP earth bank, will not be visible over the earth bank. This lighting will be on during office hours between 08:00 and 18:00 Monday to Friday. Potential for overnight reactive maintenance staff to attend site therefore outside office hours operation will be via PIR sensors with short 30 minute timer and manual override, to ensure lights are not on through night.	
General Road Lighting	As minor roads, the proposed WWTP road lighting would have 10 Lux level. Lights would be 5m high lighting columns or mounted on the building at 5m above ground level as necessary with downward pointing LED lights using warm white LEDs. Potential for overnight reactive maintenance staff to attend site therefore outside office hours operation will be via PIR sensors with short 30 minute timer and manual override, to ensure lights are not on through night. The roads in general would not be lit. Lighting will only be installed along roads beside the Gateway Building, HGV parking area and staff car park.	Operations staff would travel around the site after dark guided by their vehicle headlights.
Gateway Building	PIR controlled downward pointing 20 lux at building entry points, proposed WWTP main entrance gates and the cycle shelter lighting the local pathway. Lights would be 5m high lighting columns or mounted on the building at 5m above ground level as necessary with downward pointing LED lights using warm white LEDs.	Lighting design to follow CIBSE lighting guides and BS 8300-2:2018 Design of an accessible and inclusive built environment. Buildings - code of practice. In the office areas the surface maximum illuminance would be up to 500 Lux, but measures would be applied to the window to mitigate night-time light pollution.

Plant area	Main lighting requirements	Other lighting requirements
		200 lux task lighting for Distribution Network Operator (UK Power Networks) area mounted off structures at 5m above ground level. The 200 lux task lighting would only be required to be operational during DNO maintenance activities within this area during the hours of darkness. The Gateway Building will not be lit as a night time feature.
Motor Control Centre (MCC)	Buildings would have a 20 Lux external light, with PIR control, above the entrance door maximum height 5m agl, above which is lit at night. Access limited to emergency maintenance activities only	Walkways to be lit by 10 Lux lighting level with PIR control and at heights no greater than 5m agl.
Inlet works	100 Lux on screens, screening handling, detritor and grit plant at high level (visible over the earth bank). 50 Lux on access platforms/stairs (visible over the earth bank). Maximum height 8m above (local) ground level (agl). Local manual on/off switch with auto-reset every morning. Access limited to emergency maintenance activities only.	Walkways to be lit by 10 Lux lighting level with PIR control and at heights no greater than 5m agl.
Primary settlement tanks (PST)	50 Lux on PST rotating bridges. Maximum height 6m agl. Local manual on/off switch with auto-reset every morning. Access limited to emergency maintenance activities only.	Walkways to be lit by 10 Lux lighting level with PIR control and at heights no greater than 5m agl.
Intermediate pump station	100 Lux at pump sump. Maximum height 4m agl. Local manual on/off switch with auto-reset every morning. Access limited to emergency maintenance activities only.	
MABR/aeration lanes	50 Lux on platforms / stairs. Maximum height 8m agl.	Walkways to be lit by 10 Lux lighting level with PIR control and at heights no greater than 5m agl.

Plant area	Main lighting requirements	Other lighting requirements
	Local manual on/off switch with auto-reset every morning. Access limited to emergency maintenance activities only.	
Final settlement tanks	50 Lux on final settlement tanks rotating bridges, maximum height 9m agl. 100 Lux at ground level on pumps (4 locations), maximum height 5m agl. Local manual on/off switch with auto-reset every morning. Access limited to emergency maintenance activities only.	Walkways to be lit by 10 Lux lighting level with PIR control and at heights no greater than 5m agl.
Tertiary treatment plant / works Outfall	50 Lux on platforms/stairs Maximum height 10m agl. Local manual on/off switch with auto-reset every morning. Access limited to emergency maintenance activities only.	Walkways to be lit by 10 Lux lighting level with PIR control and at heights no greater than 5m agl.
Storm tanks	50 Lux on platforms/stairs. 100 Lux for screens. Maximum height 5m agl. Local manual on/off switch with auto-reset every morning. Access limited to emergency maintenance activities only.	Walkways to be lit by 10 Lux lighting level with PIR control and at heights no greater than 5m agl.
Sludge screening / Sludge imports	50 Lux on access platforms/stairs/roof space (maximum height 10m agl - visible over the earth bank). 100 Lux on working platform at screens (maximum height 10m agl). 100 Lux at pumps (located below 5m agl). No lighting on top of sludge tanks. Local manual on/off switch with auto-reset every morning. 100 Lux task lighting required to Odour Control base. Lighting would be mounted at 5m above ground level and would be controlled via manual on/off switch at work locations and auto-reset every morning	Walkways to be lit by 10 Lux lighting level with PIR control and at heights no greater than 5m agl.

Plant area	Main lighting requirements	Other lighting requirements
	Access limited to emergency maintenance activities only.	
Sludge thickening	Process within building so no external task lighting	Building entry points – 20 Lux . Mounted on building at 5m above ground level PIR sensor with manual override
Heating Pasteurisation Hydrolysis (HpH) process	Ground level task lighting – 100 Lux (maximum height 5m agl) High level lighting 50 Lux on access platforms and stairways (maximum height 15m agl). Local manual on/off switch with auto-reset every morning. Access limited to emergency maintenance activities only.	Walkways to be lit by 10 Lux lighting level with PIR control and at heights no greater than 5m agl.
Digesters & Post Digestion	50 Lux on access platforms/stairs/roof space (maximum height 20m agl). 100 Lux task lighting at ground level at recirculation pumps (maximum height 5m agl). Control for above via local manual on/off switch with auto-reset every morning. Four flashing navigation warning lights on the digesters (maximum height 20m agl).	Walkways to be lit by 10 Lux lighting level with PIR control and at heights no greater than 5m agl.
Liquor Treatment	No lighting at high level. 100 Lux task lighting at ground level to low level plant (maximum height 5m agl). Local manual on/off switch with auto-reset every morning. Access limited to emergency maintenance activities only.	Walkways to be lit by 10 Lux lighting level with PIR control and at heights no greater than 5m agl.
Sludge dewatering	100 Lux on working platform at dewatering units (maximum height 8m agl). 50 Lux on access platforms and stairways (maximum height 8m agl)	Walkways to be lit by 10 Lux lighting level with PIR control and at heights no greater than 5m agl.

Plant area	Main lighting requirements	Other lighting requirements
	100 Lux at pumps (maximum height 5m agl). Local manual on/off switch with auto-reset every morning. Access limited to emergency maintenance activities only.	Lighting required within dewatered Cake Storage Barn area, 100 Lux lighting level mounted under roof and pointing downwards.
Gas bag	100 Lux task lighting at gas bag blowers (maximum height 5m agl) Local manual on/off switch with auto-reset every morning. Four flashing navigation warning lights above the gas bag (maximum height 20m agl). Access limited to emergency maintenance activities only.	Walkways to be lit by 10 Lux lighting level with PIR control and at heights no greater than 5m agl.
Flare stack	100 Lux task lighting at base of flare stack (maximum height 5m agl) Local manual on/off switch with auto-reset every morning. Access limited to emergency maintenance activities only. Flare will be enclosed and no flame will be visible unless directly from above. It is assumed that flare stack does not require high level lighting	Walkways to be lit by 10 Lux lighting level with PIR control and at heights no greater than 5m agl.
Boiler house	Process within building so no external task lighting. Boiler exhaust stack (maximum height 24m agl) would need four automatic navigation lights on the top.	Building entry points – 20 Lux. Mounted on building at 5m above ground level. PIR sensor with manual override.
Gas to grid plant	100 Lux task lighting at ground level (maximum height 5m agl). Local manual on/off switch with auto-reset every morning. Access limited to emergency maintenance activities only.	Walkways to be lit by 10 Lux lighting level with PIR control and at heights no greater than 5m agl.
Odour control	No task lighting at high level. 100 Lux Task Lighting required to Odour Control base (maximum height 5m agl). Local manual on/off switch with auto-reset every morning. Access limited to emergency maintenance activities only.	Building entry points – 20 Lux. Mounted on building at 5m above ground level. PIR sensor with manual override.

Plant area	Main lighting requirements	Other lighting requirements
Terminal pumping station	100 Lux task lighting at ground level (maximum height 5m agl). Local manual on/off switch with auto-reset every morning Access limited to emergency maintenance activities only.	Walkways to be lit by 10 Lux lighting level with PIR control and at heights no greater than 5m agl.
Emergency generators	No external task lighting	Walkways to be lit by 10 Lux lighting level with PIR control and at heights no greater than 5m agl.
Generator Area	Buildings would have 20 lux external lighting, with PIR control, above the entrance doors (maximum height 5m agl) which is lit at night. Access limited to emergency maintenance activities only	Walkways to be lit by 10 Lux lighting level with PIR control and at heights no greater than 5m agl.
LV & HV Area	Buildings would have 20 lux external lighting, with PIR control, above the entrance doors (maximum height 5m agl) which is lit at night. Access limited to emergency maintenance activities only	Walkways to be lit by 10 Lux lighting level with PIR control and at heights no greater than 5m agl.

Source: Project Description (App Doc Reference 5.2.2)

4.3 CCTV security lighting

4.3.1 Infrared spectrum lighting (not within the visible light spectrum) shall be provided outside daylight hours for security purposes.

4.4 Site access public street lighting

4.4.1 It is anticipated that lighting will be required around the new proposed site access junction and the new pedestrian crossing point on Horningsea Road. The extent of the proposed lighting is to be agreed with the LHA. At present, street lighting is confined to the area in the immediate vicinity of the existing signalised junctions. As part of the Proposed Development, it is considered that as a reasonable worst case, lighting on Horningsea Road is required from Low Fen Drove Way to approximately 100m of the southern A14 on-slip signalised junction. It is anticipated that any additional lighting will be of a similar type and specification as the existing lighting provisions, i.e., 10m mounting height lighting columns with LED based luminaires.

4.5 Construction phase lighting

4.5.1 Temporary lighting will be provided during the construction phase. The use of flood lights will be minimised, and the need for extended night time working will be avoided except in exceptional circumstances (for accidents and emergencies, or critical tasks such as continuous concrete pours and at drive shaft sites).

4.5.0 The Proposed Development will comprise a number of different working areas within which a range of construction activities will be carried out including the construction of the proposed WWTP, intermediate shafts and transfer tunnel and pipe laying along for the treated effluent pipelines and the Waterbeach pipelines, and the new outfall to the River Cam. There will be a number of temporary compounds to support different aspects of the Proposed Development. The different works areas are indicated within the Works Plans (App Doc Reference 4.3.0 to 4.3.11), General Arrangement Plans 4.2 and Design Plans 4.9 – 4.14

4.5.1 During construction the following temporary lighting would be required to facilitate construction:

- lighting of temporary compounds;
- lighting on plant and equipment (i.e. cranes);
- construction vehicle lighting;
- lighting of parking facilities;
- lighting within buildings remaining under construction; and
- temporary lighting structures (including mobile structures) to illuminate working areas.

4.5.2 Lighting details (locations, duration of use, lighting types) will be agreed between The Applicant and their Principal Contractor during the detailed design stage. Where

details are not currently fixed owing to the stage of the project reasonable worst-case assumptions have been developed for the environmental lighting impact assessment as outlined within Table 4-2.

Table 4-2: Construction phase lighting requirement summary

Construction and compound area(s)	Details / tasks info	Duration of use / activity [3]	Lighting types	Maintained illuminance (Em)	Maximum height
Waterbeach compound	Up to 100 x 100m secured when not in use. Solid hoarding on eastern and southern sides of compound. Lit with PIR security lights.	12 months	LED tower lights & PIR security lights	200	8m
Railway – crossing Horizontal Directional Drilling (HDD) launch / recovery sites	Up to 25m x 25m works area in use for up to 4 weeks with the drill shot activities occurring over 14 days. Works to be completed in day and night (24/7). HDD pits would be secured when not in use and lit with PIR security lights.	Up to 1 month	LED tower lights & PIR security lights	200	8m
Burgess Drove laydown area	Secured and lit. Some task lighting for activities in darker winter months.	6 months	LED tower lights & PIR security lights	200	8m
Typical open trench section	Assume a section of up to 250m. Some task lighting for activities in darker winter months.	0.5 months	LED tower lights & PIR security lights	200	8m
A14 Crossing	25m x 25m footprint of works area in use for 4 weeks with the drill shot activities occurring over 14 days. Works to be completed during the day	0.5 months	LED tower lights & PIR security lights	200	8m

[3] Construction lighting will only apply within the 'Working Hours' defined in Section 5 of the Code of Construction Practice Part A (Appendix 2.1, App Doc Ref 5.4.2.1).

Construction and compound area(s)	Details / tasks info	Duration of use / activity [3]	Lighting types	Maintained illuminance (Em)	Maximum height
	Lighting for safety in darker winter months would be needed and as a standby for 24 hour working.				
Main compound – within land required for proposed WWTP	Maximum of a 300m x 300m compound, construction parking facilities and security entrance all secured with lighting	42 months	LED flood lights, that will be a mix of installation off the top of the first floor office, installed off storage containers supplemented by LED tower lights where required	50	8m
Construction of the proposed WWTP	Approximately 300 tonne crawler cranes in use at the peak	During the occasional night time lift or concrete pour	LED tower lights	Guidance would say 200 lux but, due to the level of detail required this will go to 300 lux	15m
Horningsea Road crossing – treated effluent pipeline	Works to construction pipeline across road using open cut methods. Temporary lighting would be in use– highways requirements, including night lighting	4 months	LED tower lights	200	8m

Construction and compound area(s)	Details / tasks info	Duration of use / activity [3]	Lighting types	Maintained illuminance (Em)	Maximum height
River /outfall compound	Up to 40m x 25m compound secured when not in use. Lit with PIR security lights. Screening in place (not solid hoarding).	4 months	LED tower lights	200	8m
Intermediate shaft 4	64m x 60m compound with solid hoarding Day works only, so would only be morning and evening lighting for start and finish during winter	3 months, then intermittent 4x equipment recover events over 5 days Reinstatement over 6 weeks	LED tower lights	50 for welfare access and egress during winter and 200 for shaft where required	8m
Intermediate shaft 5	Up to 64m x 60m compound with solid hoarding. Night time use during tunnelling works.	3 month set up Use for 24 months, including 24/7 De-mobilisation and site reinstatement over 6weeks	LED tower lights	50 for welfare access and egress during winter and 200 for shaft where required	8m
River Cam crossing south	Up to 25m x 25m footprint of works area in use for 4 weeks with the drill shot activities occurring over 14 days. Works to be completed in day. Lighting for safety in darker winter months would be needed.	0.5 months	LED tower lights and PIR security lights	200	8m
Shaft 3 within existing Cambridge WWTP	64m x 60m compound extent contained within the existing WWTP.	24 months	LED tower lights	50 for welfare access and egress during	8m

Construction and compound area(s)	Details / tasks info	Duration of use / activity [3]	Lighting types	Maintained illuminance (Em)	Maximum height
				winter and 200 for shaft where required	
Shaft 1 and 2 within existing Cambridge WWTP	Up to 60m x 130m extent contained within the existing WWTP.	7 months	LED tower lights	50 for welfare access and egress during winter and 200 for shaft where required	8m

Source Lighting Design Strategy (App Doc Reference 5.4.2.5)

4.5.3 Reasonable additional assumed worst-case assumptions have been provided within Table 4-3 these assumption document the lighting details (locations, duration of use, lighting types) Where details are not currently fixed owing to the stage of the project, the additional assumed construction phase lighting requirements have been utilised to inform the assessment of effects of the Proposed Development.

Table 4-3: Additional assumed construction phase lighting requirement summary

Construction and compound area(s)	Details / tasks info	Duration of use / activity [4]	Lighting types	Maintained illuminance (Em)	Maximum height
Construction of the proposed WWTP	General construction activities associated with the WWTP, including site clearance, excavation, loading/unloading, electric piping and cabling and demanding electrical, machine and pipe mounting. (BS EN 12464-2:2014 - Light and lighting — Lighting of work places – Part 2: Outdoor work places indicates that lighting levels / standards are dependent on the level of risk therefore as a worst case the lighting levels from Table 5.3 – Building Sites – 5.3.4 have been selected to inform the assessment)	45 months	LED tower lights	200 lux	8m
All HDD launch / recovery sites	Up to 25m x 25m works area in use for up to 4 weeks with the drill shot activities occurring over 14 days. Works to be completed in day and night (24/7). All HDD pits would be secured when not in use and lit with PIR security lights.	2 weeks in total (for each HDD launch / recovery site)	LED tower lights & PIR security lights	200	8m

Source Mott MacDonald Ltd (2022)

[4] Construction lighting will only apply within the 'Working Hours' defined in Section 5 of the Code of Construction Practice Part A (Appendix 2.1, App Doc Ref 5.4.2.1).

4.6 Mitigation measures adopted as part of the Proposed Development

4.6.1 This section refers to the mitigation types, as defined in Chapter 5: EIA Methodology (App Doc Reference 5.2.5), and how they apply to the assessment of obtrusive light.

4.6.2 In developing the Proposed Development through an iterative process including consultation and engagement with consultees, and through the Environmental Impact Assessment, (EIA) The Applicant has sought to identify and incorporate suitable measures and mitigation for potentially significant adverse effects, as well as maximising beneficial effects where possible.

4.6.3 Some measures are **'embedded'** in the design of the Proposed Development for which consent is sought by virtue of the scope of the authorised development as set out in Schedule 1 to the DCO and the accompanying Works Plans. These are considered **primary mitigation**. For example, adjustment of Order Limits to avoid sensitive features, amending the sizing and location of temporary access routes and compounds.

4.6.4 Tertiary measures comprise good practice measures (such as measures within Considerate Contractors Scheme) and measures integrated into legal requirements secured through environmental permits and consents (least flexible as either the legislation exists to create the mitigation or does not (i.e. Protected Species Licensing).

Table 4-4: Primary and tertiary mitigation measures relating to the environmental lighting impact assessment adopted as part of the Proposed Development

Mitigation measures		Type	Applied to	Justification
Over lighting (Correct level of lighting on Horningsea Road for the time and anticipated usage)	When designing the highway lighting, based on CCC 'Street Lighting Development Specification' (CCC, 2016), CCC specify the use of a Central Management System (CMS), and use a dimming regime for M class roads as detailed below: CCC M Class dimming profile (two stage) 100% Output 06:00 – 22:00 80% Output 20:00 – 24:00 60% Output 24:00 – 06:00	Tertiary (Good Practice)	Horningsea Road	Over lighting can increase energy use, associated carbon emissions and potentially increase levels of obtrusive light
Consideration of appropriate lighting standards and associated lighting levels	Selection of appropriate lighting standard from relevant water industry standard, British and European standards to ensure lighting is appropriate to the task being undertaken, the area being lit, and that areas are not over lit. Ensuring sensitive receptors and areas are considered during the lighting design process with a view to minimising obtrusive light.	Tertiary (Good Practice)	Development of Lighting designs for operation and maintenance phases	Over lighting can increase energy use and potentially increase levels of obtrusive light
Use of best practice guidance to inform design development	ILP GN01 – The Reduction of Obtrusive Light (ILP, 2021) is to be utilised to inform the detailed design process.	Tertiary (Good Practice)	Development of Lighting designs for operation, maintenance and	Minimising potential adverse effects of obtrusive light by ensuring sensitive receptors and areas are considered during the lighting design

Mitigation measures		Type	Applied to	Justification
			construction phases	process with a view to minimising obtrusive light.
Use of best practice guidance to inform design development	ILP and Bat Conservation Trust Guidance Note 08/18 Bats and Artificial Lighting in the UK, Bats and the Built Environment series (Bat Conservation Trust & ILP, 2018) is to be utilised to inform the detailed design process in collaboration with suitable biodiversity specialists.	Tertiary (Good Practice)	Development of Lighting designs for operation, maintenance and construction phases	Minimising potential adverse effects of obtrusive light on Bats.
Energy Efficiency	Wherever possible, lighting installation components (lamps, control gear, luminaires, control systems etc.) shall satisfy the criteria detailed within the 'Energy Technology Criteria List' set by the Carbon Trust (GOV.UK, 2021).	Tertiary (Good Practice)	Specification of lighting equipment for operation and maintenance phases	Reduction in energy use and associated carbon emissions.
Reduction of Upward Light	Only luminaires with an upward light ratio of 0% shall be used	Primary Mitigation (Embedded)	Development of Lighting designs for operation, maintenance and construction phases	Minimisation of skyglow
Reduction of blue spectrum Light	Selection of lower colour temperatures for light sources in rural areas, ≤2700K. Lower colour temperatures have less blue spectrum light and therefore less of an	Primary Mitigation (Embedded)	Design and specification of lighting equipment for operation,	Minimisation of skyglow

Mitigation measures		Type	Applied to	Justification
	effect in terms of skyglow (International Dark-Sky Association, 2010).		maintenance and construction phases	
Reduce mounting heights of lighting where practicable, legally compliant and safe to do so	All operational and maintenance lighting within the proposed WWTP for walkways, roadways, car parking and above internal accesses will be a maximum of 5m in height and below the height of the earth bank.	Primary Mitigation (Embedded)	Design and specification of lighting equipment within the proposed WWTP for operation and maintenance phases	Reduced visibility of lighting installation
Selection of lower colour temperatures for light sources, ≤2700K.	The warmer white colour temperature has a lower relative attractiveness to insects, resulting in a greater number of insects in dark areas, which in turn increases the availability of the main food source of multiple types of bats. [5]	Primary Mitigation (Embedded)	Design and specification of lighting equipment for operation, maintenance and construction phases	Reduction of potential adverse effects of lighting on bats

[5] Source: Bats and Lighting, Overview of current evidence and mitigation. E Stone 2014

Mitigation measures		Type	Applied to	Justification
Selection of lower colour temperatures for light sources, ≤2700K.	Increased levels of blue light exposure in the evening have been shown to cause melatonin suppression and subsequent phase delays in the melatonin cycle. To mitigate potential adverse effects on melatonin production lower colour temperature light sources (≤2700K) have been selected as they contain less blue light [6].	Primary Mitigation (Embedded)	Design and specification of lighting equipment for operation, maintenance and construction phases	Reduction of potential adverse effects of lighting on sleep cycles
Selection of light sources with warmer colour temperatures	Selection of warmer colour temperatures with peak wavelengths greater than 550 nanometres cause less of an impact on bats (Bat Conservation Trust & ILP, 2018).	Primary Mitigation (Embedded)	Design and specification of lighting equipment for operation, maintenance and construction phases	Reduction of potential adverse effects of lighting on bats
Enhanced lighting control	In higher risk areas, for example on top of tanks/digesters, where lighting is critical for safety, the lighting control will be via manual on/off switch however an automatic reset will be incorporated into the lighting control to ensure lighting is only operational for a one night and only if	Primary Mitigation (Embedded)	WWTP external lighting installations within high risk areas (Within earth bank) during	Reduced duration for visibility of lighting, reduction of potential risk of adverse effects of obtrusive light, reduction of energy use and associated carbon emissions.

[6] Source: Human responses to lighting based on LED lighting Solutions, Public Health England CRCE-RDD 01-2016

Mitigation measures		Type	Applied to	Justification
	the manual off switch is not operated when the maintenance staff leave the higher risk area.		operation and maintenance phases	
Operational hours and enhanced lighting control	The lighting for the visitor's car park will be operational during hours of darkness that coincide with office hours (between 08:00 and 18:00 – Monday to Friday). Outside office hours lighting will only operate during darkness when movement is detected via PIR sensors.	Primary Mitigation (Embedded)	WWTP external lighting installations within visitor car park (outside the earth bank) during the operational phase	Reduced duration for visibility of lighting, reduction of potential risk of adverse effects of obtrusive light, reduction of energy use and associated carbon emissions.
Minimisation of roadway lighting and enhanced lighting control	The roads in general would not be lit. Roadway lighting will only be installed along roads beside the Gateway Building, HGV parking area and staff car park. Lighting will be passive infrared sensor (PIR) controlled operating during darkness when movement is detected (with 30 minutes timers).	Primary Mitigation (Embedded)	WWTP external road lighting installations within earth bank during operation and maintenance phases	Reduced duration for visibility of lighting, reduction of potential risk of adverse effects of obtrusive light, reduction of energy use and associated carbon emissions.
Minimisation of roadway lighting	The access road from Horningsea Road to the proposed WWTP entrance will not be lit.	Primary Mitigation (Embedded)	WWTP external road lighting installations outside the earth bank during	Reduced duration for visibility of lighting, reduction of potential risk of adverse effects of obtrusive light, reduction of energy use and associated carbon emissions.

Mitigation measures		Type	Applied to	Justification
			operation, maintenance and construction phases	
Minimisation of unnecessary lighting	The Gateway Building will not be lit as a night time feature.	Primary Mitigation (Embedded)	Gateway Building during maintenance and operational phases	Reduced duration for visibility of lighting, reduction of potential risk of adverse effects of obtrusive light, reduction of energy use and associated carbon emissions.
Considerate working practices	Task lighting would only be provided for those working areas where overnight reactive maintenance (not routine maintenance) or emergency repairs are required. These areas would be those where failure could result in a pollution incident in the River Cam at the outfall or in Cambridge itself due to an inability to pump / process the waste water. Other areas would be left unlit, and maintenance will be undertaken during the next working day.	Primary Mitigation (Embedded)	Operational and maintenance phase lighting within the WWTP (inside the earth bank)	Reduced duration for visibility of lighting, reduction of potential risk of adverse effects of obtrusive light, reduction of energy use and associated carbon emissions.
Enhanced lighting control	The proposed WWTP main entrance gate external lighting will be PIR controlled operating during darkness when movement is detected.	Primary Mitigation (Embedded)	WWTP external lighting installations outside the	Reduced duration for visibility of lighting, reduction of potential risk of adverse effects of obtrusive light,

Mitigation measures		Type	Applied to	Justification
			earth bank during the operational and maintenance phase	reduction of energy use and associated carbon emissions.
Considerate working practices	Routine maintenance in the external environment of the proposed WWTP will not be carried out in the hours of darkness	Primary Mitigation (Embedded)	Operational and maintenance phase lighting	Reduced duration for visibility of lighting, reduction of potential risk of adverse effects of obtrusive light, reduction of energy use and associated carbon emissions.
Considerate construction lighting design	Construction lighting will be designed and positioned to ensure that any artificial light emitted from the working areas: minimises glare; does not prejudice health including for residents, walkers or passing drivers/trains; does not create a nuisance under the Environmental Protection Act 1990; and avoids or reduces potential impacts upon the natural and historic environment.	Primary Mitigation (Embedded)	Construction phase lighting design, specification and installation.	Reduction of potential risk of adverse effects of obtrusive light, reduction of energy use and associated carbon emissions.
Considerate construction – community Liaison	During construction of the Proposed Development, in line with the Community Liaison Plan (App Doc Reference 7.8) the construction team would work with those affected by any temporary adverse lighting	Primary Mitigation (Embedded)	Construction phase lighting design, specification and installation.	Reduction of potential risk of adverse effects of obtrusive light

Mitigation measures		Type	Applied to	Justification
	effects to remove or reduce this impact where safe, practicable and legally compliant to do so.			
Considerate security lighting for local environment	External security lighting shall use both motion sensors and infra-red spectrum lighting (not visible to human receptors) with 30 minute timers	Primary Mitigation (Embedded)	Operational, maintenance and construction phase security lighting design and specification.	No visibility of security lighting to human receptors, reduction of energy use and associated carbon emissions.
Reduction in Ultraviolet light	Sources of light with higher ultraviolet light outputs, such as mercury vapour and tungsten halogen, and to a lesser extent, metal halide and fluorescent, shall not be used	Primary Mitigation (Embedded)	Operational, maintenance and construction phase lighting design, specification and installation	Reduction of potential adverse effects of lighting on bats
Reduction of glare and spill light from internal lighting installations	Internal luminaires shall be recessed where installed in proximity to windows to reduce glare and light spill	Primary Mitigation (Embedded)	Operational, maintenance and construction phase lighting design, specification and installation	Reduction of potential adverse effects of lighting on bats

Mitigation measures		Type	Applied to	Justification
Reduction of glare and spill light from external lighting installations	Specification of supplementary photometric control methods shall be used as a last resort, and can include accessories such as baffles, hoods or louvres that can be used to reduce light spill and direct light only to where it is needed	Primary Mitigation (Embedded)	Operational, maintenance and construction phase lighting design, specification and installation	Reduction of potential adverse effects of lighting on human and biodiversity receptors
Reduction of glare and spill light from internal lighting installations	Providing automated shutters and/or blinds that would be activated when the lights are switched on	Primary Mitigation (Embedded)	Gateway building operational and maintenance phase lighting design, specification and installation	Reduction of potential adverse effects of lighting on bats
Enhanced lighting control for pathways	Pathway lighting would be provided around the proposed WWTP to enable operational staff to travel safely from vehicle to process area. Lighting will be PIR controlled operating during darkness when movement is detected (with 30 minutes timers).	Primary Mitigation (Embedded)	WWTP pathway lighting installations within earth bank during operation and maintenance phases	Reduced duration for visibility of lighting, reduction of potential risk of adverse effects of obtrusive light, reduction of energy use and associated carbon emissions.

Source: Lighting Design Strategy (Appendix 2.5, App Doc Ref 5.4.2.5)

5 Baseline Conditions

5.1 Introduction

5.1.1 The baseline conditions presented in this section are for the receptors within Table 3-1, the methodology utilised is outlined within section 3.3. This section of the report should be read in conjunction with Appendix A (drawing reference WW01003-CAMEST-MOT-05-XX-DR-X-1001).

5.2 Baseline light pollution and dark skies

5.2.1 The Campaign for Rural England (CPRE) have created an interactive map of Britain's light pollution and dark skies, this map is underlaid with 'Open Street Map', which allows information such a road types and labels to be seen to add context to the mapping data supplied. The lighting data supplied within this Night Blight interactive map has been split into nine categories as can be seen within Figure 5.1 below, each category has a defined colour from dark blues (darker areas) to dark reds (brighter areas). The mapping data is supplied based upon 400m x 400m pixels that shows the amount of light shining up into the night sky from each area. This measure is provided in nanowatts/cm2/steradian (nw/cm2/sr). In simple terms, this calculates how the satellite instruments measure the light on the ground, taking account of the distance between the two.

Categories	Brightness values (in nw/cm^2/sr)[12]
Colour band 1 (Darkest)	<0.25
Colour band 2	0.25-0.5
Colour band 3	0.5-1
Colour band 4	1-2
Colour band 5	2-4
Colour band 6	4-8
Colour band 7	8-16
Colour band 8	16-32
Colour band 9 (Brightest)	>32

Figure 5.1: Map colour bandings to show level of brightness
Source: (CPRE, England's Light Pollutioon and Dark Skies, 2016; CPRE, 2016a)

5.2.2 To provide further context to the mapping data supplied the lighting receptor locations and the proposed CWWTPR have been overlaid onto high definition (2400 DPI) PDFs of the Night Blight map in the approximate geolocations. It should be noted that whilst the data supplied is not a direct measurement of sky glow this

information provides useful guidance to areas likely to have sky glow, it is also anticipated that areas that are brighter within the Night Blight map have higher levels of sky glow in comparison to areas that are darker.

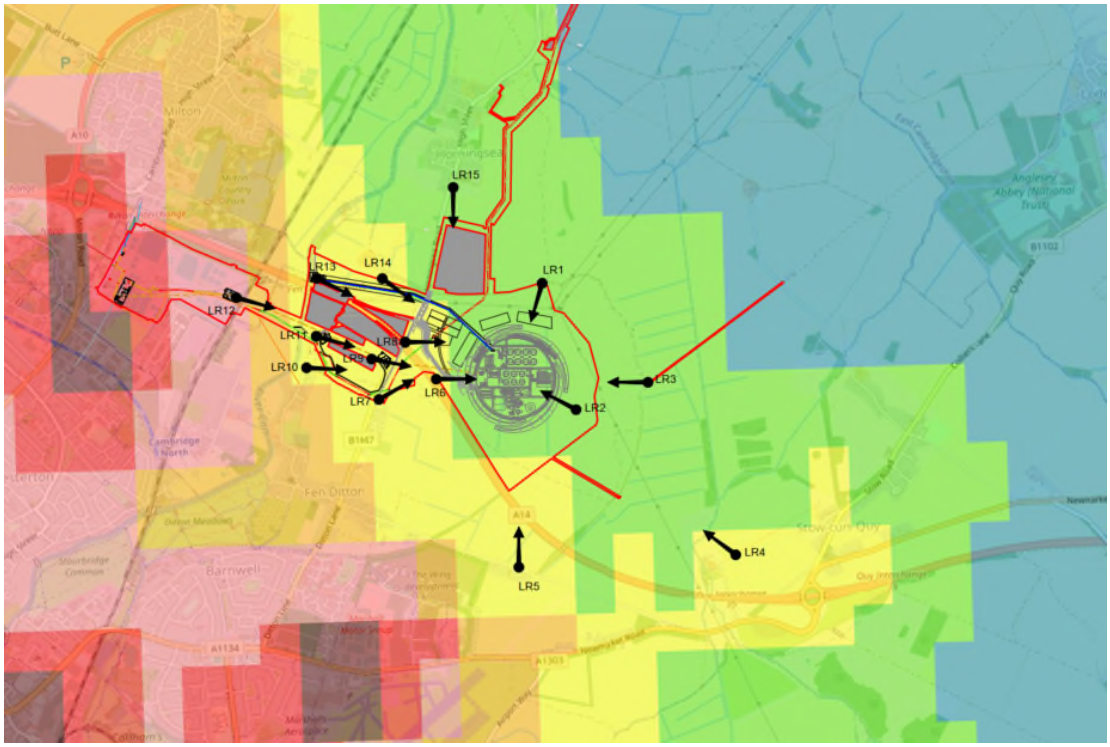

Figure 5.2: Night blight map overlay (South)

Source: (CPRE, England's Light Pollutioon and Dark Skies, 2016; CPRE, 2016a)

5.2.3 Figure 5.2 above shows the lighting receptor locations in relation to the proposed CWWTPR, the following list summarises the anticipated existing sky glow visible from each lighting receptor towards the Proposed Development: -

- Lighting receptor reference numbers LR1, LR2, LR3 and LR15's view towards the CWWTPR is of low brightness, with medium to high levels of brightness beyond the CWWTPR, it is therefore anticipated that these view directions will be able to view significant existing sky glow in the directions indicated within Figure 5.2 above.
- Lighting receptor reference number LR4's view towards the CWWTPR is of medium brightness, with medium to high levels of brightness beyond the CWWTPR, it is therefore anticipated that this view direction will be able to view significant existing sky glow in the direction indicated within Figure 5.2 above.
- Lighting receptor reference number LR5's view towards the CWWTPR is of medium brightness with brighter areas of Cambridge predominantly to the West, beyond the CWWTPR brightness reduces to lower levels therefore it is anticipated that this view direction is likely to be able to view existing sky

glow however the levels are not anticipated to be significant in the direction indicated within Figure 5.2.

- Lighting receptor reference numbers LR6, LR7, LR8, LR9, LR10, LR11, LR13 and LR14's view towards the CWWTPR is of medium brightness with brighter areas of Cambridge predominantly to the West and South, beyond the CWWTPR brightness reduces to lower levels therefore it is anticipated that these view directions are not likely to be able to view significant existing sky glow in the directions indicated within Figure 5.2.
- Lighting receptor reference number LR12's view towards the CWWTPR is of high brightness with brighter areas of Cambridge to the North, South and West. Views beyond the CWWTPR reduce to low brightness therefore it is anticipated that this view direction is not likely to be able to view significant existing sky glow in the direction indicated within Figure 5.2.

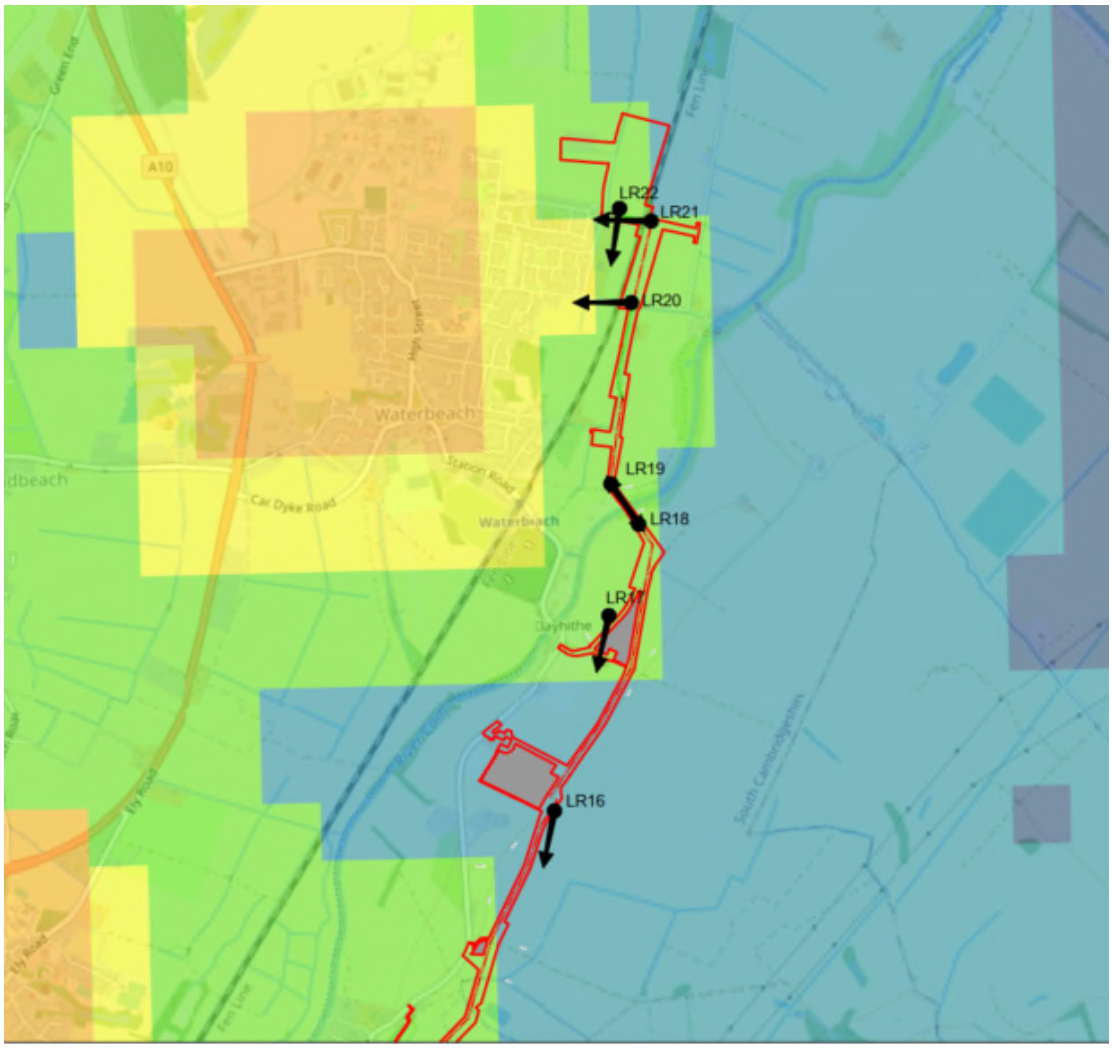

Figure 5.3: Night blight map overlay (North)

Source: (CPRE, England's Light Pollutioon and Dark Skies, 2016; CPRE, 2016a)

5.2.4 Figure 5.3 above shows the lighting receptor locations in relation to the proposed CWWTPR, the list following summarises the anticipated existing sky glow visible from each lighting receptor towards the Proposed Development: -

- Lighting receptor reference numbers LR16, and LR17's views towards the CWWTPR from the Waterbeach Pipeline are of very low and low brightness respectively, beyond the CWWTPR this increases to medium to high brightness therefore it is anticipated that these view directions are likely to be able to view significant existing sky glow in the directions indicated within Figure 5.3 above.
- Lighting receptor reference numbers LR18, LR20 and LR21's views from the Waterbeach Pipeline are of low brightness, beyond the Waterbeach Pipeline views are of Waterbeach with an increase to medium brightness therefore it is anticipated that these view directions are likely to be able to view existing sky glow in the directions indicated within Figure 5.3 above, although it is not anticipated that the sky glow in the directions indicated will be as significant as the views towards Cambridge.
- Lighting receptor reference number LR19's view from the Waterbeach Pipeline is of low brightness, beyond the Waterbeach Pipeline this decreases to lower brightness therefore it is anticipated that this view direction is not likely to be able to view significant existing sky glow in the direction indicated within Figure 5.3 above.
- Lighting receptor reference number LR22's view from the Waterbeach Pipeline towards the CWWTPR is of low brightness with brighter areas of Waterbeach predominantly to the West, beyond the CWWTPR this increases to medium to higher brightness therefore it is anticipated that this view direction is likely to be able to view significant existing sky glow in the direction indicated within Figure 5.3 above.

5.3 Baseline descriptions by receptor

LR1

5.3.1 This receptor is located on Low Fen Drove Way (by a disused building) surrounded on all sides by large open fields, several of the fields are bordered by deciduous hedgerows estimated at approximately 1.5 to 2m in height with some of the hedgerows populated with larger deciduous trees. To the North of the receptor is a small grass verge followed by an open field with deciduous trees and vegetation visible in the distance beyond the open field. To the East are views along Low Fen Drove Way with a small grass verge to the Northeast and open field beyond this, further in the distance numerous deciduous trees can be seen as well as several high voltage pylons and associated power transmission lines. Low Fen Drove Way curves beyond view to the Southeast after approximately 50m. To the Southwest of Low Fen Drove Way a disused build can be seen through gaps in the deciduous trees and vegetation. To the South a large deciduous tree directly in front of the receptor

location partially block onward views, beyond this tree is an area of hard standing associated with the disused building that is further to the Southeast. The topography is relatively flat to the South with views across open fields with broken hedgerows bordering the fields visible further in the distance. To the Southwest onward views are largely screened by a deciduous hedgerow running parallel to the road however above this hedgerow high voltage pylons and associated power transmission lines can be seen. To the West are views along Low Fen Drove Way into the distance with a small grass verge to the Northwest and open fields beyond, further in the distant to the Northwest deciduous trees and vegetation can be seen. To the Southwest of Low Fen Drove Way onward views are largely screened by a deciduous hedgerow running parallel to the road however high voltage pylons and associated power transmission lines can be seen above the hedgerow continuing to the West. The area in proximity to the receptor has no street lighting provisions and no significant sources of artificial light have been identified in proximity to this receptor location therefore taking a precautionary approach the receptor is assumed to be dark.

LR2

5.3.2 This receptor is located on the Eastern boarder of a field near a deciduous tree that is a confirmed bat roost location. The receptor is surrounded by fields, several of the fields are bordered by deciduous hedgerows estimated at approximately 1.5 to 2m in height with some of the hedgerows populated with larger deciduous trees. To the North of the receptor views are along a drainage ditch with broken hedgerows / vegetation and intermittent deciduous trees boarding the open field, several high voltage pylons and associated power transmission lines are also visible in the distance across the open fields. To the East views are across an open field with a dirt track boarding the field to the Southeast, the track has more substantial deciduous trees and vegetation blocking more distant views to the Southeast. To the Northeast a high voltage pylon and associated power transmission lines are visible, further in the distance the field is bordered by deciduous trees and vegetation blocking more distant views although Low Fen Drove Way can be seen through gaps in the vegetation. To the South views are along a drainage ditch with broken hedgerows / vegetation and intermittent deciduous trees boarding the open field to the West, further to the South more substantial deciduous trees and vegetation are blocking more distant views to the South. To the West views are across the drainage ditch to an open field with a hedgerow / vegetation and occasional deciduous tree bordering the field further to the West, ongoing views further to the west are largely screened by this vegetation. The area in proximity to the receptor has no street lighting provisions and no significant sources of artificial light have been identified in proximity to this receptor location therefore taking a precautionary approach the receptor is assumed to be dark.

LR3

5.3.3 This receptor is located in the Southeastern corner of a field with a single residential property, The Old Gatehouse, located approximately 20m to the South of the receptor on Low Fen Drove Way. To the North of the receptor is Low Fen Drove Way

however this is screened by large deciduous trees on the Western side of Low Fen Drove Way, with further views to the North screened by these large deciduous trees. To the Northeast there is a private road which is bordered by large deciduous trees and vegetation. To the South Low Fen Drove Way continues with large deciduous trees and vegetation screening views of The Old Gatehouse. To the West views are across an open field with a high voltage pylon and associated power transmissions lines, further in the distance vegetation and deciduous trees are also visible bordering the Western side of the open field, to the West the topography is relatively flat. The area in proximity to the receptor has no street lighting provisions. The residential property has internal lighting, a light above the entrance and a security floodlight on the Eastern aspect of the property mounted at a height of approximately 6m. No additional significant sources of artificial light have been identified in proximity to this receptor location therefore taking a precautionary approach the receptor is assumed to be dark.

LR4

5.3.4 This receptor is located on the Eastern edge of a field in close proximity to the Best Western Premier Collection Quy Mill Hotel & Spa. To the North of the receptor a large row of deciduous trees are visible bordering the Northern edge of the field approximately 400m from the receptor. These trees block the majority of any further views to the North, except for a small gap to the Northwest where several electrical power transmissions lines can be seen in the distance. The village of Stow cum Quy extends from the Northeast of the view around to the East at a distance of approximately 600m. The tops of multiple residential properties and St Mary's Church are visible within the village, the residential properties are assumed to be intermittently illuminated during the hours of darkness. Church Road (B1102) runs through the village; this road is illuminated by approximately 6m high columns which could potentially be visible through gaps in houses. This road leads to the South where it connects with the A1303 and the A14 at a large junction / roundabout. This area can be seen to the Southwest of the receptor and is heavily illuminated by a large quantity of approximately 10m high columns. There is minimal screening in this direction allowing for direct views of some of these columns. To the South the A14 is screened from view by a large number of non-deciduous trees at a distance of approximately 250m. To the West is the Best Western Premier Collection Quy Mill Hotel & Spa as well as a number of other facilities including a Nurse Practitioner. This area is lit with a variety of different light sources including heritage style wall mounted luminaires around the buildings (primarily directed within the site), wall mounted floodlights on the frontage and above the main entrance of the largest building, wall pack type lighting mounted to the main building, multiple large windows on all buildings, and a number of approximately 8m high heritage style column mounted area luminaires within the car park. There is a small area of non-deciduous woodland blocking the majority of the view from the receptor, however this woodland dissipates into a small hedgerow approximately 1m in height running to the Northwest which would allow for clear views of the car park. It is anticipated that while a great deal of the lighting is concentrated to an area between the

buildings, this light would still be visible from outside of the site, however due to the screening of some trees and the unknown usage of these lights a precautionary approach assumes that the receptor is dark.

LR5

5.3.5 This receptor is located on High Ditch Road near a small cluster of residential properties. The road itself has no street lighting, is relatively straight running from the Northwest to the Southeast and has a small low voltage overhead power line running parallel to the road. To the North there is a large open field with deciduous trees bordering the Western, Northern, and Eastern boundaries of the field. These trees block any further views in all these direction with only several large metal pylons associated with electrical power transmission lines visible above them in the far distance. To the South there is a dense row of non-deciduous bushes and trees screening a large proportion of the view. There is a small gap in this vegetation for an access road allowing views of the residential properties behind. These properties have a small amount of residential light sources, such as wall mounted floodlights, solar marking lighting at entrances, security lighting, and internal building lighting. The lighting produced by these sources is assumed to be minimal therefore taking a precautionary approach the receptor is assumed to be dark.

LR6

5.3.6 This receptor is located on the carriageway of the A14. At this location the A14 runs from the Northwest to the Southeast with dense non-deciduous vegetation bordering both sides of the carriageway. This vegetation is approximately 2.5m height to the North and 5m high to South blocking the majority of the view in both directions for the majority of motorized vehicle users. The A14 curves out of view to the Southeast in the distance, but to the Northwest there is a bridge that crosses the carriageway at a distance of approximately 250m from the receptor. The bridge forms part of Horningsea Road. There are no light sources directly on the bridge however approximately 10m high lighting columns can be seen leading up to the bridge on Horningsea Road. The light from these columns would not reach the receptor but the light sources would be visible, therefore taking a precautionary approach the receptor is assumed to be dark.

LR7

5.3.7 This receptor is located in a field North of number 82 Horningsea Road, in Horningsea. To the North of the receptor Horningsea Road can be seen at a distance of approximately 25m from the receptor location and runs approximately from the North-Northeast to the South-Southwest, this section of Horningsea Road is unlit other than a small traffic island with an illuminated beacon with a white LED globe mounted at approximately 4m height and two solar powered keep left traffic light ratio. In this location the Eastern side of Horningsea Road is bordered by a grass verge with little screening, the Western side is bordered by deciduous vegetation that is approximately 3m in height with a large deciduous tree directly North of the receptor, more distant views to the North are predominantly screened by this

vegetation and tree. To the East views are across a large open field with deciduous trees and vegetation bordering the field in the distance, beyond this border it is possible to see some vehicular traffic on the A14 and multiple high voltage pylons and associated power transmission lines can be seen beyond this. To the South views are across a small, grassed area directly beyond which the Northern aspect of number 82 Horningsea Road can be seen, located approximately 40m from the receptor location. This property has three double windows overlooking the receptor location, these windows are anticipated to have internal lighting with intermittently illuminated windows, no external security lighting is visible on the Northern aspect of this residential property. To the Southwest direct views of the street lighting provisions on this section of Horningsea Road are predominantly screened by a mix of deciduous vegetation that is approximately 3m in height with some larger trees however it is assumed that some lighting will be visible through gaps in the trees and vegetation. To the West Horningsea Road can be seen at a distance of approximately 10m from the receptor location, the Western side of Horningsea Road is bordered by a mix of deciduous vegetation that is approximately 3m in height and larger deciduous trees, more distant views to the West are predominantly screened by this vegetation and trees.

5.3.8 CCC were contacted to obtain 'as-built' information and associated lighting inventory data to enable development of a lighting calculation to assess the current baseline lighting levels provided by the street lighting provision. The current lighting standard was provided by CCC as ME3b, Table 5-1 shows the results of the modelled lighting calculation in Lux, Figure 5.4 below, provides context to the location of this lighting in relation to the location of LR7.

Table 5-1: Calculated Lighting Levels – LR7

Lit Area Descriptor	Lighting Standard/s	Average illuminance (Lux)	Minimum illuminance (Lux)	Uniformity (Uo)
Horningsea Road, Horningsea	ME3b	19.13	8.91	0.47

Source: Mott MacDonald Ltd (2022)

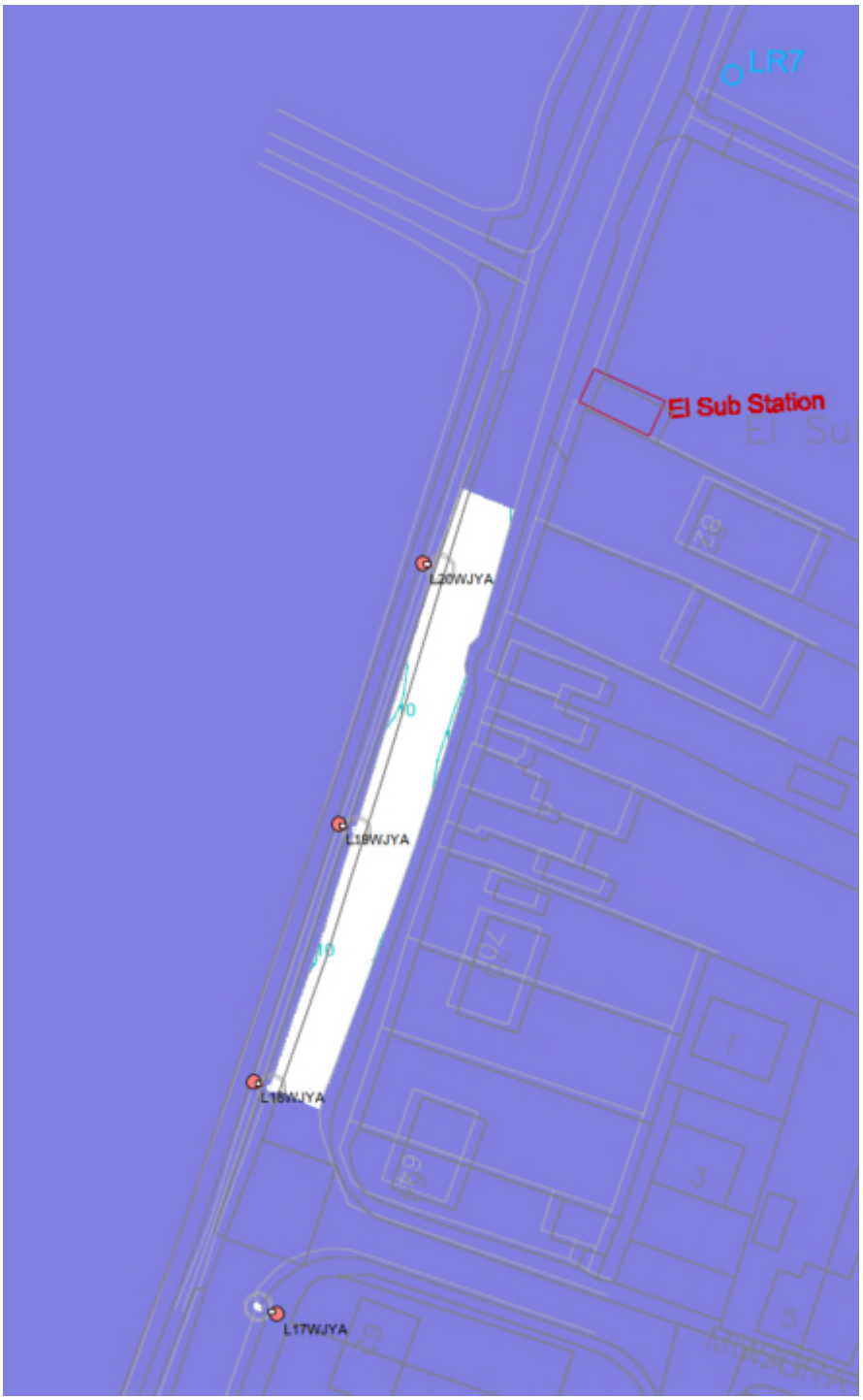

Figure 5.4: LR7 street lighting provision

Source: Mott MacDonald Ltd (2022)

5.3.9 The lighting provision shown in Figure 5.4 above on Horningsea Road consist of 8m mounting height lighting columns with post-top mounted, 5° tilt, 100W SON-T (high pressure sodium) Phillips SGS253 GB OR P4 luminaires, that produce a yellow-coloured light.

5.3.10 The lighting level at receptor LR7 is approximately 0 Lux, this result is very low because the street lighting provision within the vicinity of the receptor is approximately 65m Southwest to the nearest lighting column, reference number L20WJYA.

LR8

5.3.11 This receptor is located on Horningsea Road bridge over the A14. Horningsea Road runs approximately from the Northeast to the Southwest, the section of Horningsea Road over the A14 is unlit however further to the Northwest the approach to the bridge is lit. There are four visible lighting columns on the Eastern side of the carriageway the nearest of which is approximately 95m from the receptor location. Three traffic signal heads are also visible, the closest of which is at a distance of approximately 125m from the receptor. Looking directly North over the Horningsea Road bridge deck a large deciduous tree can be seen in close proximity to the bridge with further deciduous trees and vegetation visible beyond the large tree. To the Northwest are views of the A14 dual carriageway below, this section of the A14 has no existing lighting provisions. To the East are views over an open field that are largely uninterrupted by the deciduous trees and vegetation below the bridge that border the Northern and Southern boundaries of the field. In the far distance trees and hedgerows can been seen with multiple high voltage pylons and associated power transmission lines beyond this. To the South are views over an open field that are partially screened by the deciduous trees and vegetation below the bridge that border the Eastern and Western boundaries of the field. The A14 dual carriageway below runs to the Southeast, this section of the A14 has no existing lighting provisions. To the Southwest are views along Horningsea Road the section of Horningsea Road over the A14 is unlit however further to the Southwest the approach to the bridge is lit. There are three visible lighting columns on the Eastern side of the carriageway the nearest of which is 35m from the receptor location. Three traffic signals heads are also visible, the closest of which is at a distance of approximately 45m from the receptor. To the West are views of the A14 dual carriageway below, this section of the A14 has no existing lighting provisions, beyond the A14 carriageway dense deciduous trees and vegetation screen ongoing views.

5.3.12 CCC were consulted to obtain ‘as-built’ information and associated lighting inventory data to enable development of a lighting calculation to assess the current baseline lighting levels provided by the street lighting provision, however in this instance ‘as built’ information was not available. As an alternative topographical survey information was available and was utilised to inform lighting column positions. The current lighting standard was provided by CCC as S4, Table 5-2 shows the results of the modelled lighting calculation in Lux, **Figure *5.5*** provides context to the location of this lighting in relation to the location of LR8. Whilst the lighting standard provided by CCC is quoted as S4, it should be noted that the lighting calculation results indicate that the actual lighting levels are far in excess of the lighting levels associated with this standard.

Table 5-2: Calculated Lighting Levels – LR8

Lit Area Descriptor	Lighting Standard/s	Average illuminance (Lux)	Minimum illuminance (Lux)	Uniformity (Uo)
Horningsea Road, Northeast approach to the A14 bridge	S4	12.77	3.65	0.29
Horningsea Road, Southwest approach to the A147 bridge	S4	11.04	2.70	0.24

Source: Mott MacDonald Ltd (2022)

Figure 5.5: LR8 street lighting provision (south west approach to A14 bridge)
Source: Mott MacDonald Ltd (2022)

5.3.13 The lighting provision shown in **Figure *5.5*** above on Horningsea Road near the A14 bridge consist of 10m mounting height lighting columns with post-top mounted, 0°

tilt, DW Windsor Kirium Pro 2 - A3 - 48 LED luminaires. The luminaires have a 4000K colour temperature producing Neutral white coloured light.

5.3.14 LR8 is positioned on the A14 bridge within an approximately 142m area where there isn't a currently installed lighting provision. The closest lighting provisions are column L7WGP which is approximately 45m Southwest of the receptor and column L4WGP which is approximately 95m Northeast of the receptor. The lighting level at the receptor is approximately 0.1 Lux. This result is very low due to the distance from LR8 and the closest existing lighting provision.

LR9

5.3.15 This receptor is located in a large open field with Horningsea Road located approximately 125m to the Southeast of the receptor. To the North of the receptor there is a private access road for Poplar Hall Farm that splits the field with a small low voltage overhead power line running parallel to the road. Beyond the private access road there is a row of non-deciduous trees bordering the field blocking distant views to the North. These trees continue around to the East where approximately 10m high lighting columns associated with Horningsea Road can be seen above the trees. The bordering tree line starts to dissipate towards the South where the field opens up. Some small building can be seen through some gaps in the trees concentrated towards the Southwest where there is also a small, illuminated road utilising approximately 6m high lighting columns. To the West the tree line dissipates allowing for direct views to the River Cam with large non-deciduous trees running along the riverbanks. To the Northwest there is a cluster of buildings which are related to Poplar Hall Farm and Polar Hall, these buildings are anticipated to have internal lighting with intermittently illuminated windows, small wayfinding lights, and general security lighting. Due to the distance to the closest light source the receptor is assumed to be dark.

LR10

5.3.16 This receptor is located opposite number 38 Green End where a bat roost has been confirmed to the Northeast. Immediately to the Northwest of the receptor is a 6m mounting height lighting column with a post top luminaire mounted at a 5^0 tilt with a compact fluorescent 'white' light source, beyond this lighting column views are screened by a large deciduous tree and vegetation. At the end of Green End, a dirt track continues in a Northerly direction and is bordered on both sides with dense deciduous trees and vegetation. To the East across Green End, number 38 Green End is located approximately 20m from the receptor location. Several large windows face the receptor on the Western aspect of the property and are anticipated to have internal lighting with intermittently illuminated windows. On the Northern and Western aspect of the building two heritage style small wayfinding lights are mounted at a height of approximately 2m. A deciduous hedgerow approximately 1m high borders the Western and Eastern property boundaries with a wooden entrance gate located to the Northwest in front of the driveway. To the South views are along Green End that has street lighting provisions in this area. The lighting columns visible

in this direction are the same as the Northern direct, i.e. 6m mounting height lighting columns with a post top luminaire mounted at a 5^0 tilt with a compact fluorescent 'white' light source. To the Southeast deciduous trees and vegetation are visible, beyond this are several single and double story residential properties with some windows on both the ground and first floors visible through the trees and vegetation, it is anticipated that internal lighting will intermittently illuminate these windows. To the Southwest and West is an open grassed area adjacent to the River Cam, this area is bordered to the South with a mix of large deciduous and non-deciduous trees and vegetation. Large trees and vegetation can be seen on the Western bank of the River Cam, these block more distant views in this direction.

5.3.17 CCC were consulted to obtain 'as-built' information and associated lighting inventory data to enable development of a lighting calculation to assess the current baseline lighting levels provided by the street lighting provision. The current lighting standard was provided by CCC as S7 (undefined lighting class with no defined lighting levels, under the PFI contract this equates to a one for one replacement in the existing locations), Table 5-3 shows the results of the modelled lighting calculation in Lux, Figure 5.6 below provides context to the location of this lighting in relation to the location of LR10.

Table 5-3: Calculated lighting levels – LR10

Lit Area Descriptor	Lighting Standard/s	Average illuminance (Lux)	Minimum illuminance (Lux)	Uniformity (Uo)
Opposite number 38 Green End, Fen Ditton	S7	2.88	0.23	0.08

Source: Mott MacDonald Ltd (2022)

Figure 5.6: LR10 street lighting provision
Source: Mott MacDonald Ltd (2022)

5.3.18 The lighting provision shown in Figure 5.6 above, on Green End, Fen Ditton consists of 6m mounting height lighting columns with post-top mounted, 5° tilt, 36w PL-L (Compact Fluorescent) Phillips FGS224 luminaires, that produce a warm white coloured light.

5.3.19 The lighting level at receptor LR10 is approximately 4.2 Lux, this result is relatively high because the nearest streetlight to the receptor is approximately 5.3m Northwest, lighting column reference number L14WJY

LR11

5.3.20 This receptor is located in a large open field with Red House located approximately 50m to the Northwest of the receptor. To the North there are non-deciduous trees bordering the field blocking more distant views in this direction. To the Northeast views of Poplar Hall Farmhouse and Poplar Hall are blocked by non-deciduous trees bordering the field, a cluster of denser trees also contribute to this blocking effect. To the East the view is across a large open field with non-deciduous trees bordering Horningsea Road in the distance. The view to the South is across a large open field with non-deciduous trees bordering the field in the distance, these trees largely screen more distant views although some rooftops of residential properties on Green End can been seen above the trees. To the West there is a large amount of non-deciduous vegetation preventing views of the River Cam. Due to the distance to the closest light source the receptor is assumed to be dark.

LR12

5.3.21 This receptor is located on a circulatory dirt track on the Eastern edge of the existing Cambridge Wastewater Treatment Plant. next to the Cambridge to King's Lynn railway line. Distant views to the North, East and South are blocked by large amounts of deciduous vegetation. To the North and West there is a patch of bushes associated with the existing Cambridge Wastewater Treatment Plant, with the top of a large metal pylon associated with electrical power transmissions lines visible above. To the South and East there are multiple large deciduous trees bordering the treatment plant, through gaps in the trees a large ditch can be seen running from Northeast to Southwest, this ditch runs alongside the Cambridge to King's Lynn railway line with another row of deciduous vegetation above it. To the West views are across the existing Cambridge Wastewater Treatment Plant. It is assumed that the treatment plant is lit for operational and maintenance use however the receptor location is remote from the majority of the facilities, the receptor is therefore assumed to be dark.

LR13

5.3.22 This receptor is located in the far Southwestern corner of a small field East of the River Cam and North of the A14. To the North along the route of the River Cam there is a small dirt footpath that is bordered on both sides by small patches of deciduous vegetation. After approximately 150m the footpath continues between some deciduous trees where it turns out of view in line with the river. To the Northeast approximately 300m away Biggin Abbey Cottages can be seen through the broken tree line and vegetation bordering the small field. To the East there are multiple large open fields with small deciduous trees in a line marking the edges of the fields. Multiple large metal pylons associated with electrical power transmission lines are visible running to the distance. To the South there is a mixture of large deciduous

and non-deciduous trees bordering the A14 with a small gap directly South at the bridge. The footpath to continues South under the bridge following the direction of the River Cam. This section of the A14 is unlit and the bridge does not appear to be lit underneath by any form of lighting. To the West on the far side of the river there is another, more formal, footpath followed by a uniform row of large deciduous trees. No additional significant sources of artificial light have been identified in proximity to this receptor location therefore taking a precautionary approach the receptor is assumed to be dark.

LR14

5.3.23 This receptor is located in a field, approximately 150m Southwest of Biggin Abbey Cottages, Biggin Lane. To the North across the large open field there is a row of uniform deciduous trees bordering Biggin Lane leading to the Biggin Abbey Cottages, directly North the tree line is reduced as the trees are on the Northern side of Biggin Lane, there is also a large gap between the trees to allow access to the large field further to the North. The canopies of the trees are approximately 2m from ground level allowing clear views into the distance beyond the tree line. There are also gaps in these trees allowing for the cottages to be seen to the Northwest from the receptor location. To the East there is a view across the open field with the deciduous tree lined Biggin Lane visible. To the Southeast there is a large metal pylon associated with electrical power transmission lines, as well as four approximately 10m lighting columns on Horningsea Road running to the South towards the A14 increasing in perceived height the further South they are. To the South of the field there is a dense row of deciduous and non-deciduous trees and vegetation blocking the A14 from view. To the West across the field there are a mixture of deciduous and non-deciduous trees running parallel to the A14, and the top of a large metal pylon visible above. A gap in the trees near the A14 bridge over the River Cam is visible and is approximately 500m from the receptor. No significant sources of artificial light have been identified in proximity to this receptor location therefore taking a precautionary approach the receptor is assumed to be dark.

LR15

5.3.24 This receptor is located on Horningsea Road outside a residential property, The Lays, this section of Horningsea Road has a street lighting provision. Immediately to the Northwest of the receptor is a 5/6m mounting height lighting column with a post top luminaire mounted at a 10^0 tilt with a CPO-TW (Cosmopolis) type ‘white’ light source, beyond this lighting column views in this direction are screened by a large deciduous tree and vegetation. Directly North are views along Horningsea Road with the Eastern aspects of residential properties and associated windows visible on the Western side of the road, the properties are anticipated to have internal lighting with intermittently illuminated windows. Two additional street lighting columns of the same type as described above can be seen further in the distance on the Western side of Horningsea Road. The Plough & Fleece Public House is visible on the Western side of Horningsea Road and is approximately 45m from the receptor location, on the Southern aspect of the Public House a floodlight is mounted at a

height of approximately 4/5m illuminating the Plough & Fleece sign. On the Eastern aspect of the public house two large heritage style lights are mounted at a height of approximately 2m with an additional small light mounted to illuminate the menu. Beyond these lights, a double-sided Public House sign has two smaller floodlights illuminating each side of the sign and are mounted at a height of approximately 3/4m. On the Eastern side of Horningsea Road the entrance to Scotsdales Garden Centre and Sunflower Café can be seen and is approximately 45m from the receptor location, at the entrance a twin head lighting column can be seen with an LED and high intensity discharge type luminaire mounted atop. Further to the North in the distance both sides of Horningsea Road are lined with large deciduous trees. To the East are views of a residential property, 'The Boundary', several windows are visible on the Western aspect of the property at both ground and first floor level and are anticipated to have internal lighting with intermittently illuminated windows. A large non-deciduous hedgerow borders this property on the Northern aspect and is approximately 4/5m in height. Views of an open grassed area at the rear of the property are visible with large deciduous trees and vegetation bordering this area further to the East screening further view in this direction. Views South are along Horningsea Road with both sides of the road lined with large deciduous trees and vegetation, no further street lighting provision is visible in this direction. To the West are views of a residential property, 'The Lays', several windows are visible on the Eastern aspect of the property at both ground and first floor level and are anticipated to have internal lighting with intermittently illuminated windows, views further to the West are predominantly screened by the property however to the Southwest and Northwest large deciduous trees can be seen beyond 'The Lays'.

5.3.25 CCC were consulted to obtain 'as-built' information and associated lighting inventory data to enable development of a lighting calculation to assess the current baseline lighting levels provided by the existing street lighting provision. The current lighting standard was provided by CCC as S5, Table 5-4 shows the results of the modelled lighting calculation in Lux, Figure 5.7 below provides context to the location of this lighting in relation to the location of LR15.

Table 5-4: Calculated lighting levels – LR15

Lit Area Descriptor	Lighting Standard/s	Average illuminance (Lux)	Minimum illuminance (Lux)	Uniformity (Uo)
Horningsea Road outside a residential property, The Lays	S5	4.61	0.95	0.21

Source: Mott MacDonald Ltd (2022)

Figure 5.7: LR15 street lighting provision

Source: Mott MacDonald Ltd (2022)

5.3.26 The lighting provision shown in Figure 5.7 above on Horningsea Road consists of 5m and 6m mounting height lighting columns with post-top mounted, 10° tilt, 45w CPO-

TW (Cosmopolis) Phillips Mini Iridium SGS451 GB VX2 IT3 P1 luminaires, that produce a warm white coloured light.

5.3.27 The lighting level at receptor LR15 is approximately 10 Lux, this result is high because the nearest streetlight to the receptor is approximately 3.2m Northwest, lighting column reference number L1WJPD.

LR16

5.3.28 This receptor is located on the Western edge of a field approximately 200m East of Cambridge Country Cottages. To the North there is a clear view over an open field ending in a row of deciduous trees bordering the field. To the Northwest there is the CBS Automotive and a residential property, the 'Grange Farmhouse' is approximately 330m from the receptor. These building have wall-mounted floodlights some of which are anticipated to be visible through gaps in trees and buildings. Around to the East the field extends into the distance with sporadic deciduous trees on borders between fields, several electrical power transmissions lines and associated pylons can also be seen further in the distance. To the South a dirt track runs between two perpendicular rows of dense deciduous trees. These trees are in close vicinity to the receptor and block more distant views. To the West the Cambridge Country Cottages can be seen. Direct views to these cottages are largely screened but it is likely that individual light sources such as internally illuminated windows would be visible through the trees. No significant sources of artificial light have been identified in close proximity to this receptor location therefore taking a precautionary approach the receptor is assumed to be dark.

LR17

5.3.29 This receptor is located in a field North of the Clayhithe Farm buildings. To the North of the receptor over an open field there is a curving row of deciduous trees bordering the route of the River Cam. There are some gaps in these trees allowing for views of the River Cam and the trees and infrastructure associated with the Cam Sailing Club on the far side. To the East there is a small asphalt road lined with intermittent deciduous trees that cuts through a large open field. The view continues beyond the small asphalt road for a considerable distance before being obscured by sporadic deciduous trees and the undulating topography. Running alongside the road there are several wooden poles associated with a low voltage overhead power lines, these continue around to the South. The majority of the view to the South is obscured due to a combination of the close proximity of the Clayhithe Farm buildings, the small asphalt road lined with intermittent deciduous trees, and trees planted on the Northern aspects of the farm buildings. These farm buildings have multiple wall mounted floodlights. To the West there are multiple deciduous trees and bushes bordering the field, this vegetation provides screening for the residential buildings behind. Clayhithe Road runs by these buildings but has no street lighting columns, on the far side of the bridge there is Cambridge Motorboat Club, and The Bridge public house. The public house building has several wall mounted heritage style lights around the frontage as well as approximately 8m high column mounted

floodlights for the car park. There is approximately 200m from the receptor to the public house but due to gaps in the tree lines these light sources might be visible. No significant sources of artificial light have been identified in close proximity to this receptor location therefore taking a precautionary approach the receptor is assumed to be dark.

LR18

5.3.30 This receptor is located in a field South of the River Cam opposite the Cam Sailing Club. To the North of the receptor there is an approximately 1m high raised embankment running alongside the River Cam, likely preventing direct views of the river from within the field. On the far side of the River Cam there is an open field with the tops of large deciduous trees visible in the distance. To the East across a large open field there are several deciduous trees and a line of bushes blocking the majority of the view. In a gap between this vegetation residential properties are visible at a distance of approximately 450m. The view over the open field to the South is obstructed by several large deciduous trees. There are multiple large gaps in these trees allowing for views of the Clayhithe Farm buildings. To the West there is a row of large deciduous trees running along the path of the river. These trees end to the Northwest of the receptor allowing for direct views of the Cam Sailing Club at a distance of approximately 150m. There are no visible lights at this location however it is likely that there will be some kind of wayfinding and security lighting around the site. The sailing club is bordered behind by multiple large deciduous trees. No additional significant sources of artificial light have been identified in proximity to this receptor location therefore taking a precautionary approach the receptor is assumed to be dark.

LR19

5.3.31 This receptor is located on the Eastern edge of a field North of River Cam near the Cam Sailing Club. This field is enclosed by rows of deciduous trees and vegetation on the Northern, Eastern, and Southern boundaries. The trees to the North have multiple gaps allowing for further views of a dirt track and a line of wooden poles associated with a low voltage overhead power line. To the East and South ongoing views are obscured by the trees and vegetation. To the West the view is less obstructed, at a distance of approximately 125m from the receptor is a line of small bushes and a dirt track running from South to North splitting the field. Past this dirt track the tops of multiple allotments can be seen followed by a dense line of deciduous trees. No significant sources of artificial light have been identified in close proximity to this receptor location therefore taking a precautionary approach the receptor is assumed to be dark.

LR20

5.3.32 This receptor is located in a field East of the Cambridge to King's Lynn railway line and North of Bannold Road. To the North of the receptor over a large open field with several small wooden poles associated with a high voltage overhead power line, there is a border of small deciduous vegetation running alongside the rail line from

Cambridge to King's Lynn. Above the rail tracks is a line of power cables supported by multiple metal poles. Past the rail tracks to the Northwest there are several lines of large mixed deciduous and non-deciduous trees. Between these trees views of multiple industrial buildings can be seen, the closest building is approximately 150m from the receptor whereas the furthest is approximately 250m away. No light sources can be seen on these buildings but there is likely to be some kind of wall/building mounted floodlights for security. To the East along the asphalted Bannold Road there are more small wooden poles associated with high voltage overhead power transmission lines as well as small groups of mixed deciduous vegetation further in the distance, this road had no street lighting provision. The view extends a large distance to the Northeast due to the slightly elevated nature of the road. To the South there is a small drainage ditch filled with water bordered on both sides by dense deciduous vegetation. Beyond this ditch is an open field with a solitary area of trees around the Waterbeach Hyacinth Park approximately 100m from the receptor. To the West along Bannold Road there is a rail crossing with two sets of signals on each side of the crossing but no identified lighting columns. In the distance the tops of some deciduous trees and residential properties can be seen, the closest of which is approximately 300m from the receptor. These properties are likely to have security lighting as well as multiple internally illuminated windows. Bannold Road has street lighting, the first lighting column is opposite the entrance to Bannold Drove and is approximately 4/5m heigh, this lighting continues into Waterbeach in a Westerly direction. No additional significant sources of artificial light have been identified in proximity to this receptor location therefore taking a precautionary approach the receptor is assumed to be dark.

LR21

5.3.33 This receptor is located in a field East of the Cambridge to King's Lynn railway line and West of Long Drove. To the Northwest of the receptor there is a long clear view over the rail line from Cambridge to King's Lynn. Above the tracks is a line of power cables supported by multiple metal poles. Past the rail tracks there are several lines of large deciduous trees and vegetation. To the Northeast there is a short view over a field before a row of deciduous trees and vegetation blocks more distant views. The view to the East is mostly uninterrupted with Long Drove being slightly elevated over the surrounding fields, also with small wooden poles associated with low voltage overhead power lines. Long Drove does not have any visible street lighting. In the distance the River Cam can be seen with some deciduous trees on the Western bank. To the South there is a small ditch filled with water followed by open views over multiple fields with several deciduous trees blocking specific viewing angles. To the Southeast approximately 350m from the receptor there is a small cluster of buildings associated with Lock Farm with no identifiable light sources other than the internally illuminated windows. To the West over the rail tracks and a small row of deciduous bushes the top of multiple residential properties can be seen at an approximate distance of 250m from the receptor and the closest property. There are multiple approximately 6m street lighting columns on Capper Road running by these residential properties, there is a possibility that some of these lights sources would

be visible between gaps in trees and residential properties. Due to the distance to the closest light sources the receptor is assumed to be dark.

LR22

5.3.34 This receptor is located in a field East of Bannold Drove and West of the Cambridge to King's Lynn railway line. To the North of the receptor there is a clear view over a field running alongside an unnamed asphalt road. Small patches of deciduous trees block specific views at a variety of distances. To the East past the rail line from Cambridge to King's Lynn with a line of power cables supported by multiple metal poles, there is a clear view over multiple fields towards the River Cam with several deciduous trees on the Western bank. The view to the South is primarily blocked by a row of approximately 2.5m high bushes with only the tops of a few industrial building visible above. These buildings have wall mounted floodlights at a high level which may be visible from the receptor. To the West is the town of Waterbeach with a high number of residential properties and street lighting. The closest residential property is approximately 100m to the Southwest running along Capper Road with multiple approximately 6m high street lighting columns throughout. The entirety of this side of Waterbeach is mostly bordered by approximately 2.5m high bushes and sporadic deciduous trees primarily shielding the entirety of the properties ground floors from view. No additional significant sources of artificial light have been identified in proximity to this receptor location therefore taking a precautionary approach the receptor is assumed to be dark.

6 Impact Assessment

6.1 Introduction

6.1.1 No detailed lighting design is yet in place for the Proposed Development. The impacts discussed in this section are therefore based on the application of the lighting design identified in Section 4. The impacts identified below assume that the mitigation provided within Table 4-4 has been applied. A precautionary approach has been taken, assuming and assessing worst case impacts as necessary. Recommended secondary mitigation is provided within Table 7-1 and predicted residual effects follow.

6.2 Assumptions and clarifications for estimated impacts

6.2.1 Impacts discussed in this section are based on the lighting requirements for the various development components discussed in Section 4 of this report and the locations of each lighting application within the Proposed Development.

6.2.2 During the desk based study every effort has been made to correctly identify trees as either deciduous of non-deciduous however it is acknowledged that this identification may be flawed in some cases where the quality of desk based data is insufficient.

6.2.3 The desk based study uses sources of information such as street view photography that can vary in age therefore the current onsite condition may vary from those identified during the desk based study.

6.2.4 Trees and all other vegetation have been ignored for the purpose of this assessment to provide a 'worst case' assessment, i.e. in winter when vegetation is minimal, or to allow for vegetation to be removed in the future.

6.2.5 Information provided by the local highways authority (CCC) is assumed to be an accurate and current representation of existing street lit areas.

6.2.6 If any significant changes are implemented during design development or as a consequence of value engineering that have potential to increase the levels of obtrusive light, it is recommended that the lighting assessment is re-performed.

6.2.7 When lighting design calculations are carried out site constraints often limit the most efficient position of light fittings, often in these situations slight over lighting of areas is a result of a designer's need to compromise ideal positions or spacing between columns. The assessment of effects therefore assumes that the achieved levels of lighting for each application would be slightly beyond the minimum required levels discussed in Section 4 of this report.

6.2.8 The Lighting Design Strategy (Appendix 2.5, App Doc Ref 5.4.2.5) provides worst case lighting levels on which the assessment is based, these lighting levels are Em (maintained illuminance) levels, which are the values below which the average illuminance (in lux) on the specified surface is not allowed to fall. For the purposes of

the assessment of potential effects of obtrusive light all Em levels quoted within this document are assumed to be exceed by 25%.

6.2.9 It is assumed that all equipment specifications will be typical of the relevant applications and required lighting standard.

6.2.10 The design team have confirmed that the Gateway Building will not be lit as a decorative night time feature, given the type of development and sensitive environmental area, it is assumed that no additional buildings are being illuminated as a night time feature, as such building illuminance has been de-scoped from this assessment.

6.2.11 Upward flux ratio has also been de-scoped from this assessment as this is only required where there is a defined performance requirement, specialized fauna growth lighting systems (such as those use to promote grass growth in sports stadia), proximity to optical observatories, or lies within an E1 environmental zone which abuts a dark sky protected E0 environmental zone. Optical observatories are located to the West of Cambridge City approximately 5km from the Proposed Development, however the viewing angle towards CWWTP would require sight over Cambridge City and therefore CWWTP is not predicted to be a visible addition to the night time scene when the obscuring nature of Cambridge City lighting is considered.

6.2.12 Following a review of the Lighting Design Strategy (Appendix 5.2 App Doc Ref 5.4.2.5), the Works Plans (App Doc Refs 4.3.0 to 4.3.11), General Arrangement Plans (App Doc Ref 4.2) and Design Plans (App Doc Refs 4.9 – 4.14), and the other plans contained in Volume 4 of the application, the following construction areas are assumed not to require lighting: -

- Gayton Farm – Operational inspection / maintenance areas as indicated within General Arrangement plan – Sheet 7 (App Doc Reference 4.2.7).
- Grange Farm – Temporary construction works area, temporary construction access, and operational inspection / maintenance areas as indicated within General Arrangement plan – Sheet 8 (App Doc Reference 4.2.8).
- Temporary construction access, and operational inspection / maintenance areas as indicated within General Arrangement plan – Sheet 8 - Inset plan 8.1 - (App Doc Reference 4.2.8).
- Riverside Farm – Temporary construction access, operational inspection / maintenance areas, and temporary pedestrian route through field as indicated within General Arrangement plan – Sheet 9 – (App Doc Reference 4.2.9).

6.2.13 The route of the Waterbeach Pipeline is assumed to include temporary compounds, these compounds are assumed to be within the Waterbeach corridor, at approx. 1km intervals and will be located away from sensitive receptors. Within the Lighting Design Strategy (Appendix 2.5, App Doc Ref 5.4.2.5) 'typical open trench sections', are proposed to be lit to 200 Lux (Maintained illuminance (Em)), any temporary

compounds within the Waterbeach Pipeline are assumed to be lit in the same manner as the 'typical open trench sections'.

6.2.14 Lighting Design Strategy (Appendix 2.5, App Doc Ref 5.4.2.5) indicates that Horizontal Directional Drilling (HDD) launch / recovery sites for the 'Railway – north crossing', 'A14 crossing', and the 'River Cam crossing (south)' require lighting provisions for safety and security purposes. It is assumed that all HDD launch / recovery sites require the same lighting provisions, see Table 4-3 for details.

6.2.15 Lighting Design Strategy (Appendix 2.5, App Doc Ref 5.4.2.5) indicates that 'typical open trench sections' require lighting provisions for safety and security purposes. It is assumed that all open trench sections, including the final effluent pipeline and storm flow pipeline require the same lighting provisions, as detailed within Table 6.1 of the Lighting Design Strategy (Appendix 2.5, App Doc Ref 5.4.2.5).

6.2.16 Lighting Design Strategy (Appendix 2.5, App Doc Ref.4.2.5) does not indicate that any navigation lighting is required on the River Cam as a results of the Proposed Development, for example on the River Cam temporary Coffer Dam. Therefore, it is assumed that no navigation lighting is required.

6.2.17 Additional assumed construction lighting requirements that are not included within Lighting Design Strategy (Appendix 2.5, App Doc Ref4.2.5), have been documented within Table 4-3 and have been used to inform the assessment of potential effects for the construction phase lighting of the Proposed Development.

6.2.18 The extents of assumed worst case lighting for Horningsea Road provided within

6.2.19 Table **4-1** are assumed to include the bridge over the A14.

6.2.20 The obtrusive light limitations for an exterior lighting installation are dependent on the location of the site in terms of its Environmental Zone; the definitions of these zones are taken from GN01:2021. For further details of the Environmental Zone and the restrictions that apply to CWWTW please refer to Section 3.5.

6.3 Construction phase effects

6.3.1

Table 6-1 assesses the likely significant effects on human receptors that could result from the CWWTPR during the construction phase of works associated with the CWWTPR, taking into account the embedded, best practice and tertiary mitigation measures provided within Table 4-4. The likely duration of effect is also estimate based upon the definition provided with paragraph reference 3.7.11.

Table 6-1: Predicted construction effects

Receptor Reference		Light Intrusion	Luminous Intensity	Sky Glow	Summary of Overall Effects	Duration of effect
LR1	Pre-Curfew	None/Negligible	None/Negligible	None/Negligible	None/Negligible	N/A
	Post-Curfew	None/Negligible	None/Negligible	None/Negligible	None/Negligible	N/A
LR2	Pre-Curfew	None/Negligible	None/Negligible	None/Negligible	None/Negligible	N/A
	Post-Curfew	None/Negligible	None/Negligible	None/Negligible	None/Negligible	N/A
LR3	Pre-Curfew	None/Negligible	None/Negligible	None/Negligible	None/Negligible	N/A
	Post-Curfew	None/Negligible	None/Negligible	None/Negligible	None/Negligible	N/A
LR4	Pre-Curfew	None/Negligible	None/Negligible	None/Negligible	None/Negligible	N/A
	Post-Curfew	None/Negligible	None/Negligible	None/Negligible	None/Negligible	N/A
LR5	Pre-Curfew	None/Negligible	None/Negligible	*1 None/Negligible	None/Negligible	N/A
	Post-Curfew	None/Negligible	None/Negligible	*1 None/Negligible	None/Negligible	N/A
LR6	Pre-Curfew	None/Negligible	None/Negligible	*1 None/Negligible	None/Negligible	N/A
	Post-Curfew	None/Negligible	None/Negligible	*1 None/Negligible	None/Negligible	N/A
LR7	Pre-Curfew	None/Negligible	None/Negligible	*1 None/Negligible	None/Negligible	N/A
	Post-Curfew	None/Negligible	None/Negligible	*1 None/Negligible	None/Negligible	N/A
LR8	Pre-Curfew	None/Negligible	None/Negligible	*1 None/Negligible	None/Negligible	N/A
	Post-Curfew	None/Negligible	None/Negligible	*1 None/Negligible	None/Negligible	N/A
LR9	Pre-Curfew	None/Negligible	None/Negligible	*1 None/Negligible	None/Negligible	N/A
	Post-Curfew	None/Negligible	None/Negligible	*1 None/Negligible	None/Negligible	N/A
LR10	Pre-Curfew	None/Negligible	None/Negligible	*1 None/Negligible	None/Negligible	N/A
	Post-Curfew	None/Negligible	None/Negligible	*1 None/Negligible	None/Negligible	N/A
LR11	Pre-Curfew	Minor/Adverse	Minor/Adverse	*1 None/Negligible	Minor/Adverse	Short Term
	Post-Curfew	Minor/Adverse	Minor/Adverse	*1 None/Negligible	Minor/Adverse	Short Term
LR12	Pre-Curfew	Minor/Adverse	Minor/Adverse	*1 None/Negligible	Minor/Adverse	Short Term
	Post-Curfew	Minor/Adverse	Minor/Adverse	*1 None/Negligible	Minor/Adverse	Short Term
LR13	Pre-Curfew	Major/Adverse	Major/Adverse	*1 None/Negligible	Major/Adverse	Short Term

Receptor Reference		Light Intrusion	Luminous Intensity	Sky Glow	Summary of Overall Effects	Duration of effect
	Post-Curfew	Major/Adverse	Major/Adverse	*1 None/Negligible	Major/Adverse	Short Term
LR14	Pre-Curfew	None/Negligible	None/Negligible	*1 None/Negligible	None/Negligible	N/A
	Post-Curfew	None/Negligible	None/Negligible	*1 None/Negligible	None/Negligible	N/A
LR15	Pre-Curfew	None/Negligible	None/Negligible	None/Negligible	None/Negligible	N/A
	Post-Curfew	None/Negligible	None/Negligible	None/Negligible	None/Negligible	N/A
LR16	Pre-Curfew	Minor/Adverse	Minor/Adverse	*1 None/Negligible	Minor/Adverse	Short Term
	Post-Curfew	Minor/Adverse	Minor/Adverse	*1 None/Negligible	Minor/Adverse	Short Term
LR17	Pre-Curfew	None/Negligible	None/Negligible	*1 None/Negligible	None/Negligible	N/A
	Post-Curfew	None/Negligible	None/Negligible	*1 None/Negligible	None/Negligible	N/A
LR18	Pre-Curfew	Major/Adverse	Major/Adverse	*1 None/Negligible	Major/Adverse	Short Term
	Post-Curfew	Major/Adverse	Major/Adverse	*1 None/Negligible	Major/Adverse	Short Term
LR19	Pre-Curfew	Major/Adverse	Major/Adverse	*1 None/Negligible	Major/Adverse	Short Term
	Post-Curfew	Major/Adverse	Major/Adverse	*1 None/Negligible	Major/Adverse	Short Term
LR20	Pre-Curfew	Major/Adverse	Major/Adverse	*1 None/Negligible	Major/Adverse	Short Term
	Post-Curfew	Major/Adverse	Major/Adverse	*1 None/Negligible	Major/Adverse	Short Term
LR21	Pre-Curfew	Major/Adverse	Major/Adverse	*1 None/Negligible	Major/Adverse	Short Term
	Post-Curfew	Major/Adverse	Major/Adverse	*1 None/Negligible	Major/Adverse	Short Term
LR22	Pre-Curfew	Minor/Adverse	Minor/Adverse	*1 None/Negligible	Minor/Adverse	Short Term
	Post-Curfew	Major/Adverse	Major/Adverse	*1 None/Negligible	Major/Adverse	Short Term

Source: Mott MacDonald Ltd (2022)

***1** – Whilst it is predicted sky glow in these viewing directions will increase best practicable means of mitigation have been embedded within the design proposals to minimise sky glow, as an example an allowance of 2.5% Upward Light Ratio (ULR) is accepted within the environmental zone for this development however The Applicant has committed to providing zero ULR lighting. See Table 4-4 for further details of sky glow mitigation measures applied to the Proposed Development.

6.4 Operational and maintenance phase effects

6.4.1 Table 6-2 assesses the likely significant effects on human receptors that could result from the CWWTPR during both the operational and maintenance phases of works associated with the CWWTPR, taking into account the embedded, best practice and tertiary mitigation measures provided within Table 4-4. The likely duration of effect is also estimate based upon the definition provided with paragraph reference 3.7.11.

Table 6-2: Predicted operational and maintenance phase effects

Receptor Reference		Light Intrusion	Luminous Intensity	Sky Glow	Summary of Overall Effects	Duration of effect
LR1	Pre-Curfew	None/Negligible	None/Negligible	None/Negligible	None/Negligible	N/A
	Post-Curfew	None/Negligible	None/Negligible	None/Negligible	None/Negligible	N/A
LR2	Pre-Curfew	None/Negligible	None/Negligible	None/Negligible	None/Negligible	N/A
	Post-Curfew	None/Negligible	None/Negligible	None/Negligible	None/Negligible	N/A
LR3	Pre-Curfew	None/Negligible	None/Negligible	None/Negligible	None/Negligible	N/A
	Post-Curfew	None/Negligible	None/Negligible	None/Negligible	None/Negligible	N/A
LR4	Pre-Curfew	None/Negligible	None/Negligible	None/Negligible	None/Negligible	N/A
	Post-Curfew	None/Negligible	None/Negligible	None/Negligible	None/Negligible	N/A
LR5	Pre-Curfew	None/Negligible	None/Negligible	*[1] None/Negligible	None/Negligible	N/A
	Post-Curfew	None/Negligible	None/Negligible	*[1] None/Negligible	None/Negligible	N/A
LR6	Pre-Curfew	None/Negligible	None/Negligible	*[1] None/Negligible	None/Negligible	N/A
	Post-Curfew	None/Negligible	None/Negligible	*[1] None/Negligible	None/Negligible	N/A
LR7	Pre-Curfew	None/Negligible	None/Negligible	*[1] None/Negligible	None/Negligible	N/A
	Post-Curfew	None/Negligible	None/Negligible	*[1] None/Negligible	None/Negligible	N/A
LR8	Pre-Curfew	Major/Adverse	Major/Adverse	*[1] None/Negligible	Major/Adverse	Permanent
	Post-Curfew	Major/Adverse	Major/Adverse	*[1] None/Negligible	Major/Adverse	Permanent
LR9	Pre-Curfew	None/Negligible	None/Negligible	*[1] None/Negligible	None/Negligible	N/A
	Post-Curfew	None/Negligible	None/Negligible	*[1] None/Negligible	None/Negligible	N/A
LR10	Pre-Curfew	None/Negligible	None/Negligible	*[1] None/Negligible	None/Negligible	N/A
	Post-Curfew	None/Negligible	None/Negligible	*[1] None/Negligible	None/Negligible	N/A
LR11	Pre-Curfew	None/Negligible	None/Negligible	*[1] None/Negligible	None/Negligible	N/A
	Post-Curfew	None/Negligible	None/Negligible	*[1] None/Negligible	None/Negligible	N/A
LR12	Pre-Curfew	None/Negligible	None/Negligible	*[1] None/Negligible	None/Negligible	N/A
	Post-Curfew	None/Negligible	None/Negligible	*[1] None/Negligible	None/Negligible	N/A
LR13	Pre-Curfew	None/Negligible	None/Negligible	*[1] None/Negligible	None/Negligible	N/A

Receptor Reference		Light Intrusion	Luminous Intensity	Sky Glow	Summary of Overall Effects	Duration of effect
	Post-Curfew	None/Negligible	None/Negligible	*[1] None/Negligible	None/Negligible	N/A
LR14	Pre-Curfew	None/Negligible	None/Negligible	*[1] None/Negligible	None/Negligible	N/A
	Post-Curfew	None/Negligible	None/Negligible	*[1] None/Negligible	None/Negligible	N/A
LR15	Pre-Curfew	None/Negligible	None/Negligible	None/Negligible	None/Negligible	N/A
	Post-Curfew	None/Negligible	None/Negligible	None/Negligible	None/Negligible	N/A
LR16	Pre-Curfew	None/Negligible	None/Negligible	None/Negligible	None/Negligible	N/A
	Post-Curfew	None/Negligible	None/Negligible	None/Negligible	None/Negligible	N/A
LR17	Pre-Curfew	None/Negligible	None/Negligible	None/Negligible	None/Negligible	N/A
	Post-Curfew	None/Negligible	None/Negligible	None/Negligible	None/Negligible	N/A
LR18	Pre-Curfew	None/Negligible	None/Negligible	None/Negligible	None/Negligible	N/A
	Post-Curfew	None/Negligible	None/Negligible	None/Negligible	None/Negligible	N/A
LR19	Pre-Curfew	None/Negligible	None/Negligible	None/Negligible	None/Negligible	N/A
	Post-Curfew	None/Negligible	None/Negligible	None/Negligible	None/Negligible	N/A
LR20	Pre-Curfew	None/Negligible	None/Negligible	None/Negligible	None/Negligible	N/A
	Post-Curfew	None/Negligible	None/Negligible	None/Negligible	None/Negligible	N/A
LR21	Pre-Curfew	None/Negligible	None/Negligible	None/Negligible	None/Negligible	N/A
	Post-Curfew	None/Negligible	None/Negligible	None/Negligible	None/Negligible	N/A
LR22	Pre-Curfew	None/Negligible	None/Negligible	None/Negligible	None/Negligible	N/A
	Post-Curfew	None/Negligible	None/Negligible	None/Negligible	None/Negligible	N/A

Source: Mott MacDonald Ltd (2022)

***1 – Whilst it is predicted sky glow in these viewing directions may slightly increase best practicable means of mitigation have been embedded within the design proposals to minimise sky glow, as an example an allowance of 2.5% Upward Light Ratio (ULR) is accepted within the environmental zone for this development however The Applicant has committed to providing zero ULR lighting. See Table 4-4 for further details of sky glow mitigation measures applied to the Proposed Development.**

6.5 Biodiversity –predicted levels of lighting

6.5.1 The table below summarises the baseline light levels and predicted levels of lighting as a consequence of the Proposed Development at lighting receptors with specific biodiversity concerns, as informed by the discipline lead.

Table 6-3: Predicted levels of lighting at biodiversity receptors LR2 & LR10

Receptor reference	Baseline light levels	Predicted operational and maintenance phase lighting levels	Predicted construction phase lighting levels
LR2 (confirmed bat roost)	The area in proximity to the receptor has no street lighting provisions and no significant sources of artificial light have been identified in proximity to this receptor location therefore taking a precautionary approach the receptor is assumed to be dark.	The receptor is close (approximately 200m) to the main WWTP site, however due to the mitigation methods in place it is predicted that there would not be a level of change of >0.5 Lux in this area.	The receptor is close (approximately 200m) to the main WWTP construction compound, however due to the mitigation methods in place it is predicted that there would not be a level of change of >0.5 Lux in this area.
LR10 (confirmed bat roost to the northeast)	The lighting level at receptor LR10 is approximately 4.2 Lux, this result is relatively high because the nearest streetlight to the receptor is approximately 5.3m northwest, lighting column reference number L14WJY.	The receptor is within a street lit area, however due to the distance to any proposed operational and maintenance lighting it is predicted that there would not be a level of change of >0.5 Lux in this area.	The receptor is within a street lit area close (approximately 175m) to the shaft 4 temporary compound, however due to the mitigation methods in place it is predicted that there would not be a level of change of >0.5 Lux in this area.

Source: Mott MacDonald Ltd (2022)

6.5.2 The assessment of the overall effects on individual biodiversity receptors forms part of the relevant assessment's chapter in Chapter 8: Biodiversity. (App Doc Ref 5.4.8).

7 Secondary Mitigation

7.1 Introduction

7.1.1 The secondary mitigation methods in Table 7-1 describe lighting design techniques and offer equipment specification that will aid in reducing the impacts of the Proposed Development's lighting applications. These shall be applied where legally compliant, practicable and safe to do so, taking into account the operational, maintenance and construction requirements of the Proposed Development.

Table 7-1: Secondary mitigation measures

Mitigation measures		Applied to	Justification
Design Horningsea Road lighting to appropriate specification and guidance to reduce obtrusive light.	When designing the highway lighting, based on CCC 'Street Lighting Development Specification' (CCC, 2016), CCC specify the use of ILP GN01 (ILP, 2021) and request a lighting impact assessment as part of the highway lighting adoption process, therefore light intrusion, luminous intensity and sky glow shall be controlled and limited through this process	Operational phase lighting near receptor Ref. LR8 (Horningsea Road bridge over A14)	Control and limitation of obtrusive lighting on and from the public highway lighting provision
Selection of lower colour temperatures for light sources, ≤3000K.	The warmer white colour temperature has a lower relative attractiveness to insects, resulting in a greater number of insects in dark areas, which in turn increases the availability of the main food source of multiple types of bats [7]	Operational phase lighting near receptor Ref. LR8 (Horningsea Road bridge over A14)	Reduction of potential adverse effects of lighting on bats
Use of best practice guidance to inform design development	ILP and Bat Conservation Trust Guidance Note 08/18 Bats and Artificial Lighting in the UK, Bats and the Built Environment series (Bat Conservation Trust & ILP, 2018) is to be utilised to inform the detailed design process in collaboration with suitable biodiversity specialists	Operational phase lighting near receptor Ref. LR8 (Horningsea Road bridge over A14)	Reduction of potential adverse effects of lighting on bats
Selection of light sources with warmer colour temperatures	Selection of warmer colour temperatures with peak wavelengths greater than 550 nanometres cause less of an impact on bats (Bat Conservation Trust & ILP, 2018)	Operational phase lighting near receptor Ref. LR8 (Horningsea Road bridge over A14)	Reduction of potential adverse effects of lighting on bats

[7] Source: Bats and Lighting, Overview of current evidence and mitigation. E Stone 2014

Mitigation measures		Applied to	Justification
Considerate design, placement and direction of Shaft 4 compound and HDD launch/recovery works area lighting provisions	When designing, placing and directing Shaft 4 compound and HDD launch/recovery works area lighting provisions consideration shall be incorporated into this process to avoid light intrusion and luminous intensity for sensitive areas such as residential properties (Poplar Hall, Red House Close & Number 38 Green End) and the River Cam	Construction phase lighting near receptor Ref. LR11 (In a field Southeast of Red House Close) and HDD launch/recovery works area	Control and limitation of obtrusive lighting (light intrusion and luminous intensity) from Shaft 4 compound and HDD launch/recovery works area
Considerate design, placement and direction of Shaft 3 compound and HDD launch/recovery works area lighting provisions	When designing, placing and directing Shaft 3 compound and HDD launch/recovery works area lighting provisions consideration shall be incorporated into this process to avoid light intrusion and luminous intensity for sensitive areas such as the Cambridge to King's Lynn railway line, Northern Bridge Farm and the River Cam	Construction phase lighting near receptor Ref. LR12 (West of the Cambridge to King's Lynn railway line within the existing Cambridge Wastewater Treatment Plant) and HDD launch/recovery works area	Control and limitation of obtrusive lighting (light intrusion and luminous intensity) from Shaft 3 compound and HDD launch/recovery works area
Considerate design, placement and direction of temporary outfall compound, permanent outfall	When designing, placing and directing temporary outfall compound, permanent outfall area and open trench lighting provisions consideration shall be incorporated into this process to avoid light intrusion and luminous intensity for sensitive areas such as the River Cam and the A14	Construction phase lighting near receptor Ref. LR13 (In a field Southwest of Biggin	Control and limitation of obtrusive lighting (light intrusion and luminous intensity) from temporary outfall compound, permanent

Mitigation measures		Applied to	Justification
area and open trench lighting provisions		Abbey Cottages, Biggin Lane)	outfall area and open trench lighting
Considerate design, placement and direction of open trench lighting provisions	When designing, placing and directing open trench lighting provisions consideration shall be incorporated into this process to avoid light intrusion and luminous intensity for sensitive areas such as Eye Hall Farm and Mulberry House Farm	Construction phase lighting near receptor Ref. LR16 (In a field East of Cambridge Country Cottages)	Control and limitation of obtrusive lighting (light intrusion and luminous intensity) from open trench lighting
Considerate placement of Waterbeach Pipeline temporary compound	When selecting locations for temporary compounds associated with the construction of the Waterbeach Pipelines When selecting locations for Waterbeach Pipeline temporary compounds consideration shall be incorporated into this process to avoid locations in close proximity to sensitive areas such as Eye Hall Farm and Mulberry House Farm	Waterbeach Pipeline temporary compound locations near receptor Ref. LR16 (In a field East of Cambridge Country Cottages)	Control and limitation of obtrusive lighting (light intrusion and luminous intensity) from Waterbeach Pipeline temporary compound
Considerate design, placement and direction of open trench and HDD launch/recovery works area lighting provisions	When designing, placing and directing open trench and HDD launch/recovery works area lighting provisions consideration shall be incorporated into this process to avoid light intrusion and luminous intensity for sensitive areas such as the River Cam	Construction phase lighting near receptor Ref. LR18 (In a field South of the River Cam opposite the Cam Sailing Club)	Control and limitation of obtrusive lighting (light intrusion and luminous intensity) from open trench and HDD launch/recovery works area lighting provisions
Considerate placement of Waterbeach	When selecting locations for temporary compounds associated with the construction of the Waterbeach Pipelines consideration shall be	Waterbeach Pipeline temporary compound locations	Control and limitation of obtrusive lighting (light intrusion and luminous

Mitigation measures		Applied to	Justification
Pipeline temporary compound	incorporated into this process to avoid locations in close proximity sensitive areas such as the River Cam	near receptor Ref. LR18 (In a field South of the River Cam opposite the Cam Sailing Club)	intensity) from Waterbeach Pipeline temporary compound
Considerate design, placement and direction of open trench and HDD launch/recovery works area lighting provisions	When designing, placing and directing open trench and HDD launch/recovery works area lighting provisions consideration shall be incorporated into this process to avoid light intrusion and luminous intensity for sensitive areas such as the River Cam, Cam Sailing Club and local biodiversity receptors	Construction phase lighting near receptor Ref. LR19 (In a field North of the River Cam near Cam Sailing Club)	Control and limitation of obtrusive lighting (light intrusion and luminous intensity) from open trench and HDD launch/recovery works area lighting provisions
Considerate placement of Waterbeach Pipeline temporary compound	When selecting locations for temporary compounds associated with the construction of the Waterbeach pipelines consideration shall be incorporated into this process to avoid locations in close proximity sensitive areas such as the River Cam, Cam Sailing Club and local biodiversity receptors	Waterbeach Pipeline temporary compound locations near receptor Ref. LR19 (In a field North of the River Cam near Cam Sailing Club)	Control and limitation of obtrusive lighting (light intrusion and luminous intensity) from Waterbeach Pipeline temporary compound
Considerate design, placement and direction of open trench and HDD launch/recovery works area lighting provisions	When designing, placing and directing open trench and HDD launch/recovery works area lighting provisions consideration shall be incorporated into this process to avoid light intrusion and luminous intensity for sensitive areas such as the Cambridge to King's Lynn railway line and residential properties	Construction phase lighting near receptor Ref. LR20 (In a field East of the Cambridge to King's Lynn railway	Control and limitation of obtrusive lighting (light intrusion and luminous intensity) from open trench and HDD launch/recovery works area lighting provisions

Mitigation measures		Applied to	Justification
		line and North of Bannold Road)	
Considerate placement of Waterbeach Pipeline temporary compound	When selecting locations for temporary compounds associated with the construction of the Waterbeach Pipelines consideration shall be incorporated into this process to avoid locations in close proximity sensitive areas such as the Cambridge to King's Lynn railway line and residential properties	Waterbeach Pipeline temporary compound locations near receptor Ref. LR20 (In a field East of the Cambridge to King's Lynn railway line and North of Bannold Road)	Control and limitation of obtrusive lighting (light intrusion and luminous intensity) from Waterbeach Pipeline temporary compound
Considerate design, placement and direction of open trench, HDD launch/recovery works area, Waterbeach Pipeline construction area and compound lighting provisions	When designing, placing and directing open trench, HDD launch/recovery works area, Waterbeach Pipeline construction area and compound lighting provisions consideration shall be incorporated into this process to avoid light intrusion and luminous intensity for sensitive areas such as the Cambridge to King's Lynn railway line and Long Drove	Construction phase lighting near receptor Ref. LR21 (In a field East of the Cambridge to King's Lynn railway line and West of Long Drove)	Control and limitation of obtrusive lighting (light intrusion and luminous intensity) from open trench, HDD launch/recovery works area, Waterbeach Pipeline construction area and compound lighting provisions
Considerate design, placement and direction of HDD launch/recovery	When designing, placing and directing HDD launch/recovery works area lighting provisions consideration shall be incorporated into this process to avoid light intrusion and luminous intensity for sensitive areas such as the Cambridge	Construction phase lighting near receptor Ref. LR22 (In a field East of Bannold Drove and	Control and limitation of obtrusive lighting (light intrusion and luminous intensity) from HDD

Mitigation measures		Applied to	Justification
works area lighting provisions	to King's Lynn railway line, Capper Road residential properties and local biodiversity receptors	West of the Cambridge to King's Lynn railway line)	launch/recovery works area lighting provisions
Compliance with ILP GN01:2021 limits of obtrusive light	Designer to provide obtrusive lighting calculations in line with ILP GN01:2021, carried out with suitable methodology to prove compliance with the limits of obtrusive light described in Section 3.6 of this report. Obtrusive light calculation results to be provided to local planning authority and adhered to during the construction, maintenance and operational phase where legally compliant, practicable and safe to do so	Construction, maintenance and operational phase lighting design	Limit the potential effects of obtrusive light by complying with the limitations provided within Section 3.6 of this report
Provision of applicable lighting levels for construction tasks.	Areas of temporary lighting during construction must be carefully selected by the appointed Contractor. Lighting levels should be selected from relevant British / European standards to ensure lighting is appropriate to the work that is being undertaken and that areas are not over lit. Refer to BS EN 12464-2-2014 - Lighting for Work Places (Outdoor)	Construction phase lighting design	Over lighting can increase energy use, associated carbon emissions and potentially increase levels of obtrusive light
Material specification around lighting.	The use of high reflectance materials should be avoided directly under light sources to limit upward reflected light contributions to sky glow	Construction, maintenance and operational phase lighting design	Limit upward reflected light contributions to sky glow
Asset manager to carry out periodic	Asset manager to carry out periodic inspection and maintenance regime in line with best practice recommendations, to include as a minimum: light	Construction, maintenance and	To ensure lighting provisions are maintained in a suitable manor to continue to limit

Mitigation measures		Applied to	Justification
inspection and maintenance.	source replacement, luminaire cleaning, renewal of failed parts, checking of gaskets, optical components and screens or baffles, checking of alignment and monitoring of operation	operational phase lighting installations	potential obtrusive light emissions
Monitor the effectiveness of lighting mitigation measures for the Proposed Development	Monitoring shall consist of surveys that will involve the measurement of lighting levels following best practice guidance provided within ILP PLG04 (ILP, 2013)with measurements compared against the limits of obtrusive described in Section 3.6 of this report. Improvements will be carried out where necessary, legally compliant, practicable and safe to do so	Construction, maintenance and operational phase lighting installations	To proactively monitor and prove compliance with the limits of obtrusive described in Section 3.6 of this report
Provision of solid site hoarding.	In areas of high sensitivity the use of solid site hoarding to contain and limit light spill should be considered by the appointed Contractor	Construction phase lighting installations	To assist in limiting light spill beyond the boundary of the lit area
Excessive energy use	Specifying in accordance with BREEAM credit Ene 03 External lighting (BREEAM, 2021),which states that external light fittings used for car parking, associated roads and floodlighting should achieve luminous efficacy not less than 70 lumens per watt. External lighting installations included within the Proposed Development should aspire to achieve efficacy figures of 100 lumens per watt.	Construction, maintenance and operational phase external lighting installations	Reduced energy and associated carbon emissions
Compliance with ILP GN01:2021 limits of obtrusive light	If significant changes are implemented during design development associated with the Proposed Development or as a consequence of value engineering that have potential to significantly	Construction, maintenance and operational phase	Limit the potential effects of obtrusive light by complying with the limitations provided within Section 3.6 of this

Mitigation measures		Applied to	Justification
	increase the levels of obtrusive light, it is recommended that the lighting assessment is re-performed	external lighting installations	report during the design lifecycle of the Proposed Development
Enhanced lighting controls - over lighting (correct level of lighting for the Proposed Development in accordance with the time, level of usage and level of risk)	Consider the use of smart lighting control systems for designated areas of the Proposed Development. For example pyroelectric ("passive") infrared (PIR) motion sensors arranged in an intelligent mesh network to adjust the levels of light dependant on the number of movements detected	Maintenance and operational phase external lighting installations	Limit the potential effects of obtrusive light and energy use by tuning appropriate designated areas of the lighting installation (e.g. roadways, walkways and car parking within the earth bank) to react to the level of usage and movement
Enhanced lighting controls	Consider the use of soft start/stop lighting control to gradually raise and lower the lighting levels rather than switch on/off	Construction, maintenance and operational phase external lighting installations	Tuning on/off lighting controlled via PIR sensor can be distracting and cause a nuisance if excessive repetitions are encountered
Enhanced lighting controls	Consider the specification of adjustable PIR sensors, adjusting the PIR sensitivity can be used to limit nuisance tripping associated with local wildlife	Construction, maintenance and operational phase external lighting installations	Limiting nuisance tripping associated with local wildlife can save energy and associated carbon by reducing the number of unrequired activations of the lighting installation.

8 Residual Effects

8.1 Introduction

8.1.1 No detailed lighting design is yet in place for the Proposed Development. The effects discussed in this section are therefore based on the assumption that mitigation provides levels of obtrusive light that are in compliance with the limits identified in Section 3.7.

8.2 Residual construction phase effects

8.2.1 Table 8-1 assesses the likely residual effects that could result from the CWWTPR during the construction phase of works associated with the CWWTPR, taking into account the secondary mitigation measures. The likely duration of effect is also estimate based upon the definition provided with paragraph reference 3.7.10.

Table 8-1: Predicted residual construction effects

Receptor Reference		Light intrusion	Luminous intensity	Sky Glow	Summary of effects	Duration of effect
LR11	Pre-Curfew	None/Negligible	None/Negligible	N/A	None/Negligible	N/A
	Post-Curfew	None/Negligible	None/Negligible	N/A	None/Negligible	N/A
LR12	Pre-Curfew	None/Negligible	None/Negligible	N/A	None/Negligible	N/A
	Post-Curfew	None/Negligible	None/Negligible	N/A	None/Negligible	N/A
LR13	Pre-Curfew	None/Negligible	None/Negligible	N/A	None/Negligible	N/A
	Post-Curfew	None/Negligible	None/Negligible	N/A	None/Negligible	N/A
LR16	Pre-Curfew	None/Negligible	None/Negligible	N/A	None/Negligible	N/A
	Post-Curfew	None/Negligible	None/Negligible	N/A	None/Negligible	N/A
LR18	Pre-Curfew	None/Negligible	None/Negligible	N/A	None/Negligible	N/A
	Post-Curfew	None/Negligible	None/Negligible	N/A	None/Negligible	N/A
LR19	Pre-Curfew	None/Negligible	None/Negligible	N/A	None/Negligible	N/A
	Post-Curfew	None/Negligible	None/Negligible	N/A	None/Negligible	N/A
LR20	Pre-Curfew	None/Negligible	None/Negligible	N/A	None/Negligible	N/A
	Post-Curfew	None/Negligible	None/Negligible	N/A	None/Negligible	N/A
LR21	Pre-Curfew	None/Negligible	None/Negligible	N/A	None/Negligible	N/A
	Post-Curfew	None/Negligible	None/Negligible	N/A	None/Negligible	N/A
LR22	Pre-Curfew	None/Negligible	None/Negligible	N/A	None/Negligible	N/A
	Post-Curfew	None/Negligible	None/Negligible	N/A	None/Negligible	N/A

Source: Mott MacDonald Ltd (2022)

8.3 Residual operational and maintenance phase effects

Table 8-2 assesses the likely residual effects that could result from the CWWTPR during both the operational and maintenance phases of works associated with the CWWTPR, taking into account the secondary mitigation measures. The likely duration of effect is also estimate based upon the definition provided with paragraph reference 3.7.10.

Table 8-2: Predicted operational and maintenance phase residual effects

Receptor Reference		Light intrusion	Luminous intensity	Sky Glow	Summary of effects	Duration of effect
LR8	Pre-Curfew	None/Negligible	None/Negligible	Minor/Beneficial	Minor /Beneficial	N/A
	Post-Curfew	None/Negligible	None/Negligible	Minor/Beneficial	Minor /Beneficial	N/A

Source: Mott MacDonald Ltd (2022)

9 Glossary

Table 9-1: Glossary of terms – environmental lighting impact assessment

Term	Definition
Artificial Light	Light that is made or produced by human beings rather than occurring naturally.
Building Luminance	The measure of light emitted, passing through or reflected from a building that will be detected by an eye looking at the surface from an observer position.
Candela	International System of Units (SI) for Luminous Intensity, a common candle emits light with a luminous intensity of approximately one candela.
Colour Temperature	Colour temperature refers to a characterisation of the spectral properties of a light source (the higher the colour temperature, the bluer it appears and the lower the colour temperature the redder it appears).
Conflict Area	Typically, junctions, intersections, roundabouts and pedestrian crossings, where significant streams of motorized traffic intersect with each other, or, with other road users such as pedestrians and cyclists.
Eav	The average illuminance on a vertical plane at any specific point, measured in Lux.
Dimming Profiles	The relative change of light output over a period of time specified by a central management system or pre-programmed ballast.
Disability Glare	A reduction of visual acuity caused by light elsewhere in the field of vision that impairs the vision of objects without necessarily causing discomfort.
Discomfort Glare	A reduction of visual acuity caused by light elsewhere in the field of vision that causes discomfort without necessarily impairing the vision of objects.
Glare	The uncomfortable brightness of a light source when viewed against a darker background.
I	Light intensity in Candelas.
Illuminance	Measurement of luminous flux at a point on a surface.
Light Intrusion	Light that falls beyond the boundary or area being lit.
Light Pollution	See Obtrusive Light.
Lighting Class	Delineation of lighting levels required for different areas of highway lighting, including: Traffic Routes (M Class), Residential Roads (P Class) and, Conflict Areas (C Class).
Louvre	Device fitted either externally or internally to a luminaire to reduce obtrusive light being emitted from the luminaire.
Lumens	SI unit for Luminous Flux, a measure of the total amount of visible light emitted by a given source.

Term	Definition
Luminaire	Complete light fitting housing the lamp or light source, control gear and optical distribution control.
Luminance	Luminance describes the measurement of the amount of light emitting, passing through or reflected from a surface from a solid angle to an observer position (indicates how much luminous power can be perceived by the human eye).
Luminous Efficacy	Measurement of how efficient a light source is at producing visible light compared to the power required, measured in lumens per watt.
Luminous Flux or Luminous Power	Measurement (in Lumens) of visible light produced by a light source.
Luminous Intensity	Measured in Candelas, this is a measure of the amount of light that a source radiates in a given direction. This can be considered as the power of light in one specific angle (or given direction) often to an observer.
Luminous Intensity Class	Classes given to luminaires that meet appropriate requirements for restriction of disability glare and the control of obtrusive light.
Lux	SI unit for Illuminance, one lumen per square metre.
Maintenance Factor	Ratio applied to the average Illuminance levels in the calculation model which accounts for the depreciation of lumens emitted from the lamp over time and dirt accumulated on the luminaire.
Obtrusive Light	Light that falls or can be viewed beyond the boundary of the area being lit which may cause a nuisance, discomfort, distraction or disruptive effect on natural cycles and inhibits the observation of stars and planets.
Photometric	The distribution of luminous intensity, in candelas for the transverse and axial planes, in layman's terms this is the "footprint" of the light distribution for a given luminaire.
PIR	Passive Infrared – A sensor used to detect infrared that is radiated from all objects that emit heat, such as humans. Once activated the sensor turns on the lighting provision that is controlled by the PIR.
Sky Glow	The illumination of the sky at night by artificial light sources including light emitted directly upward from the light source and also reflected from the ground or a surface.
Spill Light	See Light Intrusion.
Supplementary photometric control methods	Additional lighting equipment such as shields, louvres and baffles attached to the luminaire or support structure which can be used to reduce the level of obtrusive light in a given direction.
Threshold Increment (TI)	The measure of disability glare (the reduction in visibility caused by intense light sources in the field of view) expressed as the percentage increase in contrast required between an object and its background for it to be seen equally well with a source of glare present. Note: Higher values of TI correspond to greater disability glare.

Term	Definition
Uniformity (Longitudinal)	Ratio of minimum luminance to the maximum luminance along the centre line of a lane from a defined observer position. (A measure to reduce the intensity of bright and dark banding on street lit surfaces)
Uniformity (Overall)	Ratio of the minimum illuminance to the average illuminance within the calculation area. (The human perception of how evenly illumination is distributed throughout the lit area)
Upward Flux Ratio (UFR)	Combined percentage of luminaire flux emitted from the installation that is reflected upwards from the ground as well as directed straight into the sky.
Upward Light Ratio (ULR)	Percentage of luminaire flux emitted from the installation that goes directly into the sky.
Veiling luminance (Lv)	The luminance that would need to be superimposed on a scene in object space to reduce the scene's contrast by an amount equal to the added retinal illuminance from scattered light on the scene's retinal image. It is this veiling effect produced by bright sources or areas in the visual field that results in reduced visual performance and visibility.

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11 Appendices

11.1 Appendix A – Lighting receptor and environmental zone plan

Scheme Order Limits Lighting Zone
Lighting receptor
E2 - Rural surrounding
E3 - Suburban surrounding

Environmental Zones

Zone	Surrounding	Lighting Environment	Examples
E0	Protected	Dark (SQM 20.5+)	Astronomical Observed 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 or suburban locations
E4	Urban	High district brightness	Town/city centres with high levels of night time activity

Source: Institution of Lighting Professionals – Guidance Note 01: The Reduction of Obtrusive Light, GN01 (2021)

Existing Waterbeach water recycling centre
Proposed new housing development with pumping station for new Waterbeach pipeline connection
LR22
LR21
Waterbeach pipelines
LR20
LR19
LR18
Waterbeach pipelines
LR17
LR16
Waterbeach pipelines
Proposed new site access to proposed WTW
Proposed landscaping
Storm flow pipeline
Temp. construction access
Outfall compound
Proposed tunnel
LR15
Horningsea Road and cycle track improvements
Temp. corridor for steel pipelines
Shaft 3 compound
Final effluent pipeline
Outfall
Final effluent and storm pipelines
Existing telecommunications mast
LR14
LR13
LR12
Temp. construction access
LR1
Temp. topsoil bunds
Proposed bridleway
Solar panels
LR11
LR8
LR9
LR10
Temp. working area compound
Shaft 4 compound
Access to site from Fen Road
LR6
LR7
LR3
LR2
Proposed waste water treatment plant
Alternative Waterbeach pipeline
Shaft 5 compound
Proposed transfer tunnel
Proposed 5m high bund
Access from Horningsea Road used for temporary construction access for Shaft 5 and 5 and Waterbeach pipeline
Main site compound area
Shaft 6
Gateway building and visitor car park
LR5
LR4
Permissive path
Proposed landscaping

Data Sources
Scheme Order Limits: Anglian Water Services @One, 2022
Lighting receptors: Mott MacDonald, 2022.
Basemapping: © Crown copyright and database rights 2021 OS 100022432

0 500 1,000 1,500 Metres

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Rev	Date	Drawn	Description	Ch'k'd	App'd
P1	27/10/22	KL	First Draft	JM	CS

Title: Cambridge Waste Water Treatment Plant Relocation Project
Lighting Assessment

Drawn	KL
Checked	JM
Approved	CS
Scale at A3	1:25,000

Drawing Number: WW01003-CAMEST-MOT-05-XX-DR-X-1001

Security	Status	Rev
STD	PRE	P1

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https://infrastructure.planninginspectorate.gov.uk/projects/eastern/cambridge-waste-water-treatment-plant-relocation/