

Horizontal Illuminance (lux)

Grid 1 - Work Area 5 Zone 1

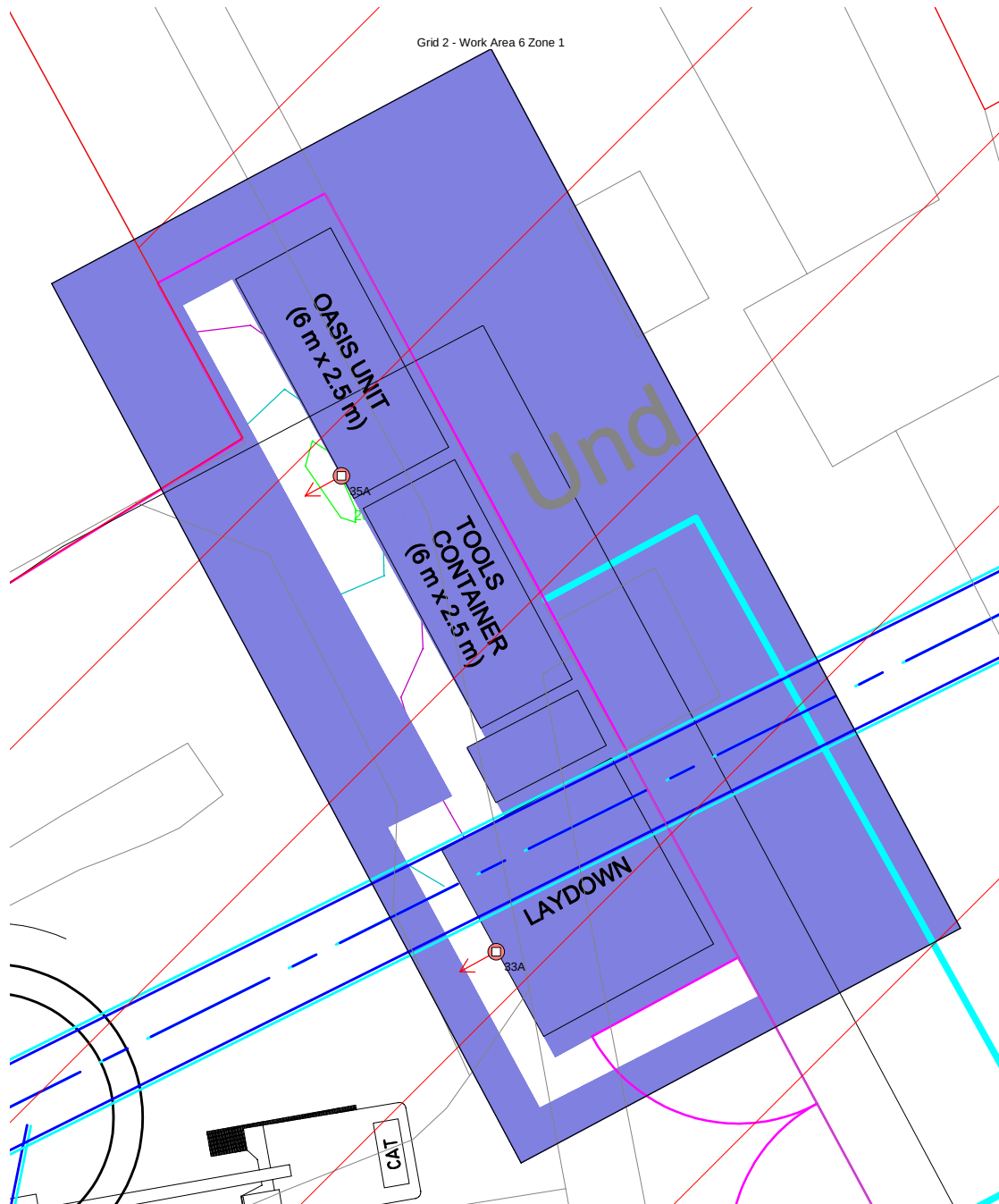


Results

Eav	12.00
Emin	6.13
Emax	21.03
Emin/Emax	0.29
Emin/Eav	0.51

Horizontal Illuminance (lux)

Grid 2 - Work Area 6 Zone 1

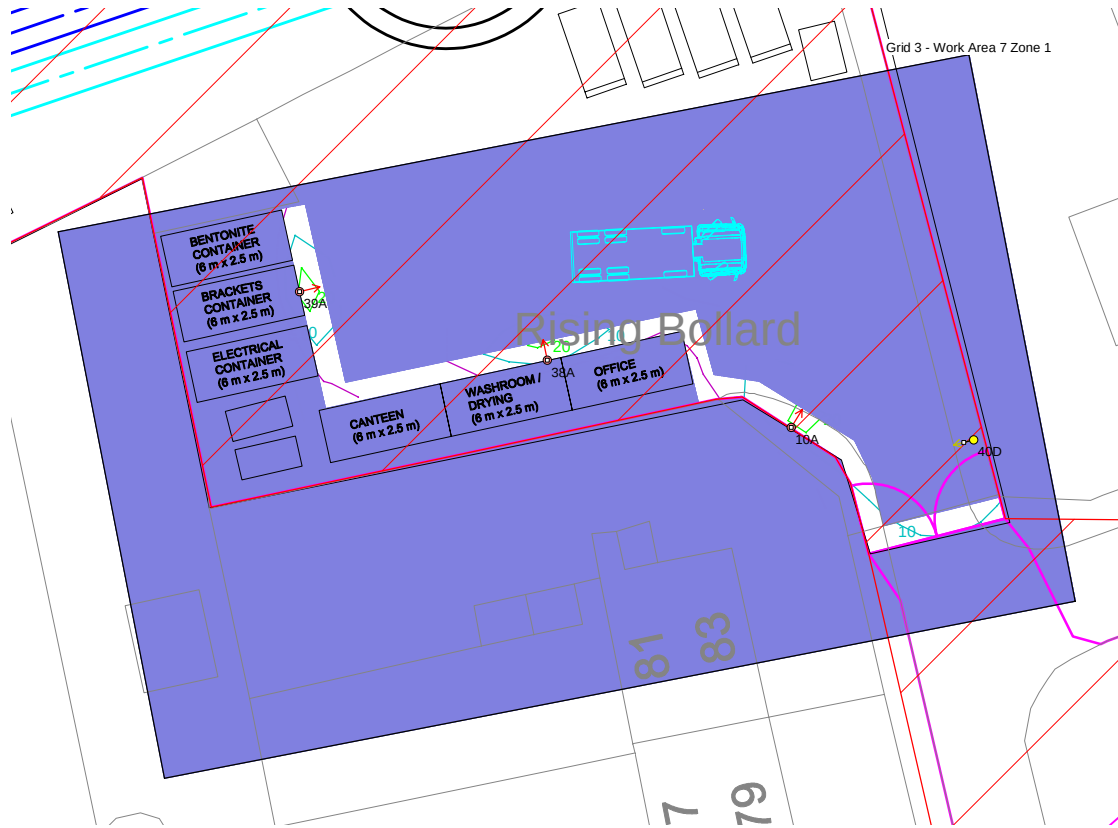


Results

Eav	9.51
Emin	2.37
Emax	23.78
Emin/Emax	0.10
Emin/Eav	0.25

Horizontal Illuminance (lux)

Grid 3 - Work Area 7 Zone 1

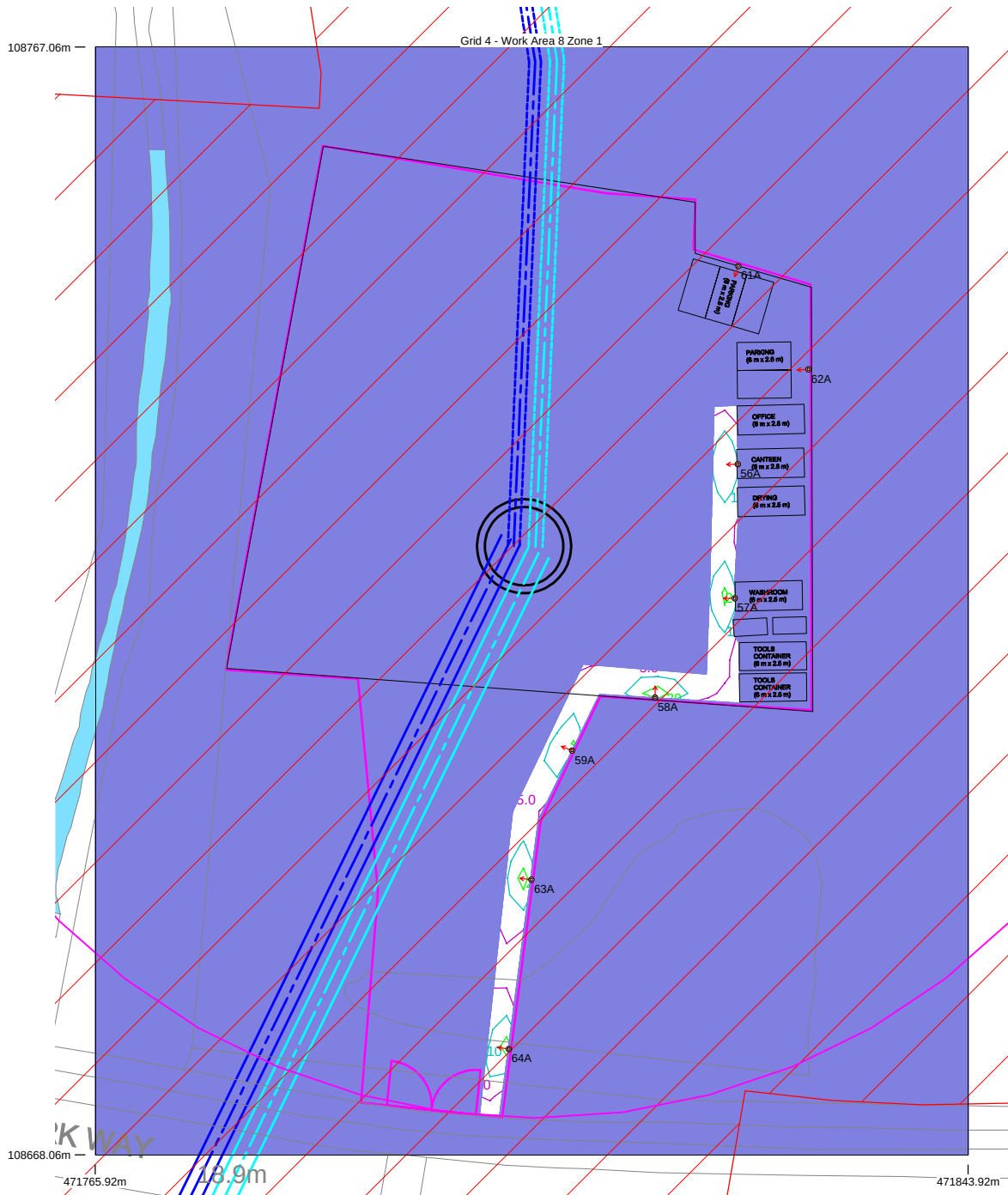


Results

Eav	12.85
Emin	4.63
Emax	29.11
Emin/Emax	0.16
Emin/Eav	0.36

Horizontal Illuminance (lux)

Grid 4 - Work Area 8 Zone 1

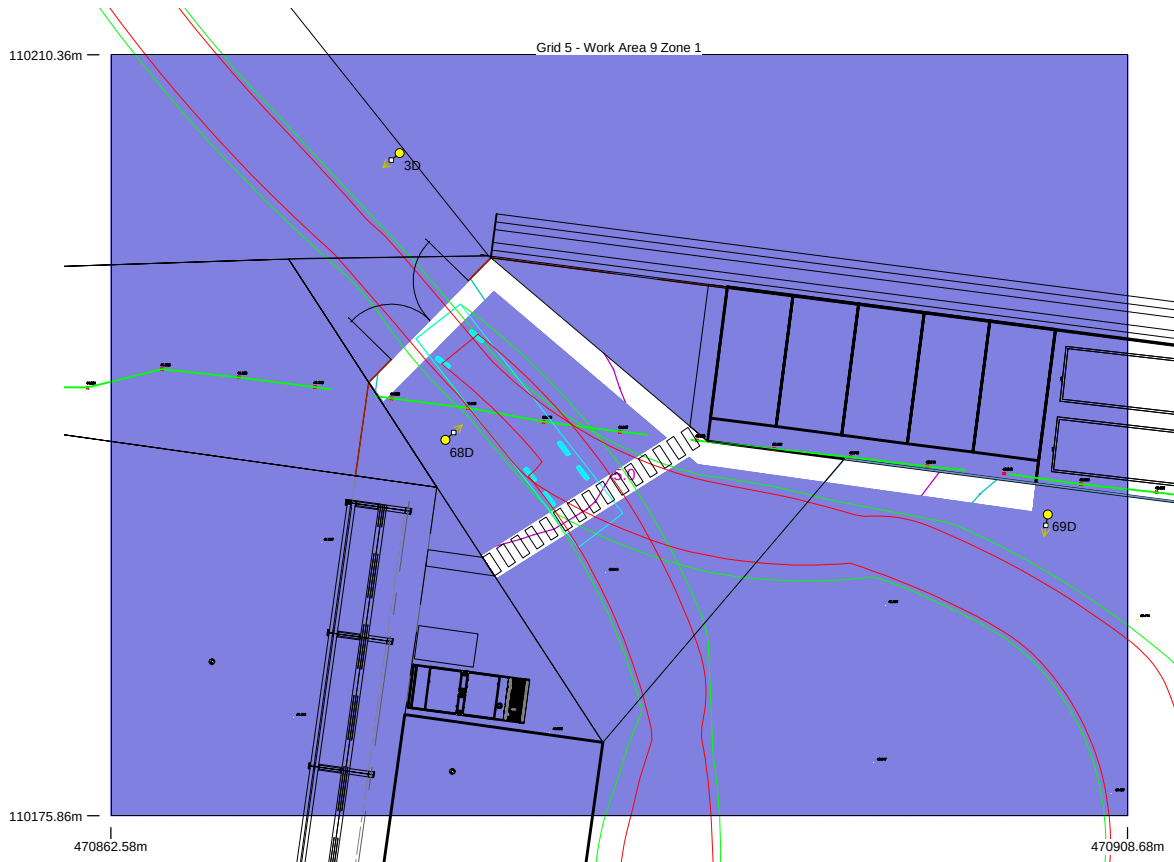


Results

Eav	10.13
Emin	3.20
Emax	27.62
Emin/Emax	0.12
Emin/Eav	0.32

Horizontal Illuminance (lux)

Grid 5 - Work Area 9 Zone 1

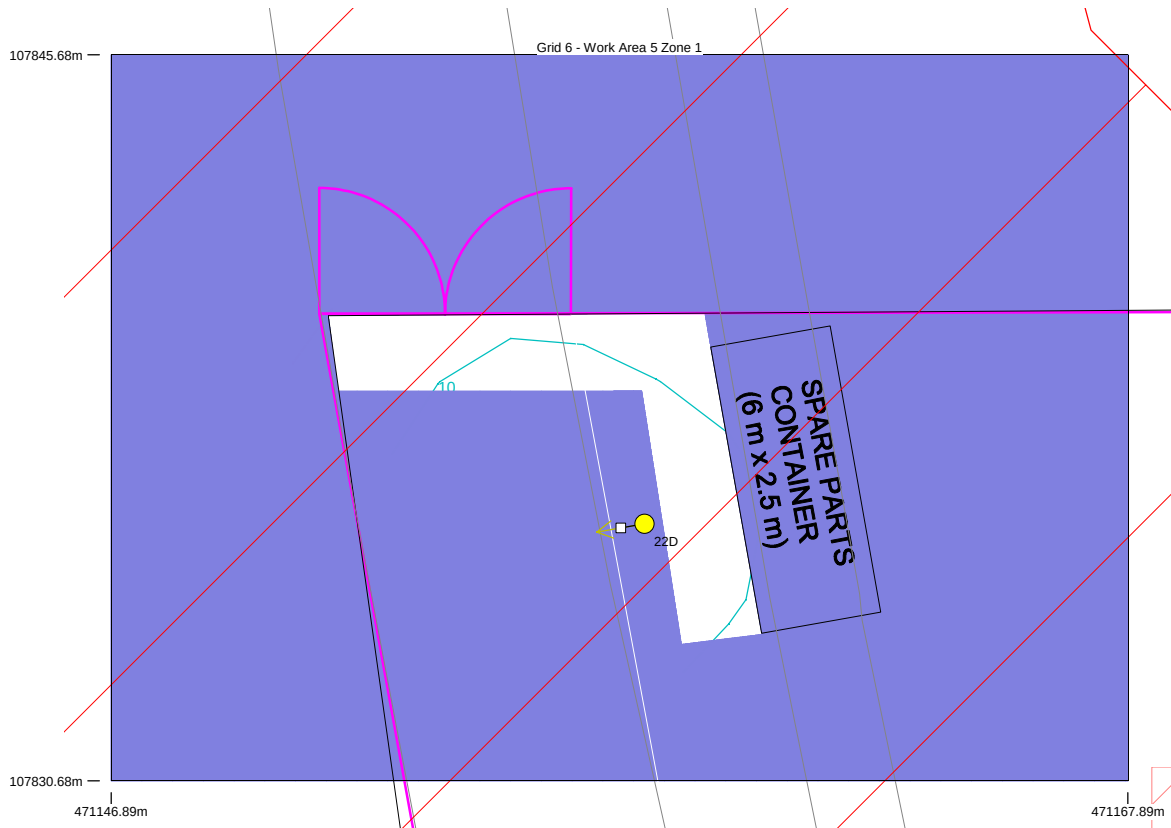


Results

Eav	5.97
Emin	1.53
Emax	13.73
Emin/Emax	0.11
Emin/Eav	0.26

Horizontal Illuminance (lux)

Grid 6 - Work Area 5 Zone 1



Results

Eav	11.13
Emin	7.28
Emax	13.79
Emin/Emax	0.53
Emin/Eav	0.65

Appendix F – MJJV Lighting Strategy Report

Havant Thicket Reservoir

Construction Lighting Strategy

01 March 2024 | Rev P02

Document Reference: HTR-FUW-ZZ-ZZ-PL-W-0534



Document Control

Version	Date	Author	Reviewed By	Approved By	Notes
P01	05/12/23	JH	GL	RW	Initial Issue
P02	01/03/24	AH	JH		Update from DS-112 comments

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1. Introduction and Scope

1.1 Introduction

- 1.1.1 This Construction Lighting Strategy (CLS) supports the planning application submitted to Havant Borough Council (HBC) and East Hampshire District Council (EHDC) on behalf of Portsmouth Water. The application pertains to Reserved Matters and the fulfilment of Planning Conditions concerning the construction of the Main Reservoir Works, including the Main Embankment, Wetlands Embankment, Wetland Structures and Culvert, in association with the Hybrid Planning Permission (reference to APP/20/00990 and 51680/001). This permission relates to the construction of a reservoir and its associated infrastructure, known as the Approved Scheme, situated on land at Havant Thicket. This location is adjacent to Sir George Staunton Country Park and Middle Park Way in Havant.

Table 1.1

Location	Havant Thicket Reservoir, Havant Thicket, Havant.PO9 4ET NAR
Expected Start and Finish Dates	Estimated completion date May 2029
Brief Explanation of Works	Future Water MJJV has been appointed to undertake: Construction of new reservoir at Havant Thicket; installation of a new Northern and Southern Access Track, complete with control house and visitor centre; construction of new drawdown and fill pipeline; modifications at Bedhampton pumping station; new pipeline route to Farlington WTW; and treatment modifications to existing works at Farlington WTW, Various culverts and drainage. Construction of the site compound at the end of the Northern Construction of Access Track and Satellite Compound Access route, highlighted in blue below as 'Main Compound'
Neighbouring Occupiers	North – Forestry Commission land East – Forestry Commission land & B2149 South – Staunton Country Park & residential East – Residential & public right of way

- 1.1.2 The Main Reservoir Site, comprising the main reservoir embankment, wetlands embankment, Wetland Structures, cut-offs and Culvert, is located to the north of the town of Havant, in Hampshire. The Main Reservoir Works lie within the two local planning authorities of Havant Borough Council (HBC) and East Hampshire District Council (EHDC).

1.2 Purpose of this document

- 1.2.1 This Construction Lighting Strategy (CLS) sets out mitigation measures to be applied to the construction activities being undertaken as part of the Havant Thicket Reservoir works, to reduce the potential for significant impacts from light emissions. This document has been produced to mitigate the impacts of construction lighting to residents and fauna to fulfil planning condition 20 which states:
- 1.2.2 "No phase of the development approved under Condition 4 shall commence until a Lighting Strategy for that phase or parcel has been approved by the local planning authority. The Strategy must include: - Proposed specifications for external lighting of service areas, parking, buildings, signs, open space and access junctions.

- 1.2.3 The purpose of this CLS is to ensure that the construction activities for the Havant Thicket Reservoir comply with relevant European and UK legislation, LPA conditions, environmental commitments as set out in the Environmental Statement (ES), and environmental and construction best practice.
- 1.2.4 This CLS will outline measures to prevent obtrusive light to residents and distraction of motorists, and measures to minimise light pollution that could affect wildlife.
- 1.2.5 The measures contained herein will form part of the contractual agreement between Portsmouth Water and its Principal Contractor (Future Water) and the implementation and compliance will be monitored by the Construction Management Team. These measures will only be revised with the agreement of East Hampshire County Council (EHCC) and Havant Borough Council (HBC).

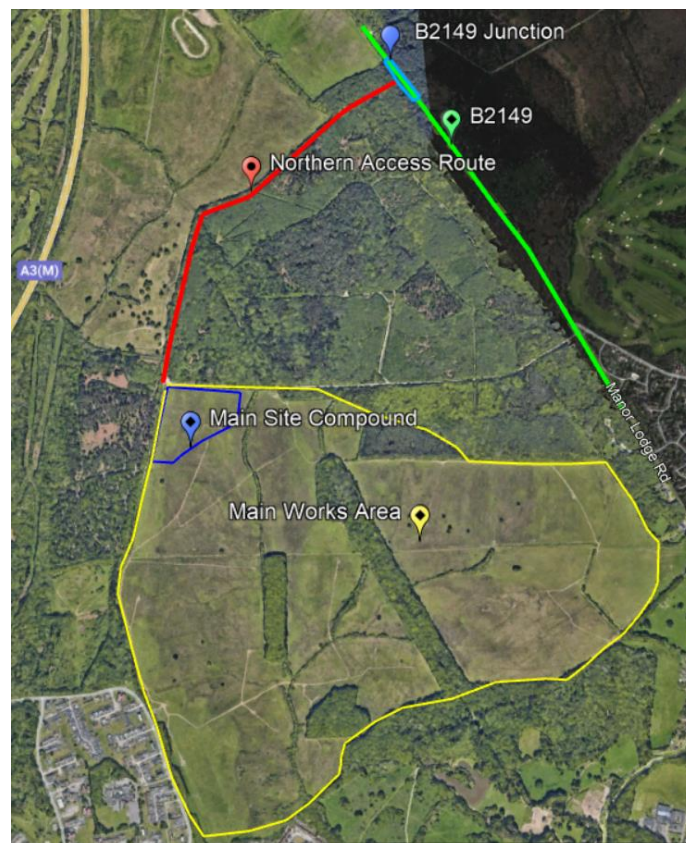


Figure 1: Site Plan

2. Construction Details

2.1 Construction Works Overview – HTR

2.1.1 The construction works related to the Havant Thicket Reservoir Project are to be carried out within the 160ha Main Reservoir Works (MRW) site boundary. The works require several phases of construction within the site to construct the Reservoir that are broken down as follows:

- Enabling Works – Drainage, archaeological investigation, ground remediation, Northern Access, Site Compound and temporary workers accommodation
- Access track and satellite compound construction
- Wetlands Retaining Structure (Earthworks)
- Wetlands flow control structures
- Main Embankment Earthworks
- Main Embankment Culvert
- Control House
- Valve Tower (Inc Secondary Means of Access)
- Installation of MEICA (Mechanical, Electrical, Instrumentation, Control & Automation) and associated fit out
- Southern Access Road
- Spillway
- Soft and Hard Landscaping
- Raising of existing Forestry England track & construction of 2nr new culverts

2.1.2 Further breakdown of construction methodology can be found in the Construction Method Statement (HTR-FUW-RZ-RE-MS-W-0505).

2.2 Establishment of Site Compounds

2.2.1 The Main Site compound will be created by excavating soil, overseen by ecologists and archaeologists. Cut and fill requirements will be met, and below-ground ducts and drainage installed. Tarmac surfaces will cover car parks and access roads. Foundations for project accommodation will be established, surrounded by a 2m high chain-link fence with controlled access. A satellite compound for the workforce will be built. Double-stacked units will arrive on lorries, craned into place. Utilities connected, offices fitted, and deliveries coordinated to avoid traffic congestion. Line marking completes the site compound establishment.

2.3 Construction of temporary drainage system, access track & haul roads

2.3.1 Before commencement of the main site works, grass in designated areas will be cut supervised by an ecologist and project ECOW (Ecological Clerk of Works). Excavators and bulldozers will strip topsoil and subsoil according to an agreed scheme with the County Archaeologist. Material will be moved to stockpiles by ADTs. Temporary drainage, culverts, and lagoons will be shaped following approved designs. Haul roads will be constructed with crushed stone and geogrids or site-won materials. Watercourses will be diverted, including installation of settlement ponds for water treatment. Culvert crossings for construction traffic will be installed.

2.4 Construction of Wetlands Earth Embankments & Control Structures

2.4.1 Material for the Wetlands Embankment will be sourced from on-site borrow pits. Excavators and bulldozers strip topsoil and subsoil, following an agreed scheme with the County Archaeologist. Clay is excavated, loaded into ADTs, transported to deposition

points, and then compacted in layers using bulldozers and rollers, guided by GPS. Testing ensures adherence to specifications, and control structures for water levels are built within the embankment. After completion, topsoil is placed on slopes, and an access track is constructed.

- 2.4.2 Control structures will be built within the embankment to maintain the required water levels in the area when the reservoir is operational. Where possible these will be constructed from pre-cast concrete elements to reduce the amount of assembly and construction on site. Elements will be delivered to the compound and taken to the workforce by excavator & installed.

2.5 Construction of Reservoir Earth Embankment

- 2.5.1 The primary embankment construction involves excavating clay from on-site borrow pits, transporting it via haul roads, and compacting it using bulldozers and rollers. GPS-guided equipment ensures precise placement. Clays undergo testing to meet specifications, with a geotechnical engineer overseeing the process. Ground improvement precedes embankment work, and drainage materials are imported, placed, and compacted. Throughout the earthworks season (March to September), GPS aids in trimming embankment zones. Topsoil is added for protection between seasons. The multi-season project expects completion in 3-4 years, with ongoing winter water management on-site while civil works persist. No earthworks occur in winter, but teams manage water, ensuring environmental preservation.

2.6 Construction of Reservoir Culvert

- 2.6.1 The scheme involves constructing new reinforced concrete control structures, with the embankment culvert and valve tower being the most significant. For their construction, a 20m-wide working platform will be created along the culvert's centreline. The platform's footprint will be excavated, lined with stone mattress and blinding, ensuring a level working base. Excavated material will be retained for testing and reuse. Reinforced concrete structures will follow standard procedures, with lattice-boomed crawler cranes, excavators, and concrete pumps assisting. Below-ground structures will use proprietary excavation support systems, subject to Temporary Works approval and design.

2.7 Valve Tower Construction

- 2.7.1 After culvert construction, the valve tower will be built following industry standards – fixing reinforcement, erecting formwork, placing concrete, curing, and removing formwork. Lattice-boomed crawler cranes, excavators, and concrete pumps will assist. Concrete, delivered by road-going drum mixer lorries via the NAR (Northern Access Road), and on-site haul roads, will be discharged and washed out into a system filtering and reusing cement-laden water. Proprietary excavation support systems ensure safe working conditions for below-ground structures and pipework installation, with subsequent backfilling and support removal undertaken using tracked excavators and crawler cranes.

2.8 Southern Access Road

- 2.8.1 The Southern Access Road (SAR) will be tarmacked, requiring a 278 agreement and traffic management at the Swanmore Road interface. Lane control with 2-way lights on the

Eastbound carriageway near the bell-mouth is proposed, pending approval. The SAR's footprint will be stripped, prepared, and receive subbase, edgings, or kerbs. A drainage ditch and culvert will manage surface water, subject to OWC and Local Flood Authority approval. Construction progresses systematically, utilising small excavators, dumpers, and imported materials. Once completed, white lining and signage will follow the approved design.

2.9 Control House Construction

- 2.9.1 Before construction, the control house and courtyard footprint will be excavated, and a granular sub-base platform created. The control house, atop mass concrete strip foundations and a culvert outlet chamber, will follow standard procedures for reinforced concrete construction. The courtyard, surrounded by RC retaining walls, will serve as material laydown during construction. Lattice-boomed crawler cranes, excavators, and concrete pumps will assist in lifting materials. Concrete delivery will be via road-going drum mixer lorries, using on-site wash-out systems for environmental sustainability. Excavated material will be stored on-site for landscaping, and proprietary support systems ensure safe working conditions.

2.10 Reservoir Pipeline – Outlet

- 2.10.1 The Reservoir Pipeline comprises dual fill and extraction pipes, terminating at Bedhampton and the reservoir. Constructed in two parts, the Bedhampton-to-reservoir section is handled separately by Ward & Burke, while the Main Reservoir section is completed by Future Water. This section carries the buried inlet pipe from a reception pit, traversing the embankment and entering the reservoir. Open-cut excavation using tracked excavators creates a trench, and after shoring installation, the prefabricated pipe sections are laid and backfilled. The pipe will be tested and commissioned in stages for handover prior to use.

2.11 Spillway Construction

- 2.11.1 After completing the main embankment, the spillway is cast in situ with reinforced concrete. Trimmed to formation level, the footprint minimizes arisings, using blinding for a stable working area. Constructed in sections, standard procedures include fixing reinforcement, erecting formwork, placing concrete, curing, and removing formwork.

2.12 Hard and Soft Landscaping

- 2.12.1 Soft landscaping will follow a phased timetable aligned with construction progress; utilising materials delivered via the NAR. Soft landscaping will be the final phase in the finishing and aesthetic works on the main embankment, wetlands and remediated areas. Hard landscaping, including fencing, walling, and the Avenue staircase, will commence after earth embankment works. Materials, delivered via the NAR, will be distributed using access tracks, with small telehandlers and dumpers conveying materials for installation by hand or small excavators.

2.13 Access/Egress

- 2.13.1 All access for the main works will be via the Northern Access Route (NAR) as noted in section 2. A Traffic Management Plan (HTR-FUW-RZ-RE-HS-W-506) will be produced and issued for approval to the LPA. This will be issued to discharge condition 12. This will detail the access routes, procedures and timings for deliveries and staff traffic to site to minimise impact. Please refer to the Construction Traffic Management Plan for more details.

3. Lighting During Construction

3.1.1 The majority of construction activities will occur during daylight hours without artificial lighting, except when necessary for safety. Limited 24-hour operations may require temporary lighting, crucial in winter with shorter daylight hours. Nightly use of temporary external lighting may occur during continuous tasks (e.g., concrete pouring), for site security, abnormal load deliveries, and potential emergency works. This lighting may impact nearby residents, ecological receptors, visual amenity, and distract passing motorists, prompting considerations for mitigating disturbances.

3.1.2 Without careful design and mitigation, lighting from these sources has the potential to have the following impacts:

- Intrusive lighting impacting nearby residents causing disturbance and annoyance, particularly with regard to sleep patterns
- Impact on ecological sensitive receptors from light spill
- Impact on visual amenity due to the illumination of the night sky
- Lighting on surrounding roads distracting passing motorists

3.2 Types and Positioning Requirements

3.2.1 Adequate lighting is essential for safe work, facility use, and movement, minimizing eye strain. Derived from the Health and Safety Executive (HSE) document Health and Safety Guidance 38 (HSG38) 'Lighting at Work' (1997), Table 1 outlines the recommended minimum lighting levels based on work activity and location. It provides suggestions for average illuminance across the work area and the minimum measured illuminance at any specific position within it.

Table 1 Recommendations for Minimum Lighting Levels (adapted from HSE document HSG38 (Lighting at Work)).

Table 3.1

Activity	Typical locations/ types of work	Average illuminance measured (lux) 1x	Minimum illuminance measured (lux) 1x
Movement of people, machines and vehicles	Accesses, haul roads and vehicle compound/parking areas.	20	5
Background work including movement of people, machines and vehicles in Hazardous areas; rough Work not requiring perception of detail	Construction site Clearance, excavation and soil work.	50	20
Task based lighting and work requiring limited perception of detail	Where specific work tasks are required to focus on a particular point or feature.	100	50

3.3 Hours of Lighting

3.3.1 The need for artificial lighting will be dependent on seasonality and will be switched on 30 minutes before sunset (which will change through the winter) to the end of the shift. It will also be switched on at the start of the shift to up to 30 minutes after sunrise. Again, this is dependent on seasonality and will change through the winter months and with daylight savings adjustments. Temporary construction lighting will be also provided during working hours only at times where natural light is not sufficient to carry out specific works to ensure safe working conditions.

3.3.2 Working hours will comply with Planning Condition 11, which states:

Construction Working Hours

11 “no nighttime working shall take place, unless otherwise in accordance with a scheme submitted to and approved in writing by the Local Planning Authority. Night-time works to be carried out strictly in accordance with the approved scheme.”

There may be a requirement for artificial lighting on emergency works, which in any case will need to comply with the minimum requirements for safe work operations, the guidance and standards (Section 6) and mitigation measures avoiding or minimising the impacts on sensitive visual and ecological receptors.

At the main site compound, site security will be 24 hours with limited lighting specific to compound offices and parking area and will be required when the compound is in operation.

3.4 Construction Lighting Strategy Implementation

3.4.1 Prior to the commencement of construction, an Environmental Clerk of Works (ECOW) will be appointed by Future Water to advise and monitor the implementation of the CLS. Contact details for the ECOW are provided in the Construction Environmental Management Plan (HTR-RHD-P2-RE-PL-Z-0018)

3.5 Guidelines and Standards

This CLS has been developed in accordance with the following guidance and standards:

- Institution of Lighting Professionals (ILP), 2020, Guidance Note for the Reduction of Obtrusive Light, (ILP, 2020);
- British Standard BS EN 12464-2:2014 Light and lighting. Lighting of workplaces. Outdoor workplaces;
- British Standard BS 5489-1:2020 Code of practice for the design of road lighting. lighting of roads and public amenity areas;
- Health and Safety and Executive (HSE), Health and Safety Guidance 38 (HSG38) ‘Lighting at Work’ (HSE, 1997);
- Guidance Note GN08/23 Bats and Artificial Lighting at Night (ILP, 2023), published by the Institution of Lighting Professionals (ILP).

4. Potentially Sensitive Receptors

4.1.1 Potentially sensitive receptors that could be affected by temporary external artificial lighting during construction works include visual and ecological receptors.

4.2 Visual receptors

- 4.2.1 Sensitive visual receptors for light from the reservoir construction works include occupiers of residential properties and people working or enjoying the adjacent countryside. A review to identify potentially sensitive receptors that could be affected by external artificial lighting considered all buildings within 250m of the site. The closest visual receptors are remote from the main and satellite compounds, and so short-term lighting of specific site works would be the main activity to be considered. These receptors are:

VISUAL RECEPTORS	NEAREST COMPOUND	NEAREST WORKS
Swanmore Road	Main (750m)	Embankment (70m)
Harbridge Court	Satellite (800m)	Embankment (80m)
Durrants Road	Satellite (980m)	Embankment (120m)
Well Meadow	Satellite (800m)	Embankment (200m)
Winterslow Drive	Satellite (600m)	Control Building (100m)

- 4.2.2 At the identified distances, light intrusion/nuisance and spill light are not considered to be significant, particularly for Swanmore Road and Harbridge Court where street lighting stands between the properties and the site. Light control measures to protect visual receptors will therefore relate to limitation of light from bright luminaries in the field of view and also sky glow. A map of the receptors is shown in Appendix B.
- 4.2.3 Public Rights of Way are located adjacent to the site shown in Figure 2. At times when construction work is proceeding with artificial lighting the users of rights of way are likely to be carrying a torch and construction lighting would not be a nuisance.

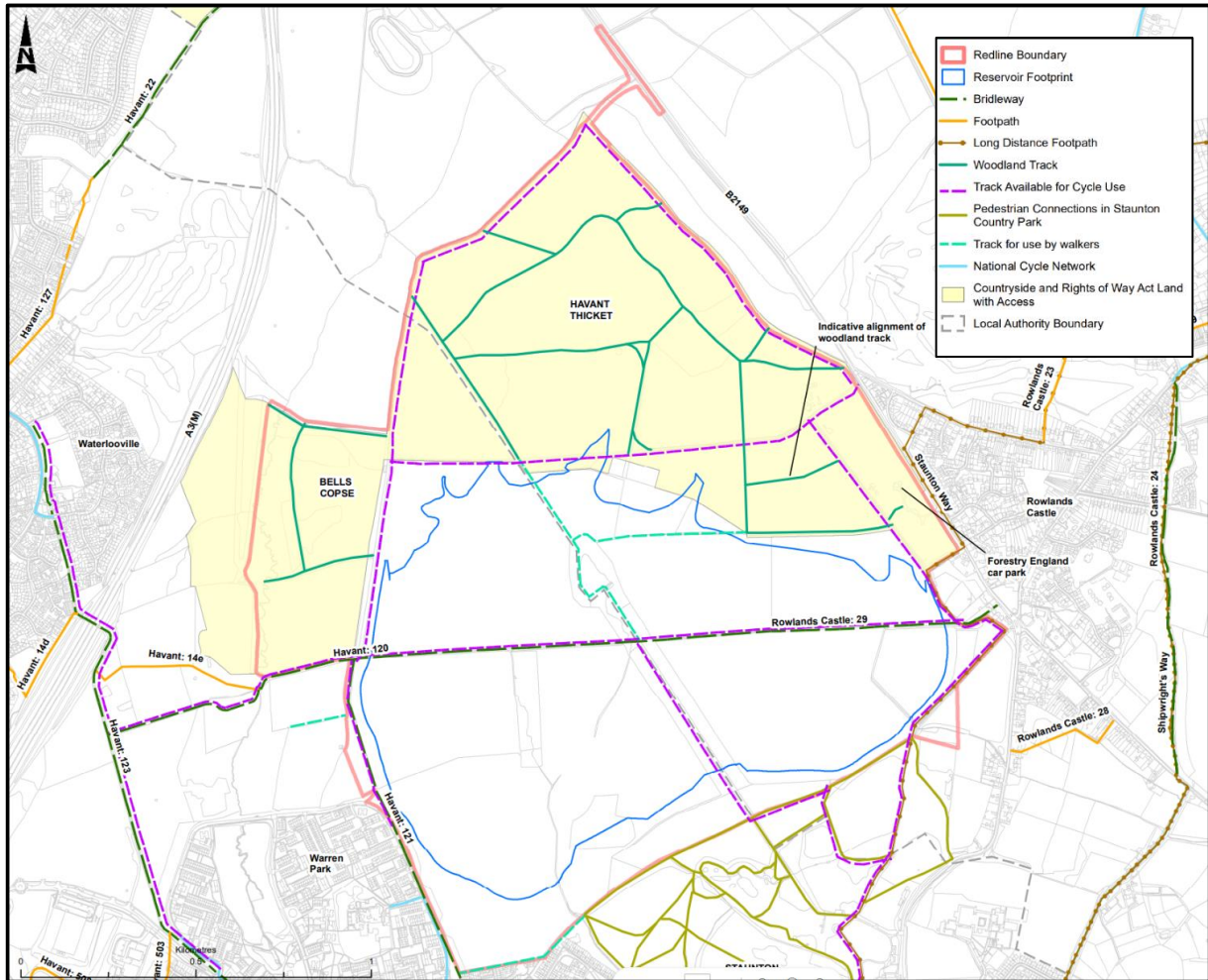


Figure 2: Site Access

A map of designations and ecological constraints can be found in Appendix A.

4.3 Ecological Receptors

- 4.3.1 Light spill and intrusive lighting from night-time works could potentially disturb ecologically sensitive receptors which includes nocturnal species. A range of nocturnal protected species have previously been identified on site including glow worms, dormice, badgers, owls and nightjars. The habitats that support these species (woodland, hedgerows, scrub and grassland) are the habitats which support bats. By ensuring optimal mitigation for light impacts on bats and their habitats on site, suitable mitigation is also provided for all other nocturnal species associated with the site.

Bats

- 4.3.2 Thirteen bat species have been recorded within the Havant Thicket Reservoir (HTR) site including Bechstein's bat *Myotis bechsteinii* (one of the UK's rarest species), with a maternity roost recorded on the southeastern Site boundary.
- 4.3.3 A bat mitigation licence to carry out works for the Project has been obtained from Natural England (Licence number 2020-50625-EPS-AD2-4). Future Water are obliged to ensure compliance with the conditions of all protected species licences obtained at all times. Ecological considerations during the development of the Lighting Strategy are presented in Appendix E. Bat roost areas and buffer zones are shown in Appendix F.

5. Objectives

5.1.1 The objectives and performance outcomes for this CLS are detailed below in Table 5-1.

Table 5.1

Objectives	Performance Outcomes
<ul style="list-style-type: none"> •To ensure temporary lighting installations are positioned so as to avoid light spill directly towards roads, residences and other potential viewing locations or ecological receptors. •To ensure the potential impacts from light emissions on haul roads for mobile equipment are reduced so far as practicable. •To utilise existing vegetation screens to minimise the impact of any light spill in the direction of roads, residences and other viewing locations or ecological receptors. •To use directional lighting to reduce light spill and minimise light emissions from night-time construction works to retain dark night skies. •To ensure procedures are in place to record and effectively respond to any complaint in respect to lighting. •To record and report the effectiveness of lighting emission controls. •To utilise appropriate mitigation measures to reduce glare. 	<ul style="list-style-type: none"> •Minimum levels of lighting are used which provide sufficient lighting to ensure that safety is not compromised. •External lighting complies with relevant UK legislation, environmental commitments as set out in the 2020 ES and environmental and construction best practice. •The safety of external traffic on nearby roads is not affected by light sources on site. •Impacts from light emissions from the works on nearby sensitive visual receptors is avoided or minimised where avoidance is not possible. •Impacts from light emissions from the works on ecological receptors are avoided or minimised, where avoidance is not possible. •Complaints are responded to quickly and effectively. •The effectiveness of lighting emission controls is reported.

6. Mitigation

6.1.1 The HTR Project necessitates illuminated construction areas, particularly the Main Compound and a satellite construction compound. The Main Compound, active year-round, includes temporary workers accommodation, planned for use until the main earthworks' completion in 2026. Prescribing an appropriate lighting strategy is crucial for Health & Safety and impact mitigation to sensitive receptors. Dense tree cover does not mitigate light's negative impact on bats, necessitating bespoke lighting specifications for the entire HTR site. These include:

- LED luminaires will be used where possible;
- Metal halide, fluorescent sources will not be used;
- Column heights will be carefully considered to minimise light spill;
- Narrow spectrum light sources will be used to lower the range of species affected by lighting;
- Light sources that emit minimal ultra-violet light will be selected;
- Lights will peak in wavelength higher than 550nm;
- White and blue wavelengths of the light spectrum will be avoided to reduce insect attraction and where white light sources are required in order to manage the blue short wavelength content, they will be of a warm / neutral colour temperature, ideally <2700Kelvin;
- Only luminaires with an upward light ratio of 0% and with good optical control will be used;
- External security lighting will be set on motion-sensors with short (1 minute) timers.

6.2 Mitigation Specific to Ecology

- All lighting selected to avoid UV elements when manufactured.

- Metal halide, compact fluorescent sources will not be used.
- LED lighting units will be used where possible due to their sharp cut-off, lower intensity, good colour rendition and dimming capability.
- A warm white light source (2700Kelvin or lower) will be adopted to reduce blue light component.
- Light sources will feature peak wavelengths higher than 550nm to avoid the component of light most disturbing to bats.
- Internal lighting will be recessed (as opposed to using a pendant fitting) where possible, in proximity to windows to reduce glare and light spill.
- Waymarking inground markers (low output with cowls or similar to minimise upward light spill) should delineate path edges.
- Column heights adjusted to minimise light spill and glare visibility.
- Only lighting with a negligible or zero Upward Light Ratio, and with good optical control, will be used.
- Lighting will always be mounted horizontally, with no light output above 90° and/or no upward tilt.
- Where appropriate, external security lighting will be set on motion sensors and set to as short a possible a timer as the risk assessment will allow. For most purposes a 1-minute timer shall be deployed on lighting; however, in some situations a 2-minute timer may be required for safety. The area being lit shall be risk assessed depending on several factors, such as, length of time under light, terrain, obstacles, and any other hazards that may require a longer illumination.
- Only if all other options have been explored, accessories such as baffles, hoods or louvres can be used to reduce light spill and direct it only to where it is needed. However, due to the lensing and fine cut-off control of the beam inherent in modern LED luminaires, the effect of cowls and baffles is often far less than anticipated and so should not be relied upon solely.

6.2.1 The location, orientation and height of newly built structures relative to each other can have a considerable impact on light spill. Buildings and hard landscaping will be sited and designed so as to block light spill from reaching important bat habitats and features. Bats will benefit from minimising light spill away from Havant Thicket Woodland and its' associated edge (buffer) habitats. Mitigation measures to further minimise light spill include:

- A reduction of the number of windows that directly face key and buffer habitats will be implemented to permanently limit light spill.
- Using curtains and/ or blinds on the temporary workers accommodation windows during the evening/night-time period.
- Column mounted luminaires will be located so that the rear shields are adjacent to habitats, or narrow optics selected that direct light into the task area where needed.
- Light spill will be screened through landscaping and the installation of fences. Windbreak mesh / dust-type netting to the inside of the compound boundary fence will help to further reduce light spill.
- On-site lighting controlled by dimming or switching either diurnally, seasonally, or according to human activity (light on demand) will be utilised.
- Lighting will be set to a low output state by default, to turn up to a predetermined output in response to a trigger and be combined with a timeclock or photocell to further add an element of seasonal or diurnal control. For example, passive infrared, AI enabled cameras, on demand controls, or pressure sensors may be used to trigger lights to come on or dim in response to movements, either by vehicles or pedestrians. Inbuilt timeclocks or photocells can ensure that this response only occurs during a set window of hours after sunset and before sunrise, or during certain months.

- Alternative lighting designed for subtle waymarking, rather than illumination will also be considered, for example very low wattage, solar-powered, ground-level luminaires. This lighting has an added benefit that there is no requirement for cabling. However, it should be noted that these systems depend on regular maintenance for them to be successful, as well as a clear view of the sky for solar-powered options.
- 6.2.2 The construction works at Havant Thicket Reservoir have been carefully designed to minimise impacts on the environment. The reuse of site won material for construction will minimise the need for additional construction works and associated artificial lighting.
- 6.2.3 Permanent lighting will comprise appropriate luminaires directed away from vegetation, particularly the boundary hedgerows and treelines to avoid any light spill onto retained vegetation. Lighting will follow good practice current at the time of detailed design. The new lighting will be task-related, associated with the visitor centre and associated car park and with no lighting on the access roads. The lux level will be as low as possible to meet their purpose safely and effectively. The lighting for each phase or parcel shall be carried out in accordance with the approved Lighting Strategy and shall be retained and maintained as such thereafter.
- 6.2.4 In mitigating for bats, all nocturnal species have been considered.

7. MONITORING AND REPORTING

7.1 Monitoring

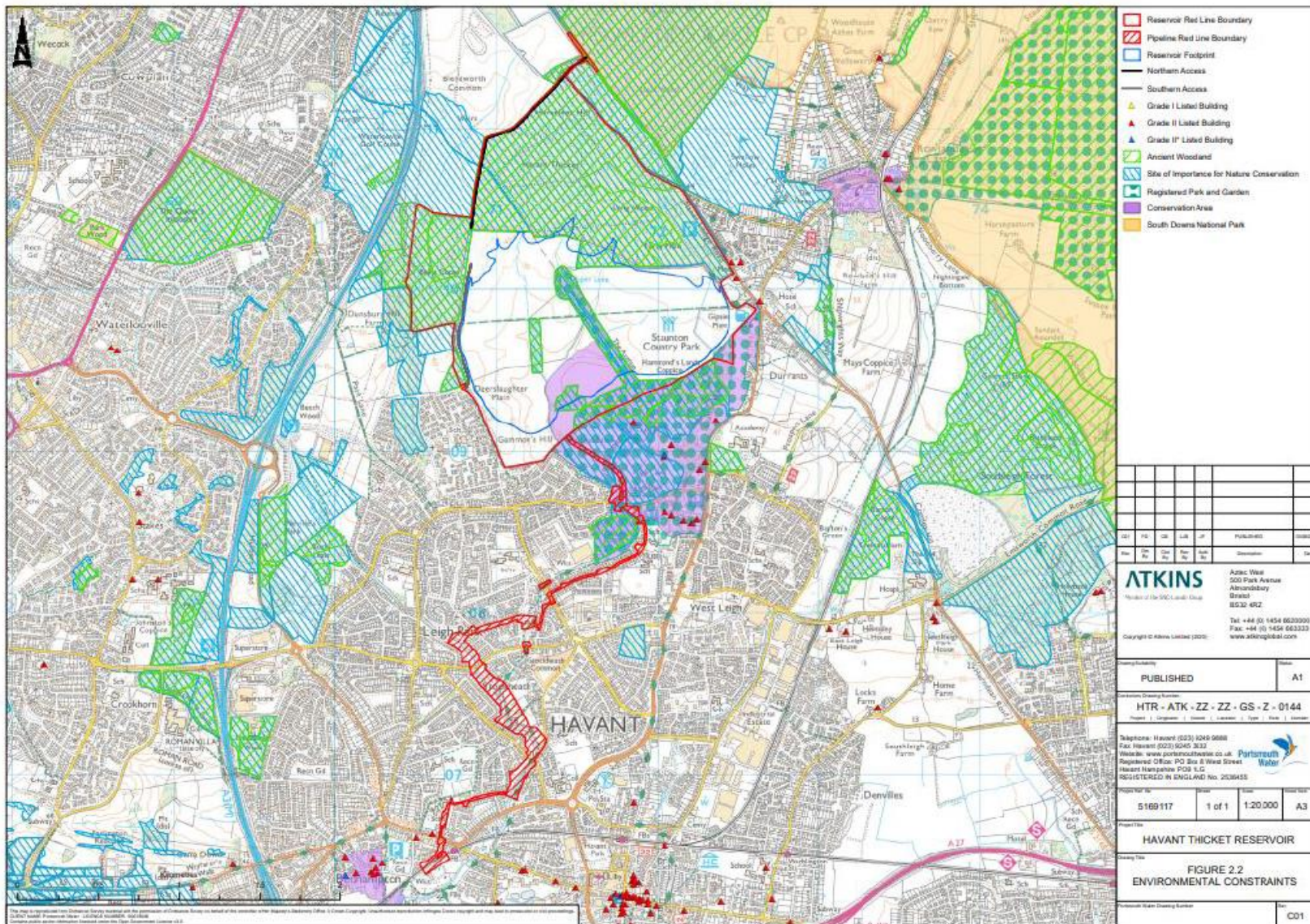
- 7.1.1 Regular inspections of lighting mitigation measures will be undertaken by the Principal Contractor's construction management team, the ECoW and ecological specialists where required, to ensure effective implementation and report any non-compliances. If non-conformity with any control and mitigation measures is identified, it will be recorded, and appropriate remedial action will be implemented.
- 7.1.2 The inspection shall be completed on a 12-weekly basis and shall be completed after sunset (when lights become effective), the purpose of the inspection is to ensure all mitigation measures are in place and functioning as designed. The inspection shall also be used to inspect for damage or tampering with mitigation measures and to ensure no supplementary lighting has been installed. In accordance with Section 7.1.1 any changes shall be raised in a non-conformance & action taken. The inspection shall be undertaken by a member of the site management team and recorded in an inspection report. The frequency of inspections may be adjusted by the ECoW as required and recorded in the Future Water monthly site inspection report. The inspections shall be completed around the time of daylight savings clock change, and at the mid-point between i.e., 12-weeks after clocks change.
- 7.1.3 Any complaint regarding lighting of the construction works will be directed to the Site Environmental Manager who will in turn notify Portsmouth Water. The Site Environmental Manager will investigate the complaint and provide a response to the complainant and Portsmouth Water within 7 days. Investigation will include checking that luminaires remain directional and suitable for the application. If the complaint is justified a solution will be found to prevent reoccurrence, such as use of hoardings or other barriers to contain light spill. This may include investigation of alternatives, such as the use of lower wattage lighting, or re-direction of lighting or re-positioning shielding.

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- 7.1.4 Should any Schedule 1 or other bird species be found to be nesting within the vicinity of the proposed construction works, an exclusion zone will be implemented specific to that species in accordance with the Ecological Management Plan (HTR-RHD-ZZ-ZZ-PL-Z-0001).

7.2 Reporting

- 7.2.1 The effectiveness of lighting controls will be reported in the Site Inspection and Audit Reports. Inspections will be undertaken by the ecological specialists, where required and will be reported to the Site Environmental Manager.

Appendix A - Environmental Constraints Drawing



Appendix B- Receptors



Appendix D – Lighting Layout – Temporary Workers Accommodation

TBA on Receipt of Design

Appendix E – Ecology Technical Note

Havant Thicket Reservoir – Ecological considerations during the development of the Lighting Strategy (planning condition 26)

Overview of effects of artificial lighting on bats

This document draws significantly from Guidance Note GN08/23 Bats and Artificial Lighting at Night¹ (ILP, 2023), published by the Institution of Lighting Professionals (ILP).

Bats have highly sophisticated echolocation systems over 50 million years that allow them to ‘see’ their environment in complete darkness. Artificial lighting can increase the chances of predation, for example by owls. At roosting sites, illumination can cause disturbance, and this may result in the bats delaying their emergence resulting in less foraging time, deserting the roost, or even becoming entombed within it. Lighting would therefore be considered an obstruction under the legislation protecting bats and their roosts.

Severing a key flightpath some distance from the roost could cause desertion in its own right, and this loss of a roosting site could constitute an offence under the legislation. Artificial lighting can affect the feeding behaviour of bats. Many night-flying species of insect that bats hunt are attracted to light, especially non-LED light sources that emit an ultraviolet component or have a high blue spectral content (this can include LEDs).

For those more manoeuvrable slower-flying species, more typically associated with cluttered dark environments such as woodlands, the key dark habitats where they can avoid predation have been drastically reduced. These ‘clutter space’ species are considered to be more ‘light averse’. Only the faster-flying species, traditionally considered to be ‘light opportunistic’ are now found throughout our towns and cities.

Many clutter space species, including long-eared, Brandt’s, whiskered, Daubenton’s, Natterer’s, Bechstein’s, barbastelle, greater and lesser horseshoe, avoid commuting and foraging routes illuminated with a variety of different street luminaires. Consequently, these species are put at a competitive disadvantage and are less able to forage successfully and efficiently, impacting fitness and breeding success.

Myotis species (Brandt’s, whiskered, Daubenton’s, Natterer’s and Bechstein’s) are known to avoid lit areas below 1 lux, and up to 25m from the light source and, in particular, avoid blue, white, orange and green spectrum light, but not ‘red-light’ sources, i.e. long wavelength light above 600nm with an RA value of 60.

Bats at Havant Thicket Reservoir

Thirteen bat species have been recorded within the Havant Thicket Reservoir (HTR) site including Bechstein’s bat *Myotis bechsteinii* (one of the UK’s rarest species), with a maternity roost recorded on the southeastern Site boundary.

A bat mitigation licence to carry out works for the Project has been obtained from Natural England (Licence number 2020-50625-EPS-AD2-4). Future Water are obliged to ensure to comply with the conditions of all protected species licences obtained at all times.

Other protected species at Havant Thicket Reservoir

A range of nocturnal protected species have previously been identified on site including glow worms, dormice, badgers, owls and nightjars. The habitats that support these species (woodland, hedgerows, scrub and grassland) are the habitats which support bats. By ensuring optimal mitigation for light impacts on bats and their habitats on site, suitable mitigation is also provided for all other nocturnal species associated with the site.

Relevant Project Documents

Several Scheme documents highlight the importance of potential negative impacts to protected species with regard to lighting. In accordance with the Project's *Ecological Management Plan - Main Reservoir Works* (HTR-RHD-ZZ-ZZ-PL-Z-0001), the following applies during the construction phase:

- Control of construction lighting to reduce impacts on roosting bats. Mitigation will be provided for lighting during construction and operation. FW will prepare a Lighting Strategy for the main site compound. Any temporary lighting required during construction will be designed to minimise light spill. Lighting will follow current good practice. Construction lighting will be task related. The lux level will be as low as possible to meet their purpose safely and effectively.
- To avoid indirect effects on bats arising during the Works, all temporary lighting will be cognisant of the BCT Guidance Note 8/23, *Bats and Artificial Lighting at Night* (BCT, 2023).

The Project's *Construction Environment Management Plan - Enabling Works Phase* (PC2625-RHD-ZZ-XX-RP-Z-0001-HTR-EW-CEMP) prescribes that:

- Where construction lighting may be required during works, control using directional lighting will be employed to reduce impact on sensitive receptors such as bats.

The Records of Environmental Actions and Commitments (REAC) in the OEMP, included in the Environmental Statement for the Scheme, and included in *Appendix D of the Construction Environmental Management Plan for the Main Reservoir Works* (HTR-RHD-P2-RE-PL-Z-0018), includes a commitment to ensure the protection of bats from indirect harm:

- Mitigation will be provided for lighting during construction and operation
- Any temporary lighting required during construction will be designed to minimise light spill.

Proposed lighting at the main compound and temporary workers accommodation

The HTR Project requires certain construction phase areas to be lit for imperative Health & Safety reasons. This includes the 'Main Compound' that is currently being constructed in the northwestern section of the site, incorporating temporary workers accommodation, close to Havant Thicket Woodland. The satellite construction compound, which will be located approximately in the centre of the main reservoir worksite, will also require lighting.

The main compound will be used throughout the year for the duration of the construction phase, and the reservoir visitor centre is proposed to be located in this area. The temporary workers accommodation would be in use all year round, with peak use occurring between the months of March and October inclusive during the main earthworks construction season and would remain in use until

the main earthworks on site has been completed, currently planned for 2026. Outside of the main earthworks season, fewer staff would use the temporary workers accommodation.

In prescribing the appropriate lighting strategy for the construction phase compound and the temporary workers accommodation, it is important to note that dense tree cover alone does not mitigate the negative impacts of light on bats, particularly on *Myotis* species. Therefore, appropriate lighting specifications for entire HTR site, including the main compound and temporary workers accommodation, will need to include the following:

- All lighting should lack UV elements when manufactured.
- Metal halide, compact fluorescent sources should not be used.
- LED lighting should be used where possible due to their sharp cut-off, lower intensity, good colour rendition and dimming capability.
- A warm white light source (2700Kelvin or lower) should be adopted to reduce blue light component.
- Light sources should feature peak wavelengths higher than 550nm to avoid the component of light most disturbing to bats.
- Internal lighting should be recessed (as opposed to using a pendant fitting) where installed in proximity to windows to reduce glare and light spill.
- Waymarking inground markers (low output with cowls or similar to minimise upward light spill) should delineate path edges.
- Column heights should minimise light spill and glare visibility.
- Only lighting with a negligible or zero Upward Light Ratio, and with good optical control, should be used.
- Lighting should always be mounted horizontally, with no light output above 90° and/or no upward tilt.
- Where appropriate, external security lighting should be set on motion sensors and set to as short a possible a timer as the risk assessment will allow. For most purposes, a 1- or 2-minute timer is appropriate.
- Use of a Central Management System (CMS) with additional web-enabled devices to light on demand should be considered.
- The use of bollard or low-level downward-directional lighting is strongly discouraged. This is due to a considerable range of issues, such as unacceptable glare, poor illumination efficiency, unacceptable upward light output, increased upward light scatter from surfaces and poor facial recognition.
- Only if all other options have been explored, accessories such as baffles, hoods or louvres can be used to reduce light spill and direct it only to where it is needed. However, due to the lensing and fine cut-off control of the beam inherent in modern LED luminaires, the effect of cowls and baffles is often far less than anticipated and so should not be relied upon solely.

The location, orientation and height of newly built structures relative to each other can have a considerable impact on light spill. Buildings and hard landscaping should be sited and designed so as to block light spill from reaching important bat habitats and features. Bats will benefit from minimising light spill away from Havant Thicket Woodland and its' associated edge (buffer) habitats. Mitigation measures to further minimise light spill include:

A ten-metre buffer zone, 'dark corridor' will be implemented between the accommodation units and any surrounding Woodline.

- A reduction of the number of windows that directly face key and buffer habitats will be the most effective way to permanently limit light spill.
- Using curtains and/ or blinds on the temporary workers accommodation windows during the evening/night-time period.
- Column mounted luminaires should be located so that the rear shields are adjacent to habitats, or narrow optics selected that direct light into the task area where needed.
- Light spill can be successfully screened through landscaping and the installation of fences. To ensure that fencing makes a long-term contribution, it is recommended that it is supported on concrete or metal posts. Windbreak mesh / dust-type netting to the inside of the compound boundary fence will help to further reduce light spill.
- On-site lighting controlled by dimming or switching either diurnally, seasonally, or according to human activity (light on demand) will be of clear benefit to bats.
- A Central Management System (CMS), specified by a lighting engineer, to dim or turn off individual or groups of luminaires when not in use or during less busy times should be considered. Dimming can be precisely controlled.
- Lighting should be set to a low output state by default, to turn up to a predetermined output in response to a trigger and be combined with a timeclock or photocell to further add an element of seasonal or diurnal control. For example, passive infrared, AI enabled cameras, on demand controls, or pressure sensors may be used to trigger lights to come on or dim in response to movements, either by vehicles or pedestrians. Inbuilt timeclocks or photocells can ensure that this response only occurs during a set window of hours after sunset and before sunrise, or during certain months.
- Alternative lighting designed for subtle waymarking, rather than illumination should also be considered, for example very low wattage, solar-powered, ground-level luminaires. This lighting has an added benefit that there is no requirement for cabling. However, it should be noted that these systems depend on regular maintenance for them to be successful, as well as a clear view of the sky for solar-powered options.

Appendix F – Bat Roost Areas and Buffer Zones

