East Anglia ONE
Offshore Windfarm

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Construction Artificial Lighting Emissions Plan
DCO Requirement 21 (1) and 20 (f)
Final for Approval

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SCOTTISHPOWER RENEWABLES

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Appendices

Abbreviations

AC – Alternating Current
CALEP – Artificial Lighting Emission Plan
CCS – Construction Consolidation Sites
CfD – Contract for Difference
CoCP - Code of Construction Practice
DC – Direct Current
DCO – Development Consent Order
DECC – Department for Energy and Climate Change
DOL – Development Order Limits
EA – Environment Agency
EA ONE – East Anglia ONE Offshore Wind Farm
EAOL – East Anglia One Limited
EcoMP – Ecological Management Plan
ECoW – Ecological Clerk of Works
EPS – European Protected Species
EPSL – European Protected Species Licence
ES – Environmental Statement
GCN – Great Crested Newt
HDD – Horizontal Directional Drilling
IEC – Iberdrola Engineering and Construction
LED – Light Emitting Diode
MW - Megawatts
NE – Natural England
OLEMS – Outline Landscape and Ecological Management Strategy
SPA – Special Protection Area
UK – United Kingdom
W&CA – Wildlife and Countryside Act 1981 (as amended)

1 Introduction

1.1 Project Overview

1. East Anglia ONE Limited (EAOL) was awarded a Development Consent Order (DCO) by the Secretary of State, Department of Energy and Climate Change (DECC) on June 17th 2014 for East Anglia ONE Offshore Wind Farm. The DCO granted consent for the development of a 1200MW offshore windfarm and associated infrastructure.

2. In February 2015 EAOL secured a Contract for Difference (CfD) award to build a 714MW project and ScottishPower Renewables announced its role in leading East Anglia ONE towards construction. In April 2015 EAOL submitted a non-material change application to DECC to amend the consent from direct current (DC) technology to alternating current (AC). In March 2016 DECC authorised the proposed change application and issued a Corrections and Amendments Order.

3. The onshore construction works associated with EA ONE comprise of the following, which based on the AC technology with a capacity of 714MW, comprises;

- A landfall site at Bawdsey, Suffolk
- Up to six underground cables, approx. 37km in length
- Up to four cable ducts for the future East Anglia THREE project
- An onshore substation located at Bramford next to existing National Grid infrastructure

1.2 Scope and Purpose

4. This Construction Artificial Lighting Emissions Plan (CALEP) sets outs mitigation measures to be applied to the construction activities being undertaken as part of EA ONE onshore construction works to reduce the potential for significant impacts from light emissions. This plan has been produced to fulfil DCO Requirements 21 (1) & (2) and 20 (2) (f) which state:

> ***21.*** *- (1) No stage of the connection works shall commence until written details of any external lighting to be installed in connection with that stage, including measures to prevent light spillage, have, after consultation with the highway authority, been submitted to and approved by the relevant planning authority; and any approved means of lighting shall be installed in accordance with the approved details and retained for the duration of the construction period.*
> *(2) Any means of construction lighting approved under sub-paragraph (1) must be removed on completion of the relevant stage of the connection works.*
>
> ***20****. (2) The code of construction practice must include-*
> *(f) artificial light emissions plan;*

5. The scope of this plan is the onshore construction works, which includes all construction activities associated within the onshore cable route and onshore substation, referred to within the DCO as Work No's 3B to 38.

6. The purpose of this CALEP is to ensure that the onshore construction works of EA ONE comply with relevant European and UK legislation, DCO conditions, environmental commitments as set out in the Environmental Statement (ES), and environmental and construction best practice.

7. This plan sets out the management measures which EAOL will require its contractors to adopt and implement for any onshore construction works for EA ONE. This includes the installation of the ducts and cables along the onshore cable route, the construction of the new onshore substation and any associated temporary works, such as temporary haul road and Construction Consolidation Sites (CCS).

2 Guidelines and Standards

8. This CALEP has been in accordance with the following guidance and standards:

- The Institution of Lighting Engineers (2000) *Guidance notes for the reduction of light pollution*[1]*.* The Institution of Lighting Engineers, UK.
- The Institution of Lighting Professionals (2011) *Guidance Notes for the Reduction of Obtrusive Light GN01:2011*[2]. The Institution of Lighting Professionals, UK.
- British Standard BS EN 12464-2:2014 Light and lighting. Lighting of work places. Outdoor work places.
- British Standard BS 5489-1:2013 Code of practice for the design of road lighting. Lighting of roads and public amenity areas.
- Bat Conservation Trust (2014). Artificial lighting and wildlife: Interim Guidance – Recommendations to help minimise the impact of artificial lighting. BCT. London.

[1] https://www.gov.je/SiteCollectionDocuments/Planning%20and%20building/SPG%20Lightpollution%202002.pdf
[2] https://www.theilp.org.uk/documents/obtrusive-light/guidance-notes-light-pollution-2011.pdf

3 Construction Details

3.1 Construction Details

3.1.1 Enabling Works

9. The onshore construction works will commence with the enabling works, which includes the establishment of the construction compounds (herein referred to as Construction Consolidation Sites), fencing and securing the working width, the topsoil strip and the installation of a haul road.

10. The onshore construction works will be supported by the installation of nine Construction Consolidation Sites (CCSs) (referenced A to I), these are compounds which will be utilised to provide welfare, site staff accommodation, parking, and secure storage for materials, plant and equipment. The CCSs are categorised as either Primary or Secondary, depending on their intended uses. There are two Primary CCSs; CCS B will be a designated storage and delivery facility and the main administrative compound and CCS E will be a main storage and delivery facility, with designated office space. The remaining seven Secondary CCSs shall be used to access the internal haul road, storage and deliveries. The establishment of the CCS compounds will be one of the first construction activities undertaken.

11. During the construction of the substation, site establishment and laydown areas will be required, including temporary offices, welfare, car parking, materials and equipment storage. The area directly east of the substation will be used as the temporary works area (referred to as Work No 38 within the DCO). At the start of the works the onshore substation compound and temporary works will be temporarily fenced.

12. The linear nature of the onshore cable route site will require fencing to be installed to both sides along the working width, not only to delineate the route but also to prevent possible vandalism and theft which could lead to possible contamination incidents.

13. Topsoil shall be stripped from the haul road location, trench areas and subsoil storage areas and stored. Topsoil storage and management shall be compliant with the recommendations and requirements set out in the Cable Landscape Management Plan (EA1-CON-R-IBR-010129). Topsoil shall be stored to one side of the working width**,** in such a way that it is not mixed with any subsoil. Typically this would be stored as an earth bund of a maximum height of two metres, to avoid compaction from the weight of the soil. Storage time shall be kept to a minimum, to prevent the soil deteriorating in quality. Topsoil stripped from different fields shall be stored separately, as would soil from specific hedgerow banks or woodland strips.

14. A temporary haul road will be installed along the route between the CCS locations and access points onto the local roads. Temporary haul road construction typically involves the placement of suitable imported stone material on a geotextile, however others methods such as soil stabilisation may be used if considered appropriate. In some instances the temporary haul road may comprise temporary trackway rather than stone due to site specific constraints. Following the initial topsoil stripping the haul road will be installed for a width of 5.5m along a designated route. The temporary haul road shall be constructed working from the installed CCS locations in two direction away from the CCS and towards the adjacent CCS along the onshore cable route.

3.1.2 Onshore Cable Route

15. The onshore cable route comprises a 37km corridor, between the Suffolk coast at Bawdsey and the substation at Bramford, passing the northern side of Ipswich. The onshore cable works comprise the installation of electricity transmission cables and ducts between the landfall location at Bawdsey and the new substation station, which is adjacent to the existing substation at Bramford. The majority of the route will be constructed using open trenching methods, other than in certain locations where the cable route traverses a number of major transport networks and natural obstacles. To enable the installation of the cable under these features, specialist trenchless techniques will be employed, such as Horizontal Directional Drilling (HDD).

16. Construction activities will be undertaken within a temporarily fenced strip of land, referred to as the working width. The working width is determined by electrical and civil engineering considerations and allows for sufficient space between the cables trenches to prevent the cables overheating, plus space for the associated temporary construction works i.e. soil storage, drainage, haul road installation and work areas for personnel and machinery. In accordance with the DCO, the

working width shall not exceed 55m, except at the HDD locations identified in DCO Requirement 10 (6), where the working width is permitted to be increased to allow for the installation and use of the specialist equipment to undertake the HDD.

17. There are two basic techniques to be used for the installation of the cable ducts during the construction of the onshore cable route. These are:

- **Open Cut techniques**; where a trench is excavated and the cable ducts laid in the trench before reinstatement, using the excavated material; and
- **Trenchless Technique**; typically HDD, where a pit is excavated to access the crossing and from which a drill is passed through the ground on one side of the obstacle to a receiving pit created on the opposite side. The bore is then gradually enlarged to receive the duct, which is the technique that will be used to pass under roads, main rivers and other sensitive sites.

18. For the open cut technique two trenches will be excavated for the EA ONE ducts and cables and an additional trench will be excavated in parallel for the cable ducts that will be installed to serve EA THREE in the future. An indicative cross section showing the open trench working width layout is included in Appendix 2. As the trench excavation progresses, subsoil will be removed to create the trenches to working depth for duct installation, the subsoil will be temporarily stored separately from the topsoil, and then reused to backfill the trenches.

19. Particular care will be taken when backfilling the trenches with the excavated material (subsoil) to reinstate it in the order in which it was excavated, again to minimise any disruption to the existing ground drainage pattern. The ducts will be installed in the trench, where they will be bedded on and then surrounded and topped by Cement Bound Sand (CBS) or equivalent which will gradually set and harden in situ as water is absorbed. Above this, the subsoil will then be used to reinstate the trench to the previous level.

20. Where, due to the existence of obstacles, it is not possible to install the cable ducts using the open trench method, trenchless installation techniques shall be used. The onshore cable route traverses a number of major transport networks and natural obstacles, to enable the installation of the cable across these features specialist techniques are required, namely the use of HDD. These key locations are referred to a 'Category 1' HDD sites as identified in Table 3-1.

21. These HDD sites will require additional equipment, storage and ancillary facilities to that required for the conventional open trench installation methods in order to accommodate the drilling activities. As such, a specialist HDD compound will be set up at each side of the HDD location to enable the specialist plant and materials to be delivered directly.

22. In addition to the above major features, a number of other features have been identified where the conventional open cut trenching technique are not appropriate. At these locations 'trenchless' methods will also to be implemented, which will comprise of a smaller HDD or auger bore. These sites are referred to as 'Category 2' HDD/trenchless. As the features to be crossed are less significant, they will not require any additional compounds and works will take place within the standard working width. Table 3-1 provides a list all the HDD / trenchless locations.

Table 3-1 HDD / Trenchless Locations

Reference	Category	Location/ Feature	Approximate Length (m)	Max Width (m)
HDD-01	Cat 1	Millers Wood off Bullen Lane	200	130
HDD-02	Cat 2	Somersham Watercourse	70	55
HDD-03	Cat 2	Pound Lane	60	55
HDD-04	Cat 1	River Gipping and Network Rail track west of A14	385	130
HDD-05	Cat 1	A14 Trunk Road and Old Ipswich Road	200	160
HDD-06	Cat 2	River Fynn	30	55
HDD-07	Cat 2	Lodge Road	60	25

HDD-08	Cat 1	A12 Trunk Road	165	120
HDD-09	Cat 2	Top Street	90	55
HDD-10	Cat 2	Sandy Lane	90	50
HDD-11	Cat 1	Martlesham Creek and Network Rail tracks south of Woodbridge	650	160
HDD-12	Cat 2	Waldringfield Road	70	55
HDD-13	Cat 2	Watercourse east of Howe's Farm	50	55
HDD-14	Cat 1	Kirton Creek	550	110
HDD-15	Cat 2	Sewage works outfall watercourse	50	55
HDD-16	Cat 1	River Deben	700	55
HDD-17	Cat 2	Queen's Fleet	70	55
HDD-18	Cat 1	Landfall, Bawdsey	1000	160
HDD-19	Cat 2	Bramford Road	60	55
HDD-20	Cat 2	Grundisburgh Road	50	55

23. The HDD technique is expected to be used at the majority of locations on the route where a trenchless method is required. This involves creating an access pit on either side of the obstacle to facilitate the installation of the drilling equipment and allow drilling under the obstacles, at an appropriate depth allowing the installation of the ducts. The HDD sites will have two access points, one either side of the HDD location, the drilling rig will be positioned on one side of the feature with ducting placed at the opposite side ready to be pulled back through the opening on completion of drilling.

24. Once the cable duct installation is completed then works will commence on the installation of the EA ONE cables within the pre-installed ducting system. As the onshore cabling typically comes on drums of up to 1,300m in length, jointing bays will be required along the cable route to join each section of cable together. These jointing bays, approximately 10m long x 5m wide x 5m deep, will be constructed at regular intervals along the onshore cable route to allow cable pulling and jointing at a later stage. The joint bay with be excavated to size and a concrete poured floor with concrete or blockwork walls surround will be installed and topped with concrete slabs to leave ground cover to a depth of 1.1m.

25. Further details on the construction methodology for the onshore cable route are presented in the Cable Method Statement (EA1-CON-R-IBR-021238).

3.1.3 Onshore Substation

26. The EA ONE onshore substation will be located within a fenced compound (150m by 190m) to the north of the existing National Grid Bramford Substation. The substation will contain electrical equipment including power transformers, switchgear, reactive compensation equipment, harmonic filters, cables, control buildings and other associated equipment, which will largely be outside with a number of the components being within the buildings.

27. The construction of the substation will include a number of key stages; include enabling works, foundations and building construction and equipment installation and commissioning. The enabling will include grading and earthworks to remove any unsuitable materials from the substation area and provide a level platform at an elevation of 56m AOD. Where possible, the materials excavated will be reused on site as engineering fill or landscaping depending on material properties. The enabling works will also include the construction of the main concrete access road.

28. Following the completion of the site grading, works will commence of the excavations for foundation for the building and trenches to accommodate electrical infrastructure and installation of the drainage networks.

29. The building is largely comprised of steel and cladding materials, with brick/blockwork at the base. The structural steelwork will be fabricated and prepared off site and delivered to site for erection activities using cranes. The composite cladding panels (e.g. Kingspan) will be delivered to site ready to erect and be fixed to the steelwork.

30. For the installation and commissioning phases a variety of specialist activities are required. The main items of electrical infrastructure, for example transformers, will be delivered sealed to site. Due to their size and weight they will be delivered via specialist means and offloaded with the use of a mobile crane (please see Traffic Management Plan (EA1-CON-R-IBR-009583) for details of abnormal load transport procedures). The smaller electrical components will be constructed on site using small mobile plant and lifting apparatus.

4 Potentially Sensitive Receptors

4.1 Introduction

31. During the construction phases, temporary lighting will be required. The sources of temporary lighting are:

- Flood lighting required for the illumination of areas to carry out various works and for security purposes; and
- Lighting for equipment such as conveyors, trucks, stockpiles and emplacement areas.

32. Lighting from these sources has the potential to have the following impacts:

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

4.2 Potentially sensitive receptors to artificial light emissions

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

4.2.1 Visual receptors

34. There are very few potential sensitive visual receptors in close proximity to the construction works. These include occupiers of residential properties, users of outdoor recreational facilities and off road users. The greatest potential for visual impact from light spill would be at locations where lighting is required at higher elevations for the construction of some structures within the substation. In order to establish a reference of potential buildings that could be affected by light spill, a distance of 100m from the CCSs and Horizontal Direction Drilling (HDD) locations is shown in Appendix 1.

4.2.2 Ecological receptors

35. Light spill and intrusive lighting from night time works could potentially disturb ecologically sensitive receptors which include nocturnal species. The key ecologically sensitive receptors include badgers, bats, otters and Schedule 1 birds (breeding and non- breeding birds). Detailed baseline data, survey results and mitigation measures are provided in the Ecological Management Plan (EcoMP) (EA1-CON-F-IBR-021237) and the findings from the surveys and mitigation measures agreed with the authorities have been taken in account in this report, and are identified in Appendix 1.

4.2.2.1 Bats

36. All species of British bats are protected by The Wildlife and Countryside Act 1981 (as amended) (W&CA) extended by the Countryside and Rights of Way Act 2000. Bats are also European Protected Species listed on The Conservation of Habitats and Species Regulations 2010. Different bat species vary in their sensitivity to lighting. *Myotis/Plecotus* species are the most light-sensitive species which have been recorded in the survey area. The effect of lighting has the potential to impact the available foraging and roosting habitat for bats as the lighting may deter bat from using a hedgerow or reaching a roosting site.

37. Little Blakenham Pit Site of Special Scientific Interest (SSSI), which is a known hibernation site for bats, is situated approximately 1km to the north west of the onshore cable route and approximately 3km from the onshore substation. There is therefore the potential for lighting impacts on favoured commuting corridors associated with the designated site in the proximity to the onshore cable route and substation.

38. Pre-construction surveys have been carried out in 2015 and 2016 (results presented in EcoMP). Ground and tree climb surveys were carried out to re-assess the potential of bat features and a further dusk and/or dawn activity surveys were undertaken in certain trees when required due to their location in relation to the cable route corridor, their bat roost suitability or if they could not be effectively surveyed previously.

39. The pre-construction surveys updated information of trees with potential Bat Features Category 1 to 3 and the three trees (TN 70, TN123 and TN128) with confirmed roost bat locations is shown in Appendix 1.

40. Bats hibernate through the winter months and begin to feed on warmer nights from March. Females begin to move to maternity roosts around April and by May the pregnant females are in maternity roosts. Young bats are born in June and July and by august are usually flying and feeding. Mating and swarming occurs September and October prior to hibernation.

41. Therefore, external lighting at night should be avoided as far as feasible, particularly during the months of higher fly activity (August – October). If lighting at night is required, it will comply with Bat Conservation Trust (BCT) recommendations on external lighting as agreed with Natural England.

42. In order to prevent the potential reduction in available foraging opportunities and access to roosting sites for bats, as a result of lighting impacts, no working at night will be undertaken along the cable route, except at specified locations where it cannot be avoided (i.e. for 24 hour HDD operations, construction consolidation sites or night time road closures).

43. Furthermore, there will be limited 24 hour lighting at the Substation compound site during particular construction activities (e.g. concrete pours) and directional lighting or shields will be used during Autumn (August – October).

4.2.2.2 Badger

44. Badgers and their setts are comprehensively protected by the Protection of Badgers Act 1992 (as amended). The varying habitats along the cable route corridor provide good opportunities for badger (*Meles meles*). The badger surveys carried out in 2012 for the ES and the 2015 and 206 pre-construction surveys have found several badger setts within the cable route corridor. As badger setts locations are confidential information as such they are not shown in Appendix 1. The species and locations are detailed in a confidential section of the EcoMP.

45. The badger breeding season is from 1st December to 30th June. Works that could result in disturbance of a breeding sett should be avoided at this time. However, if granted for the known badger setts, the licence may allow, with conditions, some activities that may disturb badgers occupying a breeding sett during the breeding season.

46. Where night time works are required lighting would be directional to avoid unnecessary lighting on woodland and water edge, so as not to disturb emerging or foraging badgers.

4.2.2.3 Otter

47. Otters are a European Protected Species (EPS). Otters and their resting sites/shelters are protected in the UK under The Conservation of Habitats and Species Regulations 2010 (as amended). Otter field signs (spraint, slides and resting sites) were recorded at various locations along the cable route in the 2012 surveys for the ES and in further pre-construction surveys carried out in 2015 and 2016. The locations of otter resting sites within and near the DOL are shown in Appendix 1.

4.2.2.4 Great Crested Newts

48. Great crested newts are a European protected species under the Conservation of Habitats and Species Regulations 2010 (as amended). Some waterbodies around the cable route showed presence of Great Crested Newts (GCN) in the 2012 and pre-construction surveys. These are shown in Appendix 1.

4.2.2.5 Schedule 1 birds and SPA Non-breeding birds

49. Bird species listed on Schedule 1 of the W&CA are afforded extra protection making it an offence to intentionally or recklessly disturb any such bird when it is building its nest or while it is in or near a nest containing dependant young, and / or disturb the dependant young of any such bird. Schedule 1 birds have been recorded in some areas surrounding the cable route. As Schedule 1 locations are sensitive information, they are not shown in Appendix 1. The species and locations are detailed in a confidential section of the EcoMP.

50. An Ecological Mitigation Plan for the Deben Estuary Special Protection Area (SPA) non-breeding birds and Schedule 1 breeding birds were presented as Appendix 4 of the Outline Landscape and Ecological Management Plan (2013). This Ecological Mitigation Plan outlines the requirement applicable for lighting mitigation for Schedule 1 bird species and SPA Non-breeding birds:

- An exclusion area for specified activities around the Marsh Harrier nest of between 100m and 400m radius, with that radius dependent on the stage of nesting activity that the Marsh Harrier has reached (nest building, eggs or chicks).

- Where HDD is used to cross the Deben Estuary and Martlesham Creek, mitigation measures will be implemented at construction site compounds and construction activities to avoid light spill and disturbance. Together with appropriate monitoring this will ensure that artificial illumination of areas used by concentrations of Brent Goose and Avocet is kept below 1 lux.

5 Lighting Scheme

5.1 Introduction

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

Table 5-1 Objectives and Performance Outcomes

OBJECTIVES	PERFORMANCE OUTCOMES
• 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 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.	• Sufficient lighting is provided on site to ensure that safety is not compromised. • External lighting complies with relevant European and UK legislation, DCO conditions, environmental commitments as set out in the 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 site on nearby sensitive visual receptors is avoided or minimised where avoidance is not possible. • Impacts from light emissions from the site on ecological receptors is avoided or minimised, where avoidance is not possible. • Complaints are responded to quickly and effectively. • The effectiveness of lighting emission controls are reported.

5.2 Lighting Requirements

52. The majority of the construction activities will be conducted during daylight hours and will not require artificial lighting, unless daylight conditions are not sufficient for specific works to ensure safe working. It is anticipated that there would be some limited activities requiring work on a 24 hour basis, these works will require the use of artificial temporary lighting to ensure safe working. Artificial lighting will also be needed particularly during the winter months when daylight hours are much shorter and shorter than the specified working hours. For the highest structures within the substation lighting at higher elevations will be required.

53. The activities which may require artificial lighting at night are:

- Where continuous periods of operation are required, such as concrete pouring and directional drilling.
- For internal fit out works associated with the onshore substation.
- For the delivery of abnormal loads.
- Works on the foreshore, if required.
- Potential emergency works.

54. The locations where activities that might require temporary construction lighting are described below and shown in Appendix 1:

- Temporary working areas along the cable route will only require artificial lighting during times where natural light is not sufficient to carry out the works. There will also be a requirement for artificial lighting on emergency works.
- At HDD locations there may be the need for lighting for 24 hour working (except at Work No. 21 or Work No. 26 as per the DCO Requirement).
- At Primary CCS sites there will be 24 hour onsite security presence and a need for artificial lighting for the duration of the works. At Secondary CCS sites security will be 24 hour with limited lighting specific to compound offices and parking area and will be programme dependant.
- Onshore substation compound and temporary works area.

5.3 Types and Positioning Requirements

55. Lighting should be sufficient to enable people to work, use facilities and move from place to place safely and without experiencing eye-strain. Table 5-2 below, which has been adapted from Health and Safety and Executive (HSE) document Health and Safety Guidance 38 (HSG38) 'Lighting at Work', details the recommended minimum lighting levels for different types of work activity and location applicable to the outside working areas. It makes recommendations for average illuminance for the work area as a whole and for minimum measured illuminance at any position within it.

Table 5-2 Recommendations for Minimum Lighting Levels (adapted from HSE document HSG38 (Lighting at Work).

Activity	Typical locations/ types of work	Average illuminance measured (lux) 1x	Minimum illuminance measured (lux) 1x
Movement of people, machines and vehicles(a)	Access 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 along the cable route focusing on a particular point in a trench or at a feature.	100	50

56. The artificial lighting required at HDD locations, CCS sites and at the onshore substation (only for key construction activities) will comply with the minimum requirements for safe work operations, the guidance and standards (Section 2) and mitigation measures avoiding or minimising the impacts on sensitive visual and ecological receptors.

57. Where HDD is used to cross the Deben Estuary and Martlesham Creek mitigation measures will be implemented with appropriate monitoring, to ensure that artificial illumination of areas used by concentrations of Brent Goose and Avocet is kept below 1 lux.

58. Light types will be selected taking into account the Bat Conservation Trust (2014) guidelines:

- Use narrow spectrum light sources to lower the range of species affected by lighting.
- Use light sources that emit minimal ultra-violet light.
- Lights should peak higher than 550nm.
- Avoid white and blue wavelengths of the light spectrum to reduce insect attraction and where white light sources are required in order to manage the blue short wave length content they should be of a warm / neutral colour temperature <4,200 kelvin.

59. Directional beams and non-reflective surfaces will be used to ensure light spill and nuisance does not encroach onto adjacent areas. The light columns will be up to 5m high with directional flow towards specific work areas.

5.4 Hours of lighting

60. 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 dependant on seasonality and will change through the winter months and with daylight savings adjustments. Temporary construction lighting will be also provided along the cable route during working hours only at times where natural light is not sufficient to carry out specific works to ensure safe working conditions.

61. Working hours will comply with DCO Requirement 23, which states:

23.—(*1) Construction work for the connection works and any construction-related traffic movements to or from the site of the connection works shall not take place other than between 0700 hours and 1900 hours Monday to Saturday, with no activity on Sundays or bank holidays, save—*

(a) where continuous periods of operation are required as assessed in the environmental statement, such as concrete pouring and directional drilling (subject to sub-paragraphs (3) and (4));

(b) for internal fitting out works associated with the onshore converter station comprised within Work No. 39;

(c) for the delivery of abnormal loads to the connection works, which may cause congestion on the local road network; and

(d) where connection works are being carried out on the foreshore.

(2) All construction operations which are to be undertaken outside the hours specified in sub-paragraph (1) must be agreed with the relevant planning authority in writing in advance, and must be carried out within the agreed times.

(3) Construction of Work No. 21 shall not take place other than between 0700 hours and 1900 hours Monday to Saturday, with no activity on Sunday or bank holidays.

(4) Construction of Work No. 26 shall not take place other than between 0700 hours and 1900 hours Monday to Friday and 0700 hours and 1400 hours on Saturday, with no activity on Sunday or bank holidays.

62. There will be the need for lighting at certain HDD sites for 24 hour working. This will be concentrated on the working area with minimal light spill and disturbance outside of the working area. Approval will be sought prior to commencing any 24 hour works and residential receptors notified of the proposals. As per DCO approval will not be sought for 24 hour working at Work No. 21 or Work No. 26.

63. There may also 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 2) and mitigation measures avoiding or minimising the impacts on sensitive visual and ecological receptors.

64. At Primary CCS sites security will be 24 hour with lighting for the duration of the onshore construction works. At Secondary CCS sites security will be 24hr with limited lighting specific to compound offices and parking area and will required when the compound is in operation.

6 Mitigation

6.1 Background

65. The onshore construction works have been carefully designed to reduce the potential for significant impacts and to minimise impacts on the environment and include a series of embedded mitigation measures. These have been adopted as part of the project design to avoid or minimise potential impacts from artificial lighting, relating to construction, on the sensitive receptors are summarised in Table 6-1.

Table 6-1 Embedded Mitigation Measures

Construction Mitigation Measures	Rationale
Onshore Cable Route	
No 24hr lighting except at CCSs and for specific work activities which have been agreed with the Local Planning Authority, which may include HDD or where night time road closures/working is required.	Minimise light pollution and disturbance to ecological receptors.
Careful routeing of the onshore cable route to avoid key areas of sensitivity (e.g. near Howes Farm, meadows near Martlesham Hall, Fynn Valley).	Avoidance of impact.
Where possible, night-time working during open trenching of watercourses would be minimised.	Minimise Impact on otters.
Pre-construction surveys for protected species and Schedule 1 birds.	To ensure that mitigation is based on up to date survey data.
Where HDD is used to cross the Deben Estuary and Martlesham Creek mitigation measures in the Ecological Mitigation Plan for the Deben Estuary Special Protection Area (SPA) non-breeding birds and Schedule 1 breeding birds will be applied.	Avoid significant disturbance to breeding and non-breeding birds.
Onshore Substation	
Careful siting of the onshore substation compound to the north of the existing Bramford substation to gain maximum benefit from the screening effect provided by existing woodland.	Minimise Impact.
Directional lighting or shields during Autumn (August to October).	Minimise Impacts on bats.
Pre-construction surveys for protected species and Schedule 1 birds.	To ensure mitigation is based on up to date survey data.
Substation to be constructed on lowered ground levels.	Minimise Impact.
Limited 24 hour lighting at substation compound site during particular construction activities (concrete pours, etc.).	Minimise Impact.

6.2 Measures to Prevent Light Pollution

68. In addition to the embedded mitigations, the following additional mitigation, presented in Table 6-1, will be implemented.

Table 6-2 Additional Mitigation Measures

Mitigation Measures	Rationale
Pre-construction	
Pre-construction bat activity surveys were undertaken in May 2016. However, it should be noted that survey works have an expiry of approximately 18-24 months. Therefore, if works on trees (removal/pruning/disturbance) are to take place 18-24 months after the current surveys, a re-survey should be undertaken in order to confirm that the status of the trees has not changed.	Minimise Impacts on bats.
A bat mitigation licence will need to be obtained from Natural England in order to avoid an offence under the Conservation of Habitats and Species Regulations 2010 (as amended) if any of the three trees identified as having bat roosts (TN70, TN123, TN128) are to be removed/pruned/disturbed by the works. Further details see EcoMP (EA1-CON-F-IBR-021237).	Minimise Impacts on bats
Construction	
There will be no 24 hour lighting along the onshore cable route except at CCSs and for specific activities locations agreed with the Local Planning Authority. There would however need to be 24 hour lighting at the onshore substation only for key construction activities, as agreed with the Local Planning Authority.(See Section 5)	Minimise Impact on sensitive receptors
At the substation, external lighting at night should be avoided as far as feasible, particularly during the months of higher bat activity (August – October). When lighting at night is required, it will comply with the Bat Conservation Trust (2014) recommendations on external lighting as agreed with Natural England. This would include provisions for directional lighting to be used at the onshore substation during 24hr working, in order to avoid lighting the flight path potentially used by the Little Blakenham Pit SSSI bats. This would illuminate the construction working area and avoid potential flight paths associated with boundary features.	Avoid Impacts on bats.
Where night time works are required lighting would be directional to avoid unnecessary lighting on woodland and water edge, so as not to disturb emerging or foraging badgers.	Avoid impact on badgers
As otters are largely nocturnal, mitigation measures during construction would focus on the restriction of night-time working (to avoid disturbance to roaming otters). Wherever possible, lighting close to watercourses would be minimised.	Avoid impact on otters.
Site lighting shall be positioned and directed to minimise nuisance to footpath users, residents, to minimise distractions to passing drivers on adjoining public highways and to minimise skyglow, so far as reasonably practicable. Temporary lighting will be selected and positioned in accordance with guidance and standards provided in Section 2.	Minimise Impact on visual receptors.
An exclusion area for specified activities detailed in the Schedule 1 Bird Ecological Mitigation Plan around the Marsh Harrier nest of between 100m and 400m radius, with that radius dependent on the stage of nesting activity that the Marsh Harrier has reached (nest building, eggs or chicks).	Avoid impact on Schedule 1 breeding birds
Where HDD is used to cross the Deben Estuary and Martlesham Creek, mitigation measures will be applied, with appropriate monitoring, to ensure that that artificial illumination of areas used by concentrations of Brent Goose and Avocet is kept below 1 lux.	Avoid impact on SPA non-breeding birds

6.3 Commitment

71. All lighting relating to the onshore construction works are temporary and will be removed as soon as possible on completion of the relevant element of works.

7 Monitoring

7.1 Monitoring

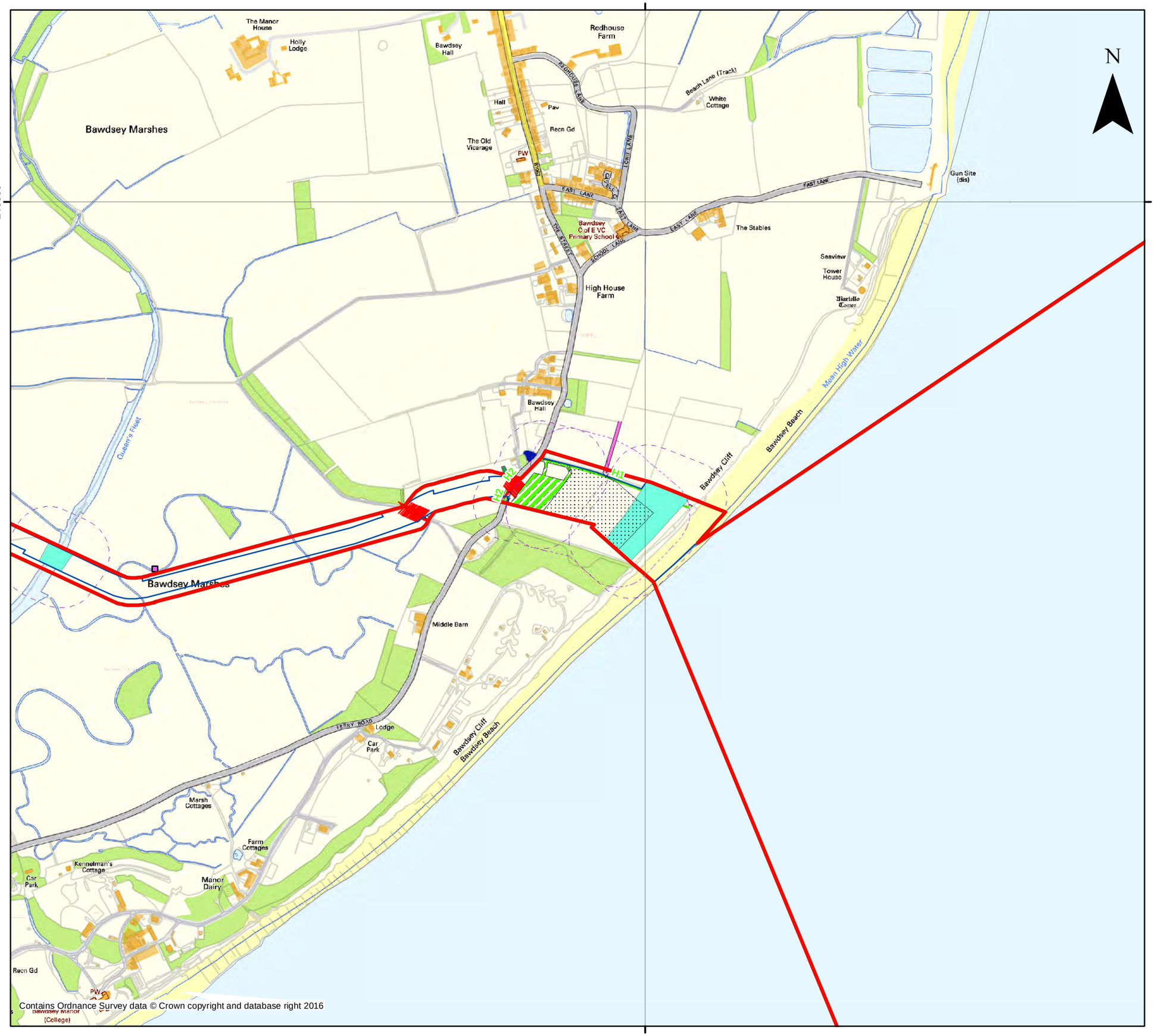
72. Regular inspections of lighting mitigation measures will be undertaken by the contractor's, construction management team, Environmental Clerk of Works (EnCoW) and ecological specialists where required, to ensure effective implementation and report any non-compliances. If non-conformity with any control and mitigation measures is identified, it will be recorded and appropriate remedial action will be implemented.

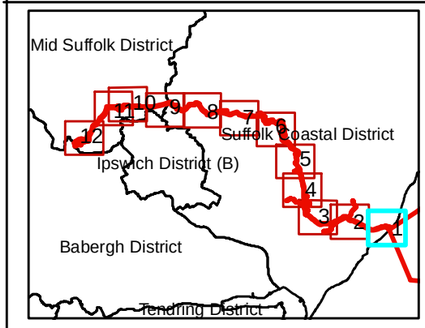
73. The frequency and the location inspections will be determined by the Environmental Clerk of Works (EnCoW) and will be included in the Project Environmental Management Plan (prepared by EAOL) and the Construction Environmental Management Plan (preperatred by contractors). Any complaint regarding lighting on the site will be directed to the EnCoW. The EnCoW will investigate the complaint and provide a response within 24 hours. This may include investigation of alternatives, such as the use of lower wattage lighting, or re-direction of lighting or re-positioning shielding.

7.2 Reporting

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

Appendix 1 Temporary Construction Lighting Figures





Legend

- EA1 DCO Boundary
- EA1 Construction Corridor (BLB)
- EA1 HDD Compounds
- HDD Compound 100m buffer
- EA1 HDD Zones
- HDD 100m buffer
- EA1 CCS Areas
- CCS 100m buffer
- Buildings (OS Maps)
- GCN Ponds (Pre Construction survey 2015)
- Proposed GCN Compensation habitat (2016)
- Surveyed Hedge Important for Bats
- Otter Couch and Layup Areas

Tree and Hedgerow Mitigation

- Hedgerow Protection
- Hedgerow Felling
- Existing Hedgerow
- Tree Protective Fencing
- Tree Felling
- Group Tree Replanting Area

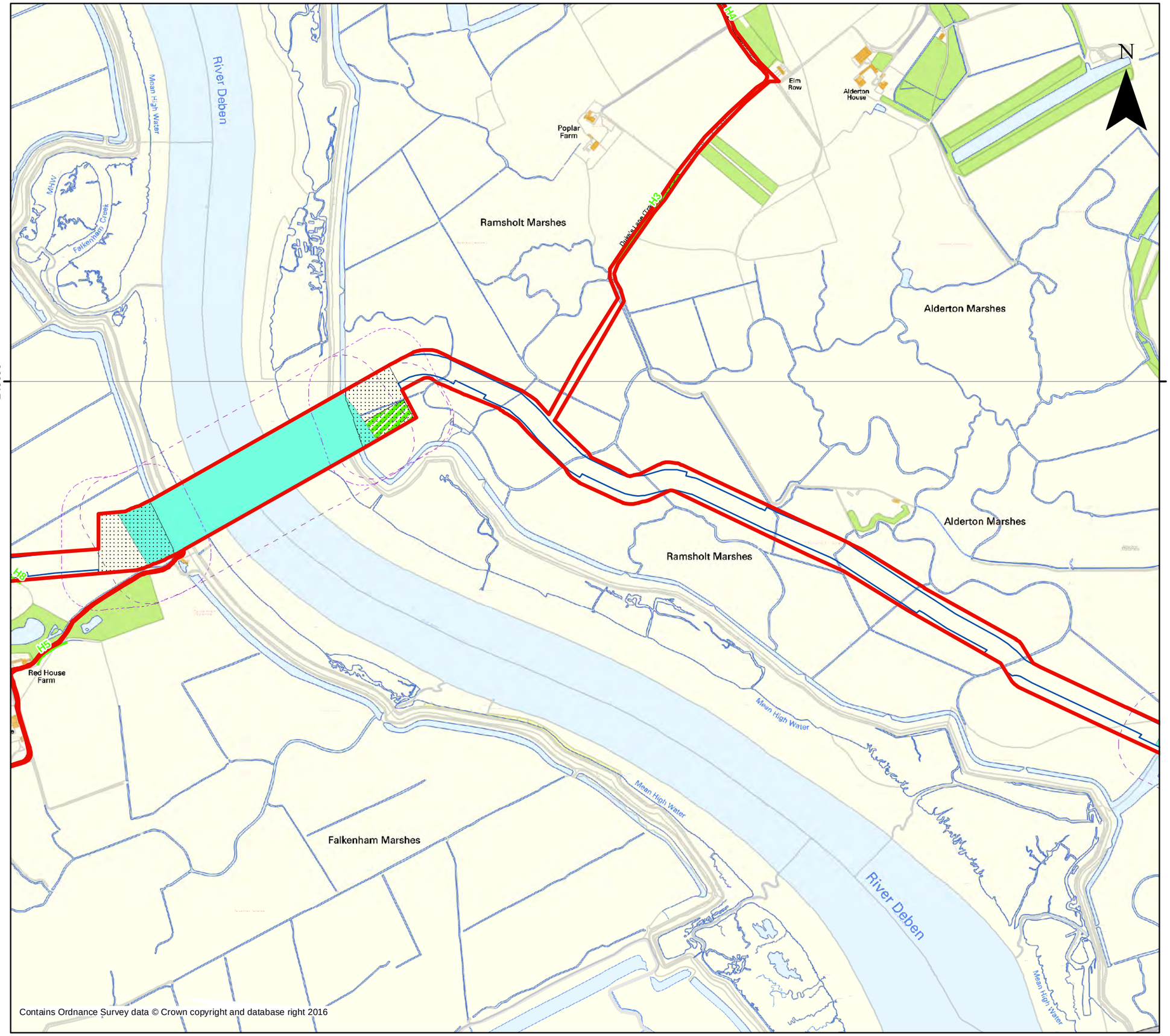
1:10,000
SCALE @ A3
0 150 300
Meters

DATE: 30/08/2016 EA1-CON-F-GBE-008548

FIGURE 1.1: Temporary Construction Lighting

Construction Artificial Lighting Emissions Plan

East Anglia ONE Offshore Windfarm



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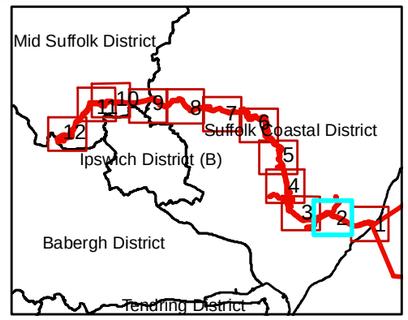


Legend

- EA1 DCO Boundary
- EA1 Construction Corridor (BLB)
- EA1 HDD Compounds
- HDD Compound 100m buffer
- EA1 HDD Zones
- HDD 100m buffer
- EA1 CCS Areas
- CCS 100m buffer
- Buildings (OS Maps)

Tree and Hedgerow Mitigation

- Hedgerow Protection
- Existing Hedgerow
- Tree Protective Fencing

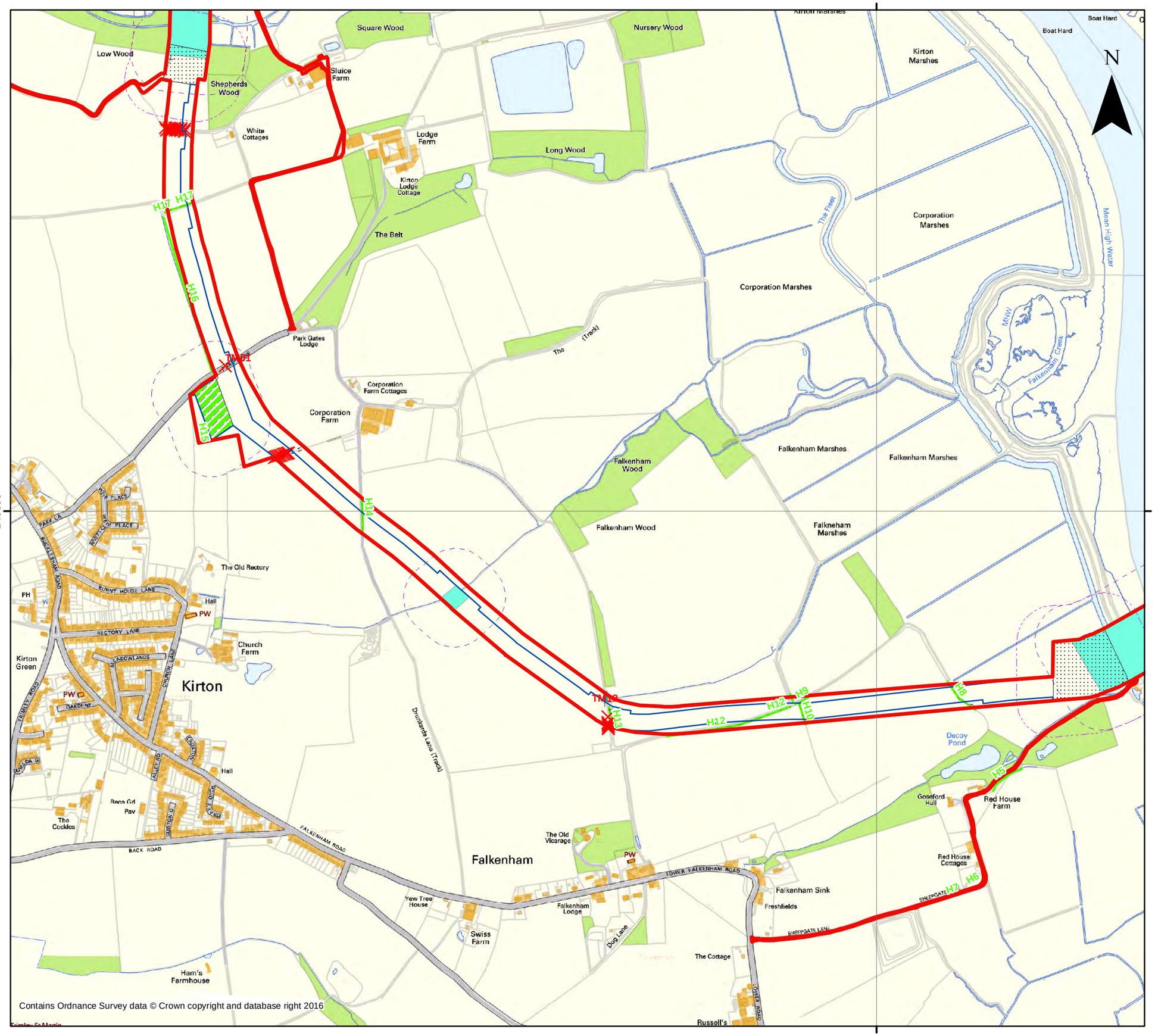
1:10,000
SCALE @ A3
0 150 300
Meters

DATE: 30/08/2016 EA1-CON-F-GBE-008548

FIGURE 1.2: Temporary Construction Lighting
Construction Artificial Lighting Emissions Plan

East Anglia ONE Offshore Windfarm

IBERDROLA Engineering & Construction



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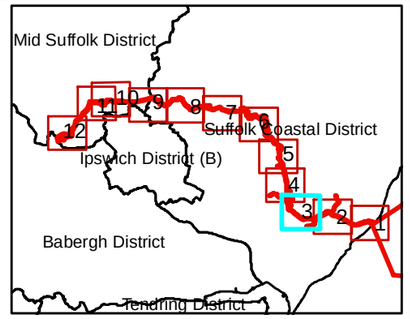

Legend

- EA1 DCO Boundary
- EA1 Construction Corridor (BLB)
- EA1 HDD Compounds
- HDD Compound 100m buffer
- EA1 HDD Zones
- HDD 100m buffer
- EA1 CCS Areas
- CCS 100m buffer
- Buildings (OS Maps)

Tree and Hedgerow Mitigation

- Hedgerow Protection
- Hedgerow Felling
- Existing Hedgerow
- Tree Replanting
- Tree Protective Fencing
- Tree Felling
- Tree Replanting RPA
- Group Tree Replanting Area

1:10,000
SCALE @ A3
0 150 300
Meters

DATE: 30/08/2016 EA1-CON-F-GBE-008548

FIGURE 1.3: Temporary Construction Lighting
Construction Artificial Lighting Emissions Plan

East Anglia ONE Offshore Windfarm

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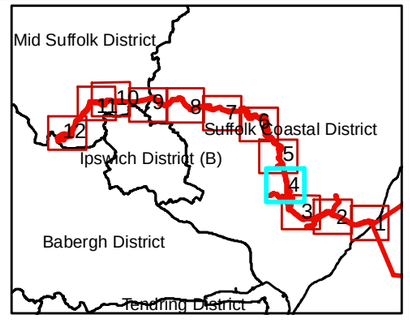
SCOTTISHPOWER RENEWABLES



Legend

Trees with potential Bat Features (Category 1 to 3 from updated 2015-2016 surveys data)

- Category 1
- Category 2
- Category 3
- EA1 DCO Boundary
- EA1 Construction Corridor (BLB)
- EA1 HDD Compounds
- HDD Compound 100m buffer
- EA1 HDD Zones
- HDD 100m buffer
- EA1 CCS Areas
- CCS 100m buffer
- Buildings (OS Maps)
- Surveyed Hedge Important for Bats
- Otter Couch and Layup Areas

Tree and Hedgerow Mitigation

- Hedgerow Protection
- Hedgerow Felling
- Existing Hedgerow
- Tree Replanting
- Tree Protective Fencing
- Tree Felling
- Tree Replanting RPA

1:10,000
SCALE @ A3
0 150 300
Meters

DATE: 30/08/2016 EA1-CON-F-GBE-008548

FIGURE 1.4: Temporary Construction Lighting Construction Artificial Lighting Emissions Plan

East Anglia ONE Offshore Windfarm

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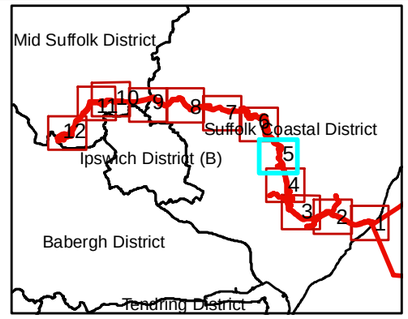


Legend

Trees with potential Bat Features (Category 1 to 3 from updated 2015-2016 surveys data)

- Category 1
- Category 2
- EA1 DCO Boundary
- EA1 Construction Corridor (BLB)
- EA1 HDD Zones
- HDD 100m buffer
- EA1 CCS Areas
- CCS 100m buffer
- Buildings (OS Maps)

Tree and Hedgerow Mitigation

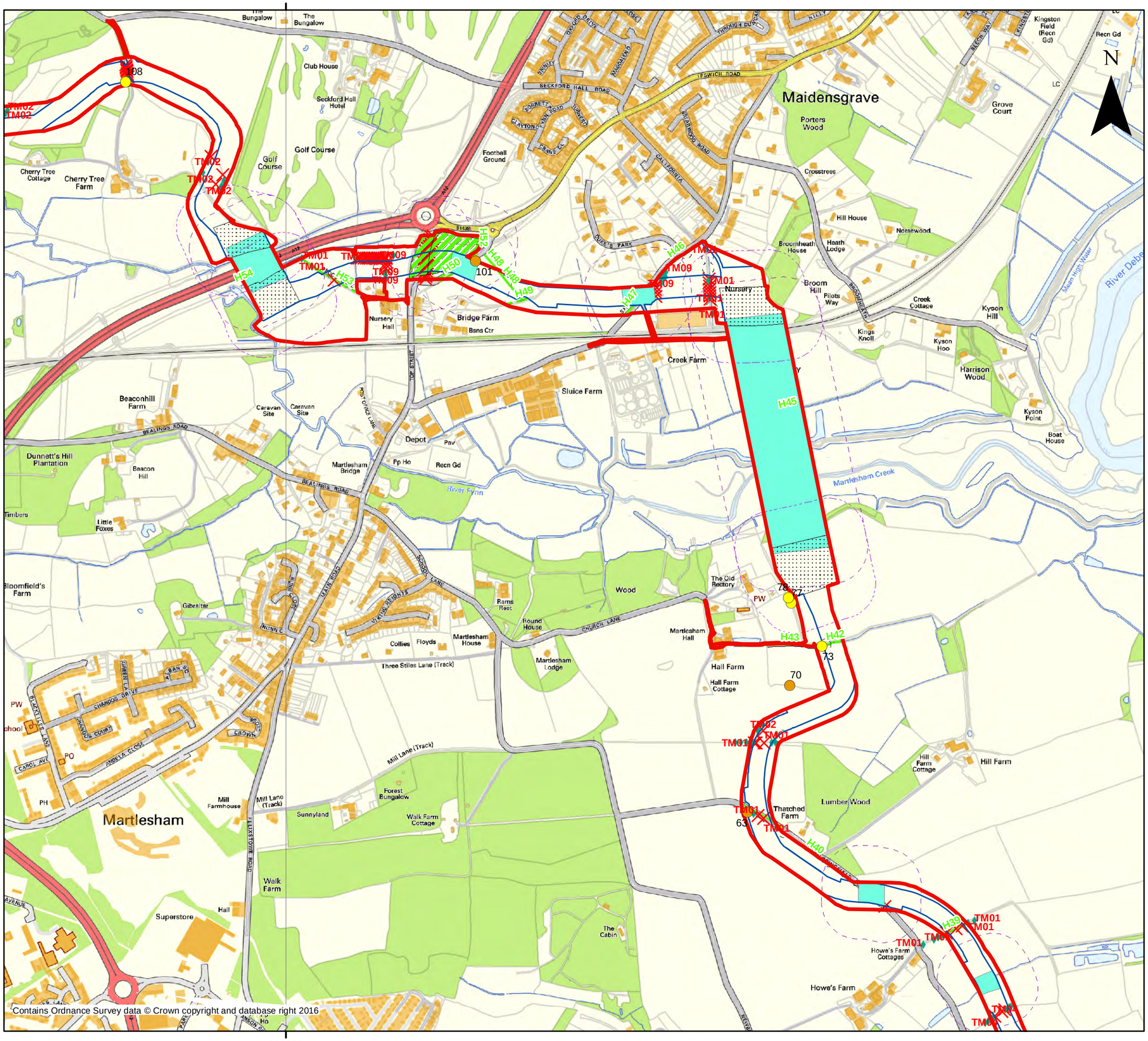
- Hedgerow Protection
- Hedgerow Felling
- Existing Hedgerow
- Tree Replanting
- Tree Protective Fencing
- Tree Felling
- Tree Replanting RPA
- Group Tree Replanting Area

1:10,000
SCALE @ A3
0 150 300
Meters

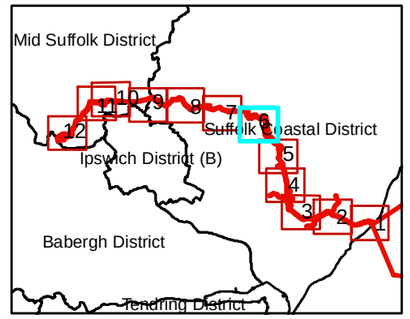
DATE: 30/08/2016 EA1-CON-F-GBE-008548

FIGURE 1.5: Temporary Construction Lighting Construction Artificial Lighting Emissions Plan

East Anglia ONE Offshore Windfarm



SCOTTISHPOWER RENEWABLES



Legend

Trees with potential Bat Features (Category 1 to 3 from updated 2015-2016 surveys data)

- Category 1
- Category 2
- EA1 DCO Boundary
- EA1 Construction Corridor (BLB)
- EA1 HDD Compounds
- HDD Compound 100m buffer
- EA1 HDD Zones
- HDD 100m buffer
- EA1 CCS Areas
- CCS 100m buffer
- Buildings (OS Maps)
- Surveyed Hedge Important for Bats
- Otter Couch and Layup Areas

Tree and Hedgerow Mitigation

- Hedgerow Protection
- Hedgerow Felling
- Existing Hedgerow
- Tree Replanting
- Tree Protective Fencing
- Tree Felling
- Tree Replanting RPA
- Group Tree Replanting Area

1:10,000
SCALE @ A3
0 135 270
Meters

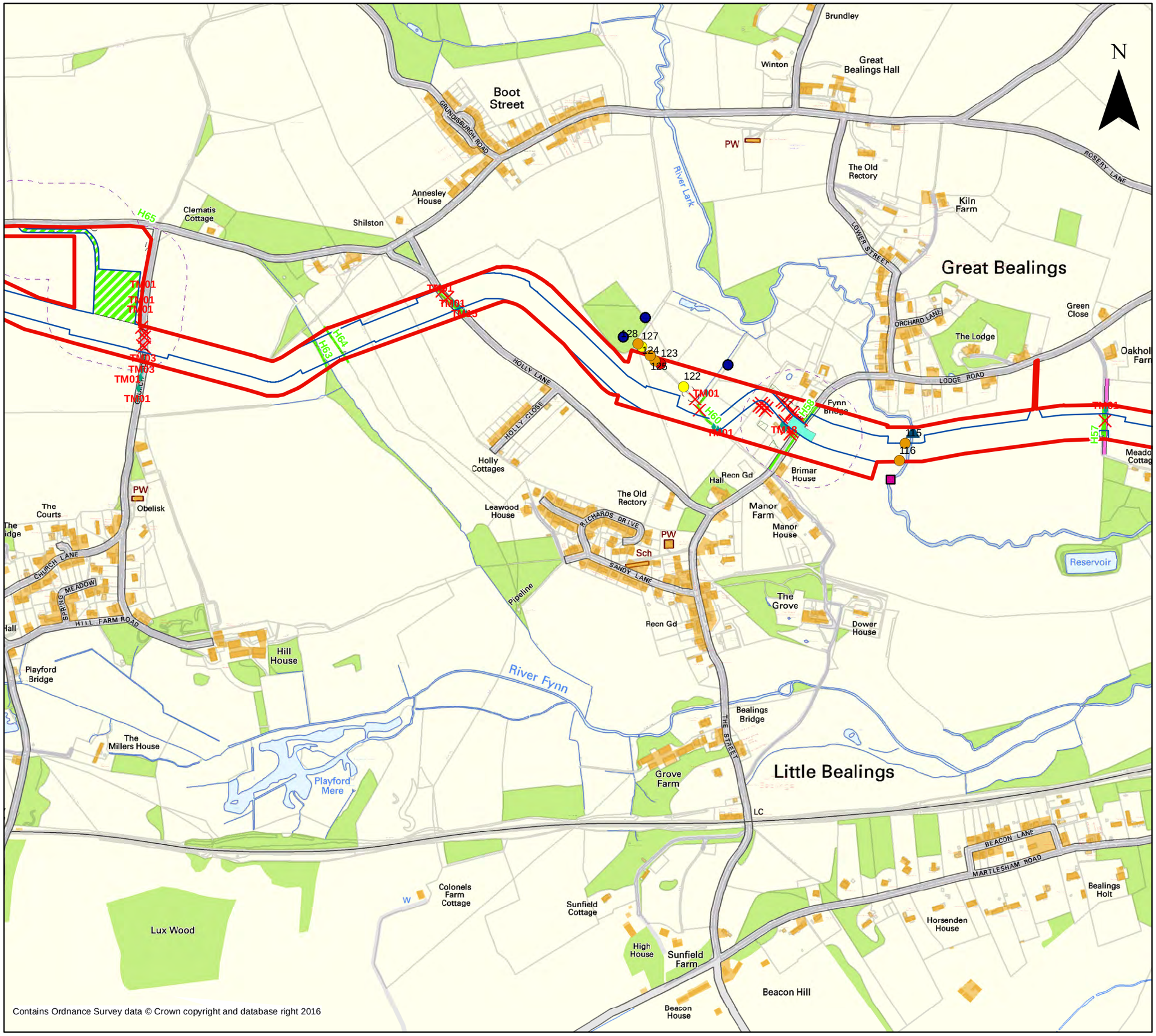
DATE: 30/08/2016 EA1-CON-F-GBE-008548

FIGURE 1.6: Temporary Construction Lighting

Construction Artificial Lighting Emissions Plan

East Anglia ONE Offshore Windfarm

IBERDROLA Engineering & Construction



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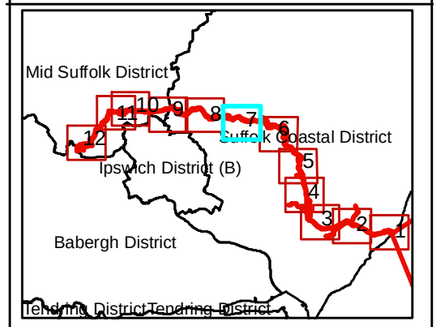

Legend

Trees with potential Bat Features (Category 1 to 3 from updated 2015-2016 surveys data)

- Category 1
- Category 2
- Category 3
- EA1 DCO Boundary
- EA1 Construction Corridor (BLB)
- EA1 HDD Zones
- HDD 100m buffer
- EA1 CCS Areas
- CCS 100m buffer
- Buildings (OS Maps)
- Surveyed Hedge Important for Bats
- Otter holts
- Otter proposed artificial holt
- Potential mitigation locations Batbox

Tree and Hedgerow Mitigation

- Hedgerow Protection
- Hedgerow Felling
- Existing Hedgerow
- Tree Replanting
- Tree Protective Fencing
- Tree Felling
- Tree Replanting RPA
- Group Tree Replanting Area

1:10,000
SCALE @ A3
0 105 210
Meters

DATE: 30/08/2016 EA1-CON-F-GBE-008548

FIGURE 1.7: Temporary Construction Lighting

Construction Artificial Lighting Emissions Plan

East Anglia ONE Offshore Windfarm

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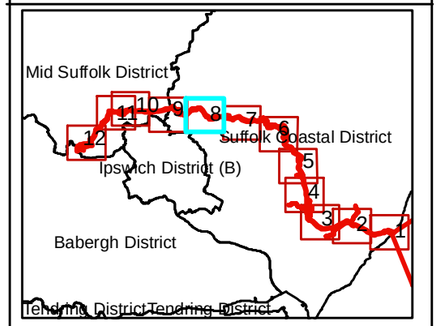

Legend

Trees with potential Bat Features (Category 1 to 3 from updated 2015-2016 surveys data)

- Category 2
- EA1 DCO Boundary
- EA1 Construction Corridor (BLB)
- EA1 HDD Zones
- HDD 100m buffer
- Buildings (OS Maps)
- Surveyed Hedge Important for Bats

Tree and Hedgerow Mitigation

- Hedgerow Protection
- Hedgerow Felling
- Existing Hedgerow
- Tree Replanting
- Tree Protective Fencing
- Tree Felling
- Tree Replanting RPA

1:10,000
SCALE @ A3
0 150 300
Meters

DATE: 30/08/2016 EA1-CON-F-GBE-008548

FIGURE 1.8: Temporary Construction Lighting

Construction Artificial Lighting Emissions Plan

East Anglia ONE Offshore Windfarm

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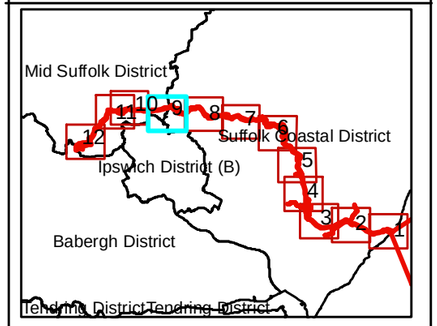

Legend

Trees with potential Bat Features (Category 1 to 3 from updated 2015-2016 surveys data)
- Category 2
- EA1 DCO Boundary
- EA1 Construction Corridor (BLB)
- EA1 CCS Areas
- CCS 100m buffer
- Buildings (OS Maps)
- GCN Ponds (Pre Construction survey 2015)
- Proposed GCN Compensation habitat (2016)

Tree and Hedgerow Mitigation
- Hedgerow Protection
- Hedgerow Felling
- Existing Hedgerow
- Tree Replanting
- Tree Protective Fencing
- Tree Felling
- Tree Replanting RPA

1:10,000
SCALE @ A3
0 150 300
Meters

DATE: 30/08/2016 EA1-CON-F-GBE-008548

FIGURE 1.9: Temporary Construction Lighting
Construction Artificial Lighting Emissions Plan

East Anglia ONE Offshore Windfarm

IBERDROLA Engineering & Construction

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Claydon

Claydon Hill

Akenham

Mockbeggar Hall

Claydon Hall

Wood House

Claydon Farm

Rede Wood Farm

High House Farm

Kennel Farm

Slade Cottages

The Bungalow

The Old Rectory

Knole House

Claydon Primary School

Claydon High School

Recreation Ground

Play Area

The Slade

The Slade (Track)

Henry VIII Farm

Bridge Trad Est

Depot

Works

Factory

Depot

Factory

Stanfield House

The Meadows

Idaliz

Motel

Broomvale Farm

Bsns Cen

Hill View Business Park

Works

Fairview

Bower Farm

Globe Farm

St Mary's Cottage

Rise Hall

Rise Hall Cottages

The Cottage

Walnut-tree Farm

The Rookery

Hilltop

The Old Paper Mill

Paper Mill Farm

Alder Carr

Landfill Site

Broom Hill

Fisk Grove

Works

Cycle

Beacon Gd

Beacon Gd

Beacon Gd

TM11

TM11

160

157

TM01

TM01

TM01

TM01

H101

H102

H99

H104

H103

H107

H108

H109

H106

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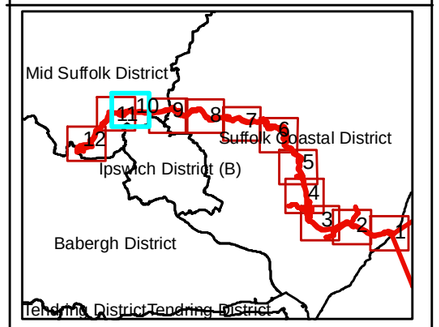


Legend

Trees with potential Bat Features (Category 1 to 3 from updated 2015-2016 surveys data)

- Category 1
- Category 2
- EA1 DCO Boundary
- EA1 Construction Corridor (BLB)
- EA1 HDD Compounds
- HDD Compound 100m buffer
- EA1 HDD Zones
- HDD 100m buffer
- EA1 CCS Areas
- CCS 100m buffer
- Buildings (OS Maps)
- GCN Ponds (Pre Construction survey 2015)
- Otter Couch and Layup Areas

Tree and Hedgerow Mitigation

- Hedgerow Protection
- Hedgerow Felling
- Existing Hedgerow
- Tree Replanting
- Tree Protective Fencing
- Tree Felling
- Tree Replanting RPA
- Group Tree Replanting Area

1:10,000
SCALE @ A3
0 150 300
Meters

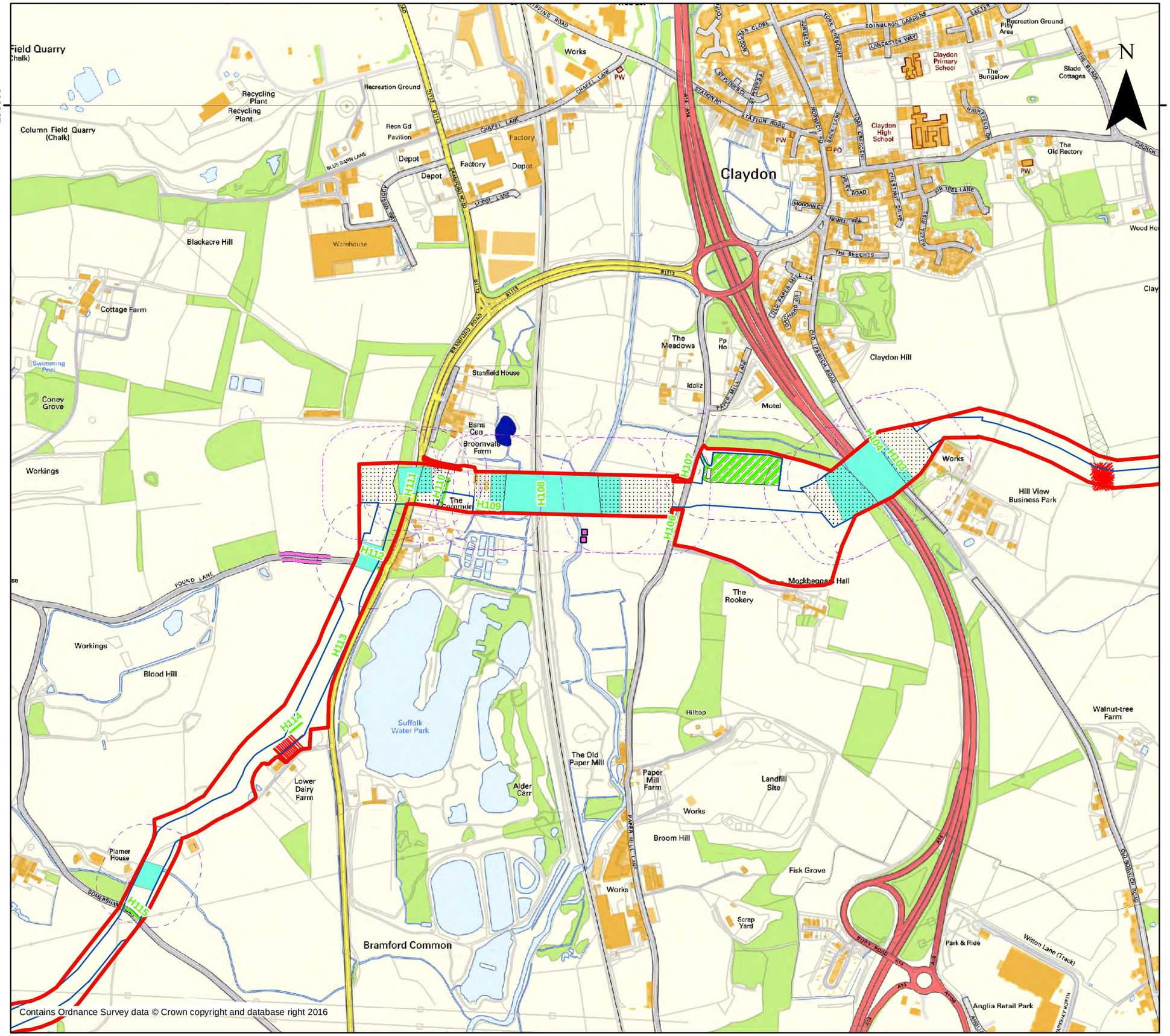
DATE: 30/08/2016 EA1-CON-F-GBE-008548

FIGURE 1.10: Temporary Construction Lighting

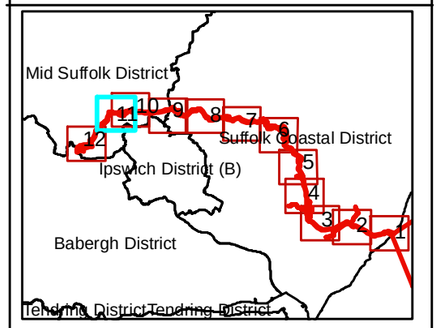
Construction Artificial Lighting Emissions Plan

East Anglia ONE Offshore Windfarm

IBERDROLA Engineering & Construction



SCOTTISHPOWER RENEWABLES



Legend

- EA1 DCO Boundary
- EA1 Construction Corridor (BLB)
- EA1 HDD Compounds
- HDD Compound 100m buffer
- EA1 HDD Zones
- HDD 100m buffer
- EA1 CCS Areas
- CCS 100m buffer
- Buildings (OS Maps)
- Little Blakenham Pit SSSI
- GCN Ponds (Pre Construction survey 2015)
- Surveyed Hedge Important for Bats
- Otter Couch and Layup Areas

Tree and Hedgerow Mitigation

- Hedgerow Protection
- Hedgerow Felling
- Existing Hedgerow
- Tree Protective Fencing
- Tree Felling
- Group Tree Replanting Area

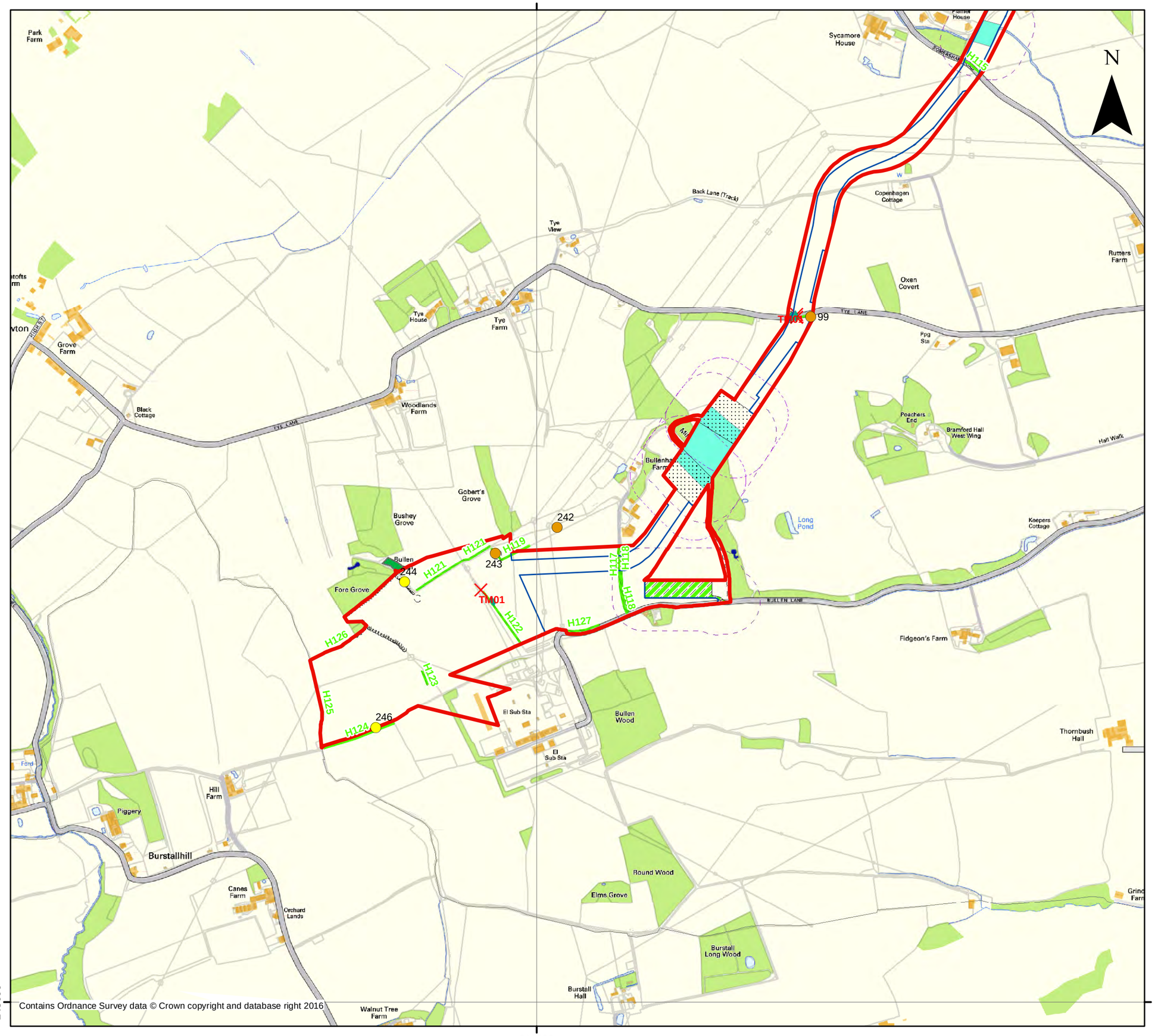
1:10,000
SCALE @ A3
0 150 300
Meters

DATE: 30/08/2016 EA1-CON-F-GBE-008548

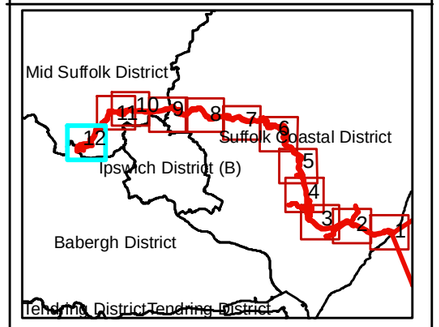
FIGURE 1.11: Temporary Construction Lighting Construction Artificial Lighting Emissions Plan

East Anglia ONE Offshore Windfarm

IBERDROLA Engineering & Construction



SCOTTISHPOWER RENEWABLES



Legend

Trees with potential Bat Features (Category 1 to 3 from updated 2015-2016 surveys data)

- Category 1
- Category 2
- EA1 DCO Boundary
- EA1 Construction Corridor (BLB)
- EA1 HDD Compounds
- HDD Compound 100m buffer
- EA1 HDD Zones
- HDD 100m buffer
- EA1 CCS Areas
- CCS 100m buffer
- Buildings (OS Maps)
- GCN Ponds (Pre Construction survey 2015)
- Proposed GCN Compensation habitat (2016)

Tree and Hedgerow Mitigation

- Hedgerow Protection
- Hedgerow Felling
- Existing Hedgerow
- Tree Replanting
- Tree Protective Fencing
- Tree Felling
- Tree Replanting RPA

1:10,000
SCALE @ A3
0 150 300
Meters

DATE: 30/08/2016 EA1-CON-F-GBE-008548

FIGURE 1.12: Temporary Construction Lighting

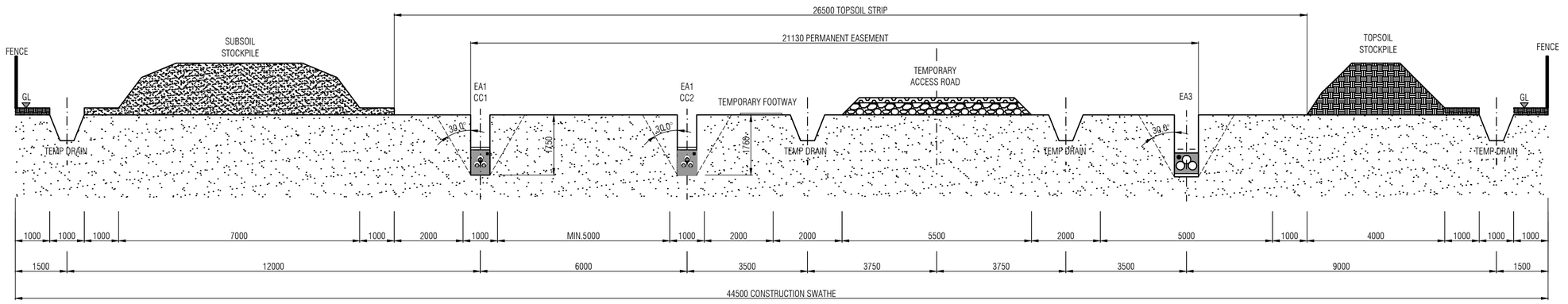
Construction Artificial Lighting Emissions Plan

East Anglia ONE Offshore Windfarm

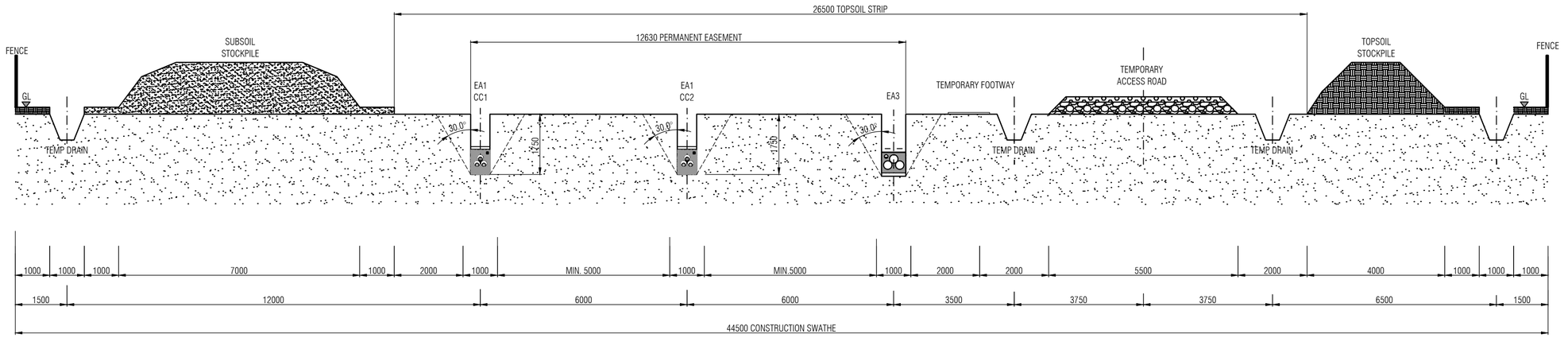
IBERDROLA Engineering & Construction

Appendix 2 Construction Swathe Indicative Cross Section

VIEW FROM SHORE LANDING TOWARDS SUBSTATIONS OPTION 1



VIEW FROM SHORE LANDING TOWARDS SUBSTATIONS OPTION 2



NOTES:
1- PASSING PLACES EACH 250 m.(FIG.1)
2- TURN ARROUND AREAS EACH 750m. (FIG.2)
3- "V" BUCKET MAY BE USED (SEE PHOTO)

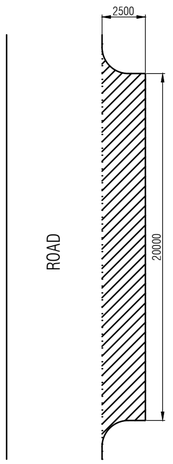


FIGURE 1

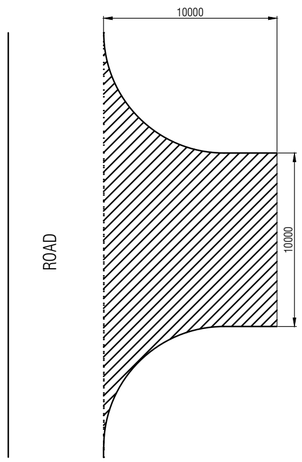


FIGURE 2

"V" BUCKET

Rev.	Date	Prepared	Reviewed	Approved	Reason / Description of changes.

IBERDROLA Engineering & Construction

Status Stamp:

Project: EAST ANGLIA

Location: BAWDSEY TO BRAMFORD

Contractor:

Status Stamp:

Drg. Title: CONSTRUCTION SWATHE TYPICAL CROSS SECTION

Client: SCOTTISHPOWER RENEWABLES

Date of First Issue: 15-07-2016

Prepared	Reviewed	Approved
IMFE	GRAT	FEBO

Drg. No.: EA1-GRD-E-IEC-007883

Contractors Drg. No. :

Sheet: 1 | Next: - | Rev: 0

Scale: 1:100 | Size: A2