HORIZON NUCLEAR POWER

WYLFA NEWYDD

ENERGY WORKING FOR BRITAIN

Wylfa Newydd Project

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Executive Summary

Introduction

1.1.1 This report presents Horizon Nuclear Power Wylfa Limited's (Horizon's) Shadow Habitats Regulations Assessment (HRA) for the Wylfa Newydd Project. Horizon is applying for a Development Consent Order (DCO) for the Project as well as the following licences from the Ministers of the Welsh Assembly (with licensing delegated to Natural Resources Wales (NRW)) and permits from NRW directly, to which this Shadow HRA is relevant:

- A Marine Licence for the marine construction works and for dredging and dredged material disposal (two licence applications are to be made, but a single Marine Licence is to be issued for all of the marine works).
- An Environmental Permit under Schedule 21 of the Environmental Permitting (England and Wales) Regulations 2016 (EPR16) for water discharge activities that will occur during the construction phase of the Project.
- An Environmental Permit under Schedule 21 of the EPR16 for a water discharge activity during the commissioning and operational phases of the Project.
- An Environmental Permit under Schedule 1 of the EPR16 for a combustion activity during the commissioning and operational phases of the Project.

1.1.2 A Radiological Substances Regulations (RSR) Environmental Permit also needs to be obtained from NRW and this is addressed in a separate RSR HRA Screening Report. Other permits and licences (from NRW) may also be required in due course (including Flood Risk Activity permits, European Protected Species licences and abstraction licences).

1.1.3 The term "Project" refers to all the works and activities to be consented by the DCO, Marine Licence and Environmental Permits described above. Those parts of the Project which are to be consented by the DCO comprise the Power Station and other on-site development (which also require Environmental Permits); Marine Works; the Off-Site Power Station Facilities; and Associated Development, including the Ecological Compensation Sites.

1.1.4 Horizon has submitted separate planning applications under the Town and Country Planning Act 1990 (as amended) (TCPA) for other development forming the Enabling Works for the Project.

The HRA process

1.1.5 The HRA process follows a four stage approach, as detailed in PINS Advice Note 10 [RD265], although for most projects only Stages 1 and 2 are required:

1) **Screening**: The process of identifying potentially relevant European Designated Sites, and whether the proposed project is likely to have a significant effect (LSE) on the interest features of the sites either alone or in-combination with other plans and projects.
2) **Appropriate Assessment**: Where a LSE for a European Designated Site cannot be ruled out, assessment of the potential effects on the integrity of the site, (either alone or in-combination with other plans and projects) in view of its qualifying features and conservation objectives is required. If an adverse impact on integrity remains following mitigation, the HRA must progress to Stages 3 and 4.
3) **Assessment of Alternative Solutions**: Examining alternative ways of achieving the objectives of the project to establish whether there are solutions that would avoid or have a lesser effect on the site(s).
4) **Imperative reasons of over-riding public interest (IROPI)**: Where no alternative solution exists, the next stage of the process is to assess whether the development is necessary for IROPI and, if so, the identification of compensatory measures needed to maintain site integrity or the overall coherence of the designated site network.

1.1.6 In respect of Stage 2, the integrity of a site is defined as the coherence of the site's ecological structure and function, across its whole area, which enables it to sustain the habitat, complex of habitats and/or populations of species for which the site has been designated [RD94]. An adverse effect on integrity, therefore, is likely to be one that prevents the site from making the same contribution to favourable conservation status for the relevant feature as it did at the time of designation.

1.1.7 In addition to the stages described above, for this Shadow HRA, a pre-screening site selection exercise was undertaken to identify the European Designated Sites and the designated features within each site to be taken forward into the Screening stage; referred to as Scoping.

1.1.8 For the assessment stage, the approach adopted for the design and construction of the Power Station, Power Station Off-Site Facilities and Associated Development was to set parameters, where necessary, for the extent of the development and key aspects of that development. The final design and construction methodology is to be limited to these parameters and limits of deviation. Hence the scenarios assessed in the HRA reflect these parameters and the worst realistic case.

Scoping European Designated Sites

1.1.9 For Scoping, the European Designated Sites identified in the strategic site-based HRA undertaken by DECC [RD76] were selected as a starting point. The scoping exercise was then re-run given the greater level of detail in relation to the location, design and the timing of Project activities available to Horizon compared with that available at the time of the DECC strategic HRA. This resulted in a greater number of European Designated Sites being 'scoped into' this Shadow HRA than identified by DECC [RD76].

1.1.10 A source-pathway-receptor approach was adopted for the scoping exercise to understand the mechanisms by which the Project might affect qualifying interest features of European Designated Sites. Ten categories of potential effect and, for each category, a number of different potential hazards to qualifying interest features were identified. For each hazard Zones of Influence (ZOIs) were established. The ZOIs were used in two ways:

- To inform the identification of relevant European Designated Sites and the relevant qualifying features to be scoped in to the Screening assessment.
- To inform the assessment of the potential for a LSE to arise (during Screening).

1.1.11 The 10 categories of potential effect examined were:

1. changes in visual and acoustic stimuli;
2. land-take, including seabed or intertidal land;
3. changes in marine water quality;
4. changes in terrestrial water quality;
5. changes in surface and groundwater hydrology;
6. introduction of non-native species;
7. change in radiation dose levels;
8. change in air quality;
9. alteration of coastal processes and hydrodynamics; and,
10. physical interaction between species and Project infrastructure.

1.1.12 The Scoping exercise identified that pathways for potential effects existed between the Project and European Designated Sites in Wales, England, Scotland, Ireland, Northern Ireland and France. The European Designated Sites scoped into the assessment are shown in figure A1 and figure A2. These sites and their interest features were considered in the Stage 1 Screening assessment.

Stage 1 Screening assessment

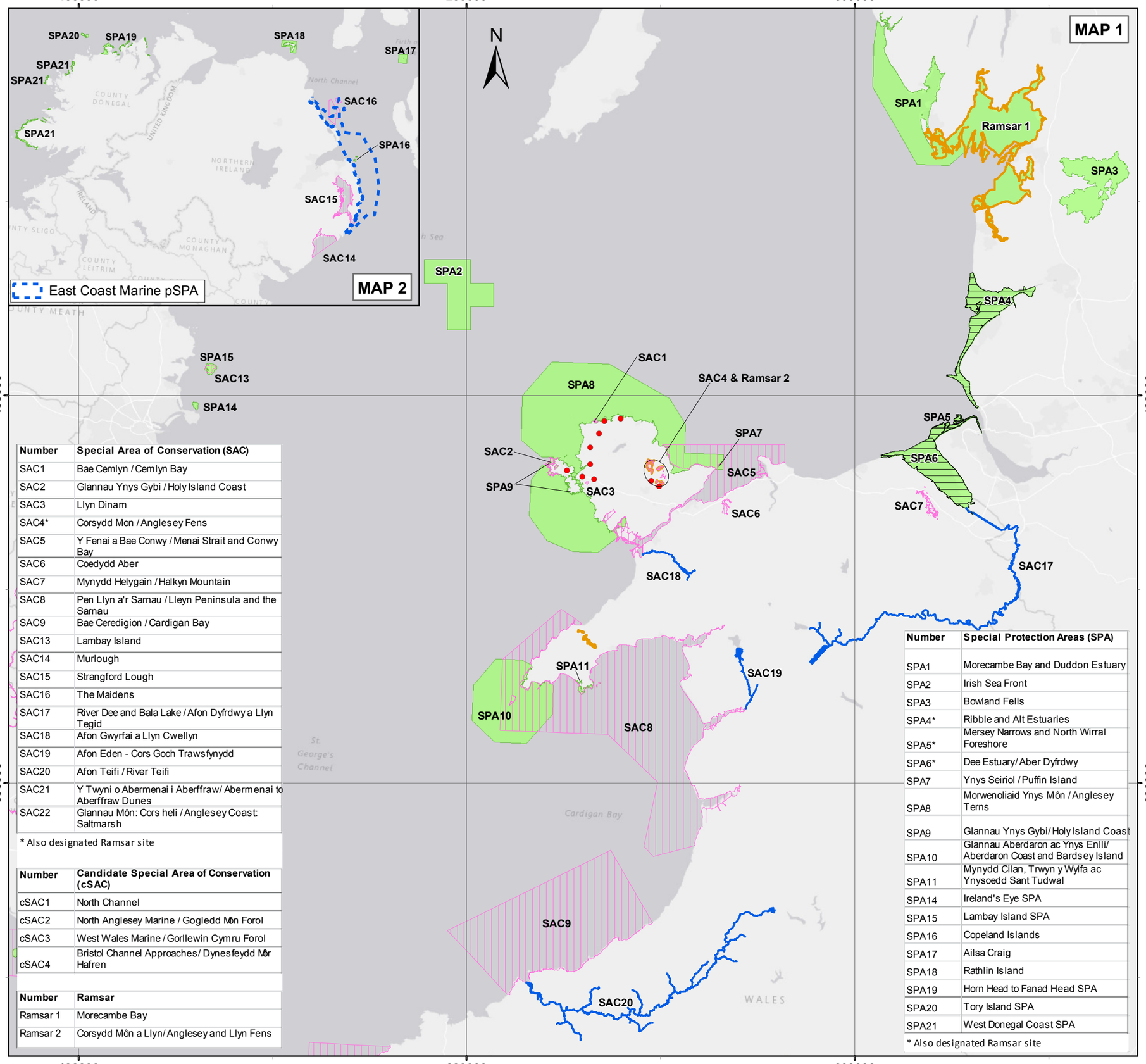
Conclusions – Construction and Operation

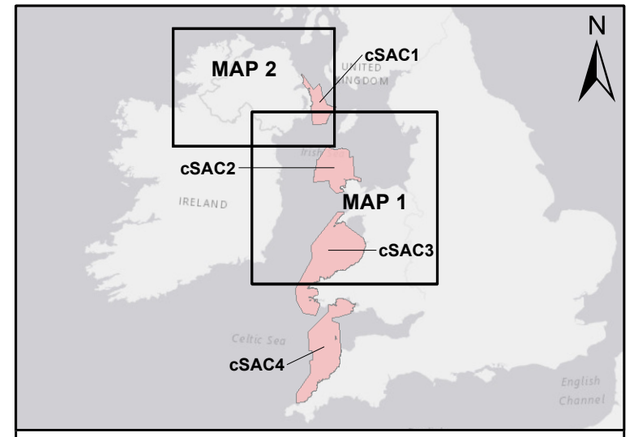
1.1.13 The Stage 1 Screening assessment identified whether LSE, either alone or in-combination with other plans and projects, is predicted to occur for the construction, operation and decommissioning phases of the Project.

1.1.14 For the construction and operation phases (decommissioning is considered below) the assessment concluded that LSEs could not be excluded for the following European Designated Sites in Wales, England, Scotland, Ireland and Northern Ireland (LSEs were excluded for all European Designated Sites in France):

Special Areas of Conservation (SACs) and candidate SACs (cSACs)

- Gogledd Môn Forol/North Anglesey Marine cSAC - Wales (UK0030398).
- Bae Cemlyn/Cemlyn Bay SAC - Wales (UK0030114).
- Glannau Ynys Gyb/Holy Island Coast SAC - Wales (UK0013046).
- Llyn Dinam SAC - Wales (UK0030186).
- Corsydd Môn/Anglesey Fens SAC - Wales (UK0012884).
- Afon Gwyrfai a Llyn Cwellyn SAC - Wales (UK0030046).
- Pen Llyn a'r Sarnau/Llyn Peninsula and the Sarnau SAC - Wales (UK0013117).
- Gorllewin Cymru Forol/West Wales Marine cSAC - Wales/England (UK0030397).
- Afon Eden–Cors Goch Trawsfynydd SAC - Wales (UK0030075).
- Afon Dyfrdwy a Llyn Tegid/River Dee and Bala Lake SAC Wales/England (UK0030252).
- Bae Ceredigion/Cardigan Bay SAC - Wales (UK0012712).
- Afon Teifi/River Teifi SAC - Wales (UK0012670).
- Dynesfeydd Môr Hafren/Bristol Channel Approaches cSAC - Wales/England (UK0030396).
- Sir Benfro Forol/Pembrokeshire Marine SAC - Wales (UK0013116).
- North Channel cSAC - Northern Ireland (UK0030399).
- Murlough SAC – Northern Ireland (UK0016612).
- Strangford Lough SAC – Northern Ireland (UK0016618).
- The Maidens SAC - Northern Ireland (UK0030384).
- Rockabill to Dalkey SAC - Ireland (IE003000).
- Lambay Island SAC – Ireland (IE0000204).





Number	Special Area of Conservation (SAC)
SAC1	Bae Cemlyn / Cemlyn Bay
SAC2	Glannau Ynys Gybi / Holy Island Coast
SAC3	Llyn Dinam
SAC4*	Corsydd Mon / Anglesey Fens
SAC5	Y Fenai a Bae Conwy / Menai Strait and Conwy Bay
SAC6	Coedydd Aber
SAC7	Mynydd Helygain / Halkyn Mountain
SAC8	Pen Llyn a'r Sarnau / Lleyn Peninsula and the Sarnau
SAC9	Bae Ceredigion / Cardigan Bay
SAC13	Lambay Island
SAC14	Murlough
SAC15	Strangford Lough
SAC16	The Maidens
SAC17	River Dee and Bala Lake / Afon Dyfrdwy a Llyn Tegid
SAC18	Afon Gwyrfai a Llyn Cwellyn
SAC19	Afon Eden - Cors Goch Trawsfynydd
SAC20	Afon Teifi / River Teifi
SAC21	Y Twyni o Abermenai i Aberffraw/ Abermenai to Aberffraw Dunes
SAC22	Glannau Môn: Cors heli / Anglesey Coast: Saltmarsh

* Also designated Ramsar site

Number	Candidate Special Area of Conservation (cSAC)
cSAC1	North Channel
cSAC2	North Anglesey Marine / Gogledd Môn Forol
cSAC3	West Wales Marine / Gorllewin Cymru Forol
cSAC4	Bristol Channel Approaches/ Dynesfeydd Môr Hafren

Number	Ramsar
Ramsar 1	Morecambe Bay
Ramsar 2	Corsydd Môn a Llyn/ Anglesey and Llyn Fens

Number	Special Protection Areas (SPA)
SPA1	Morecambe Bay and Duddon Estuary
SPA2	Irish Sea Front
SPA3	Bowland Fells
SPA4*	Ribble and Alt Estuaries
SPA5*	Mersey Narrows and North Wirral Foreshore
SPA6*	Dee Estuary/ Aber Dyfrdwy
SPA7	Ynys Seiriol / Puffin Island
SPA8	Morwenoliaid Ynys Môn / Anglesey Terns
SPA9	Glannau Ynys Gybi/ Holy Island Coast
SPA10	Glannau Aberdaron ac Ynys Enlli/ Aberdaron Coast and Bardsey Island
SPA11	Mynydd Cilan, Trwyn y Wylfa ac Ynysoedd Sant Tudwal
SPA14	Ireland's Eye SPA
SPA15	Lambay Island SPA
SPA16	Copeland Islands
SPA17	Ailsa Craig
SPA18	Rathlin Island
SPA19	Horn Head to Fanad Head SPA
SPA20	Tory Island SPA
SPA21	West Donegal Coast SPA

* Also designated Ramsar site

Legend

- Order Limits for the purposes of DCO (Refer to figure 4-1a for details)
- Special Protection Areas (SPA)
- Special Area of Conservation (SAC)
- Special Area of Conservation (SAC) - Rivers
- Ramsar only
- Designated as SPA and Ramsar
- Candidate Special Area of Conservation (cSAC)

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Client: HORIZON NUCLEAR POWER

Project: Wylfa Newydd Project

Title: European Designated Sites considered in the Shadow HRA

Figure: A1

Revision:	Date:	Drawn:	Checked:	Size:	Scale:
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Co-ordinate system: British National Grid

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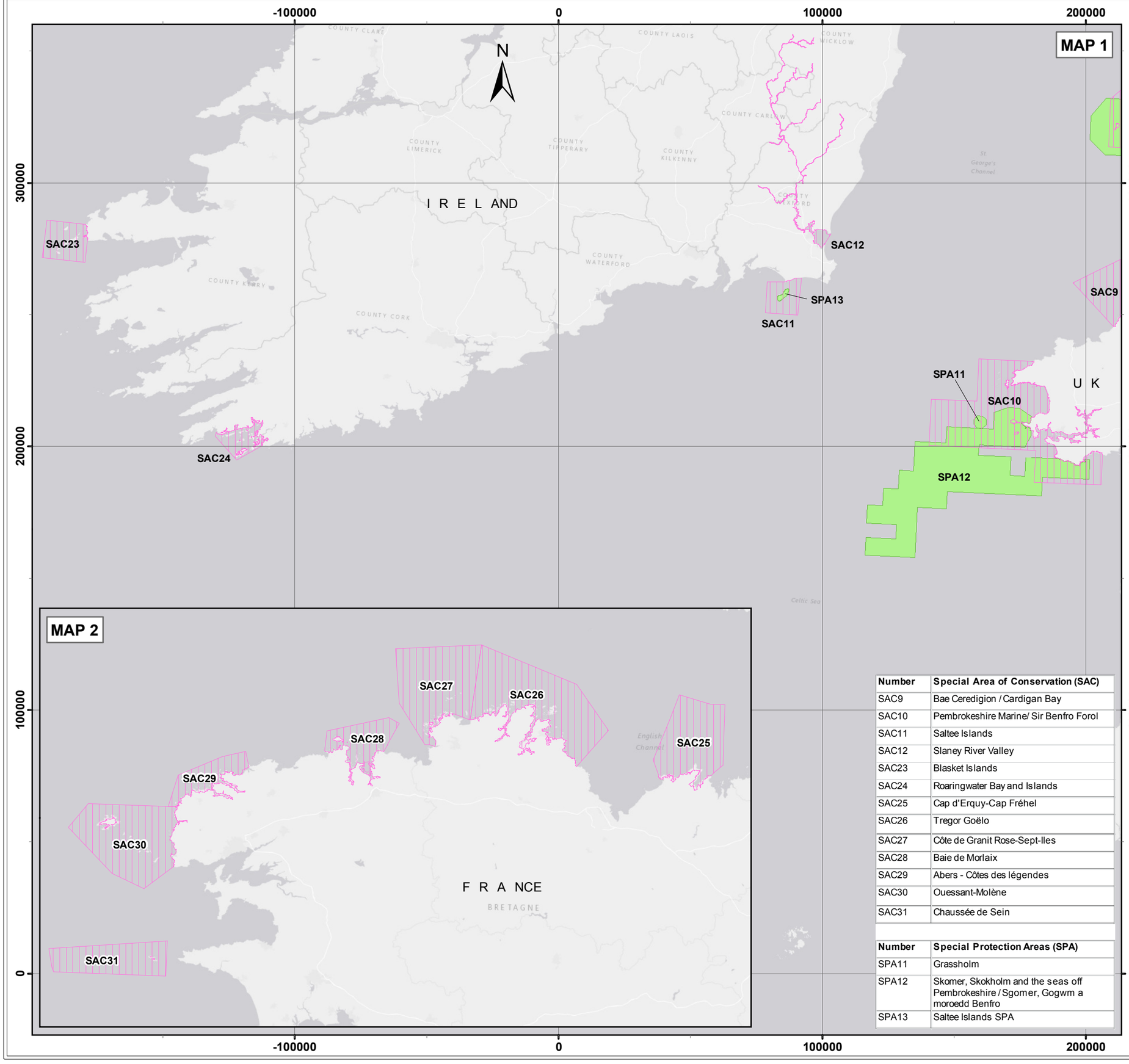

Legend

- Order Limits for the purposes of DCO (Refer to figure 4-1a for details)
- Special Protection Areas (SPA)
- Special Area of Conservation (SAC)

Number	Special Area of Conservation (SAC)
SAC9	Bae Ceredigion / Cardigan Bay
SAC10	Pembrokeshire Marine/ Sir Benfro Forol
SAC11	Saltee Islands
SAC12	Slaney River Valley
SAC23	Blasket Islands
SAC24	Roaringwater Bay and Islands
SAC25	Cap d'Erquy-Cap Fréhel
SAC26	Tregor Goëlo
SAC27	Côte de Granit Rose-Sept-Iles
SAC28	Baie de Morlaix
SAC29	Abers - Côtes des légendes
SAC30	Ouessant-Molène
SAC31	Chaussée de Sein

Number	Special Protection Areas (SPA)
SPA11	Grassholm
SPA12	Skomer, Skokholm and the seas off Pembrokeshire / Sgomer, Gogwm a moroedd Benfro
SPA13	Saltee Islands SPA

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Client: HORIZON NUCLEAR POWER

Project: Wylfa Newydd Project

Title: European Designated Sites considered in the Shadow HRA

Figure: A2

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- Slaney River Valley SAC – Ireland (IE0000781).
- Saltee Islands SAC – Ireland (IE0000707).

Special Protection Areas (SPAs) and potential SPAs (pSPAs)

- Morwenoliaid Ynys Môn/Anglesey Terns SPA - Wales (UK9013061).
- Glannau Ynys Gybi/Holy Island Coast SPA - Wales (UK9013101).
- Ynys Seiriol/Puffin Island SPA - Wales (UK9020285).
- Glannau Aberdaron and Ynys Enlli/Aberdaron Coast Bardsey Island SPA - Wales (UK9013121).
- Mynydd Cilan, Trwyn y Wylfa ac Ynysoedd Sant Tudwal/Mynydd Cilan, Trwyn y Wylfa and the St. Tudwal Islands SPA - Wales (UK9020282).
- Aber Afen Dyfrdwy/Dee Estuary SPA – Wales/England (UK9013011).
- Sgomer, Gogwm a moroedd Benfro/Skomer, Skokholm and the seas off Pembrokeshire SPA - Wales (UK9014051).
- Grassholm SPA - Wales (UK9014041).
- Mersey Narrows and North Wirral Foreshore SPA – England (UK9020287).
- Ribble and Alt Estuaries SPA – England (UK9005103).
- Morecambe Bay SPA – England (UK9005081).
- Morecambe Bay and Duddon Estuary SPA – England (UK9005081).
- Bowland Fells SPA - England (UK9005151).
- Lambay Island SPA - Ireland (004069).
- Ireland's Eye SPA - Ireland (004117).
- East Coast Marine pSPA – Northern Ireland (UK9020320).
- Copeland Islands SPA - Ireland (UK9020291).
- Saltee Islands SPA - Ireland (004002).
- Rathlin Island SPA – Northern Ireland (UK9020011).
- Horn Head to Fanad Head SPA – Ireland (004194).
- West Donegal Coast SPA – Ireland (004150).
- Tory Island SPA – Ireland (004073).
- Ailsa Craig SPA – Scotland (UK9003091).

Ramsar sites

- Corsydd Môn a Llyn/Anglesey and Llyn Fens Ramsar - Wales (UK14005).
- Aber Afen Dyfrdwy/Dee Estuary Ramsar site – Wales/England (UK11082).

- Mersey Narrows and North Wirral Foreshore Ramsar site - England (UK11042).
- Ribble and Alt Estuaries Ramsar site – England (UK11057).
- Morecambe Bay Ramsar site – England (UK11045).

Decommissioning

1.1.15 Horizon has a decommissioning strategy and decommissioning plan (which make assumptions regarding techniques to be employed during decommissioning) in place. However, the detail of the working methods to be adopted and the nature of the baseline environment conditions at the time of decommissioning (i.e. following around 60 years of operation) are currently unknown. Consequently, for the Stage 1 Screening assessment of potential decommissioning effects, it was assumed that the potential effects of construction, and for radiological discharge (assessed in a separate HRA Screening Report) the operational phase, would be replicated (to an extent) in the decommissioning phase; this represents a worst case. A set of working assumptions for decommissioning phase were established for each of the 10 screening categories.

1.1.16 The overriding assumption was that the potential effects of construction and operation would be bounding (i.e. the effects of decommissioning would be within the envelope of potential effects associated with construction and operation).

1.1.17 The Stage 1 Screening assessment concluded that, due to the likely scale of marine activities during decommissioning, LSE could not be excluded for marine water quality and changes in visual and acoustic stimuli. These issues were therefore addressed in the shadow Appropriate Assessment.

1.1.18 Based on the identified potential effects of the construction phase (and for radiological discharge the operational phase), and the set of assumptions made with regard to the (lesser extent of the) decommissioning phase, no LSEs were predicted to arise during the decommissioning phase for any of the other agreed screening categories.

1.1.19 Before any decommissioning work is undertaken there is a requirement to obtain consent from the Health and Safety Executive (HSE) under the Nuclear Reactors (Environmental Impact Assessment for Decommissioning) Regulations 1999.

Shadow Appropriate Assessment

Consultation and evidence

1.1.20 Consultation is a key part of the pre-application stage of the consenting process for Nationally Significant Infrastructure Projects (NSIP). Horizon has been consulting on its shadow HRAs for the Project and its associated consents since 2011.

1.1.21 The shadow Appropriate Assessment was informed by a number of modelling studies and assessments that have enabled a conclusion regarding potential effects on the integrity of the European Designated Sites listed above to be reached. The key studies are:

- The establishment of a seabird baseline and a marine mammal baseline (including prey species).
- Airborne and underwater noise modelling and assessment.
- Baseline disturbance monitoring at the Cemlyn tern colony.
- Marine water quality modelling (suspended sediments from drainage, dewatering, sewage, capital dredging and disposal and, for the operational phase, discharge from the Cooling Water System (CWS).
- Modelling predicted effects on groundwater and surface water flow regime.
- Air emissions (concentration and deposition) modelling.
- Coastal processes assessment (comprising waves, tidal currents, sediment regime and prediction of coastal geomorphological effect).
- Entrapment assessment (i.e. for prey species and Atlantic salmon) within the cooling water system.

In-combination effects

1.1.22 A scoping and screening exercise was undertaken to identify other plans and projects whose effects have the potential to interact with the effects of the Project and result in likely significant in-combination effects (LSIE). A list of other potentially relevant plans and projects for the in-combination assessment was compiled using the three sources of information:

- the list of projects and plans developed for the Project's Environmental Impact Assessment (EIA) cumulative impact assessment (CIA);
- a search of national registers of marine licences and foreshore licences; and
- a search of projects on the National Infrastructure Planning register (i.e. NSIPs).

1.1.23 For all other projects 'scoped into' the assessment (i.e. where the potential for interaction existed) it was assumed, on a precautionary basis, that the potential existed for a LSIE to arise. In addition, LSIE was concluded for one

plan (the North Wales Joint Local Transport Plan 2015 – 2020) due to the potential for in-combination effects to arise on the Corsydd Môn/Anglesey Fens SAC and the Corsydd Môn a Llyn/Anglesey and Llyn Fens Ramsar site.

1.1.24 In-combination assessment was undertaken for each of the projects and the plan screened in depending on their relevance to the interest features in question (e.g. harbour porpoise or Sandwich tern) as an integral part of the shadow Appropriate Assessment. The conclusions presented below reflect both the alone and in-combination assessment outcomes.

Mitigation

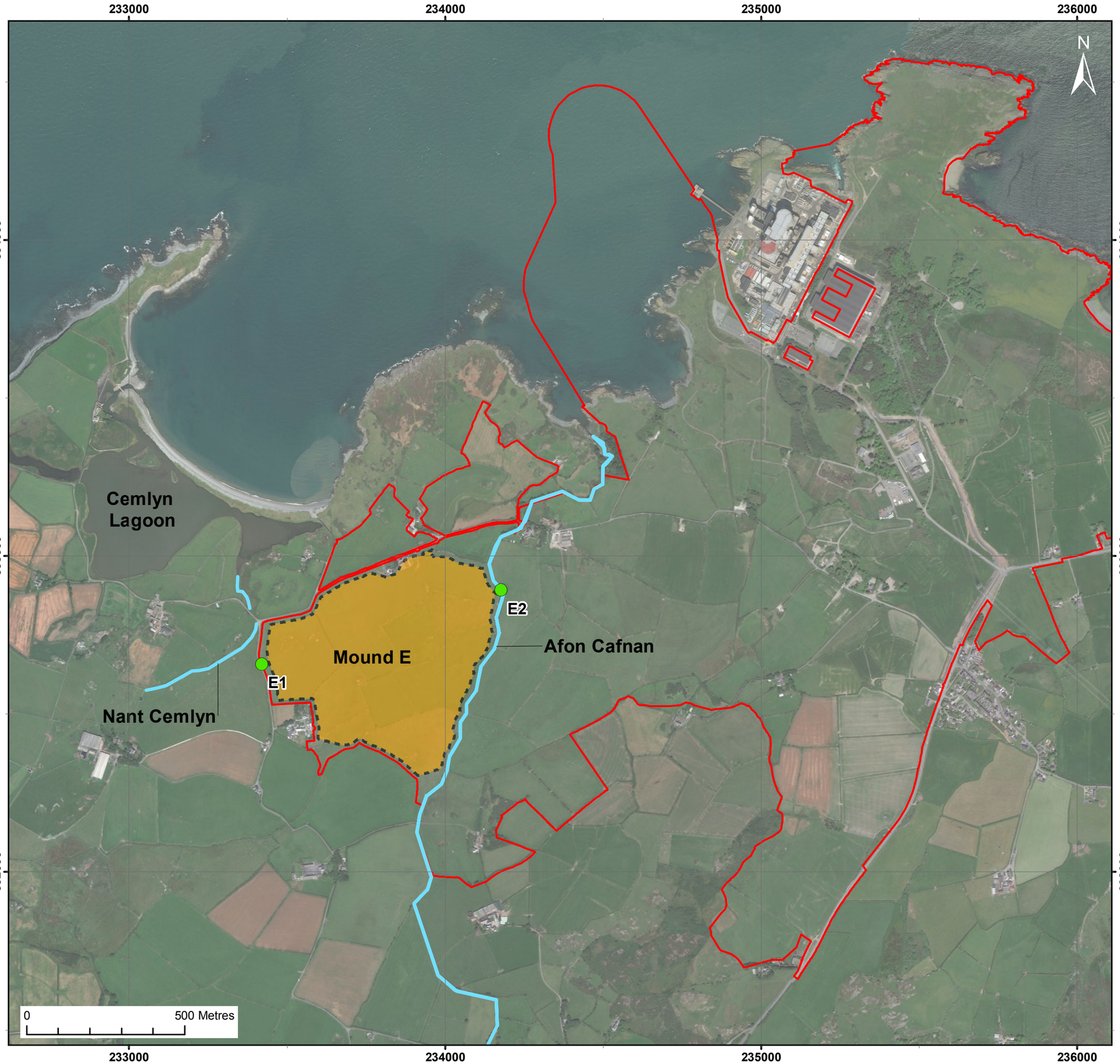
1.1.25 In reaching a conclusion regarding the effects of the Project on the integrity of European Designated Sites, proposed mitigation has been taken into account (in line with guidance). This is summarised below (note: this does not represent a full list of the measures proposed).

Increase in suspended sediment and potential change in chemical content of drainage discharge

- Appropriate drainage would be installed prior to Main Construction to manage run-off. This would include sediment settlement ponds and treatment to manage flows and meet water quality thresholds (EQS).
- From the point of the commencement of earthworks on the west of Mound E onwards, no water would be discharged into Nant Cemlyn via discharge E1 (see figure B) until vegetation has re-established and risk of sediment run off is agreed with NRW to be low.
- No polyelectrolyte dosing would be used for discharges to E1.
- After establishment of vegetation, if there are any additional bulk earthworks on the west of Mound E, no water would be discharged into Nant Cemlyn via discharge E1 until re-establishment has again been agreed in writing with NRW.
- During the above period(s) all water is to be diverted and discharged into the Afon Cafnan via discharge E2.

Operational discharge from the CWS

- The cooling water outfall has been designed to increase the momentum of the discharge to help propel the thermal plume, promote mixing and dispersal of associated biocide products to the north of Wylfa Head, where the offshore currents would aid decay and dispersion, and reduce the risk of recirculation.



Legend

- Order Limits for the purposes of DCO
- Inland discharge point

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Client: HORIZON NUCLEAR POWER

Project: Wylfa Newydd Project

Title: Location Plan

Figure: B

Revision:	Date:	Drawn:	Checked:	Size:	Scale:
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- In line with best practice, sodium hypochlorite would be used to control biofouling. The biocide dosing regime would be designed to reduce biofouling risk, normally between April and December, when sea temperatures are above 10°C. Typically biocide dosing would be applied to all areas of the CWS except around screens, to prevent harm to fish impinged on screens.

Construction dust

- Dust emissions during the construction phase would be managed in line with the requirements of the Wylfa Newydd Code of Construction Practice (Application Reference Number: 8.6).

Construction plant, machinery and marine vessels emissions

- Mains electricity or battery-powered equipment would be used where practicable to avoid the use of petrol or diesel generators.
- Construction plant and machinery would be maintained in accordance with the manufacturers' instructions to reduce the risk of elevated emissions, maintain abatement performance and ensure that any malfunctions are swiftly repaired.
- A comprehensive air quality monitoring and reporting scheme would be developed in discussion with the Isle of Anglesey County Council (IACC) and NRW, to include the agreement of thresholds and criteria to ensure compliance with appropriate environmental standards.

Combustion plant emissions

- The fuel to be used in the standby generators would be ultra-low sulphur diesel, which would reduce emissions of sulphur dioxide from the generator exhaust by a factor of 100 compared to standard gas oil
- The standby generators and boilers would always be operated in line with the selected equipment manufacturer’s operating procedures, or superseded by Horizon’s operating procedures as a nuclear operating facility. Horizon would undertake appropriate routine maintenance and testing of all proposed combustion plant to optimise combustion parameters and avoid abnormal or elevated emissions.
- For routine testing during normal operations only one standby generator would ever be tested at any one time. In addition, no routine tests on other standby generators would be undertaken within the same day to eliminate the potential for any combined short-term effects.

Underwater noise

1.1.26 The construction activities would follow best practice guidance for minimising the risk of injury to marine mammals from piling noise detailed by the Joint

Nature Conservation Committee. This guidance includes, amongst others, the requirements listed below.

- Establish a mitigation zone around the construction site.
- Only commence construction operations during the hours of daylight and good visibility.
- Visual monitoring by Marine Mammal Observer(s) (MMOs).
- Passive Acoustic Monitoring (PAM).
- Pre–construction activity search for marine mammals.
- Delay if marine mammals detected within the mitigation zone.
- Soft-start of construction activity for a period of not less than 20 minutes.
- Pre–construction activity search and soft-start procedure should be repeated before construction activity recommences, if construction activity operations pause for a period of greater than 10 minutes.
- Reports detailing the construction activity and marine mammal mitigation, the 'MMO and PAM reports', should be sent to the relevant conservation agency after the end of the construction activity.

Noise disturbance at the breeding tern colony

1.1.27 Appropriate mitigation is proposed to ensure that noise levels at the colony from construction works (including from blasts) remain below those considered likely to elicit flight responses by the terns at the Cemlyn Bay colony. This mitigation is set out below and would apply from 15th April to 15th August, unless otherwise stated.

Monitoring

1.1.28 During construction works noise levels would be measured at the tern colony either through direct monitoring on the island or calculations based on monitoring adjacent locations.

1.1.29 Where monitored noise levels are found to be above the committed noise levels (below), the following actions would be undertaken immediately (also see 'Reactive monitoring'):

- review works in the area likely to be causing the breach and consider any necessary mitigation actions (including, if necessary, temporary suspension of works);
- confirm that monitored levels are not being impacted by other noise or vibration sources;
- determine whether the exceedance is due to a particular activity or item of equipment and, if so, identify if the equipment can be substituted for an alternative piece of equipment;

- implement other feasible and reasonable measures (which may include modifying time of works, using an alternate construction methodology, or a combination of these); and
- continue monitoring to verify that the control measures have reduced the noise levels to acceptable level at the relevant receptors.

Main earthworks (anticipated to be for the first two years, but to be kept under review)

1.1.30 Horizon will commit that:

- Blasting on the site would only be undertaken when, taking into account wind factors, noise shielding and other mitigation, the predicted blast noise at the colony would be less than 60 dB or daily ambient noise at the colony (whichever is higher).
- Day-time construction noise at the colony would not exceed 59 dB $L_{Aeq, 1\text{-hour}}$ [Reason: based on modelled noise level of 58.6 dB LAeq, 1-hour].
- Night-time (7pm to 7am) maximum construction noise at the colony would not exceed 43 dB $L_{Aeq, 1\text{-hour}}$ [Reason: based on modelled noise level of 42.8 dB $L_{Aeq, 1\text{-hour}}$].

Subsequent seasons (anticipated to be year 3 onwards)

1.1.31 Day-time modelling of construction activities predicts level of 43.7 dB $_{LAeq, 1\text{-hour.}}$ Night-time (7pm to 7am) modelling of construction activities predicts level of 42.4 dB $L_{Aeq, 1\text{-hour.}}$ Therefore no specific general construction noise commitments are proposed.

1.1.32 However, Horizon will commit to the following for subsequent nesting season establishment periods (as defined below):

- Blasting would only be undertaken when blast noise calculations (including weather conditions) predict noise levels at the colony of less than 54 dB $L_{AF,max}$ [Reason: main blasting would be complete and only minor or unforeseen blasting requirements would remain].

Establishment period

1.1.33 During the ‘main earthworks’, in order to allow for the sensitivity of terns arriving and establishing their nesting colony, additional construction constraints (below) would be applied during the ‘establishment period’.

1.1.34 The ‘establishment period’ is to be defined as follows:

- The tern nesting site would be monitored from 1st April each year (historically only very few terns arrive before early April each year).
- The establishment period would be four weeks, to be taken as starting on 15th April unless significant nest establishment is observed ahead of this date, in which case it would begin earlier.

- The activities that constitute the establishment of nesting territories by any tern species that is a qualifying feature of the Morwenoliaid Ynys Môn/Anglesey Terns SPA are aerial display flights over the nesting islands and/or performing courtship behaviour on the ground by scrape making. In addition to these activities taking place, the frequency of occurrence of such activity is important in defining the establishment period, and Horizon would agree the basis for determining the start of the establishment period (including observed activity and frequency of occurrence) with NRW.
- Trained professional, independent ornithologists would monitor black-headed gull to determine if their nesting behaviour appears to be affected by construction noise. If there is a lack or low numbers (based on black-headed gull status and trends) of recorded black-headed gull nesting attempts at the Cemlyn colony, the mitigation defined below would be initiated at an earlier point in time.

1.1.35 The constraint period would be as the 'establishment period' and apply for no more than four weeks but would end earlier if >c.50% of the Sandwich terns expected to be present in the colony are considered to have begun egg-laying and be sitting on nests.

1.1.36 During the establishment period for the first two years of construction, Horizon will commit to:

- Blasting on the site would only be undertaken when, taking in account wind factors, noise shielding and other mitigation, the predicted blast noise at the colony would be less than 55 dB $L_{AF,max}$ or the daily ambient noise at the colony (whichever is higher). [Reason: this allows some blasting in favourable wind conditions (i.e. when the wind direction is such that the tern colony is not downwind of the construction works), any further constraint in blast size is likely to prevent any meaningful work on the site.]
- Day-time construction noise at the colony would not exceed 55 dB $L_{Aeq, 1\text{-hour}}$. [Reason: during this period Horizon will commit to only undertaking works on the far side of Mound E that are not visible from the colony and minimising reworking of dumped material in this area. Noise modelling of this working pattern predicts 57.5 dB $L_{Aeq, 1\text{-hour}}$. In order to achieve 55 dB $L_{Aeq, 1\text{-hour}}$, works would avoid the most adverse (light downwind) wind conditions for noise transfer to the colony.]
- Night-time (7pm to 7am) construction noise at the colony would not exceed 43 dB $L_{Aeq, 1\text{-hour}}$ [Reason: based on modelled noise level of 42.8 dB $L_{Aeq, 1\text{-hour}}$].

Reactive monitoring

1.1.37 The above mitigation provides further assurance that noise levels at the colony from construction works (including from blasts) would remain below those considered likely to elicit flight responses by the terns at the Cemlyn Bay colony. However, on a precautionary basis, ongoing monitoring by

independent, professional observers of the terns throughout the nesting period would be undertaken to understand whether there is any increase in fly-ups.

1.1.38 If this occurs and is directly related to the noise from construction, further measures would be taken to reduce noise. It is not possible to identify these further measures in advance because the assessment (including the mitigation set out above) demonstrates that there would be no effect. The monitoring is included as a precautionary measure to account for the fact that characteristics of noise other than loudness may eliciting a response from the terns at the colony and to allow the issue to be revisited in the light of experience during the construction works. The approach proposed is summarised as:

- Throughout the nesting periods during the construction phase, if the colony exhibits fly-up disturbance reactions (to be agreed with NRW) as a direct result of attributable noise events or shows a measurable increase in the incidence of disturbance events above those recorded during baseline observation works (undertaken over the 2017 and 2018 breeding seasons), then alternative methods of working or additional constraints would be applied (including the option of temporary suspension of works).
- In order to attribute noise events responsible for an observed disturbance reaction to the construction works, Horizon would establish a real time feedback mechanism between the observers and a nominated, dedicated site manager.

Visual disturbance at the breeding tern colony

- Between 15th April and 15th May there would be no works undertaken within 500m of the nesting islands and the areas on the shingle ridge that are known to be used occasionally by nesting terns. Thereafter, there would be no bulk earthworks undertaken within 500m of any known active tern nests within the Morwenoliaid Ynys Môn/Anglesey Terns SPA.

Entrapment of fish in the CWS

1.1.39 The CWS will be designed to limit the entrapment of marine organisms, including through the following measures:

- A maximum intake velocity of 0.3m/s in front of the intake opening at lowest astronomical tide.
- Screening in the form of coarse raked bars located in front of fine mesh drum screens (for the main cooling water intake) and band screens (for the service water intake). The proposed fine mesh screen size is 5mm.
- An Acoustic Fish Deterrent (AFD) in front of the cooling water intake. It equally would be designed to avoid effects on marine mammals.

- An effective Fish Recovery and Return system, with the discharge point located below Lowest Astronomical Tide that would remove fish impinged on all screens and return them to sea.

Visitor pressure

- A Workforce Management Strategy would be implemented to keep workers on site and control their interactions with the people and environment around them.

Introduction of invasive non-native species (INNS)

- Horizon would comply with the Ecology and Landscape Management Strategies in the main Code of Construction Practice (CoCP) (Application Reference Number: 8.6) and sub-CoCPs (Application Reference Numbers: 8.7, 8.8, 8.9, 8.10, 8.11, 8.12), which include a requirement to produce and adhere to a 'biosecurity risk assessment and method statement' based on industry standards.

Resilience measures

1.1.40 In addition to the above mitigation, Horizon has held discussions with the North Wales Wildlife Trust, the National Trust and the Royal Society for the Protection of Birds (RSPB) regarding various resilience measures that would be beneficial to the management of Cemlyn lagoon. These include:

- The provision of annual funding during the construction phase to maintain or enhance the productivity and breeding success of the tern colony through predator control measures, increasing the length of seasonal staffing to encompass March and the August Bank Holidays, access management and the investigation of measures to secure breeding habitat.
- The development of an incident response plan, and agreed triggers, to address any adverse effects of increased sediment loads discharging to the lagoon from storm events, nutrient release and heavy metals/contaminants.
- Discussions with the landowner, tenant and NRW regarding the introduction of a weir/sluice at the mouth of the lagoon, with a facility to stop lock the inflow and regulate storm water flows, to manage water levels.

1.1.41 These measures are not required as mitigation arising from predicted Projects effects and as such are not identified as mitigation measures in the Shadow HRA assessment. On this basis the measures do not represent a material consideration for decision making purposes. Horizon would, however, identify and facilitate initiatives to implement the identified measures on a voluntary basis.

Conclusions of the Appropriate Assessment

Habitats and species (terrestrial, freshwater and coastal) of SACs and Ramsar sites

Bae Cemlyn/Cemlyn Bay SAC

1.1.42 It is concluded that no adverse effects on the integrity of the coastal lagoon qualifying feature of the Bae Cemlyn/Cemlyn Bay SAC would arise for any of the categories of effect where LSE could not be discounted (i.e. changes to air quality, coastal processes, surface and groundwater hydrology and terrestrial and marine water quality) due to the construction, operation and decommissioning phases of the Project, either alone or in-combination with other plans and projects.

1.1.43 The mitigation measures proposed (including those embedded into the design) would reduce the potential effects of the Project on water quality in the Cemlyn lagoon. In particular, the diversion of the discharge from the drainage system from Nant Cemlyn to Afon Cafnan until the risk of suspended sediment release is low would significantly reduce effects on the lagoon.

1.1.44 With regard to the perennial vegetation of stony banks qualifying feature, the extent of vegetation and/or the typical component species have the potential to be altered due to increased nitrogen and acid deposition from construction plant, machinery and vessel emissions. However, no adverse effect on integrity of this qualifying feature is predicted.

1.1.45 Furthermore, an adverse effect is not predicted on supporting habitats (Esgair Cemlyn) as a result of the Project (i.e. due to changes in coastal processes, deposition of fine sediment during capital dredging or from discharge from the drainage system or sewage inputs).

Other SACs/Ramsar site

1.1.46 In addition to the Bae Cemlyn/Cemlyn Bay SAC, the following European Designated Sites with terrestrial, freshwater and coastal habitat and species qualifying features (excluding birds) were screened into the assessment:

- Glannau Ynys Gybi/Holy Island Coast SAC.
- Llyn Dinam SAC.
- Corsydd Môn/Anglesey Fens SAC.
- Corsydd Môn a Llyn/Anglesey and Llyn Fens Ramsar site.

1.1.47 The only screening category for which LSE was determined for the Glannau Ynys Gybi/Holy Island Coast SAC and Llyn Dinam SAC was ‘air quality’ (in the construction and operational phases).

1.1.48 For the Corsydd Môn/Anglesey Fens SAC and the Corsydd Môn a Llyn/Anglesey and Llyn Fens Ramsar site, LSE was determined for ‘air quality’ (operational phase only) and, for the creation of new fen habitat and the improvement of existing fen habitat at Cae Canol-dydd and Cors Gwawr

as compensation for potential effects on Tre'r Gof Site of Special Scientific Interest (SSSI), 'terrestrial water quality' and 'surface and groundwater hydrology'.

1.1.49 This shadow Appropriate Assessment concludes that no adverse effect on site integrity will arise for the Glannau Ynys Gybi/Holy Island Coast SAC, Llyn Dinam SAC, Corsydd Môn/Anglesey Fens SAC and Corsydd Môn a Llyn/Anglesey and Llyn Fens Ramsar site due to air emissions. The basis for this conclusion is that the flora and fauna species composition, habitat condition, habitat distribution and cover, population viability of component species and presence of invasive species (which are all criteria embodied within the conservation objectives for each European Designated Site) would not be adversely affected by the predicted effects of the Project on air quality.

1.1.50 No adverse effect on site integrity is also concluded for the Corsydd Môn/Anglesey Fens SAC and Corsydd Môn a Llyn/Anglesey and Llyn Fens Ramsar site due to changes in terrestrial water quality and surface and groundwater hydrology. In the post-construction phase, the creation of new fen habitat and the improvement of existing fen habitat is expected to contribute positively towards achieving the conservation objectives for these European Designated Sites.

Marine mammals

Introduction

1.1.51 For all European Designated Sites with marine mammals as qualifying features, the following screening categories were assessed in this shadow Appropriate Assessment in the context of the construction, operational and (where appropriate) decommissioning phases of the Project:

- changes in visual and acoustic stimuli;
- land take, including seabed or intertidal land;
- changes in marine water quality; and
- physical interaction between species and Project infrastructure.

1.1.52 For all species, the potential for the Project to affect key prey resource was assessed, with the above screening categories also being relevant in this regard.

1.1.53 The principle behind the conservation objectives for European Designated Sites with marine mammals as qualifying features is that the population is maintained and is viable, there is no significant disturbance of the species, the natural range of the population is not reduced and the presence, abundance, condition and diversity of supporting habitats and species is stable or increasing.

Harbour porpoise

1.1.54 Harbour porpoise is a qualifying interest feature of the Gogledd Môn Forol/North Anglesey Marine cSAC. The assessment of this cSAC for

harbour porpoise is based on the population of the Celtic and Irish Seas Management Unit (CIS MU).

1.1.55 The maximum predicted impact range for a permanent threshold shift (PTS) is 25m as a result of rock breaking without mitigation, which has the potential to affect less than one harbour porpoise.

1.1.56 The maximum predicted effect of the Project is due to underwater noise during the construction works, which could potentially disturb up to a maximum of three harbour porpoise (0.003% of the CIS MU). The maximum predicted area of behavioural response, which could lead to temporary disturbance of harbour porpoise is 1.26km^2 which would be 0.04% of the cSAC.

1.1.57 In light of the above assessment, this shadow Appropriate Assessment concludes that there would be no adverse effect on the integrity of the Gogledd Môn Forol/North Anglesey Marine cSAC.

1.1.58 The following European Designated Sites have harbour porpoise as a qualifying feature and are also located within the CIS MU:

- Gorllewin Cymru Forol/West Wales Marine cSAC.
- Dynesfeydd Môr Hafren/Bristol Channel Approaches cSAC.
- North Channel cSAC.
- Rockabill to Dalkey Island SAC (Ireland).

1.1.59 For these other sites, there is no potential for any direct effects and the only pathway for a potential effect is on the population of the CIS MU (i.e. the individuals associated with the SACs/cSACs). On this basis, therefore, the effects on the SAC/cSACs listed above would be the same as or smaller than the results for the CIS MU for the Gogledd Môn Forol/North Anglesey Marine cSAC. Hence, an adverse effect on integrity, alone or in-combination with other plans and projects, of these European Designated Sites is not predicted.

Bottlenose dolphin

1.1.60 Bottlenose dolphin is a qualifying interest feature of two European Designated Sites screened into the assessment (Pen Llyn a'r Sarnau/Llŷn Peninsula and the Sarnau SAC and Bae Ceredigion/Cardigan Bay SAC).

1.1.61 The maximum predicted range for a PTS is 36m as a result of rock breaking, without mitigation, which has the potential to affect 0.0014 bottlenose dolphin (0.00035% of the CIS MU reference population). During construction the maximum number of bottlenose dolphin that potentially could be temporarily disturbed as a result of underwater noise would be up to a maximum of one individual (up to 0.25% of the IS MU reference population).

1.1.62 In light of the above assessment, this Shadow HRA concludes that there would be no adverse effect on the integrity, alone or in-combination with other plans and projects, of these European Designated Sites (noting that grey seal is also a qualifying feature of the Pen Llyn a'r Sarnau/Llŷn Peninsula and the Sarnau SAC; see below) at any stage of the Project.

Grey seal

1.1.63 In addition to Pen Llyn a'r Sarna /Llŷn Peninsula and the Sarnau SAC, the Shadow HRA assessed the following European Designated Sites with grey seal as a qualifying feature:

- Bae Ceredigion/Cardigan Bay SAC.
- Sir Benfro Forol/Pembrokeshire Marine SAC.
- The Maidens SAC (Northern Island).
- Lambay Island SAC (Ireland).
- Saltee Islands SAC (Ireland).

1.1.64 The assessment for these European Designated Sites is based on the South and West England and Wales MU.

1.1.65 The maximum predicted range for a PTS is 450m as a result of rock breaking, which has the potential to affect 0.15 grey seal (0.0025% of the MU population). During construction, the number of grey seal that could be temporarily disturbed as a result of underwater noise would be up to a maximum of 20.5 individuals (up to 0.3% of the reference population).

1.1.66 In light of the above assessment, this shadow Appropriate Assessment concludes that there would be no adverse effect on the integrity, alone or in-combination with other plans and projects, of these European Designated Sites at any stage of the Project.

Harbour seal

1.1.67 Harbour seal is a qualifying feature of the following European Designated Sites with respect to:

- Murlough SAC (Northern Ireland).
- Strangford Lough SAC (Northern Ireland).
- Lambay Island SAC (Ireland).
- Slaney River Valley SAC (Ireland).

1.1.68 The assessment for these European Designated Sites is based on the population of the West England and Wales MU.

1.1.69 The maximum predicted range for PTS is 450m as a result of rock breaking, which has the potential to affect 0.0005 harbour seal (0.001% of the MU population). During construction, the maximum number of harbour seal that potentially could be temporarily disturbed as a result of underwater noise could be up to 0.05 individuals (0.1% of the MU population).

1.1.70 In light of the above assessment, this shadow Appropriate Assessment concludes that there would be no adverse effect on the integrity, alone or in-combination with other plans and projects, of these European Designated Sites at any stage of the Project.

Atlantic salmon and freshwater pearl mussel

1.1.71 A LSE could not be excluded for the following SACs with Atlantic salmon as qualifying features:

- Afon Gwyrfai a Llŷn Cwellyn SAC.
- Afon Eden–Cors Goch Trawsfynydd SAC.
- Afon Dyfrdwy a Llŷn Tegid/River Dee and Bala Lake SAC.
- Afon Teifi/River Teifi SAC.

1.1.72 In addition to Atlantic salmon, the freshwater pearl mussel *Margaritifera margaritifera* is an interest feature of the Afon Eden–Cors Goch Trawsfynydd SAC. The freshwater pearl mussel population of the Afon Eden–Cors Goch Trawsfynydd SAC spends its larval stage attached to the gills of sea trout.

1.1.73 The conservation objectives for these SACs refer to Atlantic salmon population stability and viability, the natural range of the qualifying feature not being reduced and no reduction in habitat area and quality. For the freshwater pearl mussel population of the Afon Eden–Cors Goch Trawsfynydd SAC, the conservation objectives refer to maintaining a viable population on a long term basis, no contraction in the number, age range, distribution or size of mussel beds found within the population, sufficient habitat being available to support a viable population and the transference of pearl mussel glochidia (larvae) is facilitated by an abundant and self-sustaining Atlantic salmon population (noting that this latter objective was written prior to research undertaken by NRW which suggests that sea trout is the host species for the freshwater pearl mussel).

1.1.74 This shadow Appropriate Assessment concludes that the predicted effects of the Project on underwater noise, coastal processes and water quality during its construction and operational phases are not significant in the context of the migration pathways for juvenile and adult Atlantic salmon or sea trout. In addition, no significant entrapment in the cooling water system is predicted. On this basis, no adverse effect on the integrity, alone or in-combination with other plans and projects, of the above European Designated Sites at any stage of the Project is predicted.

Birds

Morwenoliaid Ynys Môn/Anglesey Terns SPA

1.1.75 The Project lies partly within the boundary of the Morwenoliaid Ynys Môn/Anglesey Terns SPA. The qualifying features of this SPA are Sandwich tern (*Sterna sandvicensis*), common tern (*Sterna hirundo*), Arctic tern (*Sterna paradisaea*) and roseate tern (*Sterna dougallii*).

1.1.76 The potential effects of the Project were assessed for the Morwenoliaid Ynys Môn/Anglesey Terns SPA for the following screening categories:

- changes in visual and acoustic stimuli;
- land-take (including seabed or intertidal);
- changes in marine water quality;

- changes in surface and groundwater hydrology;
- change in air quality;
- alteration of coastal processes and hydrodynamics; and
- physical interaction between species and Project infrastructure.

1.1.77 The most significant potential effects on the tern populations of the SPA, particularly the Sandwich tern population that breeds on the islands within Cemlyn lagoon, are from noise and visual disturbance during construction and potential effects on tern prey resources due to changes in marine water quality during construction (suspended sediments from capital dredging, dewatering and sewage discharge) and operation (discharge of cooling water), as well as entrapment of prey species within the circulating water system.

1.1.78 With the implementation of the proposed mitigation related to construction noise, blasting noise and visual disturbance, this shadow Appropriate Assessment concludes that no adverse effect on the integrity of the Morwenoliaid Ynys Môn/Anglesey Terns SPA would occur at any stage of the Project due to alone or in-combination effects.

Other SPAs, pSPAs and Ramsar sites (with bird qualifying features)

1.1.79 The assessment for all other SPAs, pSPAs and Ramsar sites for which LSE was determined on the basis of breeding seabird populations (except the Morwenoliaid Ynys Môn/Anglesey Terns SPA) involved a species apportionment exercise. This estimates the number of birds within the population observed within the surveyed area that are expected to derive from the colonies of each relevant European Designated Site.

1.1.80 For all of these European Designated Sites, except the Glannau Aberdaron and Ynys Enlli/Aberdaron Coast Bardsey Island SPA, the apportionment exercise concluded that the population within the survey area represents a fraction of 1% of the respective population of each European Designated Site. Therefore, in this context, adverse effects on site integrity can be excluded (alone and in-combination).

1.1.81 For the Glannau Aberdaron and Ynys Enlli/Aberdaron Coast Bardsey Island SPA, the potential for connectivity was identified for the qualifying species Manx shearwater. Based on raw counts from boat surveys, a precautionary assumption was made that the Disposal Site may be used by significant numbers of breeding Manx Shearwater from the SPA. However, this shadow Appropriate Assessment concludes that adverse effects on the integrity of this SPA can be excluded (alone and in-combination) because of the lack of impact on the population from the different potential effects.

1.1.82 For three SPAs for which breeding and non-breeding chough are qualifying features, LSE was also determined on the basis of possible connectivity with the Wylfa Newydd Development Area, namely:

- Glannau Ynys Gybi/Holy Island Coast SPA.

- Glannau Aberdaron and Ynys Enlli/Aberdaron Coast Bardsey Island SPA.
- Mynydd Cilan, Trwyn y Wylfa ac Ynysoedd Sant Tudwal/Mynydd Cilan, Trwyn y Wylfa and the St. Tudwal Islands SPA.

1.1.83 This shadow Appropriate Assessment concludes that there is evidence of a functional link with the Wylfa Newydd Development Area, but adverse effects on the integrity of these SPAs can be excluded for all stages of the Project, because a functional link could only be established for the Glannau Ynys Gybi/Holy Island Coast SPA, and in this case the level of functionality is insignificant.

Conclusion of the Shadow HRA

1.1.84 The overall conclusion drawn from the above for the purposes of the Shadow HRA is that an adverse effect on the integrity of European Designated Sites or their qualifying interest features would not arise due to the effects from the Project in its construction, operation or decommissioning phases, either alone or in-combination with other plans and projects.

1.1.85 The proposed mitigation measures would be secured through the DCO, Marine Licence and Environmental Permits.

1.1.86 In the context of the HRA process, given the findings of the shadow Appropriate Assessment, this assessment can be concluded at the end of Stage 2 and, hence, Stages 3 and 4 do not need to be considered.

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1 Introduction

1.1 Purpose and scope of this document

1.1.1 This report presents Horizon Nuclear Power Wylfa Limited's (Horizon's) Shadow Habitats Regulations Assessment (HRA) for the Wylfa Newydd Project. Horizon is applying for a Development Consent Order (DCO) for the Project as well as the following licences from the Ministers of the Welsh Assembly (with licensing delegated to Natural Resources Wales (NRW)) and permits from NRW directly, to which this Shadow HRA is relevant:

- A Marine Licence for the marine construction works and for dredging and dredged material disposal (two licence applications are to be made, but a single Marine Licence is to be issued for all of the marine works).
- An Environmental Permit under Schedule 21 of the Environmental Permitting (England and Wales) Regulations 2016 (EPR16) for water discharge activities that will occur during the construction phase of the Project.
- An Environmental Permit under Schedule 21 of the EPR16 for a water discharge activity during the commissioning and operational phases of the Project.
- An Environmental Permit under Schedule 1 of the EPR16 for a combustion activity during the commissioning and operational phases of the Project.

1.1.2 A Radiological Substances Regulations (RSR) Environmental Permit for radioactive substances also needs to be obtained from NRW and this is addressed in a separate RSR HRA Screening Report (Wylfa Newydd Project - RSR - Environmental Permit Application [WN0908-HZCON-PAC-REP-00003]); the findings of which are reflected herein.

1.1.3 Other permits and licences from NRW may also be required (including Flood Risk Activity permits, European Protected Species licences and abstraction licences).

1.1.4 The term "Project" in this report refers to all the works and activities to be consented by the DCO, Marine Licence and Environmental Permits described above.

1.1.5 Horizon has submitted separate planning applications under the Town and Country Planning Act 1990 (as amended) (TCPA) for other development forming the Enabling Works for the Project. These include the Site Preparation and Clearance (SPC) works (application validated by Isle of Anglesey County Council (IACC) on 16 November 2017; application reference number 38C310F/EIA/ECON) and the A5025 On-line Highway Improvements (application validated by IACC on 7 December 2017; application reference number 27C106E/FR/ECON). These applications are subject to separate, individual HRA, but the effects of these Enabling Works have been taken into account in the assessment for the (whole) Project

included in this Shadow HRA. The SPC works are also included within the scope of works to be consented by the DCO.

1.1.6 This Shadow HRA is provided in support of the applications for the consents referred to in paragraph 1.1.1. It provides information for the Secretary of State for Business, Energy and Industrial Strategy (BEIS), in the context of the DCO, and NRW in support of their own HRA processes.

1.2 European obligations

1.2.1 European Union (EU) obligations in respect of habitats and species are imposed through Council Directive 92/43/EEC on the conservation of natural habitats and of wild fauna and flora (Habitats Directive), which requires Member States to designate important wildlife sites throughout the European Community as Special Areas of Conservation (SACs) and to give protection to habitats and species listed in the Directive as being threatened or of Community Interest (Sites of Community Interest, or SCIs).

1.2.2 The EU imposes obligations in respect of birds through Directive 2009/147/EC on the conservation of wild birds (Birds Directive). The Birds Directive provides a framework for the conservation and management of wild birds in Europe. Of particular relevance is the requirement to identify and designate Special Protection Areas (SPAs) for rare or vulnerable species listed in Annex I of the Directive, as well as for all regularly occurring migratory species, paying particular attention to the protection of wetlands of international importance. Together with SACs and SCIs, SPAs and sites that are in the process of designation as SACs and SPAs (proposed SACs (pSACs), candidate SACs (cSACs) and potential SPAs (pSPAs)) form a network of protected areas known as *Natura 2000* sites or, as they are referred to in this Shadow HRA, 'European Designated Sites'.

1.2.3 These obligations at a European level are transposed into UK legislation via The Conservation of Habitats and Species Regulations 2017 and The Conservation of Offshore Marine Habitats and Species Regulations 2017 (the Habitats Regulations).

1.3 The HRA process

1.3.1 The HRA process is designed to meet the requirements of the Habitats Regulations. Further details are provided in chapter 3, section 3.2.

1.3.2 'Screening' represents Stage 1 of the process, that is, (i) the identification of European Designated Sites relevant to the assessment and (ii) whether the effects of the Project upon the qualifying features of the European Designated Sites, either alone or in-combination with other plans and projects, are likely to be significant. Horizon has undertaken a Scoping exercise in support of the former (see chapter 4). The different consent applications require focus on different elements of the Project (e.g. the marine works for the Marine Licences) but the Screening assessment (in line with the requirements of the DCO) has considered all of the Project's components.

1.3.3 The Screening assessment reported in this document is an evolution of an 'initial' Screening assessment undertaken in November 2016, on which NRW were consulted, with a second draft provided to NRW for consultation in March 2017 (see section 3.3). The evolution of the Screening assessment is described in further detail in chapter 5.

1.3.4 Chapters 7 to 10 provide the information required for 'Appropriate Assessment' (the test of effect on integrity of European Designated Sites) – Stage 2 of the HRA process.

1.4 Data and consultation to inform HRA

1.4.1 Baseline data to inform this Shadow HRA has been gathered since 2009 and comprises information on seabirds, terns, other relevant species (particularly chough), marine mammals, prey species and the physical characteristics of the environment (e.g. supporting habitats). This work is critical to understanding how cause and effect pathways may link to receptors. Much of the data gathered forms a common evidence base that has been used within other assessment processes (e.g. Environmental Impact Assessment and Water Framework Directive assessment). Throughout this Shadow HRA reference is made to the various data sources and other evidence that have been used to inform the HRA process, and detailed cross-references are provided. The majority of the evidence referred to is provided in documents that form part of the applications for consent.

1.4.2 Consultation has been ongoing throughout the HRA process, including regular liaison with an HRA Working Group and technical workshops relating to coastal process modelling outcomes, marine and fresh water quality, noise and visual disturbance, marine mammals, fish, birds, air quality and the Cemlyn Lagoon. This consultation has been supported by the production of technical reports and notes on subject matters that are central to the HRA, such as underwater noise, marine mammals (including vessel strike), terns, chough and the response of prey species to thermal plumes. The feedback gathered through this consultation has informed the approach taken to the HRA process (see section 3.3).

1.5 Report structure

1.5.1 An **Executive Summary** provides a summary of the Shadow HRA process and the conclusions it reaches.

1.5.2 **Chapter 1** introduces the purpose, background to and scope of this report.

1.5.3 **Chapter 2** describes the Project in outline and defines the worst-case scenarios assessed in the Shadow HRA.

1.5.4 **Chapter 3** sets out the methodology adopted by Horizon for this Shadow HRA and describes the consultation carried out with relevant stakeholders.

1.5.5 **Chapter 4** provides details of Horizon's Scoping process and the European Designated Sites and interest features included in this Shadow HRA.

1.5.6 **Chapter 5** provides Horizon's Stage 1 Screening assessment, both for the Project alone or in-combination with other relevant plans and projects, in light of likely significant effects on European Designated Sites.

1.5.7 **Chapter 6** provides details of the baseline characteristics of the European Designated Sites and interest features for which a likely significant effect has been determined.

1.5.8 **Chapter 7** sets out Horizon's Appropriate Assessment (both alone or in-combination) for the coastal, freshwater and terrestrial habitats of SACs and Ramsar sites.

1.5.9 **Chapter 8** sets out Horizon's Appropriate Assessment (both alone or in-combination) for marine mammals.

1.5.10 **Chapter 9** sets out Horizon's Appropriate Assessment (both alone or in-combination) for migratory fish, namely Atlantic salmon, and freshwater pearl mussel (and includes an assessment of the potential effect of the Project on sea trout, an important host species for the larval stage of the freshwater pearl mussel).

1.5.11 **Chapter 10** sets out Horizon's Appropriate Assessment (both alone or in-combination) for birds.

1.5.12 **Chapter 11** sets out the conclusions of the Shadow HRA and provides details of how the mitigation measures set out in this report will be secured

1.5.13 **Chapter 12** provides details of the references used.

1.5.14 **Appendices A to H** include details of survey results, the outcomes of Scoping, in-combination assessment plan and project selection, and the Screening and Integrity matrices required by the Planning Inspectorate.

2 Project description

2.1 Introduction

2.1.1 This chapter provides a short overview of the Project to which this Shadow HRA relates. Full details are provided in volume A, chapter A2 (Application Reference Number: 6.1.2) of the Project Environmental Statement (ES) and in volume D, chapter D1 (Power Station Main Site) (Application Reference Number: 6.4.1), volume E, chapter E1 (Off-site Power Station Facilities) (Application Reference Number: 6.5.1), volume F, chapter F1 (Park and Ride facility) (Application Reference Number: 6.6.1), volume G, chapter G1 (A5025 Off-line Highway Improvements) (Application Reference Number: 6.7.1), volume H, chapter H1 (Logistics Centre) (Application Reference Number: 6.8.1) and the Site of Special Scientific Interest (SSSI) Compensation Strategy – Volume I and Volume II (Application Reference Numbers: 6.4.56 and 6.4.57 respectively).

2.1.2 The Project comprises the Wylfa Newydd Project and the Licensable Marine Activities.

2.2 Wylfa Newydd Project and Licensable Marine Activities

2.2.1 Horizon is applying to the Secretary of State (SoS) for a DCO under the Planning Act 2008 to construct, operate and maintain a new nuclear power station on the land west of Cemaes on Anglesey (the Wylfa Newydd Project). As the Wylfa Newydd Project is anticipated to be deployed after 2025, the Government considers that it should be considered under section 105 of the Planning Act 2008. Decisions under Section 105 need to be taken having regard to any Local Impact Report and matters that the SoS thinks are both important and relevant. These would include the policies contained in NPS EN-1 and NPS EN-6; as confirmed in the recent Ministerial Statement on Energy Infrastructure (December 2017). This further clarifies continued Government support for nuclear power, and specifically at Wylfa. NPS EN-1 and NPS EN-6 therefore remain the primary basis for decision making.

2.2.2 Those parts of the Project which are to be consented by the DCO comprise the Power Station and other on-site development (which also require Environmental Permits); Marine Works; the Off-Site Power Station Facilities; and Associated Development, including the Ecological Compensation Sites.

2.2.3 These definitions incorporate the following:

- The Power Station: the proposed new nuclear power station at Wylfa, including two UK Advanced Boiling Water Reactors, the Cooling Water System, supporting facilities, buildings, plant and structures, radioactive waste and spent fuel storage buildings and the Grid Connection.
- Other on-site development: including landscape works and planting, drainage, surface water management systems, public access works

including temporary and permanent closures and diversions of public rights of way, new Power Station Access Road and internal site roads, car parking, construction works and activities including construction compounds and temporary parking areas, laydown areas, working areas and temporary works and structures, temporary construction viewing area, diversion of utilities, perimeter and construction fencing, and electricity connections.

- Marine Works: comprising:
  - Permanent Marine Works: the Cooling Water System, the Marine Off-loading Facility, breakwater structures, shore protection works, surface water drainage outfalls, waste water effluent outfall (and associated drainage of surface water and waste water effluent to the sea), fish recovery and return system, fish deterrent system, navigation aids and Dredging; and,
  - Temporary Marine Works: temporary cofferdams, a temporary access ramp, temporary navigation aids, temporary outfalls and a temporary barge berth.
- Off-site Power Station Facilities: comprising the Alternative Emergency Control Centre (AECC), Environmental Survey Laboratory (ESL) and a Mobile Emergency Equipment Garage (MEEG).
- Associated Development: the Site Campus within the Wylfa Newydd Development Area; temporary Park and Ride facility at Dalar Hir for construction workers (Park and Ride); temporary Logistics Centre at Parc Cybi (Logistics Centre); the A5025 Off-line Highway Improvements and wetland habitat creation and enhancement works as compensation for any potential impacts on the Tre'r Gof Site of Special Scientific Interest (SSSI) at the following sites:
  - Tŷ Du;
  - Cors Gwawr;
  - Cae Canol-dydd

2.2.4 The following terms are used in this report when describing the geographical areas related to the Project:

- Power Station Site – the indicative areas of land and sea within which the majority of the permanent Power Station, Marine Works and other on-site development would be situated; and
- Wylfa Newydd Development Area – the indicative areas of land and sea including the Power Station Site and the surrounding areas that would be used for the construction and operation of the Power Station, the Marine Works, the Site Campus and other on-site development (Wylfa Newydd Development Area Development).

2.2.5 The proposed Off-Site Power Station Facilities will be located on one site in Llanfaethlu, approximately 6km south of the Power Station Site, adjacent to the A5025.

2.2.6 The proposed Logistics Centre site will be located to the south-east of Holyhead at Parc Cybi, close to Junction 2 of the A55. The proposed Park and Ride facility will be located at Dalar Hir, to the north of Junction 4 of the A55, and the A5025 Off-line Highway Improvements will take place at a number of locations along the A5025.

2.2.7 The Licensable Marine Activities comprise the Marine Works and the disposal of material from Dredging at the Disposal Site.

2.2.8 Figure 2-1 provides an indicative distribution of the Project elements.

2.3 Enabling Works

2.3.1 The Enabling Works comprise the SPC Proposals and the A5025 On-line Highway Improvements.

2.3.2 Horizon has submitted applications for planning permission for the Enabling Works under the Town and Country Planning Act 1990 to the IACC.

2.3.3 In order to maintain flexibility in the consenting process for the Wylfa Newydd Project, the SPC Proposals have also been included in the DCO application. The A5025 On-line Highway Improvements are not part of the DCO application.

2.4 Decommissioning

2.4.1 The Power Station will be decommissioned following approximately 60 years of operation and the approach will be consulted upon in accordance with the Nuclear Reactors (Environmental Impact Assessment for Decommissioning) Regulations 1999, as amended (and which may be subject to further amendment).

2.4.2 Horizon has taken the following criteria into account in the design of the Power Station as a means of facilitating the future decommissioning stage:

- Careful selection of materials to minimise the potential for them to become radioactive through activation.
- The use of containment structures (barriers and filters) and tanks and pipework that minimise the transport and deposition of contamination.
- Using modular plant components that are easy to disassemble and reduce decommissioning time.

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N

Ty Du
(SSSI compensation site)

WNDA

Cefn Coch
(Off-line Highway Improvements)

A5025
(On-line Highway Improvements)

Llanfaethlu
(MEEG and AECC/ESL and Off-line Highway Improvements)

Llanfachraeth
(Off-line Highway Improvements)

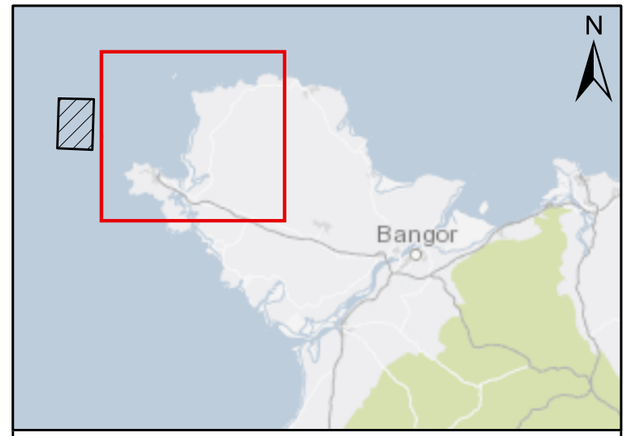
Valley
(Off-line Highway Improvements)

Dalar Hir
(Park and Ride Facility)

Parc Cybi
(Logistics Centre)

Llanbadrig
Llanfairynghornwy
Llanfechell
Bodewryd
Mynydd Mechell
Llanfflewyn
Carreglefn
Rhydwyn
Llanbabo
Llanddeusant
Elim
Llanfwrog
Llantrisant
Llanfigael
Pen-Llyn
Carmel
Holyhead
Penrhos
Llechcynfarwy
Newlands Park
Trefor
Trearddur
Four Mile Bridge
Llanfihangel Yn Nhowyn
Bryngwran
Dowyn
Llanfairyneubwll
Tregele
Tyddyn-Gele
Felin Gafnan
Cafnan
A55(T)

0 5 km



Legend

- Order Limits for the purposes of DCO
- A5025 On-line Highway Improvements (non-DCO works)
- Disposal Site
- Land side works (indicative)
- Marine side works (indicative)

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Client: HORIZON NUCLEAR POWER

Project: Wylfa Newydd Project

Title:

Location Plan (pursuant to Regulation 5(2)(g))

Figure: 2-1

Revision:	Date:	Drawn:	Checked:	Size:	Scale:
6	14/12/2017	TC	MS	A3	1:80,000
5	09/11/2017	TC	MS	A3	1:80,000

Co-ordinate system: British National Grid

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2.4.3 Horizon estimates that radioactive waste could remain on the Power Station Site for up to approximately 140 years after the end of electricity generation, although it is expected that these timescales can be reduced.

2.5 Construction schedule

2.5.1 The indicative construction timeline for the works in the Wylfa Newydd Development Area is provided in figure 2-2.

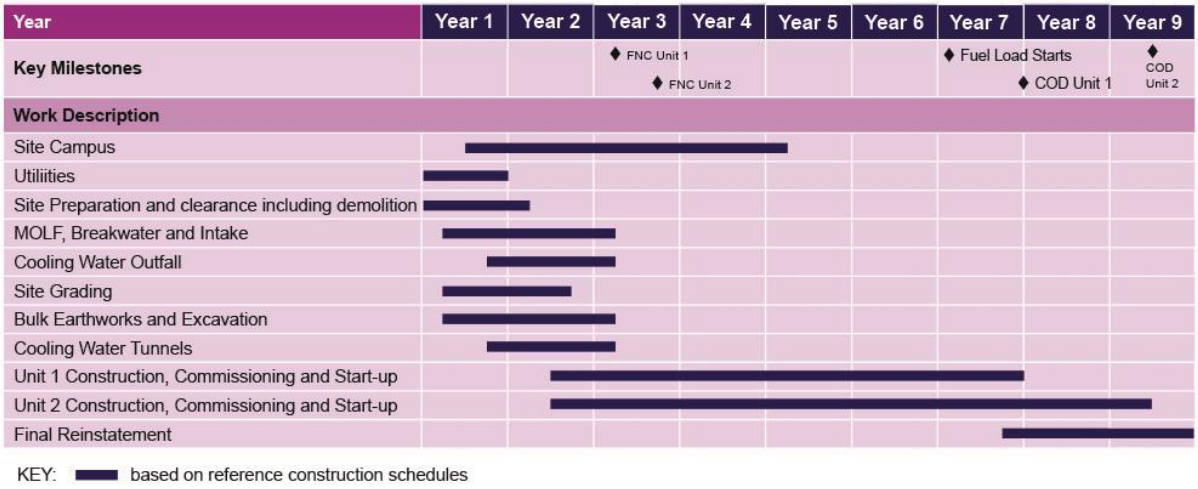


Figure 2-2 Indicative construction timeline for the Wylfa Newydd Development Area

2.5.2 The Power Station construction programme is anticipated to commence following grant of development consent. The Main Construction stage is anticipated to take approximately seven years, with the first Unit operational seven years after grant of development consent, and the second Unit operational approximately two years later.

2.5.3 Construction of the spent fuel storage facility would commence following Main Construction, to be available for use approximately 10 years into the operations phase. The solid Intermediate Level Waste (ILW) storage facility would be built at the same time.

2.5.4 Activities such as bulk earthworks, deep excavations, rock excavation and MOLF construction would commence in the first year following grant of development consent. Construction activities, concrete production, distribution and placing, steel reinforcing works, craneage, access to structures and related site logistics would likely peak during year 5 following grant of development consent.

2.6 Project parameters and plans

2.6.1 As outlined in chapter B1 of the ES (Application Reference Number: 6.2.1), the approach adopted for the design and construction of the Power Station, Power Station Off-Site Facilities and Associated Development is to set parameters, where necessary, for the extent of the development and key

aspects of that development. The final design and construction methodology would be limited to these parameters and limits of deviation.

2.6.2 Full details of the parameters used for the Project assessments are provided in the chapters referred to in section 2.1 above. The Detailed Plans describing the Project are listed in table 2.1.

Table 2-1 Detailed Plans describing the Project

Project element	Application Reference Number
Wylfa Newydd Development Area - Power Station Site Plans	2.6.1
Wylfa Newydd Development Area - Site Campus Plans	2.6.2
Wylfa Newydd Development Area - Marine Works Plans	2.6.3
Wylfa Newydd Development Area - Site Preparation and Clearance Plans	2.6.4
A5025 Off-line Highway Improvements	2.7 to 2.10
Park and Ride - Dalar Hir Plans	2.11
Logistics Centre - Parc Cybi Plans	2.12
Off-Site Power Station Facilities - Llanfaethlu Plans	2.13
Site of Special Scientific Interest Compensation Sites	2.14 to 2.16

2.7 Scenarios assessed in the Shadow HRA

2.7.1 The Shadow HRA assesses the Project as described above and within the ES chapters referenced in section 2.1. Further details of the worst-case scenarios assessed in chapters 7 to 10 of the Shadow HRA (e.g. construction noise, temperature plume) are presented in table 2-2.

2.7.2 Table 2-2 is intended to clarify the basis for the assessment presented in the Shadow HRA and to highlight any divergence from the approach adopted in the Environmental Impact Assessment (EIA); the latter is only relevant to the worst case scenarios assessed for extent of the thermal and total residual oxidant (TRO) mixing zones and one noise modelling scenario.

Table 2-2 Worst-case scenarios assessed in the Shadow HRA

Item	Assessed worst-case scenarios
Marine water quality (construction)	
Treated sewage	1,598m^3 per day discharge
	Total suspended sediment (TSS) in the sewage discharge will be limited to 30mg/L
Deep excavation and cofferdam dewatering	Discharge direct to the marine environment
	TSS limited to 70mg/L during normal conditions
Cooling water tunnel dewatering	Water from tunnel construction will be collected in sumps and pumped to attenuation points at either tunnel portal where it will be monitored and treated (as

Item	Assessed worst-case scenarios
	required) to ensure compliance with environmental limits.
Concrete batching plant process water	No process water from the concrete batching plant would enter the marine environment
Earthworks and drainage design	From the point of commencement of earthworks on the west of Mound E onwards, no water will be discharged into Nant Cemlyn via discharge E1 until vegetation has re-established and risk of sediment run off is agreed with NRW to be low
	No polyelectrolyte dosing will be employed for discharge E1
	For all discharges except E1 (see above), an upper TSS limit of either 40mg/L or 70mg/L is assessed, depending on the watercourse and based on the background concentration in the receiving watercourse
Disposal of capital dredged material	Disposal of up to 242,000m^3 over 35 days
Marine water quality (operation)	
Modelling of thermal and chemical discharge from the Circulating Water System	Cooling water abstraction rate of 126m^3/s
Extent of the thermal mixing zone	Autumn base case; this seasonal case extends over the greatest spatial extent of the modelled seasonal cases for the thermal mixing zone and has been taken as a bounding case for the Shadow HRA (the ES adopts an annual base case scenario as the basis for assessment)
Extent of the TRO mixing zone	Summer base case; this seasonal case extends over the greatest spatial extent of the modelled seasonal cases for the TRO mixing zone and has been taken as a bounding case for the Shadow HRA (the ES adopts an annual base case scenario as the basis for assessment)
Coastal processes	
Effect on wave climate	Fully-built marine works layout and 99th percentile winter '2087 reasonably foreseeable' conditions
Air quality (construction)	
Emissions from plant, machinery and marine vessels	Average emissions equivalent to the EU Stage IIIB emission standards (EC Directive 97/68/EC)
	Peak of activities associated with the site grading and bulk earthworks, deep excavations, landscape formation, cooling water tunnels and outfall construction and construction of the MOLF ('2020 peak earthworks and marine works scenario') (this was based on commencement of the

Item	Assessed worst-case scenarios
	construction programme in 2019; - the scenario represents year 2 of the construction programme)
	Peak of activities associated with the construction of the Power Station buildings and structures, including (but not limited to) concrete production, distribution and placing, steel reinforcing works, craneage, access to structures and related site logistics, such as the transportation of construction workers and materials. The scenario represents the period during which the highest number of diesel-engine plant items and site vehicles are forecast to be operating at the Wylfa Newydd Development Area after completion of the earthworks and marine works ('2023 peak construction scenario' (this was based on commencement of the construction programme in 2019; - the scenario represents year 5 of the construction programme)
Air quality (operation)	
Emissions from combustion plant (long-term scenario)	Typical operation of all the boilers and all standby generators that would be expected over the period of a year
Emissions from combustion plant (short-term scenarios)	Several scenarios to determine the maximum potential effects of various short-term operational scenarios such as maximum boiler use, routine testing and commissioning of the standby generators and also the use of all the combustion plant in an emergency situation
Noise (construction)	
Emissions from plant, machinery and marine vessels	100% 'on-time', worst case 5 minute noise levels. To assess the potential effect on breeding terns, the Shadow HRA has been based on a bounding case where all noise sources are assumed to be located against the boundaries of the working zones closest to the location of the nesting islands in Cemlyn lagoon.
Noise (operation)	
Emissions from combustion plant	Scenarios modelled for commissioning, routine testing, LOOP (Loss of Off-site Power)/LOCA (Loss of Coolant Accident) and normal winter boiler operations. For each scenario, all house boilers have been modelled as operating at full load.

3 Habitats Regulations Assessment

3.1 Introduction

3.1.1 This chapter provides details of the principles of the HRA process (in section 3.2) and describes the approach adopted by Horizon to this Shadow HRA (in section 3.3). The methodology used has been discussed in detail with NRW and the Planning Inspectorate, which have provided advice and guidance on the methodology and approach taken in the Shadow HRA (see section 3.3). Chapters 4 and 5 provide details of the European Designated Sites Scoping and Screening processes and chapters 7 to 10 provide details of the shadow Appropriate Assessment undertaken for the Project.

3.2 The HRA process

3.2.1 The Habitats Directive is transposed into English and Welsh legislation by The Conservation of Habitats and Species Regulations 2017 and The Conservation of Offshore Marine Habitats and Species Regulations 2017; hereafter referred to as the 'Habitats Regulations'. The Habitats Regulations incorporate all SPAs into the definition of European Designated Sites and, consequently, the protections afforded to SACs under the Habitats Directive apply to SPAs designated under the Birds Directive.

3.2.2 The HRA process helps meet the requirements of Article 6(3) of the Habitats Directive (replicated in Regulation 61(1)) which states that any plan or project, that is not directly connected with or necessary to the management of a European Designated Site, but would be *likely to have a significant effect* on such a site, either on its own or in-combination with other plans or projects, will be subject to an *appropriate assessment* of its implications for the European Designated Site in view of its conservation objectives. According to the Waddenzee judgement (Judgement of 7.9.2004 – Case C-127/02) (paragraph 45) an appropriate assessment will be required if a likely significant effect cannot be excluded on the basis of objective information. That is to say, if the plan or project is likely to undermine the site's conservation objectives, the assessment of that risk being made in the light *inter alia* of the characteristics and specific environmental conditions of the site concerned by such a plan or project (paragraph 49). The Sweetman Opinion (Opinion of Advocate General 22.10.2012 – Case C-258/11) (paragraph 46) states that the question is simply whether the plan or project concerned is capable of having an effect.

3.2.3 Subject to the provisions of Article 6(4) of the Habitats Directive, following appropriate assessment, the 'competent authority' will agree to the plan or project only having ascertained beyond reasonable scientific doubt that it will not adversely affect the integrity of the site(s) concerned.

3.2.4 Where a real risk to the integrity of the European Designated Site exists, it must be considered first whether any alternative solutions exist that would be capable of delivering the same overall objective as the original proposal, but in a way that does not adversely affect the integrity of a European Designated Site. If so, then the alternative should be pursued. If not, then the competent authority must consider whether the plan or project must nevertheless be undertaken for imperative reasons of overriding public interest (IROPI).

3.2.5 Article 6(4) provides that if, in spite of a negative assessment of the implications for the site, and in the absence of alternative solutions, the plan or project must nevertheless be undertaken for IROPI, the Member State will take all compensatory measures necessary to ensure that the overall coherence of *Natura 2000* sites is protected.

3.2.6 As a matter of policy, the Welsh Government also applies the HRA process to pSACs, cSACs, pSPAs and designated Ramsar sites [RD354]. Ramsar sites are wetlands of international importance as defined following the Convention on Wetlands (Ramsar, Iran, 1971), which is an intergovernmental treaty that embodies the commitments of its member countries to maintain the ecological character of their internationally important wetland habitats.

3.2.7 There is no explicit definition of likely significant effect (LSE) in the legislation. In the context of HRA, it is typically taken as any effect that reasonably may be predicted as a consequence of the project that may undermine the European Designated Sites' conservation objectives [RD354]. That is, the term 'likely' infers the presence of a risk that a significant effect could occur. By definition, this assessment is based on the consideration of a number of factors, for example, the spatial extent and duration of an identified effect, and other considerations such as the availability of appropriate mitigation. When considering such effects, a precautionary approach is adopted.

3.2.8 In general, according to [RD265], if a large amount of evidence and data gathering is necessary to determine LSE, it is assumed that a LSE could arise and 'appropriate assessment' is required.

3.2.9 The conservation status of a natural habitat, as defined in the Habitats Directive, means the *"sum of the influences acting on a natural habitat and its typical species that may affect its long-term natural distribution, structure and functions as well as the long-term survival of its typical species within the territory referred to in Article 2"*. The conservation objectives for a SAC or SPA are considered when identifying LSE. The conservation status of a natural habitat is taken as 'favourable' when:

- its natural range and area it covers within that range are stable or increasing;
- the specific structure and functions which are necessary for its long-term maintenance exist and are likely to continue to exist for the foreseeable future; and

- the conservation status of its typical species is favourable.

3.2.10 The Project has the potential to affect a number of sites designated pursuant to the Habitats Directive and Wild Birds Directive, comprising sites designated as SACs and SPAs. The Project also has the potential to affect sites that are in the process of designation as SACs and SPAs and Ramsar sites. As a consequence of this, Horizon is required to provide the competent authorities (in this case the BEIS Secretary of State for the DCO and NRW for the Marine Licences and Environmental Permits) with the information they require to undertake an assessment of what those effects are and whether they are predicted to have an adverse effect on the integrity of the European Designated Sites in question; in this case, the required information is provided in this Shadow HRA.

3.2.11 The HRA process typically follows a four staged approach, as detailed in Planning Inspectorate Advice Note 10 [RD265] (also see figure 3-1):

1) **Screening**: The process of identifying potentially relevant European Designated Sites, and whether the proposed project is likely to have a significant effect on the interest features of the site either alone or in-combination with other plans and projects. If it is concluded at this stage that there is no potential for LSE, there is no requirement to carry out subsequent stages of the HRA.

2) **Appropriate Assessment**: Where a LSE for a European Designated Site(s) cannot be ruled out, either alone or in-combination with other plans and projects, assessment of the potential effects on the integrity of the site(s), again either alone or in-combination with other plans and projects, in view of its qualifying features, conservation objectives and the conservation of each of the qualifying features which may be affected is required. Where there are potential adverse effects, an assessment of mitigation options is carried out and mitigation measures (where available) are proposed to address the effects. If there nonetheless remains a likely significant residual adverse impact, the HRA must progress to Stages 3 and 4.

3) **Assessment of Alternative Solutions**: Identifying and examining alternative ways of achieving the objectives of the project to establish whether there are solutions that would avoid or have a lesser effect on the site(s).

4) **Imperative reasons of over-riding public interest**: Where no alternative solution exists and where an adverse effect on site integrity remains, the next stage of the process is to assess whether the development is necessary for IROPI and, if so, the identification of compensatory measures needed to maintain site integrity or the overall coherence of the designated site network.

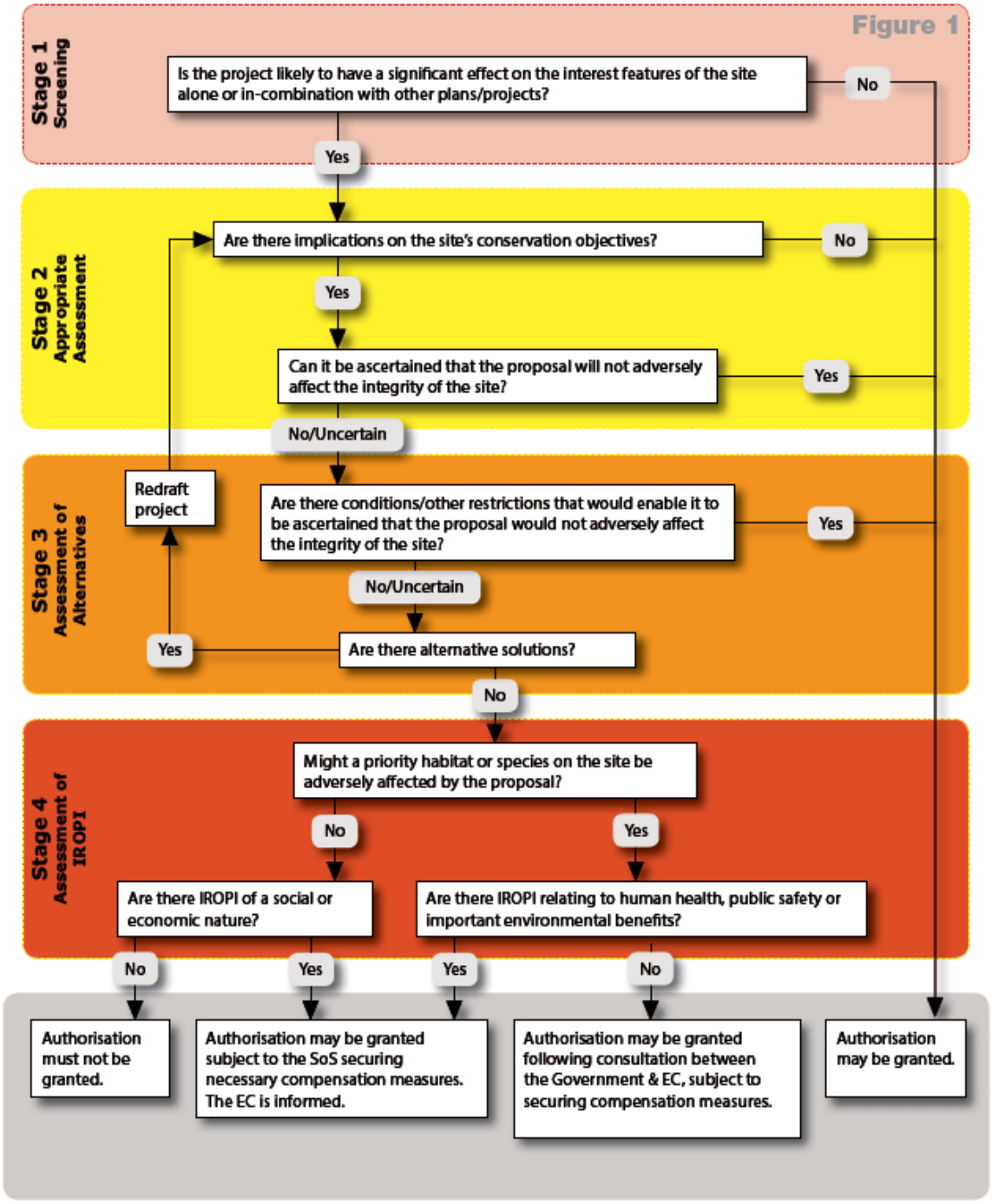


Figure 3-1 Depiction of the HRA process [RD265]

3.2.12 All four stages of the process are referred to cumulatively as the Habitats Regulations Assessment, to clearly distinguish the whole process from the step within it referred to as the 'Appropriate Assessment'.

3.2.13 In respect of Stage 2, the integrity of a site is defined as the coherence of the site's ecological structure and function, across its whole area, which enables it to sustain the habitat, complex of habitats and/or populations of species for which the site has been designated ([RD94]). An adverse effect on integrity, therefore, is likely to be one that prevents the site from making the same contribution to favourable conservation status for the relevant feature as it did at the time of designation.

3.2.14 In addition to the stages described above, although not referred to in the Habitats Directive or national legislation, it is becoming common practice for very large developments to undertake a pre-screening site selection exercise in order to identify the European Designated Sites and the designated features (within each site) to be taken forward into the Screening stage; referred to as Scoping (see chapter 4). This step has been undertaken by Horizon.

3.3 The Horizon approach

Consultation

3.3.1 Consultation is a key part of the pre-application stage of the consenting process for Nationally Significant Infrastructure Projects. Horizon has been consulting on its HRAs for the Project and its associated consents since 2011. Consultation has taken place through meetings with key stakeholders (including the Planning Inspectorate, NRW and the IACC); inviting comments on draft documents (significantly the draft Stage 1 Screening Report and Shadow HRA, including the draft Stage 2 Appropriate Assessment); and Horizon's three statutory pre-application consultation processes carried out in 2014, 2016 and 2017.

3.3.2 This section sets out the key consultation undertaken by Horizon for the purposes of this Shadow HRA. It summarises the key issues raised in response to the consultation and indicates how Horizon has addressed those issues.

Meetings with key stakeholders

3.3.3 In order to inform its approach to HRA and in an effort to secure the support of relevant stakeholders, Horizon sought to engage with the Planning Inspectorate, relevant statutory nature conservation bodies (SNCBs) and non-statutory interest groups from an early stage in the process. The principal means of consultation was and is through a HRA Working Group, the membership of which constitutes the Planning Inspectorate, NRW (as the SNCB and a competent authority in this case) and the IACC.

3.3.4 From 2011 to 2014 consultation took the form of meetings and early discussions about Horizon's proposals and regulator roles and expectations. These discussions included consideration of the requirements for HRA. The

programme for and approach to the Horizon HRA process have evolved substantially since that time and therefore the detail of these meetings have limited relevance to the final submission. Given this, details of these meetings are not presented in this document.

3.3.5 From late 2014, the HRA Working Group met regularly (approximately every two months) until spring 2016, when it began to meet approximately every month either on Anglesey/in Bangor or via conference call. Matters discussed include the overall approach to HRA for the Project, emerging designs, programmes of data collection and modelling work, and methodological and technical details (through workshops).

3.3.6 Representatives of NRW and IACC have been present at all HRA Working Group meetings. For the early meetings of the group the Welsh Government and the Marine Management Organisation (MMO) were invited and attended occasionally. As the project developed and it became apparent that the MMO did not have a specific competent authority role, they ceased to attend from early 2015. The Welsh Government initially attended in direct support of IACC, but did not attend after early 2015.

3.3.7 The Planning Inspectorate receive all HRA Working Group meeting minutes and either join Horizon in a short summary conference call after each HRA Working Group meeting or join the Group's meeting via conference call.

3.3.8 The format that the HRA Working Group meetings took and takes is a review of actions, update on general process and discussion of topics relevant to the work stream at that time. Occasional topic-specific meetings and technical workshops have also been convened. Some of these have been attended by representatives of local non-statutory interest groups (principally the National Trust (NT), North Wales Wildlife Trust (NWWT) and the Royal Society for the Protection of Birds (RSPB)). Topics covered include breeding birds, marine mammals, the marine environment and the predicted ecological effects of the Project through the course of the Project's development.

3.3.9 A summary of the HRA-specific meetings that have occurred is provided at the end of this chapter in table 3-1. A number of topic-specific meetings have also occurred as part of the EIA work stream that have covered issues relevant to the HRA, and these are detailed in volume A of the ES (Application Reference Number: 6.1.7).

History of consultation on draft documents

3.3.10 Table 3-2, also provided at the end of this chapter, lists the HRA-specific documents that have been issued by Horizon for comment since early 2015.

Consultation on draft Shadow HRA documents

3.3.11 As set out in table 3-2, the HRA Working Group provided detailed informal comments on several draft HRA documents for an earlier version of the SPC Proposals and the A5025 On-line and Off-line Highway Improvements.

3.3.12 With respect to this Shadow HRA, the HRA Working Group was consulted on the methodology to be employed by Horizon in order to identify potentially affected European Designated Sites (see chapter 4) and the methods to be adopted for the Stage 1 Screening (see chapter 5). This, and detailed comments received from NRW and the Planning Inspectorate on the Stage 1 Screening Report, led to refinement of Horizon's methodology and Shadow HRA.

3.3.13 NRW and the Planning Inspectorate provided comments on an initial draft of the Stage 1 Screening Report (in February 2017) and a revised draft of the Stage 1 Screening Report (in May 2017). Table 3-3, provided at the end of this chapter, summarises the key comments made by the Planning Inspectorate and NRW and indicates how they have been addressed.

3.3.14 In August 2017, the Planning Inspectorate and NRW were consulted on the draft Shadow HRA (i.e. including both Stage 1 Screening and Stage 2 Appropriate Assessment). A meeting was held with NRW in early October 2017 to discuss its high level comments on the draft Shadow HRA (see table 3-1) and NRW and the Planning Inspectorate subsequently provided detailed written comments on the draft Shadow HRA. These comments have been taken into account in the Shadow HRA. Horizon also provided responses to each of the NRW comments, setting out how the comment has been addressed (or, in cases where the Shadow HRA had not been updated at the time of responding to the NRW comments, how Horizon intended to address the comment). These comments have not been summarised in the tables provided at the end of this chapter as they covered the whole of the Shadow HRA in detail, and included approximately 120 new comments on chapters 1 to 6, 100 comments on chapter 7, 30 comments in chapter 8, 25 comments on chapter 9, 130 comments on chapter 10, three comments in chapter 11 and five comments on the appendices. Table 3-4, however, summarises NRW's general comments and indicates how these have been addressed.

3.3.15 In addition, the draft Shadow HRA was provided to the National Trust, NWWT and the RSPB for review, and a meeting was held with these organisations in January 2018 to discuss and respond to their queries and concerns.

Statutory pre-application consultation

3.3.16 There have been three stages of Pre-Application Consultation for the Project:

- Stage One Pre-Application Consultation (PAC1) ran from 29 September to 8 December 2014, and provided a Consultation Document and Preliminary Environmental Information Report (PEI Report) and summaries thereof.
- Stage Two Pre-Application Consultation (PAC2) ran from 31 August to 25 October 2016 and included a Consultation Document, PEI Report and Habitats Regulations Assessment Interim Report. Interim reports

were also included for Welsh Language, Health Impact and Equality Impact Assessment.

- Stage Three Pre-Application Consultation (PAC3) ran from 24 May to 22 June 2017 and principally provided an update on changes to the Project subsequent to PAC2. PAC3 included a Main Consultation Document and an overview document. Limited information relevant to HRA was included in the Main Consultation Document.

3.3.17 The key issues arising from PAC1, PAC2 and PAC3 relevant to HRA are summarised in table 3-5 at the end of the chapter.

3.3.18 A comprehensive account of consultation activities undertaken and the feedback generated relating to the Project is provided in the Consultation Report (Application Reference Number: 5.1) that accompanies the application for development consent.

Wider consultation

Consultation with other Member States

3.3.19 In February 2017 the Planning Inspectorate wrote to representatives of France, Ireland and other EU states (and others outside the EU in the context of the Espoo Convention) to provide formal notification under the EIA Directive, as implemented by the Infrastructure Planning (Environmental Impact Assessment) Regulations 2009, and under the Espoo Convention. The Planning Inspectorate stated that the Secretary of State was of the view that the Project was likely to have significant impact on the environment of those states.

3.3.20 France responded stating that the *"…French authorities do not consider it necessary to participate in the procedure concerning the Wylfa Newydd Generating Station. However, we wish to be kept informed about this project"*. Horizon has and will continue to keep France informed about the Project.

Consultation with other SNCBs

3.3.21 In addition to consulting with NRW, Horizon has consulted with the SNCBs for Scotland, England, Northern Ireland, France and Ireland on the draft HRA Stage 1 Screening Report in May 2017. A summary of their responses is provided in section 4.8 (transboundary scoping).

3.3.22 The draft Stage 1 Screening assessment identified the potential for LSE on sites in Wales, England, Scotland, Northern Ireland and Ireland but concluded that the potential for LSE on European Designated Sites in France could be discounted.

Work undertaken

Evidence base

3.3.23 Horizon has undertaken both EIA and Shadow HRA to support the Project's applications for consent.

3.3.24 Although EIA and HRA are distinct processes with separate legislative requirements, both assessments share a common evidence base, and so information has been shared between the teams responsible for the two assessments, particularly in respect of the identification of source-receptor pathways and mitigation measures. In many cases the same ecologists have provided direct input into both work streams.

3.3.25 By way of a summary, the following work has been undertaken as part of Horizon's HRA process:

- Collection of baseline environmental information through survey and other information gathering work.
- Regular liaison with the HRA Working Group, including on the HRA alone and in-combination methodology.
- Work to support applications for a Marine Licence and planning permission for detailed offshore geotechnical investigation work, and an application for planning permission for works to relocate a facility relating to the Existing Power Station.
- Technical liaison with the team preparing the EIA to support the DCO and Marine Licence Applications to share knowledge in respect of key HRA topic areas, such as the marine environment (benthic ecology, marine mammals and fish), coastal birds and noise.
- Technical workshops relating to coastal process modelling outcomes, marine and fresh water quality, noise and visual disturbance, marine mammals, fish, birds, air quality and Cemlyn Lagoon.
- Production of technical reports and notes on subject matters that are central to the HRA, such as underwater noise, marine mammals (including vessel strike), terns, chough and the response of prey species to thermal plumes.
- Production of an Evidence Record (but not an Evidence Plan/Document).
- Production of, and consultation on, the Radioactive Substances Regulations Environmental Permit Shadow HRA.
- Scoping of European Designated Sites and interest features.
- Screening for LSE for those European Designated Sites and interest features scoped into the assessment.
- Shadow HRA to support the applications for planning permission for the Site Preparation and Clearance Proposals and the A5025 On-line Highway Improvements.

3.3.26 Since 2009, a significant amount of data has been obtained from baseline surveys and monitoring to inform the HRA (and EIA). As set out in chapter 1, the information gathered includes data on seabirds, terns, other relevant species (particularly chough), marine mammals and the physical characteristics of the environment (e.g. prey species and supporting

habitats) upon which these species (some of which are qualifying features of European Designated Sites) depend. This work is critical to understanding how cause and effect pathways may link to receptors.

3.3.27 For potentially relevant European Designated Sites that are remote from the Wylfa Newydd Development Area, data collection has concentrated on mobile species (marine mammals, birds and fish), as there could be pathways for effects on such species (but not on other species).

Scoping, Screening and Appropriate Assessment

3.3.28 The approach that has been adopted for Scoping, Screening and Appropriate Assessment (consideration of the potential for an adverse effect on site integrity to arise) is founded on the principles set out in section 3.2 and detailed further in chapters 4, 5 and 7 to 10.

3.3.29 The approach described has been discussed in detail and agreed with the HRA Working Group.

3.3.30 The Scoping (chapter 4), Screening (chapter 5) and shadow Appropriate Assessment (chapters 7 to 10) have focused on assessing the implications of the pre-construction, construction (both taken to be construction) and operation phases of the Project..

3.3.31 It is recognised that the environmental studies and HRA also need to consider the potential effect of the decommissioning phase. However, the lack of knowledge around specific decommissioning activities means that the assessment can only be undertaken based on a set of assumptions about the extent of the works required and controls that will be in place at the time.

3.3.32 New consents, permits and licences will be required for decommissioning and, therefore, this phase of the Project will be subject to regulatory control.

In-combination assessment

A tiered approach

3.3.33 In-combination assessment focuses on assessing the implications of the Project being considered in conjunction with other relevant ‘past’, ‘present’ and ‘reasonably foreseeable’ future plans and projects. To achieve this, the in-combination consequences of the Project as a whole for different interest features have to be considered in the first instance.

3.3.34 For this Shadow HRA a tiered approach has been undertaken to in-combination assessment, based upon the following definitions:

- The assessment of site-specific in-combination effects which arise from each of the Project elements individually. Different aspects of each of the Project elements/activities may themselves have additive or interactive effects (e.g. the additive impact of construction noise, traffic and other disturbance effects on waterbirds). The assessment of such site-specific in-combination effects are documented within the Stage 2 Appropriate Assessment concerned with the ‘alone effects’ for the interest feature in question (e.g. terns).

- The assessment of project-wide in-combination effects which arise from the combined effects (additive or interactive) of the whole Project; that is, the in-combination effects of any part of the Project with all other elements (including the SPC works) and Associated Developments (where they have the potential to affect the same receptor(s)). In this Shadow HRA the assessment of such project-wide in-combination effects is also documented within the Stage 2 Appropriate Assessment concerned with the 'alone effects' of the wider Project for the interest feature in question.
- The assessment of wider in-combination effects which are the combined effects (additive or interactive) that may occur between any element of the Project and any other 'non Wylfa Newydd' plans and projects. These effects are considered in the in-combination assessments included in chapters 7, 8, 9 and 10.

Overlapping and discrete effects

3.3.35 The in-combination assessment takes account of effects that are discrete as well as overlapping (i.e. a spatial interaction exists). That is, in-combination effects could include effects on the same habitat/species at different locations within a European Designated Site.

3.3.36 In simple terms, the approach taken is to consider the qualifying features of the European Designated Sites under consideration (the receptors) and determine how the various effects of relevant plans and projects would affect these receptors, with specific reference to the assessed effects of the Project.

3.3.37 In certain instances there would be a spatial and temporal overlap of effects between the Project and other projects on the identified receptors. Spatially, such effects are generally confined to the immediate vicinity of the Project unless effects are far-field (e.g. significant changes in hydrodynamic processes). In other instances there may be no spatial interaction but the receptor nonetheless would be affected cumulatively by the effects of the projects in-combination (e.g. habitat loss from the same interest feature at disparate locations).

3.3.38 In respect of temporal effects, some of these may be of a short-term nature and would, from an ecological perspective, represent 'pulse' type disturbances that have no long-term effect. However, it is possible that such short-term effects could be significant and, consequently, they will be considered and assessed accordingly. Other effects may be of a long-term nature and even when the activity causing the identified impact ceases, the ecological response may still be manifest in the system.

3.3.39 Ultimately, any project effects will have both a spatial and temporal component and consideration in the assessment has to focus on how the receptor is affected by the totality of effects.

Rationale for identifying other relevant plans and projects

3.3.40 The approach taken to the identification of other plans and projects to be included in the in-combination assessment has been based upon the advice provided by the Department of Communities and Local Government [RD75], which states:

> *"In most cases, detailed consideration of the combined effects of the development proposed together with other developments will be limited to those others that are already begun or constructed or those that have not been commenced but have a valid planning permission.*
>
> *Often, future developments in the vicinity of a project site will be included in the baseline scenario as 'committed development'. But in the context of EIA the term 'committed development' conventionally refers to development for which consent has been granted"*.

3.3.41 In terms of defining 'other plans or projects' for the in-combination test, guidance ([RD94]; [RD86]; [RD265]) indicates that consideration should be limited to:

- permitted ongoing activities (e.g. discharge consents or abstraction licences);
- projects that are under construction;
- permitted application(s) not yet implemented;
- submitted application(s) not yet determined;
- all refusals subject to appeal procedures not yet determined;
- projects on the National Infrastructure's programme of projects; and,
- projects identified in the relevant development plan (and emerging development plans – with appropriate weight being given as they move closer to adoption) recognising that much information on any relevant proposals will be limited.

3.3.42 Plans and projects that fall into all of these categories have been scoped in for further consideration as part of the in-combination assessment in this Shadow HRA (see appendix B).

3.3.43 With respect to 'past' projects, a useful ground rule in in-combination assessment is that the environmental impacts of schemes that have been completed and the effects of permitted, ongoing activities should be included within the environmental baseline. As such, past and ongoing impacts will be taken into account as part of the 'alone' HRA process (baseline plus Project). Consequently, completed projects generally have been excluded from the scope of this in-combination assessment. However, it is acknowledged that the environmental impacts of recently completed projects and some permitted ongoing activities (such as maintenance dredging) may not be fully manifested and, therefore, the potential impacts of such projects have also been taken into account, where relevant.

3.3.44 In the event that 'past' projects refer to past consents not yet implemented (for example), these projects have been considered as part of the in-combination assessment.

3.3.45 Future plans or projects for which sufficient information is available (i.e. 'reasonably foreseeable' projects) have been considered as part of the in-combination assessment. Future plans or projects for which sufficient information is not available on which to base a reliable assessment, which are unlikely to be submitted or receive consent until after the proposed development has been completed, cannot reasonably be assessed in full as part of an in-combination assessment. However, the applicants for such projects will be required to take the effects of the Project into account in their own application (should it be the consenting phase or have received consent).

3.3.46 In the absence of publicly available data, it is not possible to undertake detailed in-combination assessment but, for some other plans and projects scoped into the assessment, it is possible to make judgements regarding potential effects on the basis of the characteristics of the other plans and projects being considered (where these are known) and whether there is the potential for the effects of the various projects to interact spatially and temporally. For the purposes of this assessment, on a precautionary basis, consideration has been given to the likely generic environmental effects of relevant projects on the basis of the types of activities that would be undertaken. It is not appropriate to consider worst case scenarios in this context, as this would introduce the risk that the assessment would become over precautionary and unrealistic.

Table 3-1 HRA consultation: minuted meetings and workshops

Meeting date	Meeting title and external bodies attending	Topics covered
28/11/13	Wylfa Working Group Meeting: NRW, IACC, the Planning Inspectorate, Welsh Government and the MMO	Formation of the HRA Working Group and update on project progress since new owner has been in place. Revisit project approach to HRA.
22/10/14	HRA Working Group: IACC, NRW, the Planning Inspectorate, Welsh Government and MMO	Develop structure for engagement and inform expectations for future engagement
24/02/15	HRA Working Group: IACC, NRW, the Planning Inspectorate, Welsh Government and the MMO	Update on the scheme; lead Competent Authority/HRA Governance; outline HRA programme; HRA Screening Report template[1] and Framework document; Detailed Offshore Ground Investigation (DOffGI) HRA screening
19/05/15	HRA Working Group: IACC, NRW, the Planning Inspectorate, Welsh Government and the MMO	Project and programme update; transboundary consultation; cumulative impacts assessment strategy; technical discussion groups; new SAC and SPA; DOffGI screening update; PAC 1 response
07/07/15	Update call (telecon): NRW	Horizon's approach to the HRA process and timetable; Environmental Permits and the HRA process – bespoke HRAs or packaging with the main site; NRW comments on the initial HRA Framework Document; the new SPA and SACs – conservation objectives and boundaries, plus a likelihood of further new sites
29/07/15	HRA Working Group: IACC, NRW, the Planning Inspectorate, Welsh Government and the MMO	HRA programme and overview; initial HRA Framework Document; Environmental Permitting and HRA; Site Preparation and Clearance (SPC); DOffGI works HRA; PAC2
13/08/15	Update call (telecon): NT	HRA update between Horizon and the National Trust
23/09/15	Update call (telecon): the Planning Inspectorate	Summary of the proposed Evidence Plan route; Horizon to indicate broad expectations of the Planning Inspectorate and other statutory and non-statutory groups; short discussion on the Planning Inspectorate role in consultation over transboundary impacts
02/10/15	HRA Working Group: IACC and NRW	Work stream scope and milestones; Evidence Plan; LSE methods / pre-screening; Summary of HRA input to PAC 2

[1] Details of documents issued for consultation are provided in table 3-2 below.

Meeting date	Meeting title and external bodies attending	Topics covered
10/12/15	HRA Working Group (telecon): IACC, NRW, the Planning Inspectorate	Work stream scope, milestones and Red-Amber-Green (RAG) status; Evidence Document – progress and consultations; PAC2 and HRA; SPC HRA update; moving towards DCO
27/01/16	HRA Working Group: IACC, NRW, the Planning Inspectorate	Work stream scope, milestones and RAG; HRA schedule and Tier 1 and 2 meetings; Evidence Document – progress and consultations; in-combination assessment approach
16/03/16	HRA wider consultation meeting: IACC, NRW, the Planning Inspectorate, NT, NWWT and RSPB	Wylfa project summary, including SPC; summary of HRA approach, Evidence Document, screening and in-combination method; discussion of the terms of reference for Tier 2 participation; Likely timetable for consultation
21/04/16	HRA Working Group (telecom): IACC, NRW and the Planning Inspectorate	Work stream scope, milestones and RAG; integrated programme; SPC HRA screening; Terms of Reference for Tier 2 participation; workshop programme; PAC2 - summary of HRA input
12/05/16	Update call (telecon): NRW	Informal discussion of the draft HRA report for SPC, to assist regulator review of the document
09/06/16	HRA Working Group: IACC and NRW	Site visit; further discussion of SPC; discussion of HRA screening methods
17/06/16	Update call (telecon): the Planning Inspectorate	Update on the HRA Working Group meeting
02/08/16	HRA Working Group: NRW, IACC	Receipt of informal / interim comments on SPC HRA; informal discussion on draft chough memo (SPC HRA Appendix I); drainage discharges and HRA discussion / update
01/09/16	HRA Working Group: IACC and NRW	Evidence Document; review of the SPC HRA; preparation for the tern workshop
20/09/16	Tern Data Workshop: NRW and IACC	Presentation on the tern survey work and a short discussion on chough
15/09/16	Update call (telecon): the Planning Inspectorate	An update for the Planning Inspectorate of the progress of the HRA work stream
05/10/16	HRA Working Group (telecon): IACC and NRW	HRA methodology; RSR-EP HRA Screening assessment; SPC HRA noise assessment; HRA schedule
18/10/16	HRA Birds Workshop: NRW, IACC, RSPB, BTO, NT and NWWT	Birds workshop: baseline data; approach to scoping, screening and assessment of SPA features
01/11/16	HRA Working Group: IACC and NRW	Review of HRA delivery; SPC HRA; feedback on HRA methodology ; feedback on marine mammal technical note; birds workshop discussion; coastal process outputs

Meeting date	Meeting title and external bodies attending	Topics covered
03/11/16	Update call (telecon): the Planning Inspectorate	Horizon restructure; HRA Working Group and NGO consultation; deliverables; the Planning Inspectorate engagement with deliverables & prospective meetings; in-combination effects strategy; transboundary effects strategy; strategy with regard to the devolved nations and Ireland and France; implications of ESPOO
29/11/16	Proposed methodology for the marine mammals HRA assessment: NRW, IACC, NWWT and Seawatch Foundation	Marine mammal baseline report; introduction to the proposed approach for the Shadow HRA for marine mammals and list of Designated Sites; proposed approach for designated species; proposed approach for determination of LSE; discussion of the proposed Shadow HRA approach
04/01/17	HRA Working Group (telecon): IACC and NRW	Update on Horizon's design process and programme; early feedback on the Initial Stage 1 Screening assessment and discussion on next steps; early feedback on the revised EP-RSR HRA; winter marine bird surveys in 'Block 2' memo; presentation of results of the 126 cumecs discharge modelling
01/02/17	HRA Working Group: IACC and NRW	Update on SPC proposals; update on Horizon's design optimisation and programme; proposed HRA delivery schedule; discussion on Initial Stage 1 Screening Report; air overpressure predictive methodology and strategy for trial blasting and associated monitoring; results of the drone aerial photographic survey; feedback on the revised EP-RSR HRA
07/02/17	Update meeting (the Planning Inspectorate offices Bristol): the Planning Inspectorate	HRA progress update; Stage 1 Screening report; consultation with Ireland and France
15/02/17	Project Engagement Workshop (Birmingham): NRW, IACC, Welsh Government	Summary of HRA presented as part of a two day environmental impacts workshop
02/03/17	HRA Working Group: IACC and NRW	Proposed trial blast; comments on RSR-EP HRA; approach to other SNCBs; seabird data analysis
16/03/17	Technical Workshop Birds (HRA and EIA): NRW	Brief project update (in context of potential effect on birds); noise and nesting terns; visual disturbance and nesting terns – basis for determining an appropriate Zone of Influence (ZOI); update on ornithology baseline
16/03/17	Technical Workshop Fish: NRW	Baseline fisheries evidence; fish assessment evidence; fish receptors: EIA, HRA and WFD; assessment of effects and relevant pathways; fish protection Best Available Technology (BAT) work

Meeting date	Meeting title and external bodies attending	Topics covered
05/04/17	HRA Working Group (telecon): IACC, NRW and the Planning Inspectorate	EPs and HRA; Stage 1 HRA Screening; observations from trial blast; update on technical workshops
06/04/17	In-combination assessment workshop: NRW	Presentation of proposed in-combination assessment methodology
11/04/17	Marine mammals workshop: NRW	Marine mammals workshop: pathways for and assessment of effects
09/05/17 and 10/05/17	Environmental Issues Workshop (Chester): NRW	Cross discipline workshop to discuss key environmental issues including HRA considerations
12/05/17	Telephone discussion: NRW	Discussion regarding comments provided by NRW on the Stage 1 Screening Report
17/05/17	Environmental issues workshop close-out (Chester): NRW	Environmental issues workshop close-out
18/05/17	HRA Working Group (telecon): IACC and NRW	Revised scope of SPC and online road works; bird disturbance survey; noise modelling parameters; future engagement
23/05/17	Fish Assessment Workshop: NRW	Fish Assessment Workshop -EIA and HRA; baseline results presented and assessment topics discussed.
05/06/17	Cemlyn Bay Update Meeting: RSPB, NWWT, BTO, NT, IACC	Cemlyn baseline: terrestrial ecology / benthic resources / fish / ornithology / coastal processes / water and sediment quality; and approach to marine modelling
07/06/17	HRA Working Group (telecon): NRW, IACC, the Planning Inspectorate	Feedback from Cemlyn Bay NGO meeting; baseline disturbance monitoring; Evidence Record; progress with Shadow HRA; HRA signposting reports; schedule
21/06/17	Cemlyn Resilience Workshop: NT, NWWT, RSPB, NRW	To discuss the paper prepared by the NT, NWWT and RSPB on Ecological Options for Cemlyn Natura 2000 network sites (Anglesey Terns SPA) and the Cemlyn Estate in response to the Project
06/07/17	Cemlyn Bay effects: NRW specialists	Cemlyn Bay effects workshop
06/07/17	HRA Working Group: IACC and NRW	Progress on HRA and signposting; Climate change; Mitigation and management; Schedule
07/07/17	Ornithology: NRW specialists	Tern impact workshop: SPA resilience; Results of noise modelling
07/07/17	Ornithology: NRW specialists	Compensation
06/10/17	Comments on draft Shadow HRA: NRW	NRW's general and specific comments on the draft Shadow HRA

Meeting date	Meeting title and external bodies attending	Topics covered
15/11/17	Morwenoliaid Ynys Môn/Anglesey Terns SPA: NRW specialists	Key issues referred to by NRW in its review of the draft Shadow HRA relevant to the Morwenoliaid Ynys Môn/Anglesey Terns SPA, namely impacts from construction noise disturbance, value and reliability of underpinning survey data, assessment methodology and dietary equivalence and impingement/entrainment
05/12/17	Marine effects technical workshop: NRW, National Trust, NWWT, RSPB, IACC, Seawatch	To discuss various sources of potential effect on the marine environment, comprising construction discharge, marine construction noise, wave effects and operational water discharge
17/01/18	Cemlyn lagoon effects technical workshop: NRW, NWWT, National Trust, IACC	To discuss various sources of potential effect on Cemlyn lagoon, comprising construction water discharge, effects on air quality, noise and visual disturbance and operational effects

Table 3-2 Key informal consultation on HRA documentation

Date	Activity	Provided to
2015	Draft HRA Screening Document for SPC	NRW, IACC, the Planning Inspectorate, Welsh Government and MMO
	Draft HRA Framework Document (a contextual document that was not developed for the final submission)	NRW, IACC, the Planning Inspectorate, Welsh Government and MMO
2016	Jacobs reports on the *'Entrapment of marine organisms at the Existing Power Station'* and *'The survivability of biota impinged on cooling water screens – an assessment at Pembroke Power Station*'	NRW
	Draft Reasonably Foreseeable Future Projects list (to inform HRA assessment work)	NRW, IACC
	Draft A5025 HRA Screening Document (On-line and off-line then proposed as a single TCPA project) report.	NRW, IACC
	Proposed HRA Methodology	NRW, IACC
	Draft Marine Mammal Baseline Report	NRW, IACC
	Draft Dalar Hir HRA Screening document (at that point proposed as a separate TCPA)	NRW,IACC
	EP-RSR HRA Screening Report	NRW
	HRA Evidence Document, circulated for information, not developed for final submission	NRW, IACC
	Discussion paper 'Marine Mammal Shadow HRA approach'	NRW, IACC, NWWT, Sea Watch

Date	Activity	Provided to
	First Draft Main HRA Screening Report	NRW, IACC, the Planning Inspectorate
2017	Blasting Trials Proposals and Air Over Pressure (AOP) Prediction Methodology	NRW, IACC
	Letter about proposed surface blast trial	NRW (cc IACC)
	Proposed bird disturbance field work	NRA, IACC Also subsequently circulated to NWWT and NT
	Draft Surface Trial Blast Report document	NRW, IACC
	Second Draft Main HRA Screening Report	NRW, IACC, the Planning Inspectorate, Natural England, Scottish Natural Heritage, Northern Ireland Environment Agency, France and the Republic of Ireland Also subsequently circulated to NWWT, NT and RSPB
	Underwater Noise Modelling Note (to support discussions)	NRW
	Results of independent review of proposed Noise and AOP Assessment Methodology	NRW, IACC (for information)
	Draft Shadow HRA	NRW, the Planning Inspectorate, NWWT, NT, RSPB, Scottish Natural Heritage, Northern Ireland Environment Agency, France and the Republic of Ireland
2018	Centre for Ecology and Hydrology advice on critical loads (nitrogen and acid deposition) for perennial vegetation of stony banks	NRW

Table 3-3 Summary of consultation responses to the HRA [draft] Stage 1 Screening Report

No.	Key issue raised	Action taken
NRW responses		
1	The need to provide clarity between what is meant by Scoping and what is meant by Screening.	This has been scrutinised and clarified throughout chapters 4 (Scoping) and 5 (Screening).
2	The need to clearly define the worst case for the assessment.	Where assessments are included in chapters 7 to 10 (throughout) the worst realistic case parameters on which the assessments are based are set out.

No.	Key issue raised	Action taken
3	A desire to have further information on the project components and activities.	These are detailed to the extent required in the application documents.
4	A desire to have further information on the SPC Proposals and its HRA were sought.	This has now been consulted on and is dealt with in the Report to Inform Habitats Regulations Assessment Screening (Stage 1 Report) for the SPC Proposals.
5	The provision of information on what surveys will continue beyond the DCO application date.	No further surveys to inform the Shadow HRA are currently planned.
6	The requirement for mean temperature rises above ambient of 0.2°C at the surface to be used to define the area of likely significant effect.	The Shadow HRA scoped all European Designated Sites into the assessment that fall within 5km of the outfall. Guidance on thermal standards ([RD24] and [RD368] has been used for the Appropriate Assessment.
7	NRW advised that the Marine Mammal Unit is the appropriate scale for considering the relevance of sites to include in the assessment.	For marine mammals, the Project's potential ZOIs were defined by where connectivity was considered possible between the Project's direct ZOIs and any European Designated Site within the relevant Management Unit (see table 4.2).
8	The ZOI for groundwater changes should be appropriate to the scale and nature of the potential risk (e.g. the scale of dewatering) and should take into account the localised geology, characteristics of the aquifer and sensitivity of receptors to changes in groundwater.	For the scoping stage a 3km radius ZOI was used and this has been validated as sufficiently precautionary by the groundwater modelling (see chapter 7).
9	The need for the screening categories described to also consider indirect effects on marine seabird and marine mammal features due to an effect on the prey source (see tables 5.1 to 5.4). For example, fish entrapment cannot be "scoped out" of the HRA Stage 1 test of LSE for marine mammals, relevant birds or fish.	Effects on prey species have been considered in the shadow Appropriate Assessment (see chapters 8 and 10).
10	Why a 500m buffer zone was proposed for determining visual impact on nesting terns; and a reminder it is not just sandwich terns nesting at the Cemlyn colony, that need to be considered in the HRA.	The justification for the buffer zones used for visual disturbance is provided in section 10.2 of chapter 10, where impacts are considered with respect to all of the Morwenoliaid Ynys Môn/Anglesey Terns SPA species.
11	NRW advised Horizon that the Marine Mammal Unit is the appropriate scale for considering the relevance of sites to include in the Stage 1 Screening/test of LSE assessment.	This approach was adopted for Scoping European Designated Sites into this Shadow HRA (chapter 4), but at the Screening stage, for some of these sites, LSE was not determined (based on distance and the distances that the species travel to feed) (see section 5.3).
12	NRW supported the inclusion of the River Dee for salmon in the HRA stage 1 test of likely significant effect in this Shadow HRA.	Noted.
13	NRW agreed with the Shadow HRA's screening assessment for birds.	Noted.

No.	Key issue raised	Action taken
14	NRW advised that it does not consider construction disturbance to birds to be short term/pulse effects with no long term consequences.	This was agreed (see chapter 10).
15	In NRW's view there is a pathway from construction activities in the Cemlyn Bay catchment that could directly affect the water quality of the Cemlyn Lagoon priority habitat part of Bae Cemlyn / Cemlyn Bay SAC.	This issue is addressed in chapter 7 in section 7.4.
Planning Inspectorate responses		
1	The Applicant is strongly advised to agree the approach to identifying European sites with NRW.	NRW has been consulted on the sites Scoped into the assessment (chapter 4) on a number of occasions and has not proposed any additions to those considered herein.
2	Effects arising from decommissioning of the Project need to be assessed.	LSE for decommissioning is addressed in section 5.4.
3	In terms of underwater noise and vibration, the HRA should indicate and evidence what noise level is considered to induce temporary threshold shift or behaviour effects for marine mammals.	This information is provided in table 4.2.
4	Regarding sites that were included as part of the strategic HRA Site Report for Wylfa (alongside NPS EN-6) that are proposed to be excluded from the project level HRA, the Secretary of State will expect to see particular justification linking back to the ZOIs as to why this approach is appropriate.	Justification as to why sites included in the strategic HRA Site Report are excluded from the project level HRA is provided in section 4.7.
5	For each of the screening categories and/or categories of habitats and species identified within the report, the use of figures and plans identifying the relevant ZOIs and *Natura 2000* sites included within the assessment would be beneficial.	The relevant ZOIs and *Natura 2000* sites are shown on figures 4-1a and b.
6	With reference to standard mitigation and management procedures for invasive non-native species, if such measures are to be relied upon to conclude no LSE, details of these measures and how they are secured should be provided.	Details of these measures are provided in tables 5.1 to 5.4.
7	The report should clearly explain how the in-combination assessment has been approached, particularly in relation to the extent to which the associated development and SPC have been considered.	This detail has been provided in sections 3.3 and 5.2.
8	Where agreements have been reached with NRW, Natural England and any non-statutory interest groups, these should be explained and evidence provided where possible.	Where agreements have been reached this is indicated at the relevant point in the text of the assessment (see chapters 5, and 7 to 10). For NRW, these agreements are included in the NRW comments provided on the Stage 1 Screening assessment (May 2017), which were shared with the Planning Inspectorate.

No.	Key issue raised	Action taken
9	The Applicant is reminded of the advice on completing matrices in accordance with Planning Inspectorate Advice Note 10 [RD265].	The required matrices are provided in appendices F and G.

Table 3-4 Summary of NRW's general comments in the draft Shadow HRA

No.	General comment	Action taken
1	For some conclusions there is a lack of evidence presented in the draft Shadow HRA with inconsistencies in approach between sections. Considerable amounts of referencing out to the ES documents and appendices results in the document being difficult to use and not stand alone. Where evidence is material to the conclusions presented in the shadow HRA it should be included to assist the competent authority in its decision making.	Supporting evidence has been drawn into the Shadow HRA where appropriate to ensure a stand alone document is provided, while maintaining a reasonable balance and avoiding repetition.
2	Several sections discuss and refer to mitigation in the consideration of no LSE, e.g. CoCP; invasive plan in place. Mitigation should be clear and transparent.	Further detail has been provided on how mitigation would be delivered and secured; and this is summarised in chapter 11. Chapter 5 specifically includes further details on proposals for the management of invasive species.
3	At this stage in the process it is unclear if all aspects of the project and their potential effects are fully understood, particularly relating to the marine licence activities, to sufficiently inform the HRA. Section 2.1.1 of the draft document fails to provide a reference to the project description used to inform this draft shadow assessment.	All aspects of the Project and their effects have been fully understood. With reference to Licensable Marine Activities the HRA team has worked with the marine licencing team. Chapter 2 has been re-drafted and provides references to the project description used to inform the HRA and the worst case scenarios assessed for the purposes of the Shadow HRA.
4	NRW advice that care should be taken in the draft shadow HRA to use the correct terminology. Where words such as "temporary" are used a definition should be provided as to what timescales have been been considered in the assessment for example.	Where relevant this has been addressed throughout.
5	Where assumptions have been used to inform the assessment these should be clearly laid out at the start of the relevant section, and the reasoning behind the scenario selection as the worst case for the interest features being assessed should be clearly presented.	The scenarios assessed/assumptions made in the Shadow HRA (including worst case scenrios) have been set out in Chapter 2. In addition, for each assessment included in chapters 7 to 10 the assumptinos made are presented (e.g. in introducing a modelling approach).
6	Currently the in combination approach used is unclear - more projects where not enough information to consider in-combination effects may be scoped out. Can HNP confirm if the March 2017 cut off date will be revisited given the revised schedule for applications?	The description of the methodology used for the assessment of plans/projects where little information is held has been revised (i.e. assessment has been undertaken based on available information). The cut-off data has been revised to end Nov 2017. Hinkley Point C has now also been considered in the assessment.

No.	General comment	Action taken
7	What are HNP's plans to complete outstanding modelling for this draft shadow HRA?	This was discussed with NRW and the further work undertaken is reported in this Shadow HRA.
8	The draft document does not demonstrate how effects from all aspects of the project, including proposals at Dalar Hir and Parc Cybi, have been considered	These aspects are considered where effects are relevant, based on the Zones of Influence (ZOIs).
9	It is not clear how climate change has been factored in across the HRA. There is potential for an inconsistent approach to climate change considerations.	Climate change considerations are described in the relevant chapters where necessary.
10	It would be useful to have a summary at the start of the document with a clear list of sites and qualifying features considered in the HRA. This could also be usefully presented as a map showing all sites included in the HRA.	This is included in the Executive Summary.
11	The Appropriate Assessment sections don't differentiate DCO effects from other permissions.	This has been addressed where it is possible to do so, but the approach to the supporting evidence for the HRA has been to undertake a whole Project assessment.

Table 3-5 Summary of consultation responses from Pre-Application Consultation (PAC1, PAC2 and PAC3)

No.	Key issue raised	Action taken
PAC1	No specific HRA document was produced to elicit responses at PAC1. Generally relevant comments included concerns about lack of detail and sufficiency of proposed mitigation. Concern was also raised about whether sufficient information was provided regarding the impacts of the Wylfa Newydd Project on designated sites.	The Project has developed considerably since this point, with additional baseline survey information, modelling studies, design detail and the development of mitigation packages.

No.	Key issue raised	Action taken
PAC2	Specifically relevant comments were made in response to the HRA Interim Report. These included a number of comments about various elements of detail provided in the application. General comments were made about the detail available for the assessment and lack of consultation with key stakeholders. Specific requests for additional information included: - coastal and marine processes, sediments and landforms; - impacts on plankton, and the marine food chain; - all potential impact pathways for Natura 2000 sites; - consideration of the whole scheme, both alone and in-combination; and - full details of appropriate mitigation measures to avoid adverse effects on site integrity. A full list is given in the Consultation Report (Application Reference Number: 5.1).	Since PAC2 there has been regular engagement with the regulators and, where possible, material has been shared for comment with NRW, including the screening assessment. Further details on the environmental baseline have been obtained and Horizon's understanding of the Project has been developed since PAC2. Additional survey work and the various modelling studies have been undertaken; as has an assessment of the whole Project (provided herein). Table 11-1 summarises this mitigation, including the securing mechanism in each case.
PAC3		
1	Concerns were expressed over the extent of consultation that has been undertaken in general.	Further consultation has occurred since and, in particular, topic specific HRA workshops. Details of consultation are provided in this section of this Shadow HRA.
2	NRW is the Competent Authority for the Environmental Permits.	Noted.
3	Potential effects on Cemlyn ridge or prey entrapment were not covered.	These issues were not the focus of the PAC3 consultation but they are considered in chapters 7 and 9 herein.
4	The need for consistency between ES and HRA.	A consistency review formed part of the document review process prior to submission.
5	That the number of marine receptors scoped into the HRA had changed (increased) between PAC2 and PAC3.	The change in marine receptors resulted from the approach adopted for Scoping in the Shadow HRA itself (set out in chapter 4) and reflects comments made by NRW in response to PAC2.
6	The need for the clear identification of mitigation.	Proposed mitigation measures are set out as part of the consideration of Project effects throughout chapters 7 to 10. Table 11-1 summarises this mitigation, including the proposed securing mechanism in each case.

4 Scoping European Designated Sites

4.1 Introduction

4.1.1 A Scoping exercise was undertaken as an early stage of this Shadow HRA process to identify the European Designated Sites (and qualifying features) to be carried forward to the Screening stage.

4.1.2 The Scoping exercise took into account the European Designated Sites identified in the strategic level HRA undertaken by the Department for Energy and Climate Change (DECC) as a starting point. However, the identification of relevant European Designated Sites and qualifying features was further informed by identifying the Zones of Influence (ZOI) of the Project (i.e. understanding the source and pathways by which activities arising from the Project might affect European Designated Sites (see section 4.3)).

4.2 Strategic HRA

4.2.1 The Wylfa National Policy Statement (NPS) Site was nominated for new nuclear build as part of the Government's site selection process in 2009. Nominated sites were screened for their potential to affect European Designated Sites and, where applicable (including for the Wylfa NPS Site), strategic site-based HRAs were undertaken by DECC in 2010 as part of its Strategic Siting Assessment for nuclear new build.

4.2.2 The starting point for determining which European Designated Sites should be considered in this Shadow HRA was the results of the strategic level HRA. This informed the selection of sites in the National Policy Statement for Nuclear Power Generation (NPS EN-6) [RD77], ratified by the Government on the 19th July 2011.

4.2.3 European Designated Sites within a 20km radius of the nominated site (based on known sensitivities and likely spatial extent of impacts) were scoped into the strategic-level site-based HRA Screening assessment undertaken for DECC in 2010 [RD76] as follows:

- Cemlyn Bay SAC;
- Ynys Feurig, Cemlyn Bay and The Skerries SPA;
- Holy Island Coast SAC;
- Holy Island Coast SPA;
- Anglesey Fens SAC;
- Anglesey and Llyn Fens Ramsar;
- Llyn Dinam SAC;
- Menai Strait and Conwy Bay SAC; and
- Liverpool Bay SPA.

4.2.4 In addition, because distance is in itself not a definitive guide to the likelihood or severity of effects known to arise from developments, an additional eight European Designated Sites which fall beyond 20km from the site were included given their potential hydrological connections to the site, as follows:

- Anglesey Coast Saltmarsh SAC;
- Glantraeth SAC;
- Abermenai to Aberffraw Dunes SAC;
- Puffin Island SPA;
- Lavan Sands, Conway Bay SPA;
- Snowdonia SAC;
- Afon Gwyrfai a Llyn Cwellyn SAC; and
- Great Orme's Head SAC.

4.2.5 These European Designated Sites represented the baseline from which all further project-level scoping has taken place. However, having regard to the fact that Horizon is now able to draw upon a greater level of detail in relation to the location, design and the timing of Project activities, and to reflect comments received during on-going consultation, the European Designated Sites scoping exercise was re-run.

4.3 Defining zones of influence for European Designated Sites scoping

4.3.1 Horizon adopted a source-pathway-receptor approach to the European Designated Sites scoping exercise. The method sought to understand the mechanisms (source and pathways) by which activities arising from the Project might affect qualifying interest features of European Designated Sites (the receptors).

4.3.2 The approach identified potential sources of effects and then mapped how the effect might progress along a migration pathway. An understanding of the nature of the receiving environment is fundamental to determining the risk of exposure for a given receptor. An understanding of the receptor, its behavioural traits and specific vulnerability to the anticipated level and nature of the effect is similarly important.

4.3.3 As set out in PINS Advice Note 10 [RD265], each element of each qualifying feature of each European Designated Site scoped in should be considered against screening categories which describe the likely effects of the construction and operation of the Project. For this Project, 10 screening categories were proposed, as set out in table 4-1.

4.3.4 As context, the Wylfa Newydd Development Area is proposed to extend across a total area of approximately 4.1km^2. This area is proposed to comprise a land area of approximately 3.7km^2 and marine area (within which the breakwaters and MOLF will be constructed) of approximately 0.4km^2. The maximum seaward extent of the marine works proposed is 0.7km.

Table 4-1 Project screening categories

Screening categories	Description
Changes in visual and acoustic stimuli	This pathway refers to noise and vibration during activities that may cause disturbance to terrestrial, freshwater and marine species, including prey species for seabirds and marine mammals. Anthropogenic noise can also mask biologically useful sounds (i.e. 'signals') or impair hearing. Effects could also be brought about by disturbance from changes in visual stimuli e.g. artificial lighting and/or movement from machinery or people associated with the proposed works.
Land-take, including seabed or intertidal land	This category addresses land lost as a result of permanent or temporary works. Land-take is considered to be confined to the physical footprint of the activity concerned. Indirect effects have the potential to arise through the loss of supporting habitat (i.e. loss of habitat that supports prey species for seabirds and marine mammals). Indirect functional habitat loss (e.g. through disturbance or flooding) is not included in this category, but will be considered throughout the other screening categories where it is relevant.
Changes in marine water quality	This category considers effects on seabirds, marine mammals and their prey species due to changes in marine water quality and includes changes in pH, salinity, turbidity (suspended solids) and/or thermal regime that might result from nutrient enrichment, or toxic contamination (e.g. via pollution events, heavy metals, wastewater treatment products and flocculants) released into the marine environment either directly, or via terrestrial pathways.
Changes in terrestrial water quality	This pathway refers to changes to the physical and chemical composition of surface and groundwater that could become loaded with suspended sediment, nutrients or toxic contaminants (e.g. heavy metals, flocculants and hydrocarbons). This category includes sedimentation (both short and long term), changes to water turbidity and the re-suspension of sediment-bound contaminants. Such changes could affect migratory fish and the prey species of seabirds and marine mammals. The potential for an effect to arise on Cemlyn lagoon (as a key receptor) is relevant to this screening category, and there are potential links to the alteration of the groundwater regime which could influence the water chemistry of the lagoon.
Changes in surface and groundwater hydrology	This category includes potential alterations to hydrology and hydrogeology on land, and covers changes to the flow and drainage of water and increased risks associated with flooding and sediment dynamics. Changes in local hydrology could lead to flooding in foraging areas, leading to a functional loss of habitat and displacement of species. Effects could result from increased inputs into, or abstraction from, the local water supply associated with the number of construction workers required and during the operational phase.
Introduction of Invasive Non-Native Species (INNS)	There is the potential for changes in ecology to occur, potentially affecting prey species for seabirds and marine mammals, due to competition from INNS. Existing INNS could be spread into new areas during construction works or new INNS could be introduced to the local environment via 'contaminated' machinery or materials. This is relevant to both the terrestrial and marine environment.
Change in radiation dose levels	This category addresses the pathway for potential effects from radiation emanating from the Power Station during operation and includes radiological contamination of the air, water or terrestrial environment. This category includes doses to non-human species resulting from releases to the environment from routine operations.
Change in air quality	This pathway refers to non-radiological changes in air quality, such as the creation of fugitive dust particulates lifted into the air by man-made activities (e.g. use of unpaved roads) and combustion emissions from the plant during operation and vehicles/machinery associated with the construction and operation of the Project.

Screening categories	Description
Alteration of coastal processes and hydrodynamics	This criterion refers to effects that could occur due to changes to the physical coastline due to marine and coastal works. It concerns the potential for changes in local hydrodynamics that could lead to alterations in local coastal erosion and accretion. The release and dispersal of suspended sediments and any implications for habitat functionality are also relevant considerations.
Physical interaction between species and Project infrastructure	Species potentially could be directly affected through interactions (collisions) with infrastructure or machinery associated with the Project. Indirect effects could arise through the entrainment or entrapment of prey species for marine mammals and birds and increased predation risk due to the introduction of new marine structures (e.g. breakwaters). Displacement effects are covered by other screening categories (e.g. changes in marine water quality). The risk of increased trampling of vegetation within the Bae Cemlyn/Cemlyn Bay SAC (due to either increased number of site works or increased numbers of visitors to the area who may be interested in the construction works) is also relevant to this screening category.

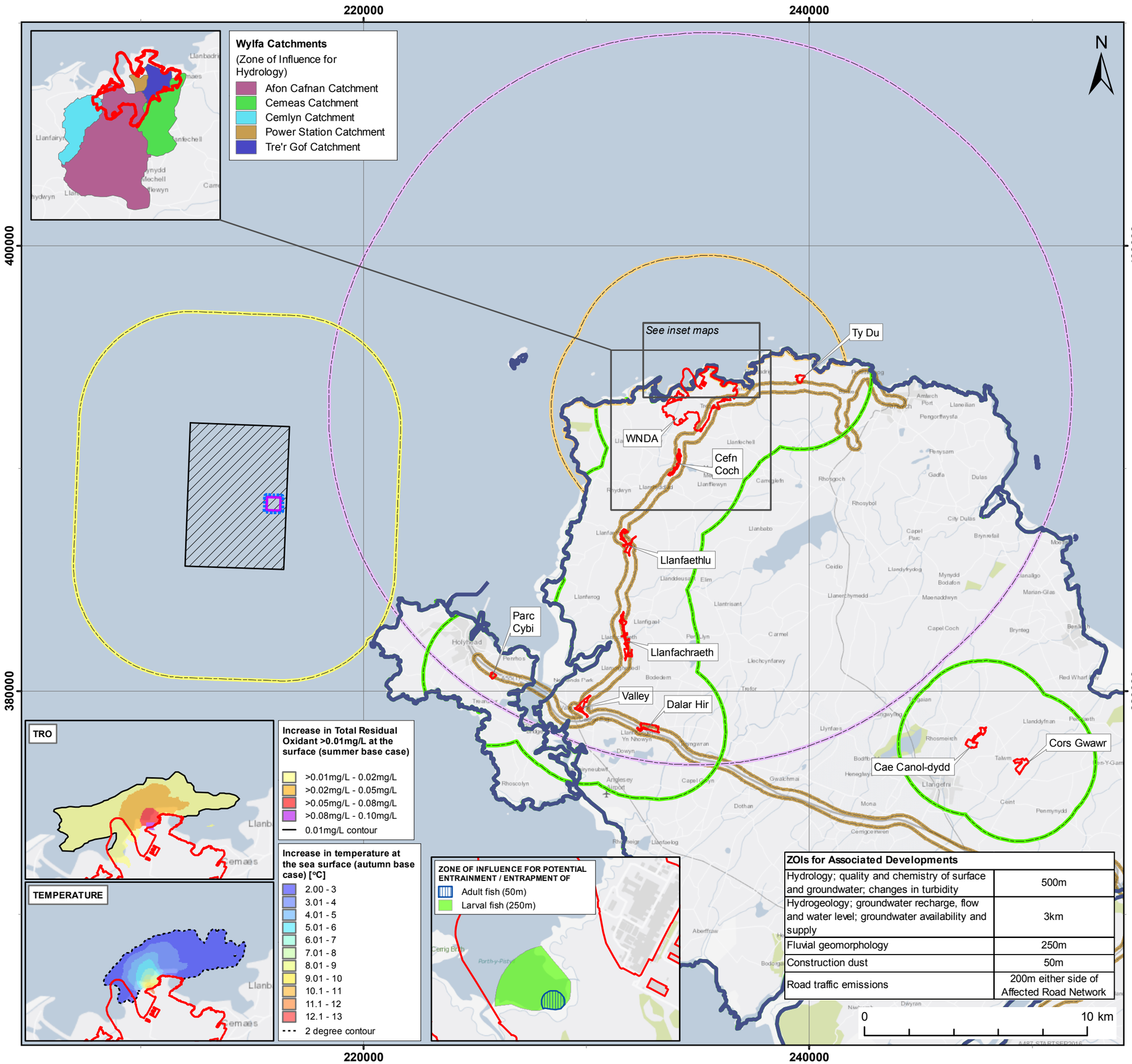
4.3.5 For each screening category identified in table 4-1, a number of potential hazards (to qualifying interest features) were identified and a ZOI defined for each potential hazard (see table 4-2 and figures 4-1 and 4-2). The qualifying interest features identified are those interest features that the 'change' in question (the screening category) has the potential to influence (e.g. changes in visual stimuli and birds). The potential hazards relate to the change and the interest features (i.e. source-pathway-receptor).

4.3.6 The ZOIs were used in two ways:

- To inform the identification of relevant European Designated Sites and the relevant qualifying features which were scoped in to the Stage 1 Screening assessment.
- To inform the assessment of potential for LSE (see chapter 5).

4.3.7 For the purposes of scoping, the maximum potential ZOIs identified in table 4-2 were applied to ensure a precautionary approach to the identification of relevant European Designated Sites and qualifying features.

4.3.8 The application of the ZOIs to the scoping exercise is described further in sections 4.4 to 4.7.



Legend

- Order Limits for the purposes of DCO
- Potential dredged material disposal area
- 100m buffer around potential dredged material disposal area
- Disposal Site
- Morfa Dinlle to Great Orme Coastal Sub-cell
- Potential zone of influence for marine water quality (WNDA site) [5km]
- Potential zone of influence for marine water quality and coastal processes (Disposal Site) [5km]
- Potential zone of influence for hydrogeology (WNDA site) [3km]
- Potential zone of influence for air quality (combustion plant) [15km]
- Potential zone of influence for air quality (affected road network) [200m]

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Client: HORIZON NUCLEAR POWER

Project: Wylfa Newydd Project

Title: Potential Zones of Influence for marine water quality, coastal processes, hydrogeology, hydrology and air quality (pursuant to Regulation 5(2)(g))

Figure: 4-1

Revision:	Date:	Drawn:	Checked:	Size:	Scale:
6	08/02/2018	TC	MS	A3	1:170,000
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Co-ordinate system: British National Grid

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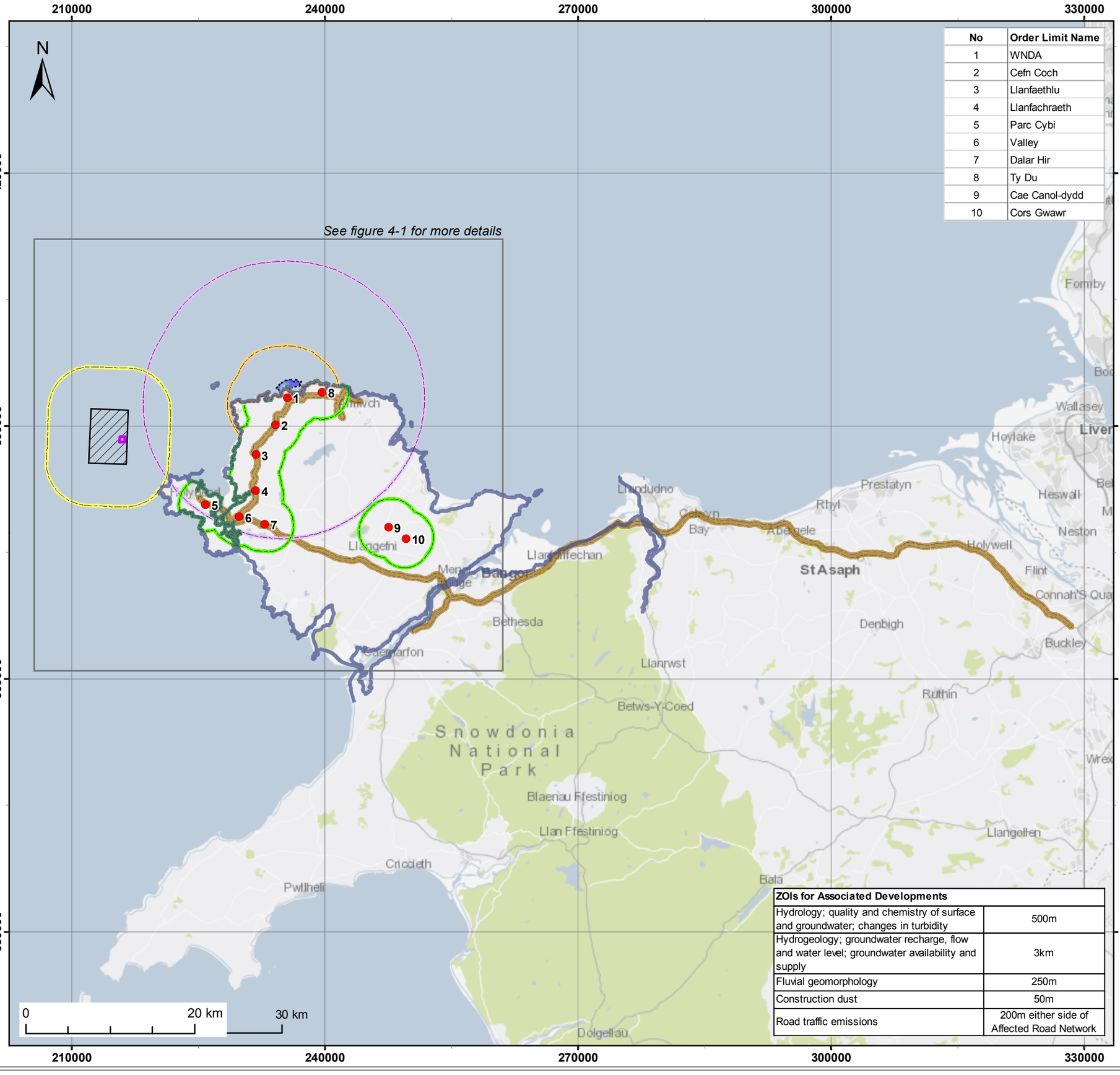

No	Order Limit Name
1	WNDA
2	Cefn Coch
3	Llanfaethlu
4	Llanfachraeth
5	Parc Cybi
6	Valley
7	Dalar Hir
8	Ty Du
9	Cae Canol-dydd
10	Cors Gwawr

ZOIs for Associated Developments	
Hydrology; quality and chemistry of surface and groundwater; changes in turbidity	500m
Hydrogeology; groundwater recharge, flow and water level; groundwater availability and supply	3km
Fluvial geomorphology	250m
Construction dust	50m
Road traffic emissions	200m either side of Affected Road Network

Legend

- Order Limits for the purposes of DCO (Refer to figure 4-1 for details)
- Potential disposal area
- Disposal Site
- Morfa Dinlle to Great Orme Coastal Sub-cell
- Potential zone of influence for marine water quality (WNDA site) [5km]
- Potential zone of influence for marine water quality and coastal processes (Disposal Site) [5km]
- Potential zone of influence for hydrogeology (WNDA site) [3km]
- Potential zone of influence for air quality (combustion plant) [15km]
- Potential zone of influence for air quality (affected road network) [200m]

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Client: HORIZON NUCLEAR POWER

Project: Wylfa Newydd Project

Title: Potential Zones of Influence for marine water quality, coastal processes, hydrogeology, hydrology and air quality (pursuant to Regulation 5(2)(g))

Figure: 4-2

Revision:	Date:	Drawn:	Checked:	Size:	Scale:
4	08/02/2018	TC	MS	A3	1:450,000
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Co-ordinate system: British National Grid

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Table 4-2 Zones of Influence defined for the Stage 1 Scoping assessment

Generic Screening category ('change')	Habitats and species (where the change has relevance)	Description of hazards associated with each Screening category	Geographical area over which it is considered that the Project hazards could have significant effects	Rationale for selected ZOI
Changes in visual and acoustic stimuli	Terrestrial, freshwater and coastal species Terrestrial and marine birds	Airborne noise and vibration from plant and machinery	The ZOI for airborne noise from plant and machinery was defined on the basis of the noise modelling of plant and machinery at the peak of construction activity, with all plant located as close as possible to the Morwenoliaid Ynys Môn/Anglesey Terns SPA boundary (on a precautionary basis). Vibration effects do not extend as far as noise effects and, therefore, the outputs of the noise modelling define the worst case scenario for this hazard. The extent of the ZOI is defined at the modelled 40dB noise contour, which extends to approximately 5km from the centre of the construction site.	This ZOI is identified as the area within which significant effects may occur. It encompasses part of the Morwenoliaid Ynys Môn/Anglesey Terns SPA (including the islands used for breeding terns in Cemlyn lagoon) and a proportion of the area within the SPA used by foraging terns. In addition, the ZOI encompasses an area of coastal waters used by other foraging seabirds. This ZOI changed through the development of the HRA process. Early in the process it was only possible to provide an assumed ZOI in the absence of modelling outputs. Subsequently the ZOI has been refined based on the results of the construction noise modelling (see ES volume D, appendix D6-1; Application Reference Number: 6.4.23). No ZOI for marine mammals was determined for airborne noise and vibration from plant machinery, as there is no potential for an effect and, therefore, this was scoped out from further consideration in the HRA.
		Airborne noise and vibration during blasting	A 5km ZOI is defined for airborne noise and vibration during blasting.	The ZOI has been aligned with that defined for noise generated by plant and machinery and has been informed by the air overpressure modelling results (see ES volume D, appendix D6-1; Application Reference Number: 6.4.23), which shows that there is no discernible effect at 5km. The key sensitive ecological receptor for airborne noise and vibration from blasting is the tern colony on the islands in Cemlyn lagoon, which are within 2km of the location of proposed blasting. The air overpressure modelling predicts that 60dB would be generated at a distance of 1,500m from the blast site using the largest maximum instantaneous charge proposed of 150kg. No ZOI for marine mammals was determined for airborne noise and vibration during blasting (dry excavation), as there is no potential for an effect and,

Generic Screening category ('change')	Habitats and species (where the change has relevance)	Description of hazards associated with each Screening category	Geographical area over which it is considered that the Project hazards could have significant effects	Rationale for selected ZOI
				therefore, this was scoped out from further consideration in the HRA.
		Noise effects associated with road transport	A zone of 600m either side of the Affected Road Network.	This ZOI was identified using professional judgement and based on Volume 11, Section 3, Part 7 – Noise and vibration of the industry standard guidance for highways (Design Manual for Roads and Bridges (DMRB); Highways Agency, 2007). Professional judgement has to be applied because there are no defined criteria for describing the effect of noise on ecological receptors. For this reason, the 600m zone prescribed in DMRB was used as road traffic is unlikely to result is a significant effect beyond this distance. DMRB (Highways Agency, 2007) defines the Affected Road Network as being any route where there is the possibility of a change of 1dB $L_{A10, 18h}$ or more in the short term or 3dB $L_{A10, 18h}$ in the long term. No ZOI for marine mammals was determined for noise effects associated with road transport, as there is no potential for an effect and, therefore, this was scoped out from further consideration in the HRA.
		Underwater noise and vibration	Underwater noise modelling was conducted to determine the predicted impact ranges for marine mammals and fish species during drilling, rock breaking, dredging and vessels.	The ZOI for underwater noise is based on the predictions from the underwater noise modelling for each species or species group (ES volume D, appendix D13-9; Application Reference Number: 6.4.91). For harbour porpoise at the Wylfa Newydd Development Area, the maximum predicted range for the 'permanent threshold shift' (PTS[2]) ZOI is 25m (for rock breaking - other noise impacts have lower calculated zones). The maximum predicted range for the 'behavioural response' ZOI is 530m (for two percussive drilling rigs - other noise impacts have lower calculated zones). For harbour porpoise at the Holyhead North disposal site, the maximum predicted range for any PTS ZOI is <1m (for cutter-suction dredging (a proxy for the disposal of material) - other noise impacts have lower calculated

[2] Used to determine the potential for auditory injury from which there is no recovery.

Generic Screening category ('change')	Habitats and species (where the change has relevance)	Description of hazards associated with each Screening category	Geographical area over which it is considered that the Project hazards could have significant effects	Rationale for selected ZOI
				zones) and the maximum behavioural response ZOI is 99m (for cutter-suction dredging). For bottlenose dolphin at the Wylfa Newydd Development Area, the maximum PTS ZOI is 36m (for rock breaking) and for behavioural avoidance is 620m (for two concurrent percussive drilling rigs). For bottlenose dolphin at Holyhead North, the maximum PTS ZOI is <1m (for cutter suction dredging) and the behavioural avoidance ZOI is 130m (for cutter suction dredging). For grey and harbour seal at the Wylfa Newydd Development Area, the maximum PTS ZOI is 450m (for rock breaking) and for behavioural avoidance is 5.9km (for two concurrent percussive drilling rigs). For grey and harbour seal at Holyhead North, the maximum PTS ZOI is 5m (for cutter-suction dredging) and for behavioural avoidance is 500m (for cutter-suction dredging).
	Fish (prey species for marine mammal and/or bird qualifying interest features and as qualifying features of SACs)	Underwater noise and vibration	The underwater noise modelling indicates that a TTS in fish with swim bladders (which are the most sensitive to this hazard) could occur up to 180m from the Project's noise sources (based on the maximum predicted impact range for rock breaking). Recoverable injury (fish with swim bladders) is predicted up to 10m from the source and mortality at 1m from source.	This ZOI was derived from the results of the underwater noise modelling (refer to ES volume D, appendix D13-9; Application Reference Number: 6.4.91); that is, the impact ranges for fish were based on the maximum predicted impact ranges from the noise modelling conducted by Subacoustech; see table 8-38).
	Terrestrial and marine birds	Unfamiliar visual stimuli (e.g. temporary infrastructure,	Breeding terns and gulls (on nest on the islands in Cemlyn lagoon). For this screening category, the	For this potential hazard the approach taken was to define the ZOI based on the location of the sensitive receptor as opposed to the source of the potential effect. The reason for this approach is that the evidence for disturbance effects (summarised below) describes the response of receptors to

Generic Screening category ('change')	Habitats and species (where the change has relevance)	Description of hazards associated with each Screening category	Geographical area over which it is considered that the Project hazards could have significant effects	Rationale for selected ZOI
		machinery and people)	approach adopted to setting an appropriate ZOI for breeding terns and gulls on the islands in Cemlyn lagoon was to define a buffer zone around the receptor. For these receptors, a precautionary buffer zone of 500m was set. Foraging, roosting and commuting seabirds, with particular relevance to terns A ZOI extending up to 1km from the source of disturbance.	disturbance and the distances over which disturbance occurs. It is therefore more logical to describe the ZOI of the Project in this way, rather than in terms of distance from the effect. Breeding terns and gulls (on nest on the islands in Cemlyn lagoon). Various studies of nesting terns or gulls have determined the distances at which birds in the colony will fly up in response to a disturbance source (i.e. flight initiation distances (FIDs)). In relation to visual disturbance, buffer zones or set-back distances may be established around breeding colonies as a conservation or protection measure. Such buffer zones are usually determined on the basis of the distances at which particular behavioural responses occur to visual disturbances, such as approaching walkers, vehicles or motorboats. For terns and gulls these buffer distances rarely exceed 200m ([RD28], [RD93], [RD283], [RD282]), although distances of between 200m and 300m were recommended for colonies of terns and skimmers during the early part of the season before birds have laid and become established on the colony [RD93]. In a review of published FIDs for responses to human disturbance, data from three different studies involving seven tern species gave mean FID values of between 0.1m and 70m, whilst a fourth study on white terns gave individual FID values ranging from 0.5m to 58m [RD192]. In all four of these studies the disturbance source was approaching walkers. The same review provided similar data for four gull species from three different studies, which gave mean FID values that ranged from 1m to 10m in one study, and individual FID values of 5m to 78m or of less than 100m in the other studies. The disturbance sources in these studies on gulls were approaching walkers in two cases and aircraft in the third. There is evidence to suggest that behavioural responses of birds tend to occur at greater distances to approaching humans than to machinery or (slow moving) approaching vehicles [RD210].

Generic Screening category ('change')	Habitats and species (where the change has relevance)	Description of hazards associated with each Screening category	Geographical area over which it is considered that the Project hazards could have significant effects	Rationale for selected ZOI
				Although, it is not possible to extrapolate in a detailed and precise way from the available studies of visual disturbance on terns and gulls to the situation for nesting terns and black-headed gulls at Cemlyn lagoon, the available evidence strongly suggests that a visual disturbance buffer zone for the Cemlyn lagoon colony would not need to extend beyond 500m, on a precautionary basis. Foraging, roosting and commuting seabirds, with particular relevance to terns Detrimental effects of visual disturbance to seabirds could also arise when birds are foraging at sea, roosting away from nesting colonies (including when at sea) or commuting between nesting or roosting sites and their foraging areas. Such visual disturbance could cause birds to avoid using potential foraging or roosting areas, and may cause birds to divert their flight routes. These impacts are equivalent to displacement and barrier effects [RD187] and, potentially, they could reduce foraging efficiency, increase energetic costs and expose birds to greater predation risk. The distance over which such effects will extend during construction, operation and decommissioning and create associated ZOIs will depend upon: • The source, type and scale of visual disturbance. • The likely behavioural response of the seabirds of interest to such visual disturbance; and • This ZOI is difficult to define with precision but its determination can be informed by the approaches that are used for other developments that may affect seabirds in such ways, most notably offshore wind farms. It is reasonable to assume that the visual disturbance resulting from medium- to large-scale offshore wind farms will extend to considerably greater distances than will the visual disturbance from the Project. This is because such offshore wind farms encompass much greater areas (frequently in excess of 150km^2), comprise a substantial number of large

Generic Screening category ('change')	Habitats and species (where the change has relevance)	Description of hazards associated with each Screening category	Geographical area over which it is considered that the Project hazards could have significant effects	Rationale for selected ZOI
				structures that contrast sharply with the surrounding landscape (i.e. open sea) and involve considerable construction activity at sea. For the purposes of undertaking assessments of the effects of offshore wind farms on seabirds, it is usual to assume buffer distances around the wind farm of between 1km and 2km, although 4km is sometimes used for particularly sensitive species (e.g. red-throated diver ([RD301], [RD148]). In the assessment of impacts from offshore wind farms, displacement and barrier effects are assumed to extend out from the wind farm and into these buffer areas. Given the dimensions of the Wylfa Newydd Development Area and the information above, it was assumed that the displacement and barrier effects will extend over considerably smaller distances than is assumed to occur for offshore wind farms, and it was proposed that a ZOI of 500m for visual disturbance is precautionary for most seabird species. For sensitive species, this ZOI was extended to 1km out from the development. It is acknowledged that the movement of vessels to and from the construction site and between the site and the Disposal Site will also represent a transient source of potential disturbance, as this was taken into account. To inform the extent to which seabird species should be considered as sensitive or not in relation to these proposed ZOIs, disturbance-vulnerability rankings ([RD117], [RD115]) was used, together with evidence on the extent to which species avoid offshore wind farms (e.g. [RD81]). In relation to Sandwich tern, disturbance-vulnerability is ranked as two on a ranking system that ranges from one to five; where one indicates 'hardly any escape/avoidance behaviour and/or none/very low fleeing distance and five indicates 'strong escape/avoidance behaviour and/or large fleeing distance [RD117]. The available data from the monitoring of offshore wind farms indicate that Sandwich tern show an overall weak avoidance to these developments, with weak avoidance defined as 'continued use of a marine

Generic Screening category ('change')	Habitats and species (where the change has relevance)	Description of hazards associated with each Screening category	Geographical area over which it is considered that the Project hazards could have significant effects	Rationale for selected ZOI
				area after construction of the wind farm, but to a lesser degree or at a lower abundance' ([RD81]).
	Terrestrial and marine birds Terrestrial, freshwater and coastal species	Changes in lighting levels	Breeding terns and gulls (on nest on the islands in Cemlyn lagoon). For this screening category, the approach adopted to setting an appropriate ZOI for breeding terns and gulls on the islands in Cemlyn lagoon was to define a buffer zone around the receptor. For these receptors, a precautionary buffer zone of 500m was set. Foraging, roosting and commuting seabirds, with particular relevance to terns. For these receptors a ZOI extending up to 1km from the source of disturbance was defined.	Refer to above comments for 'unfamiliar visual stimuli'. No ZOI for marine mammals was determined for any unfamiliar visual stimuli (e.g. temporary infrastructure, machinery and people) or changes in lighting levels, as any potential effects are unlikely to be significant and are addressed via embedded mitigation. Modelling of indicative light spill during the construction of the marine works (including the MOLF, breakwaters and cooling water intake structure) has been undertaken. This indicates that the 0.1 Lux light spill from the construction of the MOLF typically does not extend more than 50m over the water area from the location of the works. For context, a full moon on a clear night provides about 0.1 Lux of light. Modelling of light spill during the operation of the Project indicates that the 0.1 Lux light spill does not extend more than 50m from the Wylfa Newydd Development Area boundary. The light spill modelling assumes that the following embedded mitigation will be adopted: • Limiting floodlights to heights as low as possible, whilst achieving the required levels and uniformities required in terms of design standards. • Use of floodlighting luminaires that minimise glare, and provide suitable cut-off of spillage light. The effect of lighting on marine mammals is therefore scoped out from further assessment in the HRA. In addition, the effect of lighting on prey species for both marine mammals and birds is scoped out of the assessment.

Generic Screening category ('change')	Habitats and species (where the change has relevance)	Description of hazards associated with each Screening category	Geographical area over which it is considered that the Project hazards could have significant effects	Rationale for selected ZOI
Land-take, including seabed or intertidal land	Marine benthic habitats Supporting habitats for marine mammal or bird qualifying interest features and prey species	Subtidal and /or intertidal land-take	Within the Wylfa Newydd Development Area (in this case, the marine area within the Wylfa Newydd Development Area) and within the footprint of dredged material disposal.	As this hazard relates to a direct impact, the ZOI was confined to within the marine area of the Wylfa Newydd Development Area and the Holyhead North disposal site (noting that the disposal of dredged material will result in a change in habitat type as opposed to the direct loss that would arise due to the marine works within the Wylfa Newydd Development Area). Land-take includes temporary and permanent impact and in reality would not occur over the entire Wylfa Newydd Development Area, but the ZOI is defined as being the Wylfa Newydd Development Area. The disposal of dredged material will occur only within the northern section of the Holyhead North disposal site due to the southern part of the site being proposed for a tidal energy project. This ZOI was used to determine any potential effects of any loss/changes to habitats for marine mammals and birds and their prey species.
	Terrestrial, freshwater and coastal habitats and species	Land-take to accommodate temporary and/or permanent machinery and infrastructure	Within the Wylfa Newydd Development Area footprint (terrestrial and coastal zones).	All works will be within the Wylfa Newydd Development Area footprint and therefore terrestrial, freshwater and coastal habitats could be affected within this area. This hazard was considered to be potentially relevant in that supporting habitat for SPA species may be affected. No ZOI for marine mammals or birds was determined for any land-take, including any land to accommodate temporary and/or permanent machinery and infrastructure, as there is no potential for an effect and, therefore, this was scoped out from further assessment in the HRA. However, the potential for any effects on prey species was assessed.
Changes in marine water quality	Marine benthic habitats Fish Fish prey	Changes in ambient and maximum water temperature	5km radius centred on the location of the cooling water outfall.	This ZOI was defined based on the results of modelling the discharge from the circulating water system of the operational power station (see figure 4-1). The 5km zone extends beyond the area where potentially significant effects are predicted to occur, but is defined in order to acknowledge the area where the Project is predicted to result in a detectable change in temperature and to define the area on which further assessment should be focused. This ZOI was used with respect to marine mammals, birds and their prey species.

Generic Screening category ('change')	Habitats and species (where the change has relevance)	Description of hazards associated with each Screening category	Geographical area over which it is considered that the Project hazards could have significant effects	Rationale for selected ZOI
	species for SAC marine mammals and/or SPA birds Marine mammals Coastal habitats and species (including Cemlyn lagoon) Birds			As shown on figure 4-1, the modelling results (ES volume D, appendix D13-8; Application Reference Number: 6.4.90) predict a 2°C 98 percentile rise over a zone extending approximately 1.1km north and 3.1km from east to west (for the autumn base case, which is the case for which the 2°C 98 percentile rise is predicted to cover the greatest water area). The assessment undertaken considers the results for dispersion on a seasonal basis and the annual base case. In this way, the assessment will capture the worst case extent of the mixing zone and plume extent for temperature change.
		Changes in chemical parameters including pH, nitrates, ammonia, phosphates and dissolved oxygen	5km radius centred on the location of the cooling water outfall and proposed sewage discharge locations.	This ZOI was defined based on the results of modelling the discharge from the circulating water system of the operational power station. This 5km zone extends beyond the area where potentially significant effects are predicted to occur, but was defined in order to acknowledge the area where the project is predicted to result in a detectable change in water chemistry and define the area within which further assessment should be focused. The ZOI was used for marine mammals, birds and their prey species. For Total Residual Oxidant (TRO) generated from biociding the cooling water system, the assessment will present and assess the results for dispersion on a seasonal basis and the annual base case. In this way, the assessment will capture the worst case extent of the mixing zone and plume extent for TRO.
		Suspended sediment and potential contaminant re-mobilisation	The modelling studies (coastal processes and sediment plume dispersion) initially considered the potential for effect within the Morfa Dinlle to Great Orme Head coastal sub-cell. However, the modelling results indicated that potential effects will be significantly more localised and a precautionary zone of 5km radius was	The modelling studies predict no detectable change beyond 5km of the construction site or beyond 5km of the Holyhead North dredged material disposal site. This ZOI was used for marine mammals, birds and their prey species.

Generic Screening category ('change')	Habitats and species (where the change has relevance)	Description of hazards associated with each Screening category	Geographical area over which it is considered that the Project hazards could have significant effects	Rationale for selected ZOI
			determined to be appropriate for this potential hazard.	
	Marine benthic habitats / fish	Changes in freshwater flow triggers	500m from the point of discharge into the marine environment	This refers to the triggers that some species use for migration or salinity dependent niches in relation to the freshness of the water (e.g. migratory fish will seek fresher water to navigate into rivers). The ZOI was based on professional judgement. The flows from relevant watercourses are small and freshwater is quickly dispersed within the marine environment, so any effects are likely to occur within 500m of the point of discharge into the marine environment. However, it was recognised that this could have a wider effect on distant SACs designated for migratory fish. No ZOI for marine mammals or birds was determined for any changes in freshwater flow triggers, as there is no potential for an effect and, therefore, this was scoped out from further assessment in the HRA. However, the potential for any effects on marine mammal and bird prey species was assessed.
Changes in terrestrial water quality	Terrestrial, freshwater and coastal habitats and species Terrestrial and marine birds	Hydrology Quality and chemistry of surface and groundwater Changes in turbidity	The five small surface water catchment areas within and around the Project surface water study area. The catchments are: • Tre'r Gof Catchment; • Afon Cafnan Catchment; • Cemaes Catchment;	The surface water study area was based on the stream catchments at and around the Wylfa Newydd Development Area, the Mobile Emergency Equipment Garage (MEEG) and Alterative Emergency Control Centre (AECC)/Environmental Survey Laboratory (ESL) site, Park and Ride Facility, Logistics Centre and A5025 Off-line Highway Improvements, as well as important surface water features, including Cemlyn Bay. This area captures all surface water features which have the potential to be affected by the

Generic Screening category ('change')	Habitats and species (where the change has relevance)	Description of hazards associated with each Screening category	Geographical area over which it is considered that the Project hazards could have significant effects	Rationale for selected ZOI
Changes in surface and groundwater hydrology		Hydrology Surface water Runoff regime/ flooding Change in water flows and turbidity	• Power Station Catchment; and • Cemlyn Catchment. For all Associated Development locations, the surface water ZOI is defined as 500m from the Order Limit boundaries.	proposals, based on a combination of a desk study, site walkovers, site surveys, field monitoring and hydrological and hydraulic modelling. No ZOI for marine mammals or birds was determined for any changes in terrestrial water quality, surface and groundwater hydrology, as any potential effects are unlikely and therefore were out from further assessment in the HRA. However, the potential for any effects on marine mammal and bird prey species was assessed.
		Hydrogeology Groundwater recharge, flow and water level Groundwater availability and supply	Due to uncertainties regarding the radius of potential effects to hydrogeological receptors, a conservative approach was taken and a ZOI defined which measures 3km in radius.	A 3km ZOI was set based on professional judgement regarding how secondary fractured aquifers behave and the maximum likely distance across which the proposed activities could have an effect. This ZOI allowed all relevant features that could be of concern to be assessed, even where the potential effect was assessed as being extremely low. This captured residual uncertainty associated with the radius of influence calculations, especially the degree of heterogeneity of the aquifer. The heterogeneity of the aquifer was confirmed by pumping tests undertaken in late summer 2015 (refer to volume D, chapter D8 of the ES; Application Reference Number: 6.4.8). No ZOI for marine mammals or birds was determined for any changes in groundwater recharge, flow and water level, or groundwater availability and supply, as there are no potential effects.
		Fluvial geomorphology	Stream catchments extending out to 1km from the Wylfa Newydd Development Area boundary. For all Associated Development locations, the fluvial geomorphology ZOI is defined as 250m from the Order Limit boundaries.	The study area for fluvial geomorphology was defined to reflect the fact that the fluvial environment has potential pathways that could lead to effects on the coastal environment. Consideration was given to associated upstream and downstream water bodies outside the study area. Potential hazards comprise: • loss or extensive damage to geomorphological habitat and processes due to extensive modification and/or fine sediment input; • replacement of a large extent of the natural bed and/or banks with

Generic Screening category ('change')	Habitats and species (where the change has relevance)	Description of hazards associated with each Screening category	Geographical area over which it is considered that the Project hazards could have significant effects	Rationale for selected ZOI
				artificial material; and • extensive change to channel planform. No ZOI for marine mammals or birds was determined for changes in fluvial geomorphology, as no potential effects are predicted. However, the potential for effects on prey species was assessed.
Change in air quality	Terrestrial, freshwater and coastal habitats and species Terrestrial and marine birds	Road traffic emissions	A zone of 200m either side of the Affected Road Network.	The 'affected' road network is based on where there is a change in traffic flows that exceed the thresholds set out in the Environmental Protection UK and Institute of Air Quality Management guidance [RD91]. The 200m buffer was based on the guidance in the DMRB (Highways Agency, 2007). No ZOI for marine mammals was determined, as the potential for any effects are unlikely to be significant for marine mammals and, therefore, were scoped out from further consideration in the HRA.
		Construction dust	A zone 50m from the Order Limit boundaries. However, on a precautionary basis, the air quality assessment also included consideration of Bae Cemlyn/Cemlyn Bay SAC despite the fact that this site is beyond the 50m zone (the boundary of the SAC is approximately 100m from the Wylfa Newydd Development Area).	This is in line with Institute of Air Quality Management (IAQM) guidance [RD136]. No ZOI for marine mammals was determined, as the potential for any effects are unlikely to be significant for marine mammals and, therefore, were scoped out from further assessment in the HRA.
		Construction plant and machinery emissions	A ZOI extending 15km from the Wylfa Newydd Development Area site boundary.	There is no directly applicable guidance for these sources and, therefore, the ZOI was made consistent with that adopted for combustion plant emissions. It is not expected that the modelling of the air quality effect of construction plant and machinery will extend to 15km. This is therefore very precautionary. The assessment will describe the area over which air quality effects are predicted to occur from all sources, informed by air quality modelling.

Generic Screening category ('change')	Habitats and species (where the change has relevance)	Description of hazards associated with each Screening category	Geographical area over which it is considered that the Project hazards could have significant effects	Rationale for selected ZOI
				No ZOI for marine mammals was determined, as the potential for any effects are unlikely to be significant for marine mammals and, therefore, were scoped out from further consideration in the HRA.
		Operational combustion plant emissions (deposition of nitrogen and acidic compounds)	A ZOI extending 15km from the Wylfa Newydd Development Area site boundary.	A 15km study area for European Designated Sites, as per the Environment Agency risk assessment guidance ([RD90]), is generally taken to be appropriate for very large continuous combustion sources associated with the operation of large conventional fossil fuel-fired power stations (e.g. coal, oil or gas-fired power stations). The sources associated with the construction and operation of the Project are considerably smaller and will tend to operate only intermittently. However, 15km was taken to be an appropriate precautionary screening distance given the lack of certainty regarding the design of the boilers and back-up combustion plant at the scoping stage. No ZOI for marine mammals was determined, as the potential for any effects are unlikely to be significant for marine mammals and, therefore, were scoped out from further assessment in the HRA.
Introduction of Invasive Non-Native Species	Terrestrial, freshwater and coastal habitats and species Marine benthic habitats Fish Prey species for SAC marine mammals and/or SPA birds	Introduction of Invasive Non-Native Species represent a biosecurity risk which can result in significant effects on native populations (e.g. due to competition)	Within the boundary of any location where construction works will occur.	The footprint of the works (terrestrial and marine) is the area within which the greatest activity that could spread Invasive Non-Native Species (e.g. from plant, machinery and vessels) will occur and is also the area within which any mitigation measures required will be implemented. No ZOI for marine mammals or birds was determined for the introduction on invasive non-native species, as any potential effects are unlikely to be significant and, therefore, were scoped out from further assessment in the HRA. However, the potential for any effects on prey species was assessed.

Generic Screening category ('change')	Habitats and species (where the change has relevance)	Description of hazards associated with each Screening category	Geographical area over which it is considered that the Project hazards could have significant effects	Rationale for selected ZOI
Change in radiation dose levels	Terrestrial, freshwater and coastal habitats and species Marine benthic habitats Fish Marine mammals Prey species for SAC marine mammals and/or SPA birds	Releases to the environment from routine operations	A separate Stage 1 Screening assessment was undertaken in support of the Environmental Permit application under the Radioactive Substances Regulations (RSR). Environmental activity concentrations were predicted by dispersion models and used as inputs to the Environmental Risk from Ionising Contaminants Assessment and management (ERICA) Integrated Approach assessments (which are used for assessment of radiological discharge). The environmental activity concentrations used in ERICA were the worst case dose rates calculated by assuming the presence of the reference organisms for the relevant ecosystem at the location of the maximum environmental concentration due to the discharge.	The RSR screening assessment concluded that the predicted effect of the proposed Power Station, alone and in-combination with other sources of radioactive discharges, was below the 10µGy/h threshold (i.e. the level below which no further assessment is considered necessary [RD89]) for all European Designated Sites. No further consideration is given to changes in radiation dose levels in the Shadow HRA.
Alteration of coastal processes	Marine benthic habitats Fish Fish prey species for SAC marine mammals and/or SPA birds	Changes to sediment transport, currents, bed shear and waves	For scoping relevant European Designated Sites potentially affected by this hazard, the Morfa Dinlle to Great Orme Head coastal sub-cell was adopted as the ZOI. This ZOI resulted in a number of European Designated Sites for which coastal and marine habitats are qualifying interest features being scoped into the assessment (as	The coastal sub-cell was proposed as the ZOI on a precautionary basis at the scoping stage, in accordance with the advice of NRW. No ZOI for marine mammals was determined for the changes to sediment transport, currents, bed shear and waves, as any potential effects are unlikely to be significant for marine mammals and, therefore, were scoped out from further consideration in the HRA. However, the potential for effects on marine mammal prey species was assessed.

Generic Screening category ('change')	Habitats and species (where the change has relevance)	Description of hazards associated with each Screening category	Geographical area over which it is considered that the Project hazards could have significant effects	Rationale for selected ZOI
	Coastal habitats and species Terrestrial and marine birds		they are located within the sub-cell), as follows: • Bae Cemlyn/Cemlyn Bay SAC • Glannau Ynys Gybi/Holy Island Coast SAC • Y Fenai a Bae Conwy/Menai Strait and Conway Bay SAC • Y Twyni o Abermenai i Aberffraw/Abermenai to Aberffraw Dunes SAC • Glannau Môn: Cors heli/Anglesey Coast: Saltmarsh SAC. In addition to these European Designated Sites, SACs for marine mammals and migratory fish and SPAs were scoped in for this potential pathway.	
	Coastal habitats and species Marine benthic habitats	Interference with shoreline regression	Within the development footprint (in this case, the marine area within the Wylfa Newydd Development Area).	This hazard could occur due to the introduction of new structures which interfere with the regression of the coastline (albeit noting the hard rock nature of the Porth-y-pistyll). As such effects could only occur at locations where new structures are constructed and the hazard is limited to the identified ZOI. The potential for indirect, wider scale, effects on coastal processes are addressed above. No ZOI for marine mammals was determined for this effect, as any potential effects are unlikely to be significant for marine mammals and, therefore, were scoped out from further assessment in the HRA.
Physical interactions	Coastal habitats and	Trampling	Within the Wylfa Newydd Development Area, MEEG and AECC/ESL	Any effects will be confined to the footprint of the site boundaries. No ZOI for marine mammals was determined, as there are no potential effects

Generic Screening category ('change')	Habitats and species (where the change has relevance)	Description of hazards associated with each Screening category	Geographical area over which it is considered that the Project hazards could have significant effects	Rationale for selected ZOI
	species Terrestrial and marine birds Marine mammals		boundaries	on marine mammals due to trampling.
		Vessel strike (as agreed with NRW, vehicle strike is not relevant)	A ZOI encompassing the Wylfa Newydd Development Area and the marine areas between the Wylfa Newydd Development Area and Holyhead North dredged material disposal site.	It is within this zone that the potential for impact due to vessel strike exists due to the predicted concentration of vessel movements within this zone.
	Marine mammals Fish Birds	Entrainment/ entrapment	Adult fish: 50m from intake Larval fish: 250m from intake	This potential impact will be confined to the intake structure for the Power Station, and the ZOIs are identified based on there being no potential for adult fish and larval fish being drawn into the cooling water system from beyond the distances stated due to the design which reduces the flow rate of water entering the intake to a speed of less than 0.3m/s. The potential for any effects on prey species for marine mammals, birds and migratory fish that are qualifying interest features of distant SACs) was assessed. The ZOIs identified apply for marine mammals, birds and fish, because the pathway to an effect on marine mammals and birds is via an effect on their fish prey.

4.3.9 For the decommissioning phase, it was assumed that the ZOIs would be the same as or smaller than those identified in table 4-2. This is a reasonable assumption because the decommissioning works are expected to be less disturbing than the construction works (in terms of noise generation and visual disturbance etc.) and will not involve discharge to the marine environment to the same extent as that associated with operational water discharge activity. While it is assumed that the Marine Works would be decommissioned (in terms of the infrastructure installed on the MOLF and Roll-on Roll-off (Ro-Ro)), it is assumed that the structures themselves will not be removed.

4.4 Scoping in relevant habitats (terrestrial, freshwater and coastal)

4.4.1 The 15km ZOI for potential effects on air quality due to operational combustion plant emissions and 3km ZOI for hydrogeology were used to scope SACs and Ramsar sites with terrestrial, freshwater and coastal habitats (and species) into the Stage 1 Screening assessment. ZOIs for other parameters/hazards (e.g. hydrology and fluvial geomorphology) are within the extent of the above ZOIs and, therefore, do not result in additional European Designated Sites being scoped in.

4.4.2 SACs and Ramsar sites with qualifying habitats/habitat criteria within the coastal processes potential ZOI (the Morfa Dinlle to Great Orme Head coastal sub-cell) were also scoped into the Screening assessment.

4.4.3 This part of the scoping exercise captured all European Designated Sites in which terrestrial, freshwater, coastal and/or marine Annex I *habitats* (for SACs) and qualifying *habitat criteria* (Ramsar sites) are present.

4.4.4 The SACs scoped in for habitats were as follows:

- Bae Cemlyn/Cemlyn Bay SAC;
- Glannau Ynys Gybi/Holy Island Coast SAC;
- Y Fenai a Bae Conwy/Menai Strait and Conwy Bay SAC;
- Y Twyni o Abermenai i Aberffraw/Abermenai to Aberffraw Dunes SAC;
- Glannau Môn: Cors heli/Anglesey Coast: Saltmarsh SAC;
- Llyn Dinam SAC;
- Corsydd Mon/Anglesey Fens SAC;
- Coedydd Aber SAC; and,
- Halkyn Mountain/Mynydd Helygain SAC.

4.4.5 The following Ramsar site (habitat and non-bird species) was also scoped into the Shadow HRA Stage 1 Screening assessment:

- Corsydd Môn a Llyn/Anglesey and Llyn Fens Ramsar site.

4.4.6 The results of the scoping exercise for habitats were refined during the Screening exercise, as described in section 5.3.

4.5 Scoping in marine mammals

4.5.1 For marine mammals, the scoping exercise identified European Designated Sites that are applicable for each species relevant to the study area, this included:

- Determining if the Wylfa Newydd Development Area overlaps with any European Designated Sites for marine mammal species.
- Identifying a list of sites for each species that has potential connectivity with the ZOI for potential effects relevant to marine mammals (table 4-2) based on:
  - qualifying interest features identified as being present in the area; and
  - the foraging ranges of the different qualifying interest features.

4.5.2 The key factor was the potential for connectivity between individual marine mammals from designated populations and the defined ZOIs (i.e. demonstration of a clear source-pathway-receptor relationship).

4.5.3 The results of the scoping exercise for marine mammals were refined during the Screening exercise, as described in section 5.3.

Harbour porpoise (Phocoena phocoena)

4.5.4 For harbour porpoise, for the purposes of the scoping exercise, connectivity was determined to be possible between the defined ZOIs (table 4-2) and any European Designated Site within the Celtic and Irish Seas Management Unit (MU) ([RD138]), where the species is a grade A, B or C feature. Grade D indicates a non-significant population and these European Designated Sites were not, therefore, considered further. This approach to site grade applies to all marine mammal species.

4.5.5 The harbour porpoise population of the Celtic and Irish Seas MU is the most likely population to interact with the Project ZOIs. As agreed with NRW, European Designated Sites outside this MU do not need to be considered further[3].

4.5.6 The SACs and cSACs scoped in for harbour porpoise were as follows:

- Gogledd Môn Forol/North Anglesey Marine cSAC;
- Gorllewin Cymru Forol/West Wales Marine cSAC;
- Dynesfeydd Môr Hafren/Bristol Channel Approaches cSAC;
- North Channel cSAC;
- Rockabill to Dalkey Island SAC;
- Blasket Islands SAC;

[3] [RD138] states that *"The MUs provide an indication of the spatial scales at which impacts of plans and projects alone, cumulatively and in-combination, need to be assessed for the key cetacean species in UK waters, with consistency across the UK*".

- Roaringwater Bay and Islands SAC;
- Chaussee de Sein SAC;
- Ouessant-Molène SAC;
- Abers - Côtes des Légendes SAC;
- Cap d'Erquy-Cap Frehel SAC;
- Baie de Morlaix SAC;
- Côte de Granit Rose-Sept-Iles SAC; and
- Tregor Goëlo SAC.

Bottlenose dolphin (Tursiops truncatus)

4.5.7 For bottlenose dolphin, for the scoping stage, connectivity was considered possible (and agreed with NRW) between the defined ZOIs (table 4-2) and any European Designated Site within the Irish Sea MU ([RD138]), where the species is a grade A, B or C feature.

4.5.8 The SACs scoped in for bottlenose dolphin were as follows:

- Pen Llyn a'r Sarnau/Lleyn Peninsula and the Sarnau SAC; and
- Bae Ceredigion/Cardigan Bay SAC.

Grey seal (Halichoerus grypus)

4.5.9 For grey seal, for the scoping phase, connectivity was considered possible between the defined ZOIs (table 4-2) and any European Designated Site where this species is a grade A, B or C feature and the site was within the Celtic Seas OSPAR) region (as requested by NRW).

4.5.10 The SACs scoped in for grey seal were as follows:

- Pen Llyn a'r Sarnau/Lleyn Peninsula and the Sarnau SAC;
- Bae Ceredigion/Cardigan Bay SAC;
- Sir Benfro Forol/Pembrokeshire Marine SAC;
- The Maidens SAC;
- Lambay Island SAC;
- Saltee Islands SAC;
- Blasket Islands SAC;
- Roaringwater Bay and Islands SAC;
- Chaussee de Sein SAC;
- Ouessant-Molène SAC;
- Abers - Côtes des Légendes SAC;
- Baie de Morlaix SAC;
- Côte de Granit Rose-Sept-Iles SAC; and
- Tregor Goëlo SAC.

Harbour seal (Phoca vitulina)

4.5.11 For harbour seal, for the scoping phase, connectivity was considered possible between the defined ZOIs (table 4-2) and any European Designated Site where harbour seal is a grade A, B or C feature within the Celtic Seas OSPAR region (as requested by NRW).

4.5.12 The SACs scoped in for harbour seal were as follows:

- Murlough SAC;
- Strangford Lough SAC;
- Lambay Island SAC; and
- Slaney River Valley SAC.

Otter (Lutra lutra)

4.5.13 For otters, marine European Designated Sites within the defined ZOIs (table 4-2) were identified. Although the maximum potential home range for otters can be up to 40km on land ([RD121]; [RD281]), this range has not been used herein. It was deemed more appropriate to focus on those marine European Designated Sites within the potential ZOIs previously identified for the Project because, while coastal otters can hunt as far as 100m offshore in water over 10m deep, most feeding is done close to the shore in water less than 3m deep [RD237].

4.5.14 The nearest European Designated Sites for otters to the Project are Afon Gwyrfai a Llyn Cwellyn SAC, which is located approximately 34km from the Wylfa Newydd Development Area at the closest point; Pen Llyn a'r Sarnau/Lleyn Peninsula and the Sarnau SAC, which is located approximately 48km from the Wylfa Newydd Development Area and Afon Eden – Cors Goch Trawsfynydd SAC, which is located approximately 67km from the Wylfa Newydd Development Area.

4.5.15 Taking into account the distance between the European Designated Sites for otters, the distance to the Project and the potential ZOIs, it has been determined that there is a lack of a reasonable functional linkage. On this basis, it is concluded that the Project would not:

i. result in the contaminant burdens in otters at the SACs that may cause physiological damage, or immune or reproductive suppression;

ii. significantly affect the range or food resources of otters within the SACs and adjacent inter-connected areas;

iii. result in any disturbance by human activity that could suppress reproductive success, physiological health or long-term behaviour of the otters in the site; or

iv. significantly affect sources within the SACs and beyond of high quality freshwater for drinking and bathing by otters from the SACs.

4.5.16 Therefore, all marine European Designated Sites for otters were scoped out from further assessment in the shadow HRA.

4.6 Scoping in of migratory fish

4.6.1 For migratory fish, the potential for species to be present within the ZOI was considered when determining which European Designated Sites should be scoped into the Stage 1 Screening exercise. The species that were considered are discussed below.

Sea lamprey

4.6.2 Sea lamprey (*Petromyzon marinus*) has not been found in any of the surveys and has not been previously recorded; on this basis it is assumed to not be present and, therefore, no SACs designated for this species were scoped into the assessment.

River lamprey

4.6.3 River lamprey (*Lampetra fluviatilis*) is known from watercourses in the vicinity of the Power Station and a single individual has been recorded impinged on the Existing Power Station screens; however, sub-optimal habitats exist in watercourses entering the marine environment adjacent to the Power Station.

4.6.4 River lamprey does not migrate between catchments; rather they migrate from freshwater spawning grounds into the adjacent estuary/coastal waters. It is therefore considered unlikely that any river lamprey utilising the streams in the vicinity of the Power Station for spawning would contribute to SAC populations on the mainland [RD199]. Mature adults migrating to their spawning grounds spend the rest of their lives in estuaries (rather than open sea).

4.6.5 On this basis, no sites were scoped into the assessment for river lamprey.

European eel

4.6.6 The potential for European eel (*Anguilla anguilla*) that are connected with a European Designated Site to be affected by the Project has been considered. This species is listed as a species contributing to the qualifying criterion for the Môr Hafren/Severn Estuary Ramsar site, and eel use the Severn Estuary as a key migration route to their spawning grounds in the many tributaries that flow into the estuary.

4.6.7 European eels undertake a spawning migration of approximately 5000km from European water to the Sargasso Sea. The larvae are transported back to European waters by the Gulf Stream and North Atlantic Drift [RD1]. Consequently, the prevailing currents that bring elvers back to UK waters from spawning grounds in the North Atlantic will not cause eels destined for the Môr Hafren/Severn Estuary Ramsar site to interact with any elements of the Project. On this basis, no European Designated Sites were scoped into the assessment for European eel. This accords with NRW's advice.

Atlantic salmon

4.6.8 Atlantic salmon (*Salmo salar*) were not recorded in marine surveys from 2010 to 2015, either in seine netting or trawling. In addition, this species was not recorded in entrapment surveys at the Existing Power Station from 2011 to 2012; there was one record of salmon from impingement surveys carried out from 1985 to 1987 [RD318].

4.6.9 Salmon migrate through the Irish Sea to adult feeding grounds in the North Atlantic (Greenland, Faroes, Iceland). There is very little scientific research available on the exact migration routes of salmon once they leave natal rivers. Juvenile salmon are most likely to utilise ocean currents and travel directly between natal rivers and oceanic feeding grounds. Using non-direct routes will increase mortality and delay them from reaching productive feeding grounds. For this reason, SACs located to the north of Anglesey for which salmon are a qualifying feature were scoped out of further consideration, because salmon from these rivers are likely to travel directly to their natal rivers. Following this logic, juvenile salmon from rivers along the south coast of Wales (entering the Bristol Channel) and in south-west England would tend to travel directly along the west coast of Ireland rather than via the Irish Sea. This approach has been agreed with NRW.

4.6.10 Fish from SACs entering the eastern Irish Sea to the south of Anglesey (but excluding sites in south Wales entering the Bristol Channel as noted above) were scoped into the Stage 1 Screening exercise.

4.6.11 The Afon Dyfrdwy a llyn Tegid/River Dee and Bala Lake SAC was also scoped in due to its close proximity to Angelsey and because juvenile salmon migrating to the North Atlantic and adult salmon destined for the River Dee may pass close to the Wylfa Newydd Development Area. Tagging studies of juvenile fish from the River Dee [RD179] have shown that salmon tagged in the River Dee have been recaptured in Southern Ireland, indicating that some adults returning to the Dee migrate from the North Atlantic, around the west coast of Ireland and north through the Irish Sea (and therefore are likely to pass the Wylfa Newydd Development Area).

4.6.12 It is acknowledged that individuals may stray from migration pathways or enter non-natal rivers on their return; however, these individuals will represent a small proportion of the population of local and far-field SACs. The contribution of rivers out with the eastern Irish Sea are, therefore, likely to be insignificant in terms of potential connectivity to other SACs designated for salmon.

4.6.13 Given the above, the SACs scoped in for migratory fish (Atlantic salmon) were as follows:

- Afon Gwyrfai a Llyn Cwellyn SAC;
- Afon Eden–Cors Goch Trawsfynydd SAC;
- Afon Dyfrdwy a llyn Tegid/River Dee and Bala Lake SAC; and
- Afon Teifi/River Teifi SAC.

4.6.14 The freshwater pearl mussel *Margaritifera margaritifera* is an interest feature of the Afon Eden–Cors Goch Trawsfynydd SAC. This species spends its larval stage attached to the gills of salmonid fishes. Research undertaken by NRW has demonstrated that brown trout (including sea trout) *Salmo trutta* is the host species for the Afon Eden population [RD116]. Given this relationship, freshwater pearl mussel was also scoped in as a qualifying feature of relevance for this SAC.

4.7 Scoping in relevant bird species

Introduction

4.7.1 To identify SPAs, pSPAs and Ramsar sites with the potential to be affected by the Project, the starting point for the assessment was to identify the Annex I and migratory bird species recorded during the vantage point, intertidal (see figure 4-3) and boat-based transect surveys (see figure 4-4), which together provide a representative baseline. The maximum extent of the offshore survey area is that covered by the boat-based transect surveys. For the purposes of the scoping stage, all recorded bird species were taken into account. Appendix A lists all of the Annex I and migratory species recorded in the surveys (with summary information on their recorded abundance and frequency of occurrence in the survey areas).

4.7.2 Some elements of the Project were outside these survey areas, notably the Disposal Site, Parc Cybi and the road network associated with the Project. For Parc Cybi and the Project road network, there are no SPAs which overlap with these Project elements or which have connectivity to them. However, the Disposal Site lies partly within the Morwenoliaid Ynys Môn/Anglesey Terns SPA (figure 4-6) and is potentially connected to other seabird SPAs on the basis that it could provide an important foraging area for certain qualifying features of such SPAs. Therefore, boat-based transect survey data were also accessed for the breeding season months (split between 2016 and 2017) for an area that encompasses the southern part of the Disposal Site (figure 4-6).

4.7.3 Based on the list of bird species derived from the survey data set out above, it was determined whether or not the potential effects of the Project could connect with the SPAs, pSPAs and Ramsar sites whose site boundaries either overlap or lie beyond its ZOIs. For European Designated Sites with boundaries beyond the ZOIs, connectivity was considered from a functional perspective (e.g. [RD39]). Therefore, areas of land or sea within the ZOIs were considered to be linked to a particular European Designated Site where it was concluded that there was the potential for these areas to provide important resources to the qualifying features of that designated site (e.g. foraging or roosting sites).

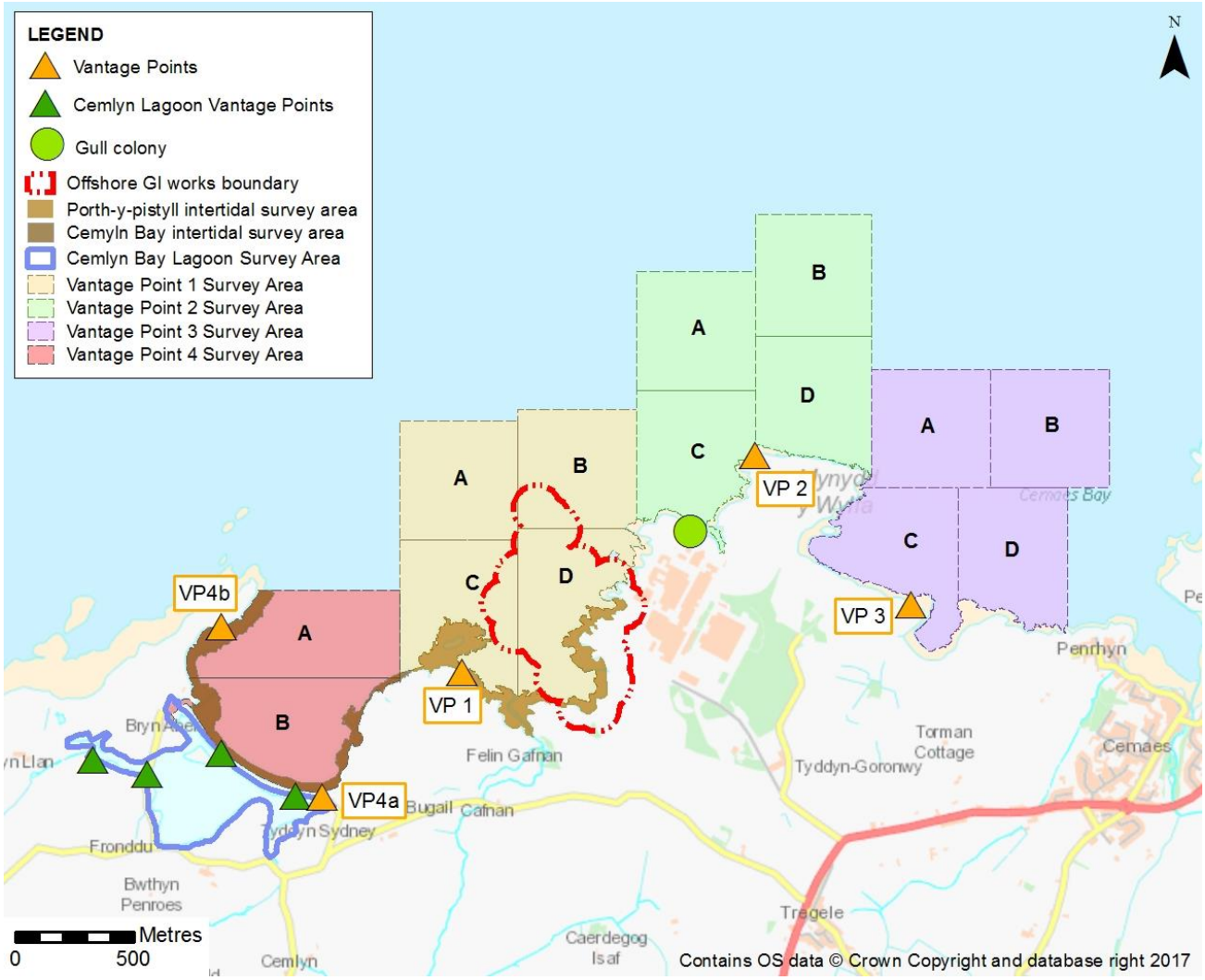

Figure 4-3 Locations of the Vantage Points, intertidal zone, Cemlyn lagoon and gull colony

4.7.4 To determine the potential for connectivity, the available information on the foraging ranges of the different species recorded on the site was used, along with knowledge of passage movements and wintering areas where relevant. Where species-specific information on foraging ranges was unavailable, the potential for connectivity was based upon precautionary assumptions of known or likely foraging ranges of related species or of relevant species groups (e.g. breeding or wintering wading birds). This information is also summarised in appendix A.

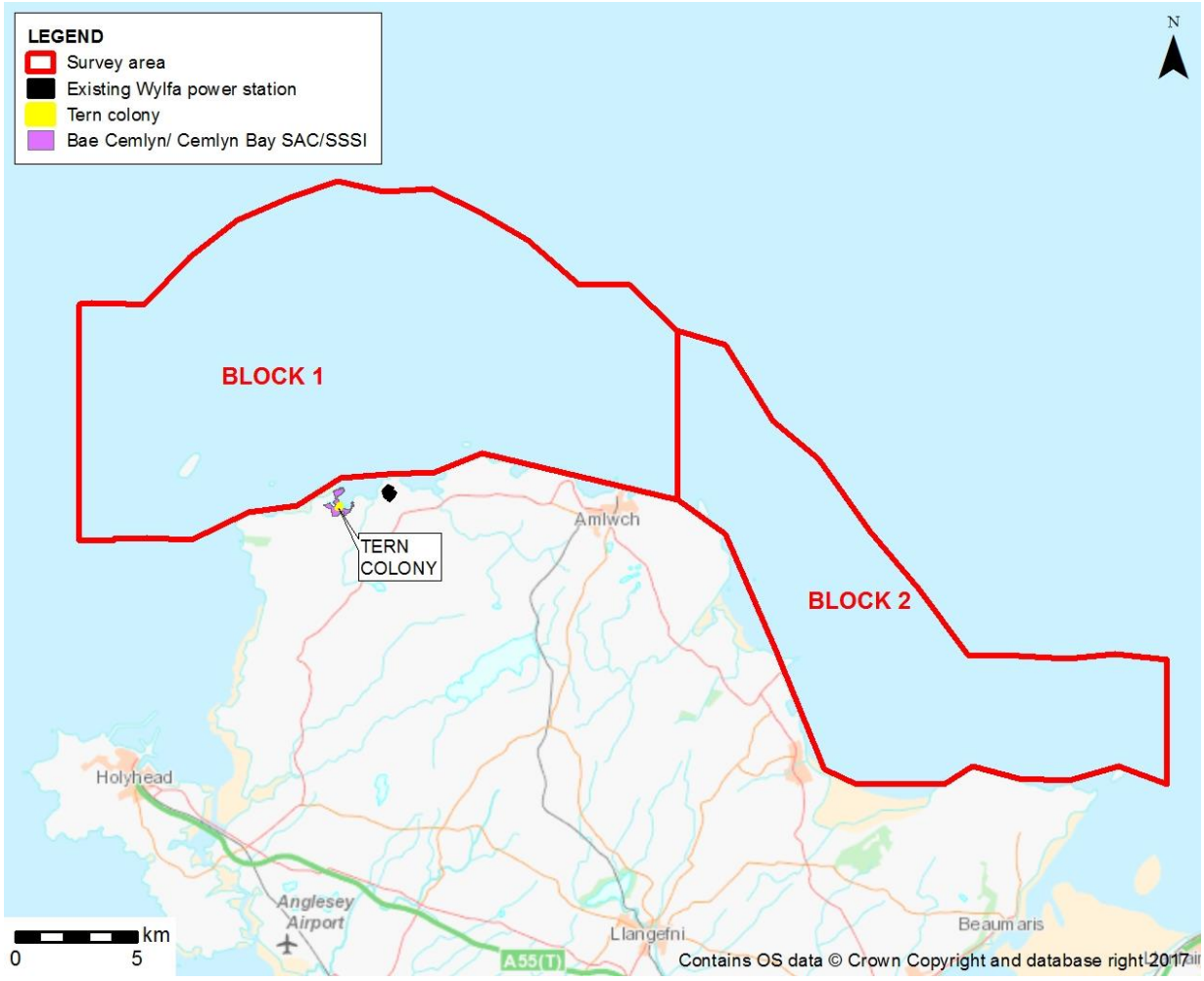

Figure 4-4 Transect survey study area (Block 1 and Block 2)

4.7.5 For populations with potential connectivity to the ZOIs, consideration is given to the potential for impact pathways to exist and the extent to which the ZOIs are of value to those species or populations. Together these aspects determine whether LSE exists in relation to the relevant SPA or Ramsar qualifying features.

4.7.6 The following criteria were used to determine the connectivity between the birds present in the Project area with relevant SPAs, pSPAs and Ramsar sites. Sites that are designated for a species that meets the criteria set out below are scoped into the Stage 1 Screening exercise. The sites scoped into the assessment are shown on figure 4-6.

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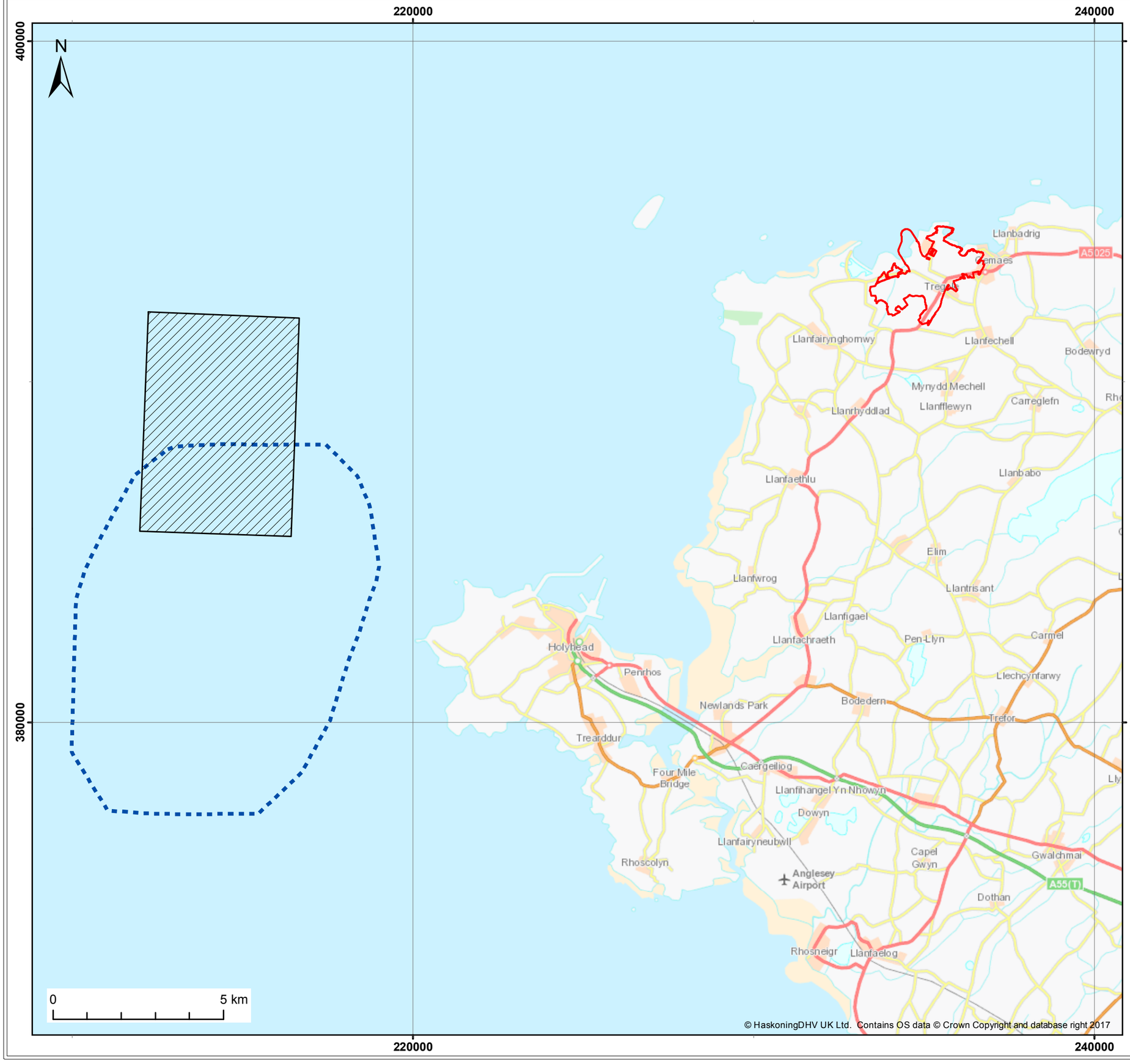

Legend

- WNDA
- Disposal Site
- Boat based survey count area

Client: HORIZON NUCLEAR POWER	Project: Wylfa Newydd Project

Title: Boat based survey area in the vicinity of the Disposal Site

Figure: 4-5

Revision:	Date:	Drawn:	Checked:	Size:	Scale:
1	04/01/2018	TC	MS	A3	1:110,000
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Co-ordinate system: British National Grid

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Seabirds

Breeding

4.7.7 For seabirds in the breeding season, connectivity is based on information on foraging distances from breeding colonies.

4.7.8 This information is mainly based on the mean maximum foraging ranges of different species where this has been estimated, with these estimates derived largely from [RD330], but augmented by other sources where relevant (e.g. analyses of space-partitioning amongst gannet colonies in the UK and Ireland – [RD351], and modelling of foraging ranges of tern species at UK colonies – [RD365]).

4.7.9 Typically the mean maximum foraging range was used to determine whether connectivity with breeding seabird SPAs (or pSPAs or Ramsar sites) is considered to be likely, although in a small number of cases where data are more limited, other sources of information are used (see appendix A for details). Tern species are potentially part of a UK and Irish metapopulation of terns and consideration was given to sites that are beyond the mean max foraging range for terns but which may have interaction with the Morwenoliaid Ynys Môn/Anglesey Terns SPA. Terns are species which frequently utilise ephemeral habitats to breed, such as temporary natural islands and sandbanks which change over time due to erosion or accretion. To compensate for loss and change of habitat they require a wider suite of breeding sites to exploit in suitable years than they need in any particular year, so they can abandon or recolonise in response to weather, erosion and other pressures, such as predation, and so survive within a number of connected breeding sites or a metapopulation (e.g. [RD292]). The SPA designated for breeding and feeding terns on the Anglesey coast and other tern SPA breeding sites (which may be within and beyond mean maximum foraging range) are, therefore, potentially linked (in regard to their being part of a wider metapopulation area). However, during any particular breeding season, there is not a functional link, as regular interchange of individuals between distant breeding sites does not occur and (except in the event of breeding failure) the SPA birds will remain at the colony to complete their breeding attempts.

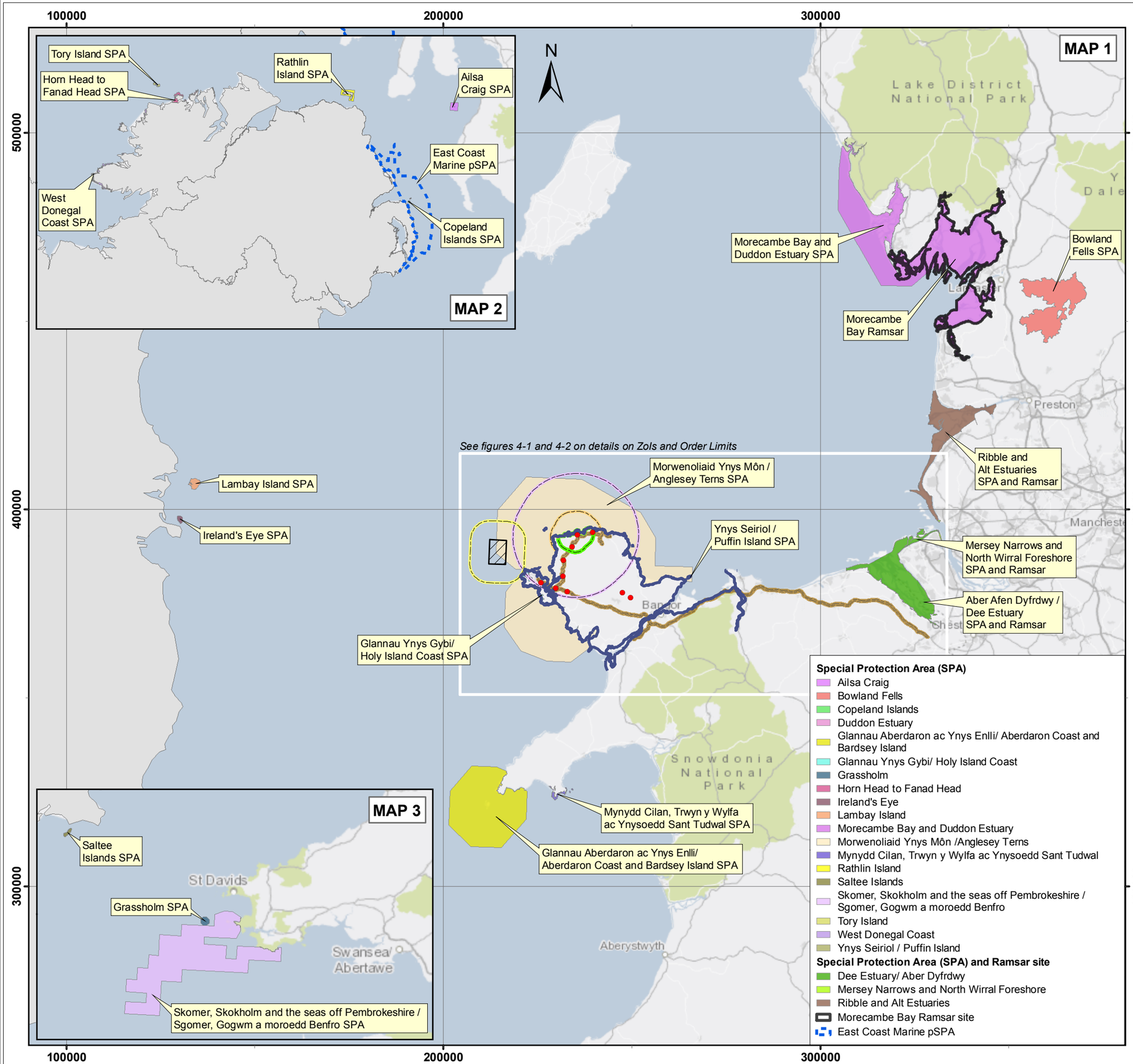
4.7.10 Effects on tern metapopulations will manifest themselves only on the breeding population of the Morwenoliaid Ynys Môn/Anglesey Terns SPA as this is the only breeding population where there is a feasible pathway to an effect. As such, any effect on the breeding tern populations of other European Designated Sites can be discounted.

4.7.11 Some seabirds occurring on passage or in winter within the ZOIs may also derive from SPA breeding colonies, giving the potential for connectivity to breeding seabird SPAs (or Ramsar sites) that occur beyond the breeding season foraging ranges. For example, kittiwakes from Irish Sea breeding colonies winter in the Irish Sea [RD112], so that kittiwakes from the Sgomer, Gogwm a moroedd Benfro/Skomer, Skokholm and the seas off Pembrokeshire SPA have potential connectivity with the ZOIs during winter.

However, for passage or wintering seabirds there will be substantial mixing amongst birds from different breeding colonies (including from populations outwith the UK), whilst a substantial proportion of wintering or passage populations are likely to comprise immatures or other birds of non-breeding status ([RD113]). Therefore, any SPA/Ramsar breeding birds occurring within the ZOIs during passage or wintering periods are likely to represent a small proportion of the source population only. Given that the ZOIs are also likely to be of relatively low importance to most wintering or passage seabird populations (see below), then this route for effects on breeding seabird SPAs/Ramsar sites was not considered further. This conclusion was agreed with NRW in May 2017 via its responses to the consultation on the Second Draft Main HRA Screening Report.

4.7.12 For breeding seabirds with potential connectivity to the ZOIs, a number of pathways exist through which effects could potentially manifest (see tables 4-2 and 5-4). Access to offshore waters for breeding seabirds is constrained by the colony location and, as such, the ZOIs have the potential to be of value to these populations even where breeding season foraging ranges are large. This potential is greatest for colonies that are within, or close to, the ZOIs, most notably the tern colonies associated with the Morwenoliaid Ynys Môn/Anglesey Terns SPA. Therefore, the following SPAs and Ramsar sites with breeding seabird qualifying features which have connectivity to the ZOIs were scoped in for further assessment in this Shadow HRA:

- Morwenoliaid Ynys Môn/Anglesey Terns SPA (Wales) – Arctic tern, common tern, Sandwich tern, Roseate tern;
- Glannau Aberdaron and Ynys Enlli/Aberdaron Coast Bardsey Island SPA (Wales) – Manx shearwater;
- Ynys Seiriol/Puffin Island SPA (Wales) – cormorant;
- Sgomer, Gogwm a moroedd Benfro/Skomer, Skokholm and the seas off Pembrokshire SPA (Wales) – Manx shearwater;
- Grassholm SPA (Wales) – gannet;
- Ribble and Alt Estuaries SPA and Ramsar site (England) – lesser black-backed gull;
- Morecambe Bay SPA and Ramsar site (England) – lesser black-backed gull;
- Morecambe Bay and Duddon Estuary SPA (England) – lesser black-backed gull;Bowland Fells SPA (England) – lesser black-backed gull;
- East Coast Marine pSPA (Northern Ireland) - Manx shearwater;
- Rathlin Island SPA (Northern Ireland) – seabird assemblage;
- Lambay Island SPA (Ireland) – fulmar, lesser black-backed gull, puffin;
- Ireland’s Eye SPA (Ireland) – guillemot;



Legend

- Order Limits for the purposes of DCO (Refer to figure 4-1 for details)
- Disposal Site
- Morfa Dinlle to Great Orme Coastal Sub-cell
- Potential zone of influence for marine water quality (WNDA site)
- Potential zone of influence for marine water quality and coastal processes (disposal site)
- Potential zone of influence for hydrogeology (WNDA site)
- Potential zone of influence for air quality (combustion plant)
- Potential zone of influence for air quality (affected road network)

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Client: HORIZON NUCLEAR POWER

Project: Wylfa Newydd Project

Title: Zones of Influence with potentially functionally linked SPAs and Ramsar sites (pursuant to Regulation 5(2)(g))

Figure: 4-6

Revision:	Date:	Drawn:	Checked:	Size:	Scale:
4	04/01/2018	TC	MS	A3	1:1,000,000
3	30/11/2017	TC	MS	A3	1:1,000,000

Co-ordinate system: British National Grid

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- Copeland Islands SPA (Ireland) – Manx shearwater;
- Saltee Islands SPA (Ireland) – fulmar, gannet;
- Horn Head to Fanad Head SPA (Ireland) – fulmar;
- West Donegal Coast SPA (Ireland) – fulmar;
- Tory Island SPA (Ireland) – fulmar; and
- Ailsa Craig SPA (Scotland) – gannet.

4.7.13 The Irish Sea Front SPA is located in UK offshore waters, approximately 36km north-west of Anglesey. This SPA is designated to protect foraging grounds of Manx shearwater. The draft JNCC Departmental Brief for the Irish Sea Front SPA [RD149] reports that the SPA represents foraging grounds for the Manx shearwater colonies of Copeland Islands and Skomer Islands (within the Sgomer, Gogwm a moroedd Benfro/Skomer, Skokholm and the seas off Pembrokshire SPA), but Manx shearwater from other colonies could also utilise the area protected by the Irish Sea Front SPA for foraging.

4.7.14 The ZOIs for the Project do not overlap with the Irish Sea Front SPA and given that the SPA is designated as a foraging area (as opposed to supporting a breeding colony), it is likely that the Manx shearwater using this SPA will forage largely within it and not outside it. Furthermore, the potential for the Manx shearwater SPA breeding colonies which contribute birds to the Irish Sea Front SPA to have connectivity with the Project is already determined on the basis of mean maximum foraging range of the species. Consequently, those SPAs that include Manx shearwater as a qualifying feature and which are scoped in for further assessment (listed above) on the basis of a potential interaction with the Project ZOIs are considered to represent all SPAs for this feature that could realistically be potentially affected by the Project.

Passage and non-breeding

4.7.15 Where non-breeding seabird populations are qualifying features of SPAs or Ramsar sites, connectivity could arise if birds from the SPA/Ramsar populations are also dependent on the ZOIs. However, for wintering populations that are SPA/Ramsar qualifying features (e.g. red-throated diver and common scoter) it is likely that they will forage largely within rather than outside the SPA/Ramsar site, given that the site boundaries have been determined to encompass the key concentrations of these species. Therefore, any use that is made of the ZOIs by wintering SPA/Ramsar populations is likely to be minimal, and the ZOIs will not be of high value to these populations, except in instances where the ZOIs overlap with SPA/Ramsar boundaries. In May 2017, NRW confirmed that it agreed with this conclusion via its responses to the consultation on the Second Draft Main HRA Screening Report.

4.7.16 Passage populations of common tern and little gull are qualifying features of the Mersey Narrows and North Wirral Foreshore SPA and Ramsar site, whilst the passage Sandwich tern population is a qualifying feature of the

Dee Estuary SPA and Ramsar site. Given that the passage movements of the two tern species (during both spring and autumn migration) are likely to follow the coast closely ([RD113]), there is potential connectivity between these SPAs/Ramsar sites and the Project ZOIs on the basis of these passage populations. This could also apply to the Mersey Narrows and North Wirral Foreshore SPA passage population of little gull, but this is not supported by the existing Project survey data, which currently include only a single record for this species (appendix A).

4.7.17 The little gull passage population associated with the Mersey Narrows and North Wirral Foreshore SPA will also be linked to the non-breeding population of this species that is a qualifying feature of the Bae Lerpwl / Liverpool Bay SPA. However, as with other wintering seabird populations, there is likely to be little dependence on the ZOIs, given the extent of the surrounding offshore habitats, including the Bae Lerpwl / Liverpool Bay SPA itself, which encompass the area utilised by this species. For this species, this conclusion appears to be borne out by the existing survey data from the Project. NRW confirmed that it agrees with this conclusion via its responses to the consultation on the Second Draft Main HRA Screening Report.

4.7.18 In contrast to breeding seabird populations, access to offshore waters for wintering or passage seabirds is not constrained by colony location. The ZOIs encompass a relatively small area of offshore habitat and they will generally be of low importance to passage or wintering populations given the overall availability of such habitat to these populations. Furthermore, the ZOIs do not overlap with the boundaries of any SPAs designated for wintering or passage seabirds. NRW confirmed that it agrees with this conclusion via its responses to the consultation on the Second Draft Main HRA Screening Report.

4.7.19 Consequently, SPAs/Ramsar sites for passage or wintering seabird populations were scoped out for further assessment in the Shadow HRA, except for the common tern and Sandwich tern passage populations from the Mersey Narrows and North Wirral Foreshore SPA and Ramsar site and the Dee Estuary SPA and Ramsar site, respectively. These populations were scoped in for further assessment in this Shadow HRA because of the potential connectivity with the ZOI, together with the importance of the ZOI for breeding populations of these species (providing the potential for a functional link to these SPAs and Ramsar sites).

Waders, wildfowl and other wetland species.

Wintering

4.7.20 For wintering waders and wildfowl, species-specific information for the assessment of connectivity was derived from several sources, notably [RD255] (for goose species) and, for wildfowl, [RD143]. For wintering waterbirds for which published information on foraging range is not available, a precautionary distance of 20km was applied from the ZOIs, beyond which SPAs, pSPAs and Ramsar sites are assumed not to have connectivity with the development.

4.7.21 The basis for the 20km threshold is as follows:

- As for wintering seabirds (and following the same principle as applied for wintering common scoter), typically, the boundaries of SPAs and Ramsar sites designated for wintering waders and wildfowl will encompass the key foraging (and other) resources for the populations and, therefore, any use that is made of the ZOIs is likely to be minimal and the ZOIs will be of limited value to these populations. On this basis, the use of a 20km threshold is considered to be precautionary. Notable exceptions can include geese, for which SPA designation may apply to roost sites but not the wider foraging areas. However, foraging range information is available for the geese species recorded on the Project survey areas (appendix A).
- With the exception of eider (which has a more strongly coastal and offshore distribution than the other wildfowl species considered), the known foraging ranges for wintering wildfowl are close to, or less than, 20km. Therefore, 20km is considered to be a precautionary threshold distance for the wildfowl species.
- Although less information is available on the wintering foraging ranges of wader species, there is evidence for restricted winter ranges and for some species at least show high levels of fidelity to their wintering areas (within and between years (e.g. [RD30]; [RD31]) and, therefore, 20km was proposed as an appropriate precautionary threshold distance for these species.

4.7.22 Application of the above criteria identified one SPA with potential connectivity to the ZOI on the basis of wintering wader or wildfowl populations (i.e. Traeth Lafan/Lavan Sands SPA for wintering oystercatcher). Although there are a number of pathways through which impacts could potentially manifest in relation to wintering waders and wildfowl (see tables 4.2 and 5.4), it is necessary to also consider the likely value of the ZOIs to the populations of interest. In the case of oystercatcher, the extent of available wintering habitat within the ZOIs is small relative to that which occurs within the Traeth Lafan/Lavan Sands SPA, and the numbers recorded within the Project survey areas are not particularly high relative to the SPA population (i.e. the maximum winter count in the Project survey areas being of 35 birds in the Cemlyn Lagoon survey area, which compares to an estimated SPA population of 6,971 birds in 2004/05 ([RD57]).

4.7.23 Therefore, no SPAs or Ramsar sites were scoped in for further assessment in the Shadow HRA on the basis of wintering wader or wildfowl populations. In comments provided in response to consultation on the draft scoping assessment in May 2017, NRW confirmed that it agrees with this conclusion via its responses to the consultation on the Second Draft Main HRA Screening Report.

Breeding

4.7.24 For breeding waders and wildfowl for which published information on foraging range is not available, a precautionary distance of 10km was applied from the Project ZOIs, beyond which SPAs, pSPAs and Ramsar sites were assumed not to have connectivity with the development.

4.7.25 The basis for the 10km threshold is as follows:

- For breeding waders, a wide range of studies have demonstrated that most activities associated with breeding occur within relatively small territories or home ranges. Even for those species that feed in different habitats to those used for nesting and chick-rearing, the feeding sites are within 10km (and usually within 2km to 3km of the nest [RD120].
- Although little information appears to be available on the territory and home range sizes of breeding wildfowl species, it is considered highly unlikely that they would regularly extend any further than 10km from nesting sites because part of the selection of a suitable nesting site will be based on proximity of an adequate food source.

4.7.26 Application of the above criteria identified no SPAs or Ramsar sites with connectivity to the ZOIs on the basis of breeding wader or wildfowl populations.

4.7.27 As for breeding seabird SPA populations, it is conceivable that connectivity with the ZOIs could arise via the occurrence of birds from such SPAs/Ramsar sites during passage or wintering periods. However, as with breeding seabirds, for wader and wildfowl species it is highly likely that there will be considerable mixing of birds from different breeding areas (including those out with the UK) during the passage and wintering periods, whilst these populations are also likely to comprise a reasonable proportion of immatures or other birds of non-breeding status. This, together with the relatively limited extent of the intertidal and coastal habitats that are generally of most importance to passage or wintering waders and wildfowl within the ZOIs, means that this route for effects on SPAs and Ramsar sites for breeding waders and wildfowl was not considered further.

4.7.28 Therefore, no SPAs were scoped in for further assessment in the Shadow HRA on the basis of breeding wader or wildfowl populations. NRW confirmed that it agreed with this conclusion via its responses to the consultation on the Second Draft Main HRA Screening Report.

Passage

4.7.29 Of the 11 species that were recorded during the surveys and which are known to be qualifying features of SPAs, or of pSPAs, on the basis of their passage populations, seven are relevant in this regard only to SPAs that are on the east or south coasts of the UK (i.e. black-tailed godwit, dunlin, greenshank, grey plover, knot, little egret and little grebe). Therefore, the passage populations of these species at these SPAs are highly unlikely to have any connectivity with the Project ZOIs.

4.7.30 Of the remaining four species, the four waders (i.e. redshank, ringed plover, sanderling and whimbrel) are each qualifying features of one or more of the Dee Estuary, Mersey Estuary, Ribble and Alt Estuaries and Morecambe Bay SPAs. All of these SPAs occur along the north-west coast of England and/or Wales and, as such, passage populations using these sites could conceivably have connectivity with the Project ZOIs. However, sanderling were recorded only rarely during the surveys, whilst redshank were of low to moderate abundance in those surveys (Appendix A). Therefore, connectivity with SPAs on the basis of passage populations of these two species is unlikely. For whimbrel, passage sites on the west coast of the UK are most important during spring migration when birds tend to be concentrated at a small number of sites in a rapid northerly migration [RD355], so again connectivity between the Ribble and Alt Estuaries SPA (in this case) and the Project ZOIs is unlikely.

4.7.31 For ringed plover connectivity could arise if passage birds from the Mersey Estuary, Ribble and Alt Estuaries and Morecambe Bay SPAs are also dependent upon the ZOIs. In this context, the highest ringed plover counts (maximum of 65 birds – Appendix A) occurred during the late summer (Appendix A). However, as with wintering and passage seabirds, it is unlikely that the ZOIs provide access to critical resources for passage populations of ringed plover.

4.7.32 Therefore, no SPAs or Ramsar sites were scoped in for further assessment in the Shadow HRA on the basis of passage wader or wildfowl populations. NRW confirmed that it agreed with this conclusion via its responses to the consultation on the Second Draft Main HRA Screening Report.

Other species

4.7.33 For the four other Annex I or migratory bird species recorded during surveys, information on foraging ranges was obtained from [RD255] in three cases, with information for chough being derived from [RD359] and [RD61].

4.7.34 No connectivity between SPAs and the Project ZOIs was identified for merlin, peregrine or short-eared owl (all of which were present within the ZOIs in small numbers only, as would be expected for these species which generally occupy exclusive, relatively large, territories – appendix A).

4.7.35 Chough were also recorded in relatively small numbers within the ZOIs (up to six birds in winter – appendix A), but this species may range widely in the winter period [RD61], and potential connectivity exists with several SPAs (see table E1, appendix E). A number of pathways exist through which impacts on this species could potentially manifest. Therefore, chough was scoped in for further assessment in this Shadow HRA.

4.7.36 NRW confirmed that it agreed with the above conclusions via its responses to the consultation on the Second Draft Main HRA Screening Report.

4.7.37 The SPAs and pSPAs scoped in for birds were as follows:

- Morwenoliaid Ynys Môn/Anglesey Terns SPA;

- Glannau Ynys Gybi/Holy Island Coast SPA;
- Glannau Aberdaron and Ynys Enlli/Aberdaron Coast Bardsey Island SPA;
- Ynys Seiriol/Puffin Island SPA;
- Mynydd Cilan, Trwyn y Wylfa ac Ynysoedd Sant Tudwal/Mynydd Cilan, Trwyn y Wylfa and the St. Tudwal Islands SPA;
- Aber Afen Dyfrdwy/Dee Estuary SPA and Ramsar site;
- Sgomer, Gogwm a moroedd Benfro/Skomer, Skokholm and the seas off Pembrokeshire SPA;
- Grassholm SPA;
- Mersey Narrows and North Wirral Foreshore SPA and Ramsar site;
- Ribble and Alt Estuaries SPA and Ramsar site;
- Morecambe Bay SPA and Ramsar site;
- Morecambe Bay and Duddon Estuary pSPA;
- Bowland Fells SPA;
- East Coast Marine pSPA;
- Rathlin Island SPA;
- Lambay Island SPA;
- Ireland's Eye SPA;
- Copeland Islands SPA;
- Saltee Islands SPA;
- Horn Head to Fanad Head SPA;
- West Donegal Coast SPA;
- Tory Island SPA; and
- Ailsa Craig SPA.

Review of findings of the strategic HRA

4.7.38 Of the European Designated Sites scoped into the strategic HRA [RD76] Glantraeth SAC, Snowdonia SAC, Great Orme's Head SAC, and Bae Lerpwl/Liverpool Bay SPA have been scoped out of this Project level scoping exercise (the Ynys Feurig, Cemlyn Bay and The Skerries SPA now forms part of the Morwenoliaid Ynys Môn/Anglesey Terns SPA).

4.7.39 The scoping exercise concluded that the European Designated Sites listed above are outside any of the ZOIs of the Project. For the Ynys Seiriol/Puffin Island SPA, although there is no overlap with the foraging range of the interest features with the Project ZOIs, Ynys Seiriol/Puffin Island SPA has been scoped into the assessment because the extent of the mean maximum foraging range for cormorant is very close to the Project ZOI for marine water quality.

4.7.40 For the Bae Lerpwl/Liverpool Bay SPA, there is no connectivity between the European Designated Site and the Project ZOIs. Traeth Lafan/Lavan Sands SPA is also scoped out for the reasons described earlier in this section.

4.7.41 NRW confirmed that it agreed with the conclusions of the scoping assessment in terms of those sites scoped into and out of the assessment via its responses to the consultation on the Second Draft Main HRA Screening Report.

4.8 Transboundary scoping

4.8.1 Horizon's initial Stage 1 Screening assessment undertaken in February 2017 (i.e. Scoping) identified the potential for LSE on sites in Wales, England, Scotland, Northern Ireland, Ireland and France. Given this, as set out in Chapter 3, Horizon consulted with the SNCBs for Scotland, England, Northern Ireland, France and Ireland on its draft HRA Stage 1 Screening assessment (second draft, dated 31 March 2017) in May 2017. This refined assessment concluded that an LSE could arise for sites in Wales, England, Scotland, Northern Ireland and Ireland, but the potential for LSE on European Designated Sites in France could be discounted.

4.8.2 In response, Scottish Natural Heritage noted that they thought the Stage 1 Screening assessment was a thorough document on the whole. They provided three comments on methodology (which have been responded to in section 3.2 of this Shadow HRA, e.g. reference to the Waddenzee judgement and Sweetman Opinion and clarification on the pre-screening approach adopted by Horizon) and stated that if it was concluded that there was a LSE on Scottish European Designated Sites, they asked to be contacted for further, focussed advice (LSE is predicted for the Ailsa Craig SPA).

4.8.3 The Department of Agriculture, Environment and Rural Affairs (Northern Ireland) did not have any technical comment, but confirmed it would like to remain part of the consultation process given the potential for effects on sites in Northern Ireland designated for transient species. The SNCB for Ireland acknowledged the consultation but has not responded. In response to the Planning Inspectorate's transboundary consultation (see section 3.3) it confirmed that it wanted to be registered as an interested party.

4.8.4 Natural England confirmed that it did not need to be consulted any further with regard to England sites, provided that NRW was being consulted.

4.8.5 The Joint Nature Conservation Committee (JNCC), as statutory adviser to the Government on UK and international nature conservation, responsible for the provision of advice in the offshore area, indicated that as the development is not located in the offshore area, does not have any potential offshore nature conservation issues and is not concerned with nature conservation at a UK level, it did not have any comments to make.

4.8.6 French representatives reiterated that they did not consider it necessary to participate in the procedure concerning the Project but wished to be kept

informed about the Project (hence the draft Stage 1 Screening Report was provided to France).

4.8.7 Horizon also consulted with those SNCBs that expressed interest in being consulted further (Scotland, Northern Ireland, France and Ireland) on its Shadow HRA in March 2018.

5 LSE Screening

5.1 Introduction

5.1.1 This chapter sets out the background to the determination of LSE in respect of the test set out in the Habitats Regulations, taking into account the various requirements set out in guidance, as well as best practice. It also provides details of the approach adopted by Horizon and the outcomes of the Stage 1 Screening assessment for the Project alone as well as in-combination with other plans and projects, in its construction, operation and decommissioning phases.

5.2 The 'LSE' Test

5.2.1 Having previously undertaken the process of identifying potentially relevant European Designated Sites in the context of the ZOIs of a project through scoping, applying the 'LSE test' encompasses the process of identifying the likely effects of the project upon the designated interest features of these sites, either alone or in combination with other plans and projects, and considering whether the effects could be significant.

5.2.2 LSE has been defined as any effect that "may reasonably be predicted as a consequence of the project" that may undermine the European Designated Site's 'conservation objectives' (Welsh Assembly Government, 2009).

5.2.3 Where a project has the potential to compromise a site's conservation objectives, it is considered likely to have a significant effect on the site. The assessment of that potential risk needs to be made in light of the characteristics and specific environmental conditions of the site concerned and, specifically, each of the designated interest features. That is, LSE should be determined on a case-by-case basis, taking account of the precautionary principle and local circumstances (e.g. is the sensitivity of the site/feature of a nature that could be negatively affected by the potential change or not); this is the basis for the LSE decision.

5.2.4 The word 'likely' in the Habitats Regulations should not be interpreted as referring to the probability of a significant effect but rather as providing a description of the existence of a risk of a significant effect (i.e. the possibility). Consequently, if the possibility of a significant effect cannot be excluded on the basis of objective information, an 'appropriate assessment' (Stage 2 of the process) will be required.

5.2.5 Although not the topic of this chapter, it is important to note that the existence of a risk to achieving the conservation objectives of a site as a result of project-related effects does not automatically equate to an adverse effect on the integrity of the site. The risk needs to be examined in detail as part of the subsequent appropriate assessment to the point that no reasonable scientific doubt remains as to the absence of an adverse effect on site integrity (see chapters 7 to 10).

5.3 Determination of LSE

Information requirements

5.3.1 The LSE test requires that consideration is given to potential causes of effects on the qualifying interest features of European Designated Sites (i.e. potential impact pathways). Information on the project is needed to identify the potential causes of effects, and information on the European Designated Sites is needed to identify any potential implications related to these effects. In the absence of a potential impact pathway it can be concluded that no LSE will arise. In respect of this aspect it is also important to ensure that the potential for a risk is credible rather than hypothetical.

5.3.2 In addition, for an impact to affect a receptor, the receptor needs to be sensitive to the change that occurs as a result of the activity and vulnerable to the impact (i.e. within the impact zone). Based on existing knowledge it is possible to screen out the potential for an impact to occur on certain interest features either because they will not be vulnerable to any changes occurring as a result of the works and/or they will not be sensitive to any changes that could occur.

5.3.3 The conclusion as to whether a significant effect is likely needs to be reached in the light of the “best scientific knowledge in the field” (based on the decision of the European Court of Justice in the Waddenzee case (case C-127/02)). Sources of information may include evidence from projects where similar operations have affected sites with similar conservation objectives and the judgement of specialists that an effect is likely. The information required will vary from project to project.

5.3.4 In line with the precautionary principle, where there is uncertainty and/or information is lacking in relation to the capacity of an effect to undermine a site’s conservation objectives it must be assumed that there will be an effect, unless further information can be made available to eliminate any areas of doubt.

Screening for LSE – alone

5.3.5 A LSE has the potential to arise when the presence of a receptor (qualifying interest feature) overlaps with the influence of an effect associated with a project that the receptor is sensitive to. Given this, cause and effect pathways need to be characterised.

5.3.6 In short, the identification of LSE is determined based on:

- the likelihood that a qualifying habitat or species (qualifying interest feature) will be present in the geographic ZOI of a project;
- the likelihood that a pathway exists between an impact source and the qualifying interest feature;
- the ability of the qualifying interest feature to avoid or adapt to impacts, the availability of alternative, suitable habitat and the likelihood that the interest feature will access it; and

- determination of the importance of the ZOI to the qualifying interest feature (in the context of the interest features' conservation objectives).

5.3.7 As described in chapter 4, each element of each qualifying interest feature of each European Designated Site scoped into the assessment should be considered against 'screening categories' which describe the likely effects of the construction, operation and decommissioning of a project. For this Project, 10 screening categories were proposed (set out in detail in table 4-1 and used below in tables 5-1 to 5-4). The relevant qualifying interest features are those interest features that the 'change' in question (the screening category) has the potential to influence (e.g. changes in visual stimuli and birds).

5.3.8 The methodology adopted for this screening assessment follows a methodology set out in [RD265], and includes the provision of screening matrices as appendices.

Screening for LSE – in-combination

5.3.9 As noted in section 5.2, the 'LSE test' needs to consider the potential for LSE both alone or in-combination with other plans and projects.

5.3.10 The in-combination component of the LSE test focuses on those plans or projects that involve activities or effects that could interact with the activities or effects associated with the project under consideration. In this respect, the determination of which plans and projects could act in-combination with a project must consider whether the effects of the other plans and projects, in combination, would:

- make predicted project effects more (or less) significant;
- make possible project effects (that alone would be unlikely to occur) more likely to occur; or
- make insignificant effects significant.

5.3.11 Note that as part of the alone Screening assessment for the Project a conclusion of no LSE has not been reached if repeated or multiple effects have the potential to occur and to be significant over the duration of the Project.

5.3.12 The approach taken to the 'alone' Stage 1 Screening assessment for the Project was deliberately precautionary, in that LSE was concluded where the potential existed for any conceivable negative effect on an interest feature to arise. As such, European Designated Sites not captured by the 'alone' LSE screening assessment do not have any potential to be affected by the Project, either alone or in-combination. This is because the approach taken to screening for the 'alone' assessment captured all effects, including minor, non-significant effects. This approach was discussed with NRW in April 2017 at an in-combination assessment workshop intended to make the proposed approach clear. It is emphasised that this methodology was adopted in order to identify relevant European Designated Sites for the in-combination Stage 1 Screening assessment; the assessment itself

considered the potential for LSE alone (section 5.4) or in-combination with other plans and projects (section 5.5).

Identifying other plans and projects relevant to in-combination effects assessment

5.3.13 A long list of potentially relevant other plans and projects to the in-combination assessment for this Shadow HRA was compiled using the three sources of information detailed below.

The list of projects and plans developed for the EIA cumulative impact assessment (CIA) for the Project

5.3.14 The list of projects and plans scoped into the CIA was developed according to the following criteria:

- Anglesey: All projects and plans subject to EIA or Strategic Environmental Assessment (SEA) (i.e. where it has been determined that significant effects could arise). On rare occasions, projects that were not subject to EIA but are so close to a Project component that a cumulative effect is highly likely to occur were also included.
- Gwynedd, Conwy: All projects and plans subject to EIA or SEA, focusing on those projects likely to have socio-economic and traffic and transport effects, and coastal projects likely to have effects on the marine environment.
- Denbighshire, Flintshire, Ceredigion, Pembrokeshire, Cheshire West and Chester, Wirral, Liverpool, Sefton, Isle of Man, Republic of Ireland (Dublin and Wicklow): Major infrastructure projects or plans which were likely to have significant socio-economic effects in the North Wales region or coastal projects which may have a significant effect on the marine environment.

5.3.15 The list developed for the CIA was issued to, and agreed with, NRW, IACC and the Welsh Government.

5.3.16 It is clear from the above that some of the criteria used to develop the list of projects and plans relevant to the CIA (e.g. those relating to socio-economic effects) are not relevant to HRA; therefore projects and plans scoped in to the CIA based on these criteria have not be taken forward into the Shadow HRA in-combination assessment. However, of relevance to this Shadow HRA, all plans and projects that have the potential to have an effect on the marine environment in the study area and on Anglesey, either alone or in-combination with the Project, were identified and are considered in appendix B (Screening of projects and scoping of plans for inclusion in the in-combination assessment). As a precautionary measure, the HRA screening exercise factored in insignificant effects associated with those projects which

potentially could act in-combination with the Project to create a significant effect. A further screening stage, beyond appendix B scoping, was undertaken for relevant plans (see section 5.5).

5.3.17 In addition to the list developed for the CIA, a search of the national registers of marine licences and foreshore licences captured all relevant coastal and marine projects in the United Kingdom and Ireland (see below for a description of the criteria applied to judge which projects were considered relevant to the in-combination assessment) regardless of their scale or the level of environmental assessment undertaken, and identified those projects that may have insignificant effects alone but which could result in significant effects arising in-combination with the Project.

A search of national registers of marine licences and foreshore licences

5.3.18 Recognising that the definition of what might represent a significant effect for CIA/EIA is different from how LSE is defined for purposes of HRA, and that coastal/marine projects are likely to be of most relevance to the HRA for the Project, a search of the marine licence registers for Wales (NRW), England (Marine Management Organisation ('Northern', 'Merseyside and Fylde' and 'Western' Districts)), Scotland (Marine Scotland), Northern Ireland (Department of Agriculture, Environment and Rural Affairs) and foreshore licences for Ireland (Department of Housing, Planning, Community and Local Government) was undertaken for the period January 2015 to November 2017. January 2015 was taken as the start date for the search on the assumption that earlier projects would be likely to have been completed. November 2017 was selected as the latest date for the search; this date is driven by the programme for the HRA.

5.3.19 This exercise generated a list of projects potentially relevant to in-combination assessment (also included in appendix B). However, not all of the projects identified have the potential to result in in-combination effects with the Project. The screening exercise undertaken therefore involved initial high level scoping/screening out of other plans and projects, respectively, which do not have the potential to result in in-combination effects based on defined criteria (scale of the project and/or distance from European Designated Sites). For example, there are certain types of activities (e.g. small scale surveys) that are considered to be insignificant in nature and scale and, as such, are unlikely to have the potential to contribute to significant in-combination effects. The seventh column of the 'projects' table provided in appendix B identifies whether or not each project is considered relevant to the in-combination assessment, with the reasoning for the decision provided in the subsequent column. The second to last column of the 'plans' table in appendix B identifies whether or not the plan needed to be considered further, with the reasoning for the decision provided in the final column.

5.3.20 The screening assessment was based on readily available public information to determine whether or not each project was relevant to the in-combination assessment. This judgement was made primarily on the basis of the scale of

the activity, its likely effects and the proximity of the activity to any the European Designated Sites where LSE was determined for the Project (alone). This informed a decision as to whether or not there was the potential for likely significant in-combination effects (LSIE) to arise based on whether the plans and projects will, firstly, overlap in space and time with the Project (this includes the potential existing for both to affect the same European Designated Site, even if this were to occur in different locations over an extended timescale) and, secondly, whether they have the potential to influence the same environmental receptors (if they do not, even though they may be spatially and temporally adjacent, an in-combination effect will not arise).

A search of projects on the National Infrastructure Planning register (Planning Inspectorate website)

5.3.21 In addition to the above, a search of projects on the National Infrastructure Planning register and a review of HRA-related information (including Reports of Implications for European Sites, where available) was undertaken. Nationally Significant Infrastructure Projects that have the potential to affect any of the same European Designated Sites as the Project were identified, as follows (where a distinction is made between those that are included in appendix B and those that are 'screened in' in addition to those plans and projects considered in appendix B):

Projects from the National Infrastructure Planning register considered in appendix B (that is, this project had already been picked by one of the other two searches)

- North Wales Connection.

Projects from the National Infrastructure Planning register automatically screened in to Stage 2 (appropriate assessment) of this Shadow HRA due to their size and nature (but not picked up by the other two searches)

- Burbo Bank Extension Offshore Wind Farm;
- Glyn Rhonwy Pumped Storage;
- South Hook Combined Heat & Power Station;
- Walney Extension Offshore Wind Farm;
- North West Coast Connections Project;
- NuGen Moorside Project in West Cumbria;
- Swansea Bay Tidal Lagoon; and
- Cardiff Tidal Lagoon.

5.3.22 Hinkley Point C New Nuclear Build was considered as part of this process, but a review of DECC's Report of Implications for European Sites indicated that there is no overlap between the European Designated Sites for which effects were assessed for Hinkley Point C and those that could be affected by the Wylfa Newydd Project. Therefore it was not assessed further.

5.4 Findings of Stage 1 Screening: construction and operation of the Project alone

Introduction

5.4.1 This section presents the findings of the Stage 1 Screening assessment for the European Designated Sites that have been scoped into the assessment, considering SACs and cSACs, Ramsar sites (habitats and non-bird species), and SPAs, pSPAs and Ramsar sites (birds) in turn. The results of the Stage 1 Screening assessment are presented in appendices C (SACs and cSACs), D (Ramsar sites (habitats and non-bird species)), E (SPAs, pSPAs and Ramsar sites (birds)) and F.

5.4.2 Appendix F has been subdivided into appendices F.1, F.2, F.3 and F.4. Appendices F.1, F.2 and F.3 present the results of the Stage 1 Screening assessment for the whole Project, alone and in-combination with other plans and projects (in the Screening matrix format required by PINS, in accordance with Advice Note 10 (PINS, 2016)). Appendix F4 presents the results of the Stage 1 Screening assessment for the construction water discharge, operational combustion activity and operational water discharge to be consented by the Environmental Permits (the HRA for the RSR Environmental Permit is presented separately, and the outcomes are summarised in the Screening tables herein) and the Licensable Marine Activities to be consented by the Marine Licences alone (i.e. in isolation from the Project).

5.4.3 This approach has been adopted to enable NRW as competent authority for the Environmental Permit applications and Marine Licence applications to isolate the effect of the proposed activities subject to Environmental Permits and Marine Licences when undertaking its HRA; but also to obtain a picture of the implications for European Designated Sites resulting from the whole project.

5.4.4 As noted in chapter 1, the SPC Proposals and A5025 On-line Highway Improvements applications have been subject to separate, individual HRA (due to the fact that separate planning applications under the Town and Country Planning Act 1990 are to be submitted for these Enabling Works), reported in the following documents:

- Wylfa Newydd Project Site Preparation and Clearance: Report to Inform Habitats Regulations Assessment Screening (Stage 1 Report).
- Wylfa Newydd Project A5025 On-line Highway Improvements: Statement to Inform Habitat Regulations Screening.

5.4.5 However, because the Enabling Works form part of the Project (and, in the case of the SPC Proposals, form part of the works to be consented by the DCO), the outcomes of the screening assessments for all relevant European Designated Sites are also summarised below; before the screening outcomes for the Project as a whole are presented.

Findings

Enabling Works

5.4.6 The HRA for the SPC Proposals assesses the potential for LSE on the following six European Designated Sites:

- Bae Cemlyn/Cemlyn Bay SAC;
- Morwenoliaid Ynys Môn/Anglesey Terns SPA;
- Glannau Ynys Gybi/Holy Island Coast SPA;
- Glannau Aberdaron and Ynys Enlli/Aberdaron Coast Bardsey Island SPA;
- Craig yr Aderyn (Bird's Rock) SPA; and
- Mynydd Cilan, Trwyn y Wylfa ac Ynysoedd Sant Tudwal/Mynydd Cilan, Trwyn y Wylfa and the St. Tudwal Islands SPA.

5.4.7 It concludes that there will be no LSE on any of the qualifying features of the European Designated Sites listed above, alone or in-combination with other plans and projects.

5.4.8 The HRA for the A5025 On-line Highway Improvements concludes that the presence of lesser black-backed gull within the ZOI of the proposed works results in potential connectivity with 12 European Designated Sites, namely:

- Bowland Fells SPA;
- Sgomer, Gogwm a moroedd Benfro/Skomer, Skokholm and the seas off Pembrokeshire SPA;
- Skokholm and Skomer SPA (which is now part of the the Sgomer, Gogwm a moroedd Benfro / Skomer, Skokholm and the seas off Pembrokeshire SPA);
- Poulaphouca Reservoir SPA;
- Ribble and Alt Estuaries SPA;
- Ribble and Alt Estuaries Ramsar site;
- Lambay Island SPA;
- Lough Neagh and Lough Beg SPA;
- Morecambe Bay SPA;
- Morecambe Bay Ramsar site;
- Saltee Islands SPA; and,
- Wexford Harbour and Slobs SPA.

5.4.9 However, given the availability of suitable alternative foraging habitat and the relatively small-scale of the habitat loss forecast due to the proposed works in the context of the gull's foraging range, the HRA predicted no LSE on any European Designated Sites, alone or in-combination with other plans and projects.

5.4.10 In light of the above conclusions, the predicted effects of the Enabling Works (SPC Proposals and A5025 On-line Highway Improvements) are not identified separately (from the broader effects of the Project) elsewhere in this Shadow HRA.

SACs and cSACs

5.4.11 The outcomes of the Screening assessment for SACs and cSACs are presented in appendix C; qualifying features that have been carried into the Stage 1 Screening exercise are shown in bold text in appendix C.

The results of the Screening assessment for SACs and cSACs are supported by figures 1 to 6 included in appendix C.

Ramsar sites (habitats and non-bird species)

5.4.13 The outcomes of the Screening assessment for Ramsar sites is presented in appendix D; qualifying features that are carried into the Stage 1 Screening exercise are shown in bold text in appendix D.

5.4.14 The results of the Screening assessment for Ramsar sites are supported by figure 7 included in appendix D. Ramsar sites designated for bird species are included alongside SPAs and pSPAs (see below).

SPAs, pSPAs and Ramsar (bird) sites

5.4.15 The outcomes of the Screening assessment for SPAs, pSPAs and Ramsar sites with bird interest are presented in appendix E; qualifying features that are carried into the Stage 1 Screening exercise are shown in bold text in appendix E.

5.4.16 The results of the Screening assessment for these sites are supported by figures 8 to 20 included in appendix E.

5.4.17 Figures 8 to 19 show SPAs and pSPAs that have been included in the Stage 1 Screening assessment on the basis of potential interaction between a qualifying species and an SPA, pSPA or Ramsar site. Figure 20 shows those sites that were included based on passage populations (noting that some of the sites shown are also included for other species, as shown on figures 8 to 19).

Screening matrices

5.4.18 The results of the Stage 1 Screening assessment are presented in screening matrices in appendix F. Where effects on a receptor cannot readily be discounted, a conclusion of LSE was determined. The text that follows describes the rationale for the screening decisions presented in appendix F.

5.4.19 Tables 5-1 to 5-4 provide the justification or rationale for the screening decisions made for the relevant European Designated Sites. Separate entries have been made in tables 5-1 to 5-4 to support those instances where, for a particular screening category, either (a) LSE cannot be excluded or (b) where a conclusion of no LSE has been reached (e.g. for the

screening category ‘Changes in marine water quality’ in table 5.1, separate entries are included (3a and 3b) to provide the justification for these two screening outcomes). This separation has been made to provide clarity regarding the rationale for reaching a screening decision and to enable a direct reference from appendix G to specific text that is particular to that screening decision. This separation is only necessary where both screening decisions have been reached for different European Designated Sites and/or interest features for a particular screening category. For example, for item 1 (Changes in visual and acoustic stimuli) in table 5.1, a screening decision of no LSE is reached for each European Designated Site and, therefore, there is no requirement to provide a justification for any other screening outcome in this case.

5.4.20 The rationales provided for the Screening decisions presented in tables 5-1 to 5-4 are relevant to the effects of the Project. However, tables 5-1 to 5-4 also provide the supporting justification for the screening assessment for the Environmental Permits and Marine Licence applications. To enable NRW to isolate the potential effects of the activities relevant to these applications, the activity subject to the Environmental Permit or Marine Licence applications is highlighted in **[bold square brackets]** after the description of the effect of the Project. Importantly, however, in all cases the rationale is relevant to the DCO application as well.

Rationale for screening decisions for habitats (SACs and Ramsar sites)

5.4.21 Table 5-1 presents the rationale for the Screening decisions made for Annex I habitats and qualifying features of SACs and Ramsar sites (habitats and non-bird sites only).

Table 5-1 Screening rationale for each screening category for SAC and Ramsar habitats

Item	Screening categories	Rationale for screening decisions
1	Changes in visual and acoustic stimuli	Justification for decision that no LSE would arise The qualifying *habitat* features of SACs and Ramsar sites are not sensitive to changes in visual and acoustic stimuli and, therefore, no impact pathway exists **[Marine Licence; Operational combustion EP; Operational water discharge activity EP; Construction water discharge EP]**. The qualifying *species* of the Corsydd Môn/Anglesey Fens SAC (and which are listed as noteworthy fauna for the Corsydd Môn a Llyn/Anglesey and Llyn Fens Ramsar site) (Southern damselfly (*Coenagrion mercuriale*), Marsh fritillary butterfly (*Eurodryas, Hypodryas*) and Geyer`s whorl snail (*Vertigo geyeri*)) theoretically could be affected by changes to visual and acoustic stimuli. The SAC and Ramsar site is, however, 14km distant from the Wylfa Newydd Development Area and on this basis no LSE was concluded.
2	Land-take, including seabed or intertidal land	Justification for decision that no LSE would arise There will be no land-take in either the terrestrial or marine environment that will affect a qualifying habitat feature of an SAC or Ramsar site **[Marine Licence]**.
3	Changes in marine water quality	3a: Justification for decision that LSE cannot be excluded For SAC qualifying marine and coastal habitats (including the saline lagoon habitat within Bae Cemlyn/Cemlyn Bay SAC), the potential for LSE due to changes in marine water quality could not be excluded at the Screening stage. Changes could occur due to dredging and dredged material disposal during the construction phase (primarily increases in suspended sediment) **[Marine Licence]** and thermal and chemical effects from the cooling water discharge **[Operational water discharge activity EP]**. In addition, there could be consequential effects on marine water quality due to changes in terrestrial water quality and direct marine water quality effects due to dewatering and discharges to sea **[Construction water discharge EP]**.
		3b: Justification for decision that no LSE would arise It was concluded that there is no potential for changes to marine water quality to affect SACs and Ramsar qualifying terrestrial and freshwater habitats due to the lack of an impact pathway **[Marine Licence; Operational water discharge activity EP; Construction water discharge EP]**.
4	Changes in terrestrial water quality	4a: Justification for decision that LSE cannot be excluded During the construction works for the proposed creation of new fen habitat and the improvement of existing fen habitat at Cae Canol-dydd and Cors Gwawr (as compensation for potential effects on Tre'r Gof SSSI) (Application Reference Number: 6.4.9), the potential exists for the release of suspended sediment or nutrients during earthmoving activities. On this basis, LSE could not be excluded for the Corsydd Môn/Anglesey Fens SAC and Corsydd Môn a Llyn/Anglesey and Llyn Fens Ramsar site, which are adjacent to the proposed compensation sites.

Item	Screening categories	Rationale for screening decisions
		In addition, changes to terrestrial water quality could have an effect on marine water quality (e.g. surface run-off containing a high sediment load) and, therefore, LSE could not be excluded for SACs with marine and coastal qualifying habitats within the potential ZOI for marine water quality (including the saline lagoon habitat within Bae Cemlyn/ Cemlyn Bay SAC) **[Construction water discharge EP]**. No discharge is to occur to Nant Cemlyn (which discharges to Cemlyn lagoon) from Mound E prior to the establishment of vegetation and, therefore, there is no potential for a direct significant effect on Cemlyn lagoon due to a change in terrestrial water quality.
		4b: Justification for decision that no LSE would arise The Project is expected to give rise to changes in terrestrial water quality. However, no effects are considered likely to occur on SACs or Ramsar sites with terrestrial or freshwater qualifying features, aside from the Corsydd Môn/Anglesey Fens SAC and Corsydd Môn a Llyn/Anglesey and Llyn Fens Ramsar site, due to either a) the separation distance between such European Designated Sites and the Wylfa Newydd Development Area (the closest European Designated Site with terrestrial or freshwater qualifying features is approximately 13km from the Wylfa Newydd Development Area (Glannau Ynys Gybi/Holy Island Coast SAC)) or b) the lack of a pathway for an effect to arise on relevant European Designated Sites due to the scale of works proposed and distance from European Designated Sites (for all off-site elements of the Project) (see table 4-2 for the definition of the ZOI for this screening category) **[Construction water discharge EP]**.
5	Changes in surface and groundwater hydrology	5a: Justification for decision that LSE cannot be excluded SACs within the precautionary ZOI (for surface and groundwater hydrology) have the potential to be affected by the Project due to changes in groundwater and surface water. On this basis, LSE could not be excluded for Bae Cemlyn/Cemlyn Bay SAC **[Construction water discharge EP]**. In addition, during the construction works for, and/or during the subsequent establishment of, the proposed new fen habitat and the improvement of existing fen habitat at Cae Canol-dydd and Cors Gwawr, there is the potential for hydrological changes to occur. Therefore, LSE also could not be excluded for the Corsydd Môn/Anglesey Fens SAC and Corsydd Môn a Llyn/Anglesey and Llyn Fens Ramsar site, which are adjacent to the compensation sites. In the longer term (i.e. post-establishment), the creation of new fen habitat is expected to contribute to the resilience of the Corsydd Môn/Anglesey Fens SAC and Corsydd Môn a Llyn/Anglesey and Llyn Fens Ramsar site, and a positive LSE is expected on this basis.
		5b: Justification for decision that no LSE would arise The only European Designated Sites within the ZOI that could be affected by changes to surface and groundwater hydrology are Bae Cemlyn/Cemlyn Bay SAC **[Construction water discharge EP]**, Corsydd Môn/Anglesey Fens SAC and Corsydd Môn a Llyn/Anglesey and Llyn Fens Ramsar site. All other potentially relevant European Designated Sites are outside the ZOI.

Item	Screening categories	Rationale for screening decisions
6	Introduction of Invasive Non-Native Species (INNS)	Justification for decision that no LSE would arise The Project has the potential to result in the spread of invasive non-native species (INNS) in the terrestrial or marine environment. This could have detrimental effects on native biodiversity and could be contrary to the Wildlife and Countryside Act 1981 (as amended), which lists invasive non-native species and makes it illegal to introduce or cause them to spread or grow in the wild. It could also be contrary to other regulations and international conventions. The works have the potential to both spread INNS that are already established on the site and elsewhere in the UK and result in the import of INNS from outside the UK **[Construction water discharge EP; Marine Licence]**. In order to manage these risks, Horizon would prepare one (or more) Biosecurity Risk Assessment(s) and Method Statement(s) to cover all activities. Each Biosecurity Risk Assessment would consider in general: a) measures that would be undertaken to control and eradicate INNS within the area of works; and, b) measures or actions that aim to prevent INNS being introduced to the site for the duration of the construction phase. In the management of existing known presence of INNS, Biosecurity Risk Assessments and Method Statements would detail: a) how areas with the presence of INNS would be demarcated; b) how any contaminated materials would be appropriately managed throughout the works, including where appropriate eradication from the site; c) appropriate disposal; and, d) how any transfer or spread would be prevented. In terms of prevention of new introduction to the site through terrestrial and marine pathways, Biosecurity Risk Assessments and Method Statements would detail: a) risk pathways and risk activities for the transfer and spread of non-native species; b) risk assessment for the transfer and spread of individual non-native species of known concern; c) methods to manage risk of transfer including any actions to be undertaken prior to reaching site; and d) contingency planning and corrective actions. Horizon would implement a monitoring programme for non-native species. This would include observational surveys on structures that may provide suitable substrate for non-native species. Surveys would record presence/abundance of non-native species with reporting in agreement with NRW. Monitoring survey requirements for specific sites would be set out in the sub-CoCPs where relevant. Where new presence of INNS is discovered, Biosecurity Risk Assessments and Method Statements would be reviewed and amended where necessary. Wherever appropriate, workers would be given an activity specific tool-box talk from an Environmental Clerk of Works

<table>
<tr><th>Item</th><th>Screening categories</th><th>Rationale for screening decisions</th></tr>
<tr><td></td><td></td><td>(ECoW). This would include photographs of any INNS species known to be present on a site.
For the marine environment, an initial pre-construction survey would be undertaken and regular surveys would begin once construction of the breakwaters and MOLF is completed. The frequency and extent of monitoring would reduce over time, particularly once the MOLF is no longer operational. The ongoing requirement for monitoring would be regularly reviewed and agreed with NRW.</td></tr>
<tr><td>7</td><td>Change in radiation dose levels</td><td>Justification for decision that no LSE would arise
A Stage 1 Screening exercise has been undertaken in support of an Environmental Permit application under RSR [RSR EP HRA]. The results of the assessment demonstrate that the total dose rate predicted to arise due to the operation of the proposed Power Station is below the screening threshold of 10µGy/h for all habitats and species [RD89].
The in-combination assessment has demonstrated that when the calculated total dose from the proposed Power Station is added to other sources, no exceedances of the 40µGy/h guideline threshold for the protection of European Designated Sites are predicted ([RD87]; [RD88]).
Given the above findings, no LSE can be concluded due to change in radiation dose levels [Operational water discharge activity EP; RSR EP].</td></tr>
<tr><td>8</td><td>Change in air quality</td><td>A screening assessment of the Project's Process Contribution (PC) (i.e. the modelled concentration from the emission sources included in the assessment) has been undertaken against the Environment Agency's short-term and long-term environmental standards ([RD90]). To screen out a PC for any substance (i.e. to confirm that no further assessment is needed), the PC must meet both of the following criteria:
• the short-term PC is less than 10% of the short-term environmental standard; and,
• the long-term PC is less than 1% of the long-term environmental standard.
Table 5.1a summarises the short- and long-term environmental standards for NOx and SO_2 applied in the LSE screening assessment.

Table 5.1a: Environmental standards applied in the screening assessment ([RD90])
<table>
<tr><th>Pollutant</th><th>Environmental standard applied in the screening assessment (µg/m^3)</th><th>Concentration measured as:</th></tr>
<tr><td rowspan="2">NO_x
(expressed as NO_2)</td><td>30</td><td>Annual mean</td></tr>
<tr><td>75</td><td>Maximum 24-hour mean</td></tr>
</table>
</td></tr>
</table>

Item	Screening categories	Rationale for screening decisions

SO_2	10	Annual mean (where lichens or bryophytes are present)
	20	Annual mean (where lichens or bryophytes are not present)

In the following tables, changes in emissions that exceed the environmental standards defined in Table 5.1a are highlighted in light blue.

Emissions from plant, machinery and marine vessels

Tables 5.1b to 5.1g present the outcome of the screening assessment for NOx and SO_2 for emissions from plant, machinery and marine vessels in the construction phase, for peak earthworks and marine works in 2020 and peak construction in 2023, for the scoped in SACs and Ramsar site. The two scenarios represent works during the peak of activities, that is:

- site grading and bulk earthworks, deep excavations, landscape formation, cooling water tunnels and outfall construction and construction of the MOLF ('2020 peak earthworks and marine works'); and,
- the construction of the Power Station buildings and structures, including (but not limited to) concrete production, distribution and placing, steel reinforcing works, craneage, access to structures and related site logistics, such as the transportation of construction workers and materials ('2023 peak construction').

Table 5.1b: Screening of short-term (24-hour mean) NOx changes (2020 peak earthworks and marine works scenario)

European Designated Site	Critical level (AQO) ($\mu g/m^3$)	Increase in NOx concentration (2020 peak earthworks and marine works; $\mu g/m^3$) (PC)	Change relative to critical level
Bae Cemlyn/Cemlyn Bay SAC	75	138	+184%
Corsydd Môn/Anglesey Fens SAC	75	4.5	+6%
Corsydd Môn a Llyn/Anglesey and Llyn Fens Ramsar site	75	4.5	+6%
Glannau Ynys Gybi/Holy	75	8.6	+12%

Item	Screening categories	Rationale for screening decisions

Island Coast SAC			
Llyn Dinam SAC	75	8.0	+10%

Table 5.1c: Screening of short-term (24-hour mean) NOx changes (2023 peak construction scenario)

European Designated Site	Critical level (AQO) (µg/m^3)	Increase in NOx concentration (2023 peak construction; µg/m^3) (PC)	Change relative to critical level
Bae Cemlyn/Cemlyn Bay SAC	75	25.8	+34%
Corsydd Môn/Anglesey Fens SAC	75	1.0	+1%
Corsydd Môn a Llyn/Anglesey and Llyn Fens Ramsar site	75	1.0	+1%
Glannau Ynys Gybi/Holy Island Coast SAC	75	1.8	+2%
Llyn Dinam SAC	75	2.2	+3%

Table 5.1d: Screening of long-term (annual mean) NOx changes (2020 peak earthworks and marine works scenario)

European Designated Site	Critical level (AQO) (µg/m^3)	Increase in NOx concentration (2020 peak earthworks and marine works; µg/m^3) (PC)	Change relative to critical level
Bae Cemlyn/Cemlyn Bay SAC	30	10.7	+36%
Corsydd Môn/Anglesey Fens SAC	30	0.1	+0.3%
Corsydd Môn a Llyn/Anglesey and Llyn Fens Ramsar site	30	0.1	+0.3%
Glannau Ynys Gybi/Holy Island Coast SAC	30	0.3	+1%
Llyn Dinam SAC	30	0.2	+1%

Item	Screening categories	Rationale for screening decisions

Table 5.1e: Screening of long-term (annual mean) NOx changes (2023 peak construction scenario)

European Designated Site	Critical level (AQO) (µg/m^3)	Increase in NOx concentration (2023 peak construction; µg/m^3) (PC)	Change relative to critical level
Bae Cemlyn/Cemlyn Bay SAC	30	1.9	+6%
Corsydd Môn/Anglesey Fens SAC	30	0.0	0%
Corsydd Môn a Llyn/Anglesey and Llyn Fens Ramsar site	30	0.0	0%
Glannau Ynys Gybi/Holy Island Coast SAC	30	0.1	0%
Llyn Dinam SAC	30	0.1	0%

Table 5.1f: Screening of long-term (annual mean) SO_2 changes (2020 peak earthworks and marine works scenario)

European Designated Site	Critical level (AQO) (µg/m^3)	Increase in SO_2 concentration (2020 peak earthworks and marine works; µg/m^3) (PC)	Change relative to critical level
Bae Cemlyn/Cemlyn Bay SAC	20	0.2	+1%
Corsydd Môn/Anglesey Fens SAC	10	0.0	0%
Corsydd Môn a Llyn/Anglesey and Llyn Fens Ramsar site	10	0.0	0%
Glannau Ynys Gybi/Holy Island Coast SAC	10	0.0	0%
Llyn Dinam SAC	20	0	0%

Item	Screening categories	Rationale for screening decisions

Table 5.1g: Screening of long-term (annual mean) SO_2 changes (2023 peak construction scenario)

European Designated Site	Critical level (AQO) (µg/m^3)	Increase in SO_2 concentration (2023 peak construction; µg/m^3) (PC)	Change relative to critical level
Bae Cemlyn/Cemlyn Bay SAC	20	0.2	+1%
Corsydd Môn/Anglesey Fens SAC	10	0.0	0%
Corsydd Môn a Llyn/Anglesey and Llyn Fens Ramsar site	10	0.0	0%
Glannau Ynys Gybi/Holy Island Coast SAC	10	0.0	0%
Llyn Dinam SAC	20	0.0	0%

Road traffic emissions

Two SACs in mainland Wales were scoped in for assessment of the effects of road traffic emissions (Coedydd Aber SAC and Mynydd Helygain/Halkyn Mountain SAC). The relevant critical level for NOx for road traffic emissions is 30µg/m^3 (annual mean). Although a short term (24-hour) mean critical level for NOx is specified in [RD90], this is applicable to industrial sources and not applied to assessment of road traffic emissions.

The results of the screening assessment for road traffic emissions are presented in Table 5.1h.

Table 5.1h: Screening of long-term (annual mean) NOx changes (road traffic emissions)

European Designated Site	Increase in NOx concentration (µg/m^3) (PC)	Change relative to critical level
Coedydd Aber SAC	0.33	+1%
Mynydd Helygain/Halkyn Mountain SAC	0.37	+1%

<table>
<tr><th>Item</th><th>Screening categories</th><th>Rationale for screening decisions</th></tr>
<tr><td></td><td></td><td>
Operational combustion
For the operating Power Station, operational combustion activity could affect SACs and the Ramsar site within the ZOI [Operational combustion EP]. Tables 5.1i to 5.1p present the outcomes of the screening assessment for NOx and SO_2 for operational combustion emissions (short-term and long term emissions). The screening assessment for short-term emissions comprises the following scenarios:
a) standby generator commissioning;
b) standby generator routine testing;
c) Loss of Off-site Power (LOOP)/Loss of Coolant Accident (LOCA) scenario;
d) maximum boiler use;
e) MEEG testing; and,
f) MEEG exercise (operation of MEEG)
The long-term scenario is assessed to determine the effects which may occur over the period of one year for comparison to the relevant annual mean critical levels. This is based on the anticipated normal annual operation of all sources and on a worst case, as it includes the additional operational hours for commissioning of the Unit 2 standby generators, followed by routine testing and an allowance for two Scheduled Outages or standby generator preventative maintenance outages for both units in the same year.
Table 5.1i: Screening of short-term (24-hour mean) NOx changes (operational combustion) (standby generator commissioning)
<table>
<tr><td>European Designated Site</td><td>Critical level (AQO) (µg/m^3)</td><td>Increase in NOx concentration (µg/m^3) (PC)</td><td>Change relative to critical level</td></tr>
<tr><td>Bae Cemlyn/Cemlyn Bay SAC</td><td>75</td><td>135.1</td><td>+180%</td></tr>
<tr><td>Corsydd Môn/Anglesey Fens SAC</td><td>75</td><td>3.4</td><td>+4.5%</td></tr>
<tr><td>Corsydd Môn a Llyn/Anglesey and Llyn Fens Ramsar site</td><td>75</td><td>3.4</td><td>+4.5%</td></tr>
<tr><td>Glannau Ynys Gybi/Holy Island Coast SAC</td><td>75</td><td>4.8</td><td>+6.4%</td></tr>
<tr><td>Llyn Dinam SAC</td><td>75</td><td>5.1</td><td>+6.8%</td></tr>
</table>
</td></tr>
</table>

Item	Screening categories	Rationale for screening decisions

Table 5.1j: Screening of short-term (24-hour mean) NOx changes (operational combustion) (standby generator routine testing)

European Designated Site	Critical level (AQO) (µg/m^3)	Increase in NOx concentration (µg/m^3) (PC)	Change relative to critical level
Bae Cemlyn/Cemlyn Bay SAC	75	49.0	+65.3%
Corsydd Môn/Anglesey Fens SAC	75	1.3	+1.8%
Corsydd Môn a Llyn/Anglesey and Llyn Fens Ramsar site	75	1.3	+1.8%
Glannau Ynys Gybi/Holy Island Coast SAC	75	2.5	+3.3%
Llyn Dinam SAC	75	1.8	+2.4%

Table 5.1k: Screening of short-term (24-hour mean) NOx changes (operational combustion) (LOOP/LOCA scenario)

European Designated Site	Critical level (AQO) (µg/m^3)	Increase in NOx concentration (µg/m^3) (PC)	Change relative to critical level
Bae Cemlyn/Cemlyn Bay SAC	75	488.1	+651%
Corsydd Môn/Anglesey Fens SAC	75	14.4	+19.2%
Corsydd Môn a Llyn/Anglesey and Llyn Fens Ramsar site	75	14.4	+19.2%
Glannau Ynys Gybi/Holy Island Coast SAC	75	19.1	+25.5%
Llyn Dinam SAC	75	19.9	+27%

Item	Screening categories	Rationale for screening decisions

Table 5.1l: Screening of short-term (24-hour mean) NOx changes (operational combustion) (maximum boiler use)

European Designated Site	Critical level (AQO) (µg/m^3)	Increase in NOx concentration (µg/m^3) (PC)	Change relative to critical level
Bae Cemlyn/Cemlyn Bay SAC	75	10.3	+13.7%
Corsydd Môn/Anglesey Fens SAC	75	0.2	0.2%
Corsydd Môn a Llyn/Anglesey and Llyn Fens Ramsar site	75	0.2	0.2%
Glannau Ynys Gybi/Holy Island Coast SAC	75	0.3	0.4%
Llyn Dinam SAC	75	0.3	0.4%

Table 5.1m: Screening of short-term (24-hour mean) NOx changes (operational combustion) (MEEG testing)

European Designated Site	Critical level (AQO) (µg/m^3)	Increase in NOx concentration (µg/m^3) (PC)	Change relative to critical level
Bae Cemlyn/Cemlyn Bay SAC	75	44.8	+60%
Corsydd Môn/Anglesey Fens SAC	75	1.8	+2%
Corsydd Môn a Llyn/Anglesey and Llyn Fens Ramsar site	75	1.8	+2%
Glannau Ynys Gybi/Holy Island Coast SAC	75	2.2	+3%
Llyn Dinam SAC	75	2.4	+3%

Item	Screening categories	Rationale for screening decisions

Table 5.1n: Screening of short-term (24-hour mean) NOx changes (operational combustion) (MEEG exercise (operation of MEEG))

European Designated Site	Critical level (AQO) (µg/m^3)	Increase in NOx concentration (µg/m^3) (PC)	Change relative to critical level
Bae Cemlyn/Cemlyn Bay SAC	75	196.6	+262%
Corsydd Môn/Anglesey Fens SAC	75	8.0	+11%
Corsydd Môn a Llyn/Anglesey and Llyn Fens Ramsar site	75	8.0	+11%
Glannau Ynys Gybi/Holy Island Coast SAC	75	12.1	+16%
Llyn Dinam SAC	75	9.5	+13%

Table 5.1o: Screening of long-term (annual mean) NOx changes (operational combustion)

European Designated Site	Critical level (AQO) (µg/m^3)	Increase in NOx concentration (µg/m^3) (PC)	Change relative to critical level
Bae Cemlyn/Cemlyn Bay SAC	30	0.5	1.7%
Corsydd Môn/Anglesey Fens SAC	30	0.0	0%
Corsydd Môn a Llyn/Anglesey and Llyn Fens Ramsar site	30	0.0	0%
Glannau Ynys Gybi/Holy Island Coast SAC	30	0.0	0%
Llyn Dinam SAC	30	0.0	0%

Item	Screening categories	Rationale for screening decisions

Table 5.1p: Screening of long-term (annual mean) SO_2 changes (operational combustion)

European Designated Site	Critical level (AQO) (µg/m^3)	Increase in SO_2 concentration (µg/m^3) (PC)	Change relative to critical level
Bae Cemlyn/Cemlyn Bay SAC	20	0.0015	0%
Corsydd Môn/Anglesey Fens SAC	10	0.0	0%
Corsydd Môn a Llyn/Anglesey and Llyn Fens Ramsar site	10	0.0	0%
Glannau Ynys Gybi/Holy Island Coast SAC	10	0.0	0%
Llyn Dinam SAC	20	0.0	0%

8a: Justification for decision that LSE cannot be excluded

SACs designated for their terrestrial, freshwater and coastal habitats (and one Ramsar site designated for its terrestrial habitat) within the defined ZOIs for air quality have the potential to be affected by the Project due to emissions from traffic and construction plant and dust generation.

On the basis of the screening assessment presented above, LSE cannot be excluded for:

i) NOx emissions from plant, machinery and marine vessels during construction for the Bae Cemlyn/Cemlyn Bay SAC, Glannau Ynys Gybi/Holy Island Coast SAC and Llyn Dinam SAC **[Marine Licence]**.

ii) Standby generation commissioning, standby generator routine testing, LOOP/LOCA scenario, maximum boiler use and MEEG testing for the Bae Cemlyn/Cemlyn Bay SAC **[Operational combustion EP]**.

iii) MEEG exercise (operation of MEEG) for the Bae Cemlyn/Cemlyn Bay SAC, Corsydd Môn/Anglesey Fens SAC, Corsydd Môn a Llyn/Anglesey and Llyn Fens Ramsar site, Glannau Ynys Gybi/Holy Island Coast SAC and Llyn Dinam SAC **[Operational combustion EP]**.

iv) LOOP/LOCA scenario for the Corsydd Môn/Anglesey Fens SAC and Corsydd Môn a Llyn/Anglesey and Llyn Fens Ramsar site, Glannau Ynys Gybi/Holy Island Coast SAC and Llyn Dinam SAC **[Operational**

Item	Screening categories	Rationale for screening decisions
		combustion EP]; and, v) Long-term NOx emissions for the Bae Cemlyn/Cemlyn Bay SAC **[Operational combustion EP]**.
		8b: Justification for decision that no LSE would arise European Designated Sites that lie outside the ZOI for changes in air quality (from any source) do not have the potential to be affected, and LSE can be ruled out **[Operational combustion EP; Marine Licence]**. Based on the results of the screening assessment presented above, LSE can also be ruled out for the Coedydd Aber SAC and Mynydd Helygain/Halkyn Mountain SAC. Y Fenai a Bae Conwy/Menai Strait and Conwy Bay SAC was scoped into the Shadow HRA because it is within the ZOI for road traffic emissions. However, this SAC is below the mean high water line, regularly inundated with sea water and not sensitive to changes in air pollution or deposition of nitrogen and acid. On this basis, LSE has been ruled out for the Y Fenai a Bae Conwy/Menai Strait and Conwy Bay SAC. The screening assessment concludes that LSE can also be excluded for any European Designated Site not referred to under this item (8b) (i.e. LSE is concluded only for those European Designated Sites referred to under item 8a).
9	Alteration of coastal processes and hydrodynamics	9a: Justification for decision that LSE cannot be excluded Bae Cemlyn/Cemlyn Bay SAC is within the ZOI for changes in coastal processes and hydrodynamics and has the potential to be affected by such changes. Consequently, LSE could not be excluded for the Bae Cemlyn/Cemlyn Bay SAC **[Marine Licence]**.
		9b: Justification for decision that no LSE would arise The modelling studies (summarised in chapter 7) clearly predict no detectable change in coastal processes due to the Project beyond 5km of the Wylfa Newydd Development Area or beyond 5km of the Disposal Site. Consequently, it was concluded that there is no potential for LSE on the following European Designated Sites that were scoped into the assessment (chapter 4) **[Marine Licence]**: • Glannau Ynys Gybi/Holy Island Coast SAC; • Y Fenai a Bae Conwy/Menai Strait and Conway Bay SAC; • Y Twyni o Abermenai i Aberffraw/Abermenai to Aberffraw Dunes SAC; and,

Item	Screening categories	Rationale for screening decisions
		• Glannau Môn: Cors heli/Anglesey Coast: Saltmarsh SAC. Corsydd Môn a Llyn/Anglesey and Llyn Fens Ramsar, Llyn Dinam, Corsydd Môn/Anglesey Fens SAC, Coedydd Aber SAC and Halkyn Mountain/ Mynydd Helygain SAC are all inland sites, so the potential for LSE for this screening category is excluded on this basis.
10	Physical interactions between species and Project infrastructure	Justification for decision that no LSE would arise As the Project does not have the potential to interact physically with the European Designated Sites scoped into the assessment for habitat qualifying features, in general no LSE can be concluded (i.e. this screening category is generally not relevant for the SACs or Ramsar sites scoped into the assessment on the basis of terrestrial, freshwater and coastal habitats **[Operational water discharge activity EP]**. Potential for effects on supporting prey species for interest features of SPAs and pSPAs are addressed in table 5-4. Workers living in the Site Campus could, in theory, affect the Bae Cemlyn/Cemlyn Bay SAC (i.e. perennial vegetation) if visitor pressure (i.e. trampling) was to increase significantly. However, a Workforce Management Strategy (Application Reference Number: 8.5) would be implemented to keep workers on site and control their interactions with the people and environment around them. It is expected that the Site Campus would be operational two years after the grant of development consent and be operational for five years, with peak occupation levels occurring across the last two years of operation.. Up to 400 members of staff would be employed for the on-site management, welfare and security of the full 4,000 beds. These staff members would work in shifts, with peak shift numbers being around 200 people. Suitable leisure facilities would be provided for the facility occupants, such as a bar, gym, snooker and table tennis tables and a 5 a side football pitch. Given this, the potential for LSE due to visitor pressure has been excluded.

Rationale for screening decisions for marine mammals

5.4.22 The results of the Scoping exercise for marine mammals are presented in section 4.5. To determine the potential for LSE, further consideration of the ecology of each marine mammal species was undertaken in the Screening assessment, as presented below. This step was undertaken to identify where there is a realistic pathway for a potential effect on European Designated Sites for marine mammals.

Harbour porpoise (*Phocoena phocoena*)

5.4.23 Harbour porpoise are highly mobile. However, they have relatively high daily energy demands and it has been estimated that they can only rely on stored energy (primarily blubber) for three to five days, depending on body condition [RD180]. Based on a swimming speed of approximately 1.5m/s, it is estimated that harbour porpoise could cover a distance of approximately 400km in three days.

5.4.24 In light of the above, it is highly unlikely that harbour porpoise from European Designated Sites located 400km or more from the Project's ZOIs are dependent on the area within the Project's ZOIs. Although harbour porpoise from European Designated Sites more than 400km away could have foraging ranges that overlap the Project's ZOIs, any potential indirect effects on prey as a result of the Project are highly unlikely to have a significant effect on harbour porpoise from that European Designated Site.

5.4.25 As there is no discrete population of harbour porpoise associated with European Designated Sites due to their wide ranging nature, it is assumed that, at any one time, harbour porpoise foraging within the Project's ZOIs are associated with the nearest European Designated Site (as they cannot simultaneously be part of the population of multiple European Designated Sites, although all are part of the larger MU population).

5.4.26 However, for all European Designated Sites for harbour porpoise within 400km of the defined ZOIs (table 4-2), the potential for a LSE to arise was determined on a precautionary basis and further assessment in the Shadow HRA was agreed to be required, including with NRW. For any European Designated Sites for harbour porpoise located more the 400km from the defined ZOIs, it was determined that the potential did not exist for a LSE to arise and further assessment in this Shadow HRA was not undertaken (see appendix C).

Bottlenose dolphin (*Tursiops truncatus*)

5.4.27 For bottlenose dolphin the potential exists for LSE to arise for all European Designated Sites that were scoped in to the assessment, as there is known connectivity between the two SACs scoped in for bottlenose dolphin (Bae Ceredigion/Cardigan Bay SAC and the Pen Llyn a'r Sarnau/Llyn Peninsula and the Sarnau SAC) and the north coast of Anglesey.

5.4.28 Photo identification studies completed by the Sea Watch Foundation ([RD348] and [RD349]) have revealed that of 221 bottlenose dolphins

recorded between 2007 and 2012 off the north coast of Anglesey, 141 (64%) had been previously recorded within the Bae Ceredigion/ Cardigan Bay SAC, as well as north of the Llyn Peninsula, and many had additionally been recorded within the Pen Llyn a'r Sarnau/Llyn Peninsula and the Sarnau SAC ([RD348] and [RD349]). This indicates that the majority of the Cardigan Bay population of bottlenose dolphin migrate between the two sites. A further 38 of these individuals have also been recorded off the coast of the Isle of Man ([RD348] and [RD349]).

5.4.29 Within the same study, 30 bottlenose dolphin encountered from the north coast of Anglesey (n=28) and the Isle of Man (n=2) were investigated to determine the seasonal movements of bottlenose dolphin. It was revealed that of the dolphins recorded in the winter surveys (December to February), 95% had previously been recorded within Cardigan Bay, supporting the theory that there is a seasonal migration of dolphins from Cardigan Bay to the north coast of Anglesey within the winter months ([RD348] and [RD349]). During spring (March to May), 62% of the individuals recorded along the north coast of Anglesey had previously been recorded in Cardigan Bay, 38% were recorded in the summer (June to August) and 98% in the autumn (September to November). This pattern gives a clear indication of the movement of bottlenose dolphins from Cardigan Bay in summer to the north coast of Anglesey and the Llyn Peninsula in the autumn and winter ([RD348] and [RD349] [RD348] and [RD349]).

5.4.30 Based on the seasonal movements of bottlenose dolphin from the west coast of wales to the north coast of Anglesey and the Isle of Man, it is determined that there is the potential for connectivity between the populations of bottlenose dolphins and the Project ZOIs with all European Designated Sites scoped in and, therefore, for a LSE to arise for all European Designated Sites scoped in.

Grey seal (*Halichoerus grypus*)

5.4.31 To identify European Designated Sites for grey seal that have potential connectivity with the Project's ZOIs (see table 4-2), the foraging ranges and telemetry studies for grey seal were assessed.

5.4.32 Grey seals forage in the open sea and they may range widely to forage and frequently travel over 100km between haul-out sites [RD316]. Foraging trips can last anywhere between 1 and 30 days. Tracking of individual grey seals has shown that most foraging probably occurs within 100km of a haul-out site, although they can feed up to several hundred kilometres offshore [RD316].

5.4.33 Telemetry data show much individual variability in the movement patterns of grey seals ([RD207]; [RD205]), with some animals ranging widely and spending time in a variety of locations; while others remain in one limited area for most of the time they were tagged.

5.4.34 Grey seals from telemetry studies off western Scotland and off northern France indicate that the tagged grey seals from these areas did not enter the Irish Sea [RD205]. Tagging data of grey seals from haul-out sites in

Liverpool Bay, Wales and southeast Ireland, indicates that most movement from these sites was contained within the Irish Sea [RD127].

5.4.35 [RD315] described telemetry studies that have been undertaken by tagging grey seals at five SACs across the UK (Pembrokeshire Marine, Lleyn Peninsula and the Sarnau, Monach Islands, Isle of May, and Berwickshire and North Northumberland Coast). The results indicate that grey seal travel between Sir Benfro Forol/Pembrokeshire Marine SAC, Pen Llyn a'r Sarnau/Llyn Peninsula and the Sarnau SAC and the Saltee Islands SAC (Ireland).

5.4.36 Data from tagging studies in the Irish Sea were examined in order to describe the extent of 'forging trips' of grey seals in the Irish Sea [RD315]. The telemetry data included in this study were from adult grey seals tagged at Ramsey (n=7), Bardsey (n=4), and Hilbre island (n=7) in 2004 and from pups tagged at Anglesey in 2009 and 2010 (n= 3 and 5), Bardsey in 2009 (n=2) and Ramsey in 2010 (n=7). Over the lifetime of the tags, pups made an average of 58 trips per seal (over the average tag duration of 151 days) with a median trip duration of 0.92 days (95% CI 0.12-7.89) between haul-out locations and covered an average distance of 19.47 km. The greatest distance travelled by one pup was 435.8 km. Grey seal adults made less trips with an average of 41 trips per seal (over the average tag duration of 131 days) and covered less distance (average maximum of 16.94 km), with trips between haul-out locations lasting on average 0.75 days (as a median, 95%CI 0.12-5.61). The greatest distance travelled by one adult was 172.6 km. The tag data showed that seals often move between haul out locations, in particular between the Lleyn Peninsula, Cardigan Bay and haul out locations around the Isle of Anglesey (ES volume D, appendix D13.06).

5.4.37 Based on the foraging ranges for grey seal and the assessment of the telemetry data in and around the Irish Sea, it was determined that there was potentially connectivity for any European Designated Site for grey seal up to 200km of the potential ZOIs (but not beyond). Consequently, for all European Designated Sites for grey seal within 200km of the defined ZOIs (table 4-2), the potential for a LSE to arise was determined and further assessment in the Shadow HRA was agreed to be required. For any European Designated Sites for grey seal located more the 200km from the Project's ZOIs, it was determined that the potential did not exist for a LSE to arise and further assessment was not undertaken (see appendix C).

Harbour seal (*Phoca vitulina*)

5.4.38 To identify European Designated Sites for harbour seal that have potential connectivity with the Project's ZOIs (table 4-2), the foraging ranges and telemetry studies for harbour seal were assessed.

5.4.39 Harbour seal exhibit relatively short foraging trips from their haul out sites. The range of these trips varies depending on the location and surrounding marine habitat. For example, 25km on the west of Scotland [RD62] and 30km-45km in the Moray Firth [RD334]. Data from telemetry studies in The Wash (2003- 2005) suggest that harbour seal travel further, and repeatedly

forage between 75km and 120km offshore, with one seal travelling 220km [RD303]). Information on harbour seal at-sea movements and habitat use in southwest Ireland suggests a limited range, generally staying within 20km of their haul-out site [RD60]. Although occasional longer trips do occur, these are often associated with young animals dispersing from sites, and are not, therefore, considered to indicate repeated connectivity between European Designated Sites and the Project.

5.4.40 There is limited telemetry data in and around the Irish Sea for harbour seal. Therefore, based on the foraging ranges for harbour seal, it was determined that there was potential connectivity for any European Designated Sites for harbour seal up to 200km of the potential ZOIs. Consequently, for all European Designated Sites for harbour seal within 200km of the defined ZOIs (table 4-2), the potential for a LSE to arise was determined and further assessment in the Shadow HRA was agreed to be required, including with NRW. For any European Designated Sites for harbour seal located more the 200km from the Project's ZOIs, it was determined that the potential did not exist for a LSE to arise and further assessment was not undertaken (see appendix C).

5.4.41 Table 5-2 presents the rationale for the screening decisions made for marine mammals.

Table 5-2 Screening rationale for each screening category for marine mammals

Item	Screening categories	Rationale for screening decisions
1	Changes in visual and acoustic stimuli	Justification for decision that LSE cannot be excluded Marine mammals that are qualifying features of the SACs and cSACs that were scoped into the assessment have the potential to be affected, particularly by underwater noise (including the acoustic fish deterrent (AFD)) **[Marine Licence; Operational water discharge EP]**.
2	Land-take, including seabed or intertidal land	Justification for decision that LSE cannot be excluded There is the potential for change and/or loss of supporting habitat for marine mammal interest features as a result of the Project within the marine area of the Wylfa Newydd Development Area and the at Disposal Site, which could have a potential effect on prey species for marine mammals. The footprint of the Project is within the Gogledd Môn Forol/North Anglesey Marine cSAC and the loss of supporting habitat for marine mammals has the potential to result in LSE **[Marine Licence]**. Although the potential for a LSE to arise on distant SACs and cSACs in Northern Ireland and Ireland is considered to be highly unlikely, a precautionary approach was taken and LSE was not excluded at this stage in the assessment **[Marine Licence]**.
3	Changes in marine water quality	Justification for decision that LSE cannot be excluded For SACs scoped into the assessment for marine mammals, LSE could not be excluded at the Screening stage. Changes to marine water quality could occur due to dredging and dredged material disposal during the construction phase (primarily increases in suspended sediment) **[Marine Licence]**, thermal and chemical effects from the cooling water discharge **[Operational water discharge activity EP]** and sewage discharge (with potential for eutrophication) **[Construction water discharge EP]**. In addition, there could be consequential effects on marine water quality due to changes in terrestrial water quality and direct marine water quality effects due to dewatering and discharges to sea **[Construction water discharge EP]**. Such changes could affect prey species and the ability of marine mammals to effectively forage for prey.
4	Changes in terrestrial water quality	Justification for decision that no LSE would arise The Project is expected to give rise to changes in terrestrial water quality, although no direct effects would occur on SACs or cSACs designated for marine mammals. However, changes to terrestrial water quality could have an effect on marine water quality (e.g. surface run-off containing a high sediment load) and, therefore, marine mammal prey species; this is considered as part of item 3 (changes to marine water quality) **[Construction water discharge EP]**.
5	Changes in surface and groundwater hydrology	Justification for decision that no LSE would arise Changes in surface and groundwater hydrology are unlikely to affect SACs and cSACs designated for

Item	Screening categories	Rationale for screening decisions
		marine mammals due to the fact that these European Designated Sites are not sensitive to such changes; hence no LSE was concluded for all sites for this screening category. However, assessment of the potential for effects on marine mammal prey species was determined to be required (see item 3) **[Construction water discharge EP]**.
6	Introduction of INNS	Justification for decision that no LSE would arise The Project has the potential to result in the spread of INNS in the marine environment. This could have detrimental effects on native biodiversity and could be contrary to the Wildlife and Countryside Act 1981 (as amended), which lists invasive non-native species and makes it illegal to introduce or cause them to spread or grow in the wild. It could also be contrary to other regulations and international conventions. The works have the potential to both spread INNS that are already established on the site and elsewhere in the UK and result in the import of INNS from outside the UK **[Construction water discharge EP; Marine Licence]**. In order to manage these risks, Horizon would prepare one (or more) Biosecurity Risk Assessment(s) and Method Statement(s) to cover all activities. Each Biosecurity Risk Assessment would consider in general: a) measures that would be undertaken to control and eradicate INNS within the area of works; and, b) measures or actions that aim to prevent INNS being introduced to the site for the duration of the construction phase. In the management of existing known presence of INNS, Biosecurity Risk Assessments and Method Statements would detail: a) how areas with the presence of INNS would be demarcated; b) how any contaminated materials would be appropriately managed throughout the works, including where appropriate eradication from the site; c) appropriate disposal; and, d) how any transfer or spread would be prevented. In terms of prevention of new introduction to the site through marine pathways, Biosecurity Risk Assessments and Method Statements would detail: a) risk pathways and risk activities for the transfer and spread of non-native species; b) risk assessment for the transfer and spread of individual non-native species of known concern; c) methods to manage risk of transfer including any actions to be undertaken prior to reaching site; and

Item	Screening categories	Rationale for screening decisions
		d) contingency planning and corrective actions. Horizon would implement a monitoring programme for non-native species. This would include observational surveys on structures that may provide suitable substrate for non-native species. Surveys would record presence/abundance of non-native species with reporting in agreement with NRW. Monitoring survey requirements for specific sites would be set out in the sub-CoCPs where relevant. Where new presence of INNS is discovered, Biosecurity Risk Assessments and Method Statements would be reviewed and amended where necessary. Wherever appropriate, workers would be given an activity specific tool-box talk from an ECoW. This would include photographs of any INNS species known to be present on a site. For the marine environment, an initial pre-construction survey would be undertaken and regular surveys would begin once construction of the breakwaters and MOLF is completed. The frequency and extent of monitoring would reduce over time, particularly once the MOLF is no longer operational. The ongoing requirement for monitoring would be regularly reviewed and agreed with NRW.
7	Change in radiation dose levels	Justification for decision that no LSE would arise A Stage 1 Screening exercise has been undertaken in support of an Environmental Permit application under the RSR **[RSR EP HRA]**. The results of the assessment demonstrate that the total dose rate predicted to arise due to the operation of the proposed Wylfa Newydd Power Station is below the screening threshold of 10µGy/h for all habitats and species [RD89]. The in-combination assessment has demonstrated that when the calculated total dose from the proposed Power Station is added to other sources, no exceedances of the 40µGy/h guideline threshold for the protection of European Designated Sites are predicted ([RD87]; [RD88]). Given the above findings, no LSE can be concluded due to change in radiation dose levels **[Operational water discharge activity EP]**.
8	Change in air quality	Justification for decision that no LSE would arise The precautionary ZOI identified for air quality overlaps with the marine environment. However, the area potentially affected is insignificant in the context of the scale of European Designated Sites designated for marine mammals and the Management Units and foraging ranges used to identify European Designated Sites to be considered in the screening assessment. In addition, marine mammals are unlikely to be sensitive to the potential effect of the Project on air quality and, consequently, no LSE was concluded for this screening category **[Operational combustion EP]**.

Item	Screening categories	Rationale for screening decisions
9	Alteration of coastal processes and hydrodynamics	Justification for decision that LSE cannot be excluded For all SACs and cSACs designated for marine mammals within the ZOI, LSE could not be excluded. Potential effects on these sites include changes to current flows and sediment transport pathways, which could affect habitats within European Designated Sites and prey species for marine mammals **[Marine Licence]**.
10	Physical interactions between species and Project infrastructure	Justification for decision that LSE cannot be excluded The mitigation proposed includes fine 5mm mesh screen and low maximum intake velocity (0.3m/s) (which is sufficiently low such that marine mammals will not be drawn into the intake), therefore, marine mammals, including seals, will be unable to enter screen wells and will not be at any risk of entrainment/entrapment. In addition, the fish return location by design has to be remote from the intakes to avoid the issue of recirculation. Therefore, whilst marine mammals, including seals, may be attracted to the return location, they will not be at risk of entrapment **[Operational water discharge EP]**. Prey species for marine mammals however could be affected, resulting in a potential indirect impact on marine mammals **[Operational water discharge EP]**. In addition, vessel strike has the potential to affect marine mammals **[Marine Licence]**. As a consequence, LSE could not be excluded.

Rationale for screening decisions for migratory fish that are qualifying features of SACs

5.4.42 Table 5-3 presents the rationale for the screening decisions made for migratory fish (noting that the only relevant species is Atlantic salmon and, for the Afon Eden – Cors Goch Trawsfynydd SAC only, freshwater pearl mussel). Freshwater pearl mussel can only be affected via an effect on the host fish species; recent research undertaken by NRW has demonstrated that brown trout (including sea trout) Salmo trutta is the host species for the Afon Eden population [RD116].

Rationale for screening decisions for birds

5.4.43 Table 5-4 presents the rationale for the screening decisions made for Annex I and migratory birds.

Table 5-3 Screening rationale for each screening category for migratory fish

Item	Screening categories	Rationale for screening decisions
1	Changes in visual and acoustic stimuli	Justification for decision that LSE cannot be excluded Migratory fish (in this case Atlantic salmon) that are qualifying features of all of the SACs that were scoped into the assessment have the potential to be affected by underwater noise as they migrate between rivers and feeding grounds in the North Atlantic (Greenland, Faroes, Iceland) (including the AFD) **[Marine Licence; Operational water discharge EP]**. Hence LSE could not be excluded for the SACs designated for migratory fish scoped into the assessment at the Screening stage.
2	Land-take, including seabed or intertidal land	Justification for decision that no LSE would arise Migratory fish (salmon) are not considered to be sensitive to intertidal or subtidal land-take due to the Project as they are migrating between rivers and feeding grounds in the North Atlantic (Greenland, Faroes, Iceland) (i.e. the habitat that would be affected by land-take is not a supporting habitat for this species) **[Marine Licence]**. Therefore it was concluded that there is not likely to be a LSE on salmon due to land-take.
3	Changes in marine water quality	Justification for decision that LSE cannot be excluded For SACs scoped into the assessment for migratory fish, LSE could not be excluded at the Screening stage. Changes to marine water quality could occur due to dredging and dredged material disposal during the construction phase (primarily increases in suspended sediment) **[Marine Licence]**, thermal and chemical effects from the cooling water discharge **[Operational water discharge activity EP]** and sewage discharge **[Construction water discharge EP]**. In addition, there could be consequential effects on marine water quality due to changes in terrestrial water quality and direct marine water quality effects due to dewatering and discharges to sea **[Construction water discharge EP]**. Such changes could affect migratory fish behaviour as they migrate between rivers and the adult feeding grounds.
4	Changes in terrestrial water quality	Justification for decision that no LSE would arise The Project is expected to give rise to changes in terrestrial water quality, but no direct effects would occur on SACs designated for migratory fish. Changes to terrestrial water quality, however, could have an effect on marine water quality (e.g. surface run-off containing a high sediment load); this is considered as part of item 3 (changes to marine water quality) **[Construction water discharge EP]**.
5	Changes in surface and groundwater hydrology	Justification for decision that no LSE would arise Changes in surface and groundwater hydrology are unlikely to result in an effect pathway to SACs designated for migratory fish; hence no LSE was concluded for all sites for this screening category **[Construction water discharge EP]**.

Item	Screening categories	Rationale for screening decisions
6	Introduction of INNS	Justification for decision that no LSE would arise The Project has the potential to result in the spread of INNS in the terrestrial or marine environment. This could have detrimental effects on native biodiversity and could be contrary to the Wildlife and Countryside Act 1981 (as amended), which lists invasive non-native species and makes it illegal to introduce or cause them to spread or grow in the wild. It could also be contrary to other regulations and international conventions. The works have the potential to both spread INNS that are already established on the site and elsewhere in the UK and result in the import of INNS from outside the UK **[Construction water discharge EP; Marine Licence]**. In order to manage these risks, Horizon would prepare one (or more) Biosecurity Risk Assessment(s) and Method Statement(s) to cover all activities. Each Biosecurity Risk Assessment would consider in general: a) measures that would be undertaken to control and eradicate INNS within the area of works; and, b) measures or actions that aim to prevent INNS being introduced to the site for the duration of the construction phase. In the management of existing known presence of INNS, Biosecurity Risk Assessments and Method Statements would detail: a) how areas with the presence of INNS would be demarcated; b) how any contaminated materials would be appropriately managed throughout the works, including where appropriate eradication from the site; c) appropriate disposal; and, d) how any transfer or spread would be prevented. In terms of prevention of new introduction to the site through terrestrial and marine pathways, Biosecurity Risk Assessments and Method Statements wouldl detail: a) risk pathways and risk activities for the transfer and spread of non-native species; b) risk assessment for the transfer and spread of individual non-native species of known concern; c) methods to manage risk of transfer including any actions to be undertaken prior to reaching site; and d) contingency planning and corrective actions. Horizon would implement a monitoring programme for non-native species. This would include observational surveys on structures that may provide suitable substrate for non-native species. Surveys would record presence/abundance of non-native species with reporting in agreement with NRW. Monitoring survey requirements for specific sites would be set out in the sub-CoCPs where relevant. Where new presence of

Item	Screening categories	Rationale for screening decisions
		INNS is discovered, Biosecurity Risk Assessments and Method Statements would be reviewed and amended where necessary. Wherever appropriate, workers would be given an activity specific tool-box talk from an ECoW. This would include photographs of any INNS species known to be present on a site. For the marine environment, an initial pre-construction survey would be undertaken and regular surveys would begin once construction of the breakwaters and MOLF is completed. The frequency and extent of monitoring would reduce over time, particularly once the MOLF is no longer operational. The ongoing requirement for monitoring would be regularly reviewed and agreed with NRW.
7	Change in radiation dose levels	Justification for decision that no LSE would arise A Stage 1 Screening exercise has been undertaken in support of an Environmental Permit application under the RSR **[RSR EP HRA]**.The results of the assessment demonstrate that the total dose rate predicted to arise due to the operation of the proposed Wylfa Newydd Power Station is below the screening threshold of 10µGy/h for all habitats and species [RD89]. The in-combination assessment has demonstrated that when the calculated total dose from the proposed Power Station is added to other sources, no exceedances of the 40µGy/h guideline threshold for the protection of European Designated Sites are predicted ([RD87]; [RD88]). Given the above findings, no LSE can be concluded due to change in radiation dose levels **[Operational water discharge activity EP]**.
8	Change in air quality	Justification for decision that no LSE would arise The precautionary ZOI identified for air quality overlaps with the marine environment. However, the area potentially affected does not interact with European Designated Sites designated for migratory fish. In addition, migratory fish are unlikely to be sensitive to the potential impact of the Project on air quality and, consequently, no LSE was concluded for this screening category **[Operational combustion EP]**.
9	Alteration of coastal processes and hydrodynamics	Justification for decision that LSE cannot be excluded For all SACs designated for migratory fish that were scoped into the assessment, LSE could not be excluded. Although the SACs are unlikely to be directly affected, migratory fish could be affected by changes in coastal processes as they migrate between rivers and feeding grounds. Potentially relevant effects include changes to current flows and sediment transport pathways **[Marine Licence]**.
10	Physical interactions between species and Project infrastructure	Justification for decision that LSE cannot be excluded Direct effects could occur, such entrapment within the circulating water intake **[Operational water discharge activity EP]**. As a consequence, LSE could not be excluded at the Screening stage.

Table 5-4 Screening rationale for each screening category for birds

Item	Screening categories	Rationale for screening decisions
1	Changes in visual and acoustic stimuli	Justification for decision that LSE cannot be excluded Noise, vibration and visual disturbance have the potential to affect the behaviour of foraging roosting, commuting and breeding birds. These potential effects will be of most significance during the construction phase and qualifying features of European Designated Sites in very close proximity to the Project (Morwenoliaid Ynys Môn/Anglesey Terns SPA) have the greatest potential to be affected. There is a sympatric relationship between black-headed gulls and terns on the nesting islands in Cemlyn lagoon and, therefore, the effects of changes in visual and acoustic stimuli on black-headed gulls and terns both need to be considered when assessing LSE **[Marine Licence]**. Workers living in the Site Campus could, in theory, disturb the Morwenoliaid Ynys Môn/Anglesey Terns SPA. However, as detailed in table 5-1, a Workforce Management Strategy (Application Reference Number: 8.5) will be implemented to keep workers on site and control their interactions with the people and environment around them. Moreover, during the breeding season in particular, wardens manage visitors to the tern colony. Given this, the potential for LSE due to visitor pressure has been excluded. There is also the potential for disturbance during the operational phase due to operational combustion activity (but this is considered to be limited to the Morwenoliaid Ynys Môn/Anglesey Terns SPA due do the proximity of this site to the Project) **[Operational combustion EP]**. For this screening category, LSE could not be excluded for any qualifying site (and features) that were scoped into the assessment on the basis that all species identified have the potential to be affected by the Project due to their presence within the ZOI and the fact that they may be foraging and/or breeding within the ZOI.
2	Land-take, including seabed or intertidal land	**Justification for decision that LSE cannot be excluded** Intertidal and subtidal land-take has the potential to impact on areas used by foraging birds through habitat loss and effects on prey species. This screening category includes the potential impact of the disposal of dredged material on subtidal habitat at Disposal Site **[Marine Licence]**. For this screening category, LSE could not be excluded for any qualifying site (and features) that were scoped into the assessment on the basis that all species identified have the potential to be affected by the project due to their presence within the ZOI and the fact that they may be foraging within the ZOI. Land-take associated with the Project also includes both permanent and temporary habitat loss of grassland areas that support (red-billed) chough foraging. A specific vulnerability of this species includes the scarcity of bare-ground, development of grass mat, absence of animal dung and associated invertebrate fauna for feeding purposes. On this basis, LSE could not be excluded for all SPAs scoped into the assessment for chough.

Item	Screening categories	Rationale for screening decisions
3	Changes in marine water quality	3a: Justification for decision that LSE cannot be excluded Changes to marine water quality could occur due to dredging and dredged material disposal during the construction phase (primarily due to increases in suspended sediment) **[Marine Licence]**, thermal and chemical effects from the cooling water discharge **[Operational water discharge activity EP]** and sewage discharge **[Construction water discharge EP]**. In addition, there could be consequential effects on marine water quality due to changes in terrestrial water quality and direct marine water quality effects due to dewatering and discharges to sea **[Construction water discharge EP]**. Such changes could affect prey species and the ability of birds to effectively forage for prey. LSE could not be excluded for any qualifying site (or features) that were scoped into the assessment on the basis that all species identified have the potential to be affected by the Project due to their presence within the ZOI and the fact that they may be foraging within the ZOI.
		3b: Justification for decision that no LSE would arise It is concluded that no LSE would arise for the chough qualifying interest feature of SPAs for this screening category, as chough feed in the terrestrial environment **[Marine Licence; Operational water discharge activity EP; Construction water discharge EP]**.
4	Changes in terrestrial water quality	Justification for decision that no LSE would arise The Project is expected to give rise to changes in terrestrial water quality. However, no direct effect will occur on SPAs, pSPAs or Ramsar sites. Changes to terrestrial water quality could have an effect on marine water quality (e.g. surface run-off containing a high sediment load); hence this is considered as part of item 3 (changes to marine water quality) **[Construction water discharge EP]**.
5	Changes in surface and groundwater hydrology	5a: Justification for decision that LSE cannot be excluded The coastal lagoon qualifying feature of the Bae Cemlyn/Cemlyn Bay SAC has the potential to be affected by changes in surface and groundwater hydrology and, on this basis, it was concluded that LSE could not be excluded for the Morwenoliaid Ynys Môn/Anglesey Terns SPA **[Construction water discharge EP]**.
		5b: Justification for decision that no LSE would arise For all SPAs, pSPAs and Ramsar sites except the Morwenoliaid Ynys Môn/Anglesey Terns SPA, changes in surface and groundwater hydrology associated with the Project are highly unlikely to result in an effect pathway; hence no LSE was concluded for all other SPAs and pSPAs **[Construction water discharge EP]**.

Item	Screening categories	Rationale for screening decisions
6	Introduction of INNS	Justification for decision that no LSE would arise The Project has the potential to result in the spread of INNS in the terrestrial or marine environment. This could have detrimental effects on native biodiversity and could be contrary to the Wildlife and Countryside Act 1981 (as amended), which lists invasive non-native species and makes it illegal to introduce or cause them to spread or grow in the wild. It could also be contrary to other regulations and international conventions. The works have the potential to both spread INNS that are already established on the site and elsewhere in the UK and result in the import of INNS from outside the UK **[Construction water discharge EP; Marine Licence]**. In order to manage these risks, Horizon would prepare one (or more) Biosecurity Risk Assessment(s) and Method Statement(s) to cover all activities. Each Biosecurity Risk Assessment would consider in general: a) measures that would be undertaken to control and eradicate INNS within the area of works; and, b) measures or actions that aim to prevent INNS being introduced to the site for the duration of the construction phase. In the management of existing known presence of INNS, Biosecurity Risk Assessments and Method Statements would detail: a) how areas with the presence of INNS would be demarcated; b) how any contaminated materials would be appropriately managed throughout the works, including where appropriate eradication from the site; c) appropriate disposal; and, d) how any transfer or spread would be prevented. In terms of prevention of new introduction to the site through terrestrial and marine pathways, Biosecurity Risk Assessments and Method Statements would detail: a) risk pathways and risk activities for the transfer and spread of non-native species; b) risk assessment for the transfer and spread of individual non-native species of known concern; c) methods to manage risk of transfer including any actions to be undertaken prior to reaching site; and d) contingency planning and corrective actions. Horizon would implement a monitoring programme for non-native species. This would include observational surveys on structures that may provide suitable substrate for non-native species. Surveys would record presence/abundance of non-native species with reporting in agreement with NRW. Monitoring survey requirements for specific sites would be set out in the sub-CoCPs where relevant. Where new presence of INNS is discovered, Biosecurity Risk Assessments and Method Statements would be reviewed and amended where necessary. Wherever appropriate, workers would be given an activity specific tool-box talk from an ECoW. This would include

Item	Screening categories	Rationale for screening decisions
		photographs of any INNS species known to be present on a site. For the marine environment, an initial pre-construction survey would be undertaken and regular surveys would begin once construction of the breakwaters and MOLF is completed. The frequency and extent of monitoring would reduce over time, particularly once the MOLF is no longer operational. The ongoing requirement for monitoring would be regularly reviewed and agreed with NRW.
7	Change in radiation dose levels	Justification for decision that no LSE would arise A Stage 1 Screening exercise has been undertaken in support of an Environmental Permit application under the RSR **[RSR EP HRA]**. The results of the assessment demonstrate that the total dose rate predicted to arise due to the operation of the proposed Wylfa Newydd Power Station is below the screening threshold of 10μGy/h for all habitats and species [RD89]. The in-combination assessment has demonstrated that when the calculated total dose from the proposed Power Station is added to other sources, no exceedances of the 40μGy/h guideline threshold for the protection of European Designated Sites are predicted ([RD87]; [RD88]). Given the above findings, no LSE can be concluded due to change in radiation dose levels [**Operational water discharge activity EP**].
8	Change in air quality	8a: Justification for decision that LSE cannot be excluded The precautionary ZOI identified for air quality overlaps with the Morwenoliaid Ynys Môn/Anglesey Terns SPA and Glannau Ynys Gybi/Holy Island Coast SPA **[Operational combustion EP; Marine Licence]**. For these sites, LSE could not be excluded due to the potential effect that changes in air quality may have on the habitats within the sites and therefore the interest features supported. The supporting evidence for this conclusion is provided in tables 5.1b to 5.1p (noting that the results for the Bae Cemlyn/Cemlyn Bay SAC are equally applicable to the Morwenoliaid Ynys Môn/Anglesey Terns SPA and the results for Glannau Ynys Gybi/Holy Island Coast SAC are equally applicable to Glannau Ynys Gybi/Holy Island Coast SPA). A precautionary approach has been taken to the assessment of SPAs designated for chough due to the fact that foraging habitat for this species may be affected by changes to air quality. On this basis, LSE could not be excluded for all SPAs scoped into the assessment for chough **[Operational combustion EP; Marine Licence]**.
		8b: Justification for decision that no LSE would arise With the exception of European Designated Sites referred to under item 8a above, LSE can be excluded because all other sites are outside the ZOI for changes to air quality **[Operational combustion EP]**.

Item	Screening categories	Rationale for screening decisions
9	Alteration of coastal processes and hydrodynamics	9a: Justification for decision that LSE cannot be excluded The Morwenoliaid Ynys Môn / Anglesey Terns SPA lies partly within the zone that could be affected by the alteration of coastal processes and hydrodynamics. In addition to this site, for all SPAs, pSPAs and Ramsar sites that are scoped into the assessment, it was concluded that the potential for LSE could not be excluded due to potential changes to current flows and sediment transport pathways, which could affect habitats within the European Designated Sites and prey species for birds **[Marine Licence]**. The likelihood of a LSE arising on lesser black backed gulls was considered to be very small, but nevertheless scoped in to ensure consistency in the approach adopted for scoping.
		9b: Justification for decision that no LSE would arise It is concluded that no LSE would arise for the chough qualifying interest feature of SPAs for this screening category, as chough feed in the terrestrial environment **[Marine Licence; Operational water discharge activity EP; Construction water discharge EP]**.
10	Physical interactions between species and Project infrastructure	Justification for decision that LSE cannot be excluded Direct effects could occur, such as entrapment within the circulating water intake. More significantly the food chain for bird species could be affected by entrainment and entrapment within the circulating water system **[Operational water discharge activity EP]**. As a consequence, LSE could not be excluded for this screening category. The exception to this conclusion is for chough which are not at risk of entrapment and the food chain for this species would not be affected by entrainment and entrapment within the circulating water system.

5.5 Findings of Stage 1 Screening: construction and operation of the Project in-combination

Introduction

5.5.1 For some European Designated Sites where an alone LSE was concluded, the potential exists for significant in-combination effects with other plans and projects for a number of the screening categories listed in table 4-1. This potential is greatest for the European Designated Sites within which the Project is located as well as for adjacent sites, due to the fact that (in general) the influence of the Project decreases with distance. However, for more distant European Designated Sites, in-combination effects could also arise as the other plans and projects identified could affect the interest features of the site in question (again) via a number of the screening categories.

Assessment

5.5.2 Based on the screening exercise presented in appendix B and the criteria set out in section 5.2, the potential for a LSIE to arise has been assumed on a precautionary basis for the following projects (with respect to spatial, temporal or designated feature interactions):

- Horizon's proposed Visitor and Media Reception Centre – clear spatial and temporal links exist between the projects.
- Decommissioning of the Existing Power Station - spatial and temporal links exist between the two projects (that is, decommissioning of the Existing Power Station and the Project that is the subject of this assessment).
- Anglesey Eco Park - spatial and temporal links exist between the two projects.
- Holyhead Waterfront Redevelopment - a spatial link and a potential temporal link exists between the two projects.
- North Wales Connection Project - a spatial link and a potential temporal link exists between the two projects.
- Rhyd-y-groes Re-power - a spatial link and a potential temporal link exists between the two projects.
- Amlwch LNG - a spatial link and a potential temporal link exists between the two projects.
- Holyhead Deep 10 MW - a spatial link and a potential temporal link exists between the two projects.
- West Anglesey Demonstration Zone - a spatial link exists between the two projects.

- Glyn Rhonwy Pumped Storage - Nationally Significant Infrastructure Project with the potential to affect the same European Designated Site(s) as the Project.
- Afon Dysynni outfall gravel removal and relocation - a potential temporal link exists between the two projects and they have the potential to affect the same European Designated Site.
- South Hook Combined Heat & Power Station - Nationally Significant Infrastructure Project with the potential to affect the same European Designated Site(s) as the Project.
- Burbo Bank Extension Offshore Wind Farm - Nationally Significant Infrastructure Project with the potential to affect the same European Designated Site(s) as the Project.
- Milford Haven Maintenance Dredge - a temporal link exists between the two projects and they have the potential to affect the same two European Designated Sites.
- Fishguard Marina Development - a potential temporal link exists between the two projects and they have the potential to affect the same European Designated Site.
- Gwynt y Môr Offshore Wind Farm - potential spatial and temporal links exist between the two projects.
- North West Coast Connections Project - Nationally Significant Infrastructure Project with the potential to affect the same European Designated Site(s) as the Project.
- Walney Extension Offshore Wind Farm - Nationally Significant Infrastructure Project with the potential to affect the same European Designated Site(s) as the Project.
- NuGen Moorside Project in West Cumbria - Nationally Significant Infrastructure Project with the potential to affect the same European Designated Site(s) as the Project.
- Barrow Offshore Wind Farm Export Cable Repair and Remediation - a potential temporal link exists between the two projects and they have the potential to affect the same European Designated Site.
- Refurbishment of the flood embankment at Hesketh Out Marsh and habitat creation - a potential temporal link exists between the two projects and they have the potential to affect the same European Designated Site.
- Swansea Bay Tidal Lagoon - Nationally Significant Infrastructure Project with the potential to affect the same European Designated Site(s) as the Project.

- Cardiff Tidal Lagoon - Nationally Significant Infrastructure Project with the potential to affect the same European Designated Site(s) as the Project.
- Argyll Tidal Demonstration Array - a potential temporal link exists between the two projects and they have the potential to affect the same European Designated Site.
- Alexandra Basin Redevelopment Project, Dublin - spatial and temporal links exist between the two projects.
- Proposed New Cruise Berth, Dun Laoghaire Harbour - spatial and temporal links exist between the two projects.
- Decommissioning of marine current turbine, Stranford Lough - a potential temporal link exists between the two projects and they have the potential to affect the same European Designated Site.
- Newcastle Harbour Co. Down - relocation of sandbar from harbour entrance - a potential temporal link exists between the two projects and they have the potential to affect the same European Designated Site.
- D3 terminal cruise ship facility and dredging, Belfast Harbour - a potential temporal link exists between the two projects and they have the potential to affect the same European Designated Site.

5.5.3 Based on the scoping exercise presented in appendix B and the criteria set out in section 5.2, the potential for a LSIE to arise has been further assessed for the following plans:

- People, Places, Futures: The Wales Spatial Plan (updated) 2008, Adopted 2004.
- Dŵr Cymru Welsh Water Draft Water Resources Management Plan 2008 [RD83].
- Anglesey and Gwynedd Joint Local Development Plan 2011–2026.
- North Wales Joint Local Transport Plan 2015–2020.
- West of Wales Shoreline Management Plan 2 (SMP2).

5.5.4 In December 2017 consultation was launched on the Draft Welsh National Marine Plan (including the HRA for this plan). As this consultation is not due to close until 29 March 2018, the plan may be subject to amendment and, therefore, it was not considered further in this in-combination screening assessment.

5.5.5 The findings of the in-combination screening assessment of the Project with other plans are presented in table 5-5.

5.5.6 With the exception of the North Wales Joint Local Transport Plan 2015–2020, the assessment concludes that either it is not possible to undertake a valid in-combination assessment given the degree of environmental assessment undertaken for the plan being considered, or, that LSIE can be excluded. Given this conclusion, no further assessment of The Wales

Spatial Plan 2008, Welsh Water Draft Water Resources Management Plan 2008, Anglesey and Gwynedd Joint Local Development Plan 2011-2026 and West of Wales SMP2 has been undertaken as part of this Shadow HRA. However, the North Wales Joint Local Transport Plan 2015–2020 has been considered further with respect to changes in terrestrial water quality during the construction phase and hydrological changes during construction and establishment.

Next steps

5.5.7 For those European Designated Sites where it was concluded that the potential for LSE alone or in-combination exists, further assessment has been undertaken as part of Stage 2 of the Shadow HRA process (Appropriate Assessment).

5.5.8 This stage comprised examining in further detail the characteristics of each project that was identified as presenting the potential for an LSE to arise in-combination with the Project through the screening exercise; for example the activities involved, works proposed, scale, timing, duration, etc. The further analysis has determined:

- Whether or not the project in question had been or is in the process of being implemented, constructed or completed and, if so, whether it is likely to have effects on the screened in European Designated Sites that are material and need to be taken into account in the in-combination assessment.
- For projects for which the potential for a material effect on a screened in European Designated Site was determined, the route via which each project could affect the screened in interest features of the European Designated Site; specifically whether each relevant project and the Project could affect the same interest feature(s).
- Where the same interest feature(s) could be affected by a project in-combination with the Project, whether the combined effect could adversely affect the integrity of a European Designated Site.

Table 5-5 Assessment of potential for LSIE with other plans

European Designated Sites potentially affected by the plan (and for which LSE could not be excluded for the Project)	Potential effects of the plans on European Designated Sites	Assessment of in-combination effects with the Project
PP01: People, Places, Futures: The Wales Spatial Plan (updated) 2008, Adopted 2004 The Wales Spatial Plan aims to deliver sustainable development through its area strategies in the context of the Welsh Governments Sustainable Development Scheme. They provide an important regional context for service delivery and land use, and inform local development plans.		
North West Wales • Morwenoliaid Ynys Môn/Anglesey Terns SPA • Bae Cemlyn/Cemlyn Bay SAC • Ynys Seiriol/Puffin Island SPA • Glannau Ynys Gybi/Holy Island Coast SPA • Glannau Ynys Gybi/Holy Island Coast SAC • Pen Llyn a'r Sarnau/Llyn Peninsula and the Sarnau SAC	The HRA screening exercise for North West Wales concludes that LSE could not be excluded for the European Designated Sites listed. The HRA notes that specific impacts could not be identified at the Plan stage due to the lack of detail on the development that might result. However, the following, potential impact themes were identified for these sites: • population and recreational pressures; • coastal processes, hydrological and water quality effects; • disturbance from shipping and aviation; • in-combination effects.	Given that LSE could not be excluded for the identified European Designated Sites, an appropriate assessment was carried out. However, this concluded that "*the aspirational and non-locational nature of the Wales Spatial Plan meant that it was not amenable to the identification of the Wales Spatial Plan implications for the sites with any great degree of precision. Therefore an HRA will be carried out in greater detail in relation to the lower tier plans, action plans, programmes which enable the delivery of the Wales Spatial Plan. The level of detail within those plans and programmes should be sufficient to enable the assessment process to be carried out with a greater degree of particularity".* Given that the HRA for the Wales Spatial Plan

European Designated Sites potentially affected by the plan (and for which LSE could not be excluded for the Project)	Potential effects of the plans on European Designated Sites	Assessment of in-combination effects with the Project
North East Wales • Afon Dyfrdwy a Llyn Tegid/River Dee and Bala Lake SAC • Aber Afen Dyfrdwy/Dee Estuary SPA • Aber Afen Dyfrdwy/Dee Estuary Ramsar site	The HRA screening for North East Wales notes that specific impacts could not be identified at the Plan stage due to the lack of detail on the development that might result. However, the following, potential impact themes were identified for these sites: • household formation; • recreational pressure; • population pressure; • coastal zone management; • economic development; • water quality/quantity; • inland and estuarial impacts; • in-combination effects particularly with the NW England region and via the Mersey Dee Alliance.	was not able to undertake further assessment beyond the HRA screening stage and could only identify potential impact themes rather than specific effects, it is not possible to undertake detailed in-combination assessment. Moreover, significant effects are not predicted for the Project with regard to a number of these impact themes, for example: • Population and recreational pressure. • Coastal processes. • Disturbance from shipping and aviation. • Household formation. • Coastal zone management. • Inland and estuarial impacts.
Central Wales • Pen Llyn a'r Sarnau/Llyn Peninsula and the Sarnau SAC • Bae Ceredigion/Cardigan Bay SAC • Afon Eden - Cors Goch Trawsfynydd SAC • Afon Teifi/ River Teifi SAC	The HRA screening for Central Wales notes that this list of sites is indicative and states that subsequent HRAs will need to confirm that no other sites would be affected, directly, indirectly or as a result of in combination effects. For example hydrological changes or air pollution may cause other sites to merit consideration. The issues that were considered to result from the screened elements are mainly associated with increasing population and recreation pressure and in combination effects.	

European Designated Sites potentially affected by the plan (and for which LSE could not be excluded for the Project)	Potential effects of the plans on European Designated Sites	Assessment of in-combination effects with the Project
Pembrokeshire • Sir Benfro Forol/Pembrokeshire Marine SAC	For Pembrokeshire, the HRA screening assessment concludes that specific impacts could not be identified at this stage due to the lack of detail on the development that might result. However, the following potential impact themes were identified: • hydrology, water quality and water resources; • population pressure; • recreation pressure; • direct and indirect effects from transport; • in-combination impacts.	
PP05: Dŵr Cymru Welsh Water Draft Water Resources Management Plan 2013 Dŵr Cymru Welsh Water produces an updated Water Resources Management Plan (WRMP) every five years which demonstrates how it will balance water supply and demand over the next 25 year period. Water abstraction has the potential to impact on European Designated Sites within Wales. HRA of the Plan has been undertaken (Dŵr Cymru, 2013).		

European Designated Sites potentially affected by the plan (and for which LSE could not be excluded for the Project)	Potential effects of the plans on European Designated Sites	Assessment of in-combination effects with the Project
• Pen Llyn a'r Sarnau/Llyn Peninsula and the Sarnau SAC • Sir Benfro Forol/Pembrokeshire Marine SAC	The HRA for the Water Resources Management Plan firstly identified whether or not a potential pathway for an effect on European Designated Sites existed due to various water resource management options in Wales. Where a pathway was identified, further assessment of the possible effects of each option on the European Designated Site was undertaken. Further assessment was undertaken for two of the European Designated Sites for which LSE could not be excluded for the Project with regard to marine mammals. However, these sites were assessed within the HRA for the Plan because of their habitat features; the HRA concluded that the marine mammals qualifying features are not sensitive to the effects of the Plan. For the European Designated Sites listed, the HRA concludes that no LSE would occur. The screening assessment identified best-practice and other specific mitigation that was taken into account in the screening assessment.	On the basis of the findings of the HRA of the Plan, and because this Shadow HRA concludes that LSE cannot be excluded only for marine mammal qualifying features that are remote from the European Designated Site boundaries, there is no potential for in-combination effects with the Project to arise on the qualifying features of these European Designated Sites.

European Designated Sites potentially affected by the plan (and for which LSE could not be excluded for the Project)	Potential effects of the plans on European Designated Sites	Assessment of in-combination effects with the Project
PP07: Anglesey and Gwynedd Joint Local Development Plan 2011 – 2026		
The LDP focuses on economic development and planning within the region. The policies set out have the potential to impact on European Designated Sites.		
European Designated Sites within the scope of the HRA for the Local Development Plan and which are relevant to the in-combination assessment are: SACs - • Afon Eden - Cors Goch Trawsfynydd SAC • Afon Gwyrfrai a Lyn Cwellyn SAC • Corsydd Môn/Anglesey Fens SAC • Bae Cemlyn/Cemlyn Bay SAC • Glannau Ynys Gybi/Holy Island Coast SAC • Pen Llyn a'r Sarnau/Llyn Peninsula and the Sarnau SAC • Llyn Dinam SAC • Afon Dyfrdwy a Llyn Tegid/River Dee and Bala Lake SAC SPAs - • Glannau Aberdaron and Ynys Enlli/Aberdaron Coast Bardsey Island SPA • Glannau Ynys Gybi/Holy Island Coast SPA • Mynydd Cilan, Trwyn y Wylfa ac Ynysoedd Sant Tudwal/Mynydd Cilan, Trwyn y Wylfa and the St. Tudwal Islands SPA • Ynys Seiriol/Puffin Island SPA • Morwenoliaid Ynys Môn/Anglesey Terns SPA Ramsar sites - • Corsydd Môn a Llyn/Anglesey and Llyn Fens Ramsar site.	The HRA for the Plan concludes there is the potential for LSE for some of the policies set out in the Plan for a number of the European Designated Sites that were scoped into the assessment, but does not specify which sites.	The HRA for the Local Development Plan concludes that "*the majority of policies are unlikely to have a significant effect as they either seek the protection and enhancement of cultural/ heritage and natural environmental assets or set out design criteria for development proposals. For some policies, it was considered that potential impacts would be more appropriately assessed against other Preferred Strategy Policies that provide further detail on the scale and location of proposed development. For other policies, it was considered that it would be more appropriate to address potential impacts at the project level once the precise nature, scale and location of development is known*". Given the approach taken to the HRA screening for the Local Development Plan, it is not possible to assess the potential effects in-combination of it with the predicted effects of the Project.

European Designated Sites potentially affected by the plan (and for which LSE could not be excluded for the Project)	Potential effects of the plans on European Designated Sites	Assessment of in-combination effects with the Project
PP09: North Wales Joint Local Transport Plan 2015 – 2020 The North Wales Joint Local Transport Plan relates to all transport across north Wales and has the potential to impact on European Designated Sites within north Wales.		
• Corsydd Môn/Anglesey Fens SAC • Corsydd Môn a Llyn/Anglesey and Llyn Fens Ramsar site	The HRA concludes that LSE cannot be excluded for the following road projects included in the Local Transport Plan for the listed European Designated Site(s): **A499 to Nefyn Link (B4417)** The wetland habitats within the SAC would be vulnerable to hydrological challenges, disturbance effects and the transfer of construction-related pollutants. **A497 Nefyn to Pwllheli Road Improvements** There is potential for direct habitat loss, disturbance and for contaminated run-off to enter these European Designated sites.	The Shadow HRA for the Project concludes that there is the potential for LSE on these European Designated Sites due to changes in terrestrial water quality during construction and hydrological changes during construction and post-construction. Consequently, it is concluded there is potential for a LSIE to arise on the Corsydd Môn/Anglesey Fens SAC and Corsydd Môn a Llyn/Anglesey and Llyn Fens Ramsar site.

European Designated Sites potentially affected by the plan (and for which LSE could not be excluded for the Project)	Potential effects of the plans on European Designated Sites	Assessment of in-combination effects with the Project
Not specified	**A550/B5373 Junction Safety Improvements** The scheme requires further design work. Impacts could only be accurately determined once specific proposals are developed. Project level HRA would be undertaken once more details are known about the scheme **A494 / A55 route into Wales – develop local Highway Network to accommodate any lack of capacity and resilience issues on the trunk road network** Individual schemes are yet to be identified. A Feasibility Study is to be undertaken. At this stage it is not therefore possible to determine whether there would be a LSE on a European site. This will need to be assessed further when the scheme is developed. **Alleviation of Flood Risk Areas on Strategic Routes** Due to uncertainty over the implementation and location of scheme, HRA cannot be undertaken at this stage. Project level HRA should be undertaken when feasibility studies and detailed design have been undertaken and locations of the scheme confirmed.	Given that there are no details available for these identified projects within the Local Transport Plan and the conclusions of the HRA for the Plan, it is not possible to undertake an assessment of potential in-combination effects with the Project.

European Designated Sites potentially affected by the plan (and for which LSE could not be excluded for the Project)	Potential effects of the plans on European Designated Sites	Assessment of in-combination effects with the Project
• Pen Llyn a'r Sarnau/Llyn Peninsula and the Sarnau SAC	The HRA concludes that LSE cannot be excluded for following road projects included in the Local Transport Plan for the listed European Designated Site: **A499 Penrhos Road Flood Alleviation Improvements** A499 between Pwllheli to Llanbedrog runs parallel with the Pen Llyn a'r Sarnau / Llyn Peninsula and the Sarnau SAC. Losses of SAC habitat are highly unlikely, however there is some hydrological connectivity between the A499 and the SAC and there could be potential for the transfer of construction related pollutants into the SAC during the works. Further assessment is not possible at this stage; therefore a HRA will be required at the project level. **Bridge Strengthening (pinch points)** The majority of the 14 bridges are situated either within or adjacent to European Designated Sites. For example, there are bridges which cross watercourses which are hydrologically linked to the Pen Llyn a'r Sarnau / Llyn Peninsula and the Sarnau SAC. Impacts to European Designated Sites would be assessed at the project level when full details of the schemes are available.	Given that there are no details available for these identified projects within the Local Transport Plan and the conclusions of the HRA for the Plan, it is not possible to undertake a detailed assessment of potential in-combination effects with the Project. However, the potential for a LSIE with the Project appears unlikely. The Plan HRA concludes that habitat loss within the European Designated Site is unlikely to occur and the only other identified effect pathway is a hydrological linkage to the site. On the basis of the findings of the HRA of the Plan, and because this Shadow HRA concludes that LSE cannot be excluded only for marine mammal qualifying features that are remote from the European Designated Site boundaries, there is no potential for an in-combination effect with the Project to arise on the qualifying features of this European Designated Site.

European Designated Sites potentially affected by the plan (and for which LSE could not be excluded for the Project)	Potential effects of the plans on European Designated Sites	Assessment of in-combination effects with the Project
PP13: West of Wales Shoreline Management Plan 2 (SMP2) The SMP2 policies for the Cardigan Bay and Ynys Enlli to the Great Orme coastline have the potential to affect European Designated Sites screened into the HRA for the Project		
• Sir Benfro Forol/Pembrokeshire Marine SAC	AEOI (due to reduction in intertidal sandflat habitat area)	The HRA for the SMP2 concludes AEOI for these European Designated Sites due to a predicted reduction in habitat area (as specified). The Project will not affect habitat area within these sites. As this Shadow HRA concludes that LSE cannot be excluded only for marine mammal qualifying features that are remote from the European Designated Site boundaries, there is no potential for in-combination effect to arise on the qualifying features of these European Designated Sites due to the Project.
• Pen Llyn a'r Sarnau/Llyn Peninsula and the Sarnau SAC	AEOI (due to reduction in intertidal sandflat and saltmarsh habitat area)	
• Bae Cemlyn/Cemlyn Bay SAC	No AEOI	The HRA for the SMP2 concludes that the policy for the coastline that has the potential to affect these sites would not result in AEOI. The Project does not have the potential to interact with the SMP2 policy in a negative way or constrain the implementation of the policy and, therefore, no LSIE with the SMP2 policy is predicted due to the Project.
• Morwenoliaid Ynys Môn/Anglesey Terns SPA	No AEOI	

5.6 Findings of Stage 1 Screening: decommissioning

5.6.1 Given the likely timescale for the commencement of decommissioning (i.e. following around 60 years of operation), it is very difficult to carry out any detailed assessments of the environmental implications of potential permissions at this stage. However, before consent for the decommissioning work is granted, there is a requirement to obtain consent from the Health and Safety Executive (HSE) under the Nuclear Reactors (Environmental Impact Assessment for Decommissioning) Regulations 1999. This requires an EIA to be undertaken and it will be during this period that it will be clearer what permissions will be required for the decommissioning process and the likely implications of such.

5.6.2 Undertaking an assessment of LSE for the decommissioning phase now is problematic because, although Horizon already has a decommissioning strategy and decommissioning plan (which make assumptions regarding techniques to be employed during decommissioning), the detail of the working methods to be adopted and the nature of the baseline environment conditions at the time of decommissioning are unknown.

5.6.3 The approach adopted herein to screening for LSE for the decommissioning phase has been to consider the identified potential effects of the construction phase (and, in the case of radiological discharge, the operational phase). These potential effects will be replicated (to an extent) in the decommissioning phase and, for each of the screening categories, a set of working assumptions for this phase of the project have been established (table 5-6).

5.6.4 The overriding assumption is that the potential effects of construction and operation are bounding (i.e. it is assumed that the effects of decommissioning will be within the envelope of potential effects associated with construction and operation). At the end of decommissioning, the site will be restored to an agreed end state that is intended to be net positive.

5.6.5 Based on the identified potential effects of the construction phase (and, in the case of radiological discharge, the operational phase), for each of the following agreed screening categories and the set of assumptions that have been made with regard to the (lesser extent of the) decommissioning phase, no LSE is predicted to arise during this phase of the Project at this time:

- Land-take, including seabed or intertidal land.
- Changes in terrestrial water quality.
- Changes in surface and groundwater hydrology.
- INNS.
- Change in radiation dose levels.
- Change in air quality.
- Alteration of coastal processes and hydrodynamics.
- Physical interaction between species and Project infrastructure.

Table 5-6 Assumptions applied to the assessment of LSE for decommissioning for each screening category

Screening categories	Summary description of effect of the Project	Assumptions applied to assessment of LSE for decommissioning
Changes in visual and acoustic stimuli	• This pathway refers to noise and vibration during activities that may cause disturbance to terrestrial, freshwater and marine species, including prey species for seabirds and marine mammals (e.g. artificial lighting and/or movement from machinery or people associated with the proposed works).	• Any significant noise generating elements of the decommissioning works will be scheduled to avoid the tern breeding season. • No rock blasting works (i.e. groundworks) are required at any time. • The number of plant required for decommissioning will be significantly less than for the construction phase.
Land-take, including seabed or intertidal land	• This category addresses land lost as a result of permanent or temporary works. Land-take is considered to be confined to the physical footprint of the activity concerned. Indirect effects have the potential to arise through the loss of supporting habitat (i.e. loss of habitat that supports prey species for seabirds and marine mammals).	• No additional permanent land take would be required for decommissioning works compared with the construction works. Any temporary land take within the Wylfa Newydd Development Area can be sited to avoid any sensitive / ecologically important habitat that may develop within the Wylfa Newydd Development Area over the operational phase of the Project.
Changes in marine water quality	• This category considers effects on seabirds, marine mammals and their prey species due to changes in marine water quality and includes changes in pH, salinity, turbidity (suspended solids).	Works in the marine environment will be needed to decommission elements of the Licensable Marine Activities (e.g. the MOLF, collision barrier, intake and outfall), potentially including the construction of a cofferdam. The water quality effect is likely to be significantly more localised than for construction (i.e. no dredging or rock removal).
Changes in terrestrial water quality	• This pathway refers to changes to the chemical composition of surface and groundwater that could become loaded with suspended sediment, nutrients or toxic contaminants (e.g. heavy metals, flocculants, hydrocarbons). This category includes sedimentation (both short and long term), changes to water turbidity and the re-suspension of sediment-bound contaminants. Such changes could affect the prey species for seabirds and marine mammals.	• Any site drainage will be of significantly smaller scale than for the construction phase. • Site drainage can be designed to avoid direct discharge to the Bae Cemlyn/Cemlyn Bay SAC (coastal lagoon).

Screening categories	Summary description of effect of the Project	Assumptions applied to assessment of LSE for decommissioning
Changes in surface and groundwater hydrology	• This category includes potential alterations to hydrology and hydrogeology on land, and covers changes to the flow and drainage of water and increased risks associated with flooding and sediment dynamics. Changes in local hydrology could lead to flooding in foraging areas, leading to a functional loss of habitat and displacement of species. Effects could result from increased inputs into, or abstraction from, the local water supply associated with the number of site workers required.	• No significant dewatering will be necessary. • No significant alteration to the drainage catchments will be necessary.
Introduction of Invasive Non-Native Species (INNS)	• There is the potential for changes in ecology to occur, potentially affecting prey species for seabirds and marine mammals, due to competition from INNS. Existing INNS could be spread into new areas during works or new INNS could be introduced to the local environment via 'contaminated' machinery or materials. This is relevant to both the terrestrial and marine environment.	• The risk of INNS can be managed through the implementation of mitigation measures.
Change in radiation dose levels	• This category addresses the pathway for potential effects from radiation emanating from the Power Station during operation and includes radiological contamination of the air, water or terrestrial environment.	• The works will be undertaken to avoid radiological contamination to the environment. The aim of decommissioning is the restoration of the site and de-licensing; this will include removal of radioactive material from the site to approved disposal facilities.
Change in air quality	• This pathway refers to non-radiological changes in air quality, such as the creation of fugitive dust particulates lifted into the air by man-made activities and vehicles/machinery associated with the construction and operation of the Project.	• The scale of decommissioning works will be significant lower than for the construction phase, requiring less plant.

Screening categories	Summary description of effect of the Project	Assumptions applied to assessment of LSE for decommissioning
Alteration of coastal processes and hydrodynamics	• This criterion refers to effects that could occur due to changes to the physical coastline due to marine and coastal works. It concerns the potential for changes in local hydrodynamics that could lead to alterations in local coastal erosion and accretion, and coastal squeeze processes. The release and dispersal of suspended sediments and any implications for habitat functionality are also relevant considerations.	• No new permanent structures will be constructed in the marine environment. • Any work required to decommission marine structures will not result in widespread disturbance to the seabed or have the potential for more than a very localised effect on hydrodynamics; no significant sediment plume will be created.
Physical interaction between species and Project infrastructure	• Species could potentially be directly affected through interactions (collisions) with infrastructure or machinery associated with the Project.	• The extent of works in the marine environment will be of significantly more localised and short term than for the construction phase. • No vessels will transit between the Wylfa Newydd Development Area and the Disposal Site.

5.6.6 Hence further assessment of decommissioning - alone and in-combination - with regard to the above screening categories has not been undertaken in this Shadow HRA.

5.6.7 It is concluded that due to the likely scale of marine works during decommissioning, however, LSE cannot be excluded for marine water quality and changes in visual and acoustic stimuli. These issues are therefore addressed in the shadow Appropriate Assessment in chapters 7 to 10 for the decommissioning phase.

5.6.8 As set out above, new consents, permits and licences will be required for decommissioning and, therefore, this phase of the Project will be subject to further regulatory control.

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6 Description of baseline conditions

6.1 Introduction

6.1.1 For the purposes of the Shadow HRA, this 'baseline conditions' chapter focuses specifically on those European Designated Sites and the interest features within them for which a LSE cannot be excluded (see chapter 5). It includes specific baseline analysis undertaken as part of the HRA and extracts information from the relevant European Designated Site citations.

6.1.2 The aim of this chapter, therefore, is to describe the baseline conditions in an appropriate level of detail to enable the Appropriate Assessment of the Project with regard to the habitats and species of SACs and Ramsar sites (chapter 7), marine mammals (chapter 8), Atlantic salmon and freshwater pearl mussel (chapter 9) and birds (chapter 10). The shadow Appropriate Assessment is subdivided into these four chapters for clarity and to simplify the structure of the document.

6.1.3 Reflecting the above approach, this chapter is structured as follows:

- Section 6.2 describes the baseline conditions for European Designated Sites with terrestrial, freshwater and coastal habitats and species as qualifying interest features.
- Section 6.3 presents baseline information for marine mammals that are qualifying interest features of the European Designated Sites screened into the assessment. In addition, a general overview of the key features of each European Designated Site is also provided.
- Section 6.4 presents the baseline information for Atlantic salmon and the freshwater pearl mussel. The closest European Designated Site for Atlantic salmon is 58km from the Wylfa Newydd Development Area and the Project has no potential to have a direct effect within the boundaries of any European Designated Site for Atlantic salmon. Consequently, this section includes a summary of the life history of Atlantic salmon and status in the vicinity of the Wylfa Newydd Development Area (based on survey work), as this is particularly relevant to the assessment of potential effects on this species. Reference is also made to the status of sea trout as this is the host species for the freshwater pearl mussel population of the Afon Eden – Cors Goch Trawsfynydd SAC.
- Section 6.5 describes the baseline conditions for birds, including breeding, passage and non-breeding birds. The section is informed by surveys undertaken by Horizon and other relevant data collected by other parties.

6.1.4 The level of detail presented for each European Designated Site for which LSE has been determined is reflective of both the amount of information available for each site and the nature of the potential effects on each relevant interest feature identified through the screening exercise.

6.2 Terrestrial, freshwater and coastal habitats and species

Introduction

6.2.1 The following sections summarise available information which is relevant to the assessment of the potential effects of the Project on the terrestrial, freshwater and coastal habitats and species of the following European Designated Sites:

- Bae Cemlyn/Cemlyn Bay SAC;
- Glannau Ynys Gybi/Holy Island Coast SAC;
- Llyn Dinam SAC;
- Corsydd Môn/Anglesey Fens SAC; and,
- Corsydd Môn a Llŷn/Anglesey and Llŷn Fens Ramsar site.

6.2.1 For the European Designated Sites other than Bae Cemlyn/Cemlyn Bay SAC, the site citations and management plans have been used to provide a summary description of the baseline habitats present. For the Bae Cemlyn/Cemlyn Bay SAC, a more detailed review of available data sources has been undertaken. This approach has been adopted because the Bae Cemlyn/ Cemlyn Bay SAC potentially could be affected by a number of effect pathways.

6.2.2 The only screening category for which LSE was determined for the Glannau Ynys Gybi/Holy Island Coast SAC and Llyn Dinam SAC was 'air quality'. For the Corsydd Môn/Anglesey Fens SAC and the Corsydd Môn a Llyn/Anglesey and Llyn Fens Ramsar site, LSE was determined for 'air quality' (operational phase only) and for 'terrestrial water quality' and 'surface and groundwater hydrology' in the context of the creation of new fen habitat and the improvement of existing fen habitat at Cae Canol-dydd and Cors Gwawras. .

Bae Cemlyn/Cemlyn Bay SAC

Coastal lagoon

Introduction

6.2.3 Cemlyn lagoon is an unusual and rare habitat of conservation importance and is a priority Annex I habitat. The status of this feature is currently 'favourable maintained'. It is considered to be the best example of a saline coastal lagoon in Wales [RD147] and one of the most important British lagoonal sites (detailed below).

6.2.4 The coastal lagoon covers an area of approximately 24ha [RD147] and is divided into two parts by a drumlin which extends north-eastwards from Plas Cemlyn farm.

6.2.5 It has been classified as a percolation lagoon. However, water exchange with Cemlyn lagoon is a combination of percolation and sluiced, with seawater exchange mainly occurring through the sluice and by percolation

through the shingle bank. The lagoon suffers temporary threats from shingle blockages of the outflow stream to the beach and from low salinity periods in response to rainfall ([RD43]).

6.2.6 The lagoon habitat features include saltmarsh, coastal grassland, marshy grassland, scrub, freshwater pools, ditches, intertidal rocks and rock pools. These are either found in or adjacent to the lagoon.

Flora and fauna

6.2.7 Cemlyn lagoon supports brackish water-crowfoot *Ranunculus baudotii* (IUCN Least Concern) and spiral tasselweed (*Ruppia cirrhosa*), beaked tasselweed (*R. maritima*) and several species of green and red algae have been recorded.

6.2.8 In October 2017, Horizon carried out a survey of Cemlyn lagoon to record brackish water-crowfoot and tasselweed. Given the difficulty of identification of tasselweeds in this season, identification was only provisionally to species level. The survey comprised an initial walkover of the perimeter of the lagoon to identify suitable habitat, including the small water body to the west of the causeway (immediately east of Tyn Llan). Once completed, a small inflatable, non-motorised boat was used to cover all other parts of the lagoon, including access to the small islands within the lagoon. To facilitate observation of submerged plants a bathyscope (underwater viewer) was employed over the side of the boat.

6.2.9 The survey recorded the presence of tasselweed in the shallow water body to the west of the causeway, where a dense mat covered the silty bed. Based on vegetative characters, all plants examined were provisionally identified as beaked tasselweed. Within the main Cemlyn lagoon, tasselweed was found only as unrooted plants on the shore next to the causeway, presumed to have been washed through from the water body to the west.

6.2.10 Owing to fluctuating environmental conditions (notably temperature and salinity) coastal lagoons are notable for their specialist invertebrate fauna. Cemlyn lagoon supports several such species, including the bryozoan *Conopeum seurati*, the lagoon cockle (*Cerastoderma glaucum*), the lagoonal mud-snail *Ventrosia ventrosa* and the lagoonal isopod *Idotea chelipes*. Studies have found approximately 30 invertebrate taxa inhabiting the lagoon. The data from a Countryside Council for Wales (CCW) survey undertaken between 2006 and 2010 [RD324] demonstrates significant seasonal changes in the lagoon benthic communities and general declines in abundance during summer and autumn and recovery in winter and spring.

6.2.11 A study by the Environment Agency [RD242] was undertaken to determine the spatial distribution of the benthic fauna in the lagoon, with specific reference to lagoonal specialist species. Fourteen stations were sampled throughout the lagoon, with grab samples taken for the analysis of benthic fauna and particle size. Salinity was also recorded.

6.2.12 In terms of the benthic infaunal community, [RD242] notes that this was homogenous throughout the lagoon, with a healthy population of three

lagoonal species being reported. The gastropod mollusc *Ventrosia ventrosa* was the most abundant and was the single most abundant taxa found throughout the lagoon. The lagoonal amphipod *Corophium insidiosum* was ubiquitous throughout the lagoon, although did appear more abundant in the western part of the lagoon in comparison with the eastern section. The isopod *Ideotea chelipes* was present in small numbers throughout the lagoon, but not recorded at site 2 (located in the eastern section of the lagoon.

6.2.13 [RD242] did not record the presence of the lagoonal cockle *Cerastoderma glaucum*; this species had been recorded intermittently by earlier studies. One earlier study by [RD10] considered that temporary shingle blockage of the outflow and low salinities resulting from high rainfall may adversely affect populations of lagoonal specialists, particularly *C. glaucum*.

Salinity

6.2.14 [RD242] reports that salinity varied spatially across the lagoon with values of between 18.5 and 25.3 g/kg (parts per thousand) recorded. A notable salinity gradient was evident, with salinity falling with distance from the shingle bank [RD242]. This is likely to indicate the relative contributions of fully saline water from the marine environment percolating through Esgair Gemlyn and via the sluice and freshwater derived from landward sources (surface run-off and from fluvial discharges). [RD242] notes that the pattern of salinity variation is likely to respond to freshwater input from rainfall.

6.2.15 The salinity within a lagoonal basin depends on the degree and timing of inputs and outputs of both saline and fresh water which are influenced by the restriction of flow across the barrier or inlet, seasonality, tidal range and cycle, and the lagoon shape and depth. The average salinity of the Cemlyn lagoon is approximately 20g/kg ([RD9], [RD10]; [RD92]; [RD242]). However, the method by which the lagoon weir is managed, using stop logs to maintain the water level during the tern breeding season, affects the flow, salinity and temperature in the lagoon. The subsequent removal of logs during the autumn and winter results in the frequent inundation of the islands as a result of high tides and northerly winds. Therefore, salinity values vary greatly during the winter months. The increase in freshwater and precipitation lowers salinity whilst a high tide accompanied by strong northerly winds raises the salinity.

6.2.16 Horizon installed loggers into Cemlyn lagoon at three locations to record water quality parameters from June 2012. One logger location (C01; see figure 6-1) is located in the eastern part of the lagoon and, therefore, is of most relevance in informing the assessment of potential effects of the Project. Salinity was recorded at this location between June 2012 and September 2013.

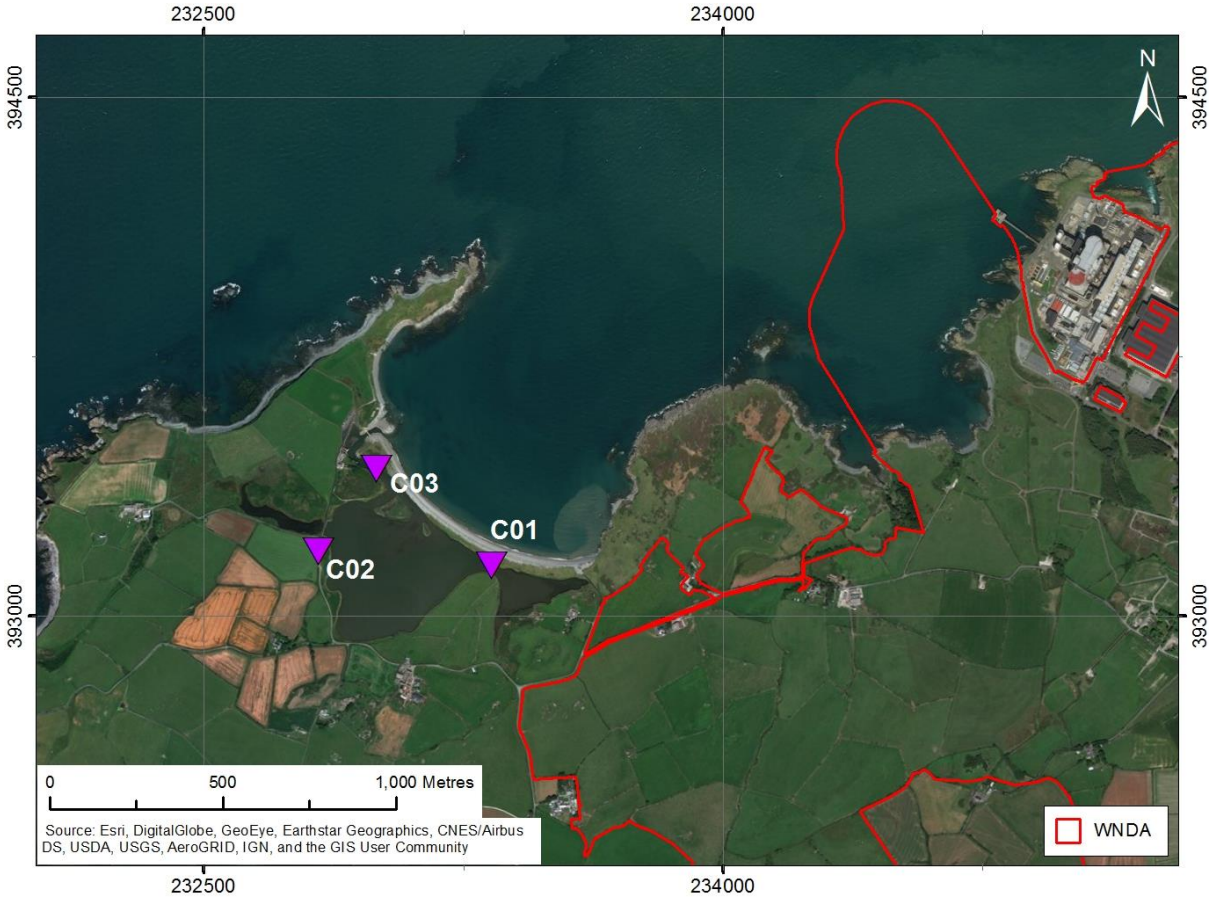


Figure 6-1 Location of Horizon's water quality monitoring stations

6.2.17 The data recorded from locations C01, C02 and C03 are shown in figures 6-2 to 6-5. The upper panel of figure 6-2 shows the whole time series to illustrate variation over the monitoring period, with the lower panel of figure 6-2 and figures 6-3 to 6-5 showing a breakdown of the salinity variation at the three monitoring locations over approximately 3 monthly intervals.

6.2.18 The data from the salinity monitoring illustrate three features of the salinity variation in the lagoon:

- The pattern of salinity variation is broadly similar at all three monitoring locations.
- An approximate 15 day cycle (i.e. between periods of peak salinity) is apparent in the six months from 1 August 2012 to 15 February 2013 which is presumably related to the tidal cycle.
- The pattern described above changes in late February/early March 2013 when salinity was notably reduced, followed by a steadily rising trend to reach peak salinity around mid-July 2013.

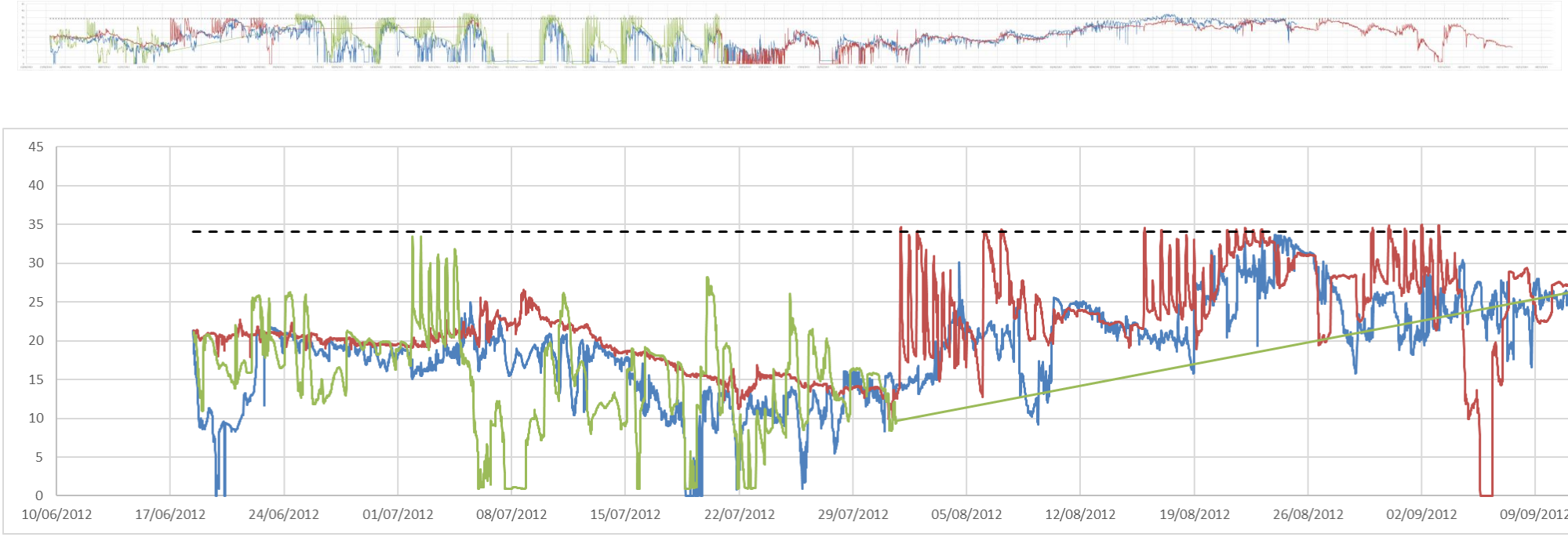


Figure 6-2 Salinity variation in Cemlyn lagoon (complete time series for June 2012 to November 2013 (upper) and extract from 17 June 2012 to 9 September 2012 (lower)) (C01 = blue line; C02 = red line; C03 = green line)

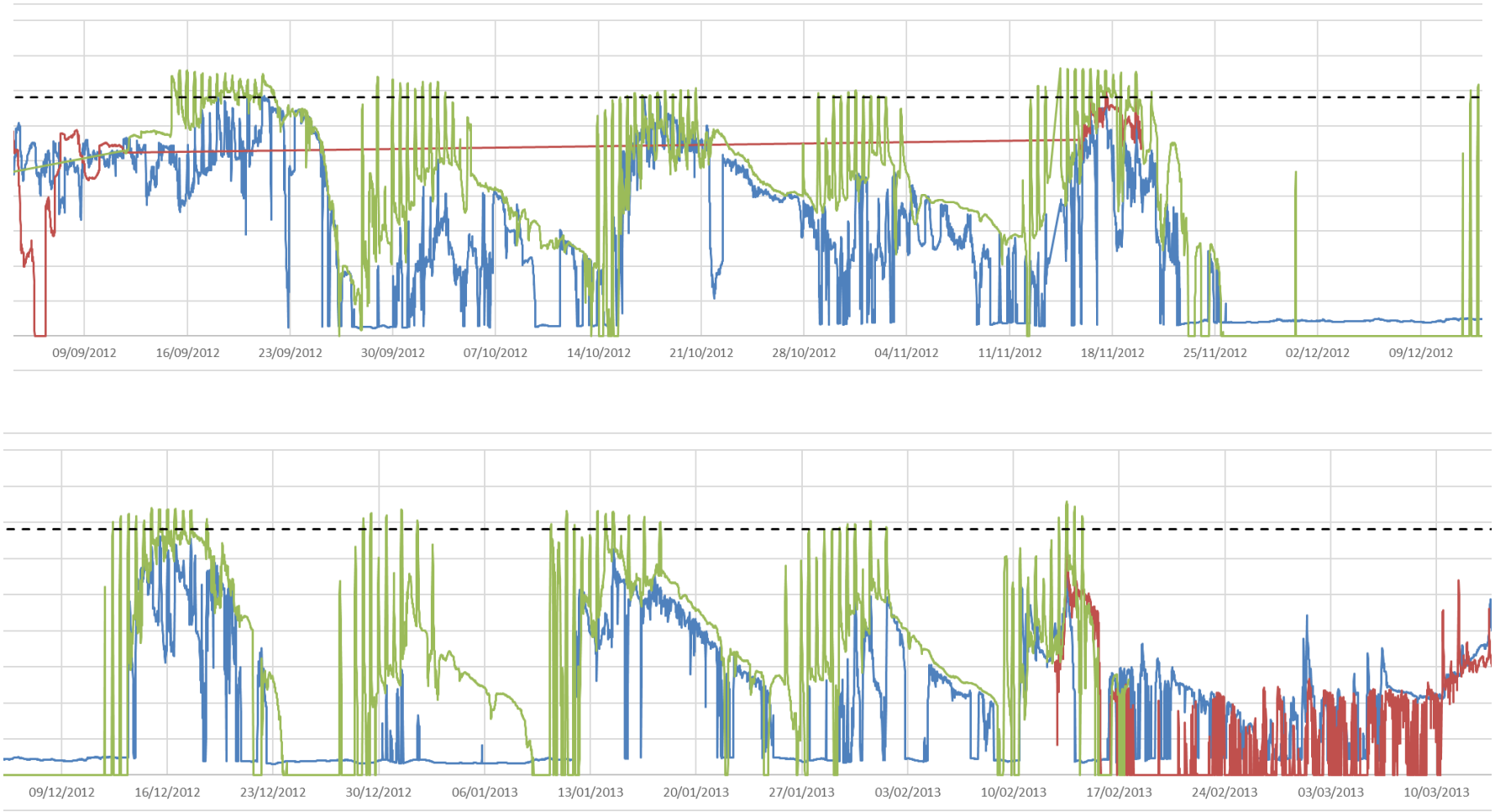


Figure 6-3 Salinity variation in Cemlyn lagoon (9 September 2012 to 9 December 2012 (upper) and 9 December 2012 to 10 March 2013 (lower)) (C01 = blue line; C02 = red line; C03 = green line)

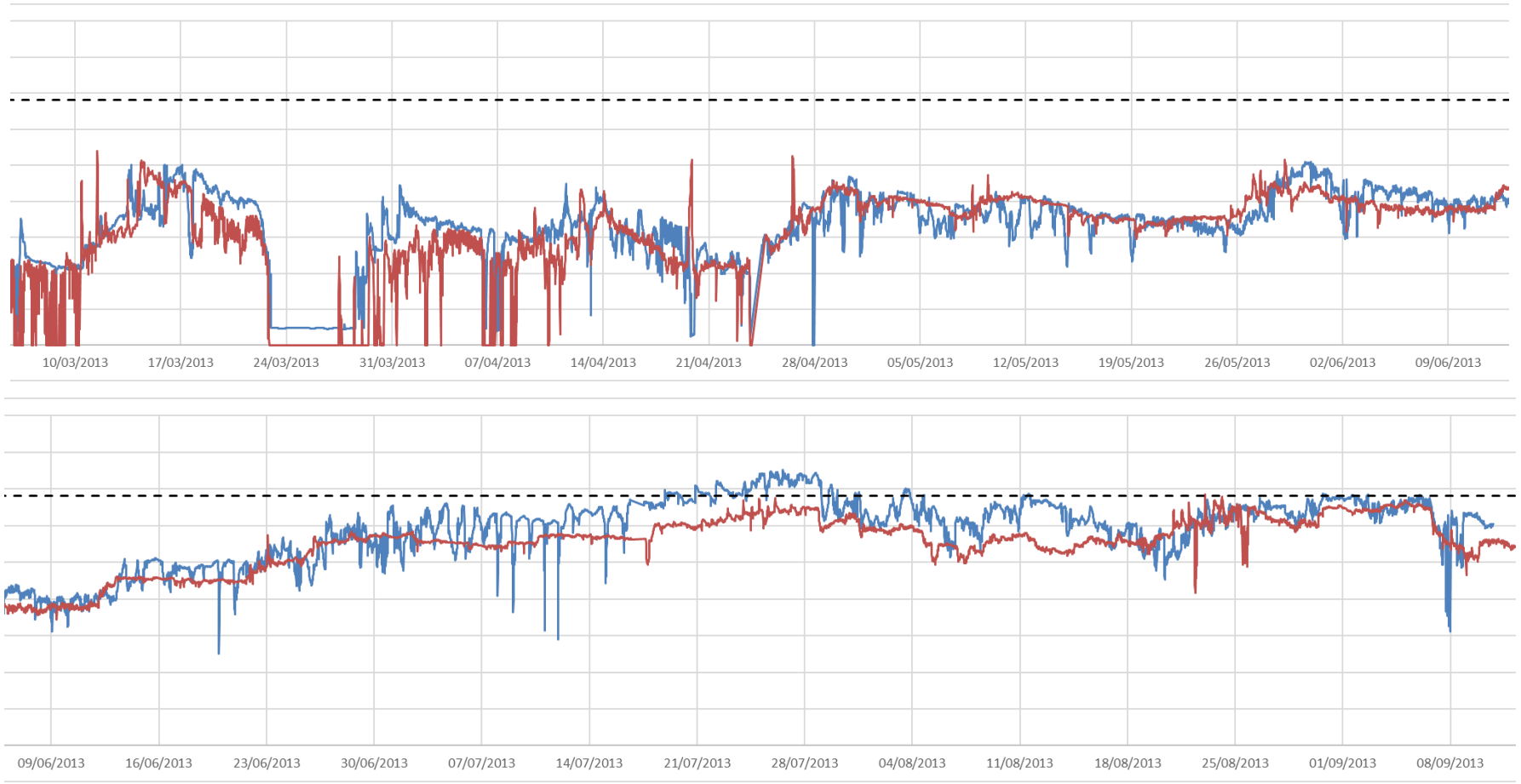


Figure 6-4 Salinity variation in Cemlyn lagoon (10 March 2013 to 9 June 2013 (upper) and 9 June 2013 to 8 September 2013 (lower)) (C01 = blue line; C02 = red line)

Figure 6-5 Salinity variation in Cemlyn lagoon (8 September 2013 to 24 November 2013 (C01 = blue line; C02 = red line)

6.2.19 The pattern in salinity variation described above and illustrated in figures 6-1 to 6-5 can be explained by the management of the water level in the lagoon during the tern breeding season. Based on the data presented above, this management appears to have a marked effect on the salinity across the lagoon, with the effect of tidal influx via the lagoon weir removed resulting in reduced short-term variability in salinity levels. During the tern breeding season it is likely that precipitation and surface water inputs from land have more of an influence on salinity than during the period when free exchange occurs between the sea and the lagoon.

6.2.20 During periods of water level management, percolation of seawater through the shingle barrier will still occur. As there is a gradual increase in salinity observed from late February/early March 2013, it appears that there is a net increase in the proportion of saline water versus freshwater, with increased evaporation likely to contribute to the gradual trend of increasing salinity over the summer months.

Salinity tolerance of lagoonal species

6.2.21 A brief summary of the salinity tolerance of important lagoonal species for the Cemlyn lagoon is presented in table 6-1 based on information provided in the Core Management Plan for the Bae Cemlyn/Cemlyn Bay SAC ([RD43]).

Table 6-1 Salinity tolerance of lagoonal species

Species	Abundance / distribution	Tolerance to salinity variation	Reference
Conopeum seurati (bryozoan)	Full distribution of this species is unknown.	2 and >40‰ Preferred range: 10 and 25‰.	[RD43]
Cerastodema glaucum (lagoon cockle)	Widely distributed in north-west Europe.	10 and 40‰ Preferred level: 35‰ Tolerate briefly: 2 to 60‰.	[RD43]
Ruppia maritima (beaked tasselweed)	Scarce plant in the UK but reported to be relatively abundant in saline lagoons.	Tolerant to low salinity levels Range: 0 to 44‰ The preferred range is not clearly known.	[RD43]
Ventrosia ventrosa (lagoonal mud-snail)	Occurs in brackish waters with preference for sheltered environment. It has declined and is rare.	Preferred range: 6‰ to 30‰ Tolerate up to 50‰	[RD43]
Idotea chelipes (lagoonal isopod)	Only site in Wales where the species is recorded.	Found at 4 to 50‰ Preferred range: 15 and 40‰.	[RD43]

Species	Abundance / distribution	Tolerance to salinity variation	Reference
Ranunculus baudotii (brackish water-crowfoot)	Distributed within coastal areas in the UK in brackish water that is still or slow-moving. In declined, particularly on the west coast of Britain.	Brackish waters: 0.05–3‰ Found in sites of up to 1‰ salinity	Kautsky, 1991

6.2.22 Importantly the species of importance identified for the SAC show a high degree of tolerance to salinity variation and are adapted to the local environmental conditions.

Perennial vegetation of stony banks

6.2.23 Cemlyn lagoon is formed by a shingle bank (Esgair Gemlyn) that effectively cuts through the embayment separating the tidal lagoon from the open shore. Esgair Gemlyn meets the criteria for the SAC designated feature 'perennial vegetation of stony banks'. The status of this feature is 'Unfavourable', which the Core Management Plan [RD43] reports is thought to be due to trampling of vegetation. However, NRW have advised that this may now be revised as trials have shown that trampling is not the cause of vegetation damage, rather it is natural storm damage.

6.2.24 The mid-bay gravel barrier is widest (maximum 50m) and highest (> 5.2m) at its eastern end, and in this area much of the shingle on the ridge crest and back-slope is vegetated. It is narrowest (< 30m) and lowest (< 4.8m) near the artificial islands in the lagoon (i.e. the islands used by breeding terns).

6.2.25 The shingle ridge is continually changing in shape and profile under the influence of waves. According to [RD269], wave overtopping will become more frequent over the next few decades but may be counterbalanced by vertical growth of the shingle ridge in line with rising water levels; but the extent to which this can occur (without ridge narrowing) will be dependent on sediment availability. Supply of new sediment to Esgair Gemlyn is limited at the present time, and it is likely that the north-central part of the barrier will become narrower and move further landward over time by between 8m and 12m by 2100 [RD269].

6.2.26 The flora recorded on the ridge includes sea kale (*Crambe maritima*) and the declining yellow horned poppy (*Glaucium flavum*). Of particular note are the long strips of pioneer floral community running along the length of foreshore that contain curly dock (*Rumex crispus littoreus*), sea campion (*Silene uniflora*) and *C. maritima*. The red fescue/sea thrift (*Festuca rubra/Armeria maritima*) community is present in the lee slope of the middle part of the ridge and also contains an unusually high density of sea beet (*Beta vulgaris maritima)*.

6.2.27 A report commissioned by JNCC [RD311] mentions that the dynamic nature of this feature has probably resulted in various changes to the communities described over time.

Glannau Ynys Gybi/Holy Island Coast SAC

Vegetated sea cliffs of the Atlantic and Baltic coasts

6.2.28 Holy Island comprises hard rock acidic cliffs and supports important examples of coastal cliff heathland vegetation. In addition to maritime heath, with several rare species such as spotted rock-rose (*Tuberaria guttata)*, there are extensive maritime cliff-crevice and grassland communities. The maritime influence is not as extreme as in north Scotland, and this site represents an important part of the range of variation on the mid-west coast of the UK [RD150].

6.2.29 The conservation status as defined in Core Management Plan [RD47] for this qualifying feature is 'Unfavourable'. [RD47] notes that this is due to the dense grass thatch over many areas and lack of bare patches due to absence of grazing animals.

European dry heaths

6.2.30 Glannau Ynys Gybi/Holy Island Coast SAC is the most important site in north Wales for maritime forms of European dry heaths. The main National Vegetation Classification (NVC) types are heather-spring squill (*Calluna vulgaris – Scilla verna*) heath and heather - western gorse (*Calluna vulgaris – Ulex gallii*) *heath*. The dry heathland is associated with small areas of wet heath and forms part of a complete zonation from maritime grassland through maritime heath to inland heath to inland heath with bracken (*Pteridium aquilinum*) to bramble (*Rubus fruticosus*) scrub. The heath is an important locus for spotted rock-rose (*Tuberaria guttata*) [RD151].

6.2.31 The conservation status as defined in Core Management Plan (CCW, 2008e) for this qualifying feature is 'Unfavourable declining'. [RD47] notes that this is largely due to low or absent grazing pressure on key dry heath areas and, in part, due to over intensive fires on Holyhead Mountain. This has led to increasing levels of other vegetation (gorse, heather and fescue grasses).

Northern Atlantic wet heaths with *Erica tetralix*

6.2.32 Northern Atlantic wet heaths with cross-leaved heath (*Erica tetralix*) is an Annex I habitat present in this SAC as a qualifying feature (albeit not the primary reason for the selection of this site). Wet heath usually occurs on acidic, nutrient-poor substrates, such as shallow peats or sandy soils with impeded drainage. The vegetation is typically dominated by mixtures of cross-leaved heath *E. tetralix*, heather *C. vulgaris*, grasses, sedges and *Sphagnum* bog-mosses [RD152].

6.2.33 The conservation status as defined in Core Management Plan [RD47] for this qualifying feature is 'Unfavourable declining'. [RD47] notes that this is largely due to low or absent grazing pressure on the key wet heath areas. This has led to the increasing levels of scrub, the decline of marsh gentian, pillwort and three-lobed water crowfoot.

Llŷn Dinam SAC

Natural eutrophic lakes with Magnopotamion or Hydrocharition-type vegetation

6.2.34 Llŷn Dinam is a coastal eutrophic lake. Common reed (*Phragmites australis*), and to a lesser extent common club-rush (*Scirpus lacustris ssp. Lacustris*), dominate the shoreline. Rigid hornwort (*Ceratophyllum demersum*) is abundant in shallow open water, often in association with autumnal starwort (*Callitriche hermaphroditica*) and ivy-leaved duckweed (*Lemna trisulca*).

6.2.35 The white and yellow water-lilies (*Nymphaea alba*) and (*Nuphar lutea*) dominate in a sheltered arm on the west side. Fennel-leaved pondweed (*Potamogeton pectinatus*), perfoliate pondweed (*P. perfoliatus*) and lesser pondweed (*P. pusillus*) have been recorded. Stoneworts (*Chara* spp.) are present.

6.2.36 Water chemistry characteristics are consistent with those expected in eutrophic lakes, including relatively high pH and phosphorus levels. Llŷn Dinam is the least-enriched of a series of Anglesey lakes which have been subjected to sediment diatom analysis [RD153].

6.2.37 The conservation status as defined in Core Management Plan [RD48] for this qualifying feature is 'Unfavourable'. [RD48] notes that this is largely because broadleaved *Potamogeton* are absent and because the mean annual total phosphorus level exceeds the limit for this type of lake.

Corsydd Môn/Anglesey Fens SAC

Northern Atlantic wet heaths with *Erica tetralix*

6.2.38 Northern Atlantic wet heaths with cross-leaved heath (E. tetralix) is an Annex I habitat present in this SAC as a qualifying feature, however it was not a primary reason for the selection of this SAC. The habitats that are the primary reason for the selection of the site are Calcareous fens with *Cladium mariscus* and species of the *Caricion davallianae*; Alkaline fens and Hard oligo-mesotrophic waters with benthic vegetation. Wet heath usually occurs on acidic, nutrient-poor substrates, such as shallow peats or sandy soils with impeded drainage. The vegetation is typically dominated by mixtures of E. tetralix, heather C. vulgaris, grasses, sedges and Sphagnum bog-mosses [RD152].

6.2.39 The conservation status as defined in Core Management Plan [RD49] for this qualifying feature is 'Unfavourable unclassified'. [RD49] notes an excess of *Molinia caerulea* litter and reduced cover of ericoid shrubs associated with inadequate burning and grazing management.

Molinia meadows on calcareous, peaty or clayey-silt-laden soils

6.2.40 Moor grass (*Molinia*) meadows on calcareous, peaty or clayey-silt-laden soils is an Annex I habitat present in this SAC as a qualifying feature,

however this feature was also not a primary reason for the selection of this site (see below).

6.2.41 *Molinia* meadows are found mainly on moist, moderately base-rich, peats and peaty gley soils, often with fluctuating water tables. They usually occur as components of wet pastures or fens, and often form mosaics with dry grassland, heath, mire and scrub communities. This habitat type includes the most species-rich *Molinia* grasslands in the UK, in which purple moor-grass (*Molinia caeruleai*) is accompanied by a wide range of associated species, including rushes, sedges and tall-growing herbs. The more impoverished forms of *Molinia* pasture on acidic substrates are excluded from the Annex I definition. In the UK, these grasslands are represented by two NVC types: purple moor-grass - meadow thistle (*Molinia caerulea – Cirsium dissectum*), fen-meadow and purple moor-grass - marsh hawk's-beard (*Molinia caerulea – Crepis paludosa*) mire [RD154].

6.2.42 The conservation status as defined in Core Management Plan ([RD49]) for this qualifying feature is 'Unfavourable declining' due to dereliction, under grazing and invasive species.

Calcareous fens with *Cladium mariscus* and species of the *Caricion davallianae*

6.2.43 The Anglesey Fens complex supports the second-largest area of calcareous fens in the UK. In some parts, the low vigour of sedge (*Cladium*) accounts for the species-richness of the vegetation, but elsewhere management prevents the development of monodominant stands, enabling the persistence of communities referable to *Caricion davallianae*. The juxtaposition between species-poor stands of *Cladium* and areas with a more diverse floristic composition and structure is widespread, with characteristically species-rich contact zones between the two. Anthropogenic disturbance is believed to have been instrumental in the development of various facies of a *Cladium – Molinia* community, a particular feature of the rich fens of north-west Wales [RD155].

6.2.44 The conservation status as defined in Core Management Plan ([RD49]) for this qualifying feature is 'Unfavourable declining'. [RD49] notes that this is because of drainage and lack of management leading to species impoverishment in undrained areas.

Alkaline fens

6.2.45 This composite SAC/Ramsar site includes four component fen systems supporting a diverse range of short-sedge mires, including the best and most extensive Welsh examples of black bog-rush - blunt-flowered rush (*Schoenus nigricans – Juncus subnodulosus*) mire and a range of communities referable to bottle sedge (*Carex rostrata*) – *Calliergon cuspidatum/giganteum* mire. These are considered to be of pre-eminent importance in the UK [RD156], owing to their extent, biogeographical significance and exceptionally rich assemblage of rich-fen species. The fens are strongly influenced by the underlying Carboniferous limestone and are fed by tufa-depositing springs and more diffuse zones of seepage.

6.2.46 The alkaline fen communities often occur within complex vegetation zonations, and typical contact communities include great fen-sedge (*Cladium mariscus*) swamp, fen carr, fen meadow communities dominated by blunt-flowered rush (*Juncus subnodulosus*) and purple moor-grass *M. caerulea*, as well as a range of vegetation types broadly referable to the *Cladio – Molinietum*. Gradations to unimproved calcicolous and neutral grasslands also occur. The characteristic mixture of southern and northern floristic elements includes a wide range of nationally or locally scarce species, including fly orchid (*Ophrys insectifera*), narrow-leaved marsh orchid (*Dactylorhiza traunsteineri*), marsh helleborine (*Epipactis palustris*), lesser clubmoss, (*Selaginella selaginoides*) and slender sedge (*Carex lasiocarpa*). Examples of black bog-rush - blunt-flowered rush (*Schoenus nigricans – Juncus subnodulosus*) mire within Anglesey Fens are strongly influenced by the discharge of calcareous groundwater providing the sole north Wales locus for the Annex II species (Southern damselfly *Coenagrion mercurial*) [RD156].

6.2.47 The conservation status as defined in Core Management Plan ([RD49]) for this qualifying feature is 'Unfavourable declining'. [RD49] notes that this is because of under grazing and shading or surface standing water. In addition to hydrological, nutrient and diversity issues this contributes to the declining nature of this feature.

Hard oligo-mesotrophic waters with benthic vegetation

6.2.48 Within the Anglesey Fens, Llyn Yr Wyth Eidion is a small active marl-producing lake. It is surrounded by the extensive calcareous valley mire of Cors Erddreiniog, which overlies limestone and protects the lake against nutrient enrichment, resulting in water of high quality. Hedgehog stonewort (*Chara pedunculata*) and the rare rugged stonewort (*C. rudis*) have been recorded at this site [RD157].

6.2.49 The conservation status as defined in Core Management Plan ([RD49]) for this qualifying feature is 'Unfavourable declining'. [RD49] notes that this is because of a shift from an oligotrophic to a eutrophic environment.

Southern damselfly

6.2.50 The southern damselfly (*Coenagrion mercurial*), present in this SAC/Ramsar site, has very specialised habitat requirements, being confined to shallow, well-vegetated, base-rich runnels and flushes in open areas or small side-channels of chalk rivers [RD158].

6.2.51 The conservation status as defined in Core Management Plan ([RD49]) for this qualifying feature is 'Unfavourable declining'. [RD49] notes that this is due to dereliction, hydrology, water quality and under grazing which are reducing habitats and populations.

Marsh fritillary butterfly

6.2.52 The marsh fritillary butterfly (*Euphydryas aurinia*) is found in a range of habitats (such as the Anglesey Fens) in which its larval food plant, devil's-bit scabious (*Succisa pratensis*), occurs. Marsh fritillaries are essentially grassland butterflies in the UK, and although populations may occur occasionally on wet heath, bog margins and woodland clearings, most colonies are found in damp acidic or dry calcareous grasslands (including *Molinia* meadows on calcareous, peaty or clayey-silt-laden soils) [RD159].

6.2.53 The conservation status as defined in Core Management Plan ([RD49]) for this qualifying feature is 'Unfavourable declining'. [RD49] notes that this is due to a decline in suitable and good habitat.

Geyer's whorl snail

6.2.54 Throughout its range (including on the Anglesey Fens), Geyer's whorl snail (*Vertigo geyeri*) is local and found in relatively exposed, constantly humid calcareous flush-fens (including the Annex I habitat type Alkaline fens) that are fed by tufa-depositing springs. These flushes are often only a few square metres in extent. Other species associated with *V. geyeri* are black bog-rush (*Schoenus nigricans*) and yellow sedge (*Carex viridula*). It requires dense cover of low-growing grasses and sedges relatively free from *Sphagnum* and other mosses [RD160].

6.2.55 The conservation status as defined in Core Management Plan ([RD49]) for this qualifying feature is 'Unfavourable declining'. [RD49] notes that this is due to dereliction and under grazing of the habitat.

Corsydd Môn a Llŷn/Anglesey and Llŷn Fens Ramsar site

6.2.56 The Corsydd Môn a Llyn/Anglesey and Llyn Fens Ramsar site coincides with the Corsydd Môn/Anglesey Fens SAC. The site qualifies as a Ramsar site because it supports:

- a suite of base-rich, calcareous fens which is a rare habitat type within the United Kingdom's biogeographical zone; and,
- a diverse flora and fauna with associated rare species and is of special value for maintaining the genetic and ecological diversity of the region.

6.2.57 The following SAC features are also listed as noteworthy fauna of international importance for the Ramsar site:

- Southern damselfly Coenagrion mercuriale;
- Marsh fritillary butterfly *Euphydryas aurinia*; and,
- Geyer's whorl snail *Vertigo geyeri*.

6.3 Marine mammals

6.3.1 The following sections summarise available information for harbour porpoise (*Phocoena phocoena*), bottlenose dolphin (*Tursiops truncatus*), grey seal (*Halichoerus grypus*) and harbour seal (*Phoca vitulina*) which is relevant to the assessment of potential effects of the Project on European Designated Sites that include one or more marine mammals as qualifying interest features, namely:

- Gogledd Môn Forol/North Anglesey Marine cSAC;
- Pen Llŷn a'r Sarnau/Llŷn Peninsula and the Sarnau SAC;
- Gorllewin Cymru Forol/West Wales Marine cSAC;
- Bae Ceredigion/Cardigan Bay SAC;
- Dynesfeydd Môr Hafren/Bristol Channel Approaches cSAC;
- Sir Benfro Forol/Pembrokeshire Marine SAC;
- North Channel cSAC;
- Murlough SAC;
- Strangford Lough SAC;
- The Maidens SAC;
- Rockabill to Dalkey SAC;
- Lambay Island SAC;
- Slaney River Valley SAC; and,
- Saltee Islands SAC.

6.3.2 In addition to providing baseline information for each relevant marine mammals species, a summary of the key features of each of the above European Designated Sites is also provided.

Harbour porpoise (Phocoena phocoena)

European Designated Sites for harbour porpoise

Gogledd Môn Forol/North Anglesey Marine candidate SAC

6.3.3 The site covers an area of 3,249km^2, reaching north-west from Anglesey into the Irish Sea. It sits at the northern end of St George's Channel, extending approximately half way across to the Republic of Ireland, skirting the national waters of the Isle of Man. The water depths within the site range between the Mean Low Water Tide (MLWT) level and 100m. Away from coastal areas, the depths largely fall within the range of between 40m and 50m. The site contains a mixture of hard substrate and sediments, including rock, coarse sediment, sand and mud [RD174].

6.3.4 The Gogledd Môn Forol/North Anglesey Marine cSAC has been recognised as an area with predicted persistent high densities of harbour porpoise. The area included within the site covers important summer habitat for porpoises,

which was identified as part of the top 10% persistent high density areas for the summer seasons within the UK [RD174].

6.3.5 The Gogledd Môn Forol/North Anglesey Marine cSAC is located in the Celtic and Irish Seas harbour porpoise MU. Additionally, three other European Designated Sites (North Channel cSAC; Gorllewin Cymru Forol/West Wales Marine cSAC and Dynesfeydd Môr Hafren/Bristol Channel Approaches cSAC) make up a series of sites proposed for Annex II harbour porpoise within this MU [RD174].

6.3.6 The Gogledd Môn Forol/North Anglesey Marine cSAC contains the Annex II species harbour porpoise as a qualifying species. The Wylfa Newydd Development Area and Disposal Site are located within the cSAC.

6.3.7 The estimated Gogledd Môn Forol/North Anglesey Marine cSAC harbour porpoise population is 1,088 individuals (95% CI = 557-2,111) for at least part of the year, based on approximately 2.4% of the UK Celtic and Irish Seas MU [RD174]. However, [RD174] notes that because this estimate is from a one-month survey in a single year it cannot be considered as a specific population number for the cSAC and it is not appropriate to assign a site population estimate because of the daily and seasonal movements of the animals. Therefore, the potential effects have been assessed for the Celtic and Irish Seas MU reference population for harbour porpoise. This is in line with [RD172] draft Conservation Objectives and Advice on Activities, which states that it is how the impacts within the site translate into effects on the MU population that are of greatest concern. In addition, the assessment also includes a spatial assessment of the potential disturbance effects in relation to the area of the cSAC.

6.3.8 Harbour porpoise is the primary reason for the designation of this cSAC and the conservation status for the species is ‘Excellent’.

Gorllewin Cymru Forol/West Wales Marine candidate SAC

6.3.9 The site covers an area of 7,376km^2, covering the majority of Cardigan Bay and the Pembrokeshire coastline to the south to the tip of the Llŷn Peninsula in the north, extending almost to the mid-line between the Republic of Ireland and Welsh waters. The boundary includes the entirety of the Bae Ceredigion/Cardigan Bay SAC and part of both the Pen Llŷn a'r Sarnau/Llŷn Peninsula and the Sarnau SAC and Sir Benfro Forol/Pembrokeshire Marine SACs. The water depths within the site range between the MLWT level and 100m. Away from coastal areas, the depths largely fall within the range of between 40m and 50m. The site contains a mixture of hard substrate and sediments, including rock, coarse sediment, sand and mud [RD175].

6.3.10 The Gorllewin Cymru Forol/West Wales Marine cSAC has been recognised as an area within the top 10% predicted persistent high densities of harbour porpoise. The area included within the site covers important summer habitat for porpoises, while parts of the Cardigan Bay area are also identified as important in the winter periods [RD175].

6.3.11 The Gorllewin Cymru Forol/West Wales Marine cSAC is located within the Celtic and Irish Seas harbour porpoise MU. Additionally, three other sites

(North Channel cSAC, Gogledd Môn Forol/North Anglesey Marine cSAC and Dynesfeydd Môr Hafren/Bristol Channel Approaches cSAC, make up a series of sites proposed for Annex II harbour porpoise within this MU [RD175].

6.3.12 The estimated Gorllewin Cymru Forol/West Wales Marine cSAC harbour porpoise population is 5,222 individuals (95% CI = 1,419 – 4,484) for at least part of the year, based on approximately 5% of the UK part of the Celtic and Irish Seas MU [RD175] (the upper 95% CI in the source reference in incorrect as it is lower than the harbour porpoise population of 5,222 individuals; this point has been raised with NRW). However, [RD175] note that because this estimate is from a one-month survey in a single year it cannot be considered as a specific population number for the site and it is not appropriate to assign a site population estimate because of the daily and seasonal movements of the animals. Therefore, the potential effects have been assessed for the Celtic and Irish Seas MU reference population for harbour porpoise. This is in line with draft Conservation Objectives and Advice on Activities [RD173], which states that it is how the impacts within the site translate into effects on the MU population that are of greatest concern. In addition the assessment also includes a spatial assessment of the potential disturbance effects in relation to the area of the cSAC.

6.3.13 Harbour porpoise is the primary reason for the designation of this cSAC and the conservation status for the species is 'Excellent'.

Dynesfeydd Môr Hafren/Bristol Channel Approaches candidate SAC

6.3.14 The site covers an area of 5,850km^2, covering the northern Cornwall and north Devon coastlines up to Carmarthen Bay along the south Wales coast and the marine area between, including Lundy Island, with 58% English inshore waters, 18% Welsh inshore and 24% offshore waters. The water depths within the site range between the MLWT level and 70m, with the majority of the site being 50m in depth, with steep slopes up to the shoreline towards the Cornish coast, and much shallower slopes up to Carmarthen Bay. The majority of the seabed is formed of sublittoral coarse sediments [RD161]. The Lundy SAC lies fully within the site, with parts of Sir Benfro Forol/Pembrokeshire Marine SAC also covered.

6.3.15 The Dynesfeydd Môr Hafren/Bristol Channel Approaches cSAC has been recognised as an area within the top 10% predicted persistent high densities of harbour porpoise for both important summer and winter habitats [RD161]. This site is located within the Celtic and Irish Seas harbour porpoise MU. Additionally, three other sites (North Channel cSAC, Gorllewin Cymru Forol/West Wales Marine cSAC; and Gogledd Môn Forol/North Anglesey Marine cSAC) make up a series of sites proposed for Annex II harbour porpoise within this MU [RD161].

6.3.16 The estimated Dynesfeydd Môr Hafren/Bristol Channel Approaches cSAC harbour porpoise population is 2,147 individuals (95% CI = 810 – 5,693) for at least part of the year, based on approximately 4.7% of the UK Celtic and Irish Seas MU [RD161]. However, [RD161] notes that because this estimate is from a one-month survey in a single year it cannot be considered as a

specific population number for the site and it is not appropriate to assign a site population estimate because of the daily and seasonal movements of the animals. Therefore, the potential effects have been assessed for the Celtic and Irish Seas MU reference population for harbour porpoise. This is in line with draft Conservation Objectives and Advice on Activities [RD235], which states that it is how the impacts within the site translate into effects on the MU population that are of greatest concern. In addition the assessment also includes a spatial assessment of the potential disturbance effects in relation to the area of the cSAC.

6.3.17 Harbour porpoise is the primary reason for the designation of this cSAC and the conservation status for the species is 'Good'.

North Channel candidate SAC

6.3.18 The site covers an area of 1,604km^2, extending from the north-east coast of Northern Ireland from Island Magee to Cloughey towards the Isle of Man and ending as it reached Manx waters. The water depths within the site range between the MLWT level to 150m in the north and eastern parts of the site. There are shallower waters near the coasts with depths of between 10m and 40m and between 50 and 130m in more offshore waters. The site contains a mixture of coarse sediments and sand near the Irish coastlines, and increasing amounts of moderate and high energy circalittoral rock in more offshore waters, with an area of mud in the south-west of the site [RD73].

6.3.19 The North Channel cSAC has been recognised as an area within the top 10% predicted persistent high densities of harbour porpoise during the winter season [RD73]. The site is located in the Celtic and Irish Seas harbour porpoise MU. Additionally, three other sites Gogledd Môn Forol/North Anglesey Marine cSAC, Gorllewin Cymru Forol/West Wales Marine cSAC and Dynesfeydd Môr Hafren/Bristol Channel Approaches cSAC, make up a series of sites proposed for Annex II harbour porpoise within this MU [RD73].

6.3.20 The estimated North Channel cSAC harbour porpoise population is 537 individuals (95% CI = 276 – 1,046) for at least part of the year, based on approximately 1.2% of the UK Celtic and Irish Seas MU [RD73]. However, [RD73] note that because this estimate is from a one-month survey in a single year it cannot be considered as a specific population number for the site and it is not appropriate to assign a site population estimate because of the daily and seasonal movements of the animals. Therefore, the potential effects have been assessed for the Celtic and Irish Seas MU reference population for harbour porpoise. This is in line with the Department of the Environment Northern Ireland (DOENI) and [RD148] draft Conservation Objectives and Advice on Activities, which states that it is how the impacts within the site translate into effects on the MU population that are of greatest concern. In addition the assessment also includes a spatial assessment of the potential disturbance effects in relation to the area of the cSAC.

6.3.21 Harbour porpoise is the primary reason for the designation of this cSAC and the conservation status for the species is 'Excellent'.

Rockabill to Dalkey Island SAC

6.3.22 Rockabill to Dalkey Island SAC is located on the eastern coastline of the Republic of Ireland 97.4km from the Wylfa Newydd Development Area and covering an area of 273.26km^2. The site extends in a strip southwards from Rockabill to Frazer Bank, encompassing the islands of Dalkey, Muglins and Rockabill. Primary features of the site are listed as the Annex I habitat of reefs and the Annex II species harbour porpoise. Harbour porpoise occur year round at this site in relatively large groups (compared to other locations) with evidence of calving occurring at this site [RD224].

6.3.23 The size, community structure and distribution or habitat use of harbour porpoise inhabiting Rockabill to Dalkey Island SAC are not fully understood [RD224]. Survey effort in the 2008 summer-autumn season delivered initial estimates of between 0.54 and 6.93 animals per km^2 within the northern half of the site (overall estimate across four surveys: 2.03 individuals per km^2, N = 211 ± 47 individuals, 95% CI = 137 – 327; CV = 0.23) and between 0.48 and 2.05 animals per km^2 within the southern half of the site, including outer Dublin Bay (overall estimate across four surveys: 1.19 individuals per km^2, N = 138 ± 33 individuals, 95% CI = 86 – 221; CV = 0.24; [RD224]. The species is present at the site in all seasons and newborn calves have also been recorded within the site, including during the calving/breeding season [RD224].

6.3.24 Harbour porpoise is the primary reason for the designation of this cSAC and the conservation status for the species is 'Good'.

Distribution and occurrence of harbour porpoise

6.3.25 Harbour porpoise distribution is generally restricted to the temperate and sub-arctic waters of the northern hemisphere, mainly on the continental shelf at depths of 20-200m and primarily within water temperatures ranging from 11^{o}C to 14^{o}C ([RD79]; [RD275]).

6.3.26 Harbour porpoise are widely distributed throughout the Celtic and Irish Seas during most months of the year ([RD275]; [RD8]; [RD126]). Their occurrence is not evenly distributed in Welsh waters with apparent hotspots at the south-west coast of the Llŷn Peninsula, southern Cardigan Bay, in the vicinity of Strumble Head and the west and north Pembrokeshire Coast and Islands (Skomer and Ramsey), in the Bristol Channel off the south coast of Wales around the Gower Peninsula and in Swansea Bay ([RD8]; [RD100] and [RD101]). Localised hotspots also appear to exist off the north and north-west coast of Anglesey, in particular around Point Lynas and South Stack, including Holyhead Deep ([RD8]; [RD100]; [RD101]). Harbour porpoise are likely to be present at these locations throughout the year, with little seasonal variation ([RD8]; [RD100]; [RD101]).

6.3.27 [RD130] provides the results of detailed analyses of 18 years of Joint Cetacean Protocol (JCP) survey data. The model results for the Celtic and Irish Seas indicate that most important factors for probability of presence of harbour porpoise in this Management Unit (MU) during summer are increasing current speeds up to 0.4m/s and with increasing eddy activity. In

winter, the same response to current speed is observed, although there are lower probabilities with high current speeds [RD130]. The responses to water depth indicate that high densities of harbour porpoise are associated with the shallowest areas (areas shallower than 40m) in summer and have a high probability of presence in the same areas in winter. During summer, high densities are often associated with sandy-gravelly sediments, with rather low densities in muddy areas [RD130].

6.3.28 [RD130] identified several persistent high density areas in the Celtic and Irish Seas MU as follows:

- three coastal areas off west Wales (Pembrokeshire and Cardigan Bay), and north-west Wales (Anglesey, Llŷn Peninsula), and part of the Bristol Channel (Carmarthen Bay);
- smaller areas north of Isle of Man (winter) and on the Northern Irish coast near Strangford Lough; and
- the Western Channel off Start Point, Cornwall (summer).

6.3.29 Boat-based and land-based surveys have been undertaken since 2010/ 2011. Dedicated vessel transect surveys, marine mammal autonomous underwater noise cetacean click detector (C-POD) surveys have been undertaken since 2016. The dedicated vessel transect surveys continued until July 2017, with the C-PODs being recovered in October 2017 and the survey results reported in Application Reference Number: 6.4.88.

6.3.30 During the site-specific surveys for the Project, harbour porpoise were the most frequently reported cetacean (Application Reference Number: 6.4.88)). The sightings were generally concentrated to the east of the Wylfa Newydd Development Area, in areas in the vicinity of Middle Mouse, approximately 4km away, and Point Lynas, approximately 14km away. The Vantage Point (VP) surveys indicated that the survey area covered from location VP2 (see figure 6-6), located off Wylfa Head, had the highest number of individuals recorded compared to the other VP locations.

6.3.31 Three C-PODs (autonomous underwater noise cetacean click detector) were deployed in October 2016 at three sites within the Wylfa Newydd Development Area and surrounding Study Area (labelled 1BW, 2BC and 3BE in figure 6-7). Two C-PODs were deployed in the vicinity of Porth-y-pistyll and Cemlyn Bay with the third located to the west of Wylfa Head. Initial results from between October 2016 and January 2017 indicate harbour porpoise presence every day (a survey period of 104 days) (subsequent data has not yet been processed). The number of harbour porpoise detections varied between locations, with location 3BE recording the highest number of detections. The physical geography of the bays (Porth-y-pistyll and Cemlyn) is such that the harbour porpoise could likely pass location 1BW and 2BC on route to other sites. The higher detections at location 3BE to the west of Wylfa Head could relate to this being a ‘high energy site’ and the preference of harbour porpoise for tidal stream areas (Application Reference Number: 6.4.88). .

6.3.32 Passive Acoustic Monitoring (PAM) was undertaken as part of the vessel transect surveys from November 2016 to July 2017 (with the exception of June 2017, where no PAM was undertaken due to adverse weather conditions). The data have been analysed for the surveys completed up to and including February 2017(Application Reference Number: 6.4.88). The results of the PAM surveys indicate a number of harbour porpoise detections across the transect lines. Peak harbour porpoise detections were seen in February 2017. Although there was no clear spatial pattern to the data, with detections being seen along all transect lines, both in and offshore, the majority of detections (74%) were located between transects 4 to 9 of Block 1 (see figure 6-8).

Abundance and density estimates

Celtic and Irish Seas Management Unit

6.3.33 Harbour porpoise within the eastern North Atlantic are generally considered to be part of a continuous biological population that extends from the French coastline of the Bay of Biscay to northern Norway and Iceland ([RD341]; [RD109], [RD110], [RD111]; [RD138]). However, for conservation and management purposes, it is useful to consider this population as smaller MUs. MUs provide an indication of the spatial scales at which the effects of plans and projects alone and in-combination need to be assessed for the key cetacean species in UK waters, with consistency across the UK ([RD138]). The Inter-Agency Marine Mammal Working Group (IAMMWG) defined three MUs for harbour porpoise: the North Sea (NS); West Scotland (WS) and the Celtic and Irish Sea (CIS). The Project is located in the Celtic and Irish Seas MU, which has an estimated harbour porpoise abundance of 104,695 (CV[4] = 0.32 and 95% CI[5] = 56,774 – 193,065; [RD138]).

[4] Coefficients of variation

[5] Confidence intervals

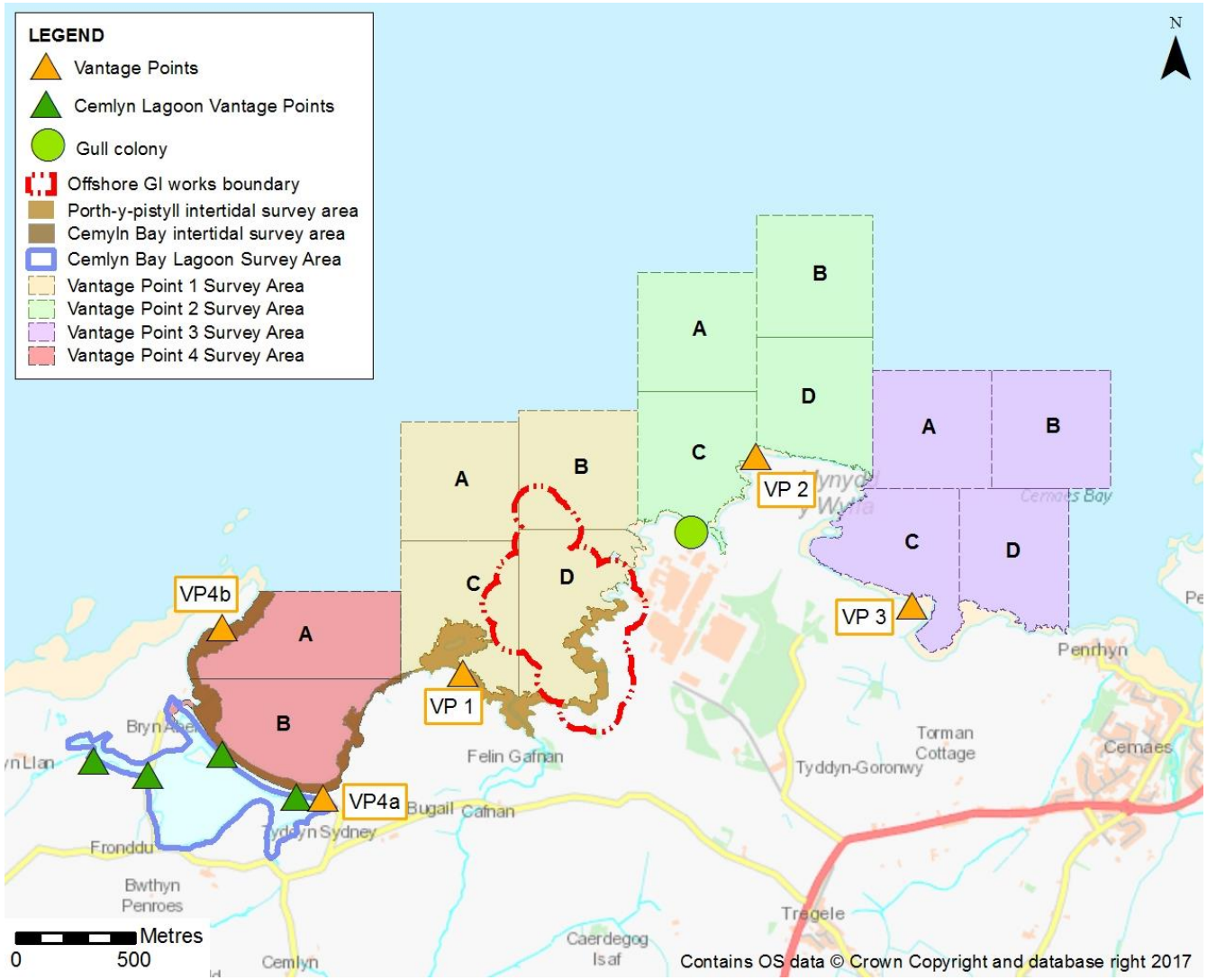


Figure 6-6 Locations of Vantage Points (VP) and survey sectors

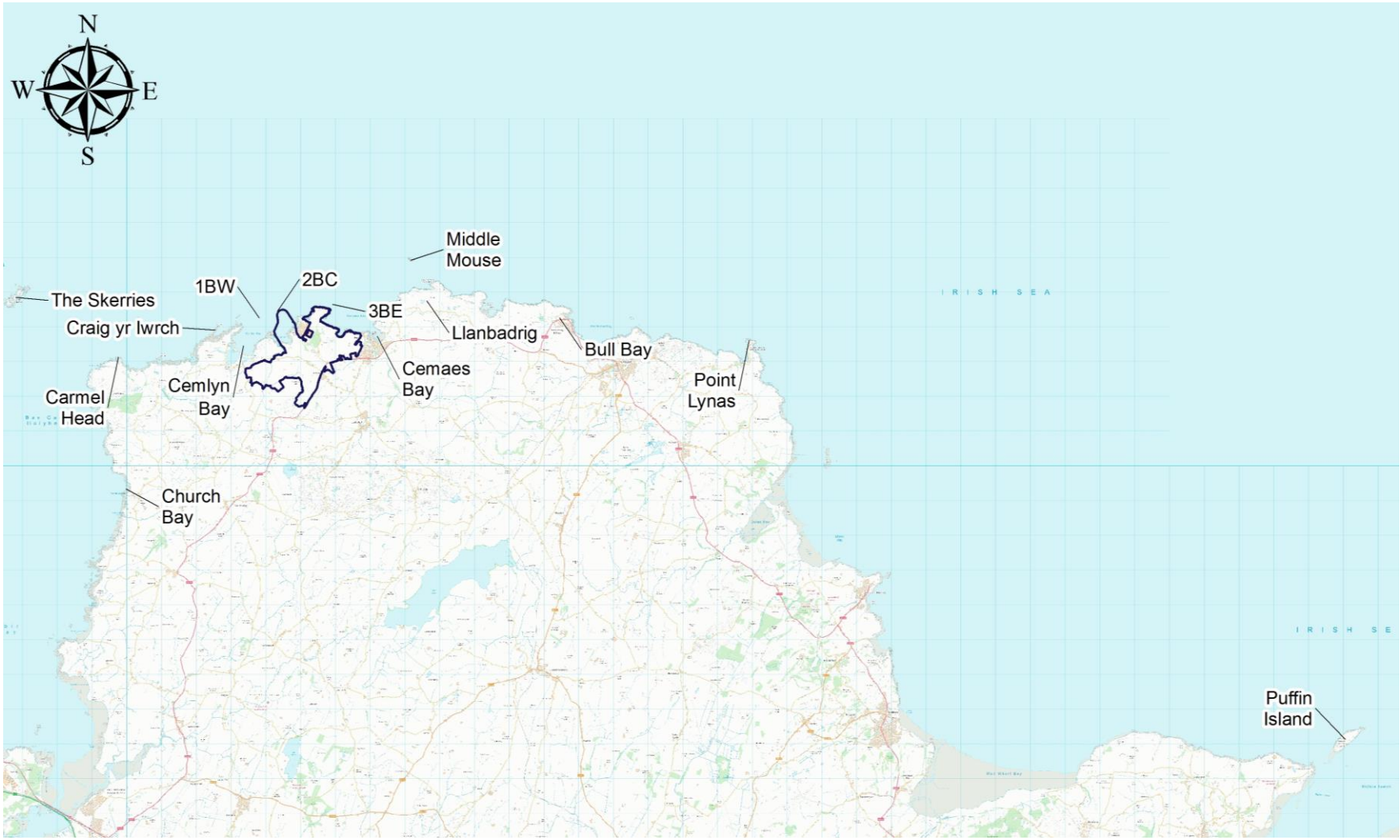


Figure 6-7 Locations of C-PODs (1BW, 2BC and 3BE)

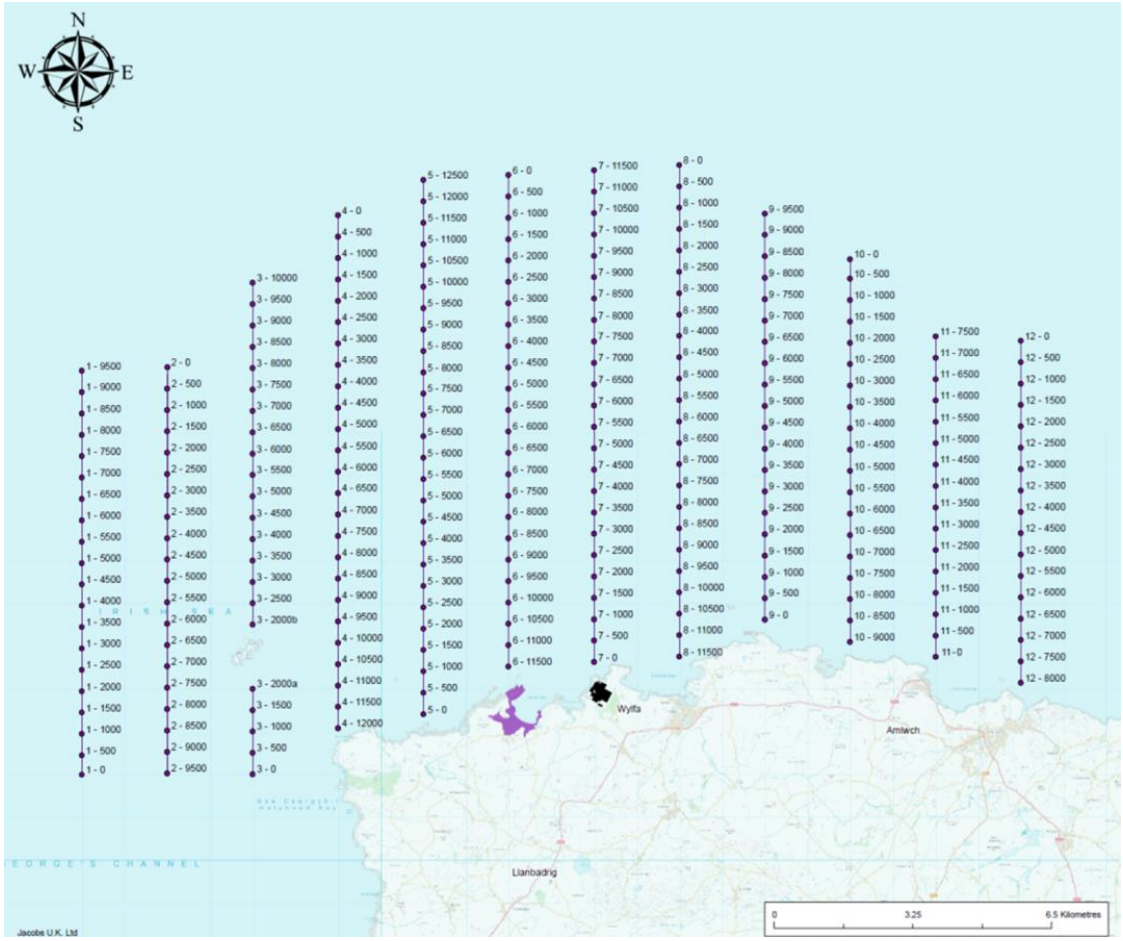


Figure 6-8 Illustration of boat survey transect lines

SCANS data

6.3.34 In July 2005, SCANS-II surveyed the entire European Union (EU) Atlantic continental shelf to generate robust estimates of abundance for harbour porpoise and other cetacean species. For the entire SCANS-II survey area, harbour porpoise abundance in the summer of 2005 was estimated to be 375,358 (CV = 0.197; [RD126]). The SCANS-II survey estimated that the abundance of harbour porpoise in survey block O (an area of 45,417km^2), which is located in the Irish Sea and includes the Project site, was 15,230 individuals (CV = 0.35) and the density was estimated to be 0.335 harbour porpoise per km^2 (CV = 0.35) ([RD126]).

6.3.35 SCANS-III in the summer of 2016 surveyed all European Atlantic waters from the Strait of Gibraltar in the south to 62°N in the north and extending west to the 200 nautical miles (nm) limits of all EU Member States (figure 6-9; [RD125]). The survey area was not the same as for SCANS-II. For the entire SCANS-III survey area, harbour porpoise abundance in the summer of 2016 was estimated to be 466,569 with an overall estimated density of 0.381/km^2 (CV = 0.154; 95% CI = 345,306-630,417; [RD125]).

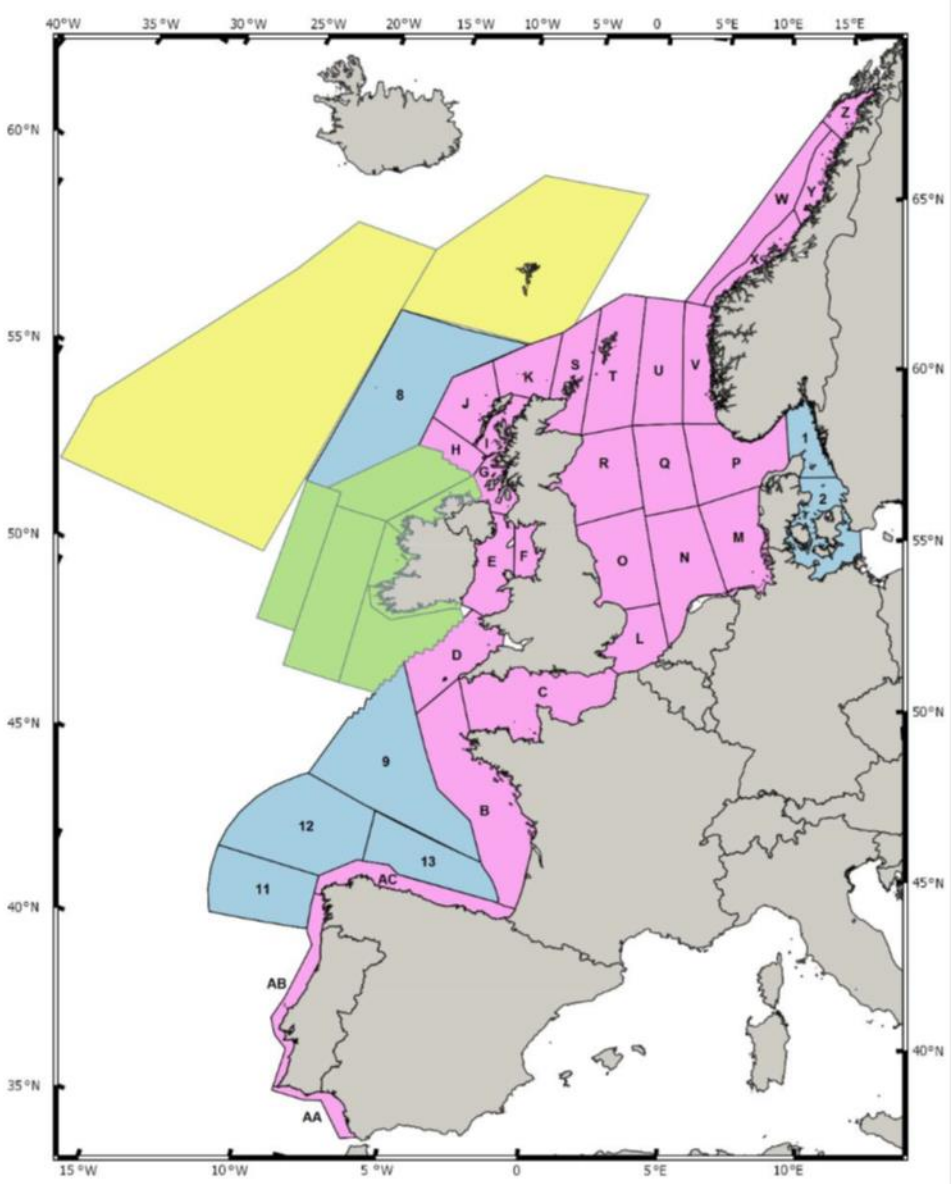


Figure 6-9 Area covered by SCANS-III and adjacent surveys (SCANS-III = pink lettered blocks were surveyed by air; blue numbered blocks were surveyed by ship. Adjacent survey = blocks coloured green to the south, west and north of Ireland which were surveyed by the Irish ObSERVE project and blocks coloured yellow which were surveyed by the Faroe Islands as part of the North Atlantic Sightings Survey in 2015; [RD125])

6.3.36 Estimates for harbour porpoise in the Celtic and Irish Seas ICES Assessment Unit (partial coverage only) during the SCANS-III survey was an abundance of 26,700 and density of 0.11/km^2 (CV = 0.25; 95% CI = 16,055 – 42,128; [RD125]).

6.3.37 The SCANS-III survey estimated that the abundance of harbour porpoise in survey block E (surface area of 34,870km^2) (figure 6-9), which is located in the Irish Sea and includes the Project site, was 8,320 individuals and the

density was estimated to be 0.239 harbour porpoise per km^2, with a mean group size of 1.31 (CV = 0.28; 95% CI = 4,643 – 14,354; [RD125]). In the adjacent area, survey block F (figure 6-5; surface area of 12,322km^2), the estimated abundance was 1,056 harbour porpoise, with an estimated density of 0.086/km^2 and mean group size of 1.00 (CV = 0.38; 95% CI = 342-2,010; [RD125]).

North Anglesey survey data

6.3.38 Two dedicated studies of the harbour porpoise population around the north coast of Anglesey have been undertaken by [RD308] and [RD119].

6.3.39 [RD308] conducted dedicated harbour porpoise surveys between 2002 and 2004 covering an area of approximately 489km^2 extending from the east of Point Lynas to the west of South Stack on the north coast of Anglesey. In the three year study, visual and acoustic methods were used to detect the animals along 31 transects extending out from the shore between May and September. [RD308] reported density estimates based on g(0) = 1, g(0) = 0.769 and g(0) = 0.5. Where g(0) is the probability of detecting an animal on track line during the survey; if all animals were detected then g(0) would be 1, if half the animals were missed (e.g. they were under the water and not surfacing) then g(0) would be 0.5. In reality, g(0) for harbour porpoise is very unlikely to be as high as 1 (e.g. [RD12]). [RD308] estimated, based on the assumption that g(0) = 1, that the minimum number of harbour porpoise off the north coast of Anglesey was 309 individuals (CV = 0.20), with an estimated density of 0.63 individuals per km^2. When g(0) = 0.5 is applied to the data, based on a more realistic worst case scenario, that half of the harbour porpoise were submerged, the estimated maximum abundance is 618 individuals, with a density estimate of 1.26 individuals per km^2.

6.3.40 The harbour porpoise study area used by [RD308] was split in to five sectors: South Stack (SS); Holyhead Harbour (HB); Carmel Head (CH); Middle Mouse (MM); and Point Lynas (PL). The survey areas around the Wylfa Newydd Development Area are Middle Mouse and Carmel Head, which had estimated abundances of 50 and 66 individuals and density estimates of 0.563/km^2 and 0.578/km^2, respectively, based on g(0) = 0.5.

6.3.41 The Disposal Site is located in the SS sector, where the estimated abundance was 207 harbour porpoise with an estimated density of 2.54/km^2, based on g(0) = 0.5. However, it is important to note that 75% of all detections were made within 5km of the shoreline in this sector, whilst the Disposal Site ranges between 4.8km and 12.1km offshore and that harbour porpoise in the SS area were more randomly distributed compared to other areas, such as PL, where they tend to concentrate around specific features ([RD308]; [RD213]).

6.3.42 [RD119] undertook cetacean surveys off the north-west coast of Anglesey at two locations, Carmel Head and South Stack. The visual and towed hydrophone acoustic surveys, passive acoustic monitoring from static acoustic loggers and visual observations from shore authors were conducted

in July and August 2009. Based on acoustic detection rates and assuming a group size of 1.5 (mean of primary and tracker observers mean group sizes) and an effective survey strip width of 186m, they estimated that the overall density of harbour porpoise in the two survey areas (Carmel Head and South Stack) to be 0.38 individuals km^2. However, after applying their expected g(0) of 0.68, the density estimate was 0.56 individuals per km^2.

6.3.43 [RD119] also deployed five automated acoustic data loggers (TPODS) to the north of the Disposal Site around the Skerries and Carmel Head in summer 2009. They confirmed relatively high detection rates of harbour porpoise in the area, with detections every day (and night) of the study. Activity levels were reported to be highest at night, probably due to diurnal patterns in prey availability ([RD119]).

Site-specific survey data

6.3.44 Marine mammals were recorded during monthly site-specific boat transect surveys undertaken between May 2016 and August 2017, with a total of 12 transects in the survey area (figure 6-8). Surveys were not completed in March, June and August 2017 due to adverse weather conditions.

6.3.45 The survey methodology involved two surveyors carrying out observations on either side of the boat. Between May and August 2016, marine mammal sightings were recorded by European Seabirds at Sea (ESAS) surveyors. This methodology changed in September 2016 with the inclusion of dedicated Marine Mammal Observers (MMO) on-board the vessel.

6.3.46 Density and abundance estimates for the MMO dedicated surveys from September 2016 to July 2017 have been calculated (Application Reference Number: 6.4.88). The MMO data set was corrected for distance and sea state and used to estimate density and abundance, as this the more robust data set using dedicated marine mammal observers.

6.3.47 The calculations were made for both g(0) = 1 which assumes that all animals were detected on the trackline and g(0) = 0.5 which assumes that 50% of the harbour porpoises were not observed. The second approach is likely to be more relevant as it accounts for the likelihood that the animals may be submerged, that they may move away from the vessel prior to detection and that they could have been missed by the observer [RD308].

6.3.48 The PAM survey data (November 2016 – February 2017) recorded a total of 74 harbour porpoise from all surveys. The average detection rate was 0.224 harbour porpoise per km. February 2017 had a peak in detections with an average detection rate of 0.381 harbour porpoise per km. Transect lines 4 to 9 in the centre of the survey area (see figure 6-8) had an average detection rate of 0.253 harbour porpoise per km, transects 1 to 3 had an average detection rate of 0.171 per km and transects 10 to 12 had an average detection rate of 0.183 per km (Application Reference Number: 6.4.88).

6.3.49 Site-specific land-based visual VP surveys were undertaken for marine mammals by trained MMOs (methods are described in Application

Reference Number: 6.4.88). These surveys were undertaken at four VP locations, with a total survey area of 3.57 km^2 (figure 6-6).

6.3.50 VP2 had the highest number of sightings for harbour porpoise across all surveys, followed by VP3. Sightings rates of harbour porpoise fluctuated throughout the year with no clear seasonal pattern, although sightings rates were consistently below the VP location average between October and December. The mean sightings rate for VP2 across all months and years was 0.672 harbour porpoise per hour of survey effort (SD = 0.718), with the months of January, February and July to September having sightings rates that were higher than the yearly average. The maximum sightings rates occurred during September with 2.5 harbour porpoise per hour of survey effort (Application Reference Number: 6.4.88).

Summary of harbour porpoise reference population and density estimates

6.3.51 Table 6-2 summarises the reference population and density estimates for harbour porpoise to be used in the assessment. Where there were more than two estimates for the same area available, the higher estimate has been included and will be used in the assessment.

Table 6-2 Summary of harbour porpoise reference population and density estimates

Area	Density estimate	Population estimate	Source	Shadow HRA
Celtic and Irish Seas Management Unit (MU)	0.858/km^2 (whole CIS) 0.758/km^2 (UK portion of CIS)	104,695 (95% CI = 56,774-193,065)	[RD138]	This will be used as the reference population.
SCANS-III Block E	0.239/km^2 (CV = 0.28)	8,320 (95% CI = 4,643-14,354)	[RD125]	For context of the density estimate for the wider area.
North Anglesey Coast	1.26/km^2 (CV = 0.25)	618 (95% CI = 406-909)	[RD308]	Density estimate used in assessment of potential areas of effects around Wylfa Newydd Development Area (maximum density estimate based on g(0) = 0.5).
North Anglesey Coast (South Stack)	2.534/km^2 (CV = 0.23)	207 (95% CI = 140-329)	[RD308]	Density estimate used in assessment of potential areas of effects in and around the Disposal Site (maximum density estimate based on g(0) = 0.5).

Area	Density estimate	Population estimate	Source	Shadow HRA
Site-specific boat transect surveys (g(0)=0.5)	0.646/km^2	620 (CI = 461-833)	Application Reference Number: 6.4.88	For context of the density estimate for the site-specific survey area.

Habitat

6.3.52 In coastal waters, aggregations of harbour porpoise are often associated at local sites with strong tidal features, such as headlands, sounds between islands, areas with upwelling, tidal races and rips, often close to reefs and small islands, where prey are probably concentrated into patches providing favourable foraging conditions ([RD118]; [RD273]; [RD262]; [RD263]; [RD203]; [RD308]). By-catch data from Ireland suggests that harbour porpoise occur regularly offshore, with records from up to 220km from land [RD284] and they have also been sighted in deep water areas beyond the shelf edge ([RD246]; [RD197]).

6.3.53 The north coast of Anglesey is characterised by many overlaying rocks and a broken, uneven seabed comprising pinnacles and gullies leading to rapid changes in seabed relief ([RD119]). This type of topography, in combination with the area's strong currents, precipitates a range of fine-scale oceanic tidal features with which harbour porpoises are commonly associated [RD308].

Diet

6.3.54 The diet of the harbour porpoise consists of a wide variety of fish, including pelagic schooling fish, as well as demersal and benthic species, especially Gadoids, Clupeids and Ammodytes. Other prey species such as cephalopods, have also been recorded. The diet varies geographically, seasonally, annually, over time and differences in diet between sexes or age classes may also exist, reflecting changes in available food resources ([RD18]; [RD180]; [RD23]; [RD289]; [RD291]).

6.3.55 The main prey fish species of harbour porpoise typically includes herring (*Clupea harengus*), whiting (*Merlangius merlangus*), haddock (*Melanogrammus aeglefinus*) and other *Gadidae* species [RD131].

6.3.56 Taking into account the fish species recorded (see Application Reference Number: 6.4.13), the main prey species of harbour porpoise in and around the Wylfa Newydd Development Area is likely to include: whiting, herring, sprat and poor cod (*Trisopterus minutus).*

6.3.57 Harbour porpoise tend to concentrate their movements in small focal regions [RD144], which often approximate to particular topographic and oceanographic features and are associated with prey aggregations ([RD271]; [RD144]; [RD183]; [RD345]). Consequently, habitat use is highly correlated with prey density rather than any particular habitat type. However, [RD174]) states that for the Gogledd Môn Forol/North Anglesey Marine cSAC, it is unknown which features of the habitat are the most

important drivers of the association with prey or what the main prey species of harbour porpoise within the site are.

6.3.58 Harbour porpoise have relatively high daily energy demands and need to consume between 4% and 9.5% of their body weight in food per day [RD180]. If a harbour porpoise does not capture enough prey to meet its daily energy requirements it has been estimated that it can only rely on stored energy (primarily blubber) for three to five days, depending on body condition [RD180].

6.3.59 A recent study [RD367] using high-resolution movement and prey echo recording tags on five wild harbour porpoise has shown that porpoises forage nearly continuously day and night, attempting to meet their metabolic demands foraging on small prey.

Movements and seasonal occurrence

6.3.60 The seasonal movements and migratory patterns of harbour porpoise are not well understood. Harbour porpoise may reside within an area for an extended period of time, although onshore/offshore migrations and movements parallel to the shore are also thought to occur ([RD246]; [RD21]).

6.3.61 Harbour porpoise are highly mobile and satellite telemetry work in Danish waters has shown an individual moving more than 1,000km from Danish waters to east of the Shetland Islands [RD329]. In Danish waters, harbour porpoise have been shown to concentrate their movements in relatively large areas, ranging from approximately 400km^2 to 1,600km^2 [RD329]. In the western North Atlantic, individuals are known to range over quite large areas, covering as much as 11,289 km^2 within a single month [RD144].

6.3.62 Although harbour porpoise are highly mobile and utilise extensive areas over which they range, they tend to occupy small core areas or focal regions for short periods and then make rapid movements over periods of hours to days across larger scales to other restricted areas ([RD144]; [RD109]), which often correspond with reliable feeding opportunities [RD203].

6.3.63 In many coastal localities there can be distinct seasonal peaks in harbour porpoise sightings ([RD100] and [RD101]). The sightings of harbour porpoise in the Irish Sea typically peak during the summer months (in particular June to August) ([RD100] and [RD101]).

6.3.64 The seasonal movements and temporal changes in distributional patterns of harbour porpoise are likely to reflect the changes in preferred prey availability and life history (e.g. breeding and calving seasons).

6.3.65 Site-specific VP and vessel transect surveys indicate that harbour porpoise are present off the coast of North Anglesey and around the Wylfa Newydd Development Area year round (Application Reference Number: 6.4.88).

Life history

6.3.66 The calving period for harbour porpoise is primarily between May and July, when sea temperatures are increasing ([RD272]; [RD313]; [RD193]; [RD11]; [RD22]; [RD188]).

6.3.67 At present not enough is known about harbour porpoise to determine whether some parts of their range are more important for breeding than others. Potential calving grounds have been identified in the German North Sea [RD312], but there is currently no evidence of specific habitat requirements for mating and calving in UK waters [RD162].

Conservation status

6.3.68 The current conservation status of the harbour porpoise, as assessed in the 3rd UK report on implementation of the Habitats Directive (submitted to the European Commission in 2013), is 'Favourable' [RD146].

Bottlenose dolphin (Tursiops truncatus)

European Designated Sites for bottlenose dolphin

Pen Llŷn a'r Sarnau/Llŷn Peninsula and the Sarnau SAC

6.3.69 The site covers an area of 1460.11km^2, from the coastlines of the Llŷn Peninsula and the northern part of Cardigan Bay, and includes three tidal inlets. The water depths range from over 40m in depth off the north and south-west coast on the Llŷn Peninsula, to less than 10m around the Sarnau [RD54].

6.3.70 The Pen Llŷn a'r Sarnau/Llŷn Peninsula and the Sarnau SAC is designated for primarily Annex I habitats, including sandbanks, estuaries, coastal lagoons, large shallow inlets and bays and reefs; however, it also lists bottlenose dolphin and grey seal as qualifying features [RD54].

6.3.71 Bottlenose dolphin are considered to be of significant importance within the Pen Llŷn a'r Sarnau/Llŷn Peninsula and the Sarnau SAC, however, they do not form a resident population but should be considered as part of the wider Wales population, including those of Cardigan Bay. Photo-identification studies have revealed that the dolphins present in this site travel between the Pen Llŷn a'r Sarnau/Llŷn Peninsula and Bae Ceredigion/Cardigan Bay SAC. Both these sites are within Cardigan Bay and their population should be considered together. It was estimated in 2007 that there were 397 individuals within the Bae Ceredigion/Cardigan Bay SAC for the period 2001-2007 [RD54]. More recent population estimates for the wider Cardigan Bay vary between 254 and 330 animals (CV = 0.25 – 0.28) for the years 2011 and 2013 inclusive [RD104].

6.3.72 The Pen Llŷn a'r Sarnau/Llŷn Peninsula and the Sarnau SAC is located within the Irish Sea MU for bottlenose dolphin.

6.3.73 Bottlenose dolphin is an Annex II species present at this site as a qualifiying feature, but not a primary reason for site selection. The conservation status for the species is 'Good'.

Bae Ceredigion/Cardigan Bay SAC

6.3.74 The site covers an area of 958.57km^2, covering an area to the southern extent of Cardigan Bay off the Ceredigion and north Pembrokeshire coastlines extending approximately 12 miles offshore, with 99.5% of the SAC comprising of marine areas and inlets, with a small area of shingle ridges and sea cliffs. The site was primarily designated for the bottlenose dolphin, with grey seal listed as a qualifying feature, alongside river and sea lamprey and three Annex 1 habitats; sandbanks, reefs and sea caves ([RD55]). Sediments present at the site range from highly homogenous sands to well mixed muddy gravels, pebbles and cobble. The site is relatively shallow, only reaching water depths of 50m in the outer parts of the Bay towards St Georges Channel, with the majority of the SAC being less than 30m in depth [RD55]. Mean spring tides range from 4-5m with generally low tidal currents of less than 1.8 knots. Surface salinities within the Bay are generally less than 35%, decreasing towards the coastline [RD55].

6.3.75 Cardigan Bay forms one of the biggest resident populations of bottlenose dolphins in the UK, alongside the Moray Firth. Bottlenose dolphins are seen year-round within the Bae Ceredigion/Cardigan Bay SAC, peaking in late September and October where large groups can be seen. Calving of bottlenose dolphins is known to occur in the site, with very young calves being noted in the spring and summer months. The Bae Ceredigion/ Cardigan Bay SAC and Pen Llŷn a'r Sarnau/Llŷn Peninsula and the Sarnau SAC should be considered together due to the strong connectivity between the two. It was estimated in 2007 that there were 397 individuals within the Bae Ceredigion/Cardigan Bay SAC for the period 2001-2007 [RD55]. More recent population estimates for the wider Cardigan Bay vary between 254 and 330 animals (CV = 0.25 – 0.28) for the years 2011 and 2013 inclusive [RD105].

6.3.76 Bae Ceredigion/Cardigan Bay SAC is located within the Irish Sea MU for bottlenose dolphin. Potential impacts to the population of bottlenose dolphin within the Bae Ceredigion/Cardigan Bay SAC will use the site population estimate, and the reference population for the Irish Sea MU to put the assessment into a wider context.

6.3.77 Bottlenose dolphin is an Annex II species present at this site as a qualifiying feature, but not a primary reason for site selection. The conservation status for the species is 'oGod'.

Distribution and occurrence of bottlenose dolphin

6.3.78 The bottlenose dolphin has a worldwide distribution across tropical and temperate seas of both hemispheres and can be found in coastal and continental shelf waters ([RD275]; [RD79]). In most regions, including the

UKCS, inshore and offshore 'sub-populations' tend to be distinct ([RD79]; [RD252]).

6.3.79 In UK waters, inshore individuals are frequently reported off north-east and south-west Scotland, in the Irish Sea, and in the western English Channel ([RD79]; [RD138]). There are two main areas of UK territorial waters where there are semi-resident groups of bottlenose dolphins: Cardigan Bay in Wales and the Moray Firth on the north-east coast of Scotland. Both of these areas have been designated SAC for bottlenose dolphins ([RD163]). There are also smaller populations of bottlenose dolphins off south Dorset and around Cornwall ([RD360]; [RD368]; [RD163]).

6.3.80 Bottlenose dolphin are recorded in the western Channel off the coast of Cornwall throughout most of the year [RD79]. A small, possibly resident, population of bottlenose dolphin may also occur in the waters around the Inner Hebrides and sightings are also reported off the west coast of the Outer Hebrides, in the Sound of Barra and in the northern entrance to the Minch ([RD122]; [RD201]; [RD79]; [RD163]). Transient groups are not infrequent almost anywhere around the British coast except the southern North Sea and south-east England [RD163].

6.3.81 In the Irish Sea, bottlenose dolphin has a predominantly coastal distribution, with higher concentrations off west Wales (particularly Cardigan Bay) and off the coast of County Wexford in south-east Ireland. They are also regularly sighted in summer off the Galloway coast of south-west Scotland and around the Isle of Man ([RD127], [RD8]; [RD79]).

6.3.82 In Welsh waters, the inshore population is centred on Cardigan Bay, although bottlenose dolphin are also regularly observed in the coastal waters between Cardigan Bay and Anglesey, with concentrations in south Cardigan Bay, south of the Llŷn Peninsula and off Anglesey ([RD259]; [RD260]; [RD8]). There are also regular sightings in the coastal waters to the east of Anglesey around Bull Bay and towards the Llandudno coast ([RD100] and [RD101]). Bottlenose dolphin is most commonly seen in Cardigan Bay within 10 miles of the coast and particularly within two miles; sightings are greatest in the southern portion of the bay [RD105].

6.3.83 The site-specific vessel transect surveys have recorded two sightings totalling 14 individuals of bottlenose dolphin (a pod of four and 10 individuals respectively). The first sighting occurred in May 2016 to the east of the Wylfa Newydd Development Area, approximately 3km off Cemaes Bay. The second sighting (consisting of adults and one calf) was recorded in January 2017 to the west of Cemlyn Bay, approximately 4km offshore (Application Reference Number: 6.4.88).

6.3.84 During the VP surveys between 2011 and 2014, bottlenose dolphins were sighted in sectors VP4a (west of the Wylfa Newydd Development Area in Cemlyn Bay) and VP1a (immediately west of the Wylfa Newydd Development Area off Cerrig Brith) (figure 6-6; Application Reference Number: 6.4.88).

6.3.85 Dolphins were not detected as frequently as harbour porpoise by the C-PODs. Out of the 104 C-POD logging days, 38 had zero dolphin detections. Site 1BW detected dolphins on 32% of the days, site 2BC detected dolphins on 46% of the days and site 3BE detected dolphins on 56% of the study days (see figure 6-7 for C-POD locations).

6.3.86 There were no dolphin whistles and only one single dolphin click identified in the PAM data any of the vessel transect surveys. This is unusual for dolphins as click detections normally appear as groups of many tens of clicks. The presence of single dolphin click suggests that potentially there were dolphins present during the surveys; however, these clicks require further analysis with a re-defined click classifier to determine if these were true dolphin detections or false positives (Application Reference Number: 6.4.88).

6.3.87 It is not possible for dolphin species to be identified (e.g. bottlenose dolphins to be distinguished from other dolphin species) in the PAM survey, and all potential detections are recorded as a dolphin species. It is therefore not possible to draw any conclusions from the PAM data as to the site use by bottlenose dolphins.

Abundance and density estimates

Irish Sea Management Unit

6.3.88 A number of inshore groups of bottlenose dolphin have been identified in UK and Irish waters and there appears to be limited interchange between these groups ([RD280]; [RD40]; [RD139]; [RD138]). [RD138] currently recognise seven MUs for bottlenose dolphin in UK waters:

(1) Coastal West Scotland and the Hebrides (CWSH, to 12nm);

(2) Coastal East Scotland (CES, to 12nm);

(3) Greater North Sea (GNS);

(4) Offshore Channel and SW England (OCSW);

(5) Coastal West Channel (CWC, to 12nm);

(6) Irish Sea (IS); and

(7) Oceanic Waters (OW).

6.3.89 The Project is located in the Irish Sea MU, which has an estimated bottlenose dolphin abundance of 397 (CV = 0.23; 95% CI = 362-414; [RD138]).

SCANS data

6.3.90 For the entire SCANS-II survey area, bottlenose dolphin abundance in the summer of 2005 was estimated to be 16,485 (CV = 0.422; [RD126]). The SCANS-II survey estimated the abundance of bottlenose dolphin in survey block O, which is located in the Irish Sea and includes the Project site, to be

235 individuals (CV=0.75) and the density was estimated to be 0.0052 bottlenose dolphin per km^2 (CV=0.75) ([RD126]).

6.3.91 For the entire SCANS-III survey area (not the same as SCANS-II area), bottlenose dolphin abundance in the summer of 2016 was estimated to be 27,697 with an overall estimated density of 0.015/km^2 (CV = 0.233; 95% CI = 17,662 – 43,432; [RD125]).

6.3.92 The SCANS-III survey estimated that the abundance of bottlenose dolphin in survey block E (surface area of 34,870km^2), which is located in the Irish Sea and includes the Project site, was 288 individuals and the density was estimated to be 0.008 bottlenose dolphin per km^2, with a mean group size of 1.50 (CV = 0.57; 95% CI = 0-664; [RD125]). In the adjacent area, survey block F (figure 6-9; surface area of 12,322km^2), no bottlenose dolphin were recorded [RD125].

Cardigan Bay

6.3.93 Cardigan Bay is the largest population in the UK with annual estimates for the wider area varying between 254 and 330 animals (CV = 0.25 – 0.28) for the years 2011 and 2013 inclusive [RD104].

6.3.94 The population is not closed as individuals may join up for periods of time from elsewhere [RD275], and sightings of individuals initially reported off the south-west coast of England, have been observed in Welsh waters ([RD369]; [RD128]).

Site-specific survey data

6.3.95 The site-specific vessel transect surveys have recorded two sightings totalling 14 individuals of bottlenoses dolphin (a pod of four and 10 individuals respectively). VP surveys between 2011 and 2014 recorded a total of six bottlenose dolphin individuals from three sightings (Application Reference Number: 6.4.88).

6.3.96 There is currently insufficient data from the site-specific surveys to provide any estimates for abundance or density in the survey area.

Summary of bottlenose dolphin reference population and density estimates

6.3.97 Table 6-3 summarises the reference population and density estimates for bottlenose dolphin to be used in the assessment. Where there were more than two estimates for the same area available, the higher estimate has been included and will be used in the assessment.

Table 6-3 Summary of bottlenose dolphin reference population and density estimates

Area	Density estimate	Population estimate	Source	Shadow HRA
Irish Sea Management Unit (MU)	0.009/km^2 (Whole IS) 0.009/km^2 (UK IS)	397 (CV = 0.23; 95% CI = 362–414)	[RD138]	This will be used as the reference population.
SCANS-III Block E	0.008/km^2 (CV = 0.57)	288 (95% CI = 0-664)	[RD125]	For context of the density estimate for the wider area.
Cardigan Bay	0.344/km^2	330 (CV = 0.24; 95% = CI 203-534)	[RD103]	Density estimate used in assessment of potential areas of effects around Wylfa Newydd Development Area and Disposal Site. Note: mean density estimate is based on area of Cardigan Bay SAC (approx. 959km^2) and maximum number of 330 individuals.

Habitat

6.3.98 Throughout its range, bottlenose dolphin occurs in a diverse range of habitats, from shallow estuaries and bays, coastal waters, continental shelf edge and deep open offshore ocean waters. However, it is primarily an inshore species, with most sightings within 10km of land, but they also occur offshore [RD163].

6.3.99 In coastal waters, bottlenose dolphins are often associated with river estuaries, headlands or sandbanks, where there is uneven bottom relief and/or strong tidal currents (e.g. [RD189]; [RD363]; [RD191]; [RD190]; [RD135]; [RD275]).

6.3.100 Within Cardigan Bay, bottlenose dolphins appear to use specific habitats. For example, areas within 3.2km of the shoreline, with strong currents, in proximity to rocky headlands and near small embayments and estuaries, are the habitats most frequented by the bottlenose dolphins ([RD189]; [RD6]). Habitat analysis shows preference for areas between 5m and 10m in depth, although areas of between 25m and 30m depth have seen an increase in sightings since 2005 with the majority of the sightings in this region occurring over the slope range of Cardigan Bay [RD260].

6.3.101 A photo-monitoring study resreaching connectivity of bottlenose dolphin in Wales [RD259] suggests that their preference for Cardigan Bay is a result of the shallow bathymetry and diverse benthic habitats, in addition to the fact that significant numbers of salmonids pass through the bay during migration.

Diet

6.3.102 Bottlenose dolphins are opportunistic feeders and take a wide variety of fish and invertebrate species. Benthic and pelagic fish (both solitary and schooling species), including, but not limited to, haddock, saithe, pollock, cod (*Gadus morhua*), whiting, hake (*Merluccius Merluccius*), blue whiting (*Micromesistius poutassou*), bass (*Dicentrarchus labrax*), mullet (Mugilidae), mackerel (Scombridae), salmon (*Salmo salar*), sea trout (*Salmo trutta trutta*), flounder, sprat and sandeels, as well as octopus and other cephalopods have all been recorded in the diet of bottlenose dolphin ([RD292]; [RD275]).

6.3.103 In Irish waters, haddock, saithe and pollock are the dominant prey species, followed by whiting, blue whiting, Atlantic mackerel (*Scomber scombrus*) and horse mackerel (*Trachurus trachurus*); cephalopods are also important [RD131]. The stomach contents analysis of three individuals in the Irish Sea indicated a highly variable diet comprising horse mackerel, hake, mackerel, poor cod, pollock, whiting and saithe [RD249].

6.3.104 Taking into account the fish species recorded in the ES (Application Reference Number: 6.4.13), the main prey species of bottlenose dolphin in and around the Wylfa Newydd Development Area is likely to include: sea trout, bass, mullet, whiting, mackerel, sandeels and flat fish, such as Dover sole.

6.3.105 Diet analysis suggests that bottlenose dolphin are selective opportunists and although they may have preference for a type of prey, their diet seems to be determined largely by prey availability. Research in Australia has shown that when presented with a choice, they will preferentially feed on certain types of prey, particularly those with a high fat content [RD42].

Movements and seasonal occurrence

6.3.106 Greatest numbers are thought to occur in UK waters between July and October with a secondary peak in some localities in March-April ([RD275]; [RD97]) although animals are present all year round in some areas ([RD363]; [RD348]; [RD349]; [RD40]). Analyses of photo-identification data from multiple studies have also shown that bottlenose dolphins can make long-distance movements [RD280].

6.3.107 In Cardigan Bay, the population ranges over an area wider than the SAC, which likely includes all of the west and north Wales coasts and a wide area of the Irish Sea [RD79]. The distribution of bottlenose dolphins is variable with main concentrations in the summer being around Tremadog Bay and southern Cardigan Bay ([RD100] and [RD101]). Sightings of bottlenose dolphins occurring around the coast of north Wales, primarily Anglesey, differed considerably to those in Cardigan Bay, with the most frequent sightings occurring during winter [RD260], suggesting possible seasonal movements in the area [RD245]. Although there are a higher number of bottlenose dolphins off north Anglesey in the winter months, bottlenose dolphins are present off north Anglesey throughout the year ([RD348]; [RD349]).

6.3.108 During photo-identification studies of bottlenose dolphin in Scotland, one individual was identified south of Aberdeen and then re-identified off Burghead 52 hours later, representing a distance of 218km and a minimum swimming speed of 4.2km/h [RD361]. For consecutive sightings five or less days apart, the median rate of travel for dolphins identified primarily within the inner Moray was 0.071km/h, whereas for dolphins observed using areas outwith the inner Moray Firth it was significantly greater at 0.22km/h. Similarly, during sightings in the outer Moray Firth and along the coasts south of Fraserburgh the median rate of progress was 7.6km/h, which was twice as fast as in the inner Moray Firth (3.9km/h) [RD361].

Life history

6.3.109 Indications suggest that bottlenose dolphins in UK waters may have two calving peaks in the year [RD96] or an extended breeding season, meaning that calves can often be observed throughout the year. Calves stay with their mothers for at least four years [RD310], but have been reported to stay together until the calf is eight years old [RD123].

6.3.110 Cardigan Bay is an important calving area for bottlenose dolphin. There are also two other important calving areas in north Wales: the Pen Llŷn a'r Sarnau and the Isle of Anglesey [RD103]. Peak calving times within the Cardigan Bay SAC are generally between July and September (when approximately 76% of all calves are born), although calving may occur at any time [RD245].

6.3.111 There is currently not enough information to determine what, if any, the habitat requirements are for any breeding areas or calving areas for bottlenose dolphins in UK waters.

Conservation status

6.3.112 The current conservation status, as assessed in the 3rd UK report on implementation of the Habitats Directive (submitted to the European Commission in 2012), of the bottlenose dolphin is 'favourable' ([RD146]).

Grey seal (Halichoerus grypus)

European Designated Sites for grey seal

Pen Llŷn a'r Sarnau/Llŷn Peninsula and the Sarnau SAC

6.3.113 This European Designated Site is also designated for bottlenose dolphin and, therefore, has been described earlier.

6.3.114 Grey seals present at this site are thought to be a part of the wider north Wales population (between 700 and 750 in winter and up to 1,100 in summer) and that the persistent breeding individuals form part of the larger Irish Sea population. The Pen Llyn a'r Sarnau/Llŷn Peninsula and Sarnau SAC had an estimated population of 365 grey seals (in 2002) and has the

largest breeding colony in north Wales with a number of important pupping sites, including Bardsey Island [RD54].

6.3.115 The Pen Llyn a'r Sarnau/Llŷn Peninsula and the Sarnau SAC is located within the South and West England and Wales MU for grey seal [RD137].

6.3.116 Grey seal is an Annex II species present at this site as a qualifiying feature, but not a primary reason for site selection. The conservation status for the species is 'Good'.

Bae Ceredigion/Cardigan Bay SAC

6.3.117 This European Designated Site is also designated for bottlenose dolphin and, therefore, has been described earlier.

6.3.118 Grey seals within the Bae Ceredigion/Cardigan Bay SAC are not part of a discrete population but a part of the wider south-west Wales population, which is estimated to be 5,000 individuals. Cemaes is the most important pupping area within the SAC, with significant numbers also born at Lochtyn, Aberporth and Cardigan. From 1992-1994, it was estimated that 66 pups were born within the Bae Ceredigion/Cardigan Bay SAC per year, representing 1.7% of the West Wales pup population [RD55].

6.3.119 Bae Ceredigion/Cardigan Bay SAC is located within the West England and Wales MU for grey seal [RD137]. The assessment of any potential impact will be made against West England and Wales MU population, using seal densities calculated from seal density maps provided by [RD178] for each impact area.

6.3.120 Grey seal is an Annex II species present at this site as a qualifiying feature, but not a primary reason for site selection. The conservation status for the species is 'Good'.

Sir Benfro Forol/Pembrokeshire Marine SAC

6.3.121 The site covers an area of 1380.39km^2, including areas of the Pembrokeshire coastline and St Brides Bay and includes the islands of Ramsey, Skomer, Grassolm, Skokholm, The Bishops and Clerks and the Smalls, with 96% of the SAC comprising of marine areas and inlets, and 3.8% of tidal areas, estuaries, mud and sand flats and lagoons. The site was primarily designated for the Annex I habitats of estuaries, large shallow inlets and bays and reefs, and the Annex I species of grey seal and shore dock. Further, Annex I habitats listed as qualifying features include sandbanks, mud and sand flats, coastal lagoons, salt meadows and sea caves, with qualifying Annex II species listed as sea and river lamprey, allis and twaite shad and otter [RD54]. Sediments present at the site are wide ranging, from very fine muds, sands and gravels to consolidated and unconsolidated pebbles and cobbles. Mean tides range from 7.8m at Milford Haven to 4.4m in Ramsey Sound with string tidal currents around the islands and islets of up to 10 knots. Surface salinities are variable, with offshore areas being relatively constant at between 34.5ppt and 35ppt and inshore

waters being variable, with levels of 33.5ppt in the winter to 36ppt in summer [RD54].

6.3.122 Grey seals within the Sir Benfro Forol/Pembrokeshire Marine SAC are not part of a discrete population but a part of the wider south-west Wales population, which is estimated to be 5,000 individuals. Annual pup production was estimated at 980, approximately 75% of the south-west Wales population [RD54].

6.3.123 Sir Benfro Forol/Pembrokeshire Marine SAC is located within the West England and Wales MU for grey seal [RD137]. The assessment of any potential impact will be made against West England and Wales MU population, using seal densities calculated from seal density maps provided by [RD178] for each impact area.

6.3.124 Grey seal is an Annex II species present at this site as a qualifiying feature, but not a primary reason for site selection. The conservation status for the species is 'Excellent'.

The Maidens SAC

6.3.125 The Maidens SAC covers an area of 74.67km^2 and is located 180.4km from the Wylfa Newydd Development Area along the north Northern Ireland coastline. The site comprises of a group of rocky reefs detached from the coastline, and identified as either being awash or emergent. Only two of these rocky reefs are deemed large enough to be called islands. The relatively remote rocks and islands located within The Maidens SAC provide important haul-out and foraging areas for the grey seal, as well as for breeding and pupping sites. This site was primarily designated for the presence of the Annex I habitats of sandbanks and reefs, with the grey seal listed as a qualifying feature [RD69]. There is a permanent population of grey seal at this site with a population of estimate of between 51 and 100 individuals [RD69].

6.3.126 Grey seal is an Annex II species present at this site as a qualifiying feature, but not a primary reason for site selection. The conservation status for the species is 'Good'.

Lambay Island SAC

6.3.127 Lambay Island SAC is located along the east coast of The Republic of Ireland, 98.8km from the Wylfa Newydd Development Area and covers an area of 4.05km^2. The island itself is 127m high with steep cliffs to the north, east and south coasts, while the west shore is low-lying and gently slopes upwards. The site is primarily designated for the Annex I habitats of reefs and vegetated sea cliffs, and the Annex II species of both grey and harbour seals. Lambay Island supports the main breeding colony of grey seal along the east coast of Ireland, with a population of 196-252. There are additionally regionally significant numbers of harbour seal present at the site.

Both species of seal occur year round at the site, along the intertidal coasts, coves and caves [RD225].

6.3.128 The conservation status for grey seal in this SAC is 'Excellent'.

Saltee Islands SAC

6.3.129 The Saltee Islands SAC is located 191km from the Wylfa Newydd Development Area along the south-east coast of The Republic of Ireland. The site covers an area of 158.09km^2, comprising of the Saltee Islands and the surrounding marine areas. There are two main islands (Great and Little Saltee) and a number of small islets and rocky outcrops approximately 4-5km off the Irish coastlines. Annex I habitats listed as primary reasons for designation are tidal mud and sand flats, large shallow inlets and bays, reefs, vegetated sea cliffs and sea caves, as well as the Annex II species grey seal. Great Saltee Island has a breeding colony of grey seal, estimated at 571-744 in 2005, and 246 in 2007 (estimated from a one off moult count) [RD220].

6.3.130 The conservation status for grey seal in this SAC is 'Excellent'.

Distribution and occurrence of grey seal

6.3.131 Grey seals only occur in the North Atlantic, Barents and Baltic Sea with their main concentrations on the east coast of Canada and United States of America and in north-west Europe [RD317].

6.3.132 Approximately 38% of the world's grey seals breed in the UK and 88% of these breed at colonies in Scotland with the main concentrations in the Outer Hebrides and in Orkney. There are also breeding colonies in Shetland, on the north and east coasts of mainland Britain and in south-west England and Wales [RD317].

6.3.133 Long-term sightings rates data as collated in the Atlas of the Marine Mammals of Wales found that the main concentrations of grey seals sightings were off the north coast of Wales, as well as the southern coast of the Isle of Man [RD8].

6.3.134 Marine Scotland commissioned Sea Mammal Research Unit (SMRU) to produce maps of grey seal distribution in UK waters [RD178]. These maps were produced by combining information about the movement patterns of electronically tagged seals with survey counts of seals at haul-out sites. The resulting maps show estimates of mean seal usage (seals per 5km x 5km grid cell).

6.3.135 The maps indicate relatively higher usage in some areas of the Celtic and Irish Sea along coastal locations of Ireland and Wales, for example, Llŷn Peninsula and West Hoyle Bank in Wales and the waters surrounding Lambay Island, as well as the south-east tip (Saltee Islands) of Ireland. Although, grey seal usage is relatively low in the area in and around the Wylfa Newydd Development Area and Disposal Site [RD178].

6.3.136 Spatial distributions indicate that grey seals have homogeneous usage near-shore, transit between haul-outs using large-scale interconnected networks, and spend time 15% of their time far-offshore [RD287].

6.3.137 Grey seal are regularly recorded in and around the Irish Sea, including north Anglesey (e.g. [RD356]; [RD357]; [RD358]; [RD178]). Grey seals are present year round on both the Irish and Welsh coasts and are known to move between the two, for example between the southeast coast of Ireland and the southwest coast of Wales [RD184].

Abundance and density estimates

6.3.138 Grey seal population trends are assessed from the counts of pups born during the autumn breeding season, when females congregate on land to give birth [RD317]. The most recent surveys of the principal grey seal breeding sites in Scotland, Wales, Northern Ireland and south-west England, resulted in an estimate of 60,500 pups (95% CI = 53,900 – 66,900; [RD317]. When the pup production estimates are converted to estimates of total population size, there are population model an estimated 139,800 UK grey seals (approximate 95% CI = 116,500 – 167,100; [RD317]).

6.3.139 The numbers of grey seals in the UK during August harbour seal surveys were 13,880 grey seals counted in eastern England in 2008 to 2015, an estimate of 1,302 in West England and Wales, and a count of 468 in Northern Ireland during the 2011 survey, giving a most recent UK total count of grey seals in August of 37,701 [RD317].

6.3.140 In Ireland, the grey seal population was estimated to between 7,284 and 9,365 individuals, during the 2009-2012 monitoring program at seven main breeding sites [RD250].

South and West England and Wales Management Unit

6.3.141 Grey seal population size is normally derived from the numbers of pups born during their autumn breeding season. Grey seal distribution during their breeding season is, however, very different to their distribution at other times of the year. For this reason, the numbers of grey seal pups born in the autumn is provided as well as the summer counts of grey seals for each MU ([RD137]).

6.3.142 In the South and West England and Wales MU, the grey seal pup production (autumn) was 1,900 with an estimated summer population size of 6,000, based on summer survey counts 1994-2003 and 2007 ([RD137]).

6.3.143 However, IAMMWG [RD137] note that the South and West England and Welsh count is less certain due to infrequent assessment over this large area.

Wales

6.3.144 The most recent data for pup production from the major breeding sites in Wales are estimates of 96 pups in north Wales, 465 pups in north

Pembrokeshire in 2005 and 379 pups born on Skomer and adjacent mainland sites in 2015. In 2014, an estimated 1,650 grey seal pups were born in Wales [RD317].

6.3.145 Haul-out sites in Anglesey and the Llŷn Peninsula surveyed in 2014 had a count of 96 pups. Based on this count, there are an estimated 242-307 grey seal pups in the whole of north Wales [RD324].

6.3.146 Based on August counts (2011-2015) of grey seals at haul-out sites in Wales there are an estimated 422 grey seal and an estimated 480 grey seal in south-west England [RD317]. However, there are no dedicated seal surveys in these areas and only sparse information is available, therefore, estimates are compiled from counts from various different sources [RD317]. In addition, it should be noted that grey seal summer counts are known to be more variable than harbour seal summer counts and therefore caution is advised when interpreting these numbers [RD317].

Seal density maps

6.3.147 The grey seal density estimates for the Wylfa Newydd Development Area and Disposal Site have been calculated from the seal density maps [RD178], based on the highest density estimate within the area:

- Wylfa Newydd Development Area = 0.24/km^2
- Disposal Site = 0.13/km^2

6.3.148 As the sightings data was too low from the site-specific surveys to determine a robust site-specific density of grey seal, the density estimates based the SMRU seals at-sea density data [RD178] have been used in the assessment (table 6-3).

Site-specific survey data

6.3.149 The site-specific vessel-based transect surveys recorded a total of 35 grey seal. The surveys with dedicated MMOs between September 2016 and July 2017 recorded 17 individuals, with the majority (10 seals) recorded between transect 1 and 6 (see figure 6-8 for transect lines). The closest grey seal sighting to the Wylfa Newydd Development Area was in Cemaes Bay, immediately east of the Wylfa Newydd Development Area (Application Reference Number: 6.4.88).

6.3.150 Site-specific land-based VP surveys recorded a total of 193 grey seal sightings (201 individuals). The average sightings rate (number of grey seals counted per hour of effort) was highest at VP3 (figure 6-6) across all months, with the highest monthly sightings rate in December of 0.67 grey seals/hour effort. VP1 and VP2 had slightly lower average sightings rates than VP3, the highest sightings rate at VP1 was 0.26 grey seals/hour effort in May and at VP2 is was 0.33 grey seals/hour effort in February and March. VP4 had the lowest average grey seal sightings rates (Application Reference Number: 6.4.88).

6.3.151 The site-specific survey data indicates that grey seal are present throughout the year around north Anglesey and the Wylfa Newydd Development Area.

6.3.152 Seal surveys conducted between 30 October 2016 and 25 January 2017 suggest that there are no breeding haul-out sites for grey seal along the north Anglesey coastline. During these surveys, no pups or harbour seals were sighted and all grey seals spotted were in the water at the following locations: Cerrig Brith (one juvenile in water, approximately 0.5km east of the site); Porth Wnal (two juveniles in water, approximately 0.8km west of the site); Trwyn y Penrhyn (one juvenile in water, approximately 2.3km west of the site) and at Porth Padrig (one juvenile in water, approximately 2.7km west of the site). Sightings of seals within the Wylfa Newydd Development Area generally represent sporadic individuals or small groups which are typically in the water rather than hauled-out (Application Reference Number: 6.4.88).

6.3.153 There is currently insufficient data from the site-specific surveys to provide robust estimates for abundance or density in the survey area.

Summary of grey reference population and density estimates

6.3.154 Table 6-4 summarises the reference population and density estimates for grey seal to be used in the assessment. Where there were more than two estimates for the same area available, the higher estimate has been included and will be used in the assessment.

Table 6-4 Summary of grey seal reference population and density estimates

Area	Density estimate	Population estimate	Source	Shadow HRA
South and West England and Wales MU	N/A	6,000	[RD137]	This will be used as the reference population.
Wales		422	[RD317]	Not to be used but included as a comparison.
South-west England		480	[RD317]	Not to be used but included as a comparison.
North Wales	N/A	242-307	[RD325]	Not to be used but included as a comparison.
Wylfa Newydd Development Area	0.24/km^2	N/A	[RD178])	Density estimate for potential areas of effects in and around Wylfa Newydd Development Area.
Disposal Site	0.13/km^2	N/A	[RD178]	Density estimate for potential areas of effects in and around Disposal Site.

Haul-out sites

6.3.155 Grey seals spend longer hauled out during their annual moult (between December and April, generally three and five months after the breeding season) and during the breeding season (between August and December [RD317].

6.3.156 In the UK grey seals typically breed on remote uninhabited islands or coasts and in small numbers in caves, where they can avoid busy beaches and storm surges. Although there are also known to breed on some exposed beaches. For example, at Donna Nook in Lincolnshire, grey seals have become habituated to human disturbance and over 70,000 people visit this colony during the breeding season with no apparent impact on the breeding seals [RD317].

6.3.157 In north Wales grey seals are known to use habitats such as intertidal rocky outcrops, beaches and sea caves that are tidally exposed [RD237]. Breeding colonies in south-west England and in Wales are typically at the foot of steep cliffs or in caves and are therefore extremely difficult to monitor [RD317]. During a grey seal haul-out site survey in Anglesey and the Llŷn Peninsula in 2014 [RD325], an estimated 48% and 75% of pups born in Anglesey and the Llŷn Peninsula respectively were born in cave habitats [RD325].

6.3.158 The nearest major seal haul-out sites to are located at The Skerries, approximately 8km from the Wylfa Newydd Development Area and at Middle Mouse, approximately 4km from the Wylfa Newydd Development Area. Other known haul-out sites are located Craig yr Iwrch/Harry Furlough's Rocks, approximately 2km from the Wylfa Newydd Development Area.

Diet

6.3.159 Grey seals are generalist feeders, foraging mainly on the sea bed at depths of up to 100m although they are probably capable of feeding at all the depths found across the UK continental shelf [RD317].

6.3.160 Principal prey items include sandeel (Ammodytidae spp.), whitefish (such as cod (*Gadus morhua*), haddock (*Melanogrammus aeglefinus*), whiting (*Merlangius merlangus*) and ling (*Molva molva*)) and flatfish (plaice (*Pleuronectes platessa*), sole (*Solea solea*), flounder (*Platichthys flesus*), dab (*Limanda limanda*)) [RD124]. Other prey species may also include herring (*Clupea harengus*), sprat (*Sprattus sprattus*), poor cod (*Trisopterus minutus*), pouting (*Trisopterus luscus*), sea trout (*Salmo trutta*), bass (*Dicentrarchus labrax*), mullet (Mugilidae), saithe (*Pollachius virens*) and pollack (*Pollachius pollachius*). Amongst these, sandeels are typically the predominant prey species. Diet varies seasonally and from region to region [RD317].

6.3.161 Food requirements depend on the size of the seal and fat content (oiliness) of the prey, but an average consumption estimate of an adult is between 4kg and 7kg per seal per day depending on the prey species [RD317].

Movements and foraging ranges

6.3.162 Grey seals forage in the open sea and return regularly to haul out on land where they rest, moult and breed. They may range widely to forage and frequently travel. Foraging trips can last anywhere between one and 30 days [RD317].

6.3.163 Tracking of individual seals has shown that most foraging probably occurs within 100km of a haul-out site, with ranges of approximately 145km [RD334], although they can feed up to several hundred kilometres offshore, with ranges of 1,088km to 6,400km recorded [RD82]. Individual grey seals based at a specific haul-out site often make repeated trips to the same region offshore, but will occasionally move to a new haul-out site and begin foraging in a new region [RD317]. Studies of regular foraging and dispersal between winter breeding sites, and summer foraging and haul out sites indicates ranges of 1,000km (e.g. [RD206]).

6.3.164 Satellite tagging of grey seals in the Irish Sea (adults in 2004 and pups from 2009-2010) has revealed an average foraging trip of 16.39km to 19.5km with maximum trips of 173km for adults and 435.8km for pups [RD315]. Over the lifetime of the tags, pups made an average of 58 trips per seal (over the average tag duration of 151 days) with a median trip duration of 0.92 days (95% CI = 0.12 7.89) between haul-out locations and covered an average distance of 19.47km. The greatest distance travelled by one pup was 435.8km. Grey seal adults made fewer trips with an average of 41 trips per seal (over the average tag duration of 131 days) and covered less distance (average maximum of 16.94km) with trips between haul-out locations lasting on average 0.75 days (as a median, 95%CI = 0.12 5.61). The greatest distance travelled by one adult was 172.6km. The tag data showed that seals often move between haul out locations, in particular Llŷn Peninsula, Cardigan Bay and haul out locations around the Isle of Anglesey [RD315].

6.3.165 Telemetry studies of grey seal in the UK have identified a highly heterogeneous spatial distribution with a small number of offshore ‘hot spots’ continually utilised ([RD205]; [RD178]).

6.3.166 Data analyses of tagged seals indicate that foraging distribution is related to their breeding distribution [RD287]. Female grey seal do not forage while suckling their pups. Therefore, the movement of female grey seals differs between the foraging and breeding seasons. [RD288] found that between 21% and 58% of females used different regions for foraging and breeding.

6.3.167 The resulting tracks from the tags also show grey seals range far from land and pups may have more long ranging movements than adults [RD287].

6.3.168 The difference in population trends between regions for UK grey seals suggests underlying regional differences in demographics. On the basis of genetic differences there appears to be a degree of reproductive isolation between grey seals that breed in the south-west (Devon, Cornwall and Wales) and those breeding around Scotland [RD317]

6.3.169 Recent telemetry data suggest that there may be significant mixing between populations outwith the breeding season, e.g. observed movements of adult seals between summer haul-out sites in northern France and both the Scottish east coast and Inner Hebrides [RD317].

6.3.170 Telemetry studies undertaken at five SACs across the UK (Pembrokeshire Marine, Llŷn Peninsula and the Sarnau, Monach Islands, Isle of May and Berwickshire and North Northumberland Coast) indicate that both adults and pups travel between SACs. For example, tagged seals have travelled between Pembrokeshire Marine SAC, Llŷn Peninsula and the Sarnau SAC and the Saltee Islands SAC (Ireland) [RD315].

Life history

6.3.171 The majority of pups in south-west Britain are born between August and September [RD317]. Pups are typically weaned between 17 days and 23 days after birth, when they moult their white natal coat and then remain on the breeding colony for up to two or three weeks before going to sea. Mating occurs at the end of lactation and then adult females depart to sea and provide no further parental care [RD317].

6.3.172 In north Wales, the grey seal pupping season spans from the beginning of September to the end of November and the number of births are thought to peak in mid-September ([RD356]; [RD357]; [RD358]).

6.3.173 The nearest grey seal breeding sites to the Wylfa Newydd Development Area are located at Carmel Head, approximately 6km from Wylfa Newydd Development Area and at The Skerries, approximately 8km from the Wylfa Newydd Development Area. Other known breeding sites are the Llŷn Peninsula and Bardsey Island, which supports the largest breeding colony in north Wales. Areas such as Carmel Head, North Stack, Trwyn Cilan and the Gwylan islands coast also appear to be important locations during the breeding season with little usage outside of these times (Application Reference Number: 6.4.88).

Conservation status

6.3.174 The current conservation status, as assessed in the 3rd UK report on implementation of the Habitats Directive (submitted to the European Commission in 2012), of the grey seal is ‘Favourable’ [RD146].

Harbour seal (Phoca vitulina)

European Designated Sites for harbour seal

Murlough SAC

6.3.175 The Murlough SAC is located along the north-eastern coastline of Northern Ireland; 117.9km from the Wylfa Newydd Development Area and covers an area of 119.04km^2. The site sits alongside Dundrum Bay, covering important harbour seal haul-out areas at Ballykinler. Annex I habitats of fixed coastal

dunes and decalcified fixed dunes and the Annex II species marsh fritillary butterfly are listed as primary reasons for the designation. Additionally, Annex I habitats listed as qualifying features only are sandbanks, mud and sand flats, salt meadows, shifting dunes and sand dunes. The harbour seal is listed as a qualifying feature of the Murlough SAC [RD70], but not a primary reason for site selection.

6.3.176 The conservation status for the species in this SAC is 'Good'.

Strangford Lough SAC

6.3.177 Strangford Loch SAC is located along the north eastern coastline of Northern Ireland, at a distance of 199.8km from Wylfa Newydd Development Area, covering an area of 153.92km^2. Strangford Lough is a large marine inlet separated from the Irish Sea by the Ards Peninsula to the east and the Lecale coast to the south, and connected to the open sea by the Strangford Narrows. This site is designated primarily for its Annex I habitats of mud and sand flats, coastal lagoons, large shallow inlets and abys and reefs, with the Annex I habitats of drift lines, stony banks, colonizing mud and sand flat habitats and salt meadows. There are no Annex II species listed as a primary reason for the sites designation, with harbour seal listed as a qualifying feature [RD71].

6.3.178 The conservation status for the species in this SAC is 'Average or Reduced'.

Lambay Island SAC

6.3.179 This European Designated Site is also designated for grey seal and, therefore, has been described earlier.

6.3.180 The conservation status for the species in this SAC is 'Average or Reduced'.

Slaney River Valley SAC

6.3.181 Slaney River Valley SAC is located to the south of The Republic of Ireland 141.2km from Wylfa Newydd Development Area, covering an area of 60.20km^2. The site contains many different areas, including the tributaries of a number of different water bodies, Ferrycarrig estuary and Wexford Harbour. The site is designated for a number of Annex I habitats, including estuaries, tidal mud and sand flats, salt meadows, floating river vegetation, oak woodlands and alluvial forests. There are also a number of Annex II species listed as primary reasons for designations, including the freshwater pearl mussel, sea, brook and river lamprey, Twaite shad, Atlantic salmon, otter and harbour seal. The harbour seal occurs year-round at the site, where sandbanks within the site are important sites for breeding, moulting and resting. At least 27 grey seal are regular at the site [RD221].

6.3.182 The conservation status for the species in this SAC is 'Good'.

Distribution and occurrence of harbour seal

6.3.183 Harbour seals have a circumpolar distribution in the Northern Hemisphere and are divided into five sub-species. The population in European waters represents one sub-species (*Phoca vitulina vitulina*) [RD317].

6.3.184 SMRU, in collaboration with others, has deployed around 344 telemetry tags on harbour seals around the UK between 2001 and 2012 [RD287]. Spatial distributions indicate harbour seals persist in discrete regional populations, display heterogeneous usage and generally stay within 50km of the coast [RD287].

6.3.185 The SMRU maps of harbour seal distribution in UK waters [RD178], based on the movement patterns of electronically tagged seals with survey counts of seals at haul-out sites, indicate that harbour seal usage is low in and around the Wylfa Newydd Development Area and Disposal Site [RD178].

Abundance and density estimates

6.3.186 Harbour seals are counted while they are on land during their August moult, giving a minimum estimate of population size [RD317]. Combining the most recent counts (2011-2015) gives a total of 31,200 counted in the UK. Scaling this by the estimated proportion hauled out (0.72 (95% CI = 0.54 – 0.88)) produces an estimated total population for the UK in 2015 of 43,300 harbour seal (approximate 95% CI = 35,500 – 59,000; [RD317]).

6.3.187 Approximately 30% of European harbour seal are found in the UK; this proportion has declined from approximately 40% in 2002 [RD317].

6.3.188 The most recent minimum estimate for England and Wales, obtained from surveys carried out mainly in 2015, is 4,869, which is 21% higher than the 2007-2009 count (4,032) and 48% higher than the 1995-1997 count (3,289; [RD317]). The 2011 count for Northern Ireland of 948, which was 25% lower than the previous complete count in 2002 (1,267). The sum of all the most recent counts carried out between 2007 and 2014 gives a UK total count of 31,216 harbour seals [RD317].

West England and Wales MU

6.3.189 IAMMWG [RD137] recognise eleven MUs for harbour seals. The Wylfa Newydd Development Area is located in the West England and Wales MU, which covers the area from Newhaven, through the SW Approaches, the Irish Sea to the Scottish border.

6.3.190 The distribution of harbour seals is not thought to change throughout the year. Harbour seal minimum population estimates are updated annually based on counts of seals at haul out sites (reports of the Special Committee on Seals). The 2015 estimate for the West England and Wales MU was 35, based on 2007-2014 surveys [RD316].

6.3.191 For the West England and Wales MU only sparse information is available as no dedicated harbour seal surveys have been undertaken. Therefore, estimates are compiled from counts from various different sources [RD316].

Wales

6.3.192 Harbour seal counts (2007-2014) during their August moult, give a minimum estimate of less than 50 individuals [RD317]; however, it should be noted that there are no systematic surveys for harbour seal in Wales.

6.3.193 Seals spend a higher proportion of their time on land during the moult than at other times and counts during the moult are thought to represent the highest proportion of the population with the lowest variance [RD317].

Seal density maps

6.3.194 The seal density maps [RD178] were used to determine the harbour seal density estimates for the Wylfa Newydd Development Area and Disposal Site, based on the highest density estimate within the area:

- Wylfa Newydd Development Area = 0.0009/km^2
- Disposal Site = 0.0007/km^2

6.3.195 As there were no harbour seal sightings from the site-specific surveys, the density estimates based the SMRU seals at-sea density data [RD178] has been used in the assessment (table 6-5).

Summary of harbour seal reference population and density estimates

6.3.196 Table 6-5 summarises the reference population and density estimates for harbour seal to be used in the assessment. Where there were more than two estimates for the same area available, the higher estimate has been included and will be used in the assessment.

Table 6-5 Summary of harbour seal reference population and density estimates

Area	Density estimate	Population estimate	Source	Shadow HRA
West England and Wales MU	N/A	35	[RD316]	Not to be used but included as a comparison.
Wales	N/A	<50	[RD317]	This will be used as the reference population.
Wylfa Newydd Development Area	0.0009/km^2	N/A	[RD178])	Density estimate for potential areas of effects in and around Wylfa Newydd Development Area.

Area	Density estimate	Population estimate	Source	Shadow HRA
Disposal Site	0.0007/km^2	N/A	[RD178]	Density estimate for potential areas of effects in and around Disposal Site.

Haul-out sites

6.3.197 Harbour seals come ashore in sheltered waters, typically on sandbanks and in estuaries, but also in rocky areas. The Harbour seal regularly haul-out on land in a pattern that is often related to the tidal cycle [RD317].

6.3.198 Harbour seals give birth to their pups in June and July, during which time females and pups spend a high proportion of their time ashore [RD317]. Harbour seals moult in August and spend a higher proportion of their time on land during the moult than at other times [RD317].

Diet

6.3.199 Harbour seals take a wide variety of prey including sandeels, gadoids, herring and sprat, flatfish and cephalopods. Diet varies seasonally and regionally, prey diversity and diet quality also showed some regional and seasonal variation [RD317].

6.3.200 Prey species for harbour seal include sandeels (Ammodytidae), whiting (*Merlangius merlangus*), herring (*Clupea harengus*), sprat (*Sprattus sprattus*), poor cod (*Trisopterus minutus*), pouting (*Trisopterus luscus*) and flat fish, such as plaice (*Pleuronectes platessa*), dab (*Limanda limanda*) and Dover sole (*Solea solea*). Other prey species could also include sea trout (*Salmo trutta*), bass (*Dicentrarchus labrax*), mullet (Mugilidae), cod (*Gadus morhua*), haddock (*Melanogrammus aeglefinus*), saithe (*Pollachius virens*) and pollack (*Pollachius pollachius*).

6.3.201 It is estimated harbour seals eat between 3kg and 5kg per adult seal per day depending on the prey species [RD317].

Movements and foraging ranges

6.3.202 Harbour seals normally feed within 40km and 50km around their haul out sites [RD317]. Tracking studies have shown that harbour seal typically travel between 50km and 100km offshore and can travel 200km between haul-out sites ([RD195]; [RD304]). Harbour seal exhibit relatively short foraging trips from their haul out sites. The range of these trips does vary depending on the surrounding marine habitat (e.g. 25km on the west of Scotland [RD62]; between 30km and 45km in the Moray Firth ([RD342]; [RD332] and data from The Wash (from 2003- 2005)) suggest that harbour seal in this area travel further, and repeatedly forage between 75km and 120km offshore (with one seal travelling 220km; [RD303]).

6.3.203 Telemetry studies indicate that the tracks of tagged harbour seals have a more coastal distribution than grey seals and do not travel as far from haul-outs [RD287].

6.3.204 SMRU telemetry data spanning 21 years (1991 – 2012) covering the UK population in all seasons revealed that there is very little harbour seal usage in the Celtic and Irish Seas [RD177]. There are small amounts of seal usage around the north-east Irish coast spanning across to the Isle of Man, but no evidence of movement to the Welsh coastline [RD177].

Life history

6.3.205 Harbour seal give birth to their pups in June and July and pups can swim almost immediately after birth [RD317]. The moult occurs in August and extends into September [RD317].

Conservation status

6.3.206 The current conservation status, as assessed in the 3rd UK report on implementation of the Habitats Directive (submitted to the European Commission in 2012), of the harbour seal is 'Unfavourable/Bad' for the overall assessment [RD146].

6.3.207 Harbour seals have been declining in recent years, with a loss of 21% of the UK population between 2000 and 2010 [RD146]. It was stated within [RD146] that the reasons for the decline could potentially be down to shooting (under licence), bycatch, disturbance, dynamic positioning vessels (ducted propellers) or it could be bio-toxin related, competition with grey seals and predations by orca and grey seal [RD146]. More recent information describes only two of these factors as potential causes; interactions with grey seals and toxins from harmful algae [RD317].

6.3.208 The decline was found predominantly in a few locations; Orkney with a population loss of 78% between 1978 and 2013, the east coast with a loss of 70% from 1997 to 2015, Firth of Tay loss of 92% from 2000 to 2015 and Shetland with a loss of 30% from 2000-2009 (this has now increased by 10% from 2009-2015) [RD317]. The population is now increasing again and is close to the levels before the decline described above.

6.4 Atlantic salmon and freshwater pearl mussel

Atlantic salmon

Introduction

6.4.1 The following European Designated Sites with Atlantic salmon as a qualifying interest feature were scoped into the assessment and the potential for LSE was determined:

- Afon Gwyrfai a Llyn Cwellyn SAC;
- Afon Eden – Cors Goch Trawsfynydd SAC;

- Afon Dyfrdwy a Llyn Tegid/River Dee and Bala Lake SAC; and,
- Afon Teifi/River Teifi SAC.

6.4.2 The closest European Designated Site for Atlantic salmon is 58km from the Wylfa Newydd Development Area (Afon Gwyrfai a Llyn Cwellyn SAC) and the Project has no potential to have a direct effect within the boundaries of any European Designated Site for Atlantic salmon. Consequently, it is only the migratory phase of Atlantic salmon that is relevant to the Shadow HRA for this species.

European Designated Sites for Atlantic salmon

Afon Gwyrfai a Llyn Cwellyn SAC

6.4.3 [RD44] states that Atlantic salmon has an unfavourable conservation status in this SAC. This results from a precautionary assessment of the distribution of the feature and abundance, and in particular the results of salmon catches and juvenile surveys. In addition, the presence of adverse factors, including flow depletion, contributes to this condition assessment ([RD44].

Afon Eden – Cors Goch Trawsfynydd SAC

6.4.4 [RD45] states that Atlantic salmon has an unfavourable conservation status in this SAC. The current population is maintained by stocking from the Mawddach hatchery, so this population is artificially maintained and the genetic profile of the population is therefore altered as a result. [RD45] also notes that the impact of removing/mitigating artificial barriers needs to be assessed.

Afon Dyfrdwy a Llyn Tegid/River Dee and Bala Lake SAC

6.4.5 [RD46] states that Atlantic salmon has an unfavourable conservation status in this SAC. The reasons for this condition assessment are summarised as the population size (adult run), water quality and ‘environmental disturbance’, with exploitation specifically referenced.

Afon Teifi/River Teifi SAC

6.4.6 [RD58] states that Atlantic salmon also has an unfavourable conservation status in this SAC. This unfavourable status results from a precautionary assessment of juvenile distribution and abundance, and the presence of adverse factors.

Life history

6.4.7 Atlantic salmon has two main phases in its life history; a freshwater phase and a saltwater phase. In the initial freshwater phase, the fish (termed alvein) remain within the breeding area and (at this stage) do not actively feed, but are nourished by the yolk sac. Following this phase, the fish (fry) actively search for food (invertebrates and small fish) before developing into parr prior to migration [RD305].

6.4.8 Migration begins typically between March and June as smolt. After this phase, growth is rapid as Atlantic salmon migrate from their natal streams and oceanic feeding grounds.

6.4.9 Adult fish feed on a range of species, including sandeels and other fish and amphipods. Prior to returning to the natal river, Atlantic salmon change into the grilse phase and they cease all feeding following their return to the natal river [RD305].

Thermal tolerance

6.4.10 Atlantic salmon is considered to be a boreal species, found in water temperatures ranging from ice to 23.5°C [RD24].

6.4.11 Production and growth of juvenile Atlantic salmon is considered optimum at water temperatures of between 15°C and 19°C, although they are known to tolerate temperatures up to 27°C, at which point they will move to colder water [RD65]. [RD142] summarised available literature at that time reported a similar preference range (between 14°C and 18°C), with a temperature of 23°C considered lethal to larvae [RD142].

Habitat requirements in the SACs

6.4.12 Elevated levels of fine sediments within spawning substrates can affect egg and fry survival; spawning habitat should be in the pebble to cobble size range, with the majority of the substrate being less than 150mm. Water depth during the spawning and incubation periods should be between 15cm and 75cm [RD44].

6.4.13 Holding areas for salmon are typically pools at least 1.5m deep with cover from features such as undercut banks, vegetation, submerged objects and surface turbulence. Coarse woody debris plays a significant role in the formation of new gravel beds and provides cover for fish and a source of food. Overhanging branches provide shade and food sources and tree root systems provide cover and flow refuge for juveniles [RD44].

Records of Atlantic salmon in the vicinity of the Wylfa Newydd Development Area

6.4.14 Baseline conditions for Atlantic salmon in the vicinity of the Wylfa Newydd Development Area are described below.

6.4.15 As reported in Application Reference Number: 6.4.13 and Application Reference Number: 6.4.86, Atlantic salmon (*Salmo salar*) were not recorded in the marine surveys undertaken for the EIA from 2010 to 2015. In addition, this species was not recorded in entrapment surveys at the existing Power station undertaken between 2011 and 2012 (there was one record of salmon from impingement surveys carried out from 1985 to 1987 [RD318]).

6.4.16 Although the data available from the surveys confirms only one historic record of salmon, three SACs that enter the eastern Irish Sea to the south of Anglesey (see above) were scoped into the assessment on the basis that

juvenile salmon are likely to travel directly between oceanic feeding grounds (North Atlantic) and natal rivers.

6.4.17 The Afon Dyfrdwy a Llyn Tegid/River Dee and Bala Lake SAC was also scoped in due to its close proximity to Anglesey and because juvenile salmon migrating to the North Atlantic and adult salmon destined for the River Dee may interact with the Project ZoIs), particularly marine water quality and underwater noise. In addition, tagging studies of juvenile fish from the River Dee [RD179] have shown that salmon tagged in the River Dee have been recaptured in Southern Ireland, indicating that some adults migrate from the North Atlantic, around the west coast of Ireland and north through the Irish Sea (and therefore likely to pass the Wylfa Newydd Development Area).

Freshwater pearl mussel Margaritifera margaritifera

6.4.18 The freshwater pearl mussel *Margaritifera margaritifera* is an interest feature of the Afon Eden – Cors Goch Trawsfynydd SAC. According to the SAC site description on the JNCC website, this supports the only population of freshwater pearl mussel *Margaritifera margaritifera* in Wales that is regarded to be viable. Recruitment is evident, with some juveniles recorded in recent years, although the population is comparatively small at an estimated 1,500 individuals. Monitoring completed in 2003 showed that the adult population had declined since 1997 and the population was close to functional extinction. The conservation status of this species is 'Unfavourable' [RD45].

6.4.19 The distribution of this species is confined to the stretch of river between Pont y Grible and Bronaber.

6.4.20 Recent research by NRW [RD116] has demonstrated that the host fish species for the Afon Eden freshwater pearl mussel population is brown trout (including sea trout) *Salmo trutta* (prior to this research it was assumed that Atlantic salmon was the host fish species). [RD45] notes that the breeding success of freshwater pearl mussel depends in part on the presence of a healthy migratory population of Atlantic salmon; however, in light of the above research, it is assumed that this dependency equally applies to sea trout.

6.4.21 Sea trout were identified in low numbers during surveys undertaken by Horizon between 2010 and 2013 in the coastal area around the Wylfa Newydd Development Area (none were recorded in 2014). Most individuals were recorded as smolts with a size range of 135mm to 205mm; however, a single parr was identified in the summer of 2010 measuring 45mm.

6.5 Birds

6.5.1 The following sections summarise available information for breeding, passage and non-breeding birds which is relevant to the assessment of potential effects of the Project on European Designated Sites for birds, namely:

- Morwenoliaid Ynys Môn/Anglesey Terns SPA;
- Glannau Ynys Gybi/Holy Island Coast SPA;
- Ynys Seiriol/Puffin Island SPA;
- Glannau Aberdaron Ynys Enlli/Aberdaron Coast and Bardsey Island SPA;
- Mynydd Cilan, Trwyn y Wylfa ac Ynysoedd Sant Tudwal/Mynydd Cilan, Trwyn y Wylfa and the St. Tudwal Islands SPA;
- Aber Afon Dyfrdwy/Dee Estuary SPA and Ramsar site;
- Sgomer, Gogwm a moroedd Benfro / Skomer, Skokholm and the seas off Pembrokeshire SPA;
- Grassholm SPA;
- Mersey Narrows and North Wirral Foreshore SPA and Ramsar site;
- Ribble and Alt Estuaries SPA and Ramsar site;
- Bowland Fells SPA;
- Morecambe Bay SPA and Ramsar site;
- Morecambe Bay and Duddon Estuary SPA;
- Lambay Island SPA;
- Ireland's Eye SPA;
- East Coast (Northern Ireland) Marine pSPA;
- Copeland Islands SPA;
- Saltee Islands SPA;
- Rathlin Island SPA;
- Horn Head to Fanad Head SPA;
- West Donegal Coast SPA;
- Tory Island SPA; and,
- Ailsa Craig SPA.

6.5.2 The conservation status of each site is described in chapter 10.

Seabirds

Breeding seabirds

Morwenoliaid Ynys Môn/Anglesey Terns SPA

The SPA populations and connectivity to the Wylfa Newydd Development Area

6.5.3 The Morwenoliaid Ynys Môn/Anglesey Terns SPA is designated for its breeding populations of Sandwich tern, Roseate tern, common tern and Arctic tern, for which the citation populations (as determined in the 2001 SPA

review) are 460, 3, 189 and 1,290 breeding pairs, respectively [RD328]. Numbers of all species other than Roseate tern have increased relative to the citation populations, with the most recent available estimates for the SPA populations of each species being 1,980 breeding pairs for Sandwich tern in 2017 [RD248], 592 breeding pairs for common tern in 2011 and 3,620 breeding pairs for Arctic tern in 2011[6] (JNCC 2017u). Roseate tern does not currently breed within the SPA. The recent SPA population sizes for each of these species are summarised by colony in table 6-6, with the longer-term trends given in Application Reference Number: 6.4.89.

Table 6-6 Recent population sizes by individual colonies for breeding tern species within the Morwenoliaid Ynys Môn/Anglesey Terns SPA, as estimated from counts of occupied nests or territories*

Colony (years for which counts obtained)	Species	Mean 5-year count	Minimum of five previous annual counts	Maximum of five previous annual counts
Ynys Feurig (2006 – 11)	Sandwich tern	0.2	0	1
	Roseate tern	0	0	0
	Common tern	178	167	196
	Arctic tern	506	416	550
Cemlyn Bay (2013 – 17)	Sandwich tern	2,398	1,980	2,650
	Roseate tern	0	0	0
	Common tern	67	20	100
	Arctic tern	41	20	60
The Skerries (2012 – 16)	Sandwich tern	0	0	0
	Roseate tern	0	0	0
	Common tern	265	236	290
	Arctic tern	3,659	3,289	3,833

*Counts derived from the Seabird Monitoring Programme database (http://jncc.defra.gov.uk/smp/Default.aspx), except for Cemlyn Bay counts for 2016 (Application Reference Number: 6.4.89) and 2017 [RD248].

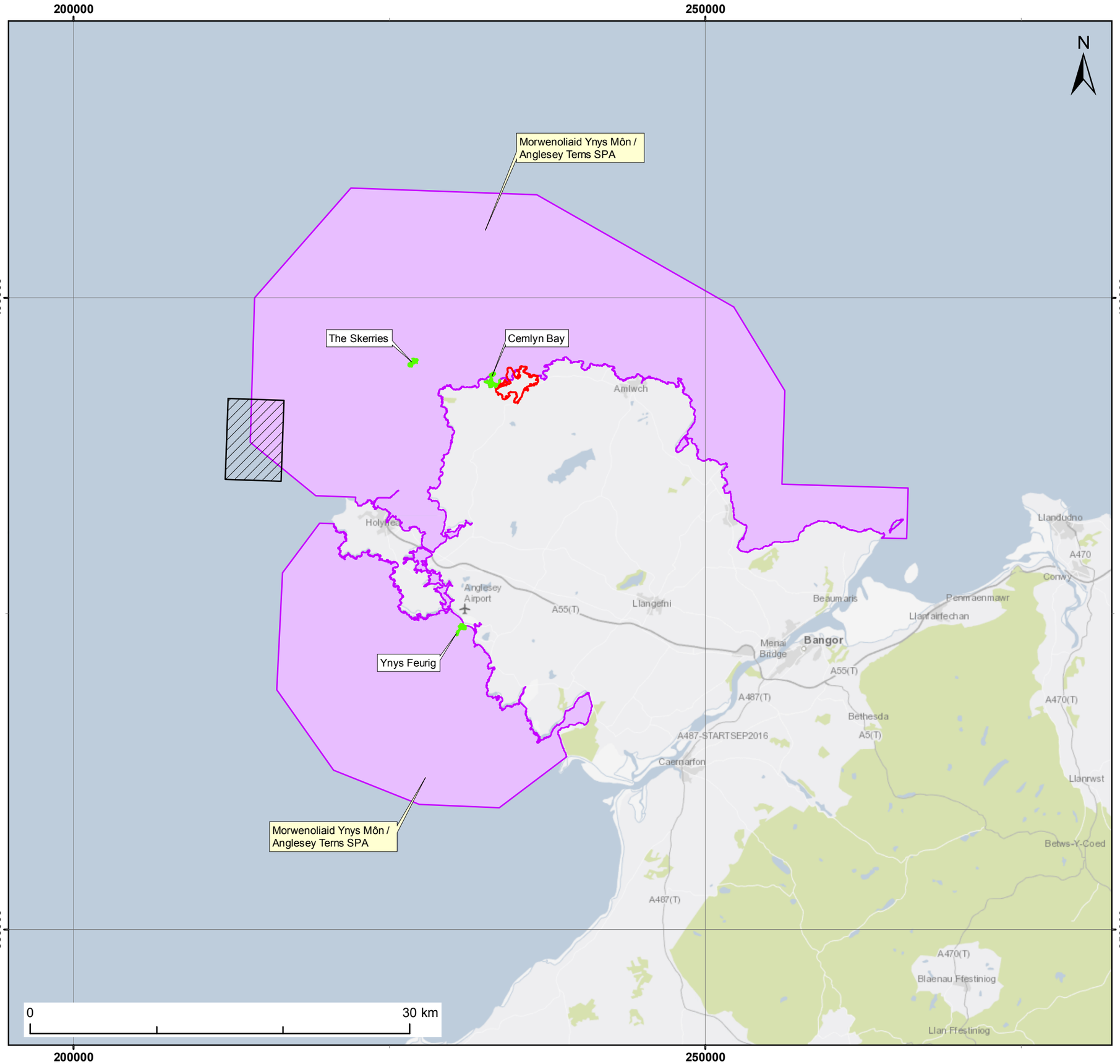
6.5.4 The SPA tern populations are distributed between the three different breeding colonies of Ynys Feurig, Cemlyn Bay and The Skerries within the SPA (figure 6-10, table 6-6). Sandwich terns are essentially restricted to the

[6] The most recent readily available counts of common and Arctic tern across the whole SPA are for 2011, because no subsequent counts are available from the Ynys Feurig colony. Sandwich terns now breed only at Cemlyn Bay, so that the 2017 count from this colony is taken to represent the SPA population.

Cemlyn Bay colony, whilst the majority of Arctic terns nest on The Skerries (84% in 2011, the most recent year with counts across all three colonies) and common terns are more evenly distributed across the three colonies. The numbers of common terns nesting at Cemlyn Bay, the closest colony to the Wylfa Newydd Development Area, have shown relatively marked variability in recent years, with the lowest of the most recent five annual counts being 20% of the peak annual count in that period (table 6-6).

6.5.5 The 2017 population estimate for Sandwich tern is lower than in the last two years (when numbers of breeding pairs were estimated to exceed 2600), but similar to the estimates for 2012 and 2013 (with approximately 2,000 breeding pairs in each year). The five-year mean count for 2013-2017 is 2,398 breeding pairs (table 6-6). The reduction in the reported numbers of Sandwich tern in 2017 was coincident with abandonment of the colony during the late incubation / early chick-rearing period, which appeared to be due to heavy predation of eggs and chicks by otters which were frequently recorded visiting the nesting islands at dusk [RD248]. The colony abandonment occurred over approximately two weeks, with the recorded numbers of Sandwich terns declining from a peak count of 2,000 individuals at the colony, recorded between 4 June and the morning of 10 June, to 1,200 by the afternoon of 10 June and then subsequently from 1,200 on 13 June to 160 by 19 June and 15 by 23 June (figure 6-11). The common and Arctic terns also abandoned the colony at the same time as the Sandwich terns.

6.5.6 It is unclear whether the colony abandonment and otter predation in 2017 were involved in causing the lower numbers of Sandwich terns recorded at the Cemlyn colony in 2017. It is also possible that the predation events in the colony prevented the 2017 count from being fully comparable to those from previous years, in terms of methods and timings [RD248]. There appeared to be no indications that birds were deterred from attempting to breed, with laying and incubation appearing to proceed as in other years (up until nests were depredated) [RD248].



Legend

- WNDA
- Disposal Site

Tern Colonies

- Ynys Feurig, Cemlyn Bay and The Skerries

Special Protection Area (SPA)

- Morwenoliaid Ynys Môn /Anglesey Terns

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Client: HORIZON NUCLEAR POWER

Project: Wylfa Newydd Project

Title: The location of the tern breeding colonies within the Morwenoliaid Ynys Môn /Anglesey Terns SPA

Figure: 6-10

Revision:	Date:	Drawn:	Checked:	Size:	Scale:
2	17/01/2018	TC	MG	A3	1:300,000
1	24/08/2017	TC	MG	A3	1:300,000

Co-ordinate system: British National Grid

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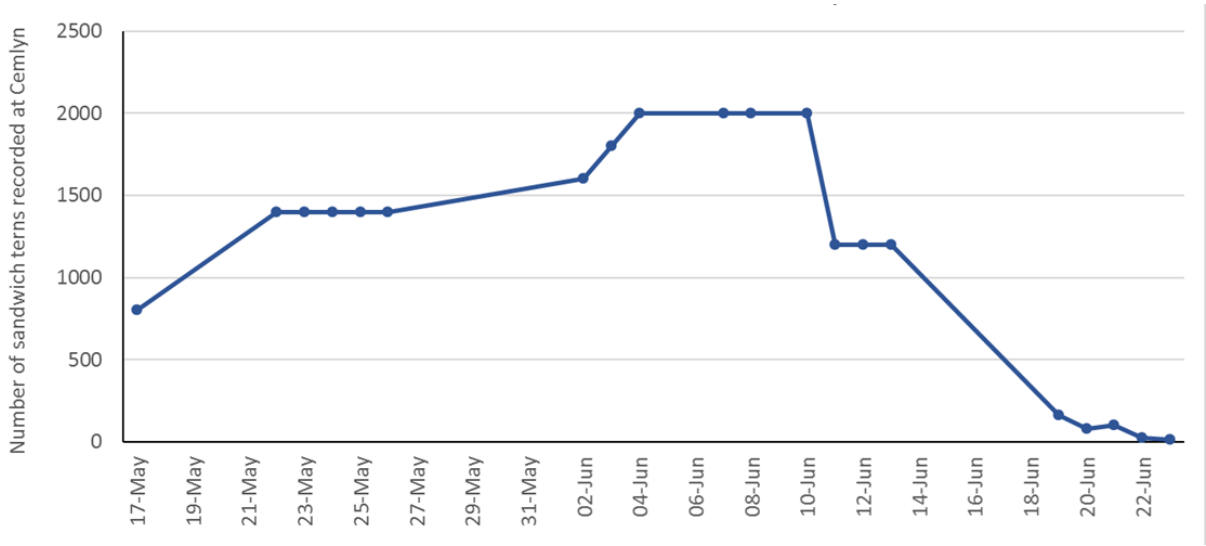

Figure 6-11 Seasonal variation in the approximate number of Sandwich terns (individuals) present at the Cemlyn Bay colony in 2017; the dates on which baseline disturbance surveys were undertaken are also shown (blue circles)

6.5.7 Years of complete breeding failure have been reported previously for all of the tern species breeding in the SPA (Application Reference Number: 6.4.89). In the case of Sandwich terns, complete and near-complete breeding failure occurred in 2007 and 2008, respectively, with predation by herons considered to be the cause in this instance [RD247]. A sharp reduction in the Sandwich tern SPA population followed the 2007 breeding failure, with the estimated number of pairs declining from 1,212 in 2007 to 409 in 2008, although numbers recovered to an estimated 1,024 pairs in 2009, despite the near-complete breeding failure in 2008 (Application Reference Number: 6.4.89, after [RD164]). Annual breeding success of Sandwich terns at Cemlyn Bay has tended to be lower since 2008 (at 0.45 – 0.88 chicks per pair, see also table 6-6) than during the mid-1990s to mid-2000s (when breeding success was close to, or above, 1 chick per pair in most years) (Application Reference Number: 6.4.89, after [RD164]).

6.5.8 Marked fluctuations in colony population sizes are a characteristic of Sandwich tern, which is considered to exhibit the most erratic population trends and distribution of any seabird species breeding in the UK [RD215]. Such fluctuations arise from a combination of large variations in the proportion of mature birds attempting to breed in any year and of mass inter-year movements between colonies, and they are often associated with predation events at colonies [RD215]. Such predation events can be a cause of colony abandonment where they occur over successive years, and particularly where they involve mammalian predators [RD215]. These traits are particularly well documented at the Scolt Head and Blakeney Point colonies, which are approximately 20km distant from each other, and which have alternated periodically as the main breeding sites for the species in North Norfolk since the growth of the Blakeney Point colony in the 1970s ([RD215], Stubbings 2012). Much of the switching between these colonies

can be attributed to predation, although localised changes in prey availability could also contribute ([RD215], [RD257]).

6.5.9 Trends in breeding success for the common tern and Arctic tern SPA populations appear broadly similar to those for Sandwich tern in that the annual breeding success of both species shows evidence of having declined in recent years (Application Reference Number: 6.4.89, after [RD164]). However, recent breeding success data for the Ynys Feurig colony are lacking (with the last reported data on JNCC's Seabird Monitoring Programme being from 2006 [RD164]). Also, during the late 1990s and early 2000s, the annual breeding success of both common tern and Artic tern tended to be higher than for Sandwich tern during this period, ranging from 1.5 to 2 chicks per pair. This pattern of lower breeding success in recent years is not apparent amongst the small numbers of common tern and Arctic tern breeding at Cemlyn Bay, for which there is greater year-to-year variation and for which there were several years in the late 1990s and early 2000s with complete, or near complete, breeding failure (Application Reference Number: 6.4.89, after [RD164]).

6.5.10 Overall, annual breeding success of Sandwich terns at the Cemlyn Bay colony averaged 0.43 chicks per pair between 2013 and 2017 (table 6-6). The most recently available breeding success data for common terns and Arctic terns at Cemlyn Bay are for the five-year period from 2011 to 2015, with the values being between 0.52 and 0.41 chicks per pair, respectively. The recent breeding success estimates reported for common terns and Arctic terns on the Skerries are higher, particularly for common terns (table 6-7).

Table 6-7 Breeding success of terns at Cemlyn Bay and The Skerries

Colony (and five year period)	Species	Mean number of chicks per pair per annum
Cemlyn Bay (2013 – 17 for Sandwich tern; 2011 – 15 for the other species)*	Sandwich tern	0.43
	Common tern	0.52
	Arctic tern	0.41
The Skerries (2009 – 13)	Common tern	1.00
	Arctic tern	0.54

*At the time of writing, 2011–15 was the most recent five year period for which annual breeding success data are available for Cemlyn Bay on the Seabird Monitoring Programme database. For Sandwich tern, the 2016 estimate was available from NWWT wardens (Application Reference Number: 6.4.89), allowing the 2013 – 17 estimate to be provided. For comparison, the 2011 – 15 estimate for Sandwich tern is 0.58 chicks per pair per annum.

Data derived from the Seabird Monitoring Programme database http://jncc.defra.gov.uk/smp/Default.aspx and [RD248].

6.5.11 The potential for an LSE to arise with respect to the Morwenoliaid Ynys Môn/Anglesey Terns SPA as a result of the Project was determined as part of the Stage 1 Screening assessment (table F1, appendix F), with all four tern species that are qualifying features of the SPA having potential

connectivity to the ZoIs associated with the Wylfa Newydd Development Area and the Disposal Site (subsequently referred to as the Project ZoIs).

6.5.12 The breeding colonies comprising the Morwenoliaid Ynys Môn/Anglesey Terns SPA are the only tern colonies within the mean maximum breeding season foraging ranges of the Project ZoIs ([RD215], [RD330]). Additionally, predictive modelling of the usage of the marine environment by breeding terns around individual UK SPA colonies indicates that only the foraging ranges of birds from the Morwenoliaid Ynys Môn/Anglesey Terns SPA colonies overlap with the Project ZoIs (figures 6-12 to 6-18, [RD362]). Therefore, no other tern SPA colonies are considered to have connectivity to the Project ZoIs and for the most part all terns recorded in the breeding season during the site-specific surveys (Application Reference Number: 6.4.89) are assumed to derive from the Morwenoliaid Ynys Môn/Anglesey Terns SPA, although it is feasible that a proportion could be non-breeders or passage birds.

Baseline disturbance levels at the Cemlyn Bay colony and the associated behavioural responses of nesting terns

6.5.13 Surveys undertaken at the Cemlyn Bay colony during the 2017 breeding season documented the baseline levels of disturbance experienced at the colony and the response of terns to disturbance events (Application Reference Number: 6.4.89).

6.5.14 A total of 38 surveys, each of two hours duration, were undertaken from 17 May to 23 June, after which time the colony was abandoned by all nesting terns (see above). Twenty-two of these 38 surveys were completed before any declines in colony attendance were recorded (on 10 June), with 30 completed before the numbers of Sandwich terns recorded at the colony fell below 1000 birds (after 13 June). Thus, the majority of these surveys were undertaken before the start of the recorded colony abandonment, with a relatively small proportion (c.20%) undertaken when few terns remained at the colony (figure 6-11).

6.5.15 The survey period encompassed the main egg laying to early chick-rearing period for tern species breeding in the Cemlyn Bay colony. Surveys spanned a range of the daylight hours (from early morning to late evening) and days of the week (to include weekends as well as week days). Sources of noise and visual disturbance were recorded during the surveys, including those of anthropogenic origin and from potential predators, and other species. Noise levels were monitored at the colony during 34 of these surveys (Application Reference Number: 6.4.89).

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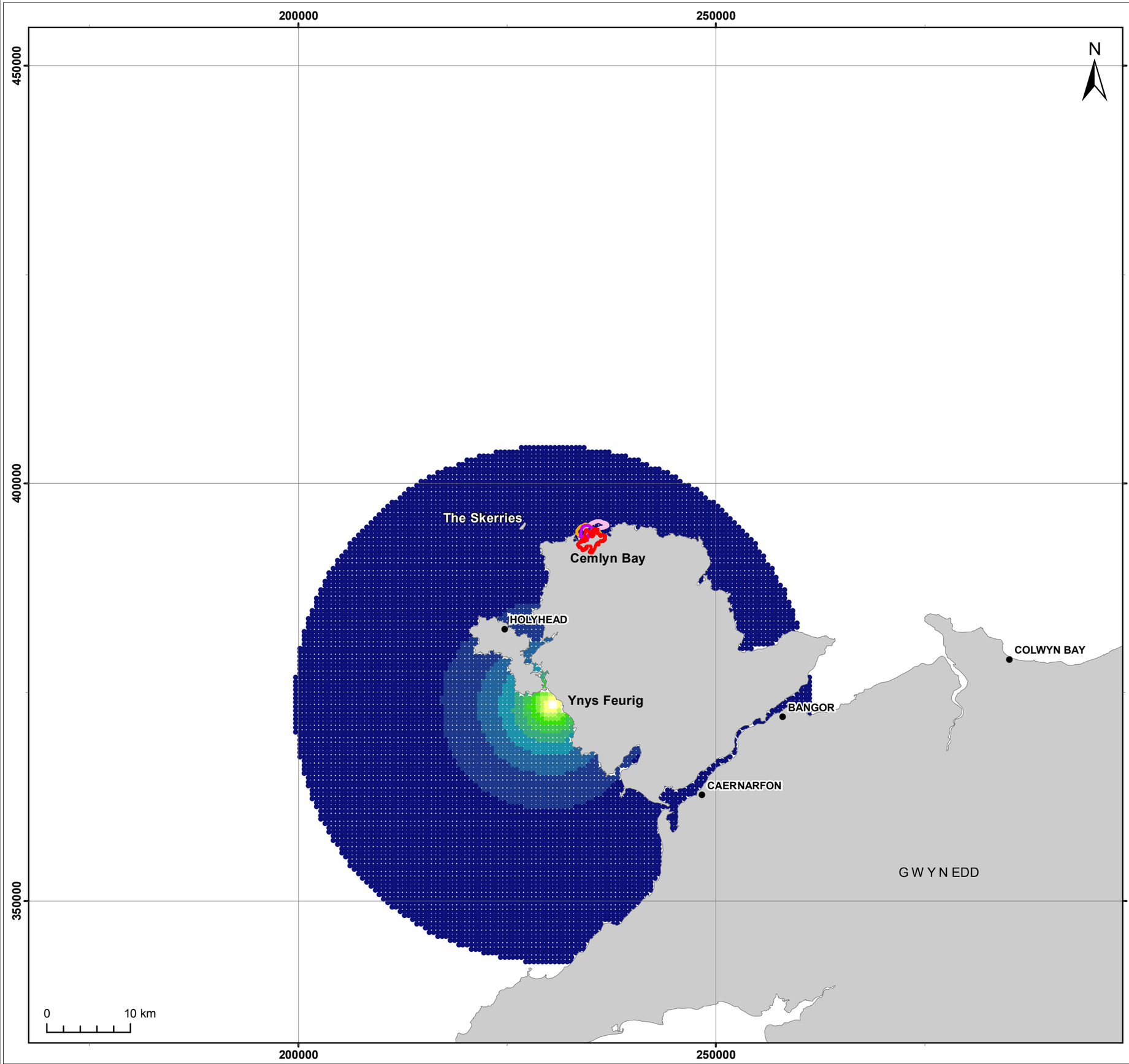

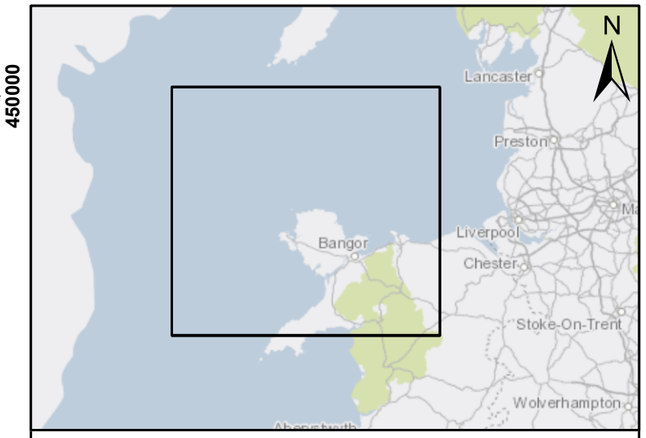

Legend

- WNDA
- Offshore visual disturbance ZOI
- Offshore airborne noise ZOI (as defined by the 65db contour)
- Thermal plume ZOI (2°C increase in sea surface temperature; annual base case (no wind))

Usage

- 0.00 - 0.09
- 0.10 - 0.33
- 0.34 - 0.74
- 0.75 - 1.38
- 1.39 - 2.24
- 2.25 - 3.54
- 3.55 - 5.19
- 5.20 - 8.02
- 8.03 - 12.84
- 12.85 - 18.24

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Client: HORIZON NUCLEAR POWER

Project: Wylfa Newydd Project

Title: Predicted Arctic tern usage for Ynys Feurig

Figure: 6-12

Revision:	Date:	Drawn:	Checked:	Size:	Scale:
1	17/01/2018	TC	MG	A3	1:450,000
0	28/06/2017	TC	MG	A3	1:450,000

Co-ordinate system: British National Grid

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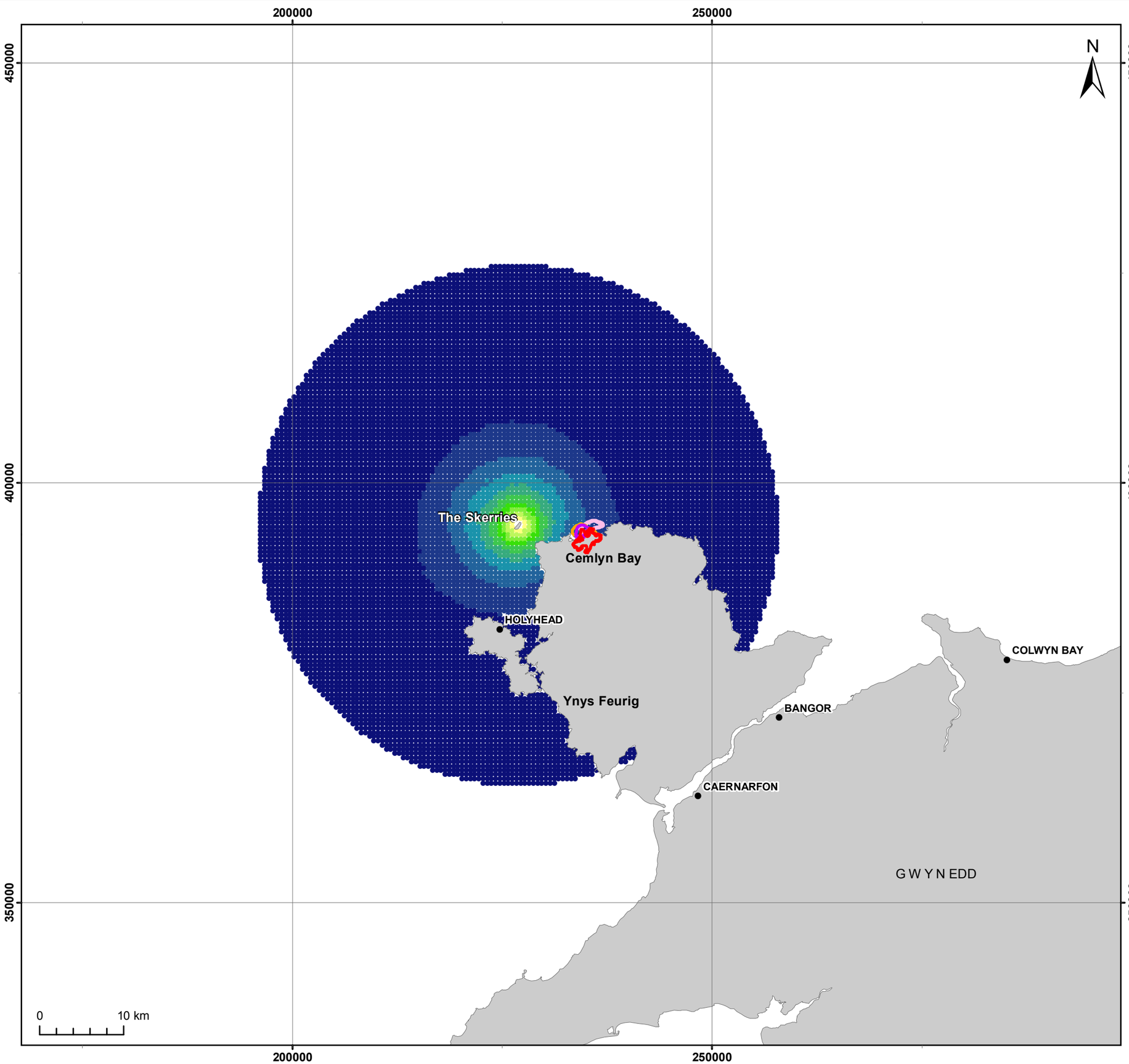

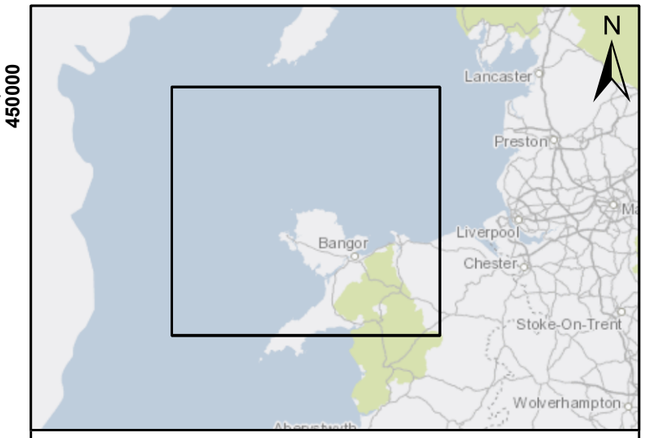

Legend

- WNDA
- Offshore visual disturbance ZOI
- Offshore airborne noise ZOI (as defined by the 65db contour)
- Thermal plume ZOI (2°C increase in sea surface temperature; annual base case (no wind))

Usage

- 0.00 - 0.07
- 0.08 - 0.24
- 0.25 - 0.51
- 0.52 - 0.89
- 0.90 - 1.45
- 1.46 - 2.18
- 2.19 - 3.18
- 3.19 - 4.76
- 4.77 - 8.07
- 8.08 - 12.13

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Client: HORIZON NUCLEAR POWER

Project: Wylfa Newydd Project

Title: Predicted Arctic tern usage for The Skerries

Figure: 6-13

Revision:	Date:	Drawn:	Checked:	Size:	Scale:
1	17/01/2018	TC	MG	A3	1:450,000
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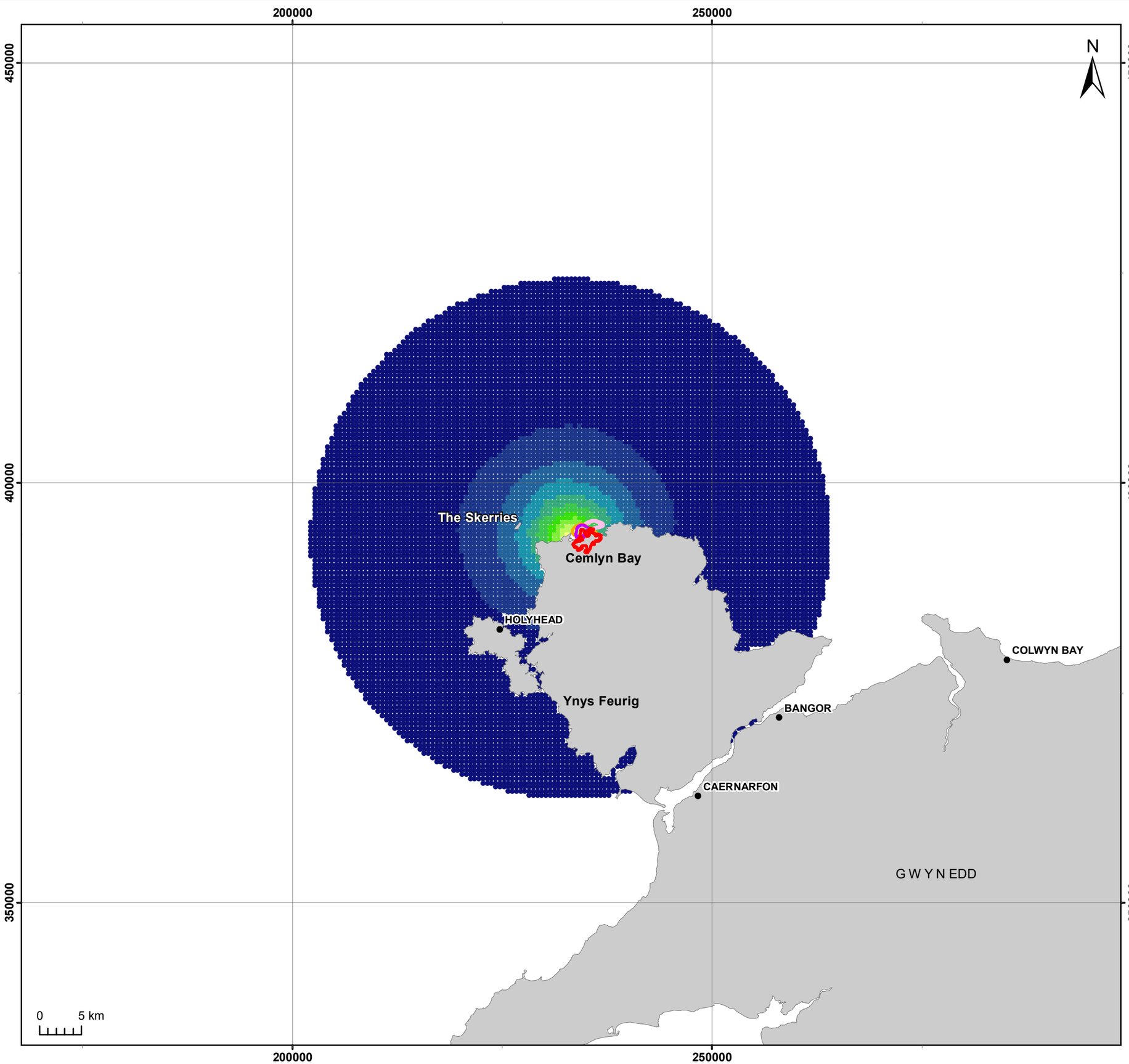

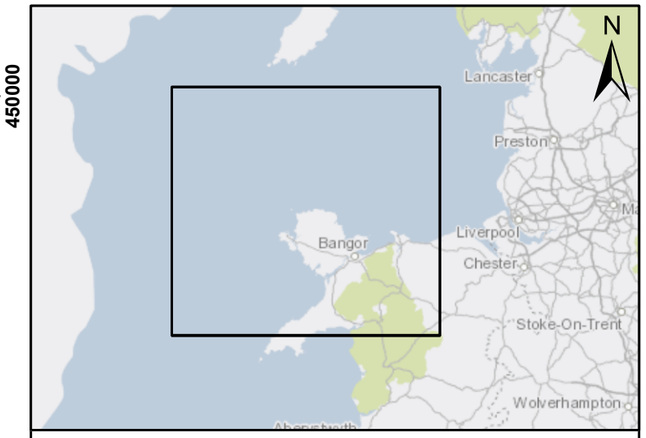

Legend

- WNDA
- Offshore visual disturbance ZOI
- Offshore airborne noise ZOI (as defined by the 65db contour)
- Thermal plume ZOI (2°C increase in sea surface temperature; annual base case (no wind))

Usage

- 0.00 - 0.09
- 0.10 - 0.30
- 0.31 - 0.65
- 0.66 - 1.16
- 1.17 - 1.94
- 1.95 - 3.11
- 3.12 - 4.74
- 4.75 - 7.78
- 7.79 - 12.97
- 12.98 - 20.98

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Client: HORIZON NUCLEAR POWER

Project: Wylfa Newydd Project

Title: Predicted Arctic tern usage for Cemlyn Bay

Figure: 6-14

Revision:	Date:	Drawn:	Checked:	Size:	Scale:
1	17/01/2018	TC	MG	A3	1:450,000
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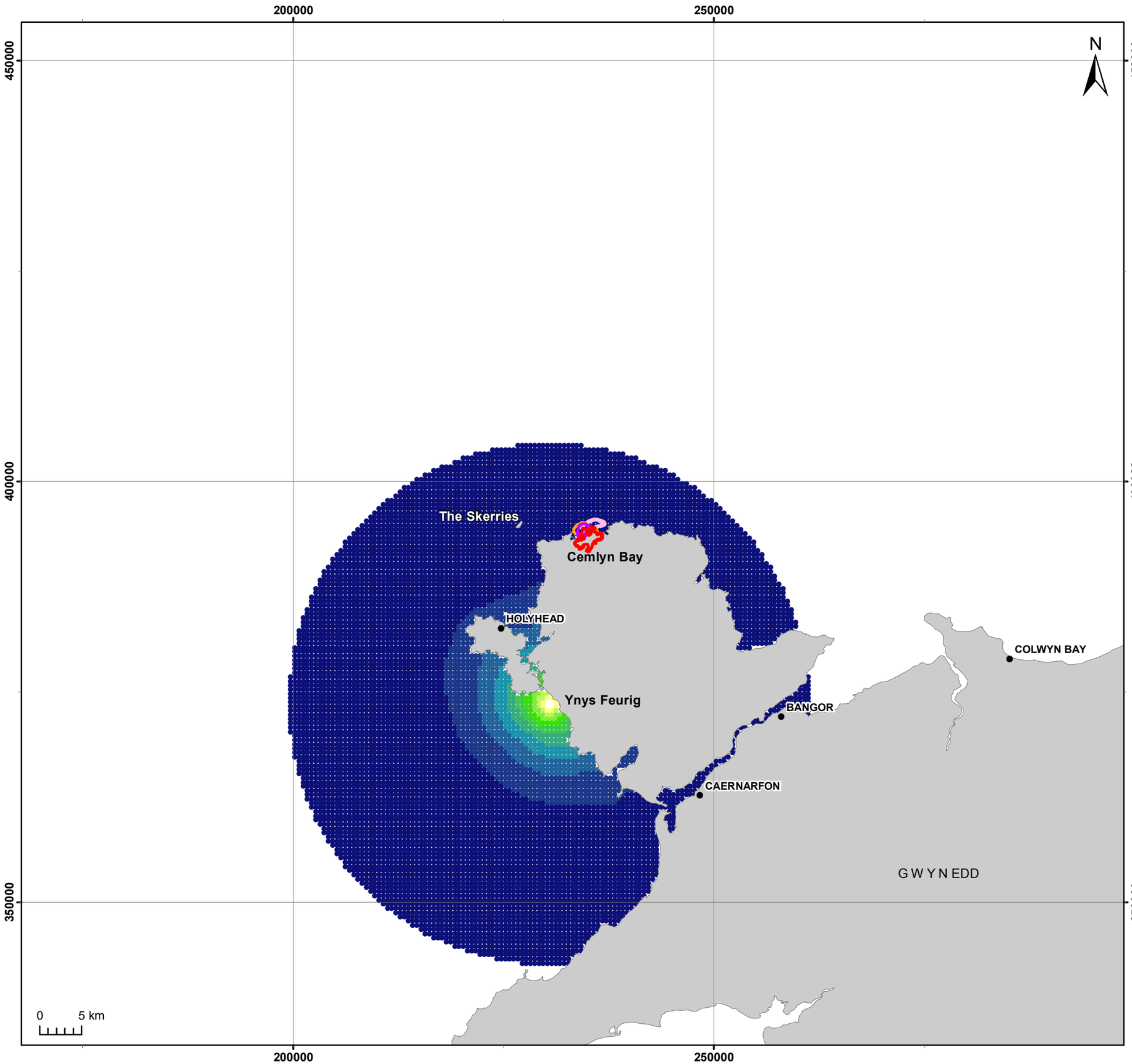

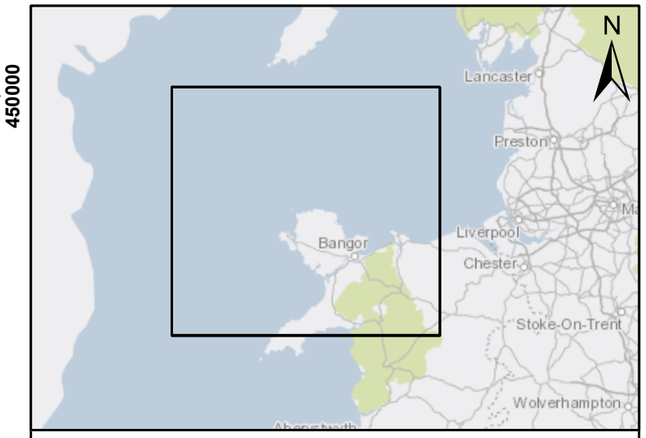

Legend

- WNDA
- Offshore visual disturbance ZOI
- Offshore airborne noise ZOI (as defined by the 65db contour)
- Thermal plume ZOI (2°C increase in sea surface temperature; annual base case (no wind))

Usage

- 0.00 - 0.08
- 0.09 - 0.30
- 0.31 - 0.66
- 0.67 - 1.21
- 1.22 - 2.08
- 2.09 - 3.40
- 3.41 - 5.42
- 5.43 - 8.64
- 8.65 - 13.71
- 13.72 - 20.05

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Client: HORIZON NUCLEAR POWER

Project: Wylfa Newydd Project

Title: Predicted Common tern usage for Ynys Feurig

Figure: 6-15

Revision:	Date:	Drawn:	Checked:	Size:	Scale:
1	17/01/2018	TC	MG	A3	1:450,000
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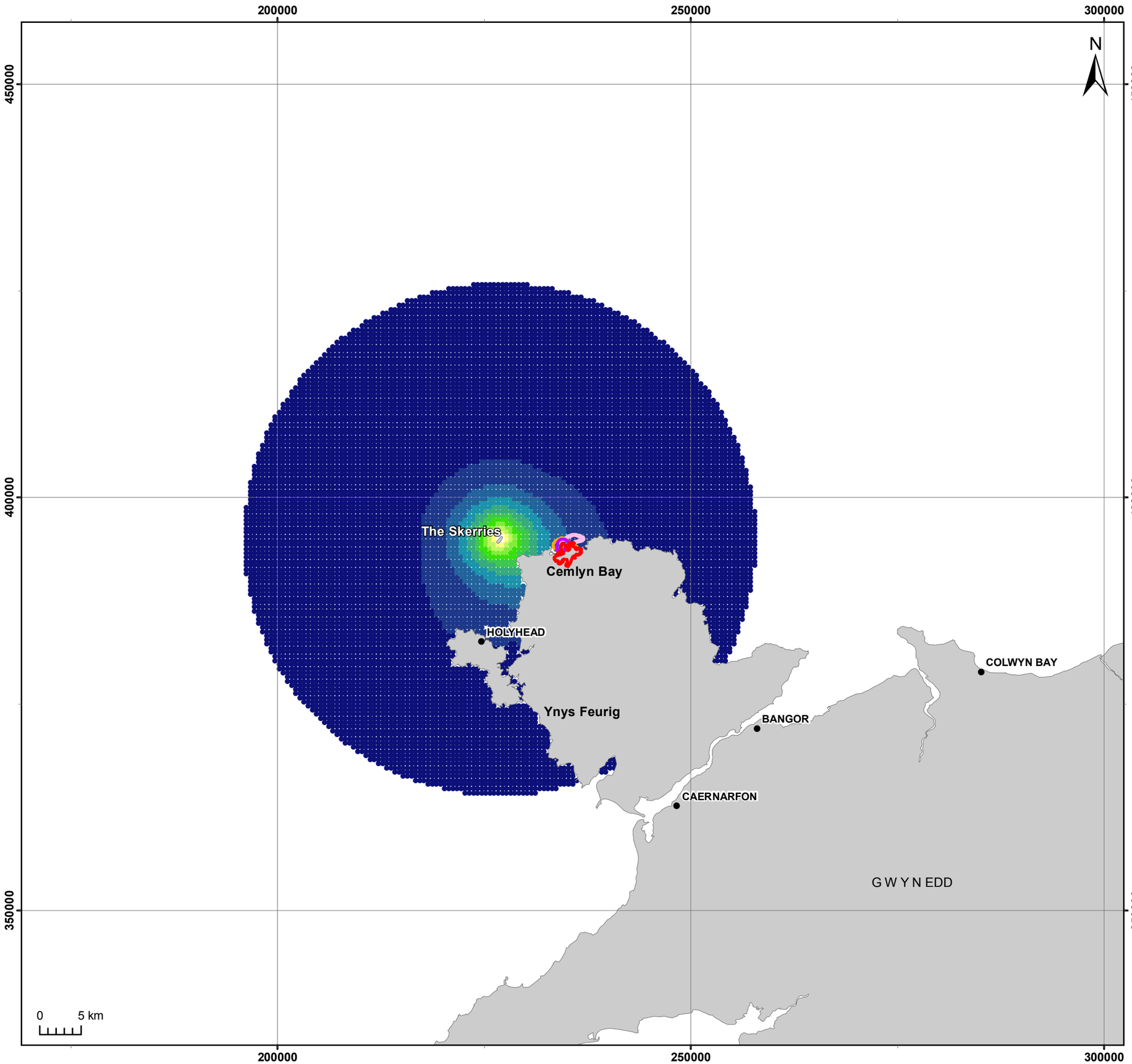

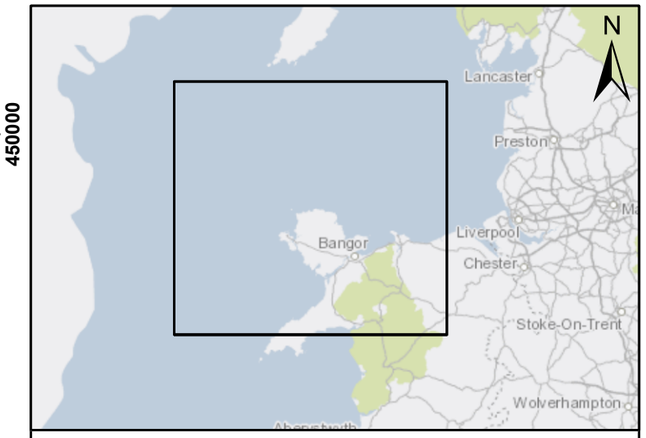

Legend

- WNDA
- Offshore visual disturbance ZOI
- Offshore airborne noise ZOI (as defined by the 65db contour)
- Thermal plume ZOI (2°C increase in sea surface temperature; annual base case (no wind))

Usage

- 0.00 - 0.08
- 0.09 - 0.29
- 0.30 - 0.59
- 0.60 - 1.04
- 1.05 - 1.67
- 1.68 - 2.51
- 2.52 - 3.77
- 3.78 - 6.02
- 6.03 - 10.11
- 10.12 - 14.81

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Project: Wylfa Newydd Project

Title: Predicted Common tern usage for The Skerries

Figure: 6-16

Revision:	Date:	Drawn:	Checked:	Size:	Scale:
1	17/01/2018	TC	MG	A3	1:458,314
0	28/06/2017	TC	MG	A3	1:458,314

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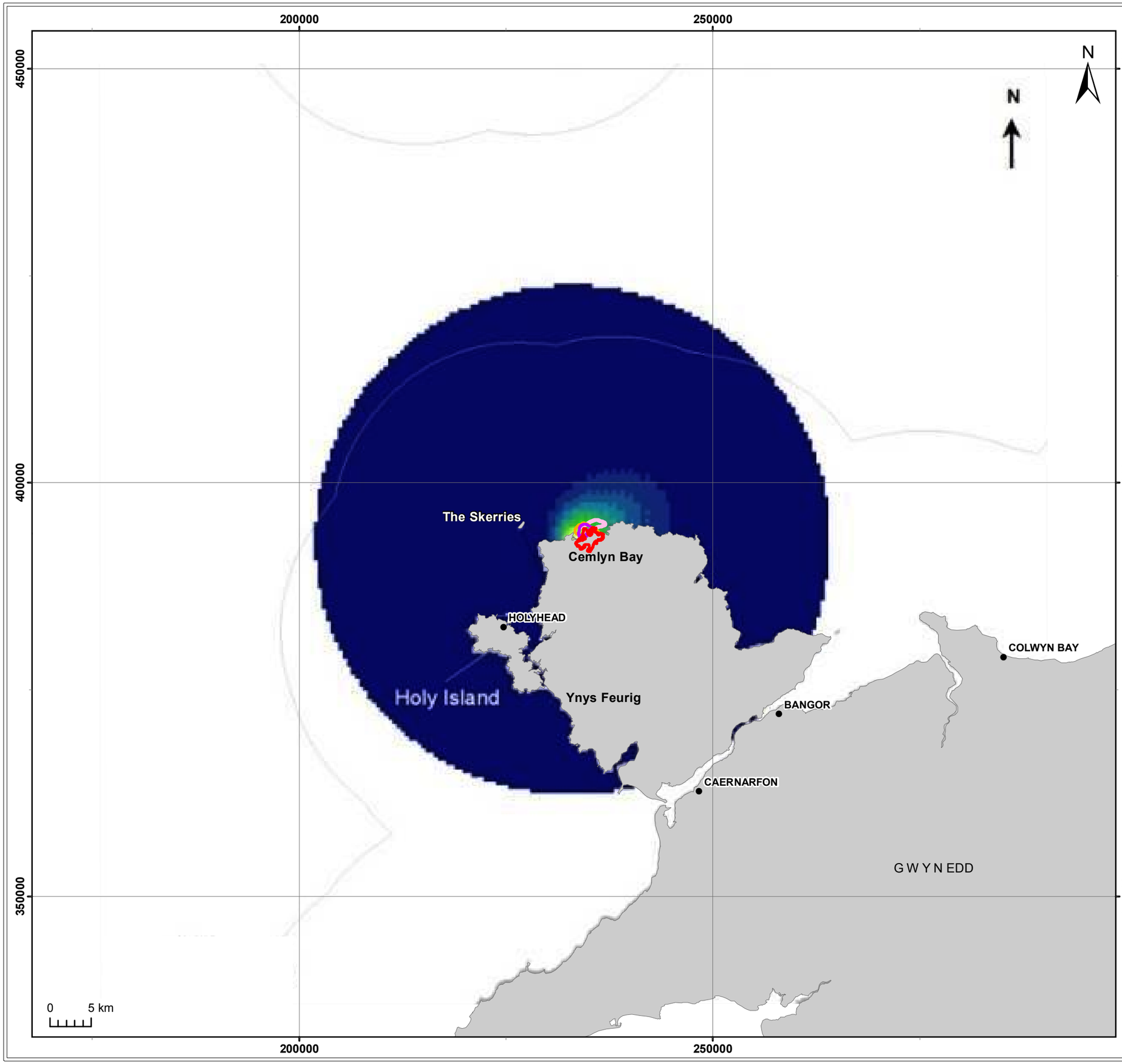

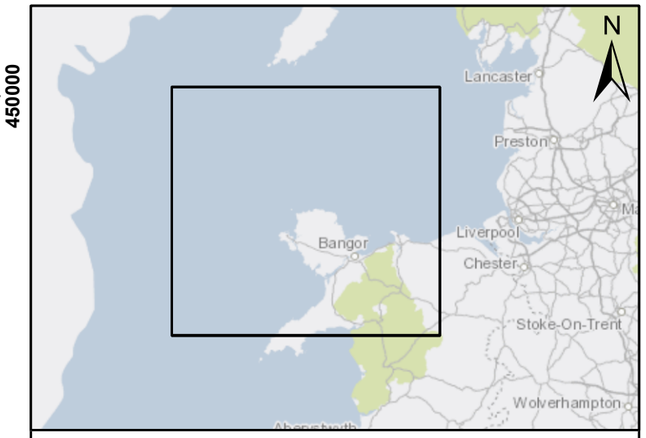

Legend

- WNDA
- Offshore visual disturbance ZOI
- Offshore airborne noise ZOI (as defined by the 65db contour)
- Thermal plume ZOI (2°C increase in sea surface temperature; annual base case (no wind))

Usage

- 0.00 - 0.19
- 0.20 - 0.67
- 0.68 - 1.47
- 1.48 - 2.70
- 2.71 - 4.35
- 4.36 - 6.50
- 6.51 - 10.20
- 10.21 - 14.41
- 14.42 - 26.98
- 26.99 - 55.22

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Client: HORIZON NUCLEAR POWER

Project: Wylfa Newydd Project

Title: Predicted Common tern usage for Cemlyn Bay

Figure: 6-17

Revision:	Date:	Drawn:	Checked:	Size:	Scale:
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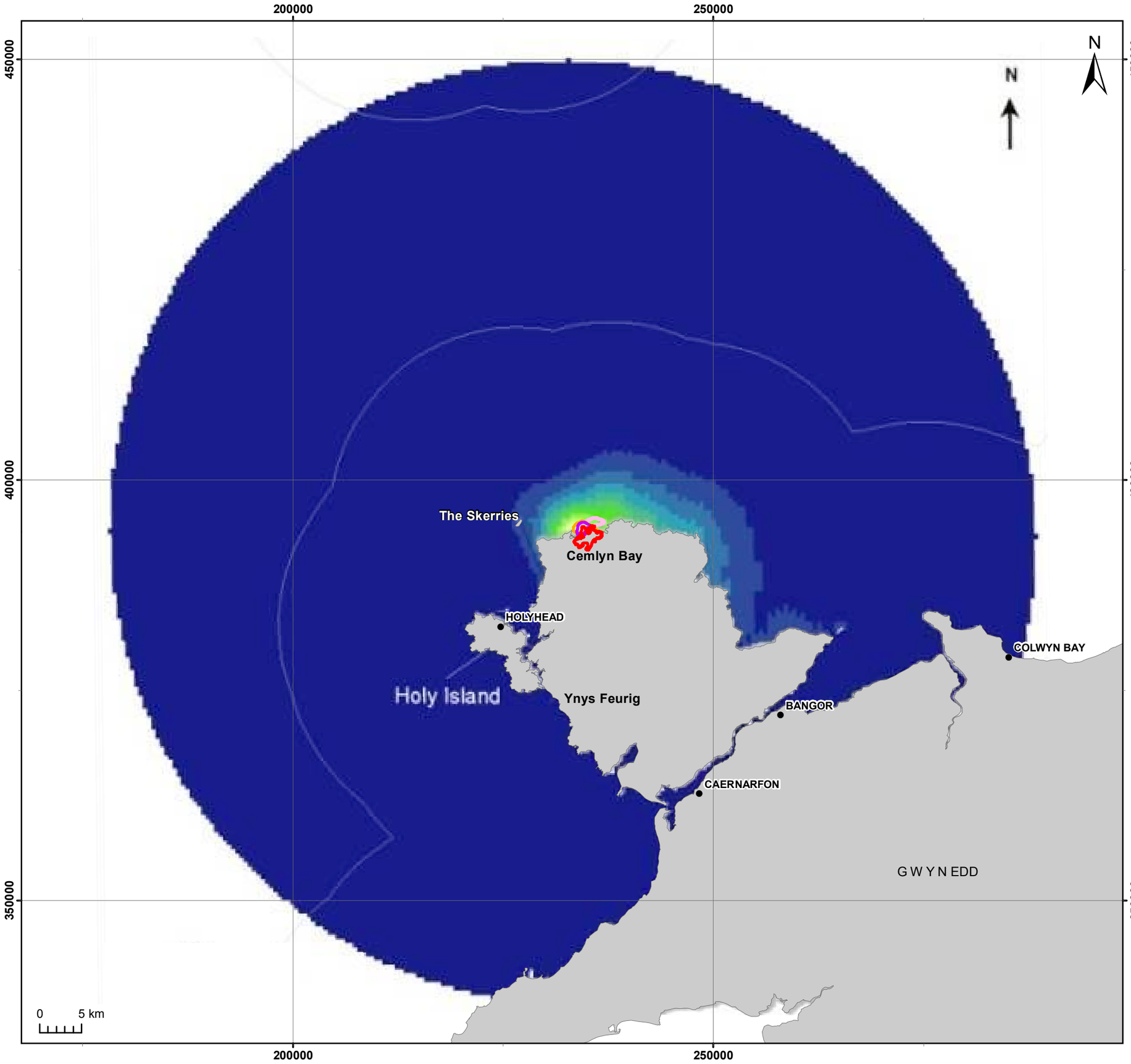

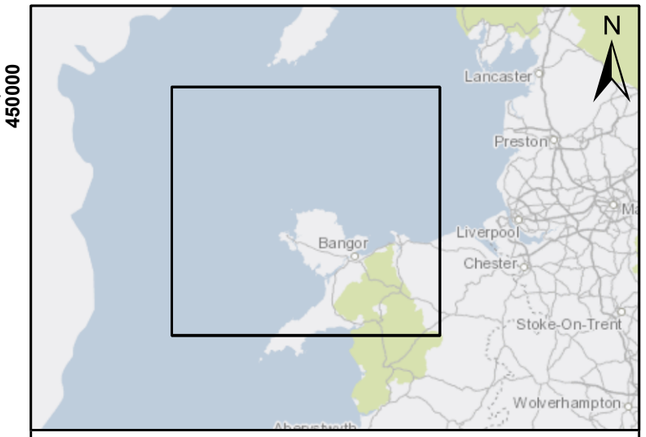

Legend

- WNDA
- Offshore visual disturbance ZOI
- Offshore airborne noise ZOI (as defined by the 65db contour)
- Thermal plume ZOI (2°C increase in sea surface temperature; annual base case (no wind))

Usage

- 0.00 - 0.08
- 0.09 - 0.30
- 0.31 - 0.69
- 0.70 - 1.29
- 1.30 - 2.09
- 2.10 - 3.17
- 3.18 - 4.81
- 4.82 - 8.74
- 8.75 - 15.30
- 15.31 - 28.97

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Client: HORIZON NUCLEAR POWER

Project: Wylfa Newydd Project

Title: Predicted Sandwich tern usage for Cemlyn Bay

Figure: 6-18

Revision:	Date:	Drawn:	Checked:	Size:	Scale:
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6.5.16 The response of terns to disturbance events was recorded following the approach of [RD141] as:

- none;
- sub-flight response (visible on-ground reaction, e.g. raising head);
- fly up (take flight, alarm calling but stay close to colony);
- attack (fly towards disturbance source and mob it); and
- dread (en masse flight from colony in silence).

6.5.17 The approximate number of birds involved in each response was recorded along with the duration of the response. Occurrences of these behaviours in the absence of apparent disturbance were also recorded. The full survey methods are detailed in Application Reference Number: 6.4.89.

6.5.18 Overall, 121 response events by terns were recorded at the colony during the disturbance monitoring surveys, equating to an average of 25.5 responses per day (if a 16 hour day is assumed and such responses do not occur at night). Of these, the vast majority were 'fly up' responses, with only three attack responses and no sub-flight or dread responses (table 6-8). The lack of reported sub-flight responses is likely to be due to the observation methods used, as opposed to an actual absence of such behaviours within the colony. Thus, observations were undertaken across the whole colony (as opposed to being focussed on individual pairs) and this would have made it extremely difficult to distinguish subtle sub-flight responses from other non-flight behaviours, given the high density of birds and considerable levels of activity within the colony. Unsurprisingly, given their greater abundance, responses were more frequent amongst Sandwich terns, which showed an average of approximately three responses per survey, compared to approximately 1.5 for each of the other two species. Approximately two-thirds of all responses involved at least half of the terns that were present at the colony. All but two of the responses involved (but were not necessarily exclusive to) Sandwich terns.

Table 6-8 Frequency of different behavioural responses by breeding terns at Cemlyn Bay

Behaviour	Species	Average number of occurrences per survey period involving		Maximum number of occurrences during a survey	
		≥ 1 bird	≥50 % of birds	≥ 1 bird	≥50 % of birds
Sub-flight response	Sandwich tern	0	0	0	0
	Common tern	0	0	0	0
	Arctic tern	0	0	0	0
Fly up	Sandwich tern	3.11	1.97	8	5

Behaviour	Species	Average number of occurrences per survey period involving		Maximum number of occurrences during a survey	
		≥ 1 bird	≥50 % of birds	≥ 1 bird	≥50 % of birds
	Common tern	1.62	1.22	7	6
	Arctic tern	1.43	0.97	7	6
Attack	Sandwich tern	0.08	0.03	1	1
	Common tern	0.03	0.03	1	1
	Arctic tern	0	0	0	0
Dread	Sandwich tern	0	0	0	0
	Common tern	0	0	0	0
	Arctic tern	0	0	0	0

6.5.19 The majority (66%) of tern responses were in relation to unidentified sources, which may have included conspecific territorial and other social interactions. This finding is unsurprising, given the high density of birds and high activity levels within the colony, and the likely consequent high level of interactions between birds. Certainly, it is not plausible that a significant proportion of these responses to unidentified causes were attributable to disturbance events associated with undetected anthropogenic activities, given that surveys were undertaken by experienced and skilled observers. The recorded presence of potential predatory bird species accounted for 18% of responses (including all three instances of attacks), whilst non-predatory bird species accounted for 5% of responses. Overall, 11% of all responses, representing 13 events over the total 76 hours of observation, were attributed to anthropogenic sources of disturbance.

6.5.20 The duration of the recorded tern responses averaged 53 seconds (range <15 to 1,800 seconds), whilst those relating solely to anthropogenic disturbance averaged 203 seconds (< 20 to 1,800 seconds). The duration of responses to anthropogenic disturbance was skewed by one long event (reserve wardens working on a nesting island), and with this value omitted the average duration was just 43 seconds. Overall, there was notable consistency in the observed tern responses, irrespective of the cause. Thus, the duration of responses to unknown causes, potential predatory bird species, non-predatory bird species and anthropogenic disturbance (excluding the instance of reserve wardens working on the nesting island) averaged 31, 47, 43 and 43 seconds, respectively (Application Reference Number: 6.4.89). Typically, ‘fly up’ responses involved the birds lifting to a height of 5 - 10m (occasionally up to 20m) for this short period and adopting what was described by the surveyors as an ‘umbrella’ formation over the

nesting island before descending again (Application Reference Number: 6.4.89).

6.5.21 The 13 anthropogenic disturbance events derived from a total of 67 recorded occurrences of potential anthropogenic disturbance (so that only 19% of such events elicited responses). Sources of anthropogenic disturbance included overhead aircraft (often fast flying military jets), boats and watercraft in Cemlyn Bay, agricultural activities in nearby fields, dogs and walkers, vehicles on nearby roads, loud noises (e.g. gunshots) and (on one occasion) reserve wardens working on the larger nesting island for a period of 25 minutes. With a few exceptions (e.g. gunshots), these different activities had the potential to cause disturbance from both noise and visual stimuli. People and/or dogs were classed as visual disturbance unless the surveyors recorded associated shouting or barking. For the other activities, their potential to be a source of noise disturbance was determined by visual inspection of the sonogram data and the extent to which the event was associated with a spike in the recorded noise levels (Application Reference Number: 6.4.89). This, of course, did not preclude the possibility that visual stimuli also contributed to any tern response to such events.

6.5.22 The background ambient noise levels at the colony averaged 48.5dB per survey, and varied from 41dB to 68dB between the 34 surveys during which noise levels were monitored. The vast majority of tern responses occurred when noise levels were below the residual peak noise levels, indicating that relatively loud noise was not a main source of disturbance to the colony.

6.5.23 Overhead aircraft (often fast flying jets) were the most frequent source of potential noise disturbance documented during the surveys, being recorded on a total of 40 occasions and from 13 of the 34 surveys for which noise levels were monitored. Tern responses appeared to be associated with overhead aircraft in three instances, with the peak noise levels for these three events ranging from 73dB to 89dB. However, aircraft are a potential source of visual as well as noise disturbance and clear spikes in the sonograms, which were markedly higher than those attributed to residual noise, were apparent for only two of these three events (Application Reference Number: 6.4.89). Peak noise levels for these two events were 78.2dB and 88.8dB (Application Reference Number: 6.4.89). In the third case (with a peak of 73dB), the associated spike recorded on the sonogram was of similar magnitude to those for the residual noise levels recorded close to the time of this event. This event was also associated with a relatively close approach by the aircraft to the colony (estimated to be c.300m).

6.5.24 The peak noise levels associated with the 37 aircraft events to which there were no recorded responses ranged from 57.2dB to 83.5dB and averaged 71.3dB. Coincident spikes in the sonograms were apparent in the majority of these 37 instances, and these were often markedly higher than for residual noise during the same surveys (Application Reference Number: 6.4.89).

6.5.25 Excluding potential disturbance events involving people and/or dogs, only three non-aircraft events were considered to be associated with tern responses. None of these had associated, marked, spikes in the sonograms, with the coincident noise levels for these three events ranging from 50.8dB to 69.7dB and averaging 62.3dB. Noise levels associated with the 12 non-aircraft (and non-people / dog) events which did not elicit responses ranged from 50.1dB to 83.0dB, averaging 67.7dB. Ten of these 12 events showed a coincident spike in the sonogram, although in only three cases was the spike markedly higher than those recorded for residual noise close to the time of each event (Application Reference Number: 6.4.89).

6.5.26 In addition to considering the overall noise levels (i.e. full sonograms of frequencies between 6.5Hz and 23.0kHz), data were examined in terms of high frequencies (4.0kHz – 20.0kHZ), low to mid frequencies (20.0Hz – 4.0kHz) and infra-sound (6.3Hz – 16.0Hz) (Application Reference Number: 6.4.89). Visual inspection of the occurrence of tern responses in relation to the recorded variation in these frequencies provided no indication of any closer correlation than that identified for the full sonograms.

6.5.27 The sonograms provide an indication of the rise times for the noise levels associated with different events, although the resolution of measurement (i.e. maximum noise levels recorded for 1 second periods) was too broad to warrant detailed analyses (Application Reference Number: 6.4.89). Three impulsive noise events with particularly sharp rise times occurred during the surveys, as follows:

- Gunshot: Heard by surveyors in the distance but with no associated spike in the sonogram.
- Slamming of tractor door: Associated with a spike in the sonogram of 75.6dB.
- Slamming of grain door: Associated with a spike in the sonogram of 65.3dB.
- No responses from the terns were recorded in relation to any of these three events (Application Reference Number: 6.4.89).

6.5.28 Responses by terns to people and/or dogs were considered to result from visual stimuli, given the absence of (relatively) loud noise associated with this source of potential disturbance. Seven of the 41 such events produced responses, with these responses occurring when the disturbance source was between 0m and 50m from the colony (with the average distance being 40m). Such events that produced no apparent response from the terns occurred at distances of between 50m and 550m from the colony (averaging 74m) (Application Reference Number: 6.4.89).

6.5.29 None of the three other non-aircraft events which were associated with responses appeared to result from noise stimuli, given the lack of coincident, marked, spikes in the sonograms (as described above). These three events resulted from passing road vehicles and responses occurred when the source was approximately 150m from the colony on each occasion. Other

events associated with road vehicles or agricultural activities that did not appear to elicit a response occurred at distances of between 150m and 685m from the colony (averaging 367m). Additionally, none of the three potential disturbance events occurring on the sea, at distances between 310m and 875m, resulted in responses from the terns (Application Reference Number: 6.4.89).

6.5.30 The findings of these surveys are described in greater detail in Application Reference Number: 6.4.89.

Modelled foraging ranges for the individual SPA colonies

6.5.31 Habitat-association models predicting the use of the marine environment by the respective tern species have been produced for each of the three colonies comprising the Morwenoliaid Ynys Môn/Anglesey Terns SPA (figures 6-12 to 6-18, [RD362]). This involved seven different models (i.e. common tern and Arctic tern models for all three colonies and a Sandwich tern model for Cemlyn Bay). These models are based on visual tracking of individual terns which were likely to be associated with the colony under study [RD258], with the tracking data collected mainly during the chick-rearing period. Foraging ranges of some breeding seabird species, at least, tend to be most constrained during chick-rearing [RD251], whilst there are indications that this may also be the case for Sandwich terns [RD257]. Consequently, impacts on foraging behaviour may be greatest at this stage of the season (at least in terms of the spatial extent of the available foraging range that is affected).

6.5.32 The habitat-association models for Sandwich terns and common terns at the Cemlyn Bay colony were based on colony-specific tracking data, but the remaining five models used pooled data from across the UK colonies at which tracking data were collected for the relevant species [RD362]. These generic models were used for the species-colony combinations for which there were few, or no, colony-specific tracking data. In all models, 'distance to colony' was a key explanatory variable, with usage declining with distance from the colony. Usage was also predicted to decline with distance from the shore for Sandwich terns at Cemlyn Bay and common terns at Ynys Feurig and The Skerries, whilst a small number of other variables (e.g. bathymetry) were important in some models.

6.5.33 Consequently, these models predict that all three species of tern from the Cemlyn Bay colony show high usage of the ZoIs associated with the Wylfa Newydd Development Area, whilst common terns and Arctic terns from The Skerries show moderate usage of these ZoIs, with common terns and Arctic terns from Ynys Feurig showing low usage of these ZoIs [RD362]. All tern species from all three colonies are predicted to show low usage of the Holyhead North ZOI.

6.5.34 Snapshot point count data from boat-based transect surveys support the findings from the modelling of the usage of the marine environment by the Morwenoliaid Ynys Môn/Anglesey Terns SPA tern populations. Thus,

counts undertaken from mid June to early July in 2010 and 2011 show that the preponderance of tern records in the areas offshore of Cemlyn Bay and to the east of Cemlyn Bay are of Sandwich terns, whilst common and Arctic tern records dominate the counts in the areas around The Skerries and Ynys Feurig (see figures 3.4 to 3.6, appendix A of Application Reference Number: 6.4.89).

Site-specific surveys for determining the usage of offshore habitats in relation to ZoIs

Methodology

6.5.35 Data from two types of surveys provided the main source of information on the extent to which terns used the ZoIs that affect the marine environment on which terns depend for foraging. These were boat-based transect surveys of a large area extending out from the north and east coasts of Anglesey (figure 6-19), undertaken using slightly modified ESAS methods [RD34], and visual tracking surveys of individual terns, undertaken using the methods of [RD258]. Additionally, the following further data relating to tern movements and seabird abundance were accessed:

- Kernel density plots of GPS tracking data from Skerries breeding Arctic terns (collected in 2016), obtained from RSPB.
- ESAS boat-based transect data from the vicinity of the Disposal Site, and encompassing the southern part of the Disposal Site, and associated ZOI. These data were obtained from Minesto and are being collected in relation to a proposed tidal turbine project in this area (http://minesto.com/projects/ holyhead-deep). The data were from surveys in August and September 2016, and March to July (inclusive) in 2017, and so comprised the main seabird breeding season months ([RD113]). Restrictions on the permitted use of these data mean that their presentation is limited to summaries of the raw data, as opposed to estimation of bird densities and population sizes in the survey area.

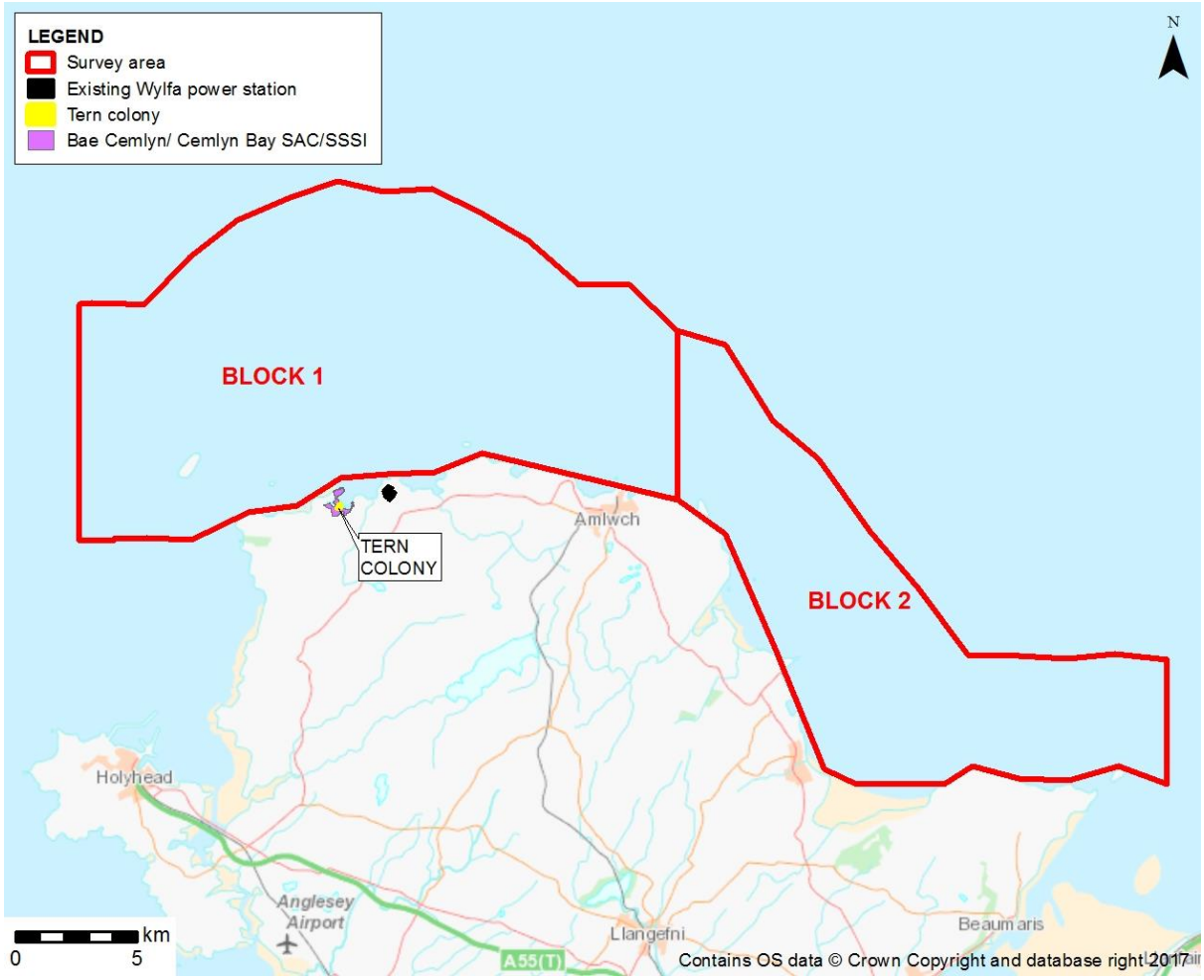

Figure 6-19 Block 1 and Block 2 survey areas

6.5.36 Data on relative levels of tern activity and tern flight lines were also collected from land-based VP surveys at four locations, extending from Cemlyn Bay in the west to Cemaes Bay in the east (figure 6-6). These surveys were undertaken from September 2010 to September 2014; with full details of the methods provided in Application Reference Number: 6.4.89. These data cannot be used to estimate densities and they extend over limited parts of the potential tern foraging ranges only. Therefore, they are unlikely to add significantly to the information provided by the ESAS and visual tracking surveys and are not used to inform the Shadow HRA.

6.5.37 The ESAS surveys were undertaken across two contiguous survey areas, one of which followed the north coast of Anglesey (Block 1), with the second following the east coast of Anglesey (Block 2). Block 1 encompassed an area of 255km^2, and Block 2 an area of 147km^2 (figure 6-19). Transects were spaced at 2km intervals and ran north to south, giving 12 transects in Block 1 (figure 6-19) and 11 in Block 2. The surveys were undertaken at monthly intervals from May 2016 to May 2017 (inclusive), except in June 2016 when two separate surveys were carried out. Surveys in Block 2 were restricted to May to September 2016, with their main purpose being to more

fully encompass the principal foraging areas of Sandwich terns from the Cemlyn Bay colony (figure 6-18).

6.5.38 Densities of seabird species from each survey were estimated from the combined counts of birds on the water and birds in flight. Distance sampling [RD26] was used to correct for the reduced detection of birds on the water with distance from the survey vessel where sample size was sufficient[7], whilst the species-specific correction factors of [RD322] were used in other cases. Full details of the survey and analysis methods are presented in Application Reference Number: 6.4.89.

6.5.39 Visual tracking of terns was undertaken between 22 June to 23 July in 2016, and between 14 and 20 June in 2017, with the 2017 surveys focussed solely on common and Arctic terns (to increase the sample sizes for these species). The tracking surveys were focussed on the Cemlyn Bay colony, with the effort being directed to tracking birds that appeared to be associated with this colony and which were likely to be leaving the colony on foraging trips. Tracked birds were followed for as long as possible, with the aim being to track the full foraging trip (i.e. the outward and return leg from and to the colony) for as many of the tracked birds as was feasible. All foraging attempts (e.g. dives, surface skims and surface dips) of tracked birds were recorded, along with the location and whether the foraging attempt had appeared to be successful. Full details of the survey methods and data recording are presented in Application Reference Number: 6.4.89.

6.5.40 Ideally, the tern tracking surveys should have encompassed the main chick-rearing periods of each of the three tern species, as this is when energetic demands on foraging terns are greatest and when foraging ranges may be most constrained [RD257]. However, delays to the start of the surveys in 2016 meant that they coincided with a time during which many of the surviving chicks were well grown and reaching independence. As such, these surveys may have included a relatively high proportion of birds that were not actively rearing chicks, with a consequent risk that the findings are not representative of the main chick-rearing phase.

6.5.41 To account for the potential problem outlined above, the analogous tracking data collected to inform the modelling of [RD362] at the Cemlyn Bay colony (see above) were sourced. These additional data came from two separate sources, both based on surveys from 2009 (i.e. JNCC and ECON Ecological Consultancy Ltd. Data collection periods were from 9 June to 6 July 2009 and 28 May to 10 July 2009 for the JNCC and ECON surveys, respectively).

6.5.42 Surveys in 2017 were focussed solely on common terns and Arctic terns, with the aim of augmenting the small sample sizes available for these two species (even after incorporation of the 2009 JNCC and ECON data). The start of the 2017 surveys was timed to coincide specifically with the expected

[7] A global detection function was used for each species, so maximising the number of species on which distance sampling could be applied.

hatching period for common and Arctic terns but, as detailed above, the Cemlyn Bay colony was abandoned soon after this time. The surveys that were undertaken in 2017 encompassed a period over which the numbers of both common tern and Arctic tern recorded at the colony remained relatively high for the 2017 breeding season (i.e. 40 common terns and 70 – 90 Arctic terns), and at least some nesting pairs of both species did appear to be present up to the time of the abandonment [RD248].

Summary of findings

6.5.43 Densities of Sandwich terns recorded during the 2016/2017 ESAS surveys peaked during June (table 6-9), with the first June survey giving a peak population estimate of 1,506 birds for the Block 1 survey area and the second June survey giving a peak population estimate of 246 birds in the Block 2 survey area. The markedly higher peak density in Block 1 compared to Block 2 is unsurprising, given the much greater proximity of Block 1 to the Cemlyn Bay colony. However, not all surveys recorded higher Sandwich tern densities in Block 1 than in Block 2, which may reflect the relatively long foraging range of this species.

Table 6-9 Densities (birds/km^2) of Sandwich and common/Arctic terns by survey area, as recorded during the ESAS-type surveys

Year	Survey month	Sandwich tern		Common / Arctic tern	
		Block 1	Block 2	Block 1	Block 2
2016	May	1.30	0.99	2.30	0.29
	June 1	5.90	1.31	1.05	0.00
	June 2	0.81	1.68	2.08	0.00
	July	0.77	0.77	3.87	0.00
	August	0.00	0.00	0.09	0.15
2017	May	0.37	-	3.16	-

* Two separate surveys were undertaken during June 2016.

6.5.44 Consistent with the findings from the earlier Cemlyn Bay Sandwich tern habitat-association model [RD362], areas of highest densities during the ESAS surveys tended to occur to the east of the colony and be relatively close to the shore (figures 6-20 to 6-24).

6.5.45 Due to the problems of distinguishing common terns and Arctic terns during boat-based surveys, these two species were recorded as a combined species group during the ESAS surveys. In the context of the ESAS surveys they are subsequently referred to as ‘commic’ terns. Commic terns were scarce or absent in Block 2, whilst the peak density in Block 1 occurred in July and equated to a peak population estimate of 988 birds in Block 1.

6.5.46 Consistent with the findings of the earlier habitat-association models for both common terns and Arctic terns at the three SPA colonies [RD362], commic tern records from the ESAS surveys were heavily skewed to the western

parts of Block 1 which are closer The Skerries colony (figures 6-25 to 6-29). A wider and more uniform distribution across the Block 1 and 2 survey areas was recorded during the May 2016 survey, which may indicate the occurrence of passage birds or greater, less constrained, foraging ranges during the earlier parts of the breeding season.

6.5.47 Substantially more tracking data were collected for Sandwich terns than for either of the other two tern species (table 6-10). This was true for the tracking surveys undertaken specifically for the current project as well as for both of the earlier tracking data sets that were accessed, and was unsurprising given that tracking was focussed on birds from the Cemlyn Bay colony where Sandwich terns are the most abundant species (table 6-10).

6.5.48 A total of 84 tracks were recorded for Sandwich terns during the 2016 tracking surveys, with 35 of these being complete tracks where the bird was followed out from, and back to, the colony. The 2009 JNCC and ECON tracking surveys used to augment the 2016 data each comprised a larger sample of Sandwich tern tracks (112 and 149, respectively) but with fewer of these being complete tracks (25 and 16, respectively). The causes of these differences in the proportions of complete tracks between the three surveys are unknown but could include differences in weather conditions during the tracking periods, in vessel or vessel operator performance or in the commuting and foraging behaviour of the terns themselves.

6.5.49 Foraging attempts by Sandwich terns appeared to be more frequent during the 2016 surveys than during either of the two earlier surveys, with both the mean number of foraging attempts and the percentage of tracks with foraging attempts being higher during the 2016 surveys (table 6-10). However, differences in the percentage of tracks with foraging attempts were eliminated, and those for the mean number of foraging attempts per track reduced, when comparisons were restricted to the complete tracks. Thus, there were no strong indications of major differences in the foraging effort of Sandwich terns recorded during the different surveys.

240000

260000

400000

380000

N

0 5 km

Legend

- WNDA
- Survey area
- Disposal Site

Grouped Sandwich tern counts (May

- 1 - 10
- 11 - 20
- 21 - 30

Sandwich tern density: count per 10,000 m ^{2}

- 0.0
- 0.1 - 7.8
- 7.9 - 15.5
- 15.6 - 25.1
- 25.2 - 36.4

Heat map expressing the number of Sandwich tern counts in 100m x 100m cell; quartic kernel function bandwidth 1500m; value range from 0 (small number of counts) to 36.4 (large number of counts) per 10,000 square metres.

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Client: HORIZON NUCLEAR POWER

Project: Wylfa Newydd Project

Title: Sandwich tern densities (individuals per ha) with the associated counts from the May 2016 ESAS survey

Figure: 6-20

Revision:	Date:	Drawn:	Checked:	Size:	Scale:
2	17/01/2018	TC	MG	A3	1:160,000
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Co-ordinate system: British National Grid

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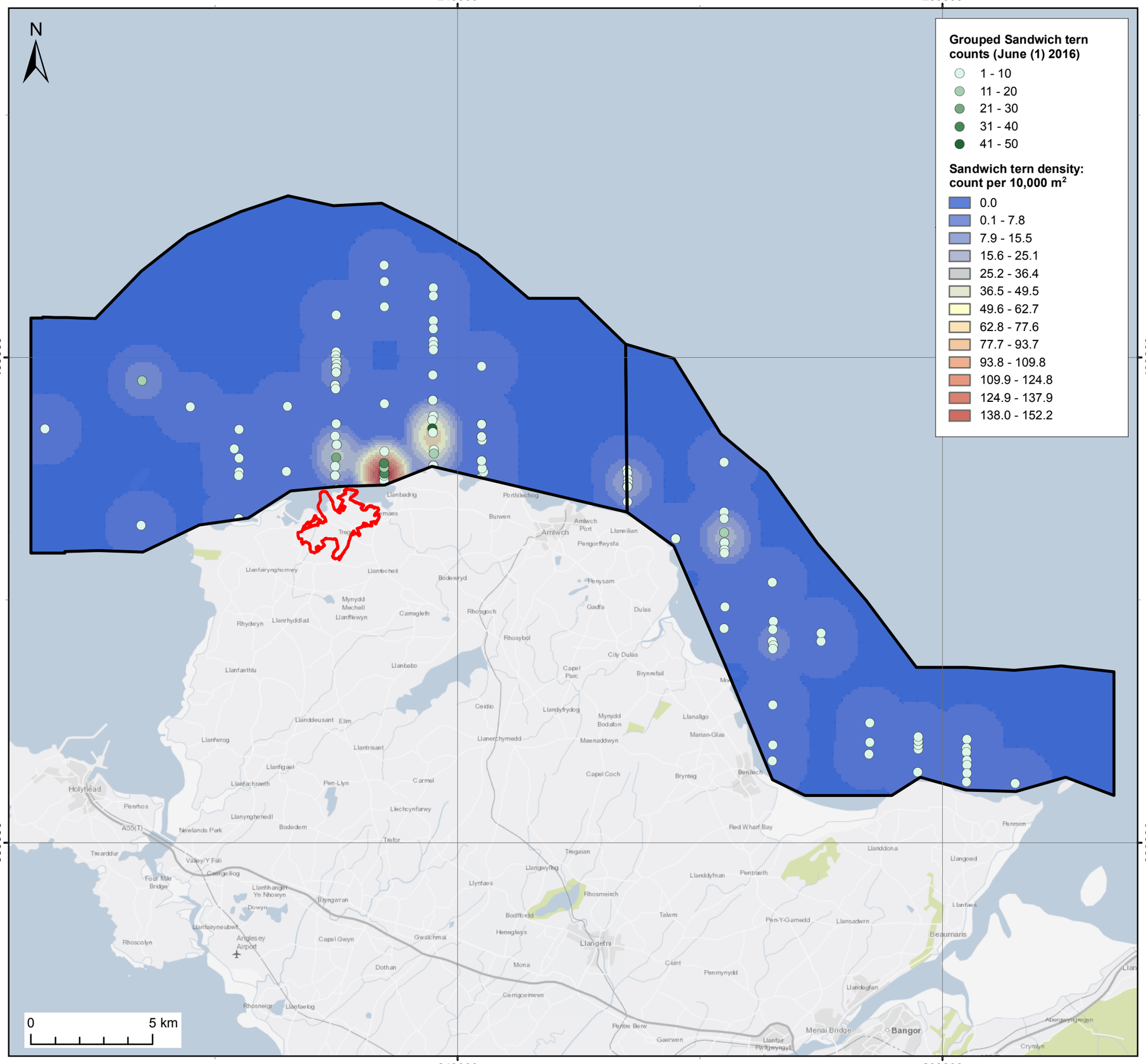

Legend

- WNDA
- Survey area
- Disposal Site

Heat map expressing the number of Sandwich tern counts in 100m x 100m cell; quartic kernel function bandwidth 1500m; value range from 0 (small number of counts) to 152.2 (large number of counts) per 10,000 square metres.

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Project: Wylfa Newydd Project

Title: Sandwich tern densities (individuals per ha) with the associated counts from the June (1) 2016 ESAS survey

Figure: 6-21

Revision:	Date:	Drawn:	Checked:	Size:	Scale:
2	17/01/2018	TC	MG	A3	1:160,000
1	24/08/2017	TC	MG	A3	1:160,000

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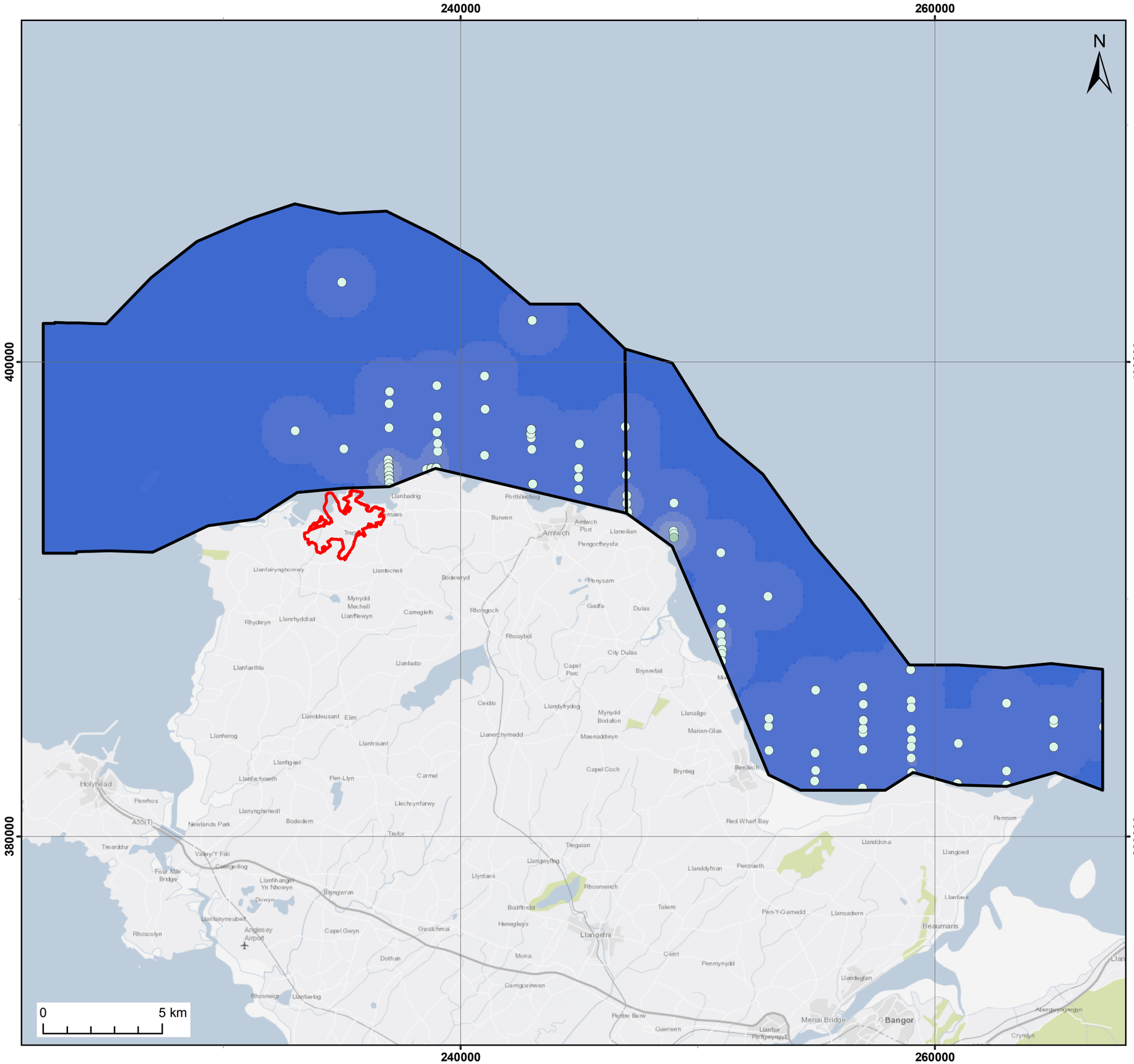

Legend

- WNDA
- Survey area
- Disposal Site

Grouped Sandwich tern counts (June (2) 2016)

- 1 - 10
- 11 - 20

Sandwich tern density: count per 10,000 m²

- 0.0
- 0.1 - 7.8
- 7.9 - 15.5
- 15.6 - 25.1

Heat map expressing the number of Sandwich tern counts in 100m x 100m cell; quartic kernel function bandwidth 1500m; value range from 0 (small number of counts) to 25.1 (large number of counts) per 10,000 square metres.

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Client: HORIZON NUCLEAR POWER

Project: Wylfa Newydd Project

Title: Sandwich tern densities (individuals per ha) with the associated counts from the June (2) 2016 ESAS survey

Figure: 6-22

Revision:	Date:	Drawn:	Checked:	Size:	Scale:
2	17/01/2018	TC	MG	A3	1:160,000
1	24/08/2017	TC	MG	A3	1:160,000

Co-ordinate system: British National Grid

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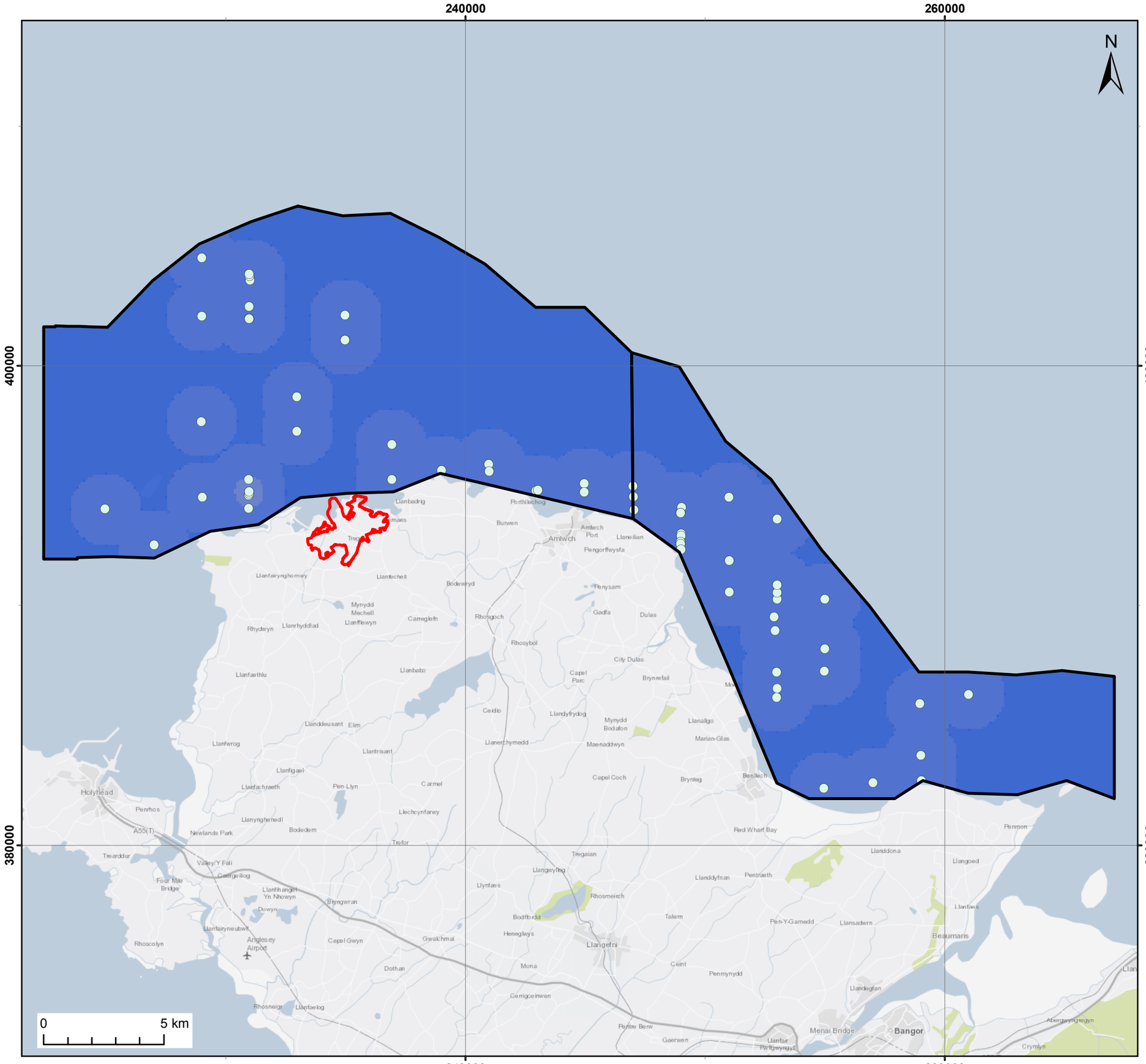

Legend

- WNDA
- Survey area
- Disposal Site

Grouped Sandwich tern counts (July 2016)

- 1 - 10

Sandwich tern density: count per 10,000 m²

- 0.0
- 0.1 - 7.8
- 7.9 - 15.5

Heat map expressing the number of Sandwich tern counts in 100m x 100m cell; quartic kernel function bandwidth 1500m; value range from 0 (small number of counts) to 15.5 (large number of counts) per 10,000 square metres.

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Project: Wylfa Newydd Project

Title: Sandwich tern densities (individuals per ha) with the associated counts from the July 2016 ESAS survey

Figure: 6-23

Revision:	Date:	Drawn:	Checked:	Size:	Scale:
2	17/01/2018	TC	MG	A3	1:160,000
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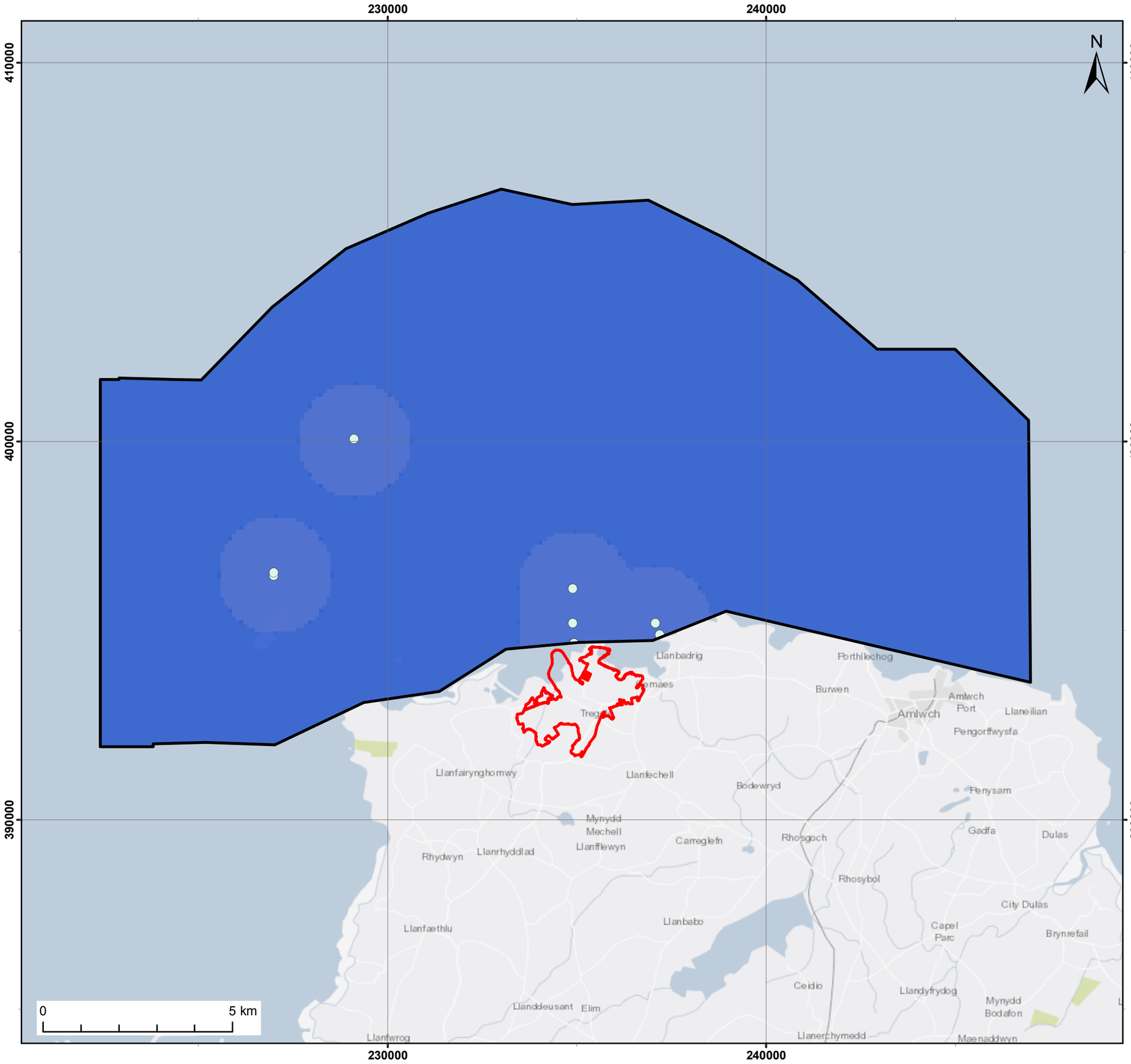

Legend

- WNDA
- Survey area
- Disposal Site

Grouped Sandwich tern counts (May

- 1 - 10

Sandwich tern density: count per 10,000 m

- 0.0
- 0.1 - 7.8

Heat map expressing the number of Sandwich tern counts in 100m x 100m; quartic kernel function bandwidth 1500m; value range from 0 (small number of counts) to 7.8 (large number of counts) per 10,000 square metres.

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Project: Wylfa Newydd Project

Title: Sandwich tern densities (individuals per ha) with the associated counts from the May 2017 ESAS survey

Figure: 6-24

Revision:	Date:	Drawn:	Checked:	Size:	Scale:
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1	24/08/2017	TC	MG	A3	1:100,000

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240000

260000

400000

380000

N

0 5 km

Legend

- WNDA
- Survey area
- Disposal Site

Grouped Commic tern counts (May 2016)

- 1 - 2
- 3 - 5
- 6 - 12
- 13 - 20
- 21 - 30

Commic tern density: count per 10,000 m²

- 0.00
- 0.01 - 8.87
- 8.88 - 15.53
- 15.54 - 22.63
- 22.64 - 30.61

Heat map expressing the number of Commic tern counts in 100m x 100m cells; quartic kernel function bandwidth 1500m; value range from 0 (small number of counts) to 30.61 (large number of counts) per 10,000 square metres.

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Project: Wylfa Newydd Project

Title: Combined densities of Common and Arctic terns (individuals per ha) with the associated counts from the May 2016 ESAS survey

Figure: 6-25

Revision:	Date:	Drawn:	Checked:	Size:	Scale:
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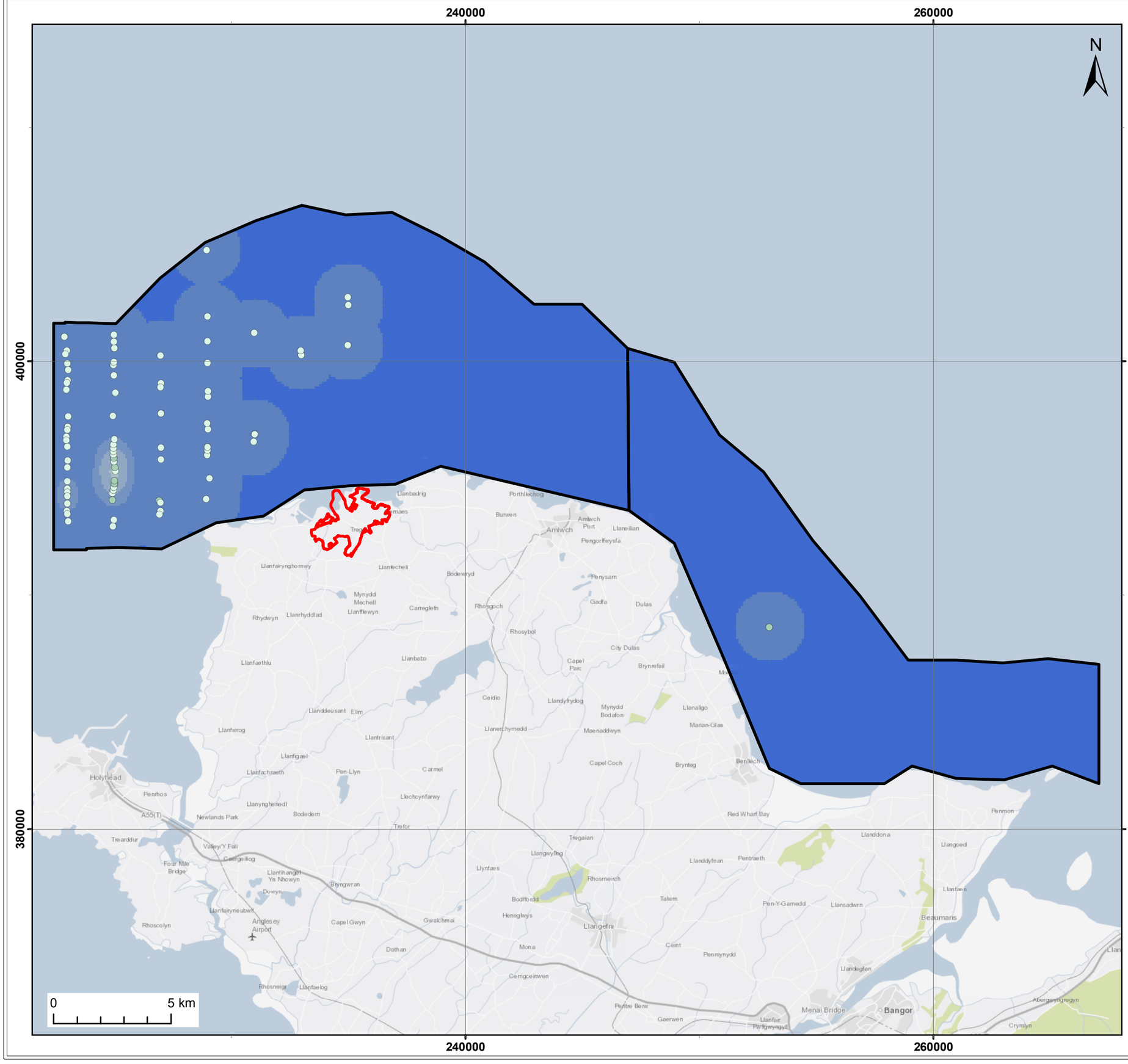

Legend

- WNDA
- Survey area
- Disposal Site

Grouped Commic tern counts (June (1) 2016)

- 1 - 2
- 3 - 5
- 6 - 12
- 13 - 20
- 21 - 30

Commic tern density: count per 10,000 m^2

- 0.00
- 0.01 - 8.87
- 8.88 - 15.53
- 15.54 - 22.63
- 22.64 - 30.61

Heat map expressing the number of Commic tern counts in 100m x 100m cells; quartic kernel function bandwidth 1500m; value range from 0 (small number of counts) to 30.61 (large number of counts) per 10,000 square metres.

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Client: HORIZON NUCLEAR POWER

Project: Wylfa Newydd Project

Title: Combined densities of Common and Arctic terns (individuals per ha) with the associated counts from the (June (1) 2016) ESAS survey

Figure: 6-26

Revision:	Date:	Drawn:	Checked:	Size:	Scale:
2	17/01/2018	TC	MG	A3	1:160,000
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N

0 5 km

Legend

- WNDA
- Survey area
- Disposal Site

Grouped Commic tern counts (June (2) 2016)

- 1 - 2
- 3 - 5
- 6 - 12
- 13 - 20
- 21 - 30

Commic tern density: count per 10,000 m²

- 0.00
- 0.01 - 8.87
- 8.88 - 15.53
- 15.54 - 22.63
- 22.64 - 30.61
- 30.62 - 42.59

Heat map expressing the number of Commic tern counts in 100m x 100m cells; quartic kernel function bandwidth 1500m; value range from 0 (small number of counts) to 42.59 (large number of counts) per 10,000 m².

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Client: HORIZON NUCLEAR POWER

Project: Wylfa Newydd Project

Title: Combined densities of Common and Arctic terns (individuals per ha) with the associated counts from the (June (2) 2016) ESAS survey

Figure: 6-27

Revision:	Date:	Drawn:	Checked:	Size:	Scale:
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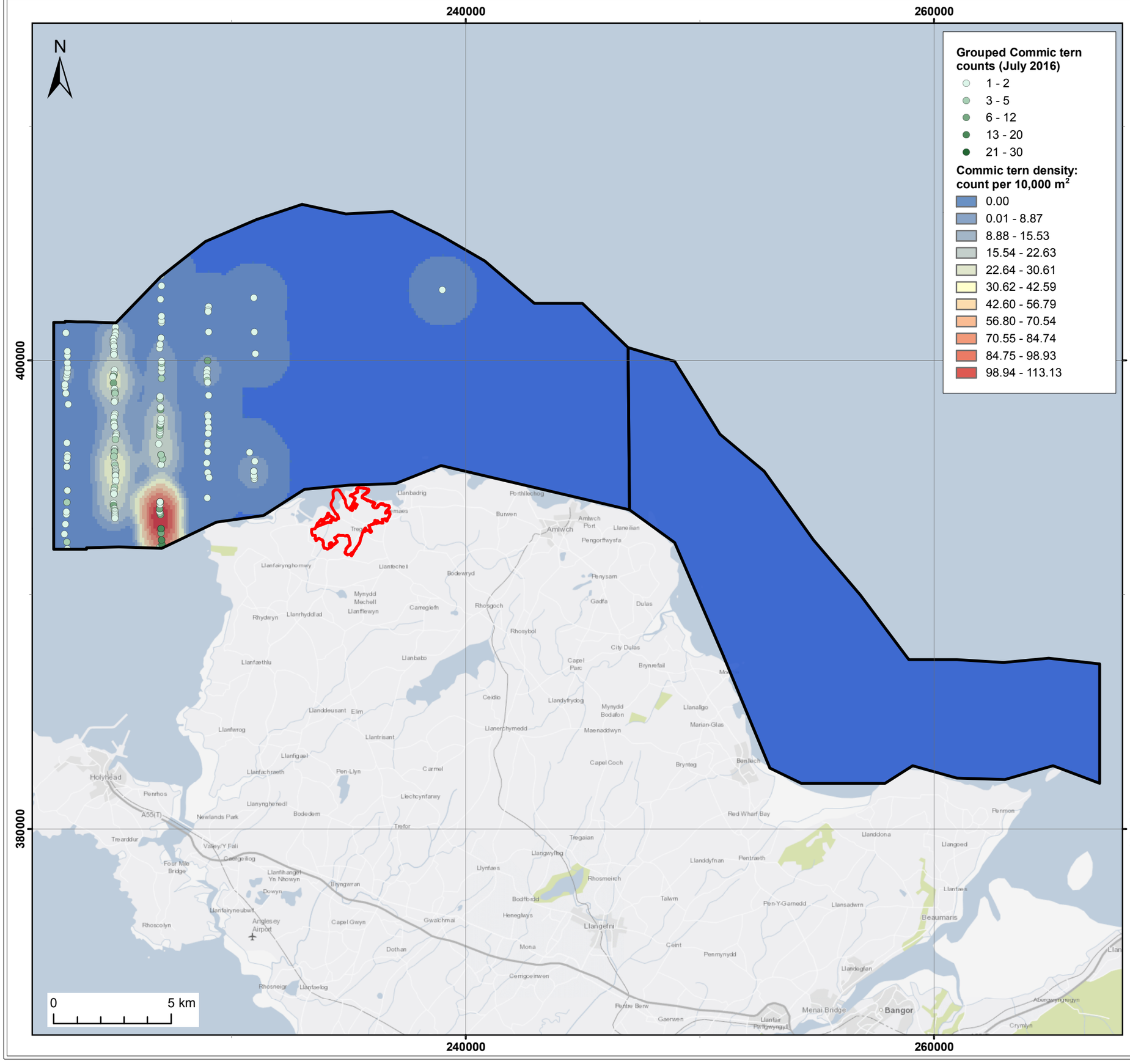

Legend

- WNDA
- Survey area
- Disposal Site

Heat map expressing the number of Commic tern counts in 100m x 100m cells; quartic kernel function bandwidth 1500m; value range from 0 (small number of counts) to 113.13 (large number of counts) per 10,000 square metres.

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Client: HORIZON NUCLEAR POWER

Project: Wylfa Newydd Project

Title: Combined densities of Common and Arctic terns (individuals per ha) with the associated counts from the July 2016 ESAS survey

Figure: 6-28

Revision:	Date:	Drawn:	Checked:	Size:	Scale:
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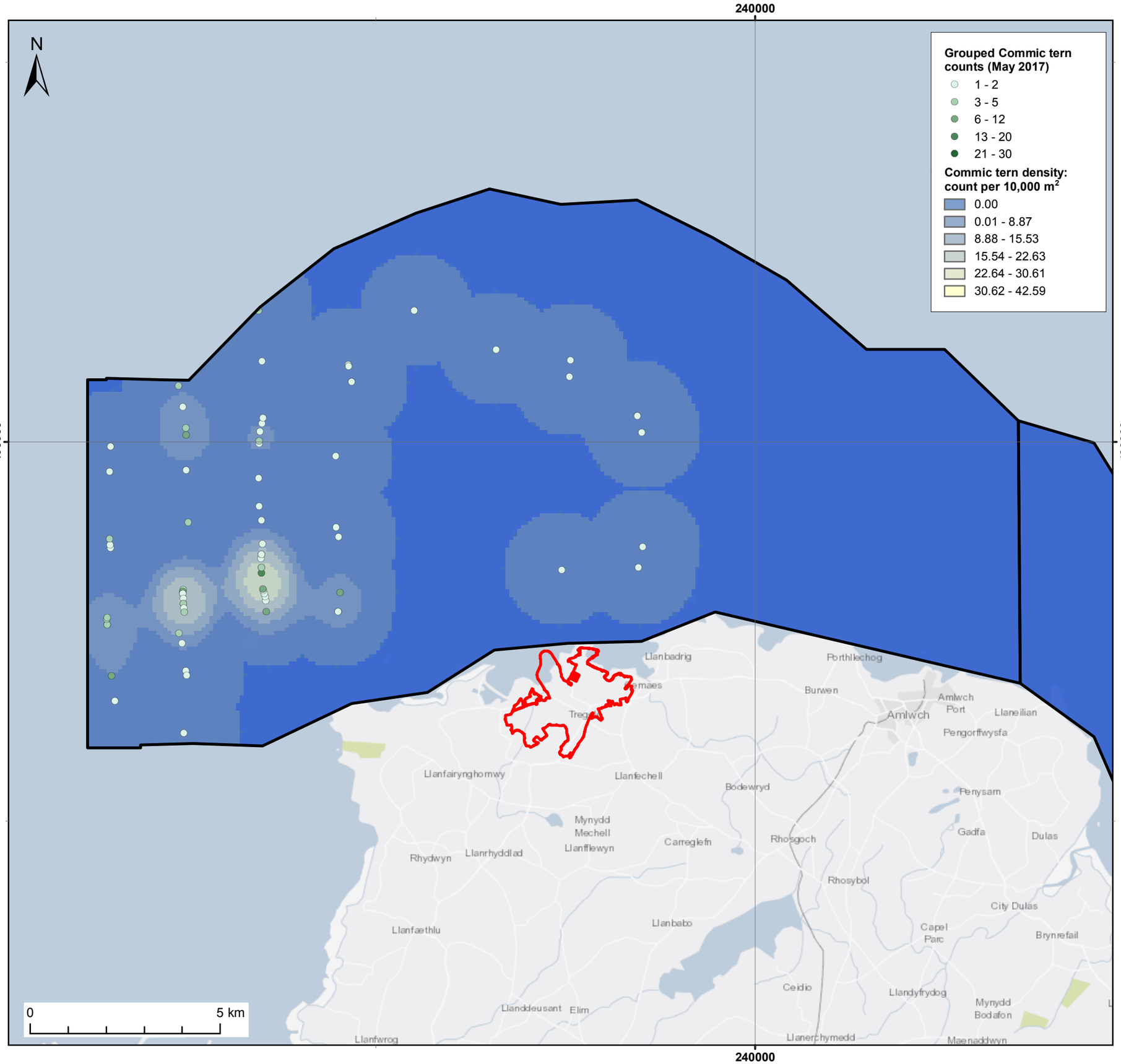

Legend

- WNDA
- Survey area
- Disposal Site

Heat map expressing the number of Commic tern counts in 100m x 100m cells; quartic kernel function bandwidth 1500m; value range from 0 (small number of counts) to 42.59 (large number of counts) per 10,000 square metres.

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Client: HORIZON NUCLEAR POWER

Project: Wylfa Newydd Project

Title: Combined densities of Common and Arctic terns (individuals per ha) with the associated counts from the May 2017 ESAS survey

Figure: 6-29

Revision:	Date:	Drawn:	Checked:	Size:	Scale:
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Table 6-10 Comparisons of foraging behaviour recorded during the different tern tracking surveys

Species	Survey	Number of tracks		Mean number foraging attempts per track		Percentage of tracks with foraging attempts	
		Total	Complete*	All tracks	Complete tracks	All tracks	Complete tracks
Sandwich tern	2016 HNP	84	35	33.6	31.5	73.8	94.3
	2017 HNP	-	-	-	-	-	-
	2009 JNCC	112	25	22.4	24.1	50.0	100
	2009 ECON	149	16	18.8	21.9	40.3	93.7
Common tern	2016 HNP	9	4	36.0	24.0	100	100
	2017 HNP	12	8	37.0	37.1	83.3	100
	2009 JNCC	30	9	36.5	27.6	50.0	100
	2009 ECON	2	0	9.5	0.0	100	-
Arctic tern	2016 HNP	17	9	18.2	22.0	82.4	88.9
	2017 HNP	4	3	10.7	14.0	100	100
	2009 JNCC	2	1	72.0	2.0	100	100
	2009 ECON	1	0	0.0	0.0	0.0	-

*Complete tracks were those where birds were followed from, and back to, the colony.

6.5.50 A total of nine and 17 tracks were recorded for common terns and Arctic terns, respectively, during the 2016 surveys (table 6-10). Of these, approximately half were complete tracks for both species. These data were augmented by a further 12 common tern and four Arctic tern tracks from the 2017 surveys, of which over half were complete (table 6-10). The earlier tracking surveys provided few data on Arctic terns, although the JNCC surveys included 30 common tern tracks. Thus, comparisons of foraging effort between the different surveys for these two species were of limited value, although data from the 2016 and JNCC surveys were similar for common tern (except for the higher percentage of tracks with dives in the 2016 surveys when considering all tracks).

6.5.51 In terms of Sandwich tern distribution and foraging effort, the data from the three tracking surveys showed broadly similar patterns, with a concentration in the waters close to the Cemlyn Bay colony and in relatively inshore waters

east of the colony along the north Anglesey coast (figure 6-30). Tracks from the 2016 surveys showed a tendency to extend further east than those recorded during the earlier surveys (which could potentially be associated with failed, or non-breeders), but this involved a small proportion of the total sample only. These broad patterns of distribution matched the modelled outputs from the [RD362] habitat-association model for Sandwich terns at the Cemlyn Bay colony, but this was unsurprising given that this model was derived from the 2009 JNCC and ECON survey data.

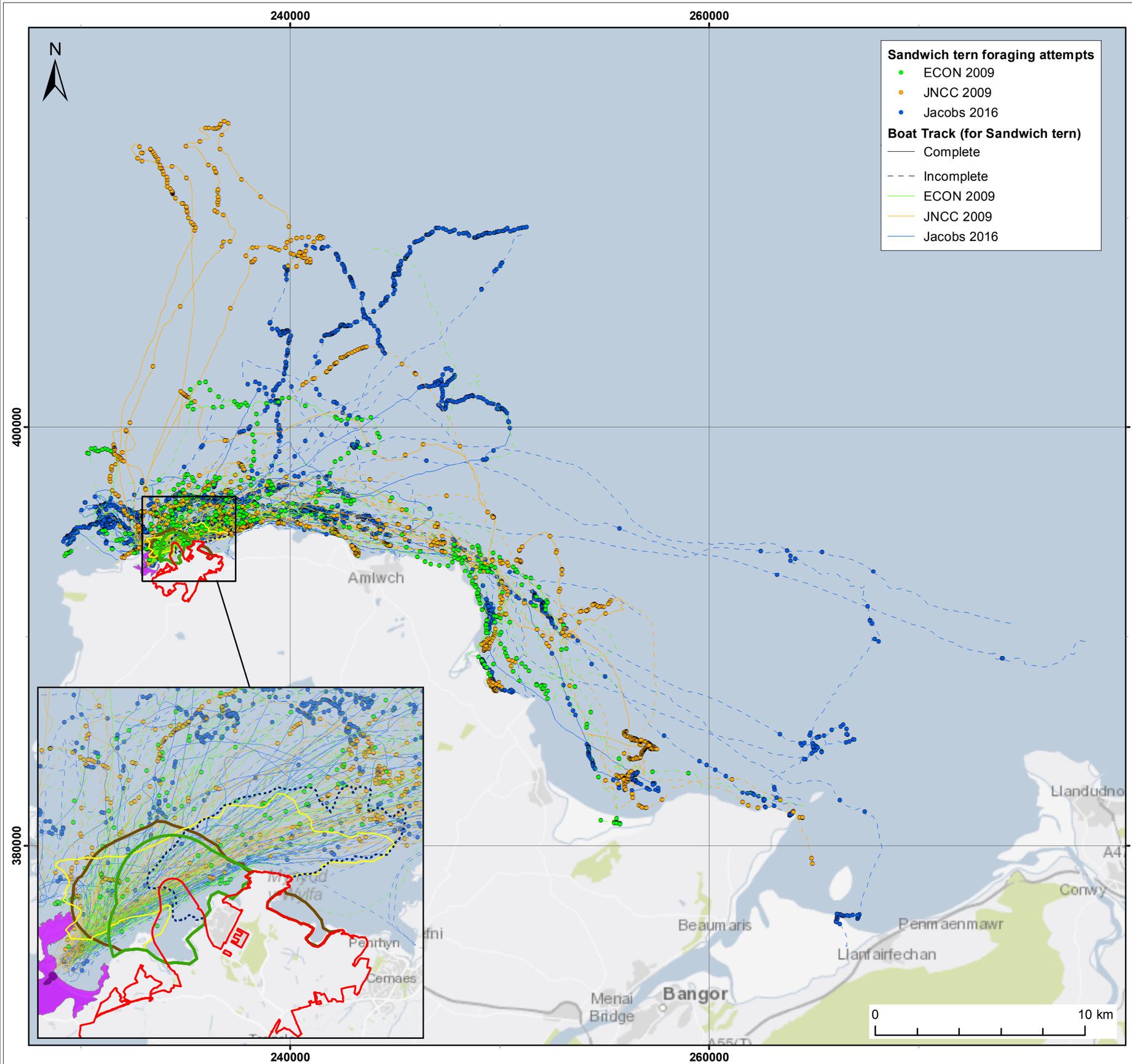
6.5.52 Figures 6-31 and 6-32 show the Sandwich tern data from the three tracking surveys overlaid on physical (bathymetry) and biological (biotope) data. These are included to assess any relationship between the data sets. However, it can be seen that the limited spatial extent of the physical and biological data makes such a comparison of no value to the assessment.

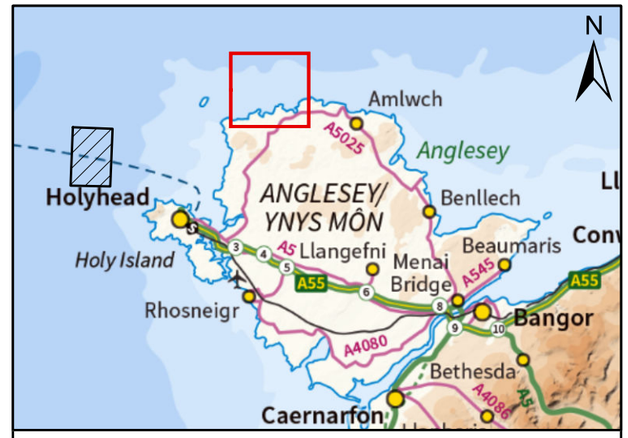
6.5.53 The distributional patterns for common terns and Arctic terns, as determined from the tracking surveys, were less distinct than for Sandwich terns. The tracks tended to extend north of the Cemlyn Bay colony and were relatively dispersed across a wide offshore area (figures 6-33 and 6-34). There was no clustering of tracks close to the colony or in the inshore waters along the Anglesey coast.

6.5.54 Full details of the results from both the ESAS and visual tracking surveys are presented in the Application Reference Number: 6.4.89.

6.5.55 The RSPB/BTO Arctic tern tracking data from the Skerries indicated that the areas of highest usage were concentrated around the Skerries, with relatively little use of the waters close to Cemlyn or the Wylfa Newydd Development Area. These latter areas are beyond the 50% utilisation distribution, which extended further offshore to the west of the Skerries as opposed to encompassing the inshore areas to the south and east (figure 6-35).

6.5.56 Sandwich and common terns were recorded only rarely during the ESAS surveys from the vicinity of the Disposal Site ZOI, with the former species limited to the May (two individuals) and June (one individual) surveys and definite records of the latter species limited to the August survey (four individuals). Arctic terns were more abundant in this survey area, being recorded during May to July (inclusive), with a maximum count of 59 – 63 individuals recorded during the May survey (the upper figure including birds recorded as commic terns) (figure 6-36).





Legend

- WNDA
- Disposal Site
- Temperature ZOI (sea surface autumn base case)
- TRO ZOI (surface summer base case)
- Noise ZOI (65db)
- 500m visual ZOI
- Cemlyn Bay SSSI/SAC
- Tern colony

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Client: HORIZON NUCLEAR POWER

Project: Wylfa Newydd Project

Title: Sandwich tern tracking results for the Jacobs (2016), JNCC (2009) and ECON (2009) surveys

Figure: 6-30

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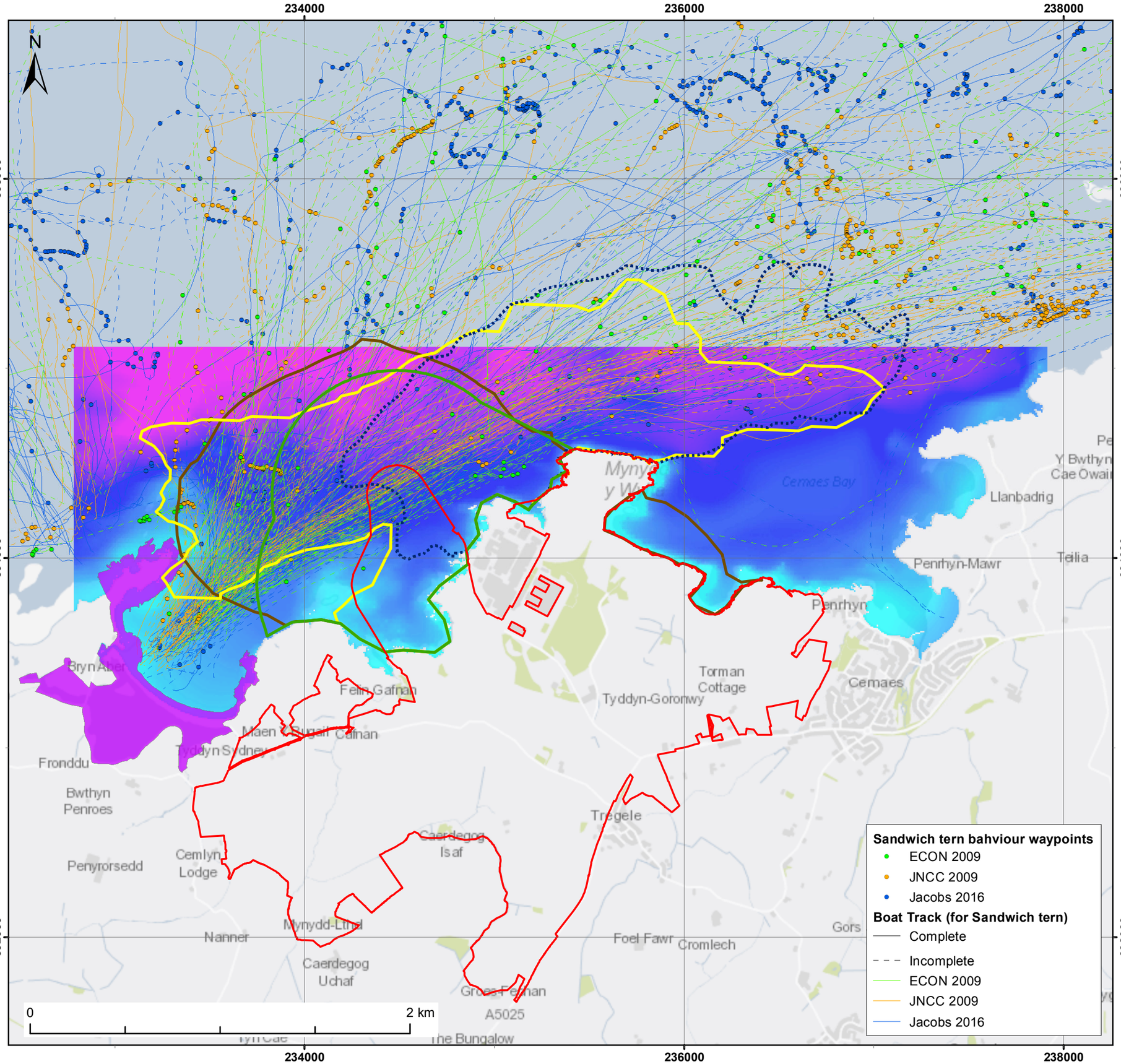

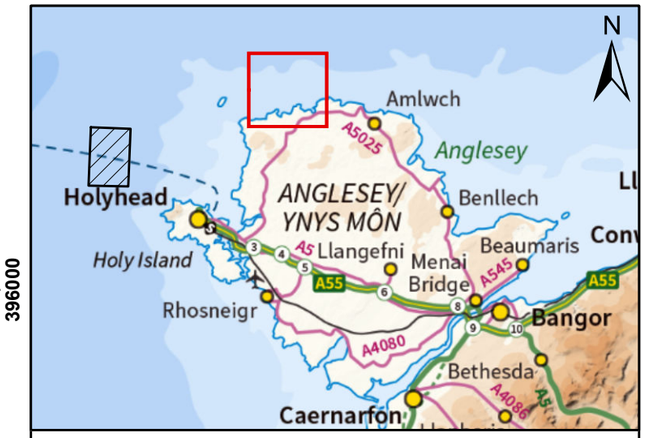

Legend

- WNDA
- Disposal Site
- Temperature ZOI (sea surface autumn base case)
- TRO ZOI (surface summer base case)
- Noise ZOI (65db)
- 500m visual ZOI
- Cemlyn Bay SSSI/SAC
- Tern colony

Bathymetry

-42m

0m

Sandwich tern bahviour waypoints

- ECON 2009
- JNCC 2009
- Jacobs 2016

Boat Track (for Sandwich tern)

- Complete
- Incomplete
- ECON 2009
- JNCC 2009
- Jacobs 2016

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Client: HORIZON NUCLEAR POWER

Project: Wylfa Newydd Project

Title: Sandwich tern tracks in relation to bathymetry of the waters in the vicinity of the WNDA

Figure: 6-31

Revision:	Date:	Drawn:	Checked:	Size:	Scale:
2	17/01/2018	TC	MG	A3	1:20,000
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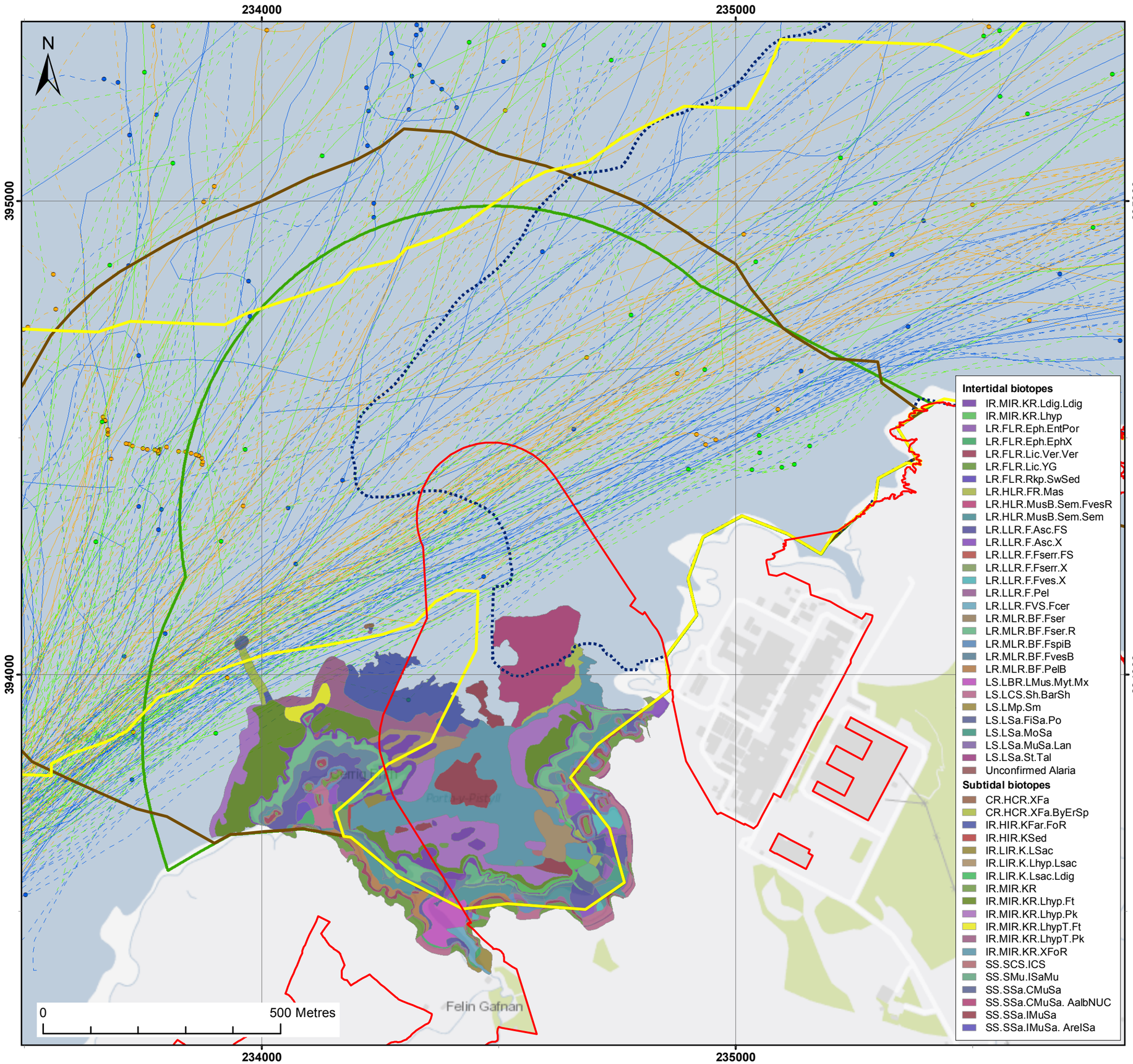

Legend

- WNDA
- Disposal Site
- Temperature ZOI (sea surface autumn base case)
- TRO ZOI (surface summer base case)
- Noise ZOI (65db)
- 500m visual ZOI

Sandwich tern foraging attempts

- ECON 2009
- JNCC 2009
- Jacobs 2016

Boat Track (for Sandwich tern)

- Complete
- Incomplete
- ECON 2009
- JNCC 2009
- Jacobs 2016

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Client: HORIZON NUCLEAR POWER

Project: Wylfa Newydd Project

Title: Sandwich tern tracks in relation to benthic biological data in the vicinity of the WNDA

Figure: 6-32

Revision:	Date:	Drawn:	Checked:	Size:	Scale:
2	17/01/2018	TC	MG	A3	1:8,000
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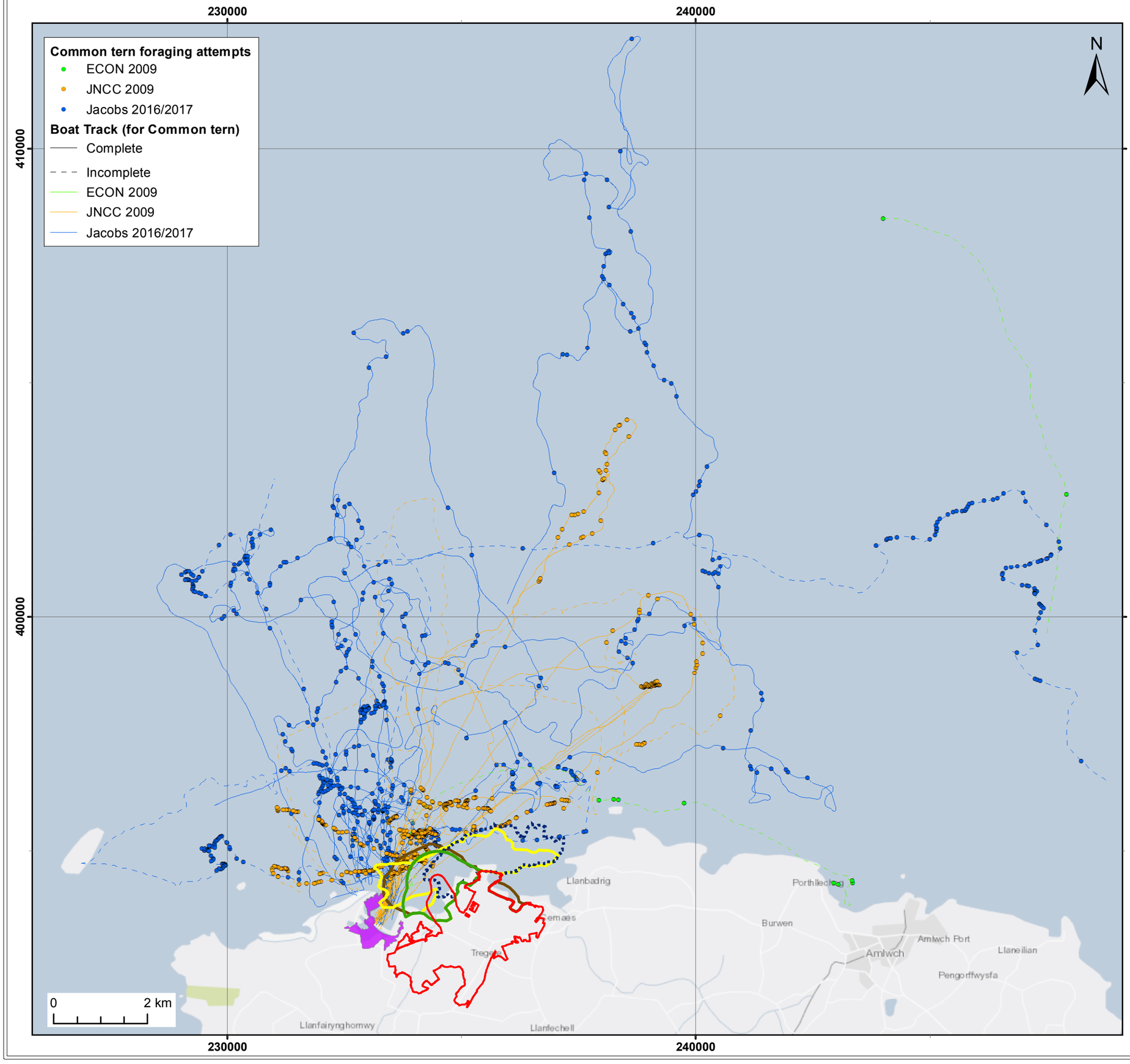

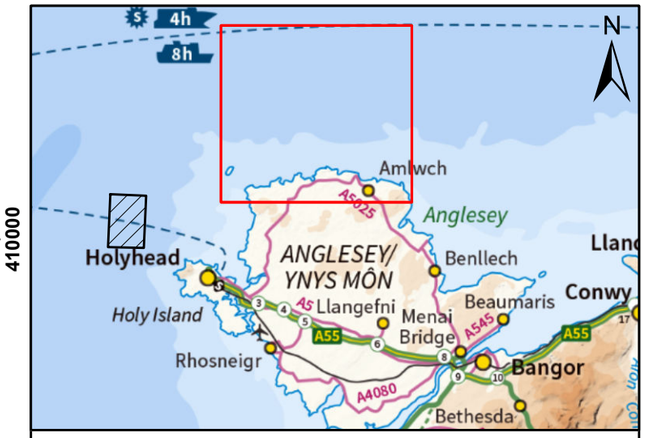

Legend

- WNDA
- Disposal Site
- Temperature ZOI (sea surface autumn base case)
- TRO ZOI (surface summer base case)
- Noise ZOI (65db)
- 500m visual ZOI
- Cemlyn Bay SSSI/SAC
- Tern colony

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Client: HORIZON NUCLEAR POWER

Project: Wylfa Newydd Project

Title: Common tern tracking results for the Jacobs (2016 and 2017), JNCC (2009) and ECON (2009) surveys

Figure: 6-33

Revision:	Date:	Drawn:	Checked:	Size:	Scale:
2	17/01/2018	TC	MG	A3	1:80,000
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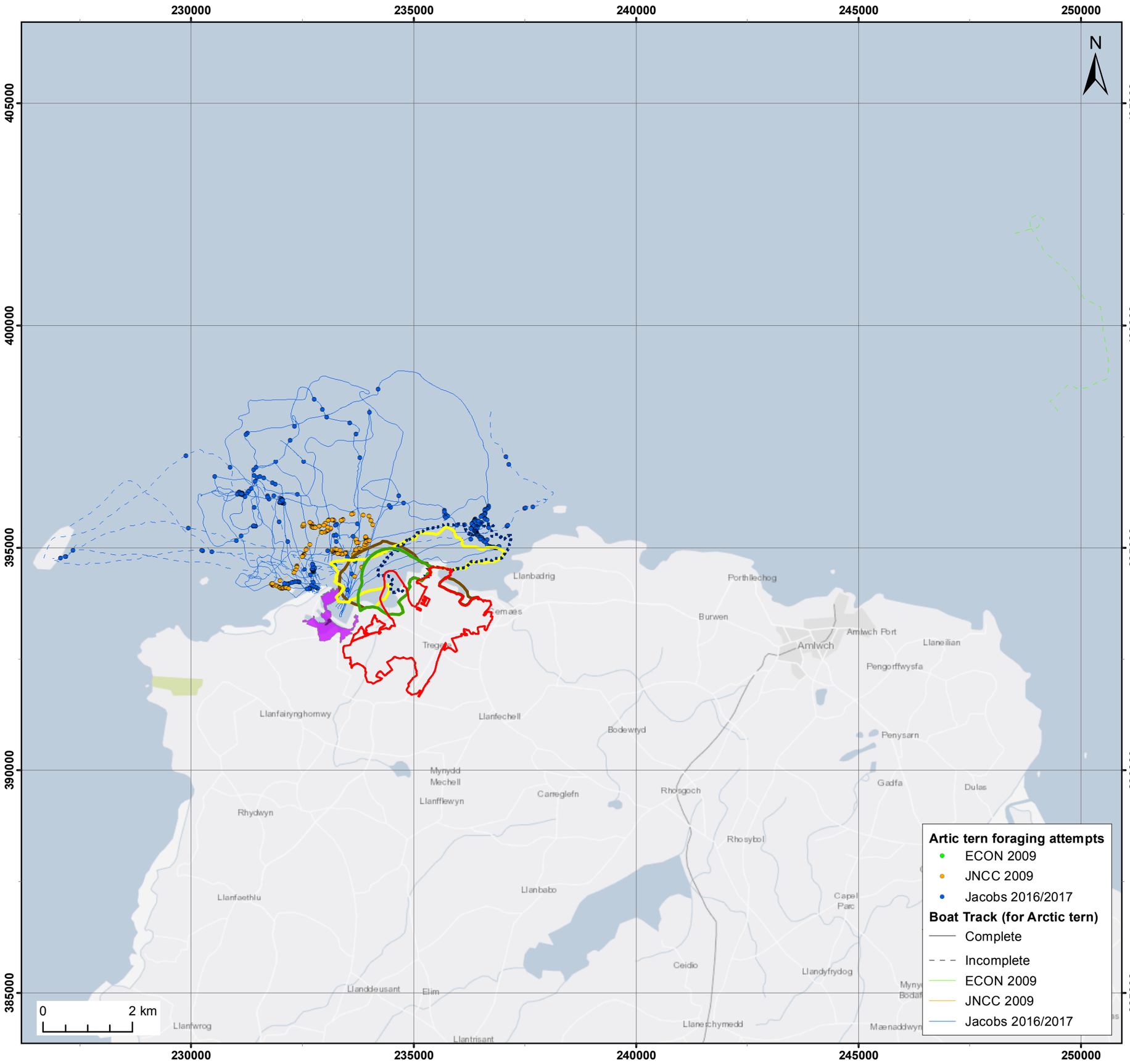

Legend

- WNDA
- Disposal Site
- Temperature ZOI (sea surface autumn base case)
- TRO ZOI (surface summer base case)
- Noise ZOI (65db)
- 500m visual ZOI
- Cemlyn Bay SSSI/SAC
- Tern colony

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Project: Wylfa Newydd Project

Title: Arctic tern tracking results for the Jacobs (2016 and 2017), JNCC (2009) and ECON (2009) surveys

Figure: 6-34

Revision:	Date:	Drawn:	Checked:	Size:	Scale:
3	17/01/2018	TC	MG	A3	1:85,000
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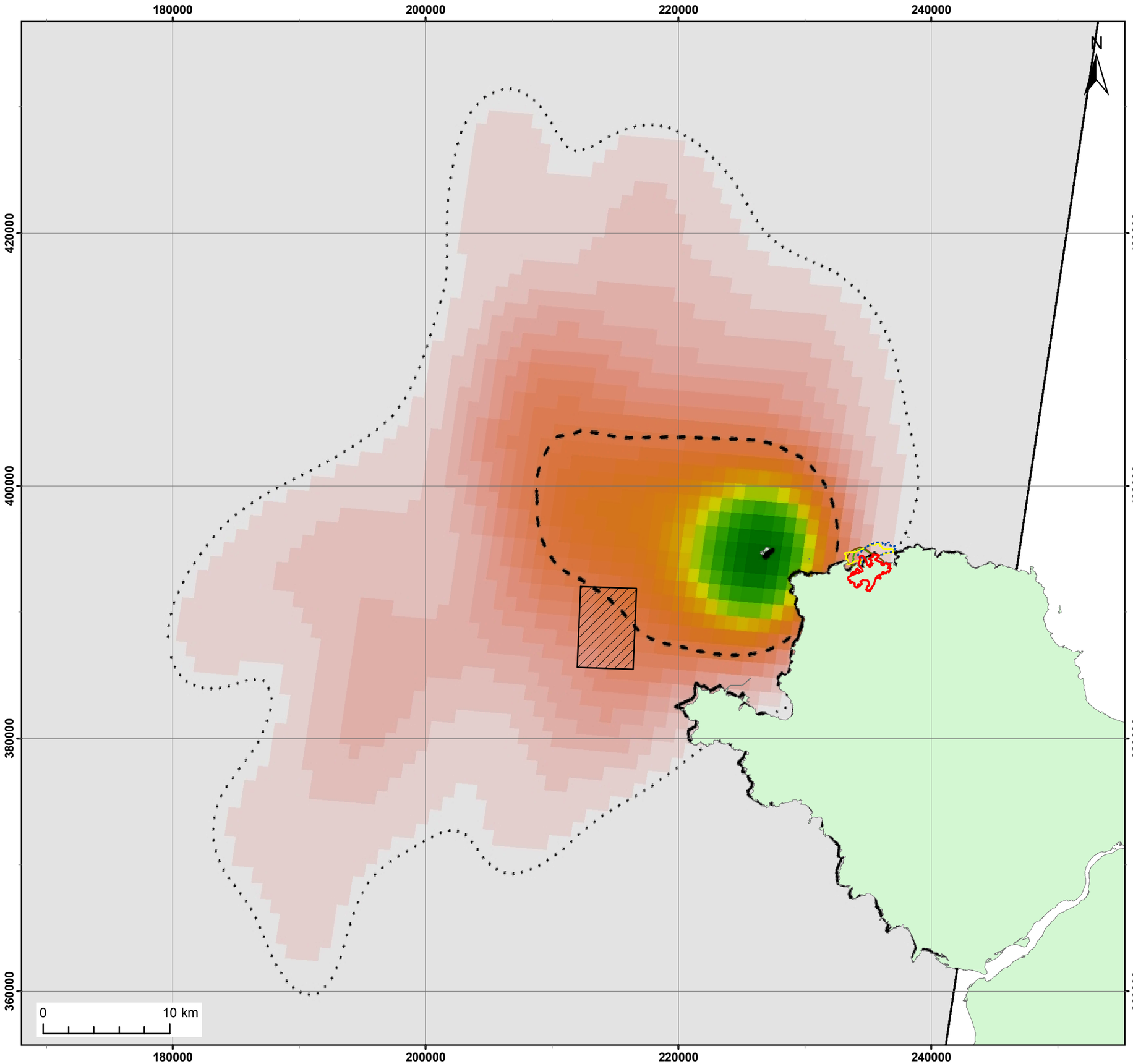

Legend

- WNDA
- Disposal Site
- Temperature ZOI (sea surface autumn base case)
- TRO ZOI (surface summer base case)
- Noise ZOI (65db)
- 500m visual ZOI
- 95% Utilisation distribution
- 50% Utilisation distribution

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Project: Wylfa Newydd Project

Title: Kernel density map for GPS-tagged Arctic terns breeding on the Skerries in 2016, with the 95% and 50% utilisation distribution shown

Figure: 6-35

Revision:	Date:	Drawn:	Checked:	Size:	Scale:
2	17/01/2018	TC	MG	A3	1:300,000
1	24/08/2017	TC	MG	A3	1:300,000

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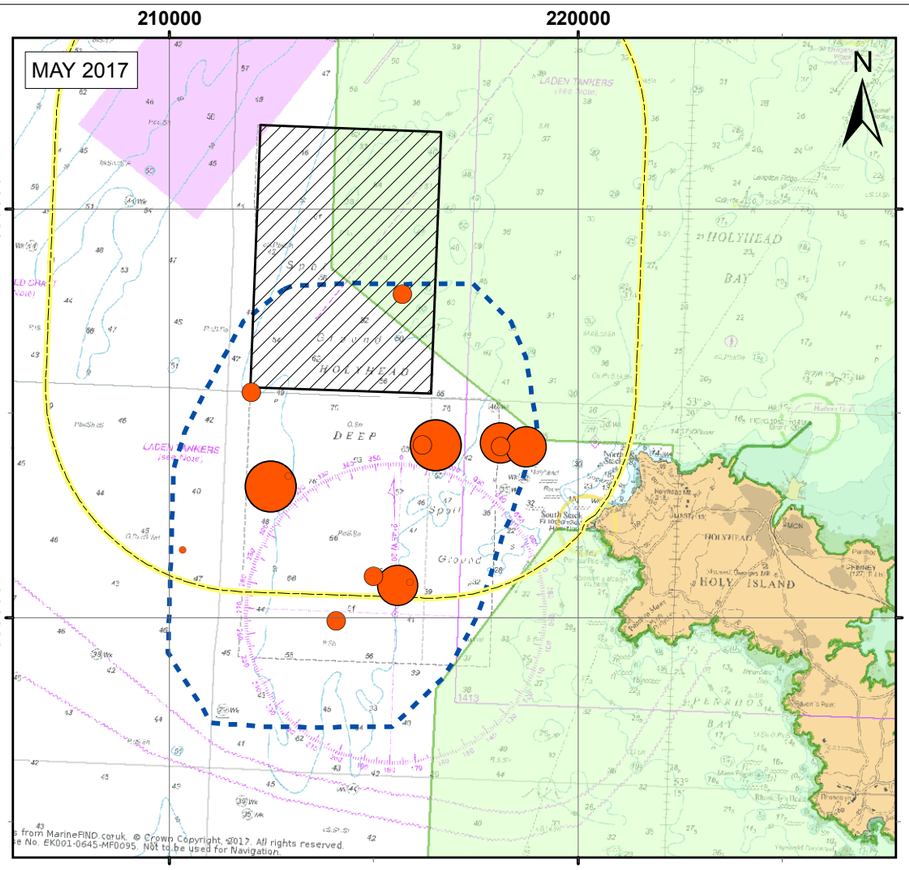

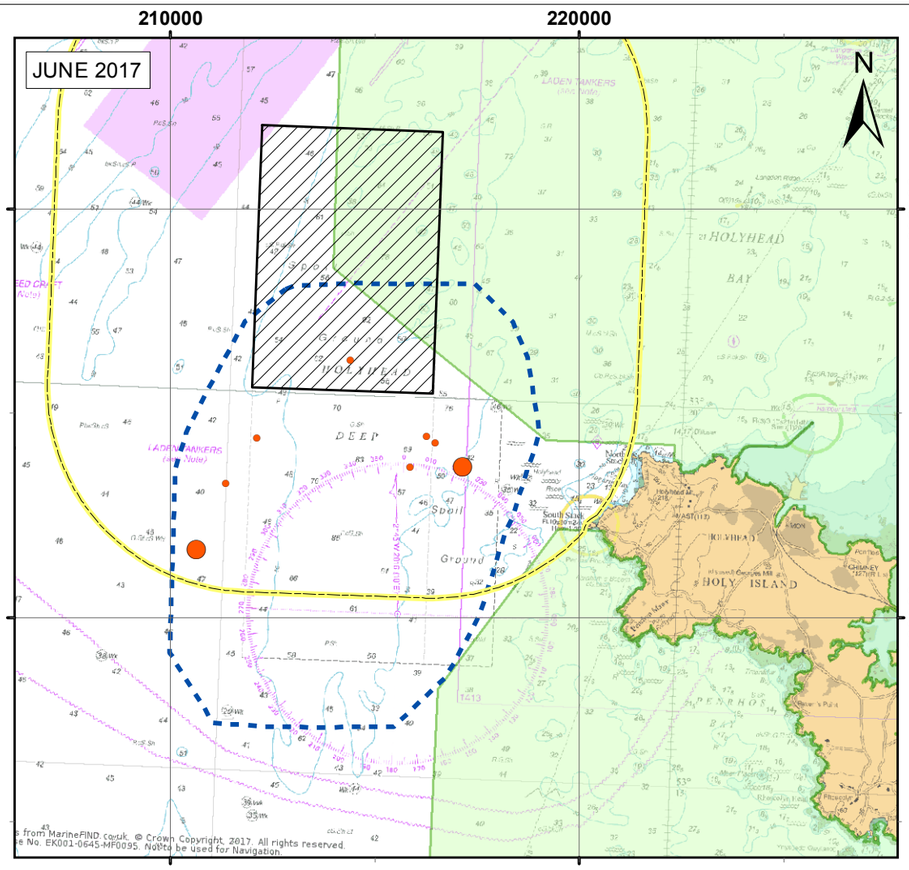

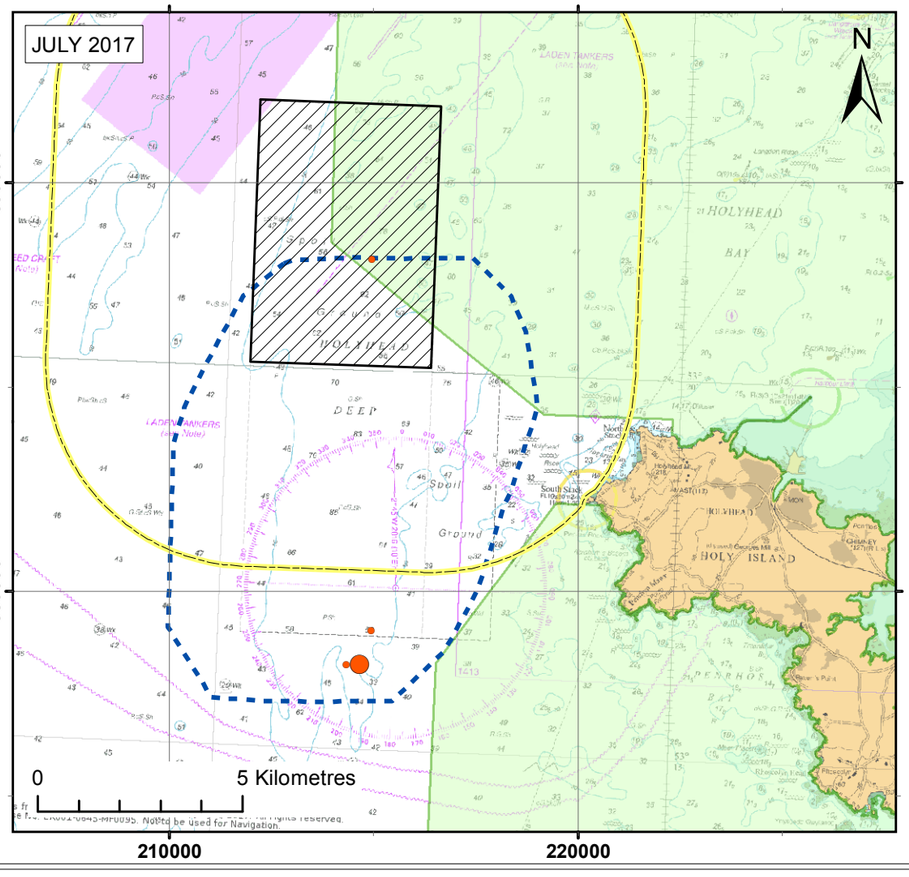

Legend

- Disposal Site
- Potential zone of influence for marine water quality
- Morwenoliaid Ynys Môn/Anglesey Terns Special Protection Area (SPA)
- Boat based survey count area

Number of birds

- 1
- 2
- 3
- 4 - 8
- 9 - 14

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Project: Wylfa Newydd Project

Title: Numbers and distribution of Arctic tern recorded by ESAS surveys in the vicinity of the Disposal Site

Figure: 6-36

Revision:	Date:	Drawn:	Checked:	Size:	Scale:
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Ynys Seiriol/Puffin Island SPA

6.5.57 The breeding cormorant population on Puffin Island is a qualifying feature of the Ynys Seiriol/Puffin Island SPA and has been screened into the Shadow HRA on the basis of having potential connectivity with the ZoIs associated with the Wylfa Newydd Development Area (see section 4.6). The SPA boundary is 25km from the 5km ZOI used in the scoping exercise for marine water quality associated with the Wylfa Newydd Development Area (table 4-2 and figure 4-5). This distance is equivalent to the estimated mean maximum foraging range of breeding cormorant [RD330]. The distance from the SPA to the potential 5km ZOI associated with the Disposal Site is beyond the mean maximum foraging range of breeding cormorant, and no connectivity is assumed with this ZOI. As for other breeding seabird species there are a number of pathways through which impacts could potentially manifest (see tables 4-2 and 5-4).

6.5.58 The citation population for the Puffin Island breeding cormorant population is 775 breeding pairs [RD165], although the most recently available estimate for the SPA (from 2015) is 489 breeding pairs (JNCC 2017u). The Seabird2000 census estimate for the SPA population, used in the apportionment calculation (because of the importance of having contemporaneous count data from the different colonies contributing to this calculation – see below), is 353 breeding pairs (http://jncc.defra.gov.uk/page-4460).

6.5.59 As for the other seabird species, the densities and distribution of cormorant in the offshore waters around the Wylfa Newydd Development Area are derived from the results of ESAS boat-based transect surveys (Application Reference Number: 6.4.89). Further data on relative levels of occurrence for the different seabird species are available from the land-based VP surveys (figure 6-6), but these data cannot be used to provide estimates of density or population size. Therefore, the initial assessment of the importance of the offshore areas around the Wylfa Newydd Development Area is based upon the findings from the ESAS surveys, with the land-based VP data being used as supporting information only where the ESAS data indicate the offshore areas to be of importance to the relevant SPA population.

6.5.60 The cormorant breeding season is defined as April to August ([RD113]), and during this period the species was recorded in low numbers only within the Block 1 survey area, with monthly densities ranging from 0.00 - 0.12 birds per km^2 (Application Reference Number: 6.4.89). Within the Block 1 survey area birds were thinly distributed along the inshore habitats, with a tendency towards an easterly bias in occurrence during some survey months. Breeding season densities were considerably higher in Block 2 (ranging from 0.98 - 2.69 birds per km^2), with birds concentrated along the east Anglesey coast and around Puffin Island (figures 3-88 to 3-93, Application Reference Number: 6.4.89).

6.5.61 The Block 1 survey area encompasses the different ZoIs that extend into the offshore environment around the Wylfa Newydd Development Area (see

figure 10-7, chapter 10), including the potential 5km ZOI used for the purposes of scoping (subsequently referred to as the 5km Wylfa Newydd Development Area ZOI). Using the maximum density estimate from the breeding season surveys for Block 1 gives a breeding season population size of 31 birds within the Block 1 survey area (E Application Reference Number: 6.4.89).

6.5.62 It cannot be assumed that all of the cormorants occurring within the Block 1 survey area will derive from the Ynys Seiriol/Puffin Island SPA population because other colonies occur within foraging range of this area (e.g. the colonies at Middle Mouse and Bwrdd Arthur to Fedw Fawr, which lie within the 5km Wylfa Newydd Development Area ZOI and 20.5km from the 5km Wylfa Newydd Development Area ZOI, respectively). Furthermore, some of the birds using the area are likely to be non-breeders (e.g. immatures).

6.5.63 To account for the occurrence of birds from other colonies an apportionment exercise was undertaken to estimate the number of birds within the Block 1 population that were expected to derive from the Ynys Seiriol/Puffin Island SPA colony. For the purposes of this exercise it was assumed that the entire Block 1 population occurred within the 5km Wylfa Newydd Development Area ZOI (because the apportionment was undertaken in relation to the distance to the ZOI and not to the Block 1 survey area).

6.5.64 The apportionment calculation followed the methods outlined in Scottish National Heritage (SNH) guidance [RD298]. Thus, the proportion of the Block 1 population that could be attributed to the different breeding colonies within the mean maximum foraging range of Block 1 was estimated on the basis of:

- The population size of each colony (as numbers of individuals) – N;
- The distance from each colony to the Wylfa Newydd Development Area (using the distance to the potential 5km ZOI for this purpose) – D; and
- The proportion of open sea within the foraging range of each colony – Psea.
- A weighting value (W) was calculated for each colony population as
- $W = (N / \text{Sum of } N) * (\text{Sum of } (D^2) / D) * (Psea / \text{Sum of } Psea)$.

6.5.65 This weighting assumes that colonies within foraging range of the 5km Wylfa Newydd Development Area ZOI would contribute more birds to the on-site population where they are larger, are closer to the ZOI and have a smaller proportion of open sea within their foraging range. The effect of colony distance is treated as the square term (as opposed to the linear term) because the expectation is that bird densities would decrease in proportion to the increasing area of sea as distance from the colony increases [RD299].

6.5.66 For the purposes of this calculation the colony population sizes are as estimated during the Seabird 2000 census [RD215], with these being extracted from the JNCC website (http://jncc.defra.gov.uk/page-4460). Although these estimates are relatively old, the available guidance is that the

count data for the colonies considered in the calculation should be concurrent, or at least from a similar time [RD299]. Therefore, the Seabird2000 data are often regarded as providing the most suitable reference point for deriving concurrent estimates of population size from different colonies. For the current calculation involving the Ynys Seiriol/Puffin Island SPA cormorant population, count data from 2016 or 2017 were available for most of the colonies considered. However, the most recent count of cormorant available on the Seabird Monitoring Programme database for the Point Lynas to Trwyn Du site was from 2001 ([RD164]).

6.5.67 Having calculated the weighting values for each colony, the proportion of the Block 1 population that could be attributed to each colony was calculated by expressing the colony weight as a proportion of the sum of all of the colony weights.

6.5.68 On the basis of this calculation, the Ynys Seiriol/Puffin Island SPA cormorant population is estimated to contribute 0.01% of the cormorants recorded in the potential 5km Wylfa Newydd Development Area ZOI during the breeding season. This represents less than one individual, and less than 0.001% of the Ynys Seiriol/Puffin Island SPA population. This conclusion is unaffected by replacing the Seabird2000 count data used in this apportionment calculation with the cormorant count data from 2016 or 2017, for those colonies where such recent data were available.

6.5.69 Therefore, even when it is assumed that the entire Block 1 population occurs within the 5km Wylfa Newydd Development Area ZOI and that all of the birds using this area are breeding adults (both of which are unrealistic and highly precautionary assumptions), it can be concluded that the 5km Wylfa Newydd Development Area ZOI is likely to be used to a very minor extent only by the Ynys Seiriol/Puffin Island SPA cormorant population.

Glannau Aberdaron and Ynys Enlli/Aberdaron Coast and Bardsey Island SPA

6.5.70 Breeding Manx shearwater is a qualifying feature of the Glannau Aberdaron and Ynys Enlli/Aberdaron Coast and Bardsey Island SPA. This SPA population has been screened into the shadow HRA on the basis of having potential connectivity with the ZoIs associated with both the Wylfa Newydd Development Area and the Disposal Site (see section 4.7). The SPA boundary is 59km from the 5km Wylfa Newydd Development Area ZOI used in the scoping exercise, and 58km from the potential 5km ZOI associated with the Disposal Site (table 4-2 and figure 4-6). These distances are within the foraging range of breeding Manx shearwater, which is estimated to be in excess of 330km [RD330]. As for other breeding seabird species there are a number of pathways through which impacts could potentially manifest (see tables 4-2 and 5-4).

6.5.71 The citation population for the Glannau Aberdaron and Ynys Enlli/Aberdaron Coast and Bardsey Island SPA breeding Manx shearwater population is 6,930 breeding pairs [RD166], although the most recently available estimate

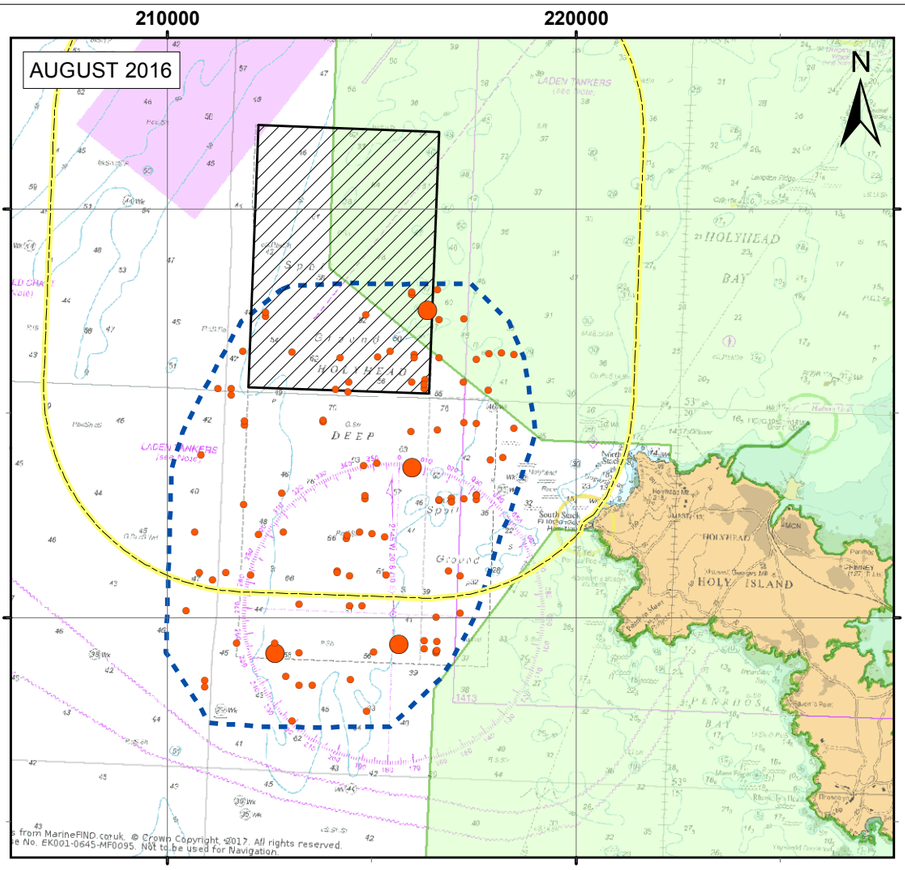
for the SPA (from 2015) is 21,000 breeding pairs (NRW, pers. comm.). The Seabird2000 census estimate of 16,183 breeding pairs for the SPA population (from 2001; [RD164]) is used in the apportionment calculation because of the lack of more recent count data for several of the other colonies considered in the calculation [RD299].

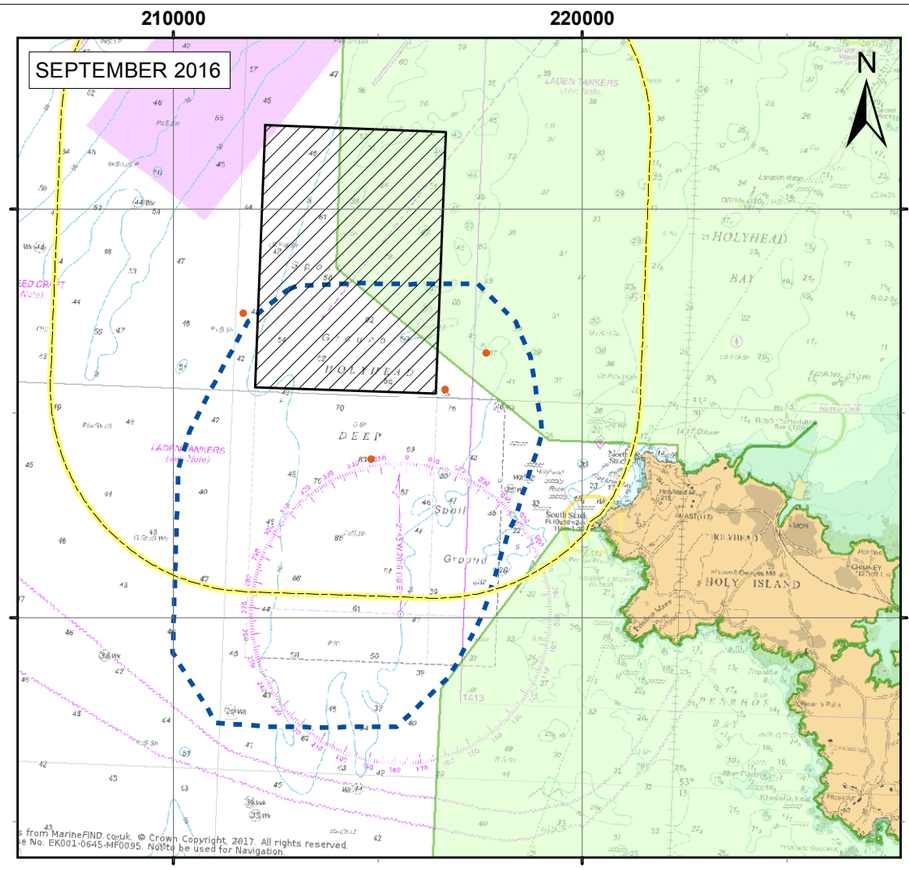
6.5.72 As for cormorant above (see 6.5.45), the ESAS boat-based transect surveys provide the primary source of data on the densities and distribution of Manx shearwater in the offshore waters around the Wylfa Newydd Development Area (Application Reference Number: 6.4.89), whilst the information from the ESAS boat-based surveys from the vicinity of the Disposal Site is also used (as the disposal site ZOI is within foraging range of the Glannau Aberdaron and Ynys Enlli/Aberdaron Coast and Bardsey Island SPA breeding Manx shearwater population).

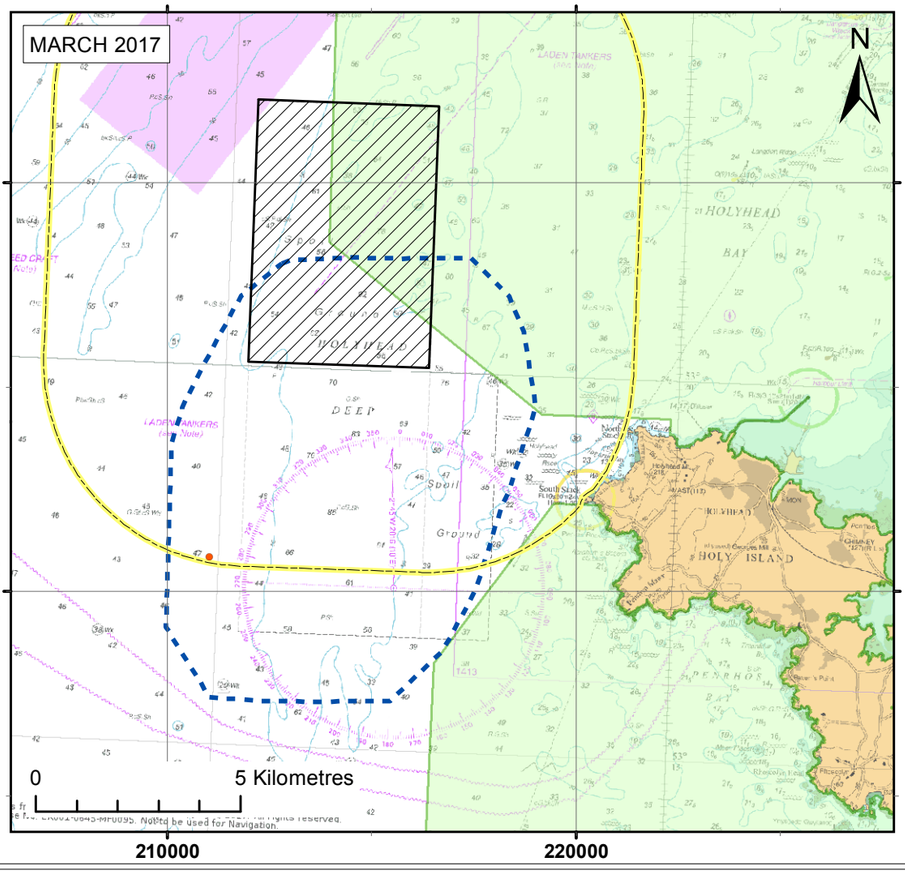
6.5.73 The breeding season for Manx shearwater is defined as April to August ([RD113]). During this period, densities ranged from between 0.37 and 2.04 birds per km^2 in Block 1, and from between 0.33 and 6.71 birds per km^2 in Block 2 (Application Reference Number: 6.4.89). Within the Block 1 survey area, Manx shearwaters were distributed relatively evenly during some surveys (i.e. June and July), whilst in others there was a tendency for highest densities to occur in the western half (i.e. April, May and August) (figures 3-68 to 3-75, Application Reference Number: 6.4.89).

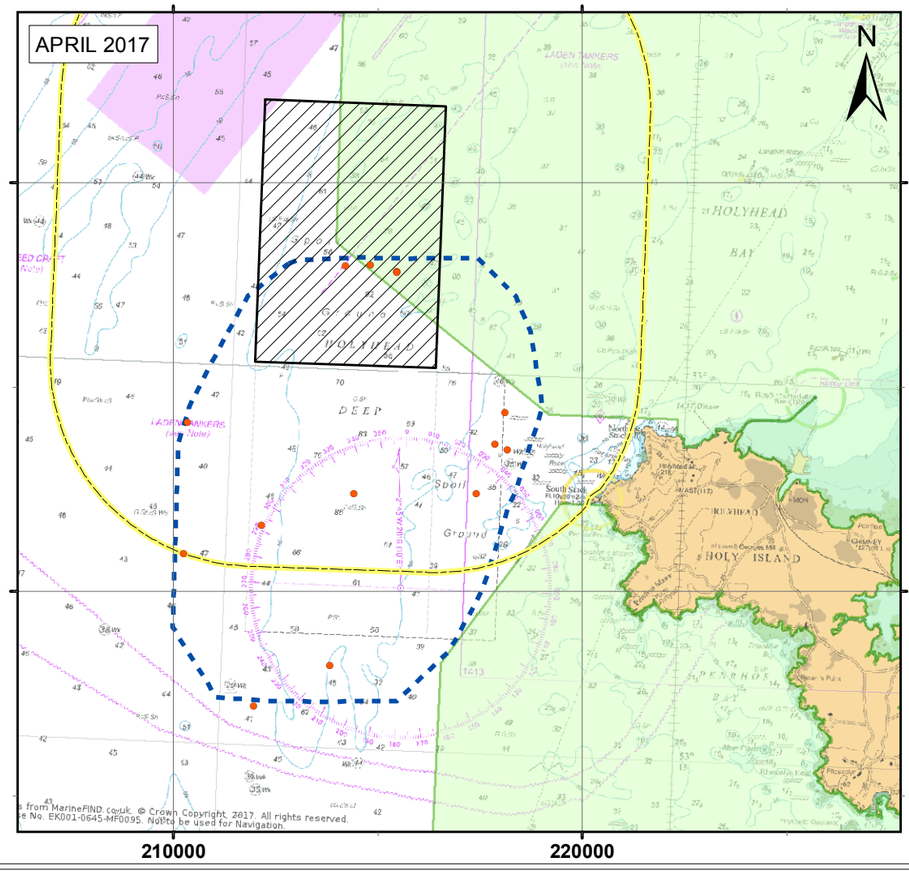
6.5.74 The maximum estimated density in Block 1 during breeding season (i.e. 2.04 birds per km^2 for the second June survey in 2016) gives a population size of 520 birds in Block 1 (Application Reference Number: 6.4.89).

6.5.75 Peak numbers of Manx shearwater within the vicinity of the Disposal Site were recorded during the May 2017 survey, for which the raw count was 586 individuals (figures 6-37a,b). This suggests an estimated peak population size for this survey area that is considerably greater than that obtained for the Block 1 survey area (given that the raw count is derived from a sample of the survey area only and has not been corrected for distance detection effects [RD26] – e.g. the peak population estimate of 520 individuals for the Block 1 survey area derived from a raw count of 147 individuals). The major concentrations of Manx shearwater in the Minesto survey area tended to be within the area of the Disposal Site ZOI (figures 6-37a,b).









Legend

- Disposal Site
- Potential zone of influence for marine water quality
- Morwenoliaid Ynys Môn/Anglesey Terns Special Protection Area (SPA)
- Boat based survey count area

Number of birds

- 1 - 3
- 4 - 10
- 11 - 26
- 27 - 45
- 46 - 80

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Title: Numbers and distribution of Manx shearwater recorded by ESAS surveys in the vicinity of the Disposal Site (1 of 2)

Figure: 6-37a

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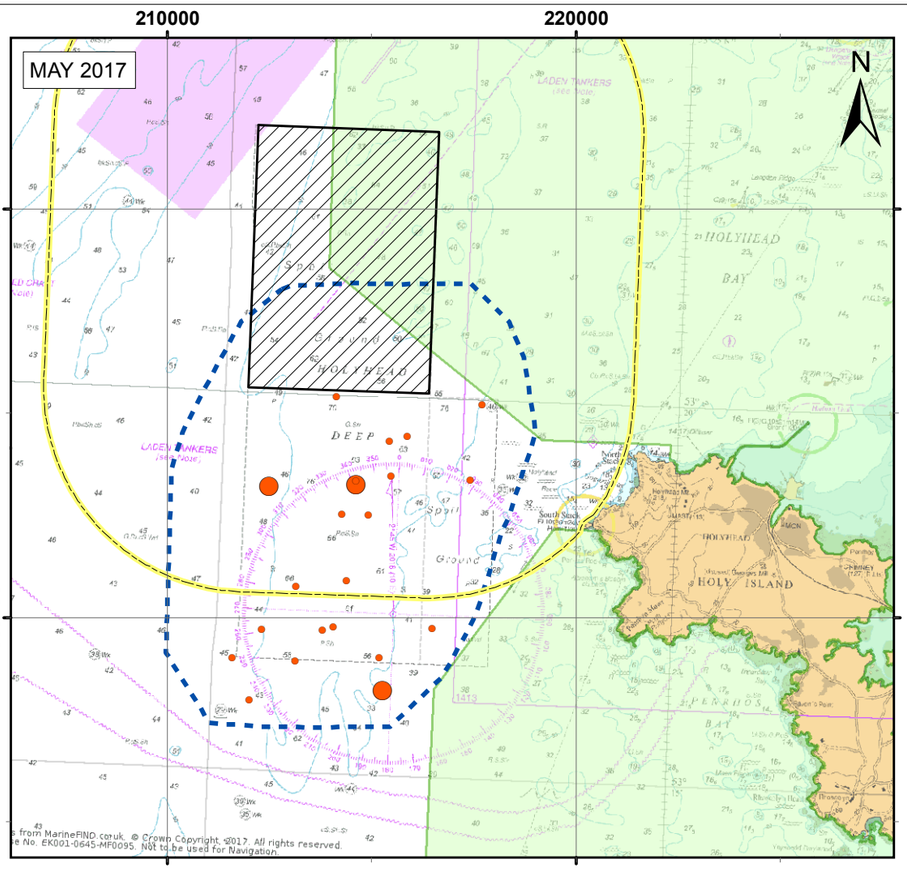

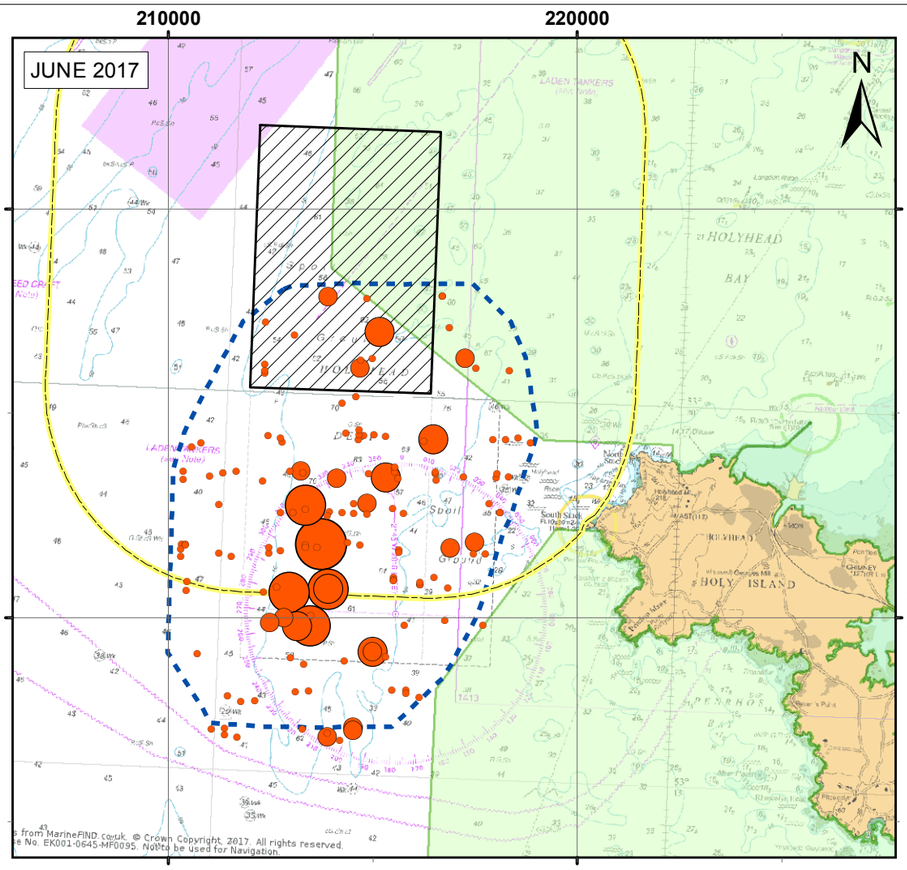

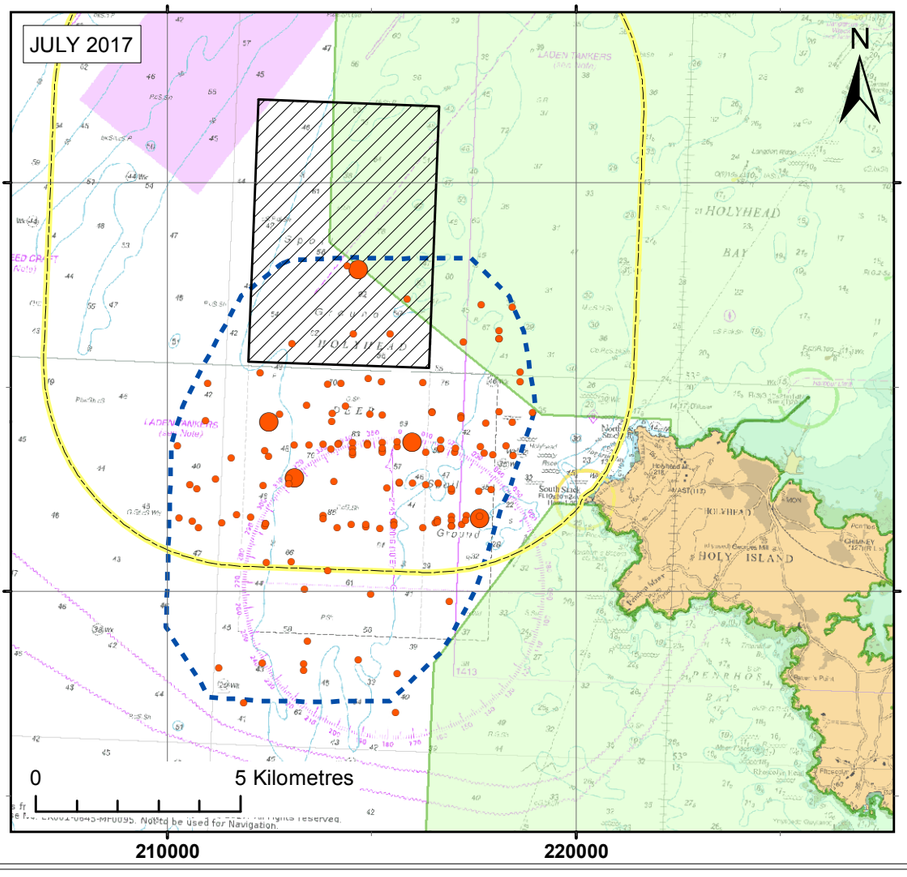

Legend

- Disposal Site
- Potential zone of influence for marine water quality
- Morwenoliaid Ynys Môn/Anglesey Terns Special Protection Area (SPA)
- Boat based survey count area

Number of birds

- 1 - 3
- 4 - 10
- 11 - 26
- 27 - 45
- 46 - 80

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Client: HORIZON NUCLEAR POWER

Project: Wylfa Newydd Project

Title: Numbers and distribution of Manx shearwater recorded by ESAS surveys in the vicinity of the Disposal Site (2 of 2)

Figure: 6-37b

Revision:	Date:	Drawn:	Checked:	Size:	Scale:
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6.5.76 The ZoIs for the Wylfa Newydd Development Area and the Disposal Site are within the foraging range of other Manx shearwater breeding colonies. Therefore, the apportionment calculation described above was undertaken following the procedures already outlined. This calculation suggests that the Glannau Aberdaron and Ynys Enlli/Aberdaron Coast and Bardsey Island SPA Manx shearwater population contributes approximately 36% of the birds present in the 5km Wylfa Newydd Development Area ZOI and 40% of those present within the Disposal Site ZOI. For the 5km Wylfa Newydd Development Area ZOI, this represents approximately 190 individuals, which is equivalent to 0.6% of the SPA population.

6.5.77 Therefore, even when it is assumed that the entire Block 1 population occurs within the 5km Wylfa Newydd Development Area ZOI and that all of the birds using this area are breeding adults (both of which are unrealistic and highly precautionary assumptions), it can be concluded that the 5km Wylfa Newydd Development Area ZOI is likely to be used to a minor extent only by the Glannau Aberdaron and Ynys Enlli/Aberdaron Coast and Bardsey Island SPA Manx shearwater population. The available survey data from the vicinity of the Disposal Site suggest that the peak abundance of Manx shearwater within the associated ZOI is considerably higher than for the 5km Wylfa Newydd Development Area ZOI and, based on the apportionment calculation, the Disposal Site ZOI is likely to support a higher proportion of the Glannau Aberdaron and Ynys Enlli/Aberdaron Coast and Bardsey Island SPA Manx shearwater population.

6.5.78 It is not possible to estimate the specific proportion of this SPA population that may use the Disposal Site ZOI, but it could conceivably be in excess of 1%, even allowing for the fact that a high proportion (possibly c.40% - [RD113]) of the Manx shearwaters within this area may be immatures, as opposed to breeding adults.

Sgomer, Gogwm a moroedd Benfro/Skomer, Skokholm and the seas off Pembrokeshire SPA

6.5.79 Breeding Manx shearwater is a qualifying feature of the Sgomer, Gogwm a moroedd Benfro/Skomer, Skokholm and the seas off Pembrokeshire SPA. This SPA population has been screened into the shadow HRA on the basis of having potential connectivity with the ZoIs associated with both the Wylfa Newydd Development Area and the Disposal Site. The SPA boundary is approximately 183km from both the 5km Wylfa Newydd Development Area ZOI used in the scoping exercise and the potential 5km ZOI associated with the Disposal Site (table 4-2 and figure 4-6). As detailed above, these distances are within the foraging range of breeding Manx shearwater.

6.5.80 The citation population for the Sgomer, Gogwm a moroedd Benfro/Skomer, Skokholm and the seas off Pembrokeshire SPA breeding Manx shearwater population is 150,968 breeding pairs [RD167], although the most recently available estimate for the SPA (from 1998 during the Seabird2000 census) is 151,000 breeding pairs ([RD164]).

6.5.81 The densities and distribution of Manx shearwater, as determined during the ESAS boat-based transect surveys, in the Block 1 and 2 survey areas are described above, as is the distribution of survey records in the vicinity of the Disposal Site ZOI. These give a maximum breeding season population size for the Block 1 survey area of 520 individuals.

6.5.82 The apportionment calculation undertaken for Manx shearwater suggests that the Sgomer, Gogwm a moroedd Benfro/Skomer, Skokholm and the seas off Pembrokeshire SPA population contributes approximately 60% of the birds present in both the 5km Wylfa Newydd Development Area ZOI and the Disposal Site ZOI. For the 5km Wylfa Newydd Development Area ZOI this represents 320 individuals, which equates to 0.1% of the SPA population (when it is assumed that all birds recorded within the Block 1 survey area are breeding adults and are restricted to the 5km Wylfa Newydd Development Area ZOI).

6.5.83 Therefore, despite the unrealistic and highly precautionary assumptions used for the apportionment calculation, it can be concluded that the 5km Wylfa Newydd Development Area ZOI is of little importance to the Sgomer, Gogwm a moroedd Benfro/Skomer, Skokholm and the seas off Pembrokeshire SPA Manx shearwater population. For the reasons given above in relation to the Glannau Aberdaron and Ynys Enlli/Aberdaron Coast and Bardsey Island SPA Manx shearwater population, the Disposal Site ZOI is likely to support a higher percentage of the Sgomer, Gogwm a moroedd Benfro/Skomer, Skokholm and the seas off Pembrokeshire SPA Manx shearwater population than does the 5km Wylfa Newydd Development Area ZOI. The lack of estimated densities for Manx shearwater within the Minesto survey area prevents the calculation of an estimate of the percentage of the SPA population which may occur within the Disposal Site ZOI. However, it seems unlikely to be in excess of 1%, given the very low value estimated for the 5km Wylfa Newydd Development Area ZOI (i.e. 0.1%) plus the likelihood of a high proportion of immatures amongst the birds recorded within the ZOI ([RD113])..Disposal SiteZOI.

Grassholm SPA

6.5.84 Breeding gannet is a qualifying feature of the Grassholm SPA. This SPA population has been screened into the shadow HRA on the basis of having potential connectivity with the ZoIs associated with both the Wylfa Newydd Development Area and the Disposal Site (see section 4.7). The SPA boundary is 191km from the 5km Wylfa Newydd Development Area ZOI used in the scoping exercise, and 170km from the potential 5km ZOI associated with the Disposal Site (table 4-2 and figure 4-6). These distances are within the mean maximum foraging range of breeding gannet, which is estimated to be 229km [RD330]. As for other breeding seabird species there are a number of pathways through which impacts could potentially manifest (see tables 4-2 and 5-4).

6.5.85 The citation population for the Grassholm SPA breeding gannet population is 33,000 breeding pairs [RD168], although the most recently available

estimate for the SPA (from 2015) is 36,011 breeding pairs ([RD164]). The Seabird2000 census estimate of 30,688 breeding pairs for the SPA population (http://jncc.defra.gov.uk/ page-4460) is used in the apportionment calculation because this is the most recent period for which count data from all five colonies considered in the calculation are available [RD299]. Two of these five colonies lack count data from 2015 (or a similar time), when the most recent count of the Grassholm SPA population was obtained.).

6.5.86 As for other breeding seabird species (see above), the ESAS boat-based transect surveys provide the primary source of data on the densities and distribution of gannet in the offshore waters around the Wylfa Newydd Development Area (Application Reference Number: 6.4.89), whilst the information from the ESAS boat-based surveys from the vicinity of the Disposal Site is also used (as the Disposal Site ZOI is within foraging range of the Grassholm SPA breeding gannet population).

6.5.87 The breeding season for gannet is defined as March to September ([RD113]). During this period densities ranged from 0.05 to 0.59 birds per km^2 in Block 1 and from 0.02 to 1.69 birds per km^2 in Block 2 (Application Reference Number: 6.4.89). Gannets tended to be widely distributed across the Block 1 survey area, with no indications of particular concentrations in any parts of the area (figures 3-76 to 3-87, Application Reference Number: 6.4.89).

6.5.88 The maximum estimated density in Block 1 during breeding season (i.e. 0.59 birds per km^2 for the April 2017 survey) gives a population size of 151 birds in Block 1 (Application Reference Number: 6.4.89).

6.5.89 The surveys from the vicinity of the Disposal Site recorded consistently low numbers of gannets only, with the maximum count of 23 obtained during the June survey (figures 6-38a,b).

6.5.90 The ZoIs for the Wylfa Newydd Development Area and the Disposal Site are within the foraging range of other gannet breeding colonies. Therefore, the apportionment calculation described above was undertaken following the procedures outlined above. This calculation suggests that the Grassholm SPA gannet population contributes approximately 55% of the birds present in the 5km Wylfa Newydd Development Area ZOI and 58% of those present within the HDisposal Site ZOI. For the 5km Wylfa Newydd Development Area ZOI, this represents approximately 85 individuals, which is equivalent to 0.14% of the SPA population. This conclusion is unaffected when the Seabird2000 count data used in this apportionment calculation were replaced with the recent count data (from 2011 – 2015) available for three of the colonies considered in this calculation (including Grassholm).

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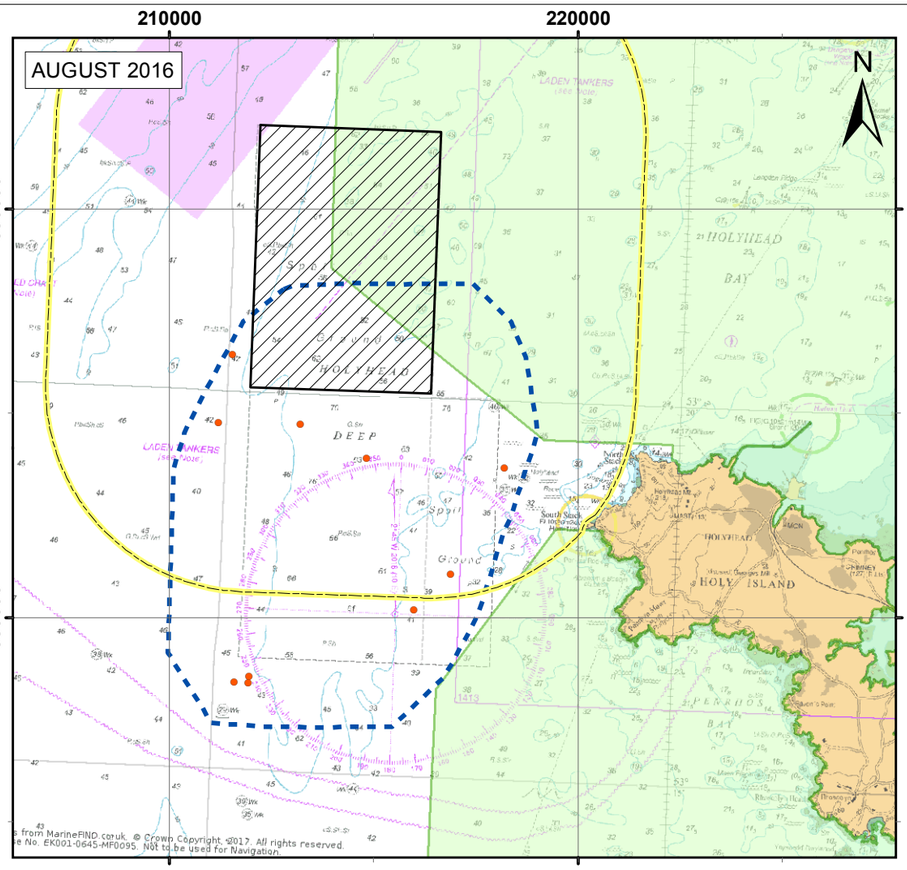
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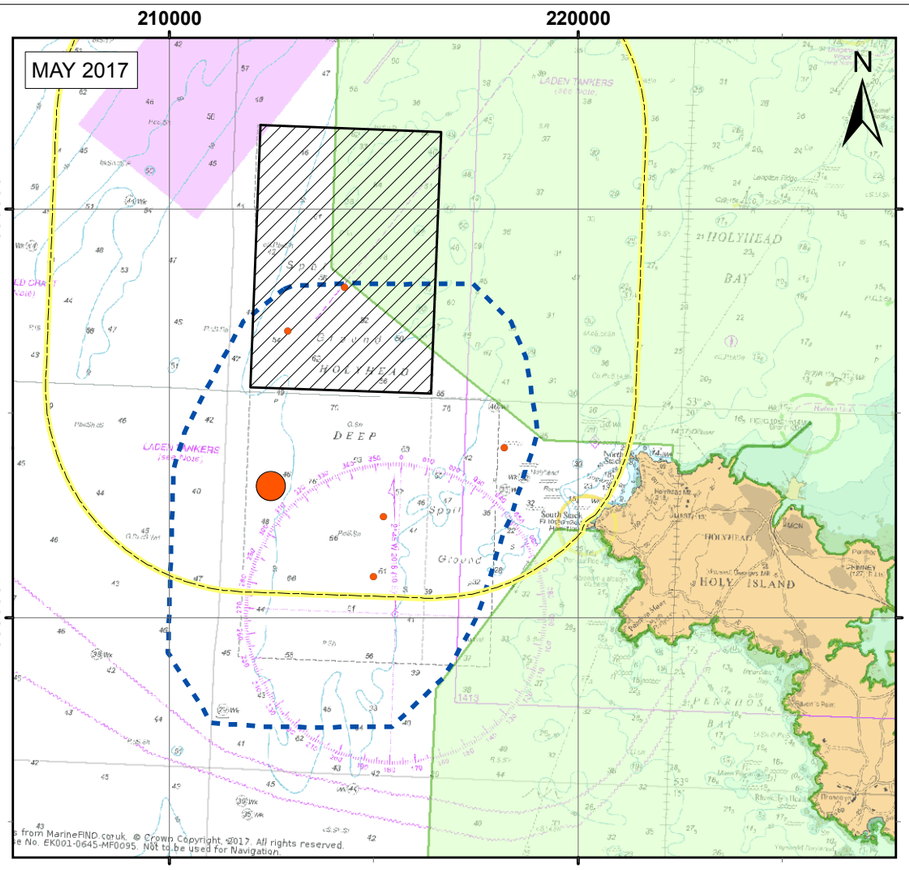
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Ground
South Stack
Fl WHO 20s
Holyhead
Breakwater
Fl(2)WR 10s
Chimney
(127m)
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Penrhos
Pier
Fl G 3s
Penrhos
Fl(2)G 10s
Penrhos
Fl(2)G 10s
Penrhos
Fl G 3

6.5.91 Detailed studies have been undertaken on colony home ranges of gannets, based on tracking data and the subsequent modelling of these data [RD351]. The resultant findings suggest that gannets partition the sea between colonies, with larger colonies using greater areas of sea. In the context of the ZoIs for the Wylfa Newydd Development Area and Disposal Site, this would suggest that the gannets using the ZoIs are most likely to derive from Ailsa Craig and Grassholm, which are the two largest colonies within foraging range of the ZoIs. However, the ZoIs lie just beyond the predicted home range of birds from the Grassholm colony [RD351], suggesting that the basic apportionment calculation undertaken here may overestimate the contribution of the Grassholm SPA population to the ZOI populations.

6.5.92 Therefore, both the 5km Wylfa Newydd Development Area ZOI and the Disposal Site ZOI are likely to be used to a minor extent only by the Grassholm SPA gannet population.

Ribble and Alt Estuaries SPA and Ramsar site

6.5.93 Breeding lesser black-backed gull is a qualifying feature of the Ribble and Alt Estuaries SPA and Ramsar site. This SPA and Ramsar site population has been screened into the shadow HRA on the basis of having potential connectivity with the ZoIs associated with both the Wylfa Newydd Development Area and the Disposal Site (see 4.6). The European Designated Site boundary is 83km from the 5km ZOI used in the scoping exercise, and 119km from the potential 5km ZOI associated with the Disposal Site (table 4-2 and figure 4-6). These distances are within the mean maximum foraging range of breeding lesser black-backed gull, which is estimated to be 141km [RD330]. As for other breeding seabird species there are a number of pathways through which impacts could potentially manifest (see tables 4-2 and 5-4).

6.5.94 The citation population for the Ribble and Alt Estuaries SPA breeding lesser black-backed gull population is 1,800 breeding pairs [RD169], although the most recently available estimate for the SPA (from 2015) is 8,416 breeding pairs [RD164]. The Seabird2000 census estimate for the SPA population, used in the apportionment calculation, is 4,108 breeding pairs (http://jncc.defra.gov.uk/page-4460).

6.5.95 As for other breeding seabird species (see above), the ESAS boat-based transect surveys provide the primary source of data on the densities and distribution of lesser black-backed gull in the offshore waters around the Wylfa Newydd Development Area (Application Reference Number: 6.4.89), whilst the information from the ESAS boat-based surveys from the vicinity of the Disposal Site is also used (as the disposal site ZOI is within foraging range of the Ribble and Alt Estuaries SPA breeding lesser black-backed gull population).

6.5.96 The breeding season for lesser black-backed gull is defined as April to August [RD113]. During this period densities ranged from 0 to 0.21 birds per km^2 in Block 1 and from 0.05 to 0.68 birds per km^2 in Block 2 (Application

Reference Number: 6.4.89). The distribution of lesser black-backed gull records tended to be relatively scattered throughout the Block 1 survey area, but with high density aggregations in a small number of the surveys (figures 3-180 – 3-190, Application Reference Number: 6.4.89).

6.5.97 The maximum estimated density in Block 1 during breeding season (i.e. 0.21 birds per km^2 for the April 2017 survey) gives a population size of 53 individuals in Block 1 (Application Reference Number: 6.4.89).

6.5.98 The surveys from the vicinity of the Disposal Site recorded consistently low numbers of lesser black-backed gulls only, with the maximum count of 26 obtained during the June survey (figures 6-39a,b).

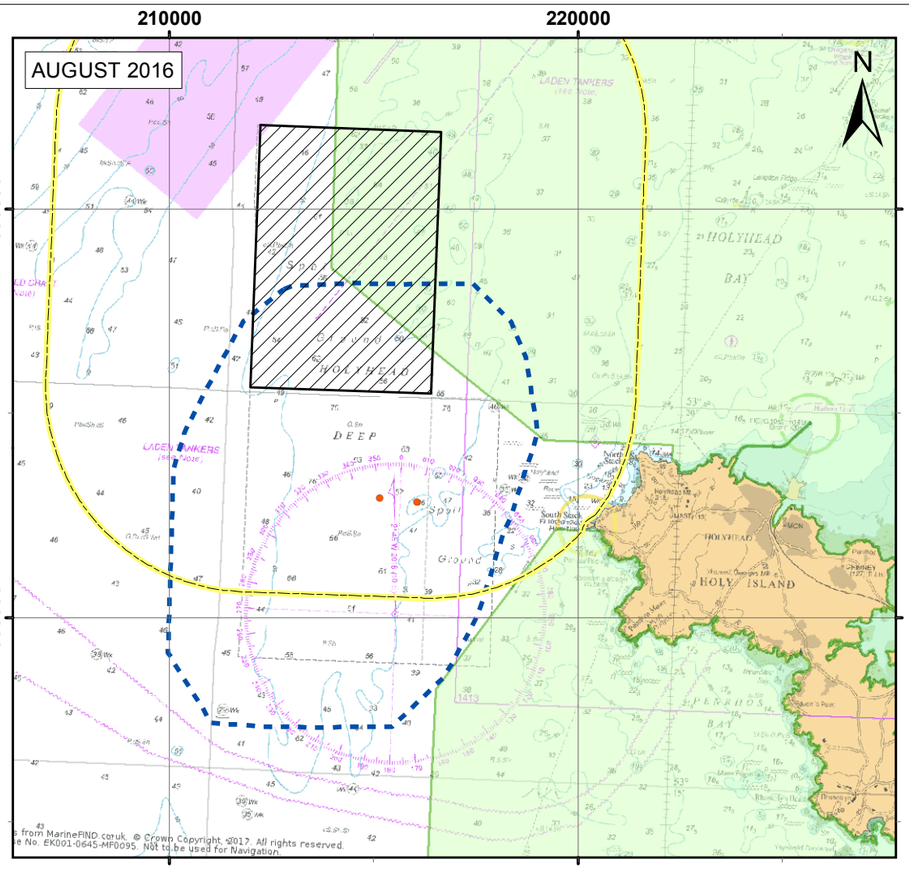
6.5.99 The ZoIs for the Wylfa Newydd Development Area and the Disposal Site are within the foraging range of a large number of other lesser black-backed gull breeding colonies. Therefore, the apportionment calculation described above was undertaken following the procedures already outlined. This calculation suggests that the Ribble and Alt Estuaries SPA lesser black-backed gull population contributes approximately 0.04% of the birds present in both the 5km Wylfa Newydd Development Area ZOI and the Disposal Site ZOI. For the 5km Wylfa Newydd Development Area ZOI this represents less than one individual, and less than 0.01% of the SPA population.

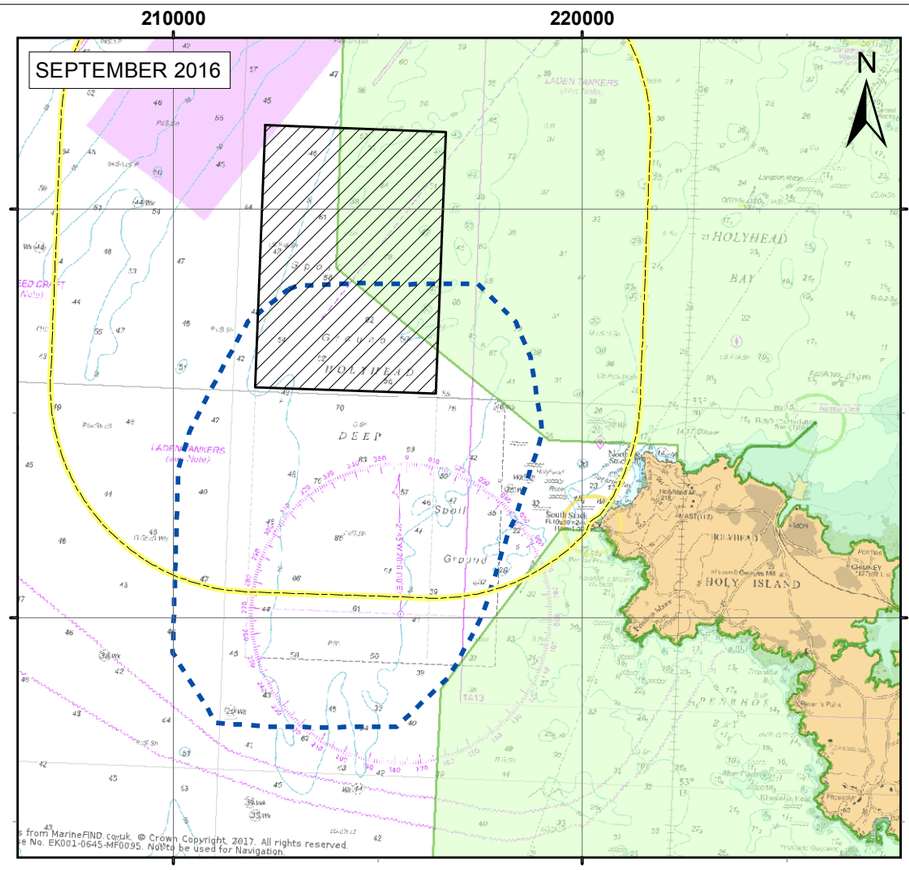
6.5.100 Therefore, even when it is assumed that the entire Block 1 population occurs within the 5km Wylfa Newydd Development Area ZOI and that all of the birds using this area are breeding adults (both of which are unrealistic and highly precautionary assumptions), it can be concluded that the 5km Wylfa Newydd Development Area ZOI is likely to be used to a minor extent only (if at all) by the Ribble and Alt Estuaries SPA and Ramsar site lesser black-backed gull population. This conclusion will also apply to the Disposal Site ZOI, given the low numbers recorded during the Minesto surveys.

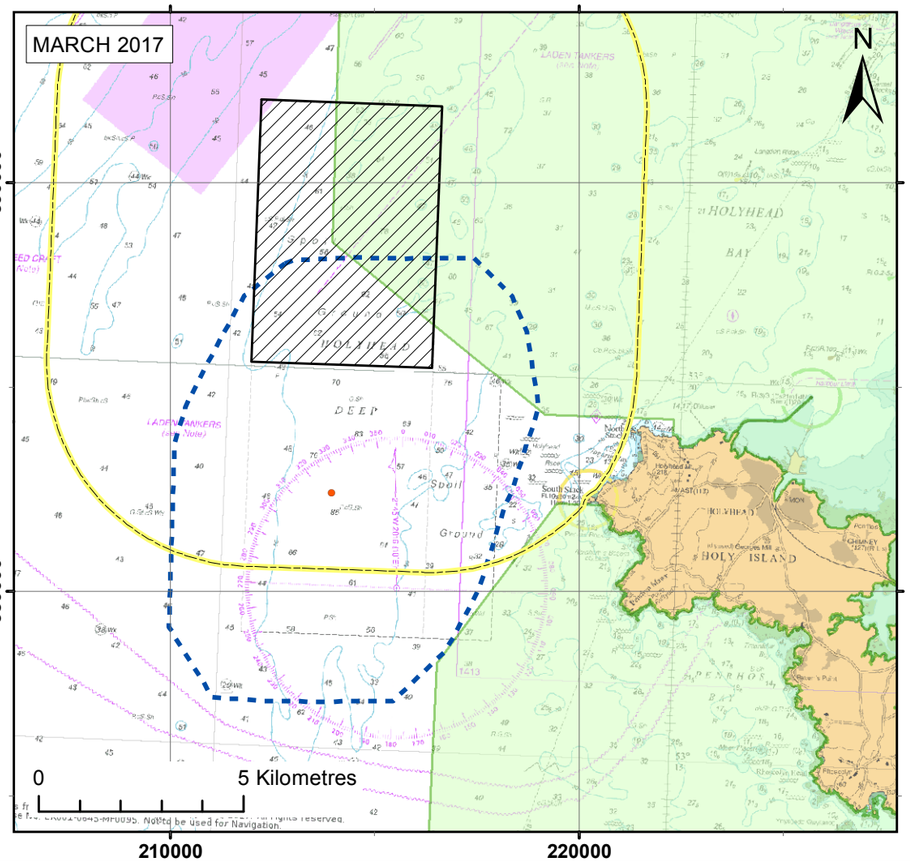
Bowland Fells SPA

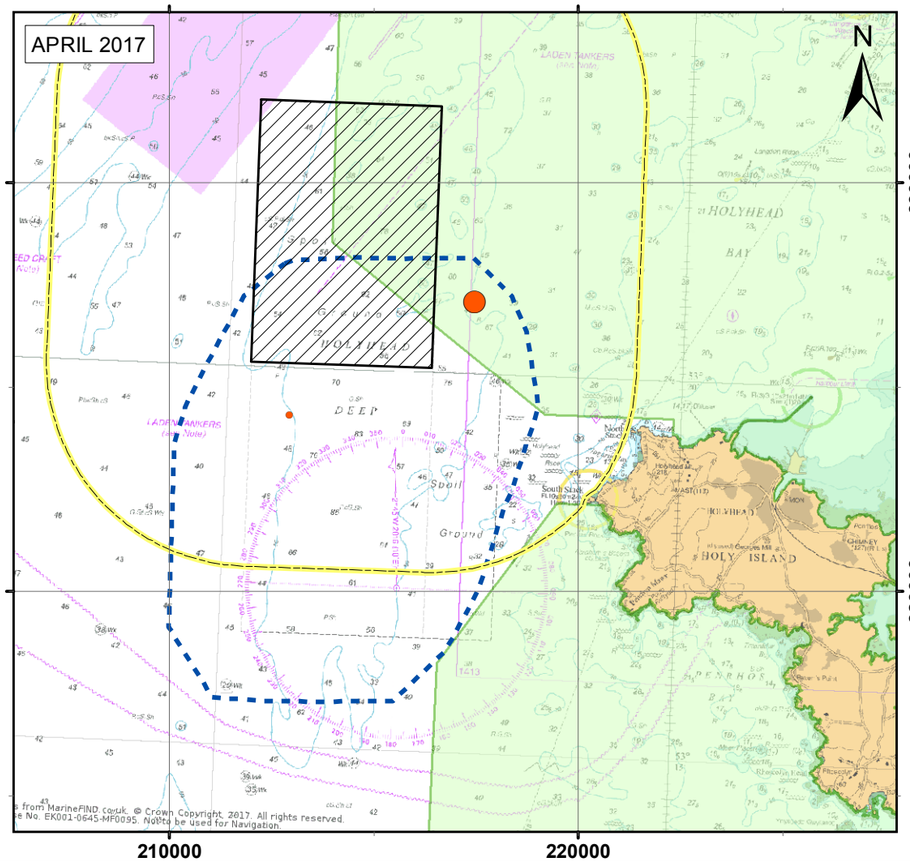
6.5.101 Breeding lesser black-backed gull is a qualifying feature of the Bowland Fells SPA. This SPA population has been screened into the shadow HRA on the basis of having potential connectivity with the ZoIs associated with the Wylfa Newydd Development Area. The SPA boundary is 124km from the 5km Wylfa Newydd Development Area ZOI used in the scoping exercise (table 4-2 and figure 4-6). As detailed above, this distance is within the foraging range of lesser black-backed gull.

6.5.102 The citation population for the Bowland Fells SPA breeding lesser black-backed gull population is 11,470 breeding pairs [RD170], although the most recently available estimate for the SPA (from 2001 during the Seabird2000 census) is 18,518 breeding pairs [RD164].









Legend

- Holyhead North disposal site
- Potential zone of influence for marine water quality
- Morwenoliaid Ynys Môn/Anglesey Terns Special Protection Area (SPA)
- Boat based survey count area

Number of birds

- 1
- 2
- 3
- 4 - 5

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Client: HORIZON NUCLEAR POWER

Project: Wylfa Newydd Project

Title: Numbers and distribution of Lesser black-backed gull recorded by ESAS surveys in the vicinity of the Disposal Site (1 of 2)

Figure: 6-39a

Revision:	Date:	Drawn:	Checked:	Size:	Scale:
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Co-ordinate system: British National Grid

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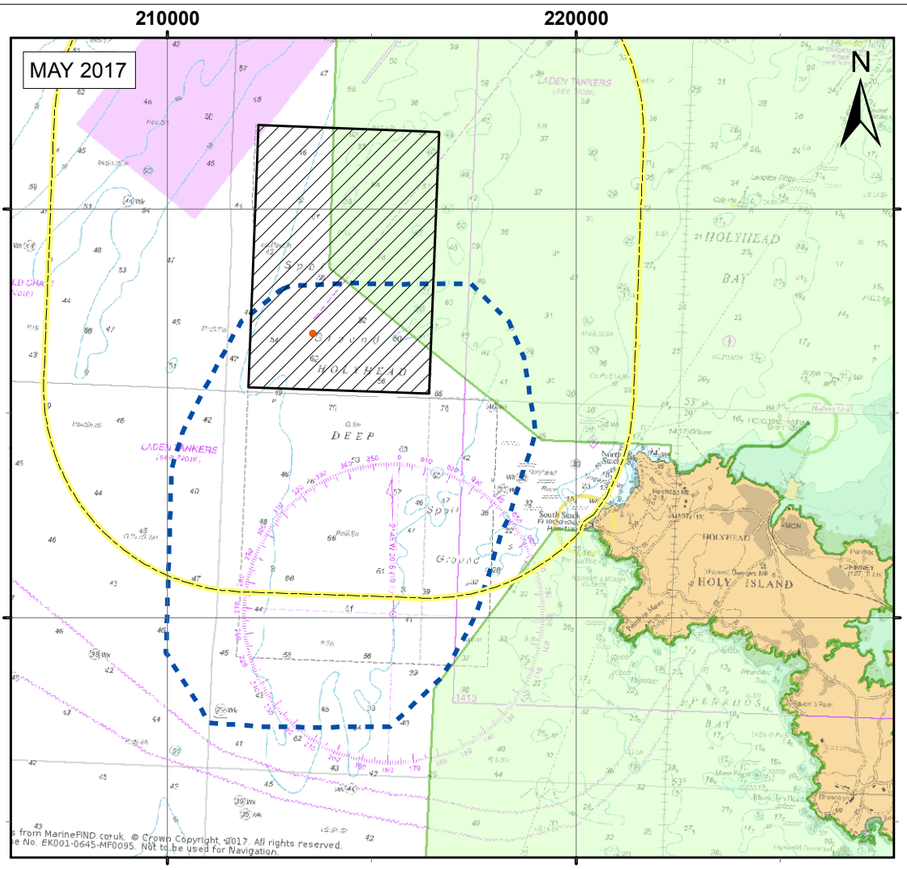
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PENRHOS BAY
South Stack
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Quarry
Pilot Mast
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Ldg Lts 238°
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6.5.103 The densities and distribution of lesser black-backed gull, as determined during the ESAS boat-based transect surveys, in the Block 1 and 2 survey areas are described above. These give a maximum breeding season population size for the Block 1 survey area of 53 individuals.

6.5.104 The apportionment calculation undertaken for lesser black-backed gull suggests that the Bowland Fells SPA population contributes less than 0.07% of the birds present in the 5km Wylfa Newydd Development Area ZOI, which represents less than one individual and less than 0.01% of the SPA population.

6.5.105 Therefore, despite the unrealistic and highly precautionary assumptions used for the apportionment calculation, it can be concluded that the 5km Wylfa Newydd Development Area ZOI is of little importance to the Bowland Fells SPA lesser black-backed gull population.

Morecambe Bay SPA and Ramsar site

6.5.106 Breeding lesser black-backed gull is a named component of the seabird assemblage qualifying feature of the Morecambe Bay SPA and Ramsar site. This SPA population has been screened into the shadow HRA on the basis of having potential connectivity with the ZoIs associated with the Wylfa Newydd Development Area and the Disposal Site. The SPA boundary is 102km from the 5km Wylfa Newydd Development Area ZOI used in the scoping exercise and 121km from the potential 5km ZOI associated with the Disposal Site (table 4-2 and figure 4-6). As detailed above, these distances are within the foraging range of lesser black-backed gull.

6.5.107 The most recently available estimate for the Morecambe Bay SPA breeding lesser black-backed gull population is 2,331 breeding pairs ([RD164]). The Seabird2000 census estimate for the SPA population, used in the apportionment calculation, is 19,490 breeding pairs (http://jncc.defra.gov.uk/page-4460).

6.5.108 The densities and distribution of lesser black-backed gull, as determined during the ESAS boat-based transect surveys, in the Block 1 and 2 survey areas are described above, as is the distribution of survey records in the vicinity of the Disposal Site. These give a maximum breeding season population size for the Block 1 survey area of 53 individuals, and demonstrate low numbers in the the vicinity of the Disposal SiteZOI.

6.5.109 The apportionment calculation undertaken for lesser black-backed gull suggests that the Morecambe Bay SPA population contributes less than 0.17% of the birds present in the 5km Wylfa Newydd Development Area ZOI, which represents less than one individual and less than 0.01% of the SPA population.

6.5.110 Therefore, despite the unrealistic and highly precautionary assumptions used for the apportionment calculation, it can be concluded that the 5km Wylfa Newydd Development Area ZOI is of little importance to the Morecambe Bay SPA lesser black-backed gull population. This conclusion

will also apply to the Disposal Site ZOI, given the low numbers recorded during the Minesto surveys.

Morecambe Bay and Duddon Estuary pSPA

6.5.111 This pSPA replaces the previous Morecambe Bay SPA and Duddon Estuary SPA. As such, the description of the baseline conditions is covered in the above text for the Morecambe Bay SPA.

Lambay Island SPA

6.5.112 Breeding populations of fulmar, guillemot, puffin and lesser black-backed gull are qualifying features of the Lambay Island SPA. These SPA populations have been screened into the shadow HRA on the basis of their potential connectivity with the ZoIs associated with both the Wylfa Newydd Development Area and the Disposal Site. The SPA boundary is 94km from the 5km Wylfa Newydd Development Area ZOI used in the scoping exercise, and 73km from the potential 5km ZOI associated with the Disposal Site (table 4-2 and figure 4-6). As such, all four of the above qualifying features are considered to have potential connectivity with the Disposal Site ZOI, and three of the four with the 5km Wylfa Newydd Development Area ZOI (the exception being guillemot, for which this ZOI is beyond the species mean maximum foraging range of 84km [RD330]). As for other breeding seabird species there are a number of pathways through which impacts could potentially manifest (see tables 4-2 and 5-4).

6.5.113 The citation population sizes and most recently available population size estimates for each of these qualifying features are, respectively:

- 635 and 530 breeding pairs for fulmar;
- 59,824 and 67,314 individuals for guillemot;
- 265 and 375 individuals for puffin ; and
- 309 and 321 breeding pairs for lesser black-backed gull ([RD222]; [RD164]).

6.5.114 The Seabird2000 census estimates for these SPA populations, used in the apportionment calculation, are 585 breeding pairs for fulmar, 60,754 individuals for guillemot, 578 individuals for puffin and 309 breeding pairs for lesser black-backed gull (http://jncc.defra.gov.uk/page-4460).

6.5.115 As for other breeding seabird species (see above), the ESAS boat-based transect surveys provide the primary source of data on the densities and distribution of these species in the offshore waters around the Wylfa Newydd Development Area (Application Reference Number: 6.4.89), whilst the information from the ESAS boat-based surveys from the vicinity of the Disposal Site is also used (as the Disposal Site ZOI is within foraging range of these SPA populations).

6.5.116 Details of the breeding season densities recorded in the Block 1 and Block 2 survey areas, and of the derived breeding season population size in Block 1,

are provided in table 6-11 for fulmar, guillemot and puffin. For lesser black-backed gull these details are provided above.

Table 6-11 The breeding season densities and maximum population sizes of fulmar, guillemot and puffin on the Block 1 and Block 2 survey areas, as determined by the ESAS boat-based surveys

Species	Breeding season period*	Density range between surveys (individuals/km^2)		Maximum estimated population size in Block 1 (individuals)
		Block 1	Block 2	
Fulmar	Jan - Aug	0.00 – 0.16	0.00 – 0.17	42
Guillemot	Mar - Jul	4.92 – 18.82	16.10 – 25.82	4,800
Puffin	Apr - Aug	0.00 – 1.2	0.08 – 0.46	312

*as defined by [RD113]

6.5.117 Fulmar was recorded in low numbers only, whilst guillemot was the most abundant of the seabird species screened into the shadow HRA. Within Block 1, guillemots were distributed widely but with a tendency in the 2016 surveys for densities to be highest in relatively inshore areas in the eastern half of Block 1. By contrast, the breeding season distribution of puffin tended to be skewed towards the western half of the Block 1 survey area (figures 3-115 – 3-124, Application Reference Number: 6.4.89).

6.5.118 The surveys from the vicinity of the Disposal Site recorded consistently low numbers of puffin and fulmar, but considerably higher numbers of guillemot. A maximum count of 10 was obtained for puffin (in the July survey) (figure 6-40a, b), whilst for fulmar the maximum count was 13 (in the August survey (figure 6-41a,b). Peak numbers of guillemot were recorded in the June survey, with a count of 655 – 669 individuals (with the upper figure including all birds recorded as either guillemot or razorbill). Guillemot were relatively evenly distributed across the survey area, but with a tendency for lower numbers in the southern quarter of the survey area during the months of May to July, when abundance tended to be greatest (figure 6-42a,b). A likely strong connectivity for the guillemots recorded in this survey area with the South Stacks breeding colony was also reported, based upon flight directions during the main chick-rearing period (Minesto, pers. comm.).

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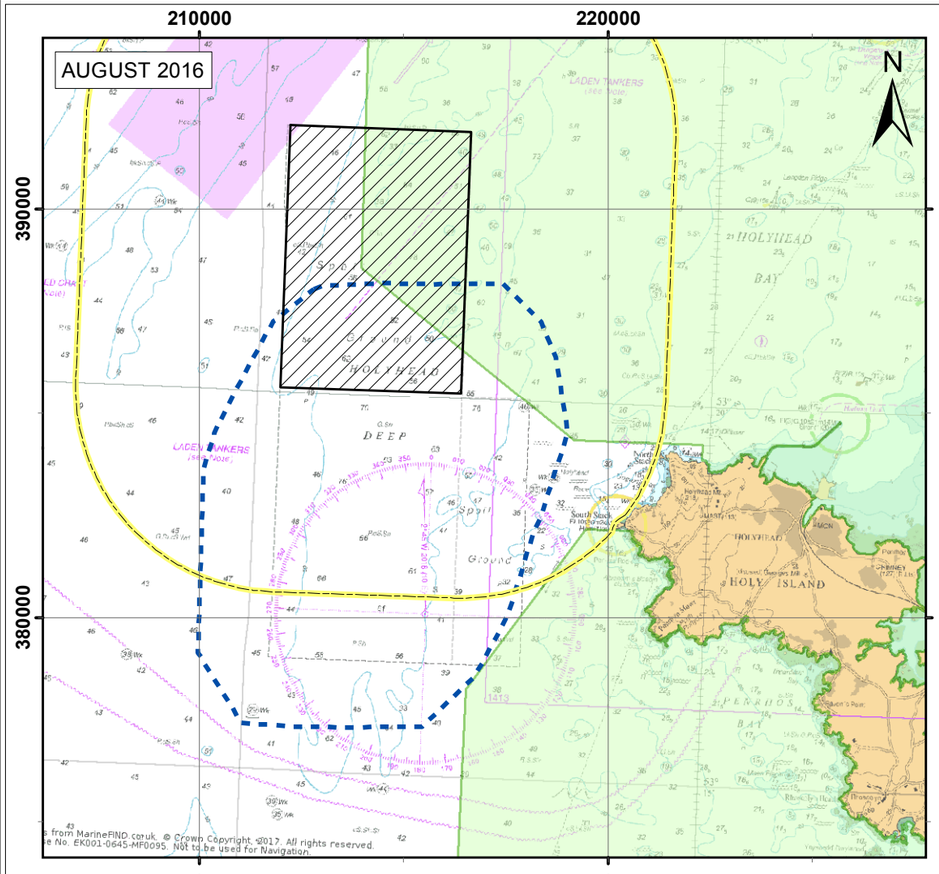

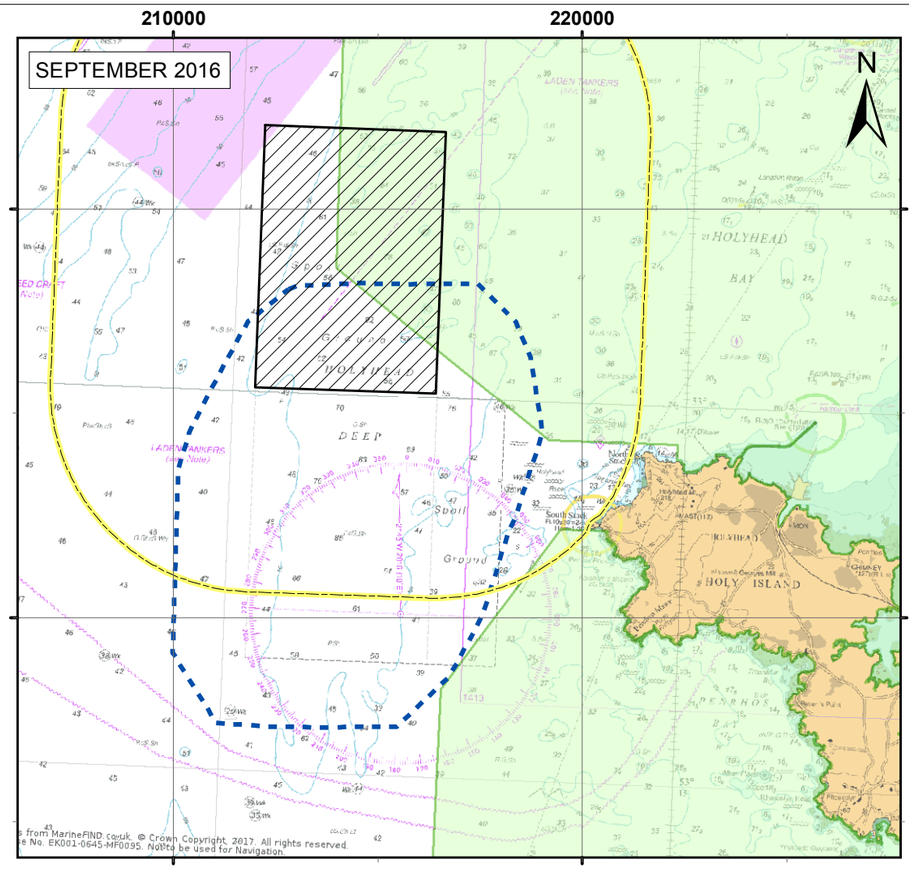

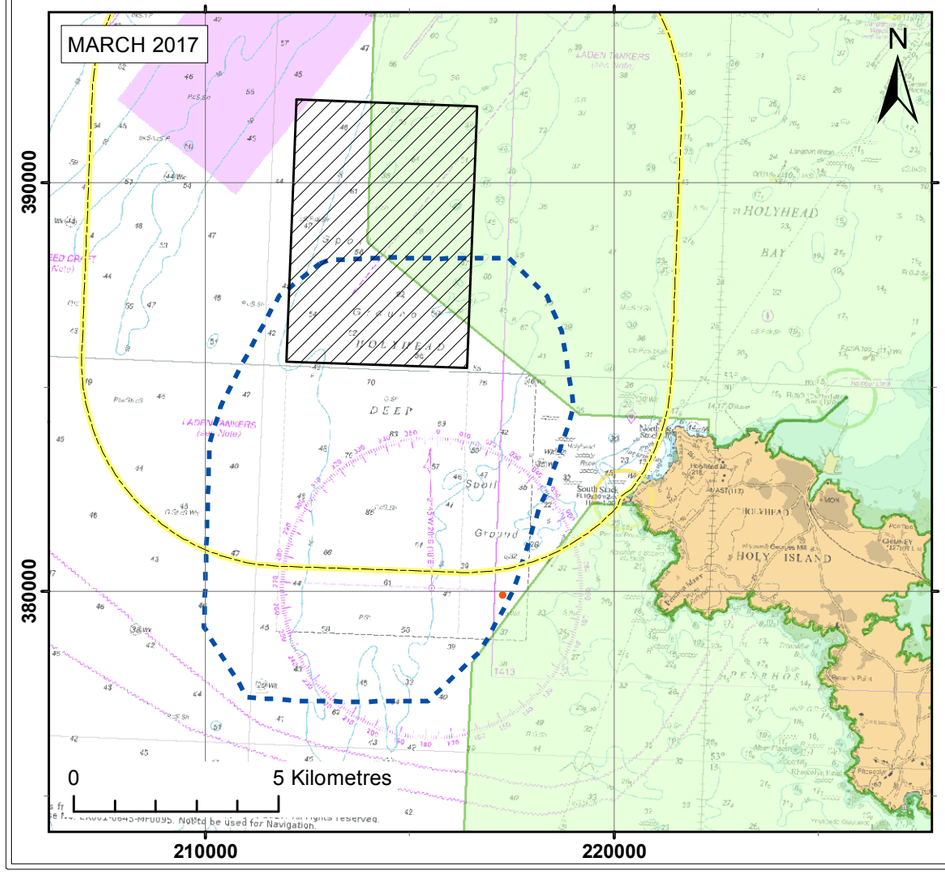

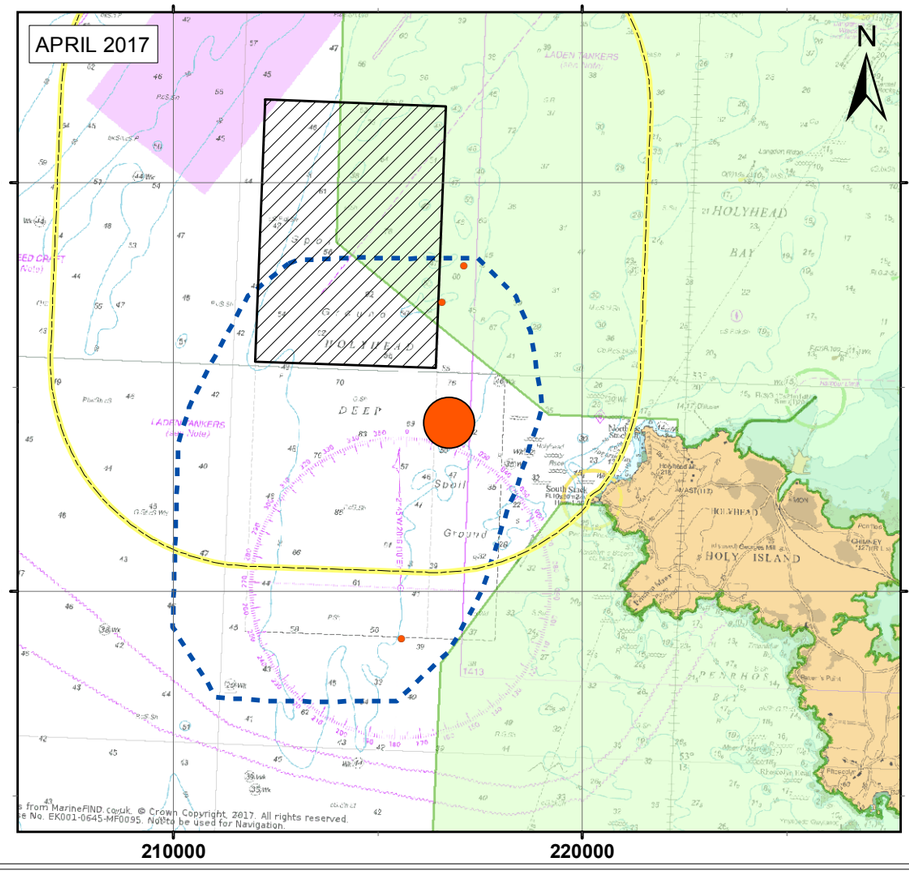

Legend

- Disposal Site
- Potential zone of influence for marine water quality
- Morwenoliaid Ynys Môn/Anglesey Terns Special Protection Area (SPA)
- Boat based survey count area

Number of birds

- 1.000000
- 1.000001 - 2.000000

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Client: HORIZON NUCLEAR POWER

Project: Wylfa Newydd Project

Title: Numbers and distribution of puffin recorded by ESAS surveys in the vicinity of the Disposal Site (1 of 2)

Figure: 6-40a

Revision:	Date:	Drawn:	Checked:	Size:	Scale:
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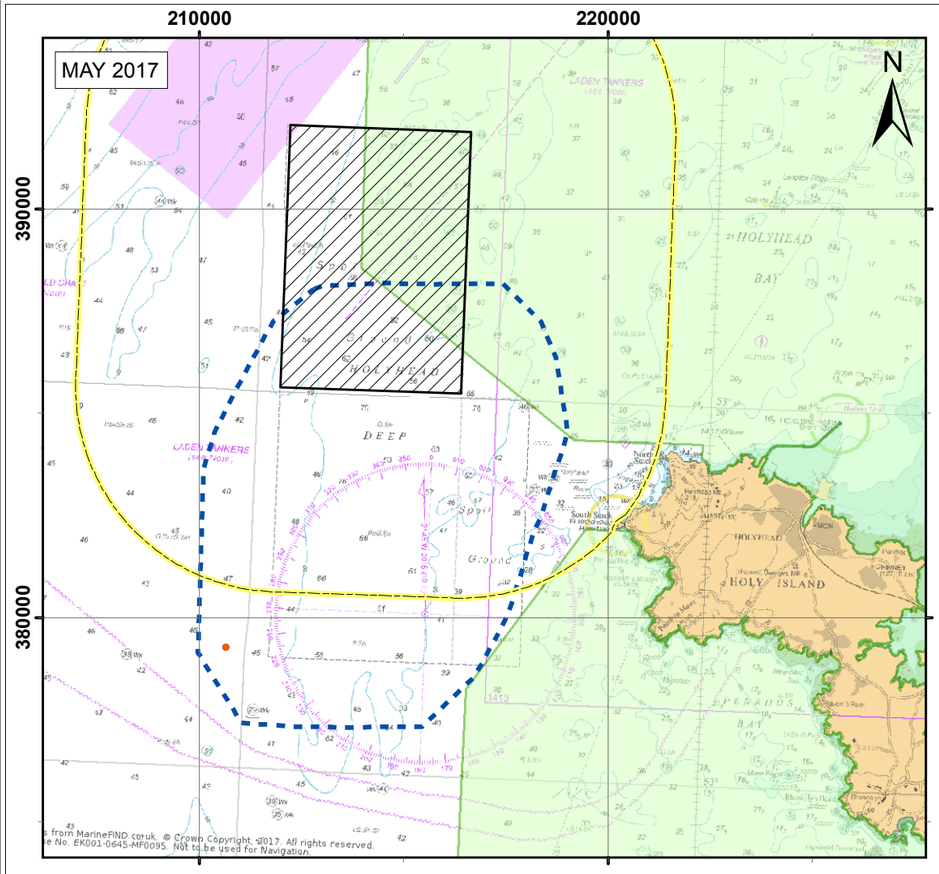
MAY 2017
210000
220000
390000
380000
N
HOLYHEAD BAY
HOLY ISLAND
PENRHOS BAY
DEEP
Ground
LADEN TANKERS
(see Note)
Spoil Ground
HOLYHEAD
Wreck
South Stack
Fl WHO 20s
Horn 30s
Fog Det Lt
Fl(2) WR 30s
Fl(3) WR 30s
Fl(4) WR 30s
Fl(5) WR 30s
Fl(6) WR 30s
Fl(7) WR 30s
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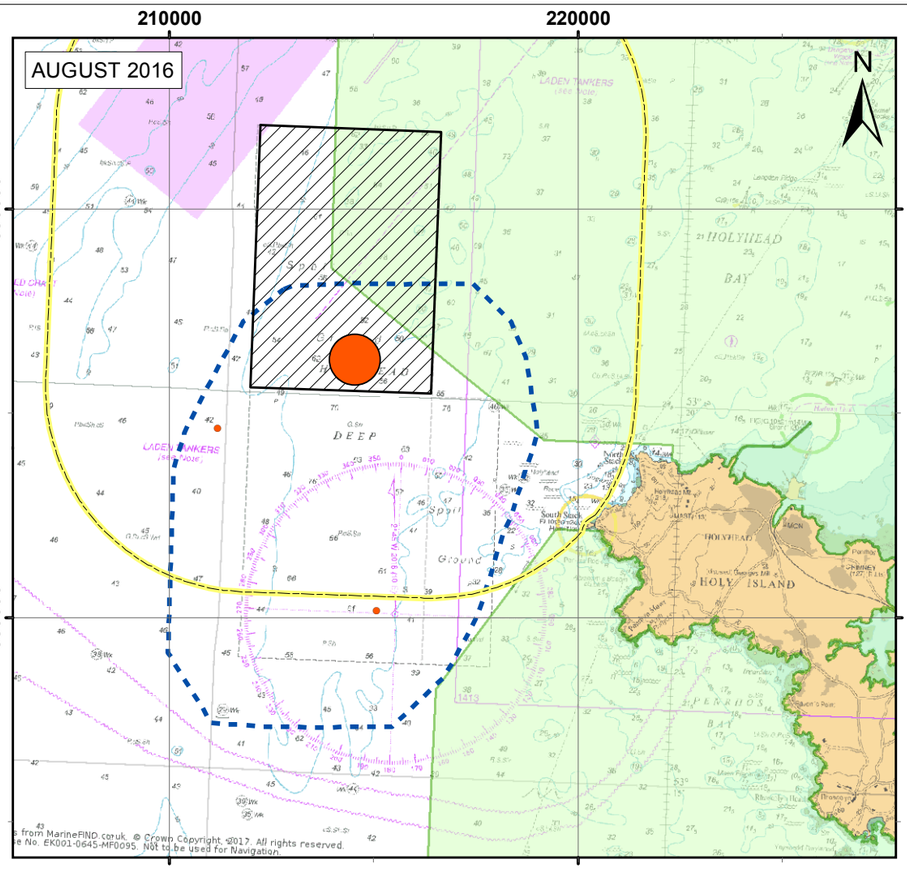
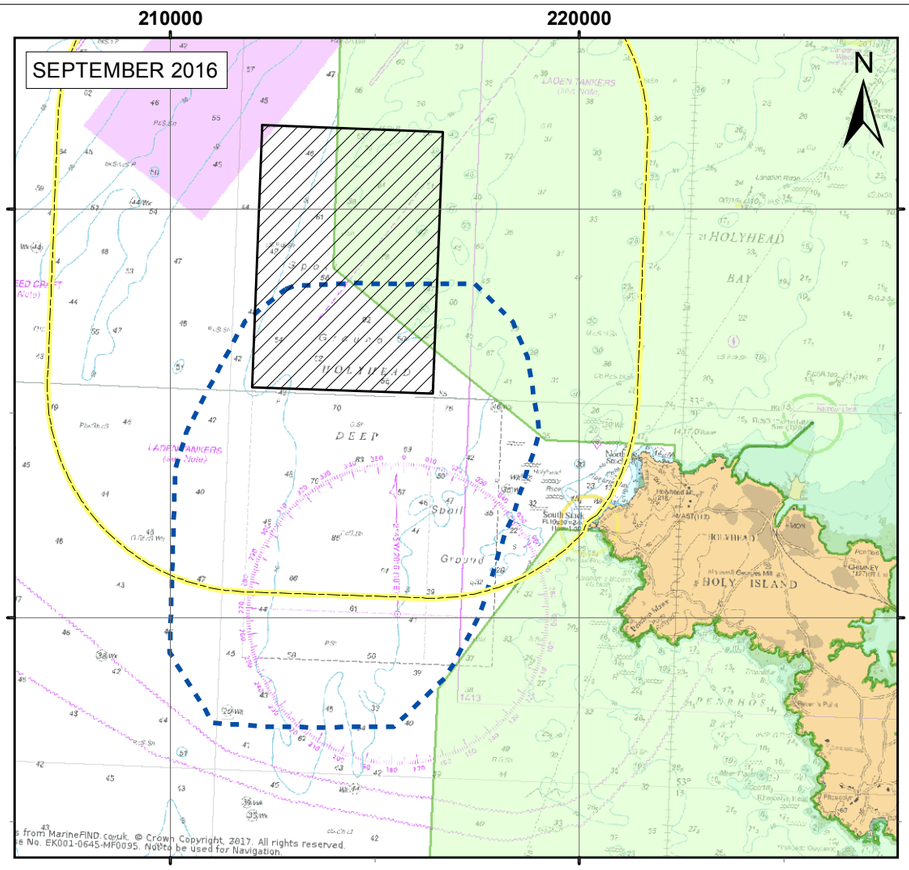
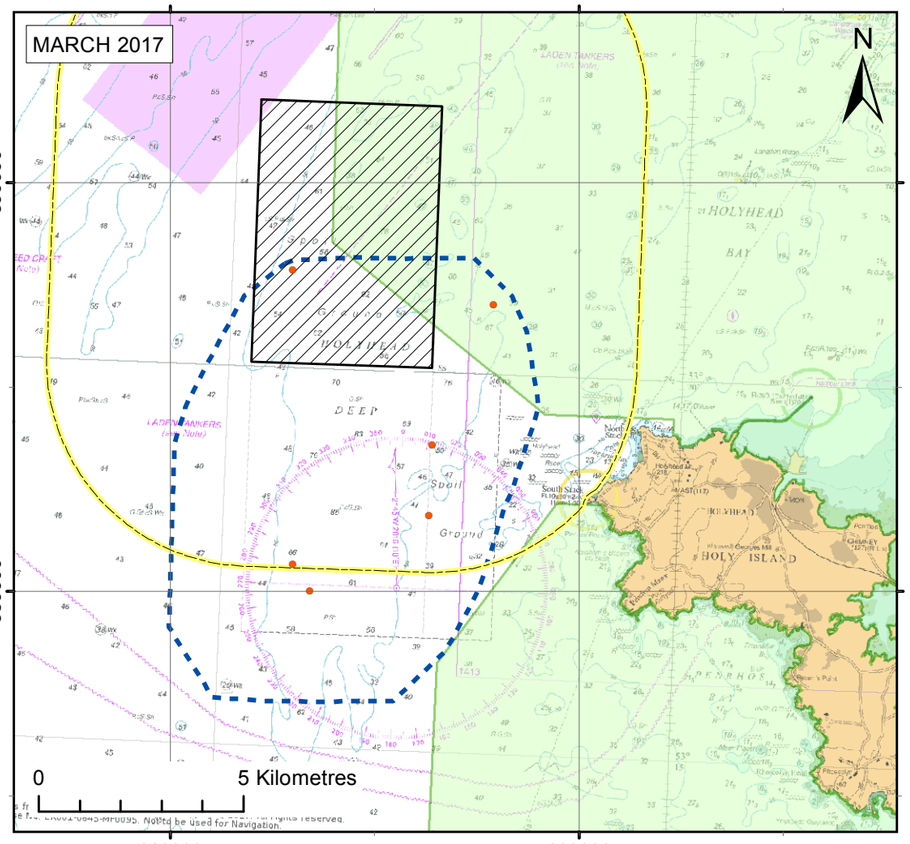
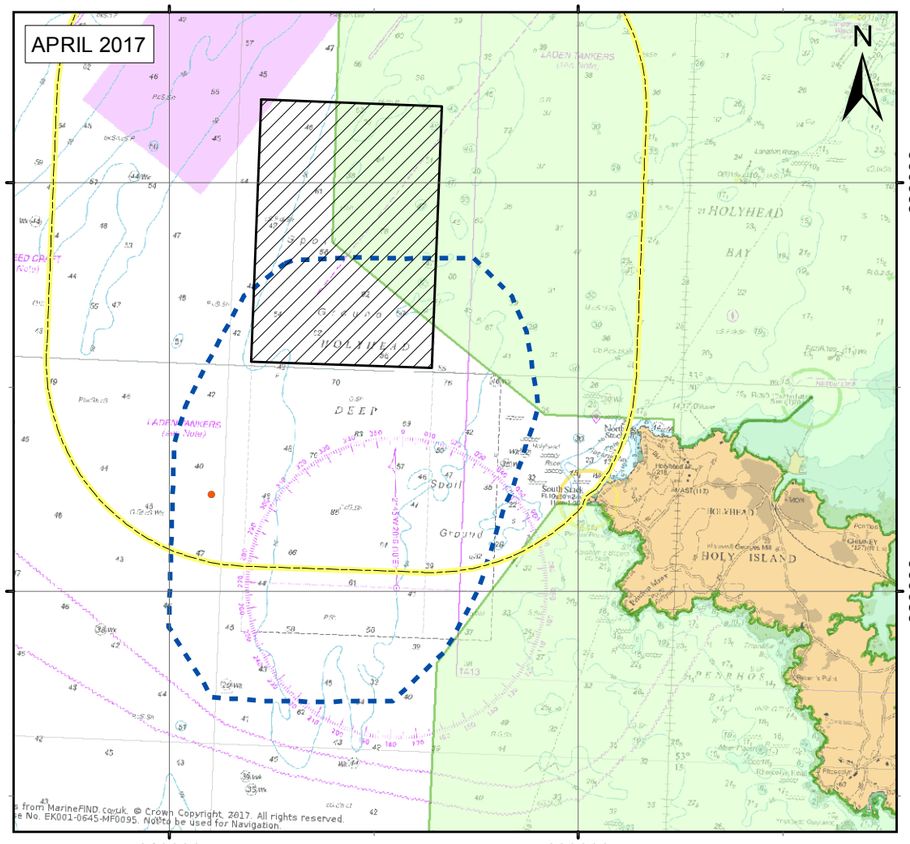
Fl(14) WR 30s









Legend

- Disposal Site
- Potential zone of influence for marine water quality
- Morwenoliaid Ynys Môn/Anglesey Terns Special Protection Area (SPA)
- Boat based survey count area

Number of birds

- 1
- 2 - 11

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Client: HORIZON NUCLEAR POWER

Project: Wylfa Newydd Project

Title: Numbers and distribution of Fulmar recorded by ESAS surveys in the vicinity of the Disposal Site (1 of 2)

Figure: 6-41a

Revision:	Date:	Drawn:	Checked:	Size:	Scale:
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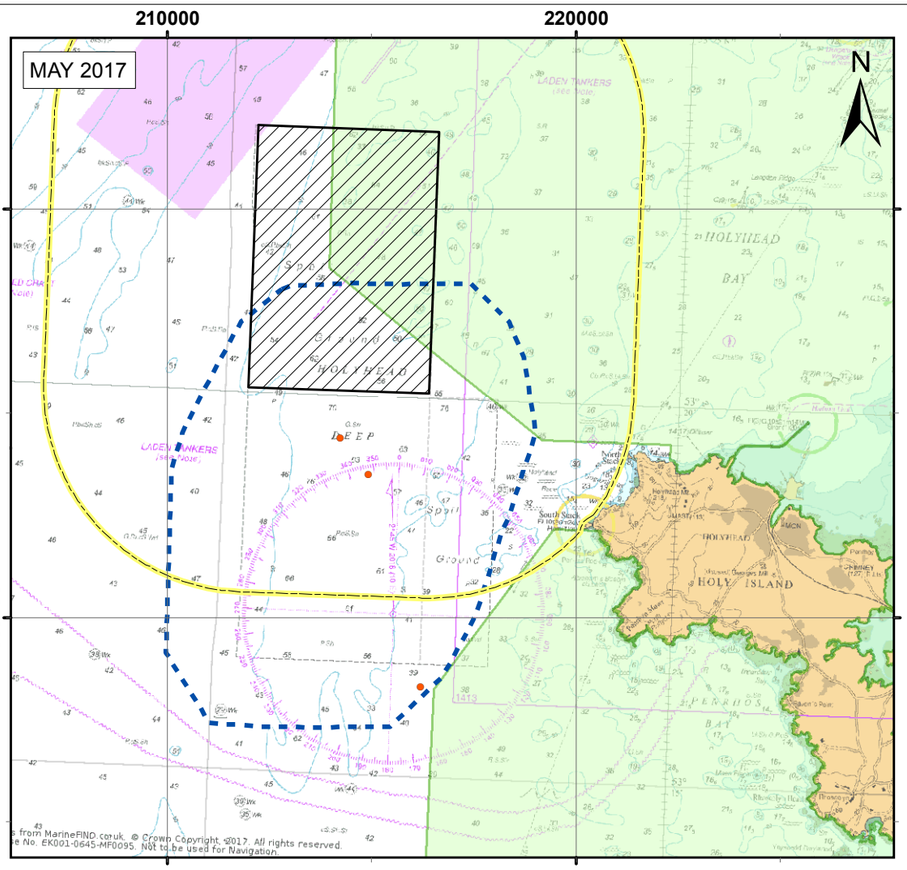

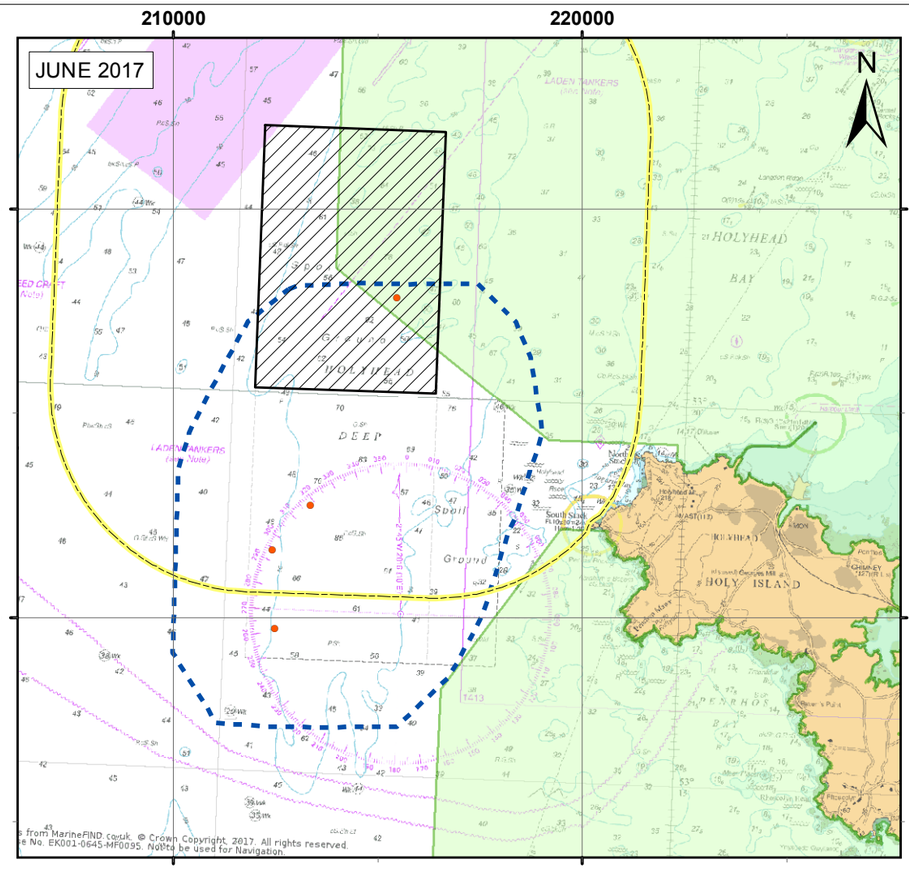

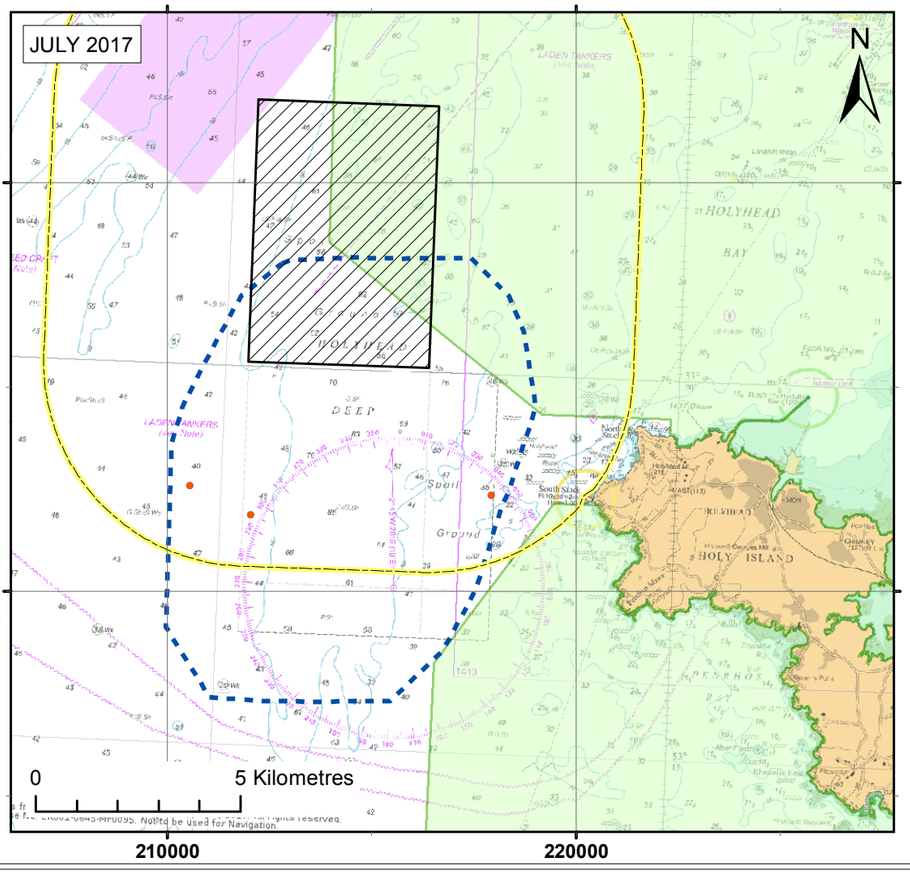

Legend

- Disposal Site
- Potential zone of influence for marine water quality
- Morwenoliaid Ynys Môn/Anglesey Terns Special Protection Area (SPA)
- Boat based survey count area

Number of birds

- 1
- 2 - 11

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Client: HORIZON NUCLEAR POWER

Project: Wylfa Newydd Project

Title: Numbers and distribution of Fulmar recorded by ESAS surveys in the vicinity of the Disposal Site (2 of 2)

Figure: 6-41b

Revision:	Date:	Drawn:	Checked:	Size:	Scale:
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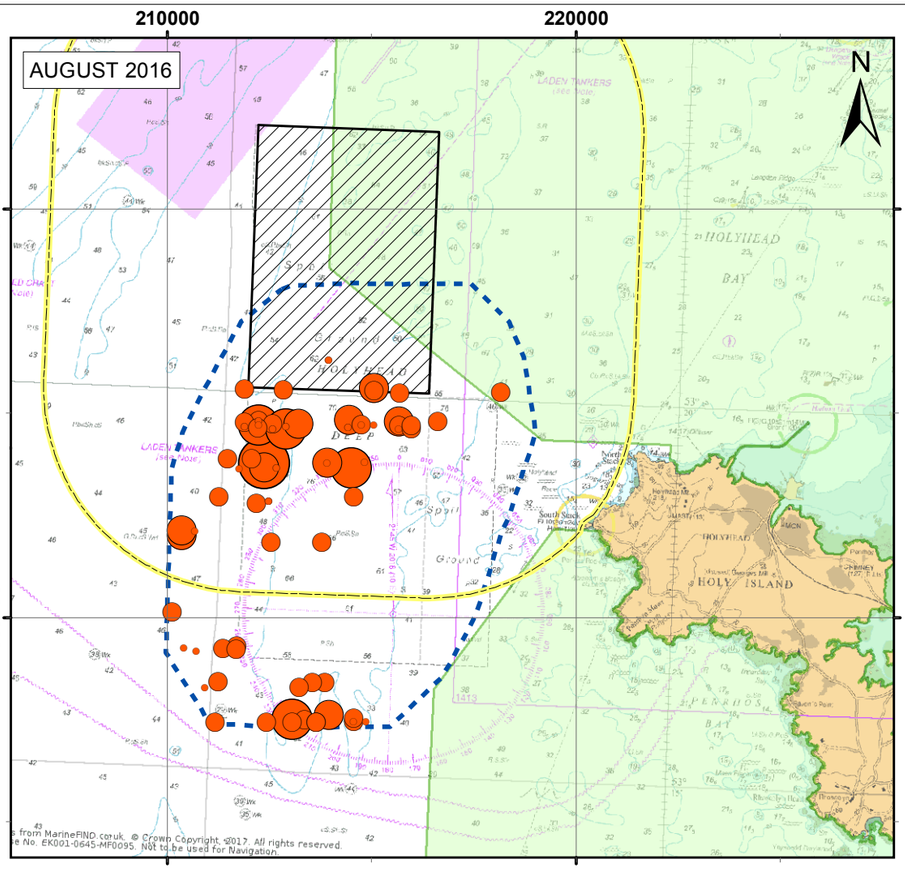

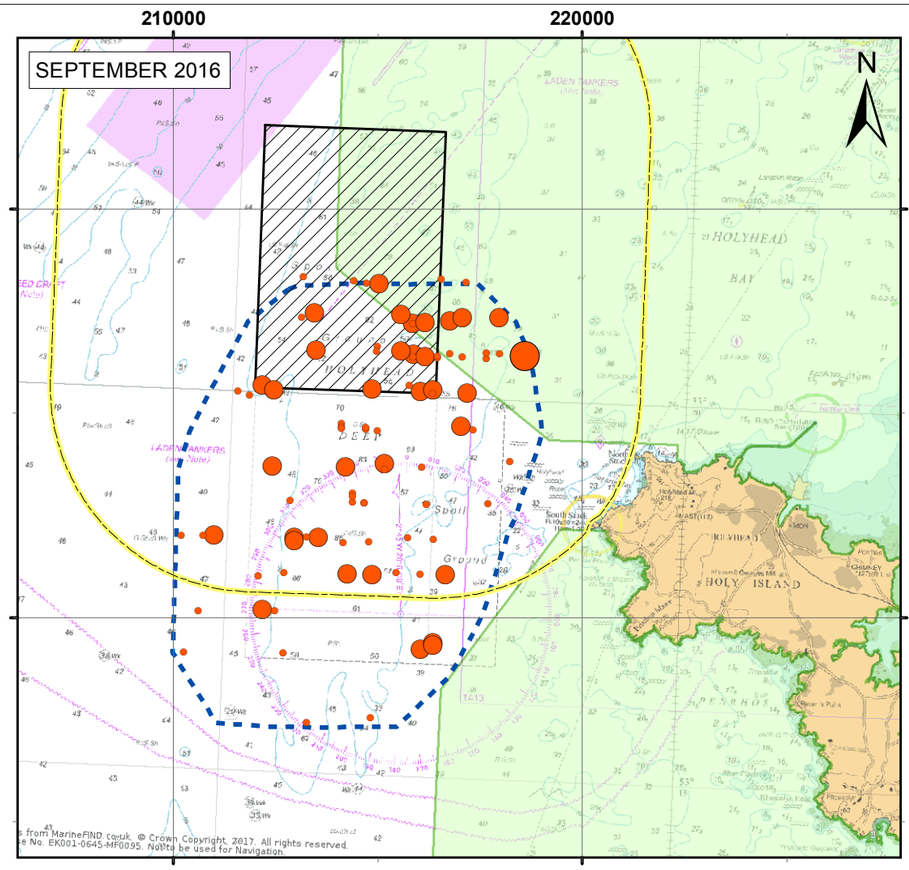

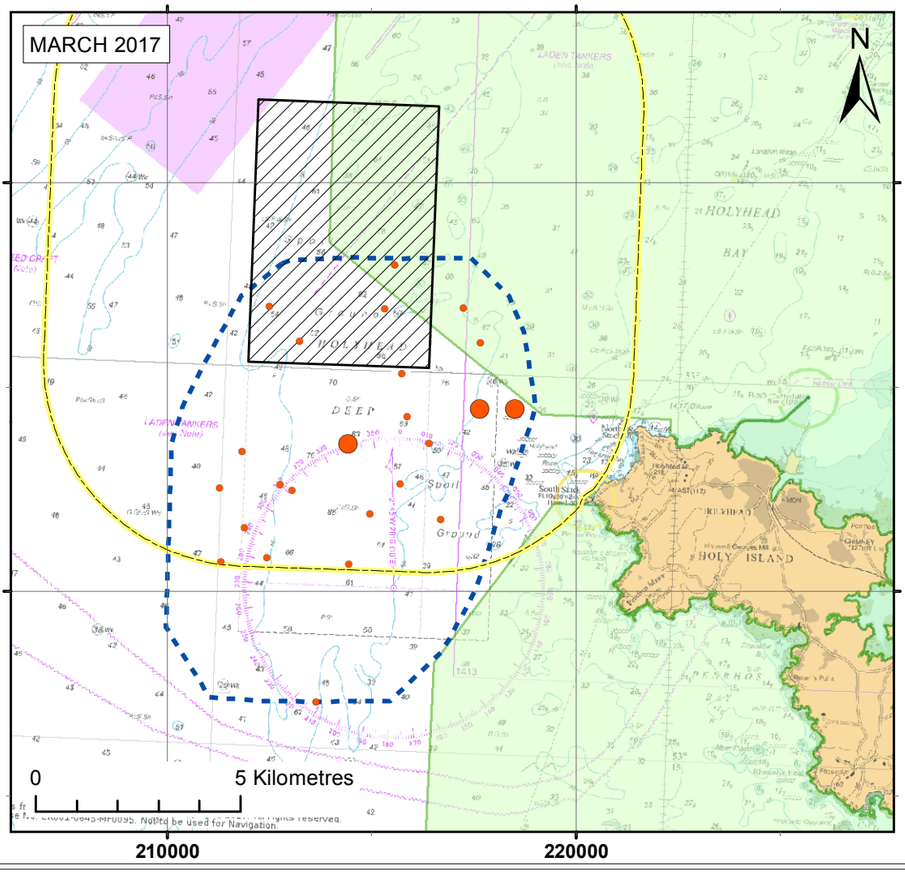

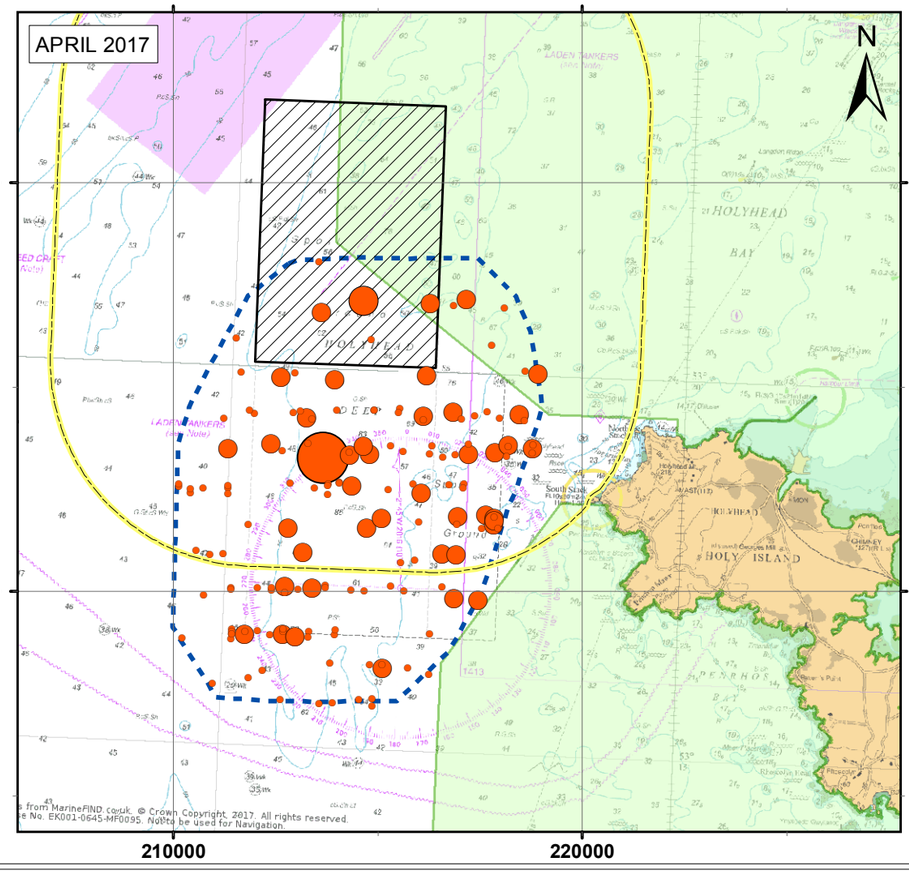

Legend

- Disposal Site
- Potential zone of influence for marine water quality
- Morwenoliaid Ynys Môn/Anglesey Terns Special Protection Area (SPA)
- Boat based survey count area

Number of birds

- 1
- 2 - 4
- 5 - 8
- 9 - 15
- 16 - 24

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Client: HORIZON NUCLEAR POWER

Project: Wylfa Newydd Project

Title: Numbers and distribution of Guillemot recorded by ESAS surveys in the vicinity of the Disposal Site (1 of 2)

Figure: 6-42a

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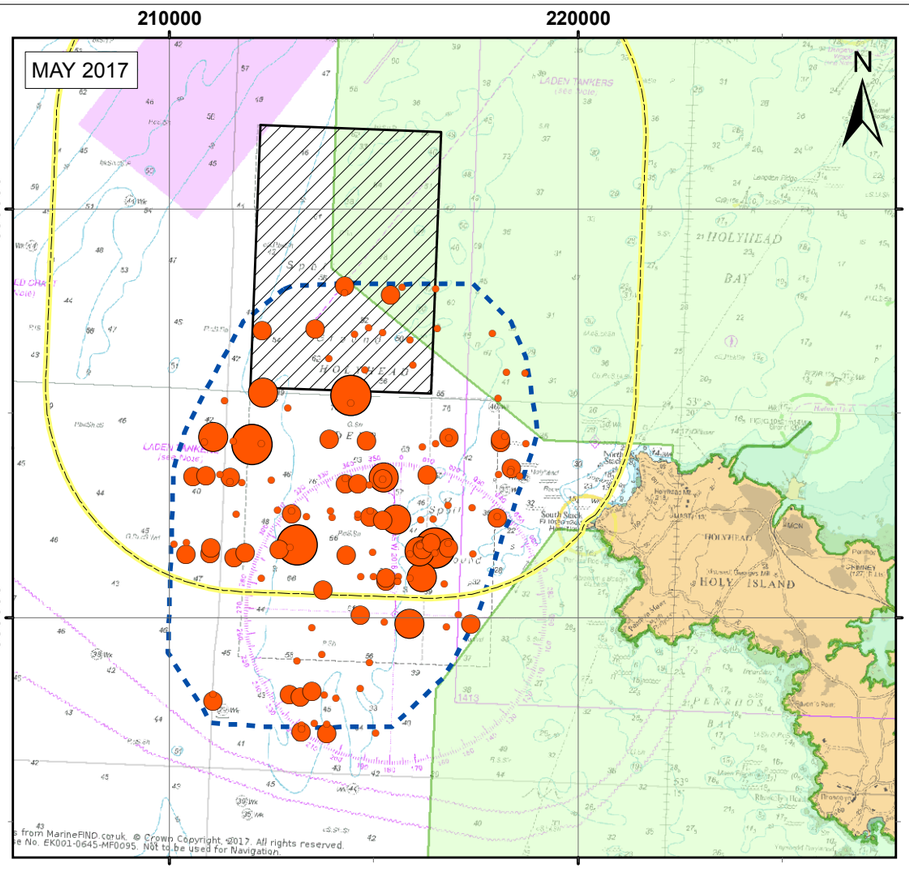

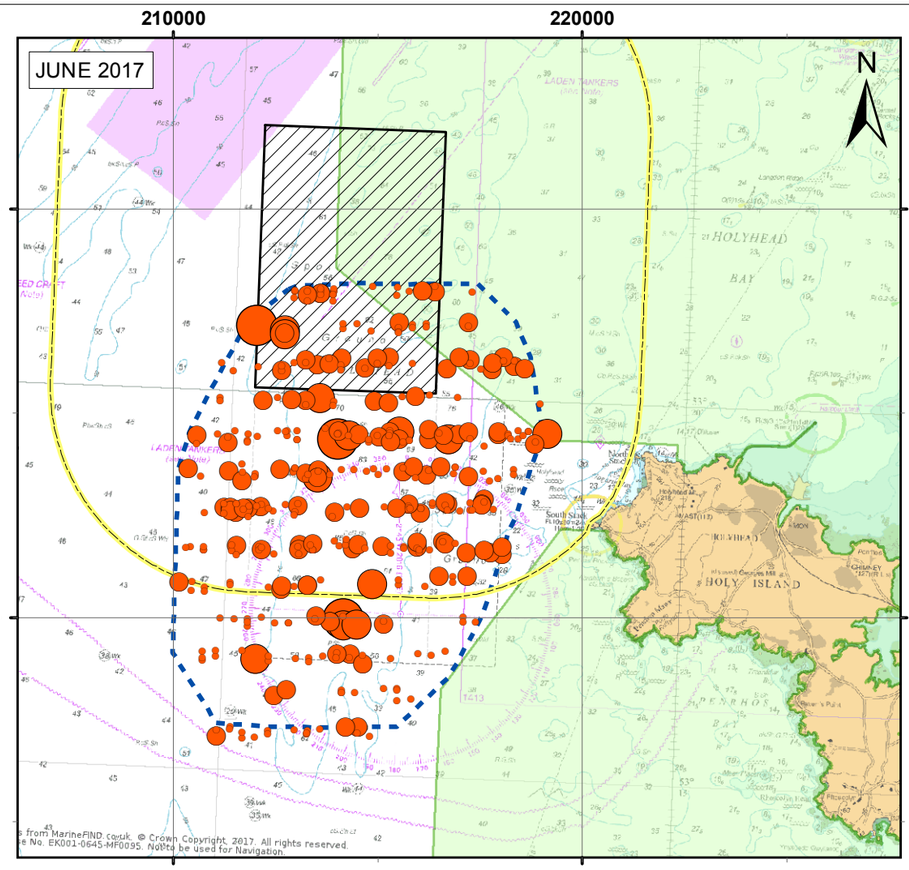

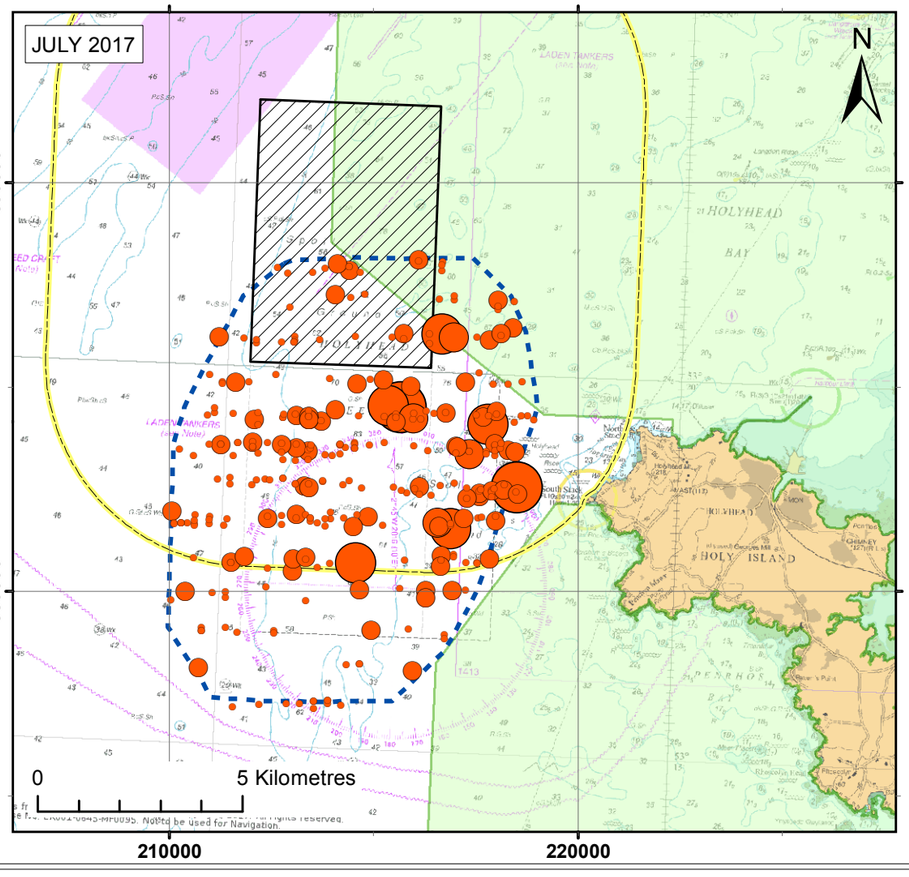

Legend

- Disposal Site
- Potential zone of influence for marine water quality
- Morwenoliaid Ynys Môn/Anglesey Terns Special Protection Area (SPA)
- Boat based survey count area

Number of birds

- 1
- 2 - 4
- 5 - 8
- 9 - 15
- 16 - 24

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Client: HORIZON NUCLEAR POWER

Project: Wylfa Newydd Project

Title: Numbers and distribution of Guillemot recorded by ESAS surveys in the vicinity of the Disposal Site (2 of 2)

Figure: 6-42b

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6.5.119 The ZoIs for the Wylfa Newydd Development Area and the Disposal Site are within foraging range of other breeding colonies of all four species. Therefore, the apportionment calculation described above was undertaken for each species, following the procedures already outlined. This indicated that for fulmar and lesser black-backed gull, the respective Lambay Islands SPA populations contribute less than 0.01% of the birds present in both the 5km Wylfa Newydd Development Area ZOI and the Disposal Site ZOI. For the 5km Wylfa Newydd Development Area ZOI this represents less than one individual, and less than 0.01% of the SPA population for both fulmar and lesser black-backed gull.

6.5.120 Similarly, the Lambay Islands SPA guillemot population was estimated to contribute approximately 0.01% of the birds present in the Disposal Site ZOI.

6.5.121 For puffin, the apportionment calculation indicated that the Lambay Islands SPA population contributes 0.03% of the birds present in the 5km Wylfa Newydd Development Area ZOI, but less than 0.01% of those present in the Disposal Site ZOI. For the 5km Wylfa Newydd Development Area ZOI, this represents approximately 10 individuals, which equates to 1.7% of the SPA population.

6.5.122 Therefore, the available survey data, together with the apportionment calculation, suggest that the 5km Wylfa Newydd Development Area ZOI is of little importance to the Lambay Islands SPA populations of breeding fulmar, lesser black-backed gull and puffin (despite the apportionment calculation involving the unrealistic and highly precautionary assumptions described above).

6.5.123 This conclusion will also apply to each of these SPA populations in relation to the Disposal Site ZOI, given the near negligible contribution these SPA populations are estimated to make to the populations within the Disposal Site ZOI in conjunction with the low numbers of these species recorded during the surveys undertaken in the vicinity of the Disposal Site. Guillemot occurs in considerably higher numbers within this survey area but the Disposal Site ZOI is likely to be of little importance to this SPA population also, given the near negligible contribution estimated from the apportionment calculation (and the observation from the Minesto surveys indicating strong connectivity between the survey area and the South Stacks guillemot colony).

Ireland's Eye SPA

6.5.124 Breeding guillemot is a qualifying feature of the Ireland's Eye SPA. This SPA population has been screened into the shadow HRA on the basis of having potential connectivity with the Disposal Site ZOI (see 4.6). The SPA boundary is 77km from the Disposal Site ZOI (figure 4-6), which is within the mean maximum foraging range of the species.

6.5.125 The citation population for the Ireland's Eye SPA breeding guillemot population is 2,191 individuals [RD226], although the most recently available estimate for the SPA (from 2010) is 2,479 individuals ([RD164]). The

Seabird2000 census estimate for the SPA population, used in the apportionment calculation, is 2,191 individuals (http://jncc.defra.gov.uk/page-4460).

6.5.126 The densities and distribution of guillemot, as determined during the ESAS boat-based transect surveys, in the Block 1 and 2 survey areas are described above (table 6-10), as is the distribution of survey records in the vicinity of the Disposal Site ZoI.

6.5.127 The apportionment calculation undertaken for guillemot suggests that the Ireland's Eye SPA population contributes less than 0.01% of the birds present in the Disposal Site ZOI. For the same reasons as given above in relation to the Lambay Island SPA guillemot population, it seems likely that the Disposal Site ZOI is of little importance to the Ireland's Eye SPA guillemot population.

Copeland Islands SPA

6.5.128 Breeding Manx shearwater is a qualifying feature of the Copeland Islands SPA. This SPA population has been screened into the shadow HRA on the basis of having potential connectivity with the ZoIs associated with both the Wylfa Newydd Development Area and the Disposal Site. The SPA boundary is approximately 149km from the 5km Wylfa Newydd Development Area ZOI used in the scoping exercise and 144km from the potential 5km ZOI associated with the Disposal Site (table 4-2 and figure 4-6). As detailed above, these distances are within the foraging range of breeding Manx shearwater.

6.5.129 The citation population size for the Copeland Islands SPA breeding Manx shearwater population is 4,800 breeding pairs [RD72], whilst the most recently available estimate for the SPA (from 2002) is 5,042 breeding pairs ([RD164]). The Seabird2000 census estimate for the SPA population, used in the apportionment calculation, is 4,633 breeding pairs (http://jncc.defra.gov.uk/page-4460).

6.5.130 The densities and distribution of Manx shearwater, as determined during the ESAS boat-based transect surveys, in the Block 1 and 2 survey areas are described above, as is the distribution of survey records in the vicinity of the Disposal Site ZOI. The ESAS boat-based surveys for Block 1 give an estimated maximum breeding season population size of 520 individuals within this survey area.

6.5.131 The apportionment calculation undertaken for Manx shearwater suggests that the Copeland Islands SPA population contributes approximately 2% of the birds present in both the 5km Wylfa Newydd Development Area ZOI and the Disposal Site ZOI. For the 5km Wylfa Newydd Development Area ZOI this represents approximately 10 individuals, which equates to 0.1% of the SPA population (when it is assumed that all birds recorded within the Block 1 survey area are breeding adults and are restricted to the 5km Wylfa Newydd Development Area ZOI).

6.5.132 Therefore, despite the unrealistic and highly precautionary assumptions used for the apportionment calculation, it can be concluded that the 5km Wylfa Newydd Development Area ZOI is of little importance to the Copeland Islands SPA Manx shearwater population. For the reasons given above in relation to the Aberdaron Coast and Bardsey Island SPA Manx shearwater population, the Disposal Site ZOI is likely to support a higher percentage of the Copeland Islands SPA Manx shearwater population than does the 5km Wylfa Newydd Development Area ZOI. The lack of estimated densities for Manx shearwater within the Minesto survey area prevents the calculation of an estimate of the percentage of the SPA population which may occur within the Disposal Site ZOI. However, it seems unlikely to be greatly in excess of 1%, given the very low value estimated for the 5km Wylfa Newydd Development Area ZOI (i.e. 0.1%) plus the likelihood of a high proportion of immatures amongst the birds recorded within the ZOI ([RD113]).

East Coast (Northern Ireland) Marine pSPA

6.5.133 Although Manx shearwater is a qualifying feature of the East Coast (Northern Ireland) Marine pSPA, this is on the basis of protecting foraging and rafting areas for this species.

6.5.134 This pSPA comprises the coastal and near-shore waters that are adjacent to the Copeland Islands SPA and is proposed for the purposes of protecting the marine foraging and rafting areas for seabirds breeding in nearby colonies (including the Copeland Islands SPA Manx shearwater population).

6.5.135 As such, the description of the baseline conditions is covered in the above text for the Copeland Islands SPA.

Saltee Islands SPA

6.5.136 Breeding populations of fulmar and gannet are qualifying features of the Saltee Islands SPA. These SPA populations have been screened into the shadow HRA on the basis of their potential connectivity with the ZoIs associated with both the Wylfa Newydd Development Area and the Disposal Site (see 4.6). The SPA boundary is 186km from the 5km Wylfa Newydd Development Area ZOI used in the scoping exercise, and 175km from the potential 5km ZOI associated with the Disposal Site (table 4-2 and figure 4-6). As such, both of these qualifying features are considered to have potential connectivity with the 5km Wylfa Newydd Development Area ZOI and the Disposal Site ZOI.

6.5.137 The citation population sizes and the most recently available population size estimates for fulmar are 525 and 439 breeding pairs, respectively, whilst the citation population size for gannet is 2,446 breeding pairs [RD223]; [RD164]). The Seabird2000 census estimates for these SPA populations, used in the apportionment calculation, are 520 and 1,930 breeding pairs for fulmar and gannet, respectively (http://jncc.defra.gov.uk/ page-4460).

6.5.138 The densities and distribution of both of these species, as determined during the ESAS boat-based transect surveys, in the Block 1 and 2 survey areas

are described above, as is the distribution of survey records in the vicinity of the Disposal Site ZOI. The ESAS boat-based surveys for Block 1 give a maximum breeding season population size of 42 individuals for fulmar and 151 individuals for gannet within this survey area. The surveys undertaken within the vicinity of the Disposal Site indicate that the associated ZOI holds low numbers of both species.

6.5.139 The apportionment calculation undertaken for fulmar suggests that the Saltee SPA population contributes less than 0.01% of the birds present in both the 5km Wylfa Newydd Development Area ZOI and the Disposal Site ZOI. For the 5km Wylfa Newydd Development Area ZOI, this represents less than one individual and less than 0.01% of the SPA population.

6.5.140 For gannet, the apportionment calculation suggests that the Saltee SPA population contributes approximately 3% of the birds present in both the 5km Wylfa Newydd Development Area ZOI and the Disposal Site ZOI. For the 5km Wylfa Newydd Development Area ZOI, this represents approximately five individuals and 0.12% of the SPA population. The findings from the studies of gannet colony home ranges suggest that these ZoIs are likely to be beyond the areas encompassed by the foraging ranges of birds from this breeding colony [RD351].

6.5.141 Therefore, the available survey data, together with the apportionment calculation, suggest that the 5km Wylfa Newydd Development Area ZOI is of little importance to the Saltee Islands SPA populations of breeding fulmar and gannet, (despite the apportionment calculation involving the unrealistic and highly precautionary assumptions described above).

6.5.142 This conclusion will also apply to both of these SPA populations in relation to the Disposal Site ZOI, given the small (or, in the case of fulmar, near negligible) contribution these SPA populations are estimated to make to the populations within the Disposal Site ZOI, in conjunction with the low numbers of these species recorded during the Minesto surveys.

Rathlin Island SPA

6.5.143 Breeding fulmar is a named component of the seabird assemblage qualifying feature of the Rathlin Island SPA. This SPA population has been screened into the shadow HRA on the basis of having potential connectivity with the ZoIs associated with the Wylfa Newydd Development Area and the Disposal Site (see 4.6). The SPA boundary is 226km from the 5km Wylfa Newydd Development Area ZOI used in the scoping exercise and 223km from the potential 5km ZOI associated with the Disposal Site (table 4-2 and figure 4-6). These distances are within the mean maximum foraging range of breeding fulmar [RD330].

6.5.144 The most recently available estimate for the Rathlin Island SPA breeding fulmar population (from 2011) is 1,518 breeding pairs ([RD164]). The Seabird2000 census estimate for the SPA population, used in the apportionment calculation, is 2,032 breeding pairs (http://jncc.defra.gov.uk/page-4460).

6.5.145 The densities and distribution of fulmar, as determined during the ESAS boat-based transect surveys, in the Block 1 and 2 survey areas are described above (table 6-10), as is the distribution of survey records in the vicinity of the Disposal Site ZoI.

6.5.146 The apportionment calculation undertaken for fulmar suggests that the Rathlin Island SPA population contributes less than 0.01% of the birds present in both the 5km Wylfa Newydd Development Area ZOI and the Disposal Site ZOI. For the 5km Wylfa Newydd Development Area ZOI, this represents less than one individual and less than 0.01% of the SPA population.

6.5.147 Therefore, the available survey data, together with the apportionment calculation, suggest that the 5km Wylfa Newydd Development Area ZOI is of little importance to the Rathlin Island SPA fulmar population (despite the apportionment calculation involving the unrealistic and highly precautionary assumptions described above). This conclusion will also apply to the Disposal Site ZOI, given the near negligible contribution this SPA population is estimated to make to the population within the Disposal Site ZOI in conjunction with the low numbers of fulmar recorded during the Minesto surveys.

Horn Head to Fanad Head SPA

6.5.148 Breeding fulmar is a qualifying feature of the Horn Head to Fanad Head SPA. This SPA population has been screened into the shadow HRA on the basis of having potential connectivity with the ZoIs associated with the Wylfa Newydd Development Area and the Disposal Site. The SPA boundary is 275km from the 5km Wylfa Newydd Development Area ZOI used in the scoping exercise and 281km from the potential 5km ZOI associated with the Disposal Site (table 4-2 and figure 4-6). These distances are within the mean maximum foraging range of breeding fulmar [RD330].

6.5.149 The citation population size for the Horn Head to Fanad Head SPA breeding fulmar population is 1,974 breeding pairs [RD227], whilst the most recently available estimate for the SPA (from 1999 during the Seabird2000 census) is 1,644 breeding pairs ([RD164]).

6.5.150 The densities and distribution of fulmar, as determined during the ESAS boat-based transect surveys, in the Block 1 and 2 survey areas are described above (table 6-10), as is the distribution of survey records in the vicinity of the Disposal Site ZoI.

6.5.151 The apportionment calculation undertaken for fulmar suggests that the Horn Head to Fanad Head SPA population contributes less than 0.01% of the birds present in both the 5km Wylfa Newydd Development Area ZOI and the Disposal Site ZOI. For the 5km Wylfa Newydd Development Area ZOI, this represents less than one individual and less than 0.01% of the SPA population.

6.5.152 Therefore, the available survey data, together with the apportionment calculation, suggest that the 5km Wylfa Newydd Development Area ZOI is of little importance to the Horn Head to Fanad Head SPA fulmar population (despite the apportionment calculation involving the unrealistic and highly precautionary assumptions described above). This conclusion will also apply to the Disposal Site ZOI, given the near negligible contribution this SPA population is estimated to make to the population within the Disposal Site ZOI in conjunction with the low numbers of fulmar recorded during the Minesto surveys.

West Donegal Coast SPA

6.5.153 Breeding fulmar is a qualifying feature of the West Donegal Coast SPA. This SPA population has been screened into the shadow HRA on the basis of having potential connectivity with the ZoIs associated with the Wylfa Newydd Development Area and the Disposal Site. The SPA boundary is approximately 300km from both the 5km Wylfa Newydd Development Area ZOI used in the scoping exercise and the potential 5km ZOI associated with the Disposal Site (table 4-2 and figure 4-6). This distance is within the mean maximum foraging range of breeding fulmar [RD330].

6.5.154 The citation population size for the West Donegal Coast SPA breeding fulmar population is 1,879 breeding pairs [RD228], whilst the most recently available estimate for the SPA (from 1999 during the Seabird2000 census) is 2,391 breeding pairs ([RD164]).

6.5.155 The densities and distribution of fulmar, as determined during the ESAS boat-based transect surveys, in the Block 1 and 2 survey areas are described above (table 6-10), as is the distribution of survey records in the vicinity of the Disposal Site ZoI.

6.5.156 The apportionment calculation undertaken for fulmar suggests that the West Donegal Coast SPA population contributes less than 0.01% of the birds present in both the 5km Wylfa Newydd Development Area ZOI and the Disposal Site ZOI. For the 5km Wylfa Newydd Development Area ZOI, this represents less than one individual and less than 0.01% of the SPA population.

6.5.157 Therefore, the available survey data, together with the apportionment calculation, suggest that the 5km Wylfa Newydd Development Area ZOI is of little importance to the West Donegal Coast SPA fulmar population (despite the apportionment calculation involving the unrealistic and highly precautionary assumptions described above). This conclusion will also apply to the Disposal Site ZOI, given the near negligible contribution this SPA population is estimated to make to the population within the Disposal Site ZOI in conjunction with the low numbers of fulmar recorded during the Minesto surveys.

Tory Island SPA

6.5.158 Breeding fulmar is a qualifying feature of the Tory Island SPA. This SPA population has been screened into the shadow HRA on the basis of having potential connectivity with the ZoIs associated with the Wylfa Newydd Development Area and the Disposal Site. The SPA boundary is 309km from the 5km Wylfa Newydd Development Area ZOI used in the scoping exercise and 296km from the potential 5km ZOI associated with the Disposal Site (table 4-2 and figure 4-6). This distance is within the mean maximum foraging range of breeding fulmar [RD330].

6.5.159 The citation population size for the Tory Island SPA breeding fulmar population (which is also the most recently available estimate for the SPA from 1999 during the Seabird2000 census) is 641 breeding pairs [RD229], [RD164]).

6.5.160 The densities and distribution of fulmar, as determined during the ESAS boat-based transect surveys, in the Block 1 and 2 survey areas are described above (table 6-10), as is the distribution of survey records in the vicinity of the Disposal Site ZoI.

6.5.161 The apportionment calculation undertaken for fulmar suggests that the Tory Island SPA population contributes less than 0.01% of the birds present in both the 5km Wylfa Newydd Development Area ZOI and the Disposal Site ZOI. For the 5km Wylfa Newydd Development Area ZOI, this represents less than one individual and less than 0.01% of the SPA population.

6.5.162 Therefore, the available survey data, together with the apportionment calculation, suggest that the 5km Wylfa Newydd Development Area ZOI is of little importance to the Tory Island SPA fulmar population (despite the apportionment calculation involving the unrealistic and highly precautionary assumptions described above). This conclusion will also apply to the Disposal Site ZOI, given the near negligible contribution this SPA population is estimated to make to the population within the Disposal Site ZOI in conjunction with the low numbers of fulmar recorded during the Minesto surveys.

Ailsa Craig SPA

6.5.163 Breeding gannet is a qualifying feature of the Ailsa Craig SPA. This SPA population has been screened into the shadow HRA on the basis of having potential connectivity with the ZoIs associated with both the Wylfa Newydd Development Area and the Disposal Site. The SPA boundary is approximately 200km from both the 5km Wylfa Newydd Development Area ZOI used in the scoping exercise, and the potential 5km ZOI associated with the Disposal Site (table 4-2 and figure 4-6). This distance is within the mean maximum foraging range of breeding gannet, which is estimated to be 229km [RD330].

6.5.164 The citation population for the Ailsa Craig breeding gannet population is 23,000 breeding pairs [RD171], whilst the most recently available estimate

for the SPA (from 2014) is 33,226 breeding pairs ([RD164]). The Seabird2000 census estimate for the SPA population, used in the apportionment calculation, is 35,825 breeding pairs (http://jncc.defra.gov.uk/page-4460). As for the Grassholm SPA gannet population, this estimate is used in the apportionment calculation because this is the most recent period for which count data from all five colonies considered in the calculation are available [RD299].

6.5.165 The densities and distribution of gannet, as determined during the ESAS boat-based transect surveys, in the Block 1 and 2 survey areas are described above, as is the distribution of survey records in the vicinity of the Disposal Site ZOI. The ESAS boat-based surveys for Block 1 give an estimated maximum breeding season population size of 151 individuals for this survey area. The surveys undertaken within the vicinity of the Disposal SiteZOI have recorded gannet in low numbers in all survey months.

6.5.166 The apportionment calculation for gannet suggests that the Ailsa Craig SPA population contributes approximately 35% of the birds present in both the 5km Wylfa Newydd Development Area ZOI and the Disposal Site ZOI. For the 5km Wylfa Newydd Development Area ZOI, this represents approximately 57 individuals and 0.08% of the SPA population. This conclusion is unaffected when the Seabird2000 count data used in this apportionment calculation were replaced with the recent count data (from 2011 – 2015) available for three of the colonies considered in this calculation (including Ailsa Craig).

6.5.167 The findings from the studies of gannet colony home ranges suggest that these ZoIs are most likely to lie within the ranges of breeding gannets from the Ailsa Craig colony, although they are at the extremity of the predicted colony home range [RD351]. If it is assumed that all gannets present within the 5km Wylfa Newydd Development Area ZOI are breeding adults from the Ailsa Craig SPA population and that the ZOI population size equates to the wider Block 1 population size (both of which are highly precautionary and unrealistic assumptions), the ZOI population would represent only 0.23% of the SPA population.

6.5.168 Therefore, the available survey data, together with the apportionment calculation and information on predicted colony home range, suggest that the 5km Wylfa Newydd Development Area ZOI is of little importance to the Ailsa Craig SPA gannet population. This conclusion also applies to the Disposal Site ZOI, given the low numbers of gannets recorded during the Minesto surveys.

Passage and non-breeding seabirds

Aber Afon Dyfrdwy/Dee Estuary SPA and Ramsar site

6.5.169 The passage population of Sandwich tern is a qualifying feature of the Aber Afon Dyfrdwy/Dee Estuary SPA and Ramsar site. This SPA population has been screened into the shadow HRA on the basis that both the spring and

autumn passage movements of this SPA population are likely to follow the coast closely ([RD113]). Hence, the Wylfa Newydd Development Area and the associated ZOIs may have connectivity with the SPA population, given their association with breeding populations of this species and their proximity to the Aber Afon Dyfrdwy/Dee Estuary SPA.

6.5.170 The ESAS boat-based transect surveys recorded no Sandwich terns in either the April or August surveys, providing no evidence for major passage movements within the survey area. Although passage birds are also likely to occur during May and July, these would not be distinguishable from locally breeding birds.

Mersey Narrows and North Wirral Foreshore SPA and Ramsar site

6.5.171 The passage population of common tern is a qualifying feature of the Mersey Narrows and North Wirral Foreshore SPA and Ramsar site. This SPA population has been screened into the shadow HRA for the same reasons as the Dee Estuary SPA Sandwich tern passage population.

6.5.172 As for Sandwich tern, no common tern were recorded during the ESAS boat-based surveys in April, whilst small numbers of 'commic' terns (i.e. either Arctic or common terns) were recorded in both Blocks 1 and 2 during the August survey.

Waders, wildfowl and other wetland species

6.5.173 No wader, wildfowl or other wetland species were screened into the assessment and, as such, no SPAs or Ramsar sites are included on the basis of these species.

Other species

6.5.174 Chough is the only non-seabird species that has been screened into the shadow HRA, with the following SPA populations being screened in:

- Glannau Ynys Gybi/Holy Island Coast SPA.
- Glannau Aberdaron and Ynys Enlli/Aberdaron Coast Bardsey Island SPA.
- Mynydd Cilan, Trwyn y Wylfa ac Ynysoedd Sant Tudwal/Mynydd Cilan, Trwyn y Wylfa and the St. Tudwal Islands SPA.

6.5.175 These SPA populations are screened in on the basis of potential connectivity with the Wylfa Newydd Development Area (and associated ZoIs) during the wintering period, when the species may range widely [RD61]. The closest distances between these SPAs and the Wylfa Newydd Development Area boundary are 13.1km, 63.3km and 65.1km for the Glannau Ynys Gybi/Holy Island Coast SPA, Glannau Aberdaron and Ynys Enlli/Aberdaron Coast and Bardsey Island SPA and Mynydd Cilan, Trwyn y Wylfa ac Ynysoedd Sant Tudwal/Mynyyd Cilan, Trwyn y Wylfa and the St. Tudwal Islands SPA, respectively (table 4-2 and figure 4-6).

6.5.176 Between four and six chough regularly occur on the Wylfa Newydd Development Area during the winter period, as established from an extensive programme of transect and vantage point surveys undertaken between 2009 and 2017 (Application Reference Number: 6.4.47). The occurrence of chough on the Wylfa Newydd Development Area during the winter period is associated (at least in part) with the presence of one to two regular breeding pairs within the Wylfa Newydd Development Area. However, it is also possible that wintering birds in the Wylfa Newydd Development Area may, on occasion, include chough from the above SPA populations, so creating a functional link between the Wylfa Newydd Development Area and the SPA populations.

6.5.177 Checks undertaken to identify individually colour-ringed chough during the 2017 surveys found that of two individuals identified, one was a breeding adult from the Wylfa Newydd Development Area whilst the second was an offspring from of the Glannau Ynys Gybi/Holy Island Coast SPA population, deriving from the 2015 cohort. As such, it will not yet have been recruited into a breeding population (Application Reference Number: 6.4.47).

7 Appropriate Assessment: habitats and species (terrestrial, freshwater and coastal) of SACs and Ramsar sites

7.1 Introduction

7.1.1 There are four SACs and one Ramsar site for which the Stage 1 Screening assessment concluded that LSE could not be excluded for terrestrial, freshwater and coastal habitats and species. These are as follows (section 5.3 provides further details):

- Bae Cemlyn/Cemlyn Bay SAC.
- Glannau Ynys Gybi/Holy Island Coast SAC.
- Llyn Dinam SAC.
- Corsydd Môn/Anglesey Fens SAC.
- Corsydd Môn a Llyn/Anglesey and Llyn Fens Ramsar site.

7.1.2 This Shadow HRA has considered all of the qualifying features of the above SACs and the qualifying habitat and species criteria of the Corsydd Môn a Llyn/Anglesey and Llyn Fens Ramsar site (see appendix D). The conservation objectives and conservation status of those qualifying features for which LSE could not be excluded are set out in section 7.2 (note that section 7.2 does not provide conservation information for those qualifying features for which LSE could be excluded). A summary of the LSEs identified in the screening matrices (see appendix F) is provided in section 7.3.

7.1.3 The predicted effects of the Project on the qualifying interest features of the Bae Cemlyn/Cemlyn Bay SAC, which is located 110m from the Wylfa Newydd Development Area, are assessed in sections 7.4 to 7.6.

7.1.4 The only screening category for which LSE was determined for the Glannau Ynys Gybi/Holy Island Coast SAC and the Llyn Dinam SAC was ‘air quality’ (during construction and operation). For the Corsydd Môn/Anglesey Fens SAC and the Corsydd Môn a Llyn/Anglesey and Llyn Fens Ramsar site, LSE was determined for ‘air quality’ (during operation) and, for the creation of new fen habitat and the improvement of existing fen habitat at Cae Canol-dydd and Cors Gwawr, ‘terrestrial water quality’ and ‘surface and groundwater hydrology’.

7.1.5 The assessment of predicted effects of the Project on the habitats and species of these sites is provided in sections 7.7 to 7.9. Because the implications of the Project for terrestrial, freshwater and coastal habitats and species are similar for all of the qualifying interest features of the other four sites, these have been assessed together.

7.1.6 The assessment of predicted effects of decommissioning on the habitats and species of all five sites (four SACs and one Ramsar site) is provided in section 7.10.

7.2 Conservation objectives

Bae Cemlyn/Cemlyn Bay SAC

7.2.1 The conservation objectives for the Bae Cemlyn/Cemlyn Bay SAC are taken from section 4.2 (coastal lagoon) and section 4.3 (perennial vegetation of stony banks) of the Core Management Plan for the SAC, published by Countryside Council for Wales (CCW) in March 2008 ([RD43]) and are as follows:

Coastal lagoon and spiral tasselweed *Ruppia cirrhosa*

7.2.2 The vision for the coastal lagoon and spiral tasselweed *Ruppia cirrhosa* is for these features to be in a favourable conservation status, where all the following conditions are satisfied:

- There is no loss of area other than that due to natural processes.
- The specialised plant and animal communities within the lagoon remain.
- All factors affecting the achievement of these conditions are under control.

7.2.3 The conservation status as defined in Core Management Plan ([RD43]) for these qualifying features is ‘Favourable maintained’.

Perennial vegetation of stony banks

7.2.4 The vision for this feature is for it to be in a favourable conservation status, where all the following conditions are satisfied:

- The extent of the vegetation of shingle banks is maintained unless altered by natural (e.g. storm) events.
- Typical component species of vegetation of shingle banks are maintained.
- Invasive alien species (e.g. *Fallopia japonica*) are absent.
- The management of activities or operations likely to damage or degrade the population dynamics, natural range and supporting habitat of the feature is appropriate for maintaining favourable conservation status and is secure in the long-term.

7.2.5 As set out in chapter 6, the conservation status as defined in the Core Management Plan [RD43] for this qualifying feature is ‘Unfavourable’. [RD43] notes that this is thought to be due to trampling, however, NRW have advised that trials have shown that natural storm damage may be the cause.

Glannau Ynys Gybi/Holy Island Coast SAC

7.2.6 The conservation objectives for Glannau Ynys Gybi/Holy Island Coast SAC are taken from sections 4.1 to 4.3 of the Glannau Ynys Gybi Core Management Plan published by Natural Resources Wales (NRW) (CCW) in April 2008 [RD47]. These are detailed below for each SAC habitat interest feature.

Vegetated sea cliffs of the Atlantic and Baltic Coasts

7.2.7 The vision for vegetated sea cliffs (of the Atlantic and Baltic coasts) is for it to be in a favourable conservation status, where all of the following conditions are satisfied:

- Cliff and crevice vegetation, maritime grassland and maritime heath occurs throughout the site in appropriate areas and their relative extent and zonation are determined by topography, exposure, grazing and natural stochastic events (e.g. storms).
- The cliff vegetation is composed of native plants such as sea spurrey *Spergularia rupicola* Sea lavenders *Limonium britannicum, L. procerum, L. binervosum* and sea samphire *Crithmum maritimum*.
- Non-native plants, such as Hottentot fig *Carpobrotus edulis* or purple dew-plant *Disphyma crassifolium* are preferably absent or at least not spreading from their 2000 extent.
- Maritime grassland occupies higher ledges on the coastal cliffs and the cliff-top.
- The following plants are common in the maritime grassland: red fescue *Festuca rubra*, thrift *Armeria maritima*, spring squill *Scilla verna* and sea plantain *Plantago maritima*.
- Maritime Heathland occupies areas inland of the maritime grassland.
- The following plants are common in the maritime heathland: heather *Calluna vulgaris*, bell heather *Erica cinerea*, Western gorse *Ulex gallii*, thrift *Armeria maritima*, sea plantain *Plantago maritima*, buck's horn plantain *Plantago coronopus* or spring squill *Scilla verna*.
- Competitive species indicative of under-grazing, particularly bracken *Pteridium aquilinum* and gorse *Ulex europaeus* and grass species indicative of improvement including creeping bent *Agrostis stolonifera*, cock's foot *Dactylus glomerata*, perennial rye-grass *Lolium perenne* and Yorkshire fog *Holcus lanatus* are largely absent from the heath.
- Sustainable populations of the plants which make up the Atlantic sea cliff rare plant assemblage will be present, notably, South Stack fleawort *Tephroseris integrifolia*, Sea lavenders *Limonium britannicum, L. procerum, L. binervosum* Golden hair lichen *Teloschistes flavicans* and Ciliate strap lichen *Heterodermia leucomelos*.

- All factors affecting the achievement of these conditions, including grazing intensity and burning, will be under control.

European dry heaths

7.2.8 The vision for this feature is for it to be in a favourable conservation status, where all of the following conditions are satisfied:

- Dry heath covers no less than the present mapped extent (to be determined)
- The following plants are common in the dry heath: heather *Calluna vulgaris*, bell heather *Erica cinerea*, western gorse *Ulex gallii*.
- Competitive species indicative of under-grazing, particularly bracken *Pteridium aquilinum*, purple moor-grass *Molinia caerulea* and western gorse *Ulex gallii* are kept in check.
- 70% of dry heath will be “good condition” dry heath.
- The dry heath provides abundant and accessible food for breeding chough.
- The dry heath supports sustainable (flowering) populations of dodder.
- Spotted rock rose occurs in at least five distinct loci (presently South Stack, Porth Dafarch north, Porth-y-Garan, Pant yr Hyman path, Pant yr Hyman heath) of at least 200 plants each.
- Juniper occurs in at least three locations totalling 50 plants.
- The dry heath supports a viable population of silver studded blue.
- All factors affecting the achievement of these conditions are under control.

Northern Atlantic wet heaths with *Erica tetralix*

7.2.9 The vision for this feature is for it to be in a favourable conservation status, where all of the following conditions are satisfied:

- Wet heath covers no less than the present mapped extent (to be determined).
- The following plants are common in the wet heath: heather *Calluna vulgaris*, cross-leaved heath *Erica tetralix*, bog moss *Sphagnum spp.* devil’s bit scabious *Succisa pratensis* and *Narthecium ossifragum*.
- Competitive species indicative of under-grazing, particularly bracken *Pteridium aquilinum*, purple moor-grass *Molinia caerulea* and western gorse *Ulex gallii* are kept in check.
- 70% of wet heath will be “good condition” wet heath.
- The wet heath supports sustainable (flowering) populations of marsh gentian, three-lobed water crowfoot, and pillwort.

- The wet heath supports a viable population of bog bush cricket *Metrioptera brachyptera*.
- The wet heath contributes potential support of a meta-population of marsh fritillary.
- All factors affecting the achievement of these conditions are under control.

Llyn Dinam SAC

7.2.10 The Llyn Dinam SAC conservation objectives are taken from section 4.1 of the Llyn Dinam SAC Core Management Plan, published by CCW in March 2008 [RD48]. These are as follows:

Natural eutrophic lakes with Magnopotamion or Hydrocharition-type vegetation

7.2.11 The vision for this feature is for it to be in a favourable conservation status, where all of the following conditions are satisfied:

- There is no loss of area other than that due to natural processes (succession).
- The aquatic plant community is typical of this lake type in terms of composition and structure.
- Plants indicating very high nutrient levels and/or excessive silt loads are not dominant.
- Invasive non-native water plants do not threaten to out-compete the native flora.
- Invasive non-native fauna do not threaten the native flora and/or fauna.
- Bird species listed as SSSI features continue to be present at ≥1% of UK populations.
- The nutrient, pH and dissolved oxygen levels are typical for a lake of this type and there is no excessive growth of cyanobacteria or green algae.
- Chlorophyll α values are low, and sufficient to allow Llyn Dinam and Llyn Penrhyn to be passed as 'Good' or better for a 'high alkalinity shallow lake' using Water Framework Directive classification methods.
- The fringing swamp and mire vegetation is maintained.
- All factors affecting the achievement of these conditions are under control.

Corsydd Môn/Anglesey Fens SAC

7.2.12 The existing conservation objectives for Corsydd Môn/Anglesey Fens SAC, as presented in section 4 of the Corsydd Môn/Anglesey Fens SAC Core

Management Plan ([RD49]), are detailed below for the individual SAC habitat and species features.

Northern Atlantic wet heaths with *Erica tetralix*

7.2.13 The vision for this feature is for it to be in a favourable conservation status, where all of the following conditions are satisfied:

- Wet heath covers at least 4%ha of the site.
- The following plants are common in the wet heath: heather *Calluna vulgaris*, Cross-leaved heath *Erica tetralix* as well as bog moss *Sphagnum spp.* Devil's bit scabious *Succisa pratensis* and *Narthecium ossifragum*.
- Competitive species indicative of under-grazing, particularly bracken *Pteridium aquilinum*, purple moor-grass *Molinia caerulea* and western gorse *Ulex gallii* will be kept in check.
- 70% of wet heath will be "good condition" wet heath.
- The wet heath supports viable populations of marsh gentian at Cors Erddreiniog.
- The wet heath contributes to the support of a viable meta-population of marsh fritillary.
- All factors affecting the achievement of these conditions are under control.

Molinia meadows on calcareous, peaty or clayey-silt-laden soils (*Molinion caeruleae*)

7.2.14 The vision for this feature is for it to be in a favourable conservation status, where all of the following conditions are satisfied:

- Molinia meadows occupy at least 2% of the total site area.
- Molinia meadows are distributed over at all seven component sites.
- The following plants are common in the Molinia meadows: purple moor-grass *Molinia caerulea*, devil's bit scabious *Succisa pratensis*; carnation sedge *Carex panicea*; saw wort *Serratula tinctoria*; lousewort *Pedicularis sylvestris*, *Carex pulicaris* and *C. hostiana* and Marsh orchids *Dactylorhiza sp.*
- Soft rush *Juncus effusus* and species indicative of agricultural modification, such as perennial rye grass *Lolium perenne* and white clover *Trifolium repens* are largely absent from the *Molinia* Meadows.
- Purple moor grass *Molinia caerulea* does not exceed 50% of ground cover.
- Scrub species such as willow *Salix* and birch *Betula* are largely absent from the *Molinia* meadows.

- *Rhododendron* spp. are absent.
- Leaf litter should comprise <25% of ground cover.
- Groundwater will be between -10cm and -25cm below ground level for most of the year.
- The integrity of the hydrological system (inputs and outputs) will be intact.
- Swards structure should reflect the requirements of feature nine (Marsh fritillary).
- All factors affecting the achievement of these conditions are under control.

Calcareous fens with *Cladium mariscus* and species of the *Caricion davallianae*

7.2.15 The vision for this feature is for it to be in a favourable conservation status, where all of the following conditions are satisfied:

- Calcareous fen occupies at least 20% (93ha) of the total site area.
- Calcareous fen is distributed over at least five of the seven sites including Cors Erddreiniog, Cors Bodeilio, Cors Goch, Gwenfro-Rhos Y Gad and Cors Y Farl.
- Calcareous fen exhibits a range of condition states (see below) in which great fen sedge *Cladium* is frequent to dominant, with no less than 10% referable to species-poor *Cladium* swamp and the remainder to either vegetation in which *Cladium* occurs with sweet gale *Myrica gale*, bluntflowered rush *Juncus subnodulosus*, purple moor-grass *Molinia caerulea* and cross-leaved heath *Erica tetralix*, or vegetation with many of the above elements as well as bog-bean *Menyanthes trifoliate, a* marsh cinquefoil *Potentilla palustris*, bladderwort *Utricularia vulgaris*, and slender sedge *Carex lasiocarpa* and other small sedges. .
- Species indicative of drainage or agricultural modification, such as Yorkshire fog *Holcus lanatus*, bramble *Rubus spp.,* nettle *Urtica dioica* are largely absent from the calcareous fen.
- Purple moor grass *Molinia caerulea* does not exceed 25% of ground cover.
- Leaf Litter forms no more than 20% of the ground cover at any location.
- Scrub species such as willow *Salix* and birch *Betula* are largely absent from the calcareous fen.
- Rhododendron spp. is absent.
- Standing surface water is present or expressible on footfall over most of the winter period.

- Groundwater is within 15cm of surface in mid-summer.
- All hydrological (diffuse, surface and sub-surface) pathways (inputs and outputs) are restored and/or intact (includes ditch infilling, blocking, diversion and re-engineering). Water quality reflects the base-rich but nutrient poor requirements of the habitat.
- All factors affecting the achievement of these conditions are under control.

Alkaline fen

7.2.16 The vision for this feature is for it to be in a favourable conservation status, where all of the following conditions are satisfied:

- Alkaline fen occupies at least 17% of the total site area.
- Alkaline fen is found on all seven component sites.
- The following plants are common in the alkaline fen: black bog rush *Schoenus nigricans*, moss *Campyllium stellatum*, great fen sedge *Cladium mariscus* (up to 1m tall), blunt flowered rush *Juncus subnodulosus*, sweet gale *Myrica gale*, moss *Drepanocladus revolvens*, bladderwort *Utricularia sp.*, butterwort *Pinguicula vulgaris*.
- Species indicative of drainage or agricultural modification, such as Yorkshire fog *Holcus lanatus*, bramble *Rubus spp*., nettle *Urtica dioica*, are largely absent from the alkaline fen.
- Purple moor grass *Molinia caerulea* does not exceed 25% of ground cover and is restricted to drier areas.
- Bare ground including tufa constitutes about 10% of the ground cover.
- Alkaline Fen exhibits a diverse age and height structure across the site (tussocks are undamaged and 20% short grazed, 50% mature – 30% in between incl bare ground).
- Scrub species such as willow *Salix spp* and birch *Betula pubescens* are largely absent from the alkaline fen.
- Rhododendron spp. is absent.
- Water expressable on foot-fall or running surface water is present between tussocks throughout the year.
- All Hydrological (diffuse, surface and sub-surface) pathways (inputs and outputs) should be restored and/or intact (includes ditch infilling, blocking, diversion and re-engineering).
- Water quality is appropriate to the needs of the vegetation and species.
- All factors affecting the achievement of these conditions are under control.

Hard oligo-mesotrophic waters with benthic vegetation of *Chara* spp.

7.2.17 The vision for this feature is for it to be in a favourable conservation status, where all of the following conditions are satisfied:

- Open water occupies not less than 1% of the total site area.
- Natural deep lakes persist at Cors Goch and Cors Erddreiniog component sites.
- The macrophyte, phytoplankton, zooplankton and predator components of the ecosystem operate in balance in a clear-water environment, where:
- Characteristic macrophyte species are present in the water bodies, including dense beds of stoneworts *Chara spp*, in areas <6m deep.
- Invasive non-native species are absent, or occur at no more than rare or occasional frequency.
- Locally native (non-coarse) fish are present.
- All coarse fish are absent.
- Water quality is such as to maintain pH of between 7 and 9 and mean annual Total Phosphorus <15µg/l.
- The water is clear throughout the year, with an absence of algal blooms.
- Marl deposition occurs within all the lakes.
- There is minimal extraneous sediment input
- The integrity of the natural hydrological system (inputs and outputs) is intact.
- Appropriate water level is maintained throughout the year, (seasonal fluctuation 30cm).
- All factors affecting the achievement of these conditions are under control.

Southern damselfly *Coenagrion mercuriale*

7.2.18 The vision for this feature is for it to be in favourable conservation status, where all of the following conditions are satisfied:

- Population size is stable or increasing.
- The population occupies at least three distinct management units.
- The total area of good breeding habitat does not fall below $1000m^{2.}$
- Seepages and shallow runnels at Nant Isaf will be clear, pollution free and will support good numbers of native aquatic plants.
- The population of southern damselflies on the site (allowing for normal annual fluctuations) is maintained or increases.

- Species indicative of drainage or agricultural modification, such as Yorkshire fog *Holcus lanatus*, bramble *Rubus spp*., nettle *Urtica dioica* are largely absent.
- Alkaline fen habitat exhibits a diverse age and height structure across the site (tussocks are undamaged and 20% short grazed, 50% mature, 30% in between short grazed and mature (and including bare ground).
- Scrub species such as willow *Salix spp* and birch *Betula pubescens* are largely absent from the alkaline fen habitat.
- *Rhododendron spp.* is absent from the feature.
- Appropriate grazing is managed across 100% of the site.
- Standing or running surface water is present between tussocks throughout the year and visible over 30% of the tussock covered area.
- All Hydrological (diffuse, surface and sub-surface) pathways (inputs and outputs) should be restored and/or intact (includes ditch infilling, blocking, diversion and re-engineering).
- Water quality is appropriate to the needs of the vegetation and species.
- All factors affecting the achievement of the foregoing conditions are under control.

Marsh fritillary butterfly *Euphydryas aurinia*

7.2.19 The vision for this feature is for it to be in a favourable conservation status, where all of the following conditions are satisfied:

- The site supports a sustainable metapopulation of the marsh fritillary.
- The population is viable in the long term, (acknowledging the extreme population fluctuations of the species).
- Habitats on the site are in optimal condition to support the metapopulation.
- At least 6% (approximately 30ha) of the total site area is marshy grassland or wet heath suitable for supporting marsh fritillary, with Devil's-bit scabious *Succisa pratensis* present and only a low cover of scrub.
- At least 40% of this 30ha is good marsh fritillary breeding habitat, dominated by purple moorgrass *Molinia caerulea*, with *S. pratensis* abundant throughout and a vegetation height of between 10cm and 20cm over the winter period.
- Areas of good marsh fritillary habitat are scattered over several management units.

- Off-site habitats that function as stepping stone or corridors located between SAC compartments will be maintained for migration, dispersal, foraging and genetic exchange purposes.
- All factors affecting the achievement of the foregoing conditions are under control.

Geyer's whorl snail (*Vertigo geyeri*)

7.2.20 The vision for this feature is for it to be in a favourable conservation status, where all of the following conditions are satisfied:

- *Vertigo geyeri* is frequent in suitable habitat at Cors Erddreiniog and Waun Eurad sections.
- There are abundant areas of flushed fen grassland (M13/feature 2) with sedge/moss lawns that are between 5cm and 15cm tall, containing species such as *Carex viridula subsp. brachyrrhyncha, Pinguicula vulgaris, Briza media, Equisetum palustre, Juncus articulatus* and the mosses *Drepanocladus revolvens* and *Campylium stellatum*, with scattered tussocks of *Schoenus nigricans* no greater than 80cm tall.
- Soils are saturated *Schoenus* tussocks lower than 80cm.

European dry heaths

7.2.21 The vision for this feature is for it to be in a favourable conservation status, where all of the following conditions are satisfied:

- Dry heath covers at least 1.2% ha of the site.
- The following plants are common in the dry heath: heather *Calluna vulgaris,* bell heather *Erica cinerea* and western gorse *Ulex galii*.
- Competitive species indicative of under-grazing or over-frequent burning, particularly bracken *Pteridium aquilinum*, purple moor-grass *Molinia caerulea* and European gorse *Ulex europeaus* are not abundant.
- Competitive species indicative of agricultural improvement such as ryegrass *Lolium perenne*, Yorkshire fog *Holcus lanatus*, nettles *Urtica dioica* are no more than rare or occasional.
- 70% of dry heath will be "good quality" dry heath.
- Invasive exotic species, e.g. Rhododendron are absent.
- All factors affecting the achievement of these conditions are under control.

7.2.22 The conservation status as defined in Core Management Plan ([RD49]) for this qualifying feature is 'Unfavourable unclassified'. [RD49] notes that this is due to litter build up and lack of grazing.

Corsydd Môn a Llyn/Anglesey and Llyn Fens Ramsar site

7.2.23 The boundary of the Corsydd Môn a Llyn/Anglesey and Llyn Fens Ramsar site coincides with that of the Corsydd Môn/Anglesey Fens SAC. The site qualifies as a Ramsar site because it supports:

- a suite of base-rich, calcareous fens which is a rare habitat type within the United Kingdom's biogeographical zone; and,
- a diverse flora and fauna with associated rare species and is of special value for maintaining the genetic and ecological diversity of the region.

7.2.24 The following SAC features are also listed as noteworthy fauna of international importance for the Ramsar site:

- Southern damselfly *Coenagrion mercuriale*;
- Marsh fritillary butterfly *Euphydryas aurinia*; and,
- Geyer's whorl snail *Vertigo geyeri*.

7.2.25 The Core Management Plan ([RD49]) for the Corsydd Môn/Anglesey Fens SAC notes that the concept of favourable conservation status provides a practical and legally robust basis for conservation objectives for *Natura 2000* sites and Ramsar sites. Consequently, it identifies which of the Ramsar qualifying criteria are equivalent to the SAC features. That is, the conservation objectives for the SAC features 'Calcareous fens with *Cladium mariscus* and species of the *Caricion davallianae*' and 'Alkaline fen' (both of which are described above for the Corsydd Môn/Anglesey Fens SAC) are relevant to the base rich-calcareous fens qualifying feature of the Ramsar site.

7.3 Summary of the outcomes of Screening

Alone

Bae Cemlyn/Cemlyn Bay SAC

7.3.1 The Stage 1 Screening assessment concluded that the potential for a LSE to arise exists (or cannot be ruled out) with respect to the screening categories and qualifying interest features (✓ = LSE) for the Bae Cemlyn/Cemlyn Bay SAC and its coastal habitats (see appendix F for further details) detailed in table 7-1.

Table 7-1 Potential for LSE for the Bae Cemlyn/Cemlyn Bay SAC

Site Features	Changes in marine water quality	Changes in terrestrial water quality	Changes in surface and groundwater hydrology	Change in air quality*	Alteration of coastal processes and hydro-dynamics
Coastal lagoon (priority feature)	✓	✓	✓	✓	✓
Perennial vegetation of stony banks	✓	✓	✓	✓	✓

* emissions from plant, machinery and marine vessels and operational combustion

Other SACs and Corsydd Môn a Llyn/Anglesey and Llyn Fens Ramsar site

7.3.2 The Stage 1 Screening assessment concluded that the potential for a LSE to arise cannot be ruled out with respect to the air quality screening category and qualifying interest features (✓ = LSE) of the Glannau Ynys Gybi/Holy Island Coast SAC, Llyn Dinam SAC, Corsydd Môn/Anglesey Fens SAC and the Corsydd Môn a Llyn/Anglesey and Llyn Fens Ramsar site, but not for all phases of the works, as detailed in table 7-2 (× = no potential for LSE). For the Corsydd Môn/Anglesey Fens SAC and the Corsydd Môn a Llyn/Anglesey and Llyn Fens Ramsar site LSE was also determined for 'terrestrial water quality' and 'surface and groundwater hydrology'.

7.3.3 Greyed out cells indicate that no pathway exists through which an effect could arise.

Table 7-2 Potential for LSE: Glannau Ynys Gybi SAC, Llyn Dinam SAC, Corsydd Môn SAC and the Corsydd Môn a Llyn/Anglesey and Llyn Fens Ramsar site

Site Features	Changes in air quality (emissions from plant, machinery and marine vessels)	Changes in air quality (road traffic emissions)	Changes in air quality (operational combustion)	Change in terrestrial water quality	Change in surface and groundwater hydrology
Glannau Ynys Gybi/Holy Island Coast SAC • Vegetated sea cliffs of the Atlantic and Baltic coasts. • European dry heaths. • Northern Atlantic wet heaths with *Erica tetralix*.	✓	×	✓	-	-
Llyn Dinam SAC • Natural eutrophic lakes with Magnopotamion or Hydrocharition-type vegetation.	✓	×	✓	-	-

Site Features	Changes in air quality (emissions from plant, machinery and marine vessels)	Changes in air quality (road traffic emissions)	Changes in air quality (operational combustion)	Change in terrestrial water quality	Change in surface and groundwater hydrology
Corsydd Môn/Anglesey Fens SAC • Northern Atlantic wet heaths with *Erica tetralix*. • *Molinia* meadows on calcareous, peaty or clayey-silt-laden soils • Calcareous fens with *Cladium mariscus* and species of the *Caricion davallianae* • Alkaline fens • Hard oligo-mesotrophic waters with benthic vegetation • Southern damselfly (*Coenagrion mercuriale*) • Marsh fritillary butterfly (Eurodryas, Hypodryas) • Geyer`s whorl snail (*Vertigo geyeri*) • European dry heaths	×	×	✓	✓	✓
Corsydd Môn a Llyn/Anglesey and Llyn Fens Ramsar site • Suite of base-rich, calcareous fens which is a rare habitat type within the United Kingdom's biogeographical zone • Diverse flora and fauna with associated rare species and is of special value for maintaining the genetic and ecological diversity of the region	×	×	✓	✓	✓

In-combination

Bae Cemlyn/Cemlyn Bay SAC

7.3.4 The in-combination screening assessment concluded that the potential for a LSIE to arise exists (or cannot be ruled out) for the Bae Cemlyn/Cemlyn Bay SAC with respect to the projects and screening categories set out in table 7-3 (✓ = potential for LSIE; × = no potential for LSIE). Therefore the implications of these projects have been assessed further to determine the potential for any in-combination effects with the Project that could adversely affect the integrity of the European Designated Sites.

Table 7-3 Other projects relevant to the in-combination assessment

Site Features	Changes in marine water quality	Changes in terrestrial water quality	Changes in surface and groundwater hydrology	Change in air quality*	Alteration of coastal processes and hydro-dynamics
Bae Cemlyn/Cemlyn Bay SAC (coastal lagoon)					
Wylfa Decommissioning	×	✓	×	×	×
Anglesey Eco Park	×	×	×	×	✓
Visitor and Media Centre (Horizon)	×	✓	×	×	×
North Wales Connection	×	✓	✓	✓	×
Bae Cemlyn/Cemlyn Bay SAC (perennial vegetation of stony banks)					
Anglesey Eco Park	×	×	×	×	✓
North Wales Connection	×	×	✓	✓	×

✓ = potential for LSIE; × = no potential for LSIE

7.3.5 As described in chapter 5, there is no potential for LSIE to arise with respect to this SAC with any of the plans screened into the assessment.

Other SACs and Corsydd Môn a Llyn/Anglesey and Llyn Fens Ramsar site

7.3.6 The in-combination screening exercise did not identify any other projects that have the potential to act in-combination with the Project with respect to any of the other SACs under consideration or the Corsydd Môn a Llyn/Anglesey and Llyn Fens Ramsar site.

7.3.7 LSIE was concluded for one plan (the North Wales Joint Local Transport Plan 2015 – 2020) due to the potential for its effects to interact with those of the Project and influence the Corsydd Môn/Anglesey Fens SAC and the Corsydd Môn a Llyn/Anglesey and Llyn Fens Ramsar site.

7.3.8 One of the pylons within the development corridor for the National Grid's North Wales Connection Project is shown as being within the proposed fen enhancement and creation area at Cae Canol-dydd, but this is not within the Corsydd Môn/Anglesey Fens SAC or the Corsydd Môn a Llyn/Anglesey and Llyn Fens Ramsar site. Horizon has liaised with National Grid on this matter and requested whether the pylon can be located outside of the area of proposed fen enhancement and creation (within the limit of deviation of the proposed corridor) and National Grid has confirmed that it would try to accommodate this. Given that the pylon is not proposed to be located within the SAC or Ramsar site, no LSIE with the proposed fen enhancement and creation area at Cae Canol-dydd is concluded.

7.4 Assessment of potential effects (alone) on Bae Cemlyn/Cemlyn Bay SAC: construction and operation

Introduction

7.4.1 This section presents the assessment of the potential effects (alone) on the two Annex I habitat qualifying features of Bae Cemlyn / Cemlyn Bay SAC, namely 'Coastal lagoon' (a priority feature) and 'Perennial vegetation of stony banks', for which LSE was determined. For each category of effect outlined in section 7.3 and table 7.1 above, a number of potential effects have been identified (see table 4-2 for further details; A1, A2, B1 etc. below) and are detailed below for the construction and operational phases. The predicted effects of the Project during decommissioning are considered separately in section 7.10.

Coastal lagoon

A Changes in terrestrial water quality and marine water quality

Construction

A1 Increase in suspended sediment from drainage discharge, dewatering, sewage, capital dredging and disposal of dredged material [Marine Licence; Construction water discharge EP]

Drainage discharge

7.4.2 The construction works could affect the surface water quality of the Cemlyn catchment and Nant Cemlyn, which feed Cemlyn lagoon, by introducing increased concentrations of suspended sediment into the surface water runoff, especially during wet weather conditions. Leaks and spillages of fuels or oils and cement components from construction could also affect water quality. As demonstrated in the Core Management Document for Bae Cemlyn/Cemlyn Bay SAC [RD43], Cemlyn lagoon is particularly sensitive to changes in water quality.

7.4.3 The Project would alter existing drainage catchment characteristics through site clearance, the construction and operation of site drainage, topsoil storage, material storage and landscaping mound creation. As part of the construction of the platforms to accommodate the new Power Station Site, spoil removed during excavation of the platforms would be used to form a total of five earthwork mounds across the Wylfa Newydd Development Area. One of the mounds, namely Mound E, is located east of Cemlyn lagoon, as illustrated in figure 7-1. For certain periods during the earthworks, surface water runoff from Mound E would discharge into Nant Cemlyn (via discharge E1; figure 7-1), but the timing of the operation of this discharge would be constrained (as described below).

7.4.4 As detailed in the summary provided of the preliminary design for construction surface water drainage (Application Reference Number: 6.4.33), it is proposed to use a Sustainable Drainage Systems (SuDS) to manage surface water runoff and provide natural treatment. SuDS work by mimicking the natural drainage system and providing a method to decrease the peak rate of surface water runoff and improve water quality.

7.4.5 Due to the sensitivity of the Cemlyn lagoon, however, specific measures have been embedded into the drainage design to minimise the potential effects associated with discharge from Mound E, as follows:

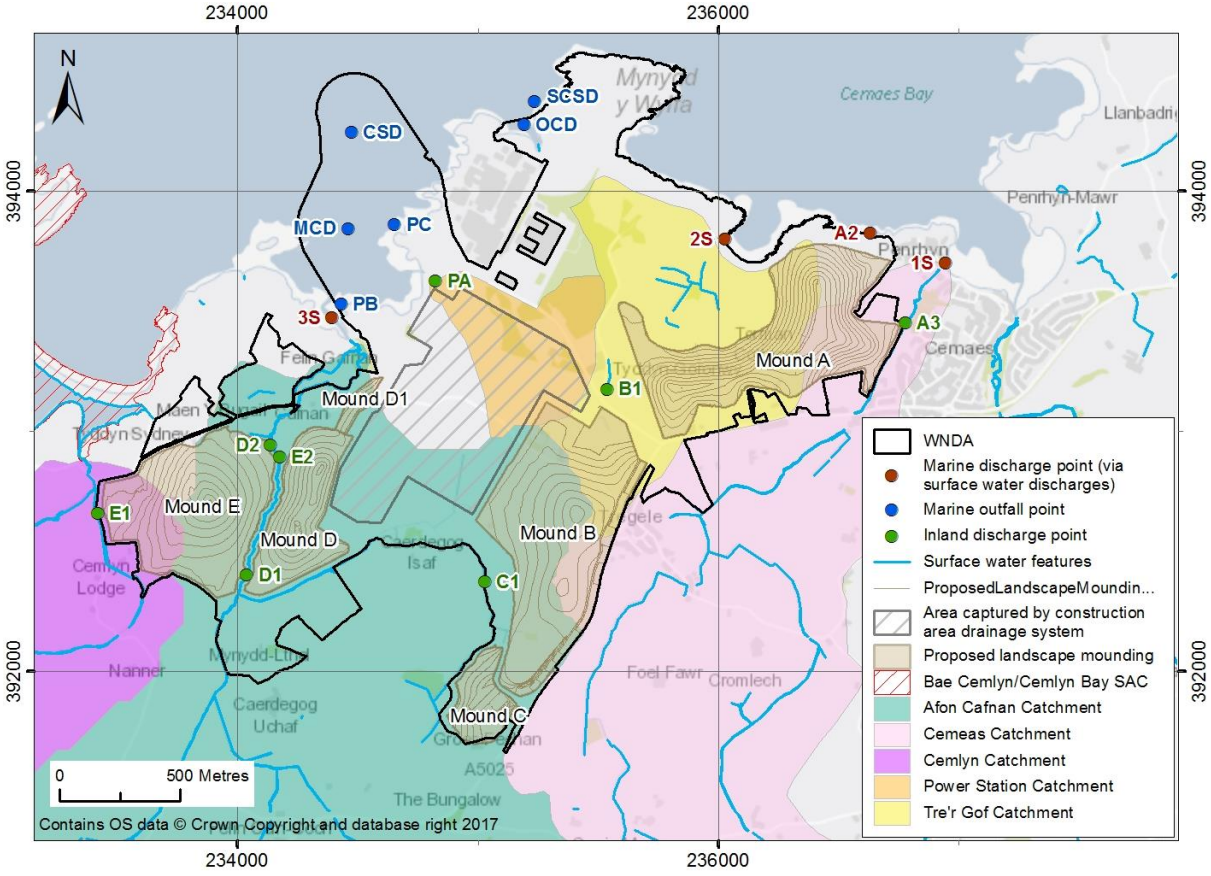

Figure 7-1 Location of Mound E and discharges into surface watercourses

- From the point of commencement of earthworks on the west side of Mound E onwards, no water would be discharged into Nant Cemlyn until vegetation has re-established and the risk of sediment run-off is agreed (in writing) with NRW to be low.
- No polyelectrolyte dosing would be employed for discharge E1.
- After the establishment of vegetation, if there are any additional bulk earthworks on the west of Mound E resulting in a risk of sediment discharge, no water would be discharged into Nant Cemlyn via discharge E1 until vegetation re-establishment has occurred and been agreed in writing with NRW.
- During the above period(s) all water would be diverted and discharged into the Afon Cafnan via discharge E2.

7.4.6 The effect of the diversion of run-off from the portion of Mound E in the Cemlyn catchment to the Afon Cafnan on the total freshwater discharge into the lagoon has been considered in detail as part of the examination of the effects detailed in effects B2 to B4 below.

7.4.7 For all other discharges shown on figure 7-1, an upper TSS limit of either 40mg/L or 70mg/L is proposed, depending on the background concentration in the receiving watercourse watercourse during normal rainfall conditions.

Worst case assessments to the marine environment have been based on suspended solid concentrations predicted during a spring – neap tidal cycle for a 1 in 2 year average with a 1 in 30 year storm event (as presented in Application Reference Number: 6.4.90).

7.4.8 As an additional measure to the SuDS system, a polyelectrolyte coagulant dosing system would be used to remove TSS below a particle size of 0.002mm. The dosing units would be located adjacent to the SuDS treatment ponds. It is anticipated that a flow proportional system of dosing would be used only to respond to increased TSS concentrations resulting from storm events during construction.

RD43Sewage discharge

7.4.9 In addition to the drainage discharge, there would be additional sources of suspended sediment input direct to the marine environment.

7.4.10 It is proposed that treated sewage arising from the Main Construction would be discharged into the north of the Porth-y-pistyll at a rate of approximately 1,598m^3 per day during this phase. The amount of suspended sediment in the sewage discharge would be limited to 30mg/L.

7.4.11 An extension to the existing Cemaes Welsh Water Treatment Plant, operated by Dŵr Cymru Welsh Water (DCWW), and located to the west of the Site Campus, would treat sewage derived from the Site Campus. This would discharge through the current DCWW outfall or otherwise through the new Cooling Water outfall to be constructed for the Wylfa Newydd Project. The maximum daily rate of discharge from the Site Campus would be approximately 1,598m^3 per day.

Dewatering

7.4.12 There would also be discharges to the marine environment from dewatering (from the deep excavations, the three cofferdams and cooling water intake and outfall tunnels). Suspended sediment would be limited to 70mg/L under normal rainfall conditions for dewatering.

Concrete batching plant

7.4.13 Surface water run-off from the concrete batching plant would drain into the main site surface water drainage (there would be no other discharges relating to the concrete batching plant other than the drainage of surface water). Run-off would be intercepted within the batching plant site and monitored for pH levels. If the pH is above eight, then it would be treated prior to discharge.

Capital dredging and disposal

7.4.14 The dominant source of suspended sediment introduced into the marine environment would be spill from the capital dredging activity and increased suspended sediment during the disposal of dredged material (these sources are included in the modelling results provided below).

Modelling

7.4.15 A Delft-3D hydrodynamic model was used to assess the cumulative effects of all sources of suspended sediment (i.e. drainage, dewatering, surface water run-off from the concrete batching plant and sewage, as well as dredging) and predict the fate of the suspended sediment discharged to the marine environment. The disposal of dredged material was modelled separately, as there would be no spatial interaction between the suspended sediment generated by dredging and disposal.

7.4.16 The modelling was based on a realistic worst case with the fluvial and sewage sources discharging at the maximum design limit for suspended solids and continuous dewatering of the deep excavations and cofferdams. Both sediment plume dispersion and sediment settlement rates have been modelled. The full results of the modelling are presented in the Marine Hydrodynamic Modelling Report (Application Reference Number: 6.4.90).

7.4.17 During capital dredging a maximum (worst case) area of approximately 25ha is predicted to experience an increase in suspended sediment (solids) concentration of greater than 6.1mg/L from all input sources (see figure 7-2 which shows the absolute suspended sediment concentration; the total suspended sediment in the water column (i.e. background plus predicted inputs)). This modelled result is for mid-depth in the water column.

7.4.18 A concentration of 6.1mg/L is equal to the low end of observed ambient average annual concentrations (calculated annual averages ranged from 6.1mg/L in 2011 to 13.0mg/L in 2014 based on marine water quality sampling at nine sites between May 2010 and November 2014; Application Reference Number: 6.4.13). Within this area, suspended sediment concentration increases by up to approximately 60mg/L during capital dredging, with rapid decay (within hours) after dredging ceases (see figure 7-2). The size of the affected area would reduce between dredging events as the suspended sediment disperses.

7.4.19 The modelled deposition of suspended solids on the bed an hour and six days after the last dredge event are plotted on figure 7-3 and figure 7-4 respectively.

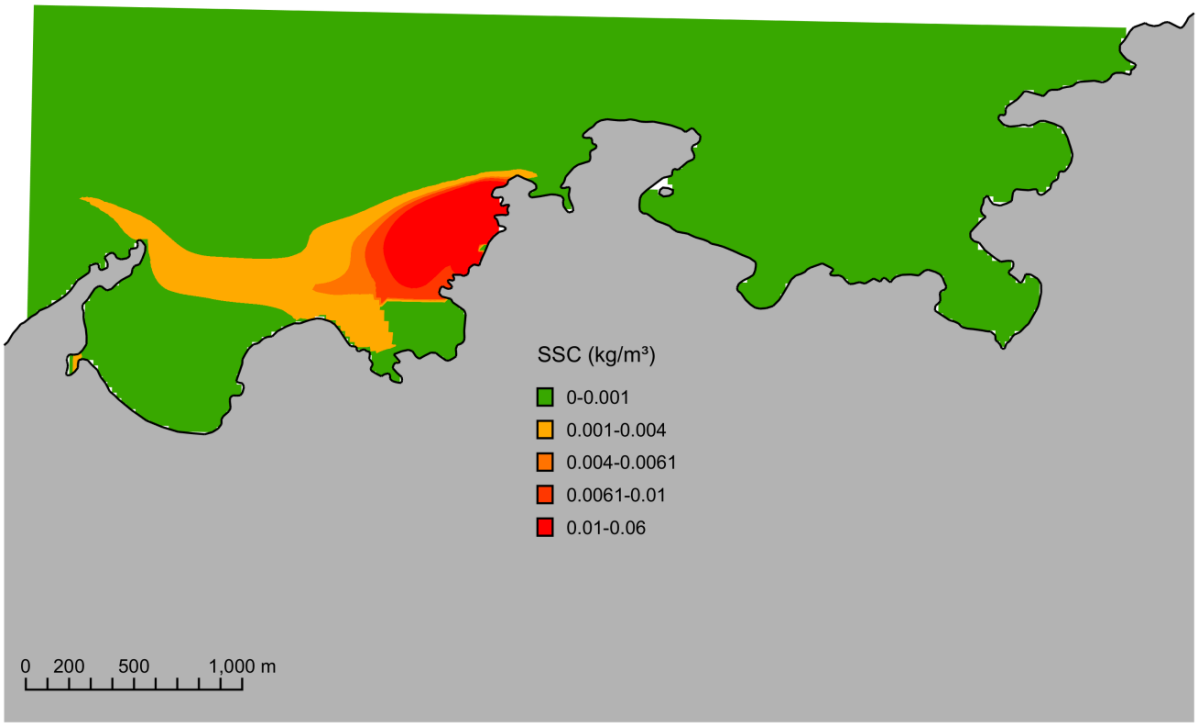

Figure 7-2 Suspended solids concentration (kg/m^3) an hour after the final dredge (mid-depth) (note 1mg/L = 0.001kg/m^3)

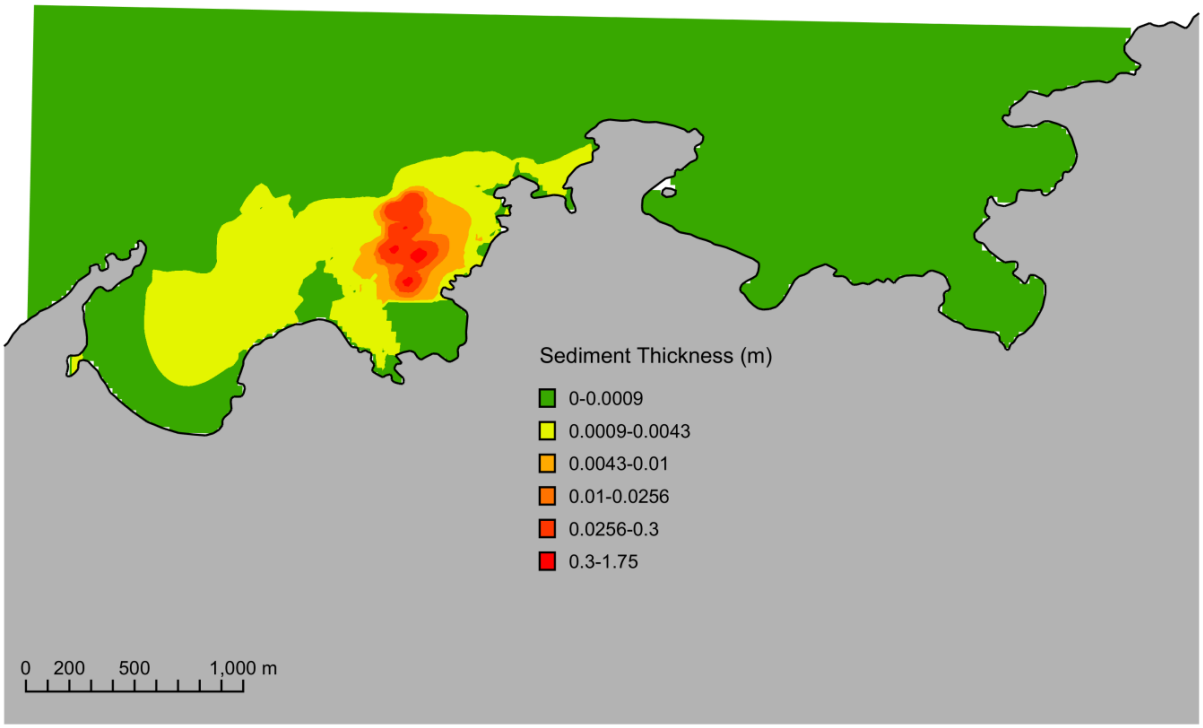

Figure 7-3 Predicted sediment thickness one hour post-dredging (at end of 17 July-21 August simulation)

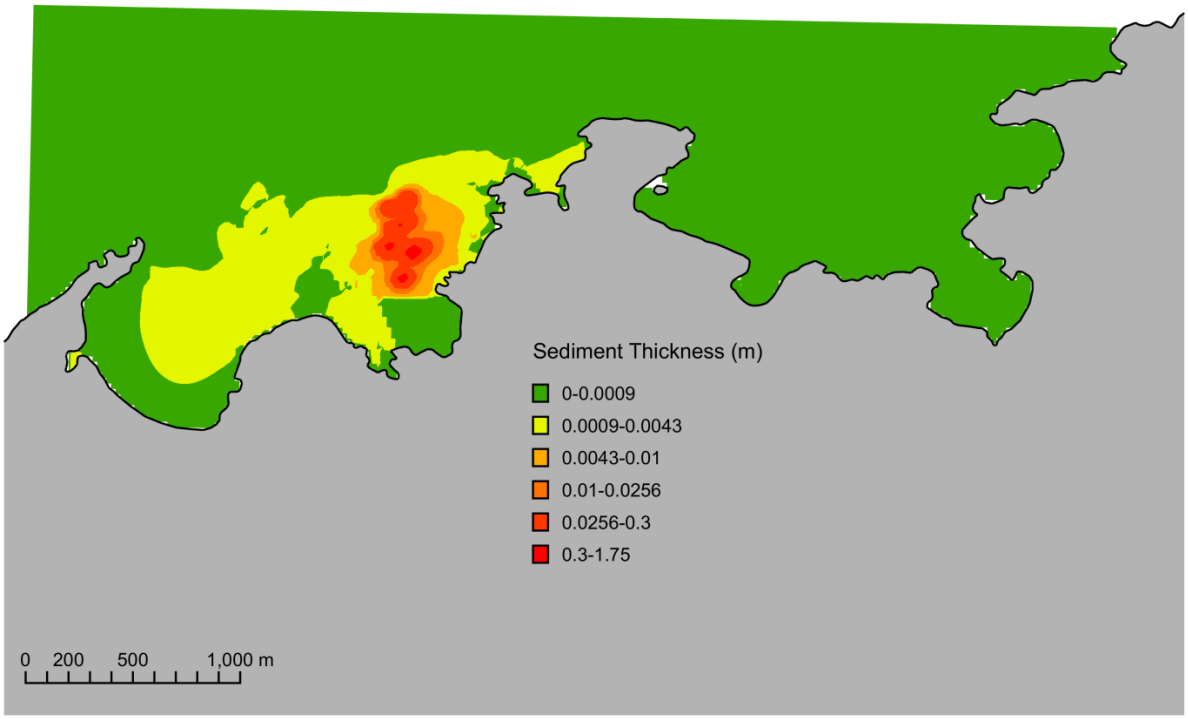

Figure 7-4 Predicted sediment thickness post-dredging (+6 days) at the end of the simulation

7.4.20 The differences in the distribution of the material at these two times reflect the potential for transport of the deposited sediments. The model predicts less than 0.9mm deposition towards Esgair Gemlyn.

7.4.21 For the disposal of dredged material at the Disposal Site, the modelling of all sediment fractions (coarse sand, medium sand, fine sand and fines fractions) for the whole period of disposal (of up to 242,000m^3 over 35 days) predicts that, in the upper 10% of the water column (where the highest concentrations would occur), the suspended sediment concentration would increase above typical background concentration in a zone of approximately 1km around the disposal location (see figure 7-5). The typical background suspended sediment concentration is 5.5 x $10^{-3}kgm^{-3}$, with values ranging from <3 x $10^{-3}kgm^{-3}$ to 10 x $10^{-3}kgm^{-3}$.

7.4.22 The full results of the modelling at the Disposal Site are presented in the Marine Hydrodynamic Modelling Report – Disposal Site (Application Reference Number: 6.4.94).

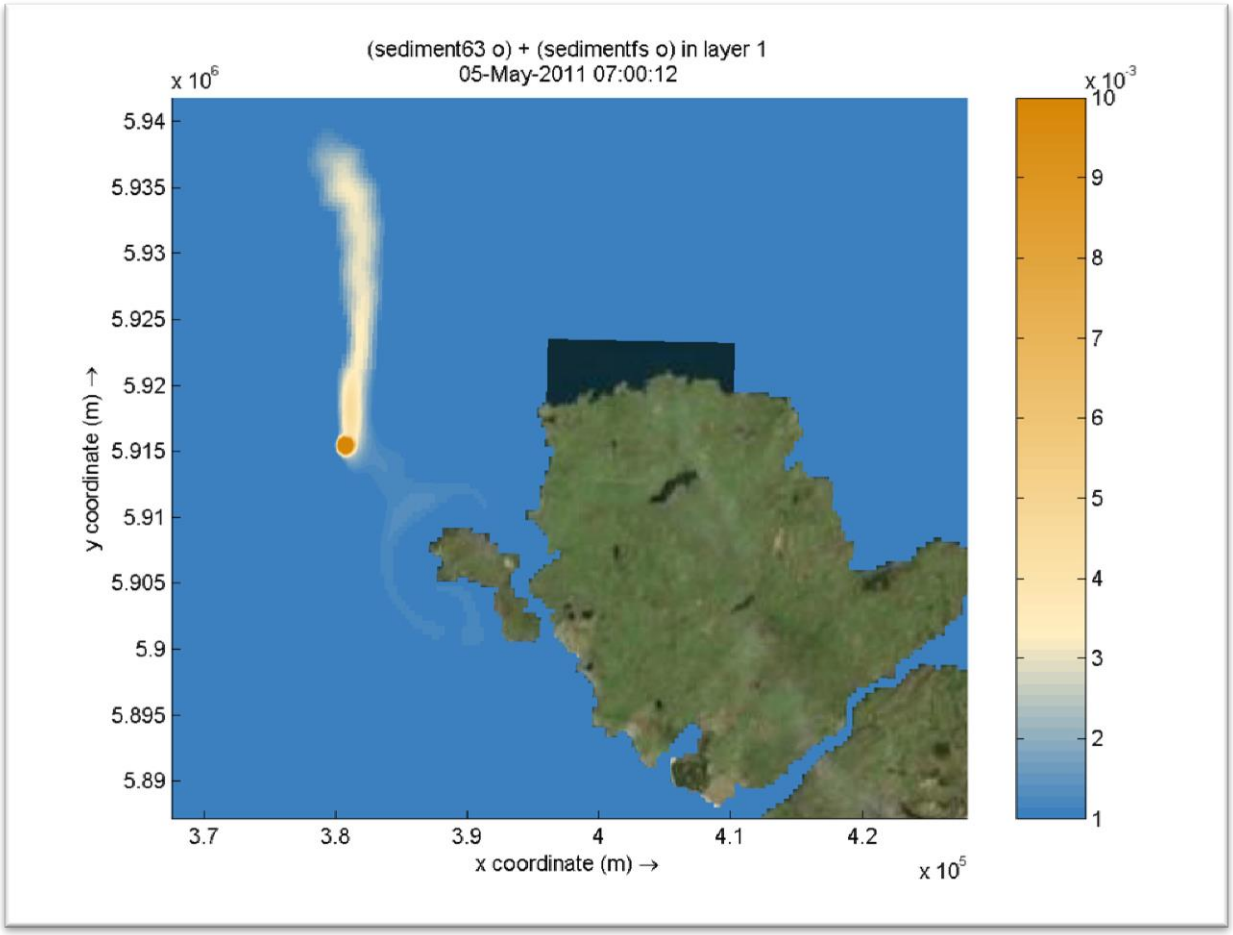

Figure 7-5 Suspended sediment concentrations (kgm^{-3}), full programme final disposal +1h, all fractions (coarse sand, medium sand, fine sand and fines fractions in summation)

7.4.23 Figure 7-6 shows the predicted increase in suspended sediment (for the finest sediment fraction only (0.063mm diameter)) 48 hours after the final disposal event. This sediment fraction is expected to remain in suspension for the longest period of time and, therefore, is indicative of the duration over which the effect of the disposal on suspended sediment concentrations would be evident. Figure 7-6 shows that suspended sediment concentrations would fall below the typical background concentration within 48 hours and that the effect on water quality associated with disposal would be experienced for a short duration following the completion of disposal. The modelling predicts that the sediment plume would disperse to background suspended sediment concentrations after approximately 3 hours.

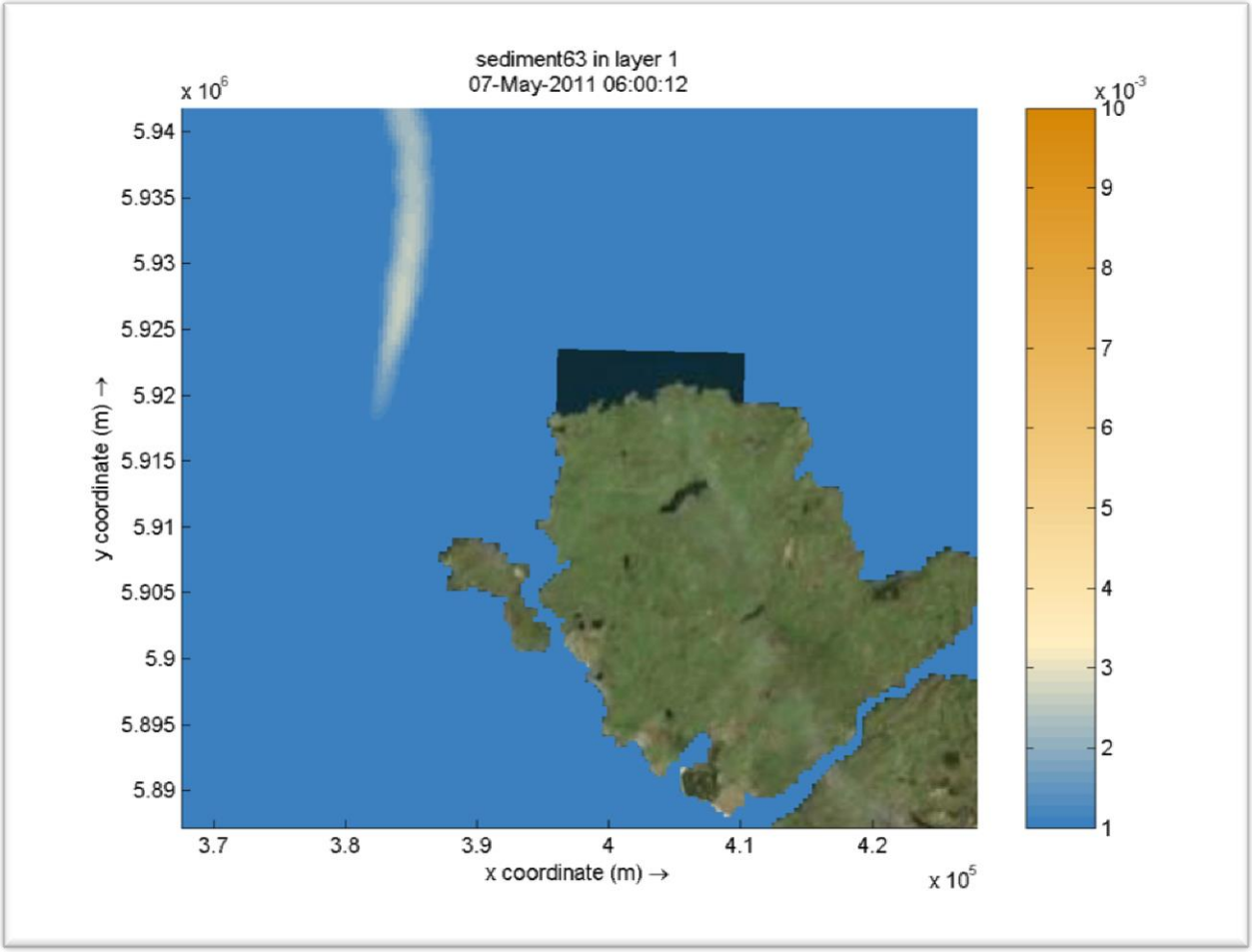

Figure 7-6 Suspended sediment concentrations (kgm^{-3}), full programme final disposal +48h (fine sediment fraction, 0.063mm diameter)

7.4.24 After the suspended sediment generated by dredging has dispersed, the suspended solids concentrations derived from the drainage flows alone would be low (figure 7-7). Predicted suspended solid concentrations in the marine environment from fluvial sources, as depicted by the modelling, are shown to be below baseline concentrations within approximately 500m from the discharge points.

7.4.25 After the storm event (figure 7-8), there is an increase in both the extent of areas of elevated suspended solids concentration adjacent the outfalls, and the maximum suspended solids concentration (approximately 63mg/L).

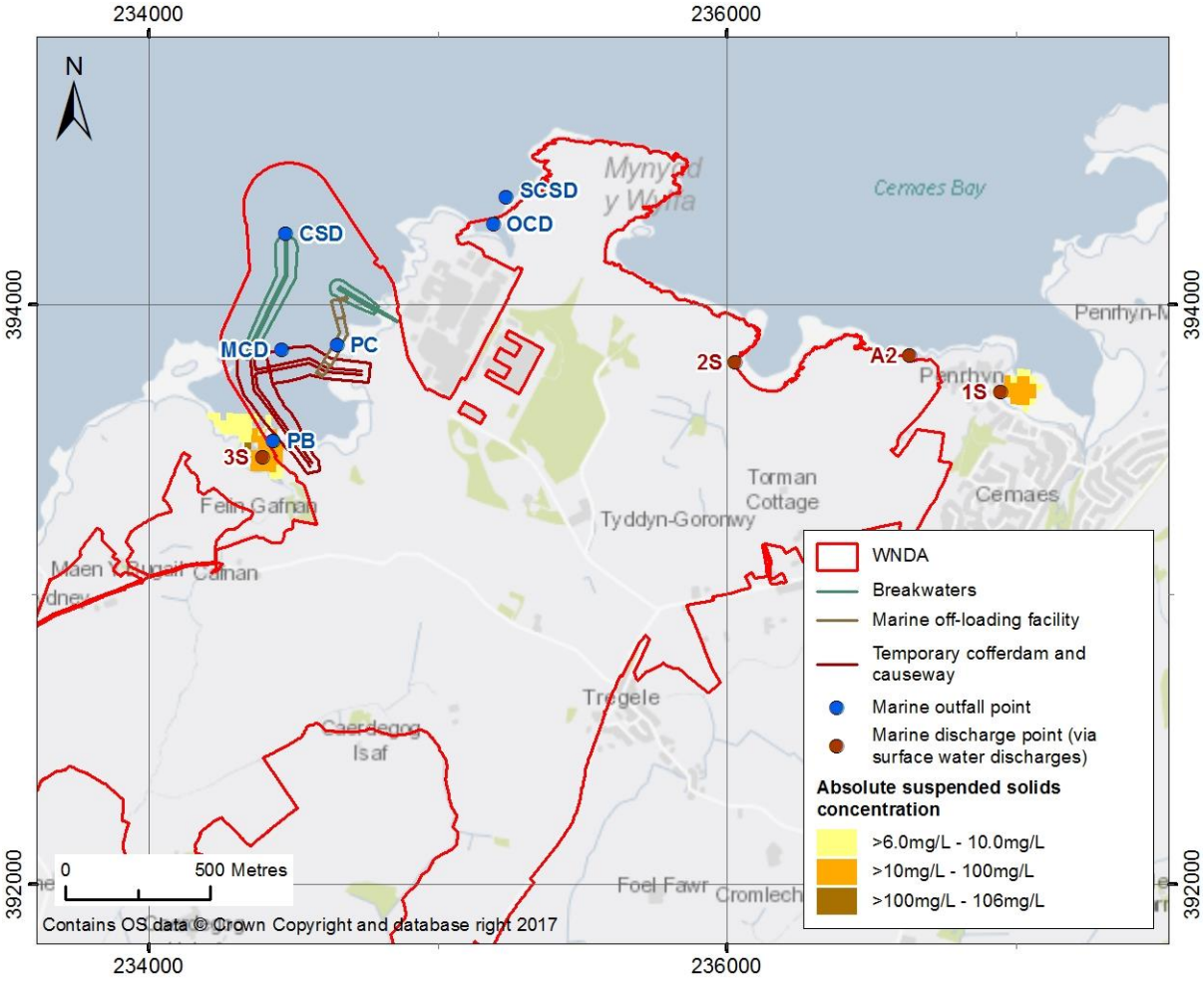

Figure 7-7 Suspended solids concentration resulting from land drainage

7.4.26 The modelling assumed suspended sediment inputs at either 40mg/L or 70mg/L at each discharge point, with the corresponding flow for each particular discharge point.

7.4.27 The predicted thickness of suspended solids deposited on the bed as a result of the land drainage during construction at the end of the modelling simulation is plotted as figure 7-9. Figure 7-9 shows there to be very low levels of deposition of suspended material from the land drainage discharges beyond approximately 500m (maximum) from the discharge location, with no predicted deposition in the vicinity of Esgair Gemlyn.

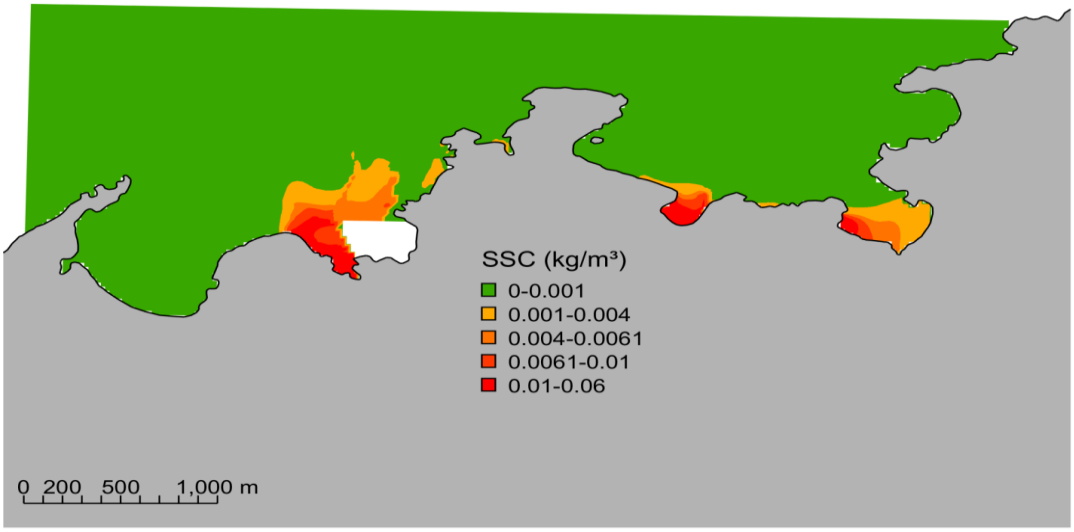

Figure 7-8 Construction drainage suspended solid concentration at the end of the storm event (kg/m^3); blanked out area represents the main cofferdam area (note 1mg/L = 0.001kg/m^3)

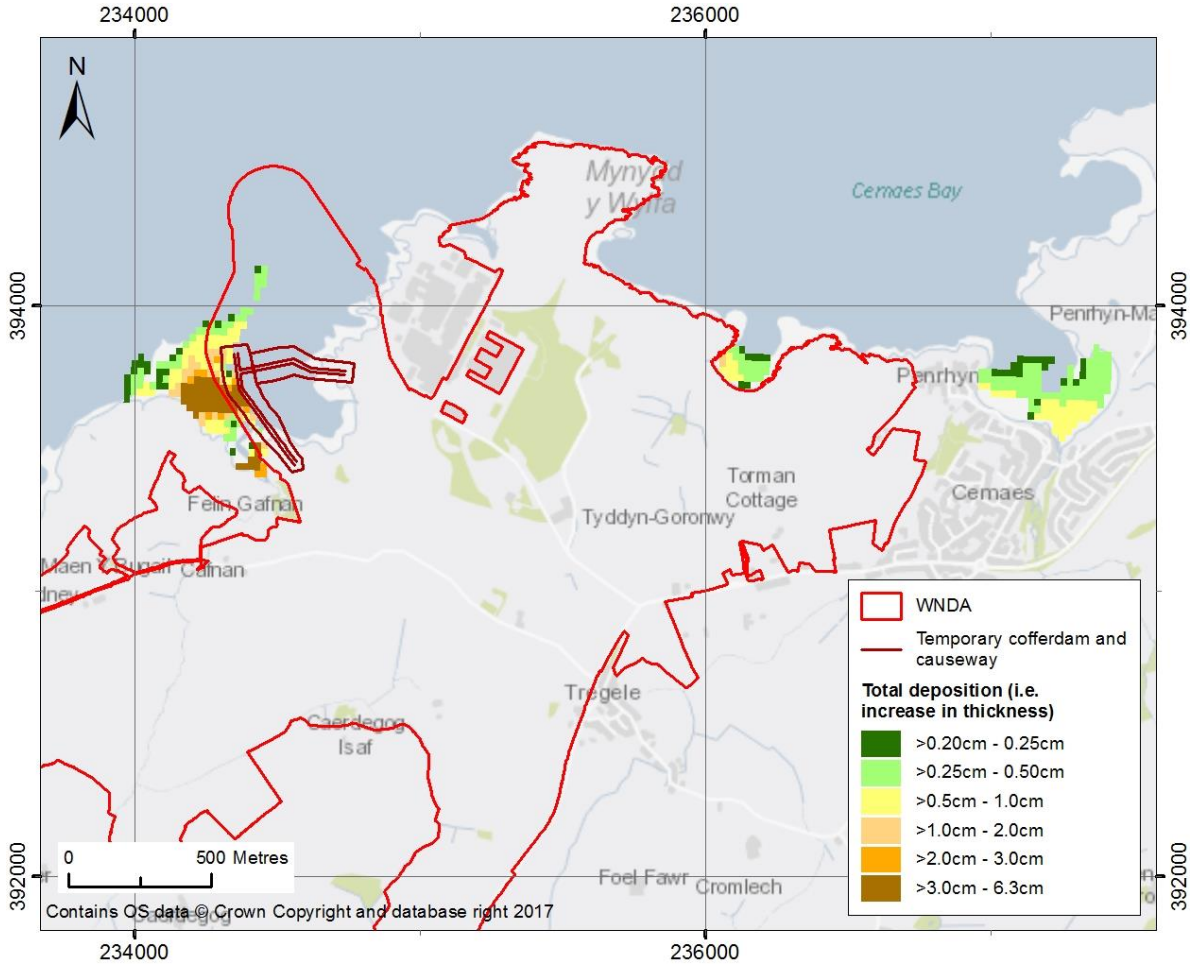

Figure 7-9 Predicted thickness of deposited material as a result of land drainage at the end of the modelling simulation

Predicted effect on Cemlyn lagoon

7.4.28 Suspended sediment input direct to the marine environment associated with capital dredging, the disposal of dredged material, treated sewage discharge, dewatering and surface water run-off from the concrete batching plant would not influence the lagoon feature. The modelling of the deposition of sediment predicts the deposition of a fraction of a millimetre in Cemlyn Bay.

7.4.29 Due to the proposed drainage design (and specifically the mitigation embedded within the design related to discharge from the western side of Mound E), there is no potential for an effect on the background total suspended sediment load in Nant Cemlyn.

7.4.30 Soil management measures proposed to manage erosion and sediment loss during construction would be implemented in accordance with the Wylfa Newydd Code of Construction Practice (CoCP) (Application Reference Number: 8.6).

7.4.31 Given the above, an adverse effect on the integrity of the coastal lagoon feature is not predicted to arise due to increases in suspended sediment concentration or its subsequent deposition associated with the construction phase of the Project.

A2 Change in water chemistry [Construction water discharge EP]

Introduction

7.4.32 During construction there is the potential for changes to water chemistry to arise due to discharges into the marine environment, including from land drainage, dewatering and sewage. It is expected that the stripping of topsoil and the construction of landscape mounds would lead to increased concentrations of TSS (including silt) within the surface water runoff (including water diverted and discharged from Mound E to the Afon Cafnan) (described in effect A1 above).

7.4.33 Contaminants such as heavy metals, nutrients and organic carbon have a higher ability to associate with finer fractions (silt and clay). These activities would be the main pollutant source from the Wylfa Newydd Development Area and would remain so until vegetation has become established on the earthwork mounds (see summary of the preliminary design for construction surface water drainage (Application Reference Number: 6.4.33)).

7.4.34 Other potential sources of potential pollution include leaks and spillages of fuels or oils, heavy metal leaching from soil and the release of cement components in surface water runoff from construction.

Treatment

7.4.35 The TSS load released to the environment would be treated prior to discharge by a series of ponds; however, finer particles (less than 0.002mm) are likely to remain in suspension. As described above, it is proposed to use

a polyelectrolyte coagulant dosing system which can remove TSS below a particle size of 0.002mm, alongside the SuDS system. This would involve the use of chemicals and could lead to an increased level of chemicals in the discharge water if the dose levels are not properly managed.

7.4.36 Flow proportional dosing is proposed and, therefore, it is very unlikely that there would be any notable concentrations of polyelectrolytes being discharged from the system. Dosing is expected to be in the range of between 0.1mg/L and 1mg/L, thus any accidental releases of the polyelectrolyte would be in concentrations less than 1mg/L.

7.4.37 A review of polyelectrolytes undertaken for the Environment Agency [RD370] concluded that the impact of polyelectrolytes on the aquatic environment (including brackish waters) is low due to:

- the strong and irreversible sorption (or binding) to suspended and dissolved organic matter;
- losses due to hydrolysis and biodegradation; and
- a low potential to bioaccumulate.

Predicted effect on Cemlyn lagoon

7.4.38 As part of the permit application for water discharges associated with construction works, an assessment of impacts on the receiving waters is required (this is known as an H1 assessment). The H1 assessment evaluated the effects of surface water discharges from the drainage works associated with the construction of the Power Station. The H1 assessment followed the H1 guidance published by the Environment Agency and the results determine appropriate discharge limits for the Environmental Permit.

7.4.39 Given that Horizon is not seeking an Environmental Permit to discharge construction water to Nant Cemlyn there is no potential for a direct effect on Cemlyn lagoon. For marine waters, and the potential for an indirect effect to arise, the H1 assessment (Application Reference Number: 6.4.96) concluded that dissolved copper, lead, zinc and nickel required further modelling, and Delft3d modelling was carried out for these metals.

7.4.40 The modelling predicted that the maximum concentrations of dissolved nickel would be below its annual average EQS of 8.6µg/L and the dispersion occurs in very close proximity (within a few metres) of the discharge. For zinc, lead and copper the predicted maximum concentrations are above the relevant annual average EQSs.

7.4.41 The predicted maximum concentration for dissolved zinc is predicted to occur in proximity to discharge point 3S, downstream of the Afon Cafnan, and the zinc AA EQS exceedance would be limited to the area shown in figure 7-10.

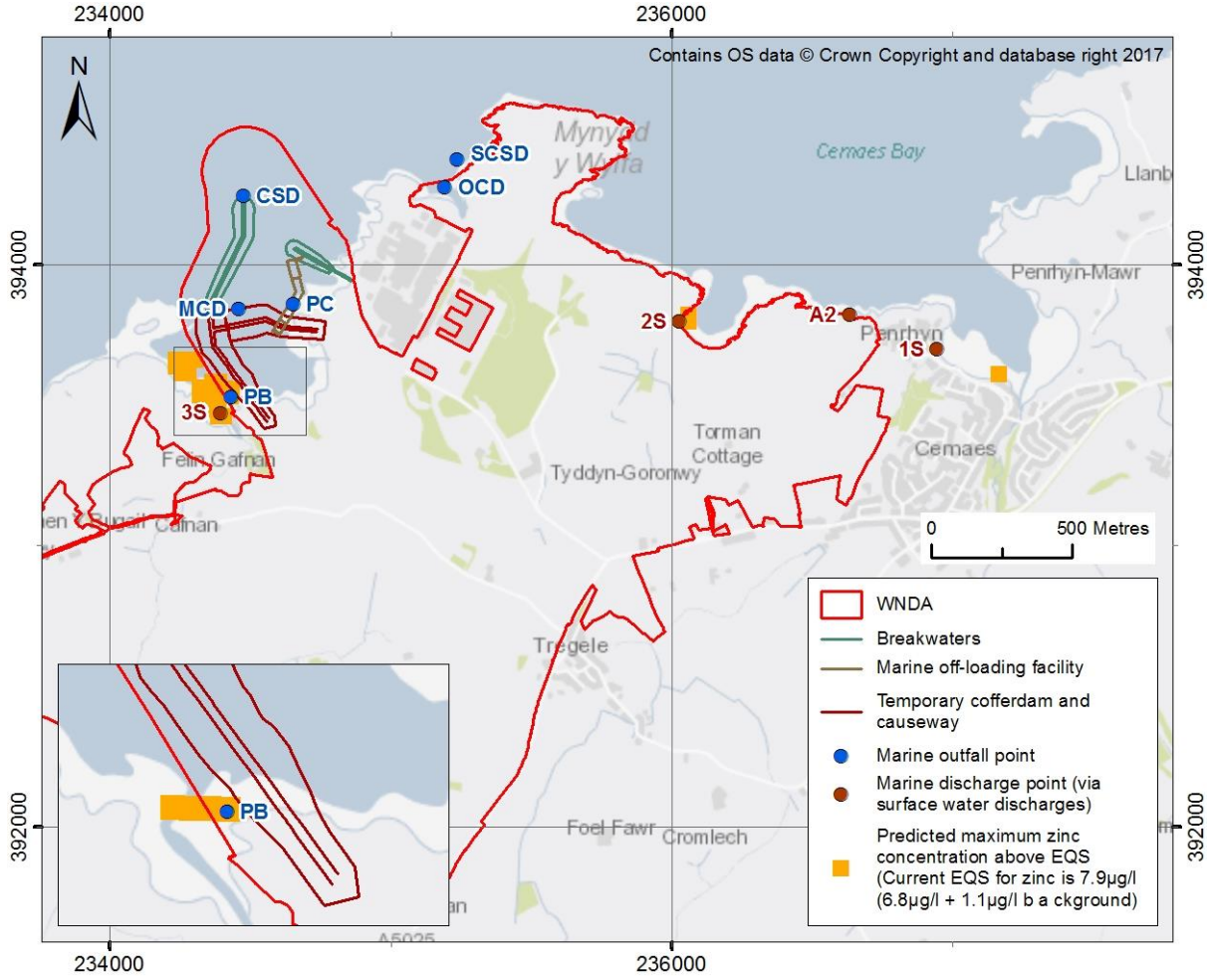

Figure 7-10 Predicted dilution of dissolved zinc in the marine environment at the surface

7.4.42 For dissolved lead the predicted maximum concentration is predicted to occur in proximity to discharge point 3S and the dissolved lead AA EQS exceedance would be limited to the area shown in figure 7-11.

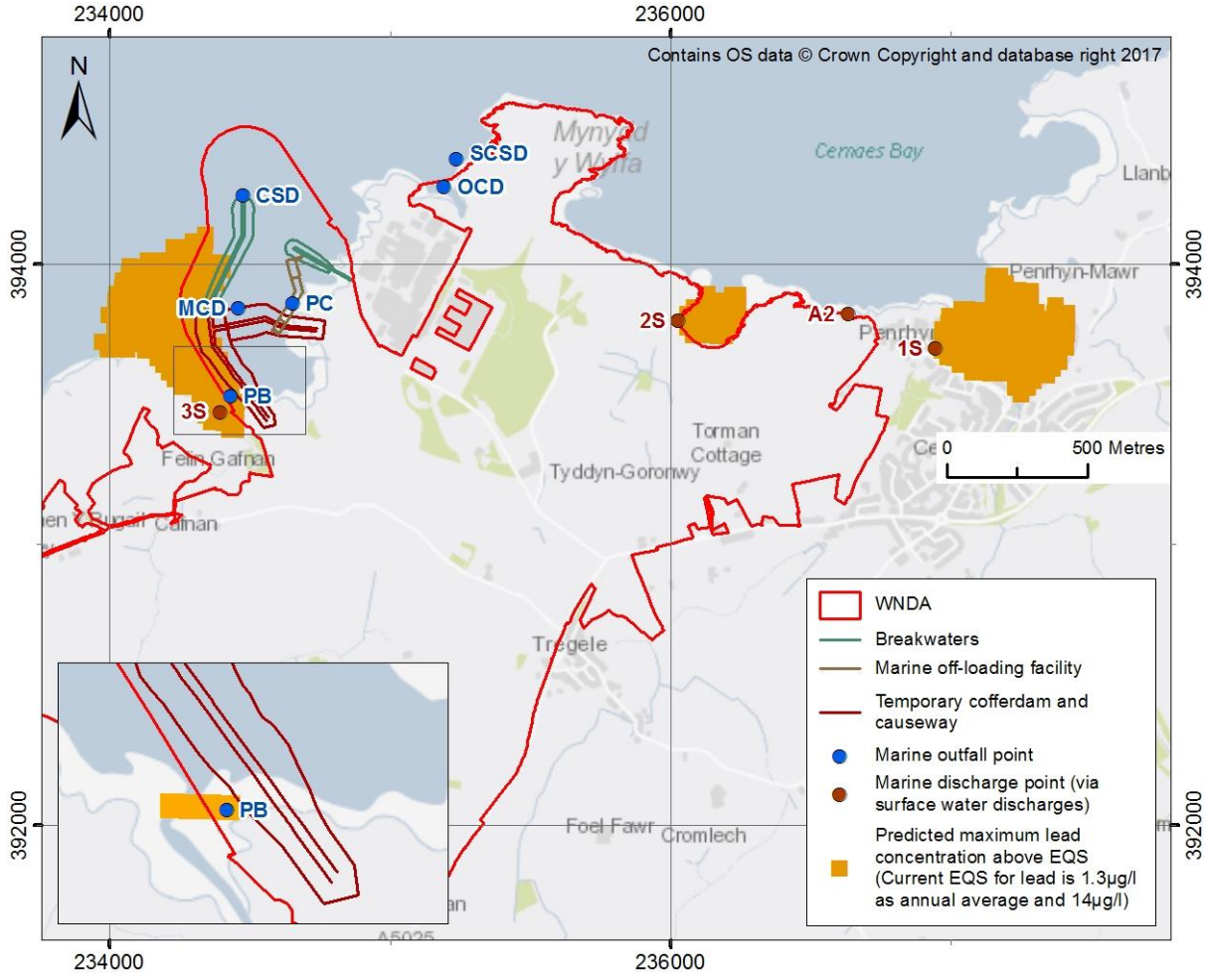

Figure 7-11 Predicted dilution of dissolved lead in the marine environment at the surface

7.4.43 For dissolved copper the predicted maximum concentration is predicted to occur in proximity to discharge point 3S and the dissolved copper AA EQS exceedance would be limited to the area shown in figure 7-12.

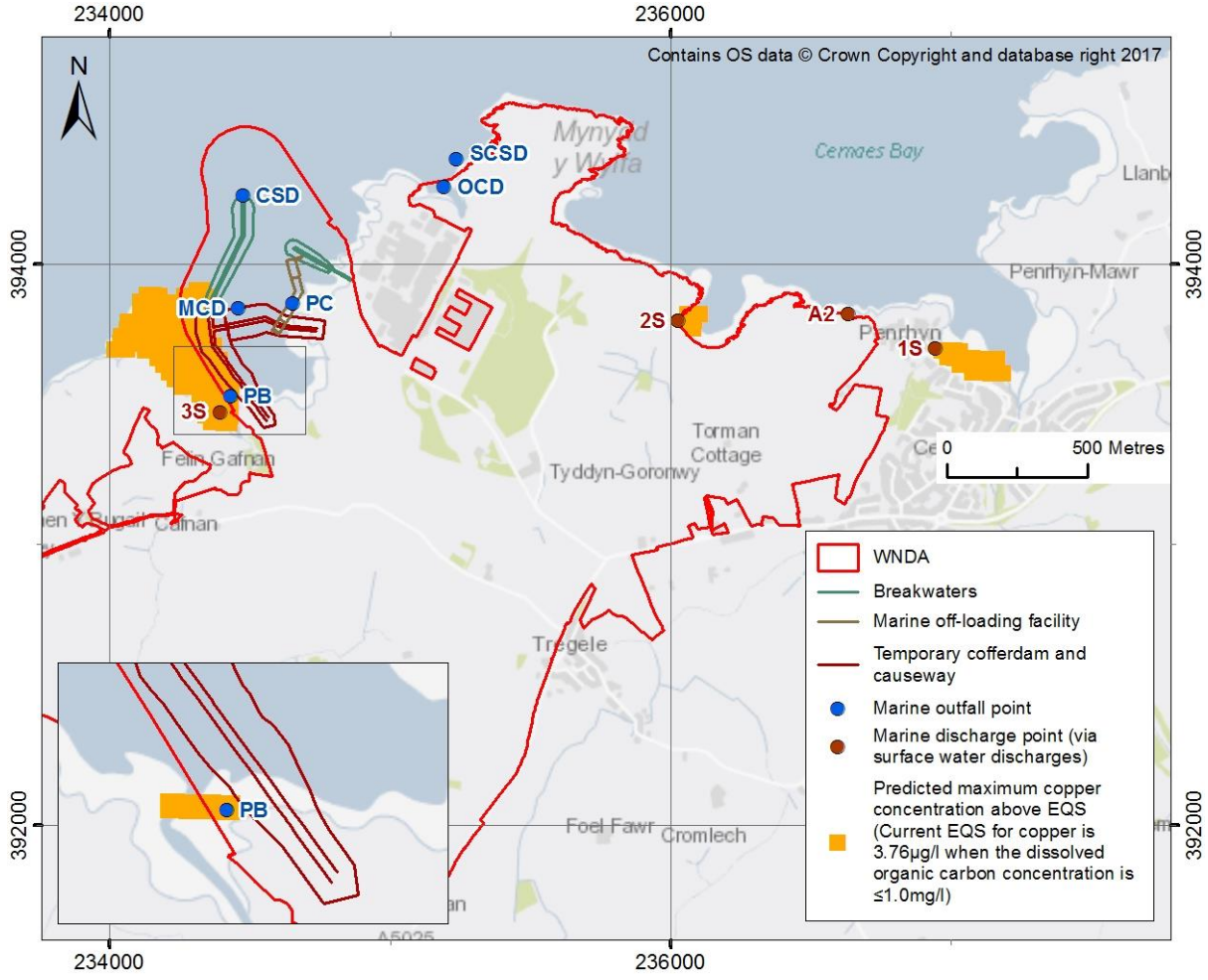

Figure 7-12 Predicted dilution of dissolved copper in the marine environment at the surface

7.4.44 The predicted mixing zones are also precautionary, as soil stripping, earthworks, dewatering and mound creation would occur in different locations at different times, rather than together as assumed by the model. The H1 assessment presents the worst case scenario as the assessments screening phase uses raw data from leaching tests and assumes that the surfaces of the mounds are bare soil. In fact the mounds would be seeded, reducing the leaching of substances from the soil and, therefore, the effect would not be permanent.

7.4.45 On this basis, no direct or indirect effects are anticipated on the habitats and species of Cemlyn lagoon due to changes in chemical content during the construction phase and the integrity of the coastal lagoon interest feature is expected to be maintained.

A3 Change in surface and ground water flow - affecting salinity [Construction water discharge EP]

Estimates of change

7.4.46 It is predicted that during the construction phase there is the potential for a change in the flow rate of groundwater and surface water (see effects B1 and B2 below) to affect the salinity of Cemlyn lagoon. Conservative estimates of the change in freshwater discharge into the lagoon, and corresponding estimates in the resulting changes to the salinity, are presented in table 7-4.

Table 7-4 Estimates of the effect on salinity caused by changes to discharges into Cemlyn lagoon for different flow conditions during the construction phase

Flow Range	Low	Median	High
Flow exceedance probability range (inclusive)	**Q90 to Q100**	**Q45 to Q55**	**Q5 to Q15**
Construction phase (not including diversion from the western side of Mound E to E2)			
Change in freshwater discharge (m^3day^{-1})	-4.7	13.5	49.8
Percentage salinity change after 15 days (%)	+0.010	-0.028	-0.104
Percentage salinity change over a 6 month period (based on annual mean change in discharge of +20.11m^3/day)	+0.5%		
Construction phase (including diversion from the western side of Mound E to E2)			
Change in freshwater discharge (m^3day^{-1})	-35.9	-119.9	-425.7
Percentage salinity change after 15 days (%)	+0.075	+0.250	+0.895
Percentage salinity change over a 6 month period (based on net annual mean change in discharge of -170.99m^3/day) (%)	+4.5		

7.4.47 The estimates for the change during the construction phase are based on changes in discharge if construction takes place during an 'average' climate scenario. Estimates based on changes in discharge if construction takes place during 'wet' or 'dry' climate scenarios are not significantly different.

7.4.48 The estimates of salinity change are also based on an average lagoon depth of 0.3m. The effect over a 15 day period is predicted given that this is the approximate interval between the peaks in salinity, as observed during water quality monitoring in 2012 to 2013.

7.4.49 The predicted percentage change in salinity reported in table 7-4 is conservative because the predictions assume a change in discharge at the stated rate continuously for the whole 15 day period.

7.4.50 The largest proportional change in salinity is expected to occur under high flow conditions during the construction phase, at times when there is diversion of discharge from the western side of Mound E to discharge E2. At these times there may be a periodic increase in salinity of up to approximately 0.9% (over a 15 day period).

7.4.51 Further predictions have been made regarding the potential effect of the Project on salinity over the (approximately 6 month) period when water levels are actively managed in the lagoon for the benefit of breeding terns. It can be seen from table 7-4 that the effect of the diversion of the discharge would be an increase in salinity of 4.5% over the 6 month period when water levels are managed (i.e. before a return to the approximate 15 day interval between peaks in salinity).

Predicted effect on Cemlyn lagoon

7.4.52 In the context of (a) the background variability in salinity, (b) the significant effect on salinity that occurs during the management of water levels in the lagoon and (c) the tolerance of lagoonal species to salinity variation (as set out table 6-1), the predicted change is not considered to be significant, in that it would not have an effect on lagoon flora and fauna. Therefore, an adverse effect is not anticipated on the habitats and species of Cemlyn lagoon due to changes in salinity during the Project's construction phase and no adverse effect on the integrity of the coastal lagoon interest feature is predicted.

Operation

A4 Change in salinity due to overtopping of the shingle ridge (Esgair Gemlyn) [Marine Licence]

7.4.53 A change in the salinity of Cemlyn lagoon due to overtopping of Esgair Gemlyn has been identified as a potential risk. During periods of high tides and stormy weather, waves are able to break over Esgair Gemlyn.

7.4.54 The Core Management Plan for Bae Cemlyn/Cemlyn Bay SAC ([RD43]) outlines the importance of maintaining favourable conditions for species in Cemlyn lagoon. Consideration therefore needs to be given to the potential effects of the Project on waves approaching Esgair Gemlyn and how these effects could influence salinity in the lagoon compared to the existing and future predicted baseline.

Modelling

7.4.55 The modelling of wave conditions has been undertaken using the wave transformation model SWAN, as reported in the Main Site Wave Modelling Report (Application Reference Number: 6.4.82). Present-day ('present day (2023)') and evolving ('foreseeable future 2087') 35.5 year-long wave climate records were generated by the SWAN model for a range of scenarios and these are reported within the Main Site Wave Modelling Report (Application Reference Number: 6.4.82). The results for the present day (2023) (table 7-5) and reasonably foreseeable (2087) (table7-6) fully built scenario scenarios are used for the assessment of operational phase effects.

Table 7-5 Changes in wave height (SWAN model results) for worst case (winter, 99th percentile wave) present day (2023) scenarios over 35.5 year model period

Point	Difference (partially built minus baseline) in significant wave heights for present day winter wave from north-west sector		Difference (fully built minus baseline) in significant wave heights for present day winter wave from north-east sector	
	Difference in mean significant wave height (%)	Difference in 99%ile significant wave height (%)	Difference in mean significant wave height (%)	Difference in 99%ile significant wave height (%)
6 (Cemlyn Bay) (adjacent to Esgair Gemlyn)	+2%	+1%	+1%	-1%

Table 7-6 Changes in wave height (SWAN model results) for worst case (winter, 99th percentile wave) reasonably foreseeable (2087) scenarios over 35.5 year model period

Point	Difference (fully built minus baseline) in significant wave heights for reasonably foreseeable (2087) winter wave from north-west		Difference (fully built minus baseline) in significant wave heights for reasonably foreseeable (2087) winter wave from north-east	
	Difference in mean significant wave height (%)	Difference in 99% significant wave height (%)	Difference in mean significant wave height (%)	Difference in 99% significant wave height (%)
6 (Cemlyn Bay) (adjacent to Esgair Gemlyn)	+4%	+0.8%	0%	0%

Predicted effect on Cemlyn lagoon

7.4.56 For worst case scenarios, (winter, 99th percentile wave) arising from north-westerly directions, the wave transformation modelling predicts a potential increase in wave height up to approximately +4% (table 7-6).

7.4.57 This change would affect baseline values in the range of 1.0m to 1.2m, resulting in an increase in wave height of up to approximately +0.05m under present day winter storm conditions. This increased wave height is lower than that of baseline storm waves arising from the north-east and is within the range of natural variation.

7.4.58 A decrease in wave height of up to -1% adjacent to Esgair Gemlyn (at point 6) is predicted for storm waves arising from the north-east (table 7-5). This is due, in part, to sheltering effects and the broad alignment of the western breakwater structure with the more powerful waves entering the bay from the north-east.

7.4.59 Based on the predictions of the wave transformation modelling, it is concluded that the changes due to the Project during the operational phase, under the worst case conditions, would be insignificant in the context of the background. No change in the salinity of the lagoon during overtopping is predicted as a consequence of the Project, and no effect on the coastal lagoon feature would arise.

A5 Potential for increase in suspended sediment

Predicted effect on Cemlyn lagoon

7.4.60 Once the construction phase is completed, Mound E would be grassed and vegetated with the overall SuDS principle remaining unchanged, whereby the ditches would remain connected to ponds. The other components of the drainage systems, such as silt fences, curtains and dosing installations, would be removed (Application Reference Number 6.4.33). The intention is for the drainage system at Mound E to return to its near existing flows and sediment loads during operation of the Power Station (this is discussed further under effect B below).

7.4.61 Based on 35 samples collected from 2013 to 2017, existing TSS concentrations in the Cemlyn catchment range from 2.3mg/L to 161mg/L (see the Surface Water Baseline Report; Application Reference Number: 6.4.26). Once the construction works are completed, TSS levels would return to those similar to existing background concentrations prior to the start of the Project. Therefore, provided that the existing flow regime is replicated, no additional effects are anticipated as a result of the Project on TSS concentration during the operational phase (Application Reference Number: 6.4.33); and no effect on the coastal lagoon feature would arise.

A6 Thermal and chemical changes due to discharge from the cooling water system [Operational water discharge activity EP]

Predicted effect on Cemlyn lagoon

7.4.62 The modelling results for the extent of the thermal mixing zone (with a cooling water abstraction rate of 126m^3/s) predict an approximate area of 2.09km^2 for a 2°C 98%ile rise at the surface and 0.88km^2 for a 3°C 98%ile rise at the surface, based on annual base case (with no wind). Of the four seasons, the modelled results for the autumn base case has the greatest predicted extent of the thermal plume, with an area of 2.4km^2 for a 2°C 98%ile rise at the surface and 0.91km^2 for a 3°C 98%ile rise at the surface (figure 7-13).

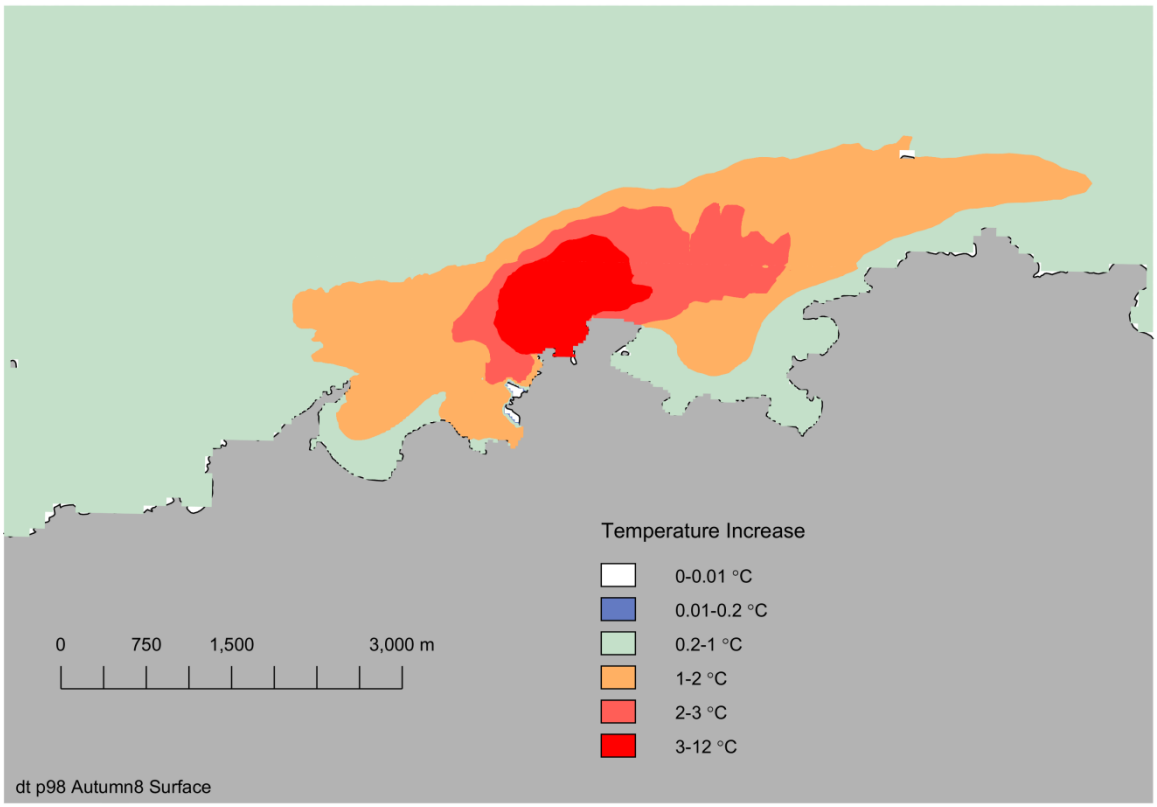

Figure 7-13 Surface temperature rise (98%ile, autumn base case)

7.4.63 For TRO, the area of the 0.01mg/L (10µg/L) mixing zones' (95%ile) rise at the surface is approxiamtely 3.13km^2. For the summer base case (largest extent), the model predicted that the mixing zone at the surface would extend approximately 1km north and 3.9km from east to west (figure 7-14).

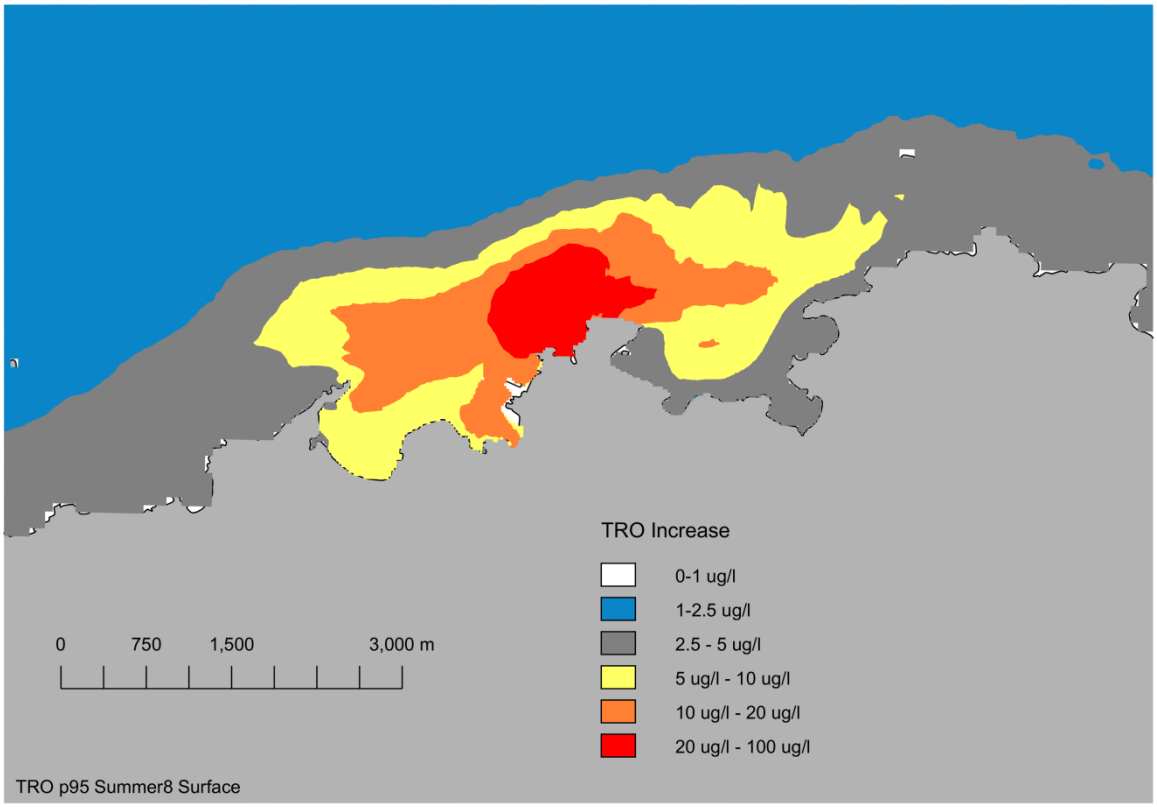

Figure 7-14 Surface TRO concentration (95%ile, summer base case)

7.4.64 It can be seen from figures 7-13 and 7-14 that the predicted effect of the thermal plume on temperature rise and TRO concentration under the maximum modelled mixing zone extent scenarios does not predict an effect that could significantly influence water quality within Cemlyn lagoon (i.e. the 98%ile temperature rise in the marine environment (Cemlyn Bay) is predicted to be less than 1^{o}C and the 95%ile TRO increase is predicted to be less that 0.01mg/L (10µg/L)). Consequently, an adverse effect on water quality in the coastal lagoon feature is not predicted.

A7 Change in surface and ground water flow - affecting salinity

Estimates of change

7.4.65 During the operational phase, it is predicted that there is the potential for a change in the flow rate of groundwater and surface water (see effects B1 and B2 below) to affect salinity in Cemlyn lagoon. Conservative estimates of the change in freshwater discharge into the lagoon, and corresponding estimates in the resulting changes to the salinity, are presented in table 7-7.

Table 7-7 Estimates of the effect on salinity caused by changes to discharge into Cemlyn lagoon for different flow conditions during the operational phase

Flow Range	Low	Median	High
Flow exceedance probability range (inclusive)	**Q90 to Q100**	**Q45 to Q55**	**Q5 to Q15**
Change in freshwater discharge (m^3day^{-1})	5.7	4.9	62.8
Percentage salinity change after 15 days (%)	-0.012	-0.010	-0.131
Percentage salinty change over a 6 month period (based on annual mean change in discharge of +21.7m^3/day) (%)	-0.55		

7.4.66 Estimates of salinity change are based on an average lagoon depth of 0.3m. The effect over a 15 day period is predicted (given that this is the approximate interval between the peaks in salinity, as observed during water quality monitoring in 2012 to 2013).

7.4.67 The predicted percentage change in salinity reported in table 7-7 is conservative because the predictions assume change in discharge at the stated rate continuously for the whole 15 day period.

7.4.68 The largest proportional change in salinity is expected to occur under high flow conditions during the operational phase when a decrease in salinity of approximately 0.13% (over a 15 day period) would occur.

7.4.69 Further predictions have been made on the potential effect on salinity over the (approximately 6 month) period when water levels are actively managed in the lagoon. It can be seen from table 7-7 that the effect over this period would be a reduction in salinity of 0.55%.

Predicted effect on Cemlyn lagoon

7.4.70 In the context of (a) the background variability in salinity, (b) the significant effect on salinity that occurs during the management of water levels in the lagoon and (c) the tolerance of lagoonal species to salinity variation (table 6-1), the predicted change is not considered significant in that it would not have an effect on lagoon flora and fauna. Therefore, no effects are anticipated on the habitats and species of Cemlyn lagoon due to changes in salinity during the operational phase and an adverse effect on the integrity of the coastal lagoon interest feature is not predicted.

B Changes in surface and groundwater hydrology

Construction

B1 Change in groundwater recharge, availability and supply [Construction water discharge EP]

Introduction

7.4.71 The construction works could affect water availability within the Cemlyn catchment and Bae Cemlyn/Cemlyn Bay SAC. Dewatering of the excavations, to ensure that groundwater inflow into deep excavations is controlled, would change groundwater levels and groundwater flow direction. This may result in effects to base flows and water availability within the catchment. Cemlyn lagoon is not, however, a groundwater dependant ecosystem; it is a tidally dominated regime and, for this reason, groundwater is not referred to in the citation for the SAC or the conservation objectives. It is, however, acknowledged that groundwater does indirectly contribute through discharging into the surface watercourses which flow into the lagoon.

7.4.72 The hydrological modelling quantifies the predicted changes to the groundwater and surface water flow regimes within the Wylfa Newydd Development Area, including the Cemlyn catchment (chapter D8 of the ES (Surface and groundwater) (Application Reference Number: 6.4.8). This has considered all the stages of the construction phase, including dewatering of excavations to -18 mAOD. It simulates a period of 7 years from baseline conditions to the peak of dewatering, followed by a subsequent period of 5 years from the peak of dewatering to the long term operational conditions. The key findings for groundwater relevant to Cemlyn lagoon are presented below.

Predicted effects on Cemlyn lagoon

7.4.73 The results indicate that significant changes in bedrock groundwater heads within the centre of the Wylfa Newydd Development Area are expected to occur. This is mainly due to the change in land cover where the new infrastructure is proposed to be built. Figure 7-15 shows the expected worst case impacts on groundwater levels during the construction phase.

7.4.74 The groundwater model predicts that groundwater flow direction does not change appreciably due to the Project and groundwater continues to flow into Nant Cemlyn and Cemlyn lagoon, with little or no drawdown predicted adjacent to the lagoon or Nant Cemlyn.

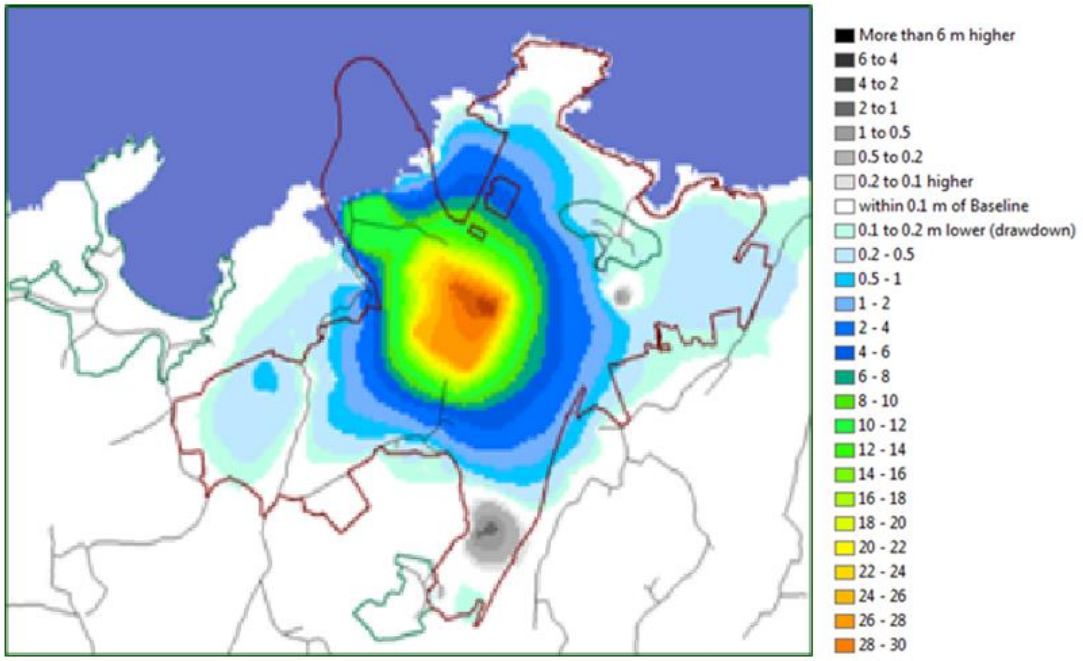

Figure 7-15 Worst case groundwater impacts based on excavation to –18 mAOD

7.4.75 The bedrock groundwater flow model shows that groundwater discharging directly to Cemlyn lagoon does not significantly change during the construction phase. The model shows a reduction in flow of only 0.1m^3day^{-1} compared with total modelled bedrock groundwater inflow into the SAC of between 81.6m^3day^{-1} and 170m^3day^{-1} (i.e. a change of approximately 0.12% of the typical dry level discharge and approximately 0.06% of the typical wet level discharge).

7.4.76 Historical ordnance survey maps (up to 1978) show the presence of several springs on the edge of the lagoon (close to Plas Cemlyn) which may represent groundwater discharge areas. The groundwater model does consider discharges into watercourses; however, these small features close to the lagoon are too small to be represented individually within the model. The mapped springs are further west than Nant Cemlyn and so any impact conceptually is unlikely. The model calibration encompasses all small discharges within the total modelled bedrock groundwater inflow into the SAC and, therefore, the model predicts that the impact on any small springs adjacent to Cemlyn lagoon is likely to be very small.

7.4.77 The direct groundwater discharge into the lagoon is significantly smaller than the discharge from Nant Cemlyn and the other watercourses which enter it. The modelled baseline discharge from groundwater is between 81.6m^3day^{-1} and 170m^3day^{-1}. The modelled baseline discharge from Cemlyn Lagoon into the sea (which must balance inflows into the lagoon from surface water, direct precipitation and groundwater) varies between 531m^3day^{-1} at Q_{95} for the driest baseline scenario to 8,734m^3day^{-1} for the wetter baseline scenario.

Changes in discharge from surface watercourses, which are also influenced by changes in the groundwater regime, are considered in effect B2 below.

7.4.78 Based on these findings, the predicted changes to the groundwater regime at Cemlyn lagoon are predicted to be very small during the construction phase. In light of this predicted change and the fact that the lagoon is not dependent on groundwater supply, an adverse effect on the integrity of the coastal lagoon interest feature is not predicted in this context.

B2 Change in surface water flow in the Cemlyn catchment [Construction water discharge EP]

Introduction

7.4.79 The Project would alter the existing drainage characteristics in the Cemlyn catchment through the change in land cover and formation of mounds using spoil removed during excavation of the platforms. These activities have the potential to change the surface and groundwater flow within the Cemlyn catchment, including to Cemlyn lagoon. Mound E is relevant to the Cemlyn catchment but only a small part of the Cemlyn catchment (approximately 4%) is within the footprint of Mound E (figure 7-16).

7.4.80 Groundwater flow would be affected within the wider groundwater catchment due to dewatering and changes to the land cover. This would change the discharges to Nant Cemlyn (and another small drain) which flow into Cemlyn lagoon.

7.4.81 The effects of changes to the drainage characteristics and to the groundwater regime have been considered together within the hydrological modelling. The resulting changes to flow to the lagoon within both Nant Cemlyn and the small drain have been assessed in the surface water modelling and assessment. When considering the construction phase, the effect of re-routing drainage from the western part of Mound E into the Afon Cafnan has also been considered.

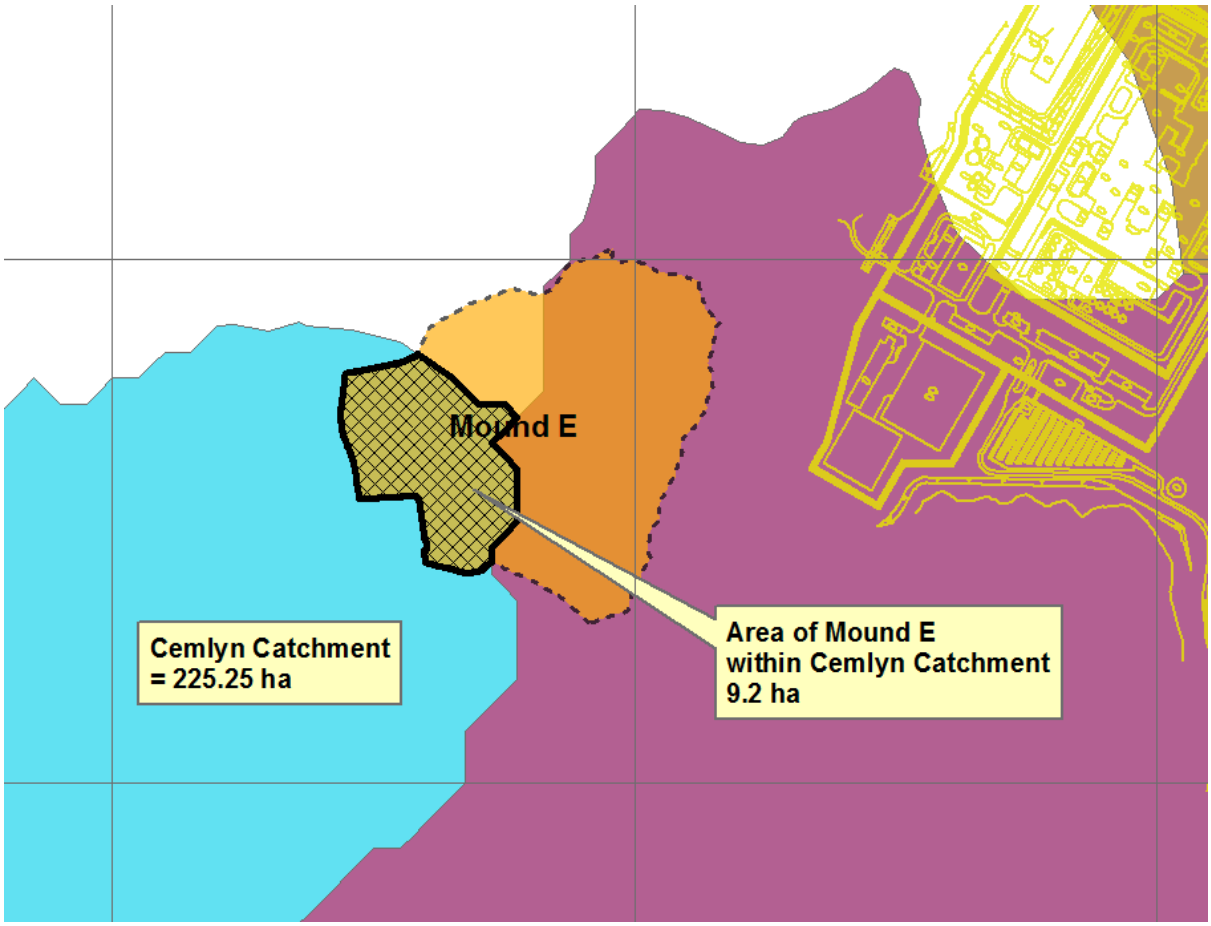

Figure 7-16 Relationship between Mound E and the Cemlyn catchment

Predicted effects on Cemlyn lagoon

7.4.82 The model has considered changes to flows in the two watercourses for typically dry, average and wet periods during the construction phase (based on historical climate records). The location of analysis points considered in the model are shown in figure 7-17. Model points Cem4 and Cem5 represent the discharge into the lagoon from Nant Cemlyn and the smaller watercourse respectively.

7.4.83 The modelling results for the construction phase are presented in figures 7-18 and 7-19. Figure 7-18 shows the modelled change in discharge for Nant Cemlyn and the net change when both Nant Cemlyn and the smaller watercourse are considered. It shows the modelled change for construction during typical wet, typical dry and average rainfall conditions. Figure 7-19 shows the same results, this time as a percentage of the baseline discharge. It should be noted that the model was calibrated for the normal range of flows and, therefore, the results presented for extreme flows should be treated with caution.

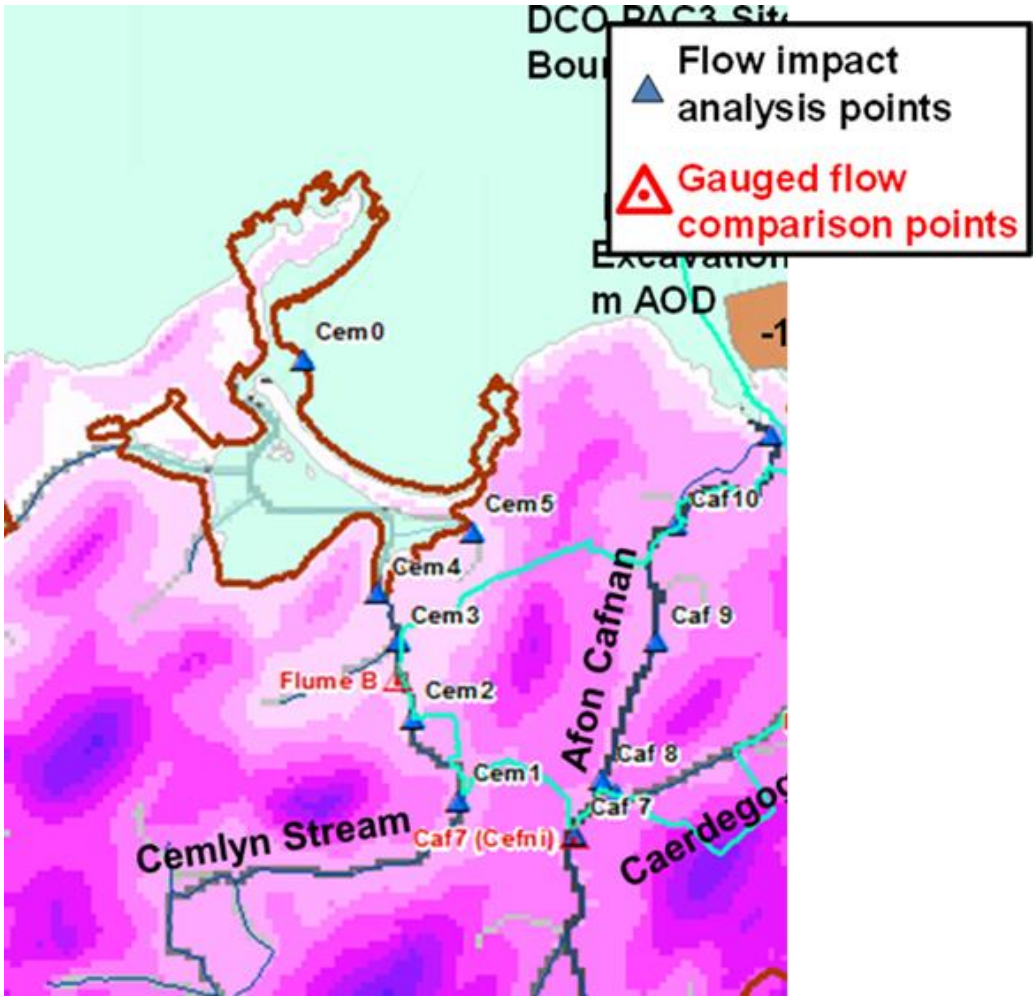

Figure 7-17 Location of analysis points in the Cemlyn catchment in the surface water model

7.4.84 Predicted net changes to discharge into Cemlyn lagoon for different flow conditions and climate scenarios during the construction phase are summarised in table 7-8.

7.4.85 The mean discharge from Mound E to Nant Cemlyn during average climatic conditions is expected to be 133m^3day^{-1}. Diverting the discharge to E2 for any period would negate the predicted increase at Cem4 during the period of diversion.

7.4.86 The assessment of the modelling results indicates that (in the absence of diversion of the discharge from Nant Cemlyn to E2) the predicted increase in flows where Nant Cemlyn enters the lagoon would be largely offset by the decrease in flows at the small tributary north of Mound E during the construction phase. The small tributary would experience an average of approximately 31% decrease in flows in the construction phase. However, the net increase would only represent a small increment on the baseline volume entering the lagoon as a whole (<2% in total during the construction phase).

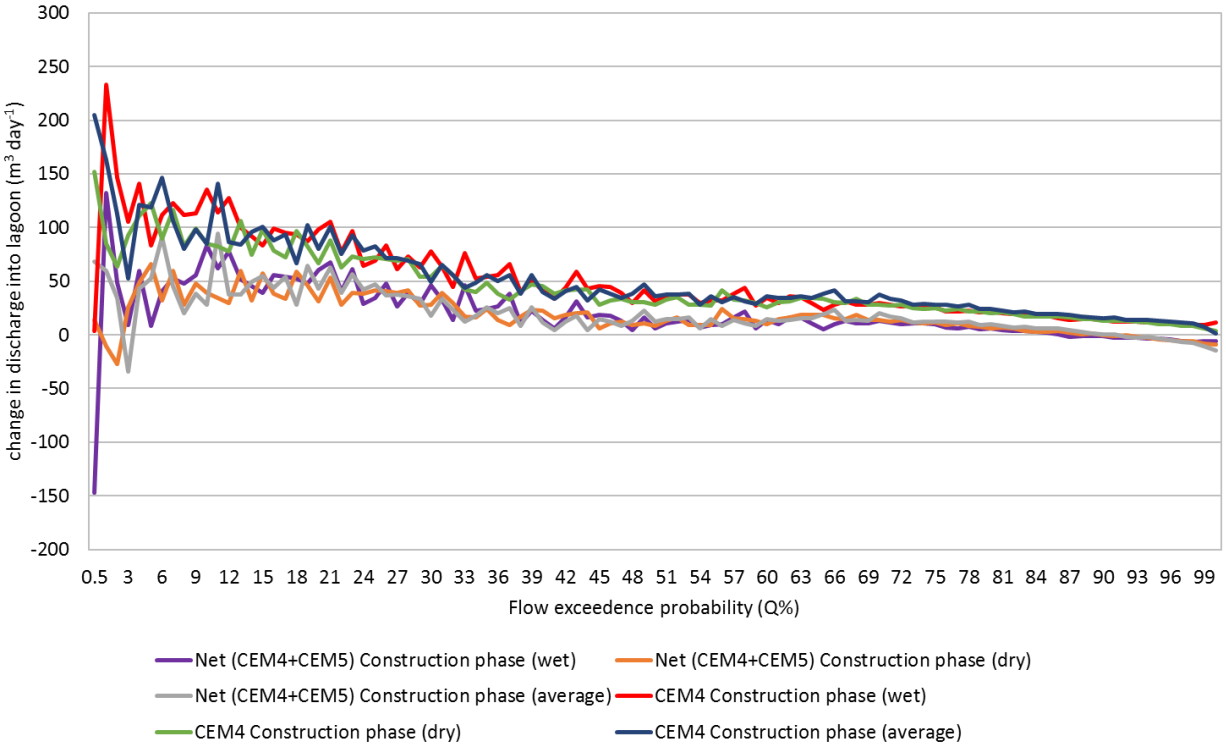

Figure 7-18 Modelled change in discharge into Cemlyn lagoon (construction phase)

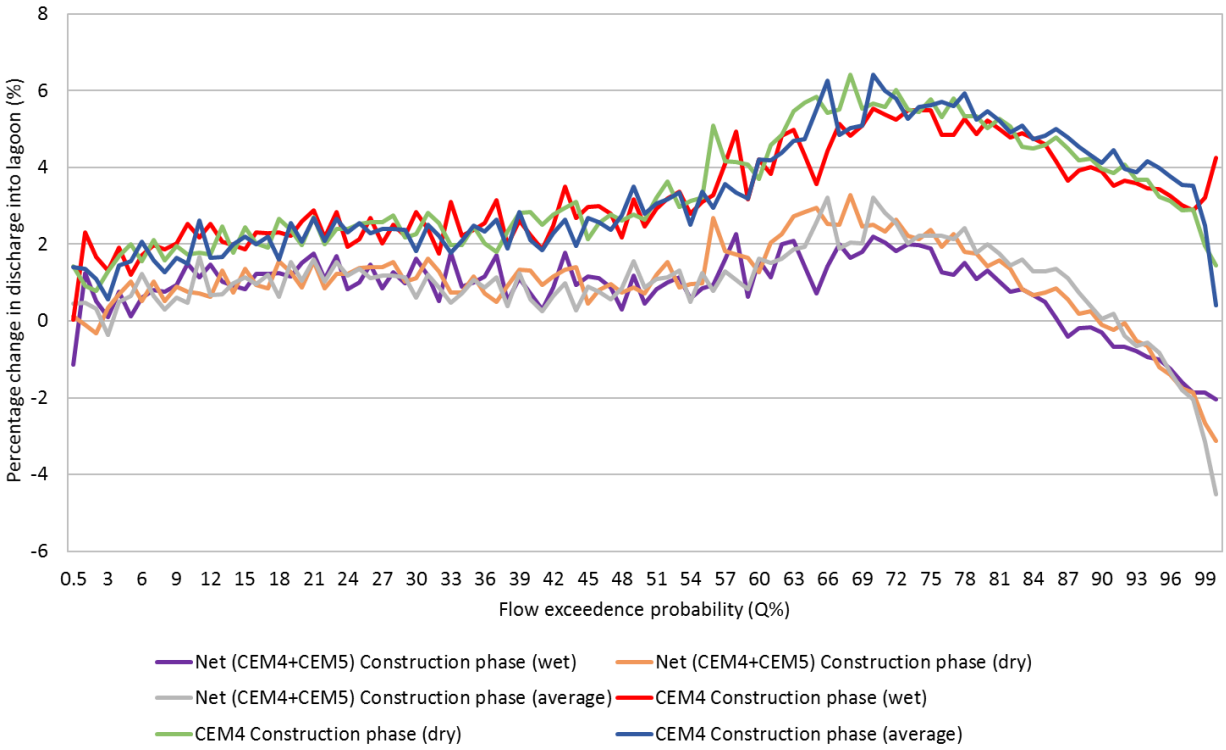

Figure 7-19 Modelled percentage change in discharge into Cemlyn lagoon (construction phase)

Table 7-8 Predicted net changes to discharge into Cemlyn lagoon for different flow conditions and climate scenarios during the construction phase

Flow Range	Low	Median	High
Flow exceedance probability range (inclusive)	**Q90 to Q100**	**Q45 to Q55**	**Q5 to Q15**
Dry climate scenario			
Increase in discharge at Nant Cemlyn (Cem4) (m^3day^{-1})	(+)10.0	(+)30.4	(+)94.1
Percentage increase at Cem4 (%)	(+)3.16%	(+)2.88%	(+)1.92%
Net increase in discharge (Cem4 + Cem5) (m^3day^{-1})	(-)4.0	(+)10.3	(+)44.2
Percentage net increase (Cem4 + Cem5) (%)	(-)1.23%	(+)0.92%	(+)0.86%
Net increase in discharge (Cem4 + Cem5) including diversion of discharge from the western side of Mound E to E2 (m^3day^{-1})	(-)31.7	(-)105.1	(-)358.9
Net increase in discharge (Cem4 + Cem5) including diversion of discharge from the western side of Mound E to E2 as percentage of total discharge into Cemlyn lagoon (all sources)	(-)6.0%	(-)6.0%	(-)4.5%
Wet climate scenario			
Increase in discharge at Nant Cemlyn (Cem4) (m^3day^{-1})	(+)11.2	(+)36.7	(+)108.6
Percentage increase at Cem4 (%)	(+)3.47%	(+)2.90%	(+)1.99%
Net increase in discharge (Cem4 + Cem5) (m^3day^{-1})	(-)4.1	(+)11.8	(+)51.4
Percentage net increase (Cem4 + Cem5) (%)	(-)1.18%	(+)0.86%	(+)0.92%
Net increase in discharge (Cem4 + Cem5) including diversion of discharge from the western side of Mound E to E2 (m^3day^{-1})	(-)33.7	(-)117.4	(-)397.3

Flow Range	Low	Median	High
Net increase in discharge (Cem4 + Cem5) including diversion of discharge from the western side of Mound E to E2 as percentage of total discharge into Cemlyn Lagoon (all sources)	(-)6.1%	(-)5.7%	(-)4.4%
Average climate scenario			
Increase in discharge at Nant Cemlyn (Cem4) (m^3day^{-1})	(+)11.8	(+)37.6	(+)103.9
Percentage increase at Cem4 (%)	(+)3.48%	(+)2.92%	(+)1.79%
Net increase in discharge (Cem4 + Cem5) (m^3day^{-1})	(-)4.7	(+)13.5	(+)49.8
Percentage net increase (Cem4 + Cem5) (%)	(-)1.37%	(+)0.98%	(+)0.82%
Net increase in discharge (Cem4 + Cem5) including diversion of discharge from the western side of Mound E to E2 (m^3day^{-1})	(-)35.9	(-)119.9	(-)425.7
Net increase in discharge (Cem4 + Cem5) including diversion of discharge from the western side of Mound E to E2 as percentage of total discharge into Cemlyn Lagoon (all sources)	(-)6.3%	(-)5.6%	(-)4.5%

7.4.87 During high flow conditions, the increase in flow discharge from Nant Cemlyn into the lagoon is likely to be of the order of between 1% and 2.5%. Again, this would be offset by a decrease in flow at the small tributary.

7.4.88 The effect of diverting the drainage from the western part of Mound E would be significantly greater than other changes predicted during the construction phase. A conservative estimate is that, during the limited period of diversion, there would be a reduction in total freshwater discharge into the lagoon varying between $426m^3day^{-1}$ during high flow (approximately Q_{10}) conditions and $35.9m^3day^{-1}$ during low flow (approximately Q_{95}) conditions. This equates a reduction of 4.5% and 6.3% against the baseline total freshwater

discharge, respectively. The effect of this change on the salinity of water within Cemlyn lagoon is discussed in effect A3.

7.4.89 The predicted extent of the change in surface water flow is considered to be small. Furthermore, in the context of (a) the background variability in salinity, (b) the significant effect on salinity that occurs during the management of water levels in the lagoon and (c) the tolerance of lagoonal species to salinity variation (as set out table 6-1), the predicted change is not considered to be significant, in that it would not have an effect on lagoon flora and fauna. Consequently, no adverse effect on integrity is predicted.

Operation

B3 Change in groundwater recharge and availability and supply

Predicted effects on Cemlyn lagoon

7.4.90 The results of the groundwater modelling study (Application Reference Number: 6.4.32) indicate that a very small change would occur to the predicted amount of groundwater discharging into the lagoon.

7.4.91 In all modelled scenarios, the predicted change in bedrock groundwater heads within the Bae Cemlyn/Cemlyn Bay SAC are within 0.1m of the baseline. This is lowest classification of predicted change based on the presentation of the results, as illustrated in figure 7-15 for the construction phase.

7.4.92 The bedrock groundwater flow model predicts that groundwater discharging to the Cemlyn Lagoon directly from groundwater during the operation phase would reduce by 0.1m^3day^{-1} and 0.2m^3day^{-1} (for the dry and wet period respectively). This compares to a total baseline bedrock groundwater inflow into the SAC of 81m^3day^{-1} and 170m^3day^{-1} for the two scenarios, respectively (i.e. a change of 0.1% of the total inflow for both scenarios).

7.4.93 In light of the low magnitude of the changes predicted by the modelling studies and summarised above, and the fact that the Cemlyn lagoon is not a groundwater dependant habitat, the pathway for an effect is weak. On this basis, an adverse impact on the integrity of the coastal lagoon feature is not predicted.

B4 Change in surface water flow in the Cemlyn catchment

Prediction of effects

7.4.94 The modelling results for the operational phase are presented in figures 7-20 and 7-21. Figure 7-20 shows the modelled change in discharge for Nant Cemlyn and the net change when both Nant Cemlyn and the other small watercourse are considered. Figure 7-21 shows the same results, this time as a percentage of the baseline. It should be noted that the model was calibrated for the normal range of flows and, therefore, the results presented for extreme flows should be treated with caution.

7.4.95 The predicted net changes to discharge into Cemlyn Lagoon during the operational phase are summarised in table 7-9.

Table 7-9 Predicted net changes to discharge into Cemlyn lagoon during the operational phase

Flow Range	Low	Median	High
Flow exceedance probability range (inclusive)	**Q90 to Q100**	**Q45 to Q55**	**Q5 to Q15**
Increase in discharge at Nant Cemlyn (Cem4) (m^3day^{-1})	(+)11.2	(+)13.2	(+)62.2
Percentage increase at Cem4 (%)	(+)3.37%	(+)1.02%	(+)1.05%
Net increase in discharge (Cem4 + Cem5) (m^3day^{-1})	(+)5.7	(+)4.9	(+)62.8
Percentage net increase (Cem4 + Cem5) (%)	(+)1.56%	(+)0.35%	(+)1.01%

7.4.96 During the operational phase (i.e. on completion of construction of Mound E for the purposes of this aspect of the assessment), the earthworks mounds would be fully grassed and the drainage system would be fully installed. No more earthworks are planned during this phase.

7.4.97 The presence of the landscape mounding and drainage would increase the Cemlyn catchment area by 1.3ha, resulting in higher flows within the catchment. The increased slope angle on Mound E would also act to increase the ratio of run-off to infiltration, further increasing run-off flows within the catchment (the effect of increased run-off on water quality is discussed in effect A5). The modelling results predict that the mean change in flow duration from the baseline to the operational scenario across the Cemlyn catchment is an increase of $27m^3day^{-1}$ (or $0.3ls^{-1}$) at the most downstream model node (Cem4) where Nant Cemlyn enters the Cemlyn lagoon. This increase represents a long-term change equivalent of between +/-5% and +/-10% of the Q_{95}.

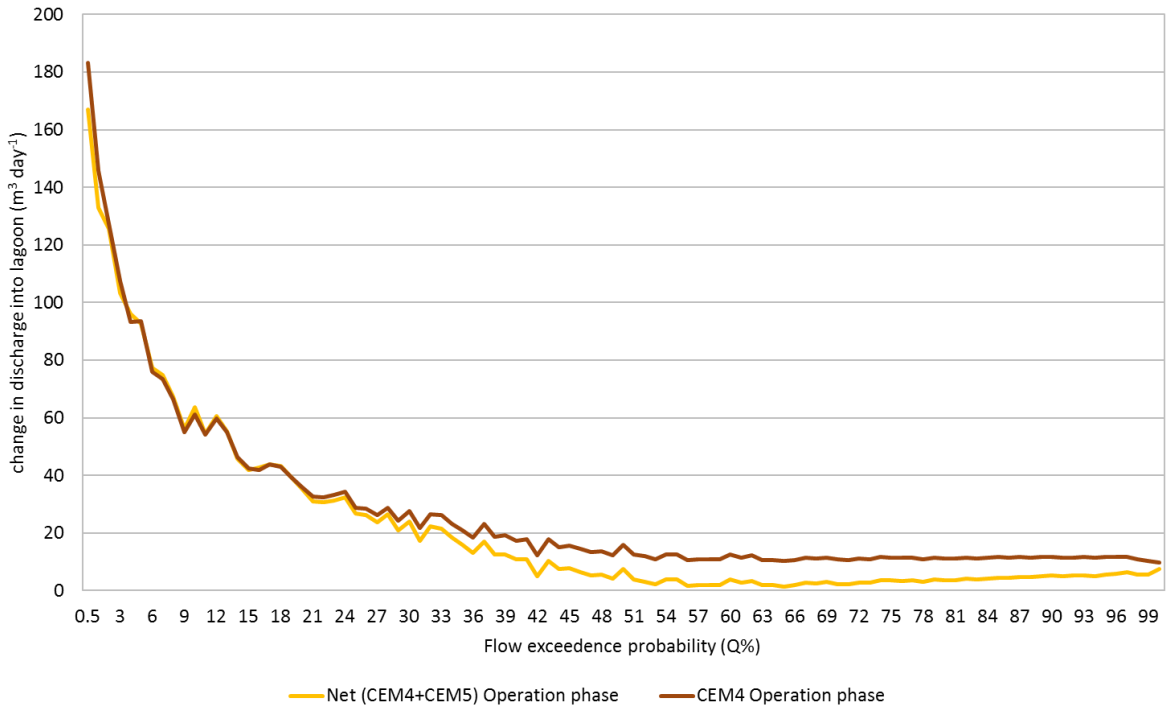

Figure 7-20 Modelled change in discharge into Cemlyn lagoon (operational phase)

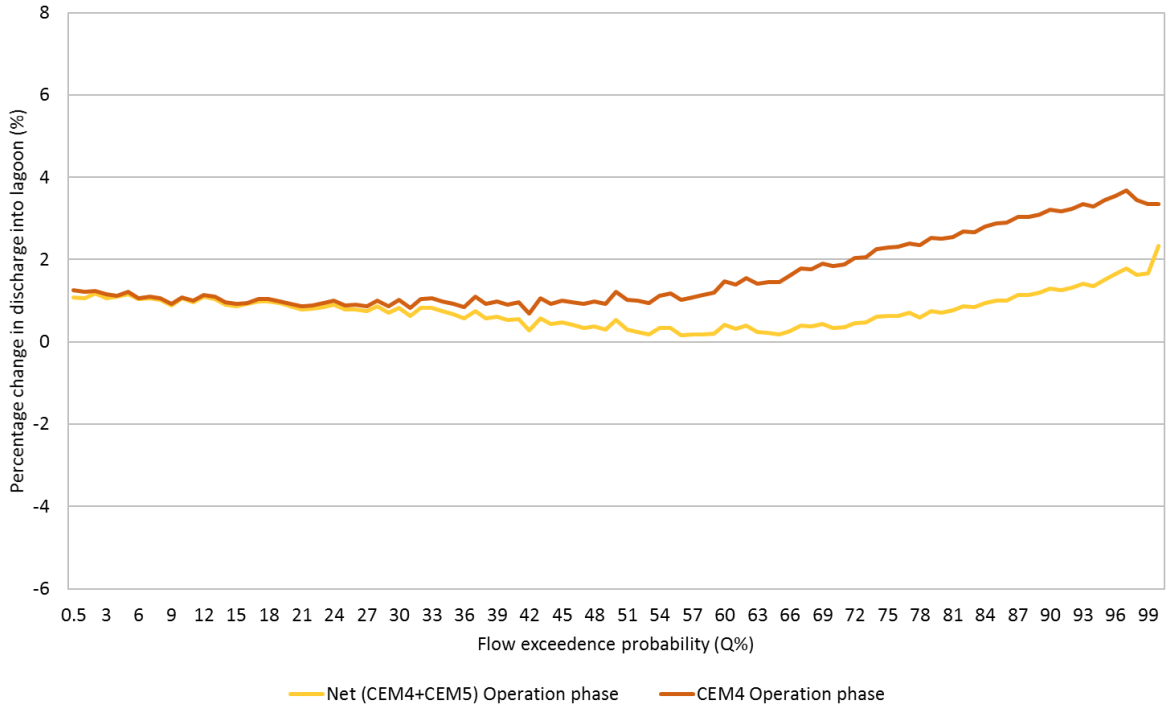

Figure 7-21 Modelled percentage change in discharge into Cemlyn lagoon (operational phase)

7.4.98 The model predicts that during lower flow events, much of the increase in discharge to the lagoon from Nant Cemlyn would be partly offset by a decrease in discharge from the other smaller watercourse. It predicts that during higher flow events this offset would not occur; however, the overall increase in the discharge would be of the order of 1% of the baseline.

Predicted effect on Cemlyn lagoon

7.4.99 A predicted change of the nature and scale set out above is not likely to be distinguishable and, given that the coastal lagoon interest feature is not sensitive to changes in water supply of this magnitude, an adverse effect the integrity of the SAC is not predicted. The consequence of the predicted changes in flow on water quality (salinity) is of more relevance to the qualifying features of the SAC; this is discussed in effect A7.

7.4.100 Effect A7 concludes that in the context of (a) the background variability in salinity, (b) the significant effect on salinity that occurs during the management of water levels in the lagoon and (c) the tolerance of lagoonal species to salinity variation (table 6-1), the predicted change is not considered significant in that it would not have an effect on lagoon flora and fauna, an adverse effect on the integrity of the coastal lagoon interest feature is not predicted.

B5 Change in flood risk in the Cemlyn catchment

Predicted effects on Cemlyn lagoon

7.4.101 A Flood Consequences Assessment (FCA) has been undertaken which assesses potential surface water and groundwater effects during the construction, operational and decommissioning phases (reported in Application Reference Number: 6.4.29).

7.4.102 In terms of fluvial and pluvial flooding, the FCA notes that as Bae Cemlyn/Cemlyn Bay SAC is within the Cemlyn catchment and receives flows from Nant Cemlyn and a pluvial driven small road drain, the risk from Nant Cemlyn is limited to the eastern edge of the SAC, as the majority of the SAC lies within the extent of tidal flood risk.

7.4.103 The FCA predicts that for the operational phase there is a high risk of flooding with a 0.38m increase in flood depth at the 1% AEP (annual exceedance probability) event where Nant Cemlyn outfall into the lagoon. This change is driven by the increase in the area of the Cemlyn catchment.

7.4.104 The predicted increase in flood depth is not considered to represent a risk to the SAC in terms of duration of period of inundation or change in water level, because the outfall of Nant Cemlyn is into the lagoon and flood water would dissipate.

7.4.105 The increase in the volume of water could, however, affect salinity. During periods of flooding, where there would be an influx of freshwater into the lagoon, increased inputs during the operational phase could further lower

salinity in areas of the lagoon and/or increase areas over which lower salinity levels are experienced.

7.4.106 The predicted effect on surface water flow under various flow conditions is described under effect B4 above, with the consequences for salinity in the lagoon assessed under effect A7. The assessment concludes that an adverse effect on the integrity of the coastal lagoon interest feature is not predicted.

C Change in air quality

Construction

C1 Construction dust (earthworks and material handling)

Predicted effects on Cemlyn lagoon

7.4.107 On the basis of the distance criteria included in the IAQM guidance [RD136], the SAC is not considered to be at significant risk of dust deposition due to the Project. However, on a precautionary basis, the air quality assessment (Application Reference Number: 6.4.5) assumed a high risk of sensitivity to dust deposition. The SAC is approximately 110m from the Wylfa Newydd Development Area at its closest point.

7.4.108 The concrete batching plant would be located adjacent to the Marine Off-Loading Facility (MOLF), which would unload bulk concrete materials such as sand, aggregates and cement powder from vessels. The concrete batching plant would be approximately 1km away from the nearest point of the boundary of the SAC.

7.4.109 The air quality assessment (Application Reference Number: 6.4.5) concludes that the majority of any dust emitted from the earthworks would be deposited before reaching the SAC boundary due to distance between the earthworks and the SAC. In addition, the meteorological data analysis indicates that the wind which could transport any emitted dust towards the SAC during dry conditions (i.e. wind blowing from the east-southeast through to the south) would occur for only approximately 8% of the time. This risk is further reduced during periods of wet soil conditions, which would reduce the friability of the materials and the potential for dust emissions during placement in Mound E and from wind erosion.

7.4.110 On the basis of the above assessment and with the adoption of the proposed mitigation measures set out below, an adverse impact on the integrity of the coastal lagoon feature is not predicted to occur.

Mitigation

7.4.111 The management of dust emissions during the construction phase would be in line with the requirements of the Wylfa Newydd CoCP (Application Reference Number: 8.6) and the relevant sub-CoCPs (Application Reference Number: 8.7 and Application Reference Number: 8.8). Good practice

measures to control dust during construction have been derived from the guidance on the assessment of dust from demolition and construction.

C2 Construction plant, machinery and marine vessels emissions [Marine Licence]

Context

7.4.112 During the construction phase, emissions to air would be mainly associated with the on-site use of construction plant and machinery powered by diesel engines and marine vessels required for capital dredging/disposal activities and the construction of the MOLF. These activities could result in the deposition of nitrogen and acidic compounds and affect sensitive receptors in the SAC.

7.4.113 The relevant critical levels that were used in the assessment for Bae Cemlyn/Cemlyn Bay SAC are summarised in table 7-10.

Table 7-10 Ambient Air Directive (AAD) Limit Values8, Air Quality Objectives (AQOs)9 and Environmental Assessment Level (EALs)10 used for the assessment of potential effects on Bae Cemlyn/Cemlyn Bay SAC

Pollutant	Standard	EQS (µg/m^3)	Concentration measured as
NO_x (expressed as NO_2)	AAD Limit Value and AQO	30	Annual mean
	EAL	200	Maximum 24-hour mean
SO_2	AAD Limit Value and AQO	20	Annual mean

7.4.114 The introduction to the air quality assessment (Application Reference Number: 6.2.5) describes the relationship between NO_x, SO_2 and ozone (O_3) and how this relates to the appropriate critical level for 24-hour mean exposure to NO_x. This indicates that 200µg/m^3 of NO_x may be an appropriate critical level for a 24-hour mean exposure; however, interactions between NO_x, SO_2 and O_3 can affect the assimilation of NO_x by plants and, therefore, in the presence of concentrations of the latter compounds near or above their critical levels, 75µg/m^3 of NO_x is considered a more appropriate critical level.

7.4.115 Following a review of SO_2 and O_3 data in the vicinity of the Wylfa Newydd Development Area, it was concluded that there is a very low potential for interaction of NO_x with SO_2 or O_3 at locations where lichens and bryophytes

[8] Ambient Air Quality Directive 2008/50/EC

[9] Air Quality (Wales) Regulations 2000 and Air Quality (Amendment) (Wales) Regulations 2002

[10] Non-statutory air quality standards specified by NRW for a range of pollutants

are not present due to the low SO_2 and O_3 background concentrations. As agreed with NRW, the 24-hour mean critical level of 200µg/m^3 was used at all locations apart from where lichens and bryophytes are present. Given that the qualifying features or conservation objectives for the Bae Cemlyn/Cemlyn Bay SAC do not include lichens and bryophytes, a 24-hour mean critical level of 200µg/m^3 was applied (note that for Stage 1 screening (table 5-1), 75µg/m^3 was adopted in line with [RD90] guidance).

7.4.116 For SO_2 an annual mean of 20µg/m^3 was applied, in line with [RD90] guidance for sites where lichens and bryophytes are not present.

7.4.117 The significance of the predicted long-term (annual mean) NO_x and SO_2 concentrations or deposition at European Designated Sites was determined in line with guidance provided by NRW during consultation, which derives from the Environment Agency guidance ([RD90]). This is summarised below and has been applied in this Shadow HRA.

7.4.118 Where the process contribution (PC) (meaning the contribution made by the activity) is less than 1% of the relevant critical level or critical load, the emission is not likely to be significant alone or in-combination, irrespective of the existing concentrations or deposition rates. This step was applied at the Stage 1 screening stage (see table 5.1).

7.4.119 Where the contribution is above 1%, further consideration of existing background concentration or deposition rate is required. Then where the total concentration or deposition is less than 70% of the critical level or critical load, calculated in combination with other committed projects or developments, the emission is not predicted to be significant.

7.4.120 For annual mean concentrations, where the contribution is above 1%, and the total concentration or deposition rate is greater than 70% of the critical level or critical load, either alone or in combination with other committed projects or developments, then this may indicate that a significant effect could arise and further consideration is required. This should be undertaken on a site-by-site basis through determination of the applicability of the critical levels and critical loads at each site, and further ecological assessment.

7.4.121 The above approach is used to give a clear definition of what effects can be regarded as insignificant, and which need to be considered in more detail in relation to the predicted annual mean concentrations or deposition.

7.4.122 For short-term mean concentrations (i.e. the 24-hour mean critical level for NO_x), a potentially significant effect would be identified where the predicted contribution from the modelled sources lead to an exceedance of the critical level. In this case, further ecological consideration is required, taking into account factors such as the evidence base for effects due to short-term exposure to elevated NO_x concentrations, the magnitude of the concentrations, the likelihood of occurrence and the duration of the exposure.

Results of air quality modelling for construction plant, machinery and marine vessels emissions

7.4.123 Two scenarios were modelled in the air quality assessment (Application Reference Number: 6.4.5) representing the peak of bulk earthworks, excavations, landscape formation and marine works activity in 2020 (i.e. Year 2 of the Project) and the peak of construction activity in 2023 (i.e. Year 5 of the Project); see tables 7-11 to 7-16.

Table 7-11 2020 peak earthworks and marine works scenario – magnitude of annual mean NOx changes

Critical level (AQO) (µg/m^3)	Total concentration for:		Change as a percentage of AQO (%)	Total concentration as a percentage of AQO (%)
	2020 baseline (µg/m^3)	2020 peak earthworks and Marine Works (µg/m^3)		
30	5.3	16.0	+36%	53%

Table 7-12 2023 peak construction scenario – magnitude of annual mean NOx changes

Critical level (AQO) (µg/m^3)	Total concentration for:		Change as a percentage of AQO (%)	Total concentration as a percentage of AQO (%)
	2023 baseline (µg/m^3)	2023 peak construction (µg/m^3)		
30	5.3	7.2	+6%	24%

Table 7-13 2020 peak earthworks and marine works scenario – magnitude of short-term NOx changes

Critical level (AQO) (µg/m^3)	Total concentration for:		Change as a percentage of AQO (%)	Total concentration as a percentage of AQO (%)
	2020 baseline (µg/m^3)	2020 peak earthworks and marine works (µg/m^3)		
200	10.6	148.6	+69%	74%

Table 7-14 2023 peak construction scenario – magnitude of short-term NOx changes

Critical level (AQO) (µg/m^3)	Total concentration for:		Change as a percentage of AQO (%)	Total concentration as a percentage of AQO (%)
	2023 baseline (µg/m^3)	2023 peak construction (µg/m^3)		
200	10.6	36.4	+13%	18%

Table 7-15 2020 peak earthworks and marine works scenario – magnitude of annual mean SO_2 changes

Critical level (AQO) ($\mu g/m^3$)	Total concentration for:		Change as a percentage of AQO (%)	Total concentration as a percentage of AQO (%)
	2020 baseline ($\mu g/m^3$)	2020 peak earthworks and marine works ($\mu g/m^3$)		
20	1.9	2.1	+1%	10%

Table 7-16 2023 peak construction scenario – magnitude of annual mean SO_2 changes

Critical level (AQO) ($\mu g/m^3$)	Total concentration for:		Change as a percentage of AQO (%)	Total concentration as a percentage of AQO (%)
	2023 baseline ($\mu g/m^3$)	2023 peak construction ($\mu g/m^3$)		
20	1.9	2.1	+1%	10%

7.4.124 The critical load for nitrogen deposition for coastal lagoons adopted in this Shadow HRA is 20kgN/ha/year (using saltmarsh habitat as the closest analogue, as there are no critical loads established for coastal lagoons). Critical loads are presented in the Air Pollution Information System (APIS) (http://www.apis.ac.uk/) [RD38]. The APIS states that coastal lagoons are not sensitive to acidification and, therefore, there is no critical load for acid deposition for this feature.

7.4.125 Tables 7-17 and 7-18 present the modelled change to nitrogen deposition within the SAC.

Table 7-17 2020 peak earthworks and marine works scenario – change to nitrogen deposition rate

Nitrogen deposition (kgN/ha/year)				Change as a percentage of CL (%)	Total deposition rate as a percentage of CL (%)
Critical load (CL)	Existing deposition rate	2020 peak earthworks and marine works contribution	Total		
20	9.9	1.1	11.0	+5.4%	55%

Table 7-18 2023 peak construction scenario – change to nitrogen deposition

Nitrogen deposition (kgN/ha/year)				Change as a percentage of CL (%)	Total deposition rate as a percentage of CL (%)
Critical load (CL)	Existing deposition rate	2023 peak construction contribution	Total		
20	9.9	0.2	10.1	+1%	51%

Predicted effects on Cemlyn lagoon

7.4.126 Given that the critical level and critical load thresholds are not predicted to be exceeded, the coastal lagoon qualifying feature is not expected to be significantly affected by air quality effects from construction plant, machinery and marine vessels emissions, and no adverse effect on the integrity of this feature is predicted. Furthermore, the critical load of 20kgN/ha/year is likely to be conservative as it relates to saltmarsh habitat, and the vegetation of saltmarsh habitat is likely to be more vulnerable and sensitive to changes in air quality than that of the coastal lagoon due to the exposure of the former habitat to the atmosphere.

Operation

C3 Combustion plant emissions [Operational combustion EP]

Introduction

7.4.127 There would be five main sets of combustion plant at the Wylfa Newydd Power Station, as described below.

- Emergency Diesel Generators (EDG).
- Back-up Building Generators (BBG).
- Auxiliary Standby Generators (ASG).
- House boilers.
- Various emergency response equipment and vehicles such as mobile generators and pumps, stored in the on-site and at the off-site Mobile Emergency Equipment Garage (MEEG).

7.4.128 In addition, there would be some smaller combustion plant at the Power Station Site, including two diesel-engine fire pumps.

7.4.129 The combustion products emitted by the combustion plant include:

- oxides of nitrogen (NOx), primary pollutant of concern which comprises nitric oxide (NO), nitrogen dioxide (NO_2), and nitrous oxide (N_2O);
- oxides of sulphur, primarily comprising sulphur dioxide (SO_2);

- particulate matter (PM);
- carbon monoxide (CO);
- carbon dioxide (CO_2); and
- Volatile Organic Compounds (VOCs).

7.4.130 In addition there would be minor emissions from diesel generator crankcase venting (oil and combustion products) steam vents and fuel tank breathing losses (fugitive emissions).

7.4.131 A 15km study area has been considered with regard to the potential effects of the operational combustion plant emissions (deposition of nitrogen and acidic compounds). A number of modelling scenarios were assessed to determine the potential long-term and short-term air quality effects during full operation (these are described fully in the air quality assessment; Application Reference Number: 6.4.5 and Application Reference Number: 6.4.22).

7.4.132 For the Bae Cemlyn/Cemlyn Bay SAC, the Stage 1 Screening assessment concluded that LSE could not be excluded for the following operational combustion scenarios:

- Standby generator commissioning;
- Standby generator routine testing;
- LOOP/LOCA scenario;
- maximum boiler use;
- MEEG testing;
- MEEG exercise (operation of MEEG);
- Long-term NOx emissions.

7.4.133 As embedded mitigation, all combustion plant (including the standby generator) would operate on ultra-low sulphur diesel, which has a sulphur content of 10 parts per million or less (i.e. 0.001% sulphur content), where this does not compromise safety and operational requirements. This would reduce emissions of sulphur dioxide from the generator exhaust by a factor of 100 compared to standard gas oil with a sulphur content of 0.1%.

7.4.134 The standby generators and boilers would always be operated in line with the selected equipment manufacturer's operating procedures, and in many cases these would be superseded by Horizon's operating procedures as a nuclear operating facility. Horizon would undertake appropriate routine maintenance and testing of all proposed combustion plant to optimise combustion parameters and avoid abnormal or elevated emissions.

7.4.135 For routine testing during normal operations only one standby generator would ever be tested at any one time. In addition, no routine tests on other standby generators would be undertaken within the same day to eliminate the potential for any combined short-term effects. Additional tests would need be undertaken in line with commissioning and operating procedures,

which may include same day testing during commissioning and other infrequent occurrences (e.g. in unlikely event of a generator breakdown or failures to start).

7.4.136 The relevant critical levels (concentration) used for the assessment are summarised in table 7-5. For the coastal lagoon qualifying feature, the same (worst case) critical load for deposition was used for this assessment as described under effect C2 - Construction plant, machinery and marine vessels emissions (i.e. 20kgN/ha/year).

7.4.137 The results of the assessment for the operational combustion scenarios listed above are presented in tables 7-19 to 7-26 below.

Table 7-19 Predicted maximum 24-mean NOx concentration (standby generator commissioning)

Critical level (AQO) ($\mu g/m^3$)	Averaging period	Background ($\mu g/m^3$)	Project (PEC) ($\mu g/m^3$)	Project (PC) ($\mu g/m^3$)	Change as a percentage of AQO (%)	Total concentration (PEC) as a percentage of AQO (%)
200	Maximum 24-hour mean	10.6	145.8	135.1	68%	73%

Table 7-20 Predicted maximum 24-mean NOx concentration (standby generator routine testing)

Critical level (AQO) ($\mu g/m^3$)	Averaging period	Background ($\mu g/m^3$)	Project (PEC) ($\mu g/m^3$)	Project (PC) ($\mu g/m^3$)	Change as a percentage of AQO (%)	Total concentration (PEC) as a percentage of AQO (%)
200	Maximum 24-hour mean	10.6	59.7	49.0	25%	30%

Table 7-21 Predicted maximum 24-mean NOx concentration (LOOP/LOCA scenario)

Critical level (AQO) ($\mu g/m^3$)	Averaging period	Background ($\mu g/m^3$)	Project (PEC) ($\mu g/m^3$)	Project (PC) ($\mu g/m^3$)	Change as a percentage of AQO (%)	Total concentration (PEC) as a percentage of AQO (%)
200	Maximum 24-hour mean	10.6	498.8	488.1	244%	249%

Table 7-22 Predicted maximum 24-mean NOx concentration (maximum boiler use)

Critical level (AQO) ($\mu g/m^3$)	Averaging period	Background ($\mu g/m^3$)	Project (PEC) ($\mu g/m^3$)	Project (PC) ($\mu g/m^3$)	Change as a percentage of AQO (%)	Total concentration (PEC) as a percentage of AQO (%)
200	Maximum 24-hour mean	10.6	21.0	10.3	5%	10%

Table 7-23 Predicted maximum 24-mean NOx concentration (MEEG testing)

Critical level (AQO) ($\mu g/m^3$)	Averaging period	Background ($\mu g/m^3$)	Project (PEC) ($\mu g/m^3$)	Project (PC) ($\mu g/m^3$)	Change as a percentage of AQO (%)	Total concentration (PEC) as a percentage of AQO (%)
200	Maximum 24-hour mean	10.6	55.4	44.8	22%	28%

Table 7-24 Predicted maximum 24-mean NOx concentration (MEEG operation)

Critical level (AQO) ($\mu g/m^3$)	Averaging period	Background ($\mu g/m^3$)	Project (PEC) ($\mu g/m^3$)	Project (PC) ($\mu g/m^3$)	Change as a percentage of AQO (%)	Total concentration (PEC) as a percentage of AQO (%)
200	Maximum 24-hour mean	10.6	207.2	196.6	98%	104%

Table 7-25 Predicted long term NOx concentration

Critical level (AQO) ($\mu g/m^3$)	Averaging period	Background ($\mu g/m^3$)	Project (PEC) ($\mu g/m^3$)	Project (PC) ($\mu g/m^3$)	Change as a percentage of AQO (%)	Total concentration (PEC) as a percentage of AQO (%)
30	Annual mean	5.3	5.8	0.5	2%	19%

Table 7-26 Predicted nitrogen deposition concentration

Nitrogen deposition (kgN/ha/year)				Total deposition rate as a percentage of CL (%)
Critical load (CL)	PC	Exsiting deposition	PEC	
20	0.051	9.9	9.99	50%

Predicted effects on Cemlyn lagoon

7.4.138 The assessment of potential effects of operational combustion plant indicates that there would be exceedance of the 24-mean NOx concentration significance criteria for the LOOP/LOCA scenario. The LOOP/LOCA is a very unlikely scenario (the occurrence of a LOOP event that would extend to 24 hours is regarded by the Office for Nuclear Regulation as a one in 200 year event). The modelled scenario was based on six EDGs, four BBGs and the two ASGs operating simultaneously and continuously for the full year. This approach is highly conservative and likely to overestimate predictions of short-term PCs.

7.4.139 The modelling predicts an exceedance of the significance threshold for MEEG operation. However, this scenario would only apply for 1 hour and, therefore, the 24-hour mean NOx objective would not apply.

7.4.140 Based on the results of the air quality assessment for operational combustion, no effects are predicted which could adversely affect the integrity of the coastal lagoon qualifying feature of the Bae Cemlyn/Cemlyn Bay SAC.

D Alteration of coastal processes and hydrodynamics

Construction

D1 Change in waves, tidal currents, bed shear stress and sediment regime and effect on Esgair Gemlyn [Marine Licence]

Introduction

7.4.141 The Core Management Plan for Bae Cemlyn/Cemlyn Bay SAC ([RD43]) outlines the importance of preserving the integrity of the shingle barrier to maintain favourable conditions for the vegetation identified at Esgair Gemlyn.

7.4.142 The coastal processes and geomorphology assessment (Application Reference Number: 6.4.12 (ES chapter)) provides a full assessment of the predicted effects of the Project during the construction and operational phases. Two scenarios in the construction phase have been assessed – a partially built scenario and a fully built scenario. Both these scenarios are assessed for present day (defined as 2023) conditions. The longer term

potential operational effects are assessed as a foreseeable future scenario (2087).

7.4.143 During periods of high tides and stormy weather, waves are able to break over the shingle ridge. This feature is continually changing in shape and profile (Application Reference Number: 6.4.12). Previous studies from [RD269] and [RD270] mention that the frequency and severity of over-topping are predicted to increase at Cemlyn lagoon over the next few decades. This effect may be counterbalanced by vertical growth of the shingle ridges in line with rising water levels, but the extent to which this can occur (without ridge narrowing) would be dependent on sediment availability.

7.4.144 Analyses of the scale of potential changes to waves, currents and bed shear stresses leading to effects upon the sediment regime (including fine sediment plumes) has informed the assessment of potential effects on coastal geomorphology receptors. Changes to coastal and marine processes have been identified through hydrodynamic (Delft3D) and wave (SWAN) modelling investigations (described in Application Reference Number: 6.4.12).

Waves

7.4.145 Within the wave (SWAN) model, a set of points were chosen to investigate modelled data outputs through time series generated by the 35.5 year model run. Table 7-27 presents the predicted effect on wave climate for the modelled location within Cemlyn Bay, adjacent to Esgair Gemlyn for the mean and the 99th percentile values, representing the average and worst case, respectively (Application Reference Number: 6.4.12).

Table 7-27 Changes in wave height (SWAN model results) for worst case (winter, 99th percentile wave) present day (2023) scenarios over 35.5 year model period

Difference (partially built minus baseline) in significant wave heights for present day winter wave from north-west sector		Difference (fully built minus baseline) in significant wave heights for present day winter wave from north-east sector	
Difference as mean significant wave height (%)	Difference as 99%ile significant wave height (%)	Difference as mean significant wave height (%)	Difference as 99%ile significant wave height (%)
+2%	+1%	+1%	-1%

7.4.146 As shown in table 7-27, for a partially built scenario, when the cofferdam is in place, with storm waves approaching from the north-west, it is predicted that there could be a change in wave height ranging between -1% and +2%. For a fully built scenario, with storm waves approaching from the north-east, it is predicted that there could be a change in wave height ranging between -1% and +1%.

Bed shear stress

7.4.147 Alterations to combined waves and tidal current patterns indicated by the Delft3D hydrodynamic model have been used to investigate potential changes to sediment mobilisation and sediment transport processes which could affect geomorphological receptors. The focus of this assessment was on Esgair Gemlyn and Cemlyn lagoon. The potential effect of fine sediment deposition from combined natural and artificial (dredging) sources during the construction period has also been investigated.

7.4.148 Bed shear stress under spring ebb tidal conditions are the most dynamic and have been assessed to represent a worst case scenario.

7.4.149 Within Cemlyn Bay and Porth-y-pistyll the changes to bed shear stress are minimal (Application Reference Number: 6.4.12). In the head region of Cemlyn Bay near to Esgair Gemlyn, no change in bed stress is predicted except for a small localised zone to the north and associated with the ebb tidal delta of the lagoon drainage system.

Deposition of fine sediment

7.4.150 Predictions of changes to coupled waves and tidal currents have been used to investigate the potential effects of dispersal and deposition of a fine sediment plume which could be generated by dredging activities. Baseline fluvial discharges of fine sediment were also considered in these investigations.

7.4.151 Calm conditions (with no waves) have been represented within the hydrodynamic model (Delft3D) as a worst-case scenario for the modelling of suspended fine sediment.

7.4.152 The modelling indicates the dispersal of fine sediment under the action of tidal currents alone during calm conditions would take place rapidly. Within Cemlyn Bay, in the area of existing sand deposits, deposition of around 1mm depth (equivalent to approximately the diameter of a coarse sand grain) is predicted during calm conditions. In the vicinity of Esgair Gemlyn, predicted deposition of up to 0.1mm is predicted (figure 7-22). Due to the likely depth and location of deposition on existing soft sediments, this is not considered a significant effect. Tidal currents and wave activity would rapidly redistribute sediment.

7.4.153 The assessment concludes that there is no risk of a significant deposition of fine sediment in the vicinity of Esgair Gemlyn. On this basis, no effects are predicted on the Cemlyn lagoon as a result of fine sediments being deposited on the shingle ridge and blocking the interstices of the gravels. It is concluded, therefore, that there is no risk of adverse effect on the sediment composition of Esgair Gemlyn due to sediment deposition during dredging.

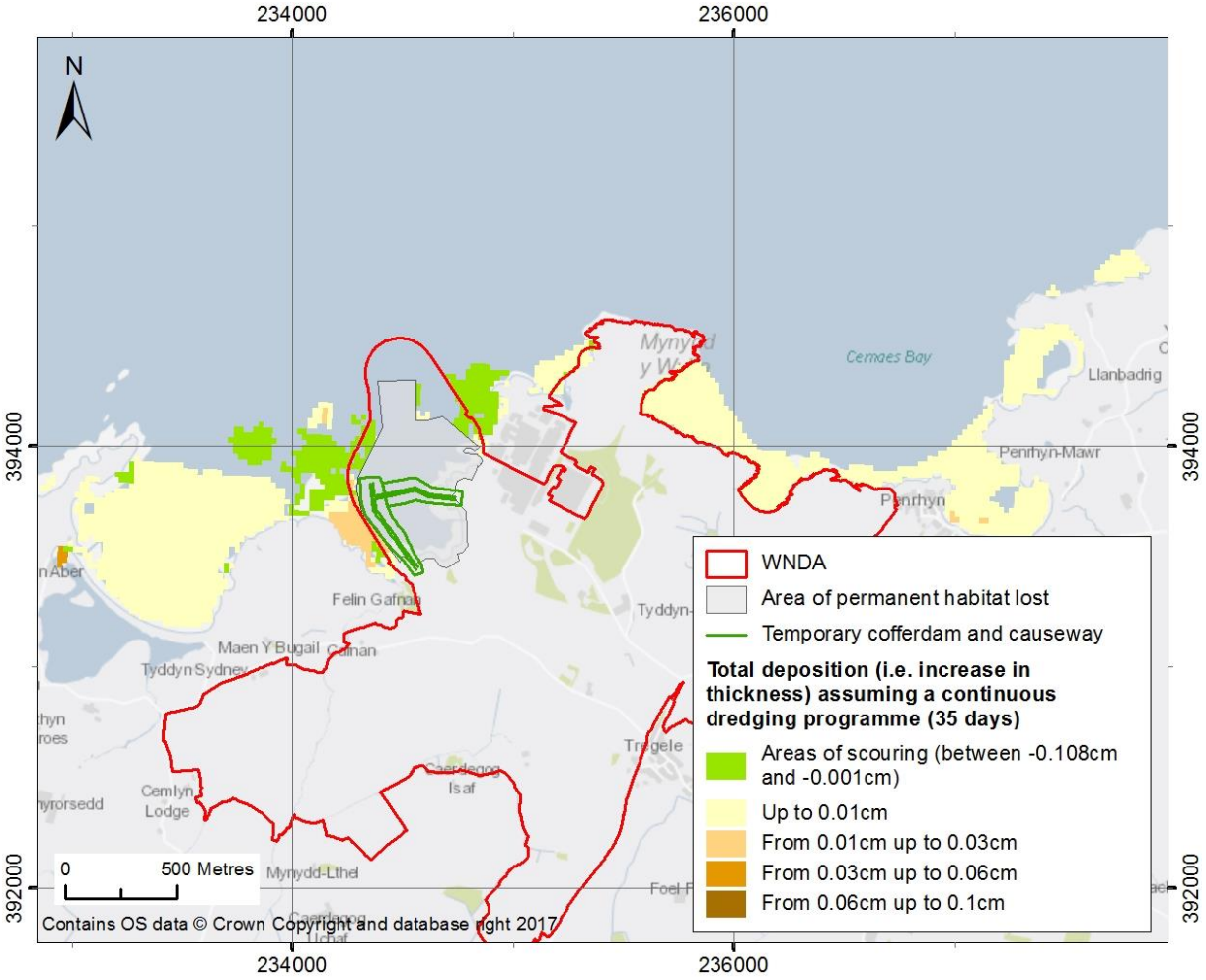

Figure 7-22 Predicted total sediment deposition during capital dredging

Predicted effect on Esgair Gemlyn

7.4.154 The geomorphological assessment for Esgair Gemlyn (Application Reference Number: 6.4.12) takes into account the combined effects described above.

7.4.155 For worst case scenarios, the rare (99th percentile) winter waves arising from north-westerly directions during construction activities, this could represent a potential increase in wave height up to approximately 1%, or 2% for mean conditions (table 7-27). Baseline wave height is in the range of 1.0m to 1.2m, resulting in an increase of up to approximately +0.03m under present day winter storm conditions. The increased wave height is lower than that of baseline storm waves arising from the north-east, consequently this change is within the range of natural variation.

7.4.156 Given the above conclusion, no effect on the integrity of Esgair Gemlyn, or the coastal lagoon feature, is predicted during the construction phase. Longer term operational phase effects are discussed below.

D2 Potential for blockage of the outflow from Cemlyn lagoon due to sediment deposition during dredging activities [Marine Licence]

Predicted effect on Cemlyn lagoon

7.4.157 According to the Core Management Plan for the Bae Cemlyn/Cemlyn Bay SAC ([RD43]), low salinity levels can occur in the lagoon during rainfall events due to shingle blockages of the outflow stream.

7.4.158 The potential for sediment dispersion and deposition during the marine construction works, including capital dredging, has been assessed as part of the coastal geomorphology assessment and is described above (effect D1). Given the predicted extent of dispersion and magnitude of deposition reported above, there is no risk of the exchange of water between the lagoon and open sea (or the interest feature) being adversely affected as a result of the Project.

Operation

D3 Change in wave, tidal currents, bed shear stress and sediment regime and effect on Esgair Gemlyn [Marine Licence]

Predicted effect on Esgair Gemlyn

7.4.159 The potential changes to waves during the operational phase have been investigated in comparison with the current and evolving baseline using the SWAN modelling results (Application Reference Number: 6.4.12).

7.4.160 For the worst case winter storm scenario (represented by the 2087 reasonably foreseeable winter 99th percentile, north-west sector results), no discernible change in wave heights is predicted.

7.4.161 Table 7-28 summarises predicted percentage changes in wave height at the head of Cemlyn Bay adjacent to Esgair Gemlyn.

Table 7-28 Changes in wave height (SWAN model results) for reasonably foreseeable (2087) scenarios over a 35.5 year model period adjacent to Esgair Gemlyn

Difference (fully built minus baseline) in significant wave heights for reasonably foreseeable (2087) winter wave from north-west		Difference (fully built minus baseline) in significant wave heights for reasonably foreseeable (2087) winter wave from north-east	
Difference in mean significant wave height (%)	Difference in 99% significant wave height (%)	Difference in mean significant wave height (%)	Difference in 99% significant wave height (%)
+4%	+0.8%	0%	0%

7.4.162 The largest waves are expected to be observed for the north-west sector (worst case scenario); the differences in wave height may extend up to Cemlyn Bay due to the reflection of waves from the structures; as they approach the coast, refraction and shoaling effects would occur. For this sector, the directions and heights of the reflected waves combined with other

effects are likely to cause a small amount of refocussing of the wave energy in Cemlyn Bay (figure 7-23).

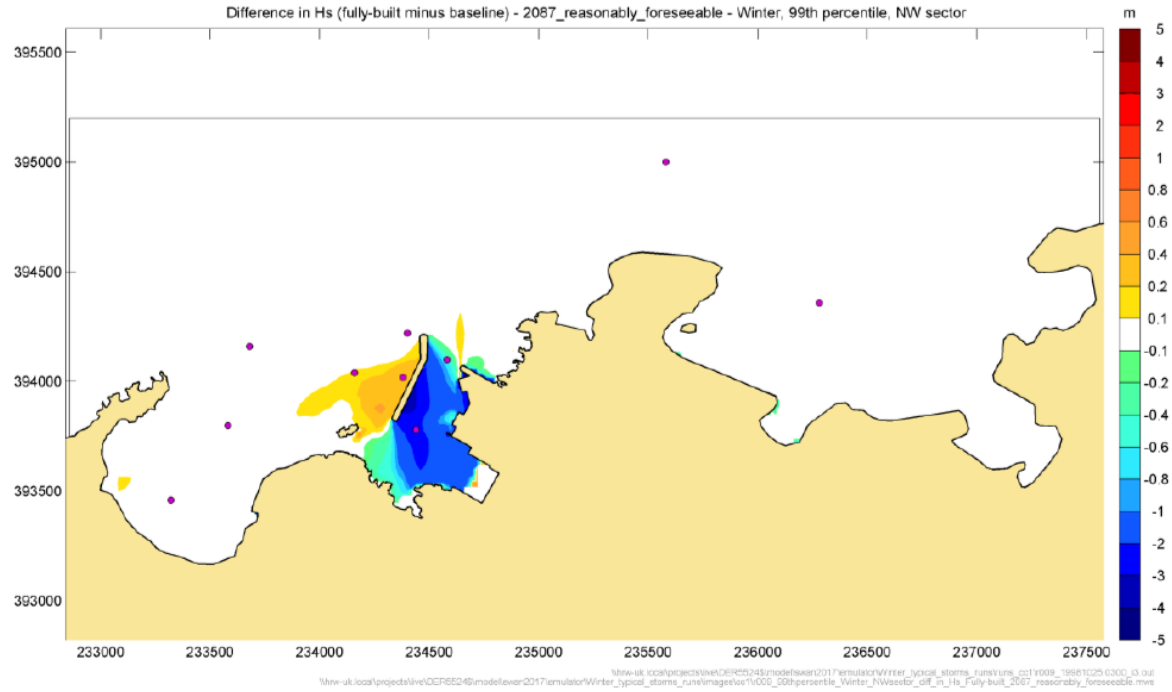

Figure 7-23 Difference in significant wave height, fully-built compared to baseline, '2087 reasonably foreseeable' conditions – 99th percentile winter wave conditions, north-west sector

7.4.163 Adjacent to Esgair Gemlyn within Cemlyn Bay, for a fully built scenario with storm waves approaching from the north-west, it is predicted that there could be a change in wave height ranging between +4% and 0.8% on a baseline wave height of 1.2m to 1.4m, respectively, or an increase of up to +0.05m.

7.4.164 With storm waves approaching from the north-east, no change in wave height is predicted adjacent to Esgair Gemlyn.

7.4.165 The magnitude of the predicted change due to the Project is very small in the context of the evolving baseline conditions are not considered to have the potential to alter the evolution of Esgair Gemlyn.

7.4.166 Changes in bed shear stress arising in construction (described above) would be expected to continue during the operational phase.

7.4.167 Based on these findings, it is not expected that the Project would influence the future trend for sediment transport at Esgair Gemlyn or would have a direct or indirect effect on this geomorphological receptor. On this basis, an adverse effect on the integrity of Esgair Gemlyn is not predicted to occur in the operational phase.

D4 'Coastal squeeze' [Marine Licence]

7.4.168 This potential hazard could occur due to the introduction of new structures which interfere with the regression of the coastline. As such, effects could only arise at locations where new structures are constructed.

7.4.169 There would be no new structures introduced at locations that could directly affect Cemlyn lagoon or the future evolution of Esgair Cemlyn. In the context of Bae Cemyln/Cemlyn Bay SAC, coastal squeeze is not a risk and no further assessment has been undertaken.

Perennial vegetation of stony banks (alone)

E Changes in terrestrial water quality and marine water quality

Construction

E1 Increase in suspended sediment from drainage discharge, dewatering, sewage, capital dredging and disposal of dredged material [Marine Licence; Construction water discharge EP]

Predicted effect

7.4.170 The results presented for this potential effect under effect A1 (for the coastal lagoon) are equally relevant to this qualifying interest feature.

7.4.171 As described under effect A1, there are a number of sources of suspended sediment input to the marine environment during the construction phase, the primary source being from capital dredging. This qualifying feature (perennial vegetation of stony banks) is not, however, susceptible to these effects given that the feature is not routinely exposed directly to the water, with the exception of during wave overtopping events.

7.4.172 The only possible pathway to an effect could be if the composition of Esgair Gemlyn is affected to such an extent that the vegetation it supports is affected (e.g. through accumulation of fine particles within the structure of the shingle ridge which could affect the drainage regime within the shingle ridge). The modelling studies undertaken and the assessment presented under effect A1 indicate that this effect would not arise.

7.4.173 In conclusion, no adverse effect on this qualifying feature is predicted as a consequence of increases in suspended sediment during the construction phase.

Operation

E2 Potential for increase in suspended sediment

7.4.174 The assessment presented in effect A5 concludes that the intention is for the drainage system at Mound E to return to its near existing flows and sediment loads during the operational phase. Furthermore, no effects on the chemical

content in the drainage discharge are expected as a result of the Project in this phase.

7.4.175 This qualifying feature is less vulnerable to potential effects during the operational phase than the coastal lagoon qualifying feature due to its location on and adjacent to Esgair Gemlyn. No adverse effect is predicted on this qualifying feature during the operational phase for this potential change.

F Changes in surface and groundwater hydrology

Construction and operation

F1 Change in groundwater recharge and availability and supply [Construction water discharge EP]

7.4.176 This qualifying feature of the SAC (perennial vegetation of stony banks) is not vulnerable to changes in groundwater recharge, availability and supply given its location on Esgair Gemlyn. At this location, the exchange of water between Cemlyn lagoon and the open sea is the dominant process.

7.4.177 Given the above, no adverse effect on the integrity of the perennial vegetation of stony banks qualifying feature is predicted.

F2 Change in surface water flow in the Cemlyn catchment [Construction water discharge EP]

7.4.178 This qualifying feature of the SAC (perennial vegetation of stony banks) is not vulnerable to changes in surface water flow in the Cemlyn catchment given its location of Esgair Gemlyn. This location is dominated by marine processes and would not be affected by changes to surface water flow in the Cemlyn catchment during construction or operation.

7.4.179 Given the above, no adverse effect on the integrity of the perennial vegetation of stony banks qualifying feature is predicted.

G Change in air quality

Construction

G1 Construction dust (earthworks and material handling)

Predicted effect

7.4.180 The construction phase dust assessment and conclusions (effect C1 for the coastal lagoon), including the stated mitigation, equally applies to this qualifying feature (perennial vegetation of stony banks). On the basis of that assessment, an adverse effect on perennial vegetation of stony banks is not predicted.

G2 Construction plant, machinery and marine vessels emissions [Marine Licence]

Predicted effect

7.4.181 The air quality modelling of the effect of construction plant, machinery and vessel emissions at Bae Cemlyn/Cemlyn Bay SAC is reported under effect C2.

7.4.182 There is no defined critical load for nitrogen deposition for the perennial vegetation of stony banks. Consequently, the Centre for Ecology and Hydrology (CEH) provided expert advice on this matter and advised on the most appropriate analogue habitat for the perennial vegetation of stony banks, to allow the identification of the most appropriate critical load against which to assess the modelled effect of changes in air quality.

7.4.183 CEH's advice on the above is included in this Shadow HRA at appendix G. In summary, CEH's advice is that the most appropriate analogue habitat is saltmarsh vegetation, with an appropriate critical load of 20-30kgN/ha/yr (for *Festuca*-dominated vegetation in the lee of the shingle bank; that is, the vegetation community on the shingle bank is not considered to be sensitive to nitrogen deposition). CEH also advised that the perennial vegetation of stony banks is not sensitive to acid deposition.

7.4.184 Based on the above advice, the lower end of the recommended critical load range has been applied as a precautionary approach (i.e. 20kgN/ha/yr). Given that this is the same critical load as applied for the coastal lagoon qualifying feature, the results of the air quality modelling and the implications for the perennial vegetation of stony banks qualifying feature are as described under effect C2.

7.4.185 Consequently, given that the critical level and critical load thresholds are not predicted to be exceeded, the perennial vegetation of stony banks qualifying feature is not expected to be significantly affected due to air quality effects from construction plant, machinery and marine vessels emissions and no adverse effect on the integrity of this feature is predicted.

Mitigation

7.4.186 The following mitigation measures are identified to reduce emissions of pollutants:

- The drivers of all vehicles would switch off their engines when stationary – there would be no idling vehicles.
- Mains electricity or battery-powered equipment would be used where practicable to avoid the use of petrol or diesel generators.
- Construction plant and machinery would be maintained in accordance with the manufacturers' instructions to reduce the risk of elevated emissions due to poor engine/emissions, maintain abatement performance and ensure that any malfunctions are swiftly repaired.

7.4.187 A comprehensive air quality monitoring and reporting scheme would be developed in discussion with the IACC and NRW, including agreement of thresholds and additional achievement criteria to ensure compliance with the appropriate environmental standards. Since the Project is in development it would continue to be developed with the regulator and finalised for approval prior to the start of construction. Where necessary additional modelling and assessment would be undertaken to support the development of the Project as it matures. In order to achieve the appropriate environmental standards the Project would include a range of measures to achieve that outcome, for example:

- A fleet mix that would include newer NRMM complying with the EU Stage IV NRMM emissions standards (i.e. plant generally manufactured after 2014), which emit 80% less NOx than Stage IIIB plant.
- Active and on-going management of the plant and machinery operating in close proximity to the key exceedance areas where an impact is predicted..
- Use of continuous NOx and NO_2 monitoring to track compliance against the AQOs, critical levels and mitigation objectives, including appropriate feedback mechanisms to ensure the emissions management scheme can be adapted to respond to measured exceedances or elevated concentrations. The continuous monitoring would be supplemented with passive NO_2 diffusion tube monitoring at a greater number of locations to track the changes in annual mean NO_2 concentrations.

7.4.188 The main achievement criteria would be to prevent an exceedance of the NO_2 AQOs. Continuous monitoring of NO_2 would be used to identify exceedances of the one-hour mean AQO and identify the need to alter the emissions management strategy. Regular reports will be made to the IACC and NRW and an on-line web access system to the monitoring system and monitoring data set up.

Operation

G3 Combustion plant emissions [Operational combustion EP]

Predicted effect

7.4.189 The assessment presented for operational combustion for coastal lagoons (effect C3) applies to the perennial vegetation of stony banks qualifying feature. Based on the results of the air quality assessment for operational combustion, no effects are predicted which could adversely affect the integrity of the perennial vegetation of stony banks qualifying feature of the Bae Cemlyn/Cemlyn Bay SAC.

H Alteration of coastal processes and hydrodynamics

Construction

H1 Increase in sediment deposition during dredging activities [Marine Licence]

Predicted effect

7.4.190 The modelling results (described above under effect D1) show that sediment thickness on the seabed as a result of dredging operations around the MOLF is predicted to exceed approximately 1mm around the dredge site itself, with no significant deposition in Cemlyn Bay. This is partly due to the presence of the breakwater in its various construction phases which would restrict sediment pathways to the west. During dredging activities, the thickness of sediments on the seabed is predicted to be small and of relatively short duration.

7.4.191 The assessment concludes that there is no risk of a significant deposition of fine sediment in the vicinity of Esgair Gemlyn. On this basis, no effects are predicted on the perennial vegetation of stony banks qualifying feature.

Operation

H2 Change in wave, tidal currents, bed shear stress and sediment regime and effect on Esgair Gemlyn [Marine Licence]

Predicted effect

7.4.192 The effect on Esgair Gemlyn due to predicted change in wave, tidal currents, bed shear stress and sediment regime is described in effect D3.

7.4.193 It is concluded that it is not expected that the Project would influence the future trend for sediment transport at Esgair Gemlyn or would have a direct or indirect effect on this geomorphological receptor. On this basis, an adverse effect on the integrity of Esgair Gemlyn is not predicted to occur in the operational phase. On this basis, no effects are predicted on the perennial vegetation of stony banks qualifying feature.

7.5 Assessment of potential effects (in-combination) on Bae Cemlyn/Cemlyn Bay SAC: construction and operation

7.5.1 The potential for in-combination effects on terrestrial and marine water quality to arise, with potential implications for the coastal lagoon, has been identified for the Project and three other projects in the construction and operational phases: Wylfa Decommissioning, the Visitor and Media Reception Centre (Horizon) and the North Wales Connection. In addition, the North Wales Connection project has the potential to affect surface and groundwater hydrology and air quality, with potential implications for the coastal lagoon and perennial vegetation of stony banks interest features.

7.5.2 For coastal processes, the potential for in-combination effects with the Project has been identified for the Anglesey Eco Park. For this proposed development, a potential pathway has been identified for in-combination effects on the coastal lagoon and the perennial vegetation of stony banks interest features.

7.5.3 The assessment of the potential for in-combination effects to arise with other projects is presented in table 7-29.

7.5.4 As described in chapter 5, for the Bae Cemlyn/Cemlyn Bay SAC, there is no potential for LSIE with any of the plans scoped into the assessment.

7.6 Conclusions for Bae Cemlyn/Cemlyn Bay SAC: construction and operation

7.6.1 It is concluded that no adverse effects on the integrity of the coastal lagoon qualifying feature of the Bae Cemlyn/Cemlyn Bay SAC would arise in the context of changes to terrestrial and marine water quality, air quality and coastal processes due to the construction and operation of the Project, either alone or in-combination with other plans and projects. Decommissioning is considered in section 7.10.

7.6.2 With regard to perennial vegetation of stony banks, it is predicted that:

- the extent of the vegetation of the shingle banks is expected to be maintained unless altered by natural (e.g. storm) events;
- the typical component species of vegetation of shingle banks are expected to be maintained;
- invasive alien species (e.g. *Fallopia japonica*) are expected to be absent; and
- the management of activities or operations likely to damage or degrade the population dynamics, natural range and supporting habitat of the feature would be appropriate for maintaining favourable conservation status and secure in the long-term.

7.6.3 No adverse effect is similarly predicted on supporting habitats (Esgair Cemlyn) as a result of the Project (i.e. due to changes in coastal processes or deposition of fine sediment during capital dredging or from discharge from the drainage system, dewatering or sewage inputs).

Table 7-29 Assessment of potential for in-combination effects with other projects on Bae Cemlyn/Cemlyn Bay SAC

Project	Potential effect on terrestrial and marine water quality	Assessment of potential in-combination effect for relevant interest features
Wylfa Decommissioning	The ES for this project identifies that pathways exist that could cause impacts to the terrestrial water environment (and, consequently, on marine water quality through inputs from fluvial sources). The pathways identified comprise demolition, excavation, soil handling, construction and the movement of plant/traffic which have the potential to release sediments into terrestrial waters. In addition, the potential impact of spills and leaks of non-radioactive substances was assessed.	**Coastal lagoon** The assessment for the Wylfa Decommissioning project concludes that any potential risks to the terrestrial and coastal water environment can be effectively mitigated through adherence to pollution prevention measures and measures to avoid the risk of leaks and spillages. The ES concludes that any effects on the terrestrial and coastal water environment would not be significant on this basis. It should also be noted that the Wylfa Decommissioning project would not have an effect on Nant Cemlyn and, consequently, there is no potential for a direct in-combination effect with the construction and operational phases of the Project. A longer term beneficial impact is predicted for the Wylfa Decommissioning project due to the end of all site discharges and the removal of any need for discharge permits. The HRA for the Wylfa Decommissioning concluded that the decommissioning would not result in a “significant adverse impact” and a ‘no significant effects report’ was produced. On the basis of the above, it is concluded that there would not be a significant in-combination effect on terrestrial and marine water quality due to the project in-combination with the Wylfa Decommissioning.

Visitor and Media Reception Centre (Horizon)	When the Wylfa Newydd Project is operational, Horizon intends to apply for planning permission for a Visitor and Media Centre. There is no potential for a temporal link, but there is potential for a spatial link with the Wylfa Newydd Project. Given that this is a future planning application, there are currently no details or environmental assessments available for the Visitor and Media Centre. In-combination assessment would be more appropriately carried out for the planning application for the Visitor and Media Reception Centre.	**Coastal lagoon** Given the stage that the development of Visitor and Media Reception Centre has reached, an assumption has been made that its construction and operation can be managed and mitigated in such a way that there would be no significant effect on terrestrial and marine water quality that could influence the Bae Cemlyn/Cemlyn Bay SAC, and no significant adverse in-combination effect with the Project is predicted.
North Wales Connection	For the North Wales Connection project, there is no ES or HRA available to inform the in-combination assessment. The potential effects of this project have been identified based on the Preliminary Environmental Information Report [RD219].	**Coastal lagoon** Given the stage that the North Wales Connection project has reached, an assumption has been made that its construction and operation can be managed and mitigated in such a way that there would be no significant effect on terrestrial and marine water quality that could influence the Bae Cemlyn/Cemlyn Bay SAC, and no significant in-combination effect is predicted. Furthermore, the information within the Preliminary Environmental Information Report illustrates that the North Wales Connection project would not affect the same catchment as the Project.

Project	Potential effect on coastal processes and hydrodynamics	Assessment of potential in-combination effect for relevant interest features
Anglesey Eco Park	This proposed development includes a deep water jetty for bulk import and, on this basis, it has been screened into the in-combination assessment due to potential for effect on coastal processes and hydrodynamics.	**Coastal lagoon and perennial vegetation of stony banks** An ES for the Anglesey Eco Park has not yet been prepared and, therefore, there is no detailed environmental assessment information available. However, given the distance of the proposed development from the Bae Cemlyn/Cemlyn Bay SAC (13km), it is highly unlikely that any effect of the marine works that form part of the proposed development would have any influence on coastal processes that could affect the coastal lagoon (in particular Esgair Gemlyn). On this basis, no significant in-combination effect with the Project is predicted on the Bae Cemlyn/Cemlyn Bay SAC.
Project	**Potential effect on surface and groundwater hydrology**	**Assessment of potential in-combination effect for relevant interest features**
North Wales Connection	For the North Wales Connection project, there is no ES HRA available to inform the in-combination assessment. The potential effects of this project have been identified based on the Preliminary Environmental Information Report [RD219].	**Coastal lagoon and perennial vegetation of stony banks** Given the current status of the North Wales Connection, an assumption has been made that its construction and operation effects would not be of such a magnitude that it could influence the surface and groundwater regime to an extent that the SAC would be affected. This is a reasonable assumption given the relatively minor footprint of the project. No significant in-combination effect with the Project on the Bae Cemlyn / Cemlyn Bay SAC is therefore predicted.
Project	**Potential effect on air quality**	**Assessment of potential in-combination effect for relevant interest features**
North Wales Connection	For the North Wales Connection project, there is no ES or HRA available to inform the in-combination assessment. The potential effects of this project have been identified based on the Preliminary Environmental Information Report [RD219].	**Coastal lagoon and perennial vegetation of stony banks** Given the current status of the North Wales Connection, an assumption has been made that its construction and operation can be managed and mitigated in such a way that there would be no significant effect on air quality that could influence the Bae Cemlyn / Cemlyn Bay SAC, and no significant in-combination effect with the Project is predicted.

7.6.4 The conclusion reached for the Bae Cemlyn/Cemlyn Bay SAC interest features is summarised in table 7-30 (× = no adverse effect on integrity).

Table 7-30 Conclusions for Bae Cemlyn/Cemlyn Bay SAC

Site Features	Changes in marine water quality	Changes in terrestrial water quality	Changes in surface and groundwater hydrology	Change in air quality*	Alteration of coastal processes and hydro-dynamics
Coastal lagoon (priority feature)	×	×	×	×	×
Perennial vegetation of stony banks	×	×	×	×	×

7.7 Assessment of potential effects (alone) for other SACs and the Corsydd Môn a Llyn/Anglesey and Llyn Fens Ramsar site; construction and operation

Introduction

7.7.1 The only screening category for which LSE was determined for the Glannau Ynys Gybi/Holy Island Coast SAC and the Llyn Dinam SAC was 'air quality' (in the construction and operational phases).

7.7.2 For the Corsydd Môn/Anglesey Fens SAC and the Corsydd Môn a Llyn/Anglesey and Llyn Fens Ramsar site, LSE was determined for 'air quality' (in the operational phase only). In addition, LSE was determined for 'terrestrial water quality' and 'surface and groundwater hydrology' for the creation of new fen habitat and the improvement of existing fen habitat at Cae Canol-dydd and Cors Gwawr.

7.7.3 The plans for the creation of new fen habitat and the improvement of existing fen habitat are presented in Application Reference Number: 2.15 (Cae Canol-dydd) and Application Reference Number: 2.14 (Cors Gwawr).

7.7.4 The implications for the conservation objectives of each of these European Designated Sites are described in section 7.9.

Corsydd Môn/Anglesey Fens SAC and the Corsydd Môn a Llyn/Anglesey and Llyn Fens Ramsar site

A Change in terrestrial water quality

Construction

A1 Potential increase in suspended sediment in the drainage network during the creation of new and improvement of existing fen habitat at Cae Canol-dydd and Cors Gwawr

Predicted effect

7.7.5 The creation of new fen habitat and the improvement of existing fen habitat at Cae Canol-dydd and Cors Gwawr would require various earthworks which may affect the network of drainage ditches. During these earthworks, there is the potential for the mobilisation of fine sediment (e.g. from topsoil stripping, storage mounds and as a result of the bare earth surfaces). This has the potential to affect the adjacent Corsydd Môn/Anglesey Fens SAC and the Corsydd Môn a Llyn/Anglesey and Llyn Fens Ramsar site due to the introduction of an increased supply of sediment to the habitats within these European Designated Sites.

7.7.6 Topsoil stripping is proposed to be completed in phases across two years, thereby reducing the area of bare soil exposed at any one time. This approach would minimise the amount of suspended sediment which has the potential to be entrained and enter the drainage system.

7.7.7 Sediment management procedures (as detailed in the Wylfa Newydd CoCP; Application Reference Number: 8.6), including the use of silt fences, drainage systems and sediment settlement lagoons (with treatment if necessary), are also proposed. The implementation of these procedures is expected to avoid any significant inputs of sediment into the drainage network and avoid affecting the habitats of the Corsydd Môn/Anglesey Fens SAC and the Corsydd Môn a Llyn/Anglesey and Llyn Fens Ramsar site.

7.7.8 Given the proposed phasing of the earthworks and the implementation of sediment management procedures, an adverse effect on either the integrity of the Corsydd Môn/Anglesey Fens SAC or the Corsydd Môn a Llyn/Anglesey and Llyn Fens Ramsar site is not predicted to arise due to potential increases in suspended sediment during the creation of new and improvement of existing fen habitat.

Operation

A2 Potential increase in suspended sediment in the drainage network during the creation of new and improvement of existing fen habitat at Cae Canol-dydd and Cors Gwawr

7.7.9 Once the Cae Canol-dydd and Cors Gwawr sites are re-vegetated, no significant risk of increased suspended sediment inputs to the drainage network would exist, as there would no longer be exposed ground. In addition, given that the sites would be taken out of agricultural use, the

application of nutrients to the soil would cease. Consequently, there would be no negative effect on water quality.

7.7.10 However, there is the potential for a beneficial effect to arise as there would be no further nutrients added to the soil following the works and so leaching of nutrients to the watercourses would be reduced.

B Changes in surface and groundwater hydrology

Construction

B1 Potential effect on surface waters and groundwater during the creation of new and improvement of existing fen habitat at Cae Canol-dydd and Cors Gwawr

Predicted effect

7.7.11 In-channel working would be required on the larger tributary Afon Canol-dydd for the channel realignment/diversion works (Application Reference Number: 6.4.18). This would result in the removal and disturbance of the channel bed and banks, as well as the removal of riparian vegetation. In-channel working would also be required along the Afon Canol-dydd to install the proposed dams to retain water on site, altering the channel bed and banks.

7.7.12 The potential effects would be managed through the application of appropriate guidance and a risk assessment, as detailed in the Wylfa Newydd CoCP (Application Reference Number: 8.6), and any effects would be local to the footprint of the works. Hence no effect on the wider surface waters of the Corsydd Môn/Anglesey Fens SAC and the Corsydd Môn a Llyn/Anglesey and Llyn Fens Ramsar site is predicted to occur.

7.7.13 Potential effects on groundwater during construction comprise the creation of increased impermeable areas, including construction compounds and compacted ground caused by plant and machinery. These effects could reduce rainwater reaching groundwater, potentially altering local recharge rates and resource availability for groundwater levels and groundwater flow directions. However, the proposed works would take place largely above ground level and would have very little direct interaction with the groundwater.

7.7.14 Any increase in the impermeable area created during construction would be temporary and would comprise a very small proportion of the groundwater catchments.

7.7.15 Given this, an adverse effect on the integrity of the Corsydd Môn/Anglesey Fens SAC and the Corsydd Môn a Llyn/Anglesey and Llyn Fens Ramsar site is not predicted due to changes in surface and groundwater hydrology during the creation of new and the improvement of existing fen habitat.

Operation

B2 Potential effect on surface waters and groundwater post-creation of new and the improvement of existing fen habitat at Cae Canol-dydd and Cors Gwawr

Predicted effect

7.7.16 The proposed creation of new fen habitat and the improvement of existing fen habitat are designed to increase water retention at Cae Canol-dydd and Cors Gwawr.

7.7.17 At Cae Canol-dydd, the functioning of the Afon Canol-dydd would be changed due to the introduction of new dam structures which would lead to the removal of the natural bed and bank material and locally act as a barrier to flow and sediment processes. This localised effect is not considered significant in the context of the SAC and Ramsar site as there would not be an effect on the qualifying features.

7.7.18 The two new bridge crossings would also remove riparian vegetation, alter lateral connectivity with the floodplain and lead to a length of bank being reinforced with artificial material. Runoff to the Afon Canol-dydd would also be altered as a result of the excavation of the surrounding land and modifications to the larger tributary.

7.7.19 At Cors Gwawr, the functioning of the watercourses would also fundamentally change, with the dam structures on the watercourses leading to the removal of the natural bed and bank material and acting locally as a barrier to flow and sediment processes. This localised effect is not considered to be significant in the context of the SAC and Ramsar site as there would not be an effect on the qualifying features (i.e. no negative effect on the species composition of the qualifying habitats or habitat distribution across the SAC and Ramsar site habitats).

7.7.20 Due to the likely low permeability of the glacial till, groundwater recharge is already limited/slow, and the proposed habitat improvement/enhancement works are unlikely to significantly affect groundwater levels or quality.

7.7.21 The works at both sites would re-create/reinstate fen habitat and improve lateral connectivity with the floodplain. On the basis of the above, in the post-creation (operation) phase, the works are not considered to have the potential to adversely affect the integrity of the Corsydd Môn/Anglesey Fens SAC and the Corsydd Môn a Llyn/Anglesey and Llyn Fens Ramsar site.

7.7.22 In the longer-term, the creation of new fen habitat and the improvement of existing fen habitat would help to link up the fen network in mid-Anglesey which includes both the Corsydd Môn/Anglesey Fens SAC and Corsydd Môn a Llyn/Anglesey and Llyn Fens Ramsar site. This aligns with the objectives of the Core Management Plan ([RD49]) for the sites.

Glannau Ynys Gybi/Holy Island Coast SAC and Llyn Dinam SAC

C Change in air quality

Construction

C1 Construction plant, machinery and marine vessels emissions [Marine Licence]

7.7.23 The Stage 1 screening assessment concluded that LSE could not be excluded for NOx emissions from plant, machinery and marine vessels during the construction phase for the Glannau Ynys Gybi/Holy Island Coast SAC and the Llyn Dinam SAC. These two European Designated Sites are, therefore, considered further below.

Modelling results

7.7.24 The relevant critical levels that were used in the assessment for Glannau Ynys Gybi/Holy Island Coast SAC and Llyn Dinam SAC are summarised in table 7-31. As shown in table 7-31, the lower critical levels of 75µg/m^3 NOx (maximum 24-hour mean) and 10µg/m^3 SO_2 (annual mean) are used in the assessment for Glannau Ynys Gybi/Holy Island Coast SAC due to the presence of bryophytes and lichens (as referenced in the Core Management Plan for the SAC; [RD47]).

7.7.25 Tables 7-32 to 7-37 present the results of the air quality modelling for the peak of bulk earthworks, excavations, landscape formation and marine works activity in 2020 and the peak of construction activity in 2023.

Table 7-31 Ambient Air Directive (AAD) Limit Values[11], Air Quality Objectives (AQOs)[12] and Environmental Assessment Level (EALs)[13] used for the assessment of potential effects on Glannau Ynys Gybi/Holy Island Coast SAC and Llyn Dinam SAC

Pollutant	Standard	European Designated Site	EQS (µg/m3)	Concentration measured as
NO_x (expressed as NO_2)	AAD Limit Value and AQO	Glannau Ynys Gybi/Holy Island Coast SAC and Llyn Dinam SAC	30	Annual mean
	EAL	Llyn Dinam SAC	200	Maximum 24-hour mean

[11] Ambient Air Quality Directive 2008/50/EC

[12] Air Quality (Wales) Regulations 2000 and Air Quality (Amendment) (Wales) Regulations 2002

[13] Non-statutory air quality standards specified by NRW for a range of pollutants

Pollutant	Standard	European Designated Site	EQS (µg/m3)	Concentration measured as
		Glannau Ynys Gybi/Holy Island Coast SAC	75	
SO_2	AAD Limit Value and AQO	Llyn Dinam SAC	20	Annual mean
		Glannau Ynys Gybi/Holy Island Coast SAC	10	

Table 7-32 2020 peak earthworks and marine works scenario – magnitude of annual mean NOx changes

European Designated Site	Critical level (AQO) (µg/m^3)	Total concentration for:		Change as a percentage of AQO (%)	Total concentration as a percentage of AQO (%)
		2020 baseline (µg/m^3)	2020 peak earthworks and marine works (µg/m^3)		
Glannau Ynys Gybi/Holy Island Coast SAC	30	6.0	6.3	+1%	21%
Llyn Dinam SAC		6.2	6.4	+1%	21%

Table 7-33 2023 peak construction scenario – magnitude of annual mean NOx changes

European Designated Site	Critical level (AQO) (µg/m^3)	Total concentration for:		Change as a percentage of AQO (%)	Total concentration as a percentage of AQO (%)
		2023 baseline (µg/m^3)	2023 peak construction (µg/m^3)		
Glannau Ynys Gybi/Holy Island Coast SAC	30	6.0	6.1	0%	20%
Llyn Dinam SAC		6.2	6.3	0%	21%

Table 7-34 2020 peak earthworks and marine works scenario – magnitude of short-term NOx changes

European Designated Site	Critical level (AQO) ($\mu g/m^3$)	Total concentration for:		Change as a percentage of AQO (%)	Total concentration as a percentage of AQO (%)
		2020 baseline ($\mu g/m^3$)	2020 peak earthworks and marine works ($\mu g/m^3$)		
Glannau Ynys Gybi/Holy Island Coast SAC	75	12.0	20.7	+12%	28%
Llyn Dinam SAC	200	12.5	20.5	+4%	10%

Table 7-35 2023 peak construction scenario – magnitude of short-term NOx changes

European Designated Site	Critical level (AQO) ($\mu g/m^3$)	Total concentration for:		Change as a percentage of AQO (%)	Total concentration as a percentage of AQO (%)
		2023 baseline ($\mu g/m^3$)	2023 peak construction ($\mu g/m^3$)		
Glannau Ynys Gybi/Holy Island Coast SAC	75	12.0	13.9	2%	18%
Llyn Dinam SAC	200	12.5	14.7	1%	7%

Table 7-36 2020 peak earthworks and marine works scenario – magnitude of annual mean SO_2 changes

European Designated Site	Critical level (AQO) ($\mu g/m^3$)	Total concentration for:		Change as a percentage of AQO (%)	Total concentration as a percentage of AQO (%)
		2020 baseline ($\mu g/m^3$)	2020 peak earthworks and marine works ($\mu g/m^3$)		
Glannau Ynys Gybi/Holy Island Coast SAC	10	2.2	2.2	0%	0%
Llyn Dinam SAC	20	1.5	1.5	0%	0%

Table 7-37 2023 peak construction scenario – magnitude of annual mean SO_2 changes

European Designated Site	Critical level (AQO) ($\mu g/m^3$)	Total concentration for:		Change as a percentage of AQO (%)	Total concentration as a percentage of AQO (%)
		2023 baseline ($\mu g/m^3$)	2023 peak construction ($\mu g/m^3$)		
Glannau Ynys Gybi/Holy Island Coast SAC	10	2.2	2.2	0%	0%
Llyn Dinam SAC	20	1.5	1.5	0%	0%

7.7.26 Tables 7-38 to 7-41 present the modelled changes to nitrogen and acid deposition within the Glannau Ynys Gybi/Holy Island Coast SAC and Llyn Dinam SAC.

Table 7-38 2020 peak earthworks and marine works scenario – change to nitrogen deposition rate

European Designated Site	Nitrogen deposition (kgN/ha/year)				Change as a percentage of CL (%)	Total deposition rate as a percentage of CL (%)
	Critical load (CL)	Existing deposition rate	2020 peak earthworks and marine works contribution	Total		
Glannau Ynys Gybi/Holy Island Coast SAC	10	8.1	0.0	8.1	0%	81%
Llyn Dinam SAC	10	12.2	0.0	12.2	0%	122%

Table 7-39 2020 peak earthworks and marine works scenario – change to acid deposition rate

European Designated Site	Acid deposition (keq/ha/year)				Change as a percentage of CL (%)	Total deposition rate as a percentage of CL (%)
	Critical load (CL)	Existing deposition rate	2020 peak earthworks and marine works contribution	Total		
Glannau Ynys Gybi/Holy Island Coast SAC	1.97	0.71	0.0	0.71	0%	36%
Llyn Dinam SAC	0.50	1.02	0.0	1.02	0%	204%

Table 7-40 2023 peak construction scenario – change to nitrogen deposition rate

European Designated Site	Nitrogen deposition (kgN/ha/year)				Change as a percentage of CL (%)	Total deposition rate as a percentage of CL (%)
	Critical load (CL)	Existing deposition rate	2023 peak construction contribution	Total		
Glannau Ynys Gybi/Holy Island Coast SAC	10	8	0.0	8.1	0%	81%
Llyn Dinam SAC	10	12	0.0	12.2	0%	122%

Table 7-41 2023 peak construction scenario – change to acid deposition rate

European Designated Site	Acid deposition (keq/ha/year)				Change as a percentage of CL (%)	Total deposition rate as a percentage of CL (%)
	Critical load (CL)	Existing deposition rate	2023 peak construction contribution	Total		
Glannau Ynys Gybi/Holy Island Coast SAC	1.97	0.71	0.00	0.71	0%	36%
Llyn Dinam SAC	0.50	1.02	0.00	1.02	0%	204%

Predicted effects

7.7.27 Given that the critical level and critical load thresholds are not predicted to be exceeded (with no contribution to existing nitrogen and acid deposition rates), the qualifying features of the Glannau Ynys Gybi/Holy Island Coast SAC and Llyn Dinam SAC are not expected to be adversely affected by the air quality effects from construction plant, machinery and marine vessels emissions, and no adverse effect on the integrity of these SACs is predicted.

Corsydd Môn/Anglesey Fens SAC, Corsydd Môn a Llyn/Anglesey and Llyn Fens Ramsar site, Glannau Ynys Gybi/Holy Island Coast SAC and Llyn Dinam SAC

Operation

C2 Combustion plant emissions [Operational combustion EP]

7.7.28 The Stage 1 Screening assessment concluded that LSE could not be excluded for the LOOP/LOCA and MEEG exercise (that is, operation of the MEEG) operational combustion scenarios for the Corsydd Môn/Anglesey Fens SAC, Corsydd Môn a Llyn/Anglesey and Llyn Fens Ramsar site, Glannau Ynys Gybi/Holy Island Coast SAC and Llyn Dinam SAC (noting that the assessment for Bae Cemlyn/Cemlyn Bay SAC is reported in section 7.4).

7.7.29 The results of the air quality modelling for the operation of MEEG and LOOP/LOCA operational combustion scenarios are presented in tables 7-42 and 7-43.

Predicted effects

7.7.30 Given that the critical level thresholds are not predicted to be exceeded, the qualifying features of the Corsydd Môn/Anglesey Fens SAC, Corsydd Môn a Llyn/Anglesey and Llyn Fens Ramsar site, Glannau Ynys Gybi/Holy Island Coast SAC and Llyn Dinam SAC would not be adversely affected due to operational combustion air quality effects of the Project, and no adverse effect on the integrity of these European Designated Sites is predicted.

7.8 Assessment of potential effects (in-combination) for other SACs the Corsydd Môn a Llyn/Anglesey and Llyn Fens Ramsar site: construction and operation

7.8.1 The in-combination screening exercise did not identify any other projects that have the potential to act in-combination with the Project for any of the three SACs or the Corsydd Môn a Llyn/Anglesey and Llyn Fens Ramsar site that are the focus of this section.

7.8.2 LSIE was however concluded for one plan (the North Wales Joint Local Transport Plan 2015 – 2020) due to the potential for the effects of this plan and the Project to interact and influence the Corsydd Môn/Anglesey Fens SAC and the Corsydd Môn a Llyn/Anglesey and Llyn Fens Ramsar site.

7.8.3 The HRA for the North Wales Joint Local Transport Plan 2015 – 2020 concluded that the A499 to Nefyn Link (B4417) could affect these European Designated Sites due to hydrological challenges, disturbance effects and the transfer of construction-related pollutants. In addition, the A497 Nefyn to Pwllheli road improvements could affect these European Designated Sites through direct habitat loss, disturbance and for contaminated run-off.

7.8.4 The HRA for the North Wales Joint Local Transport Plan 2015 – 2020 recognises that scheme-level HRA would be necessary and only provides high-level identification of the potential effects on the Corsydd Môn/Anglesey Fens SAC and the Corsydd Môn a Llyn/Anglesey and Llyn Fens Ramsar site, as presented above.

7.8.5 With regard to the A499 to Nefyn Link (B4417), the HRA proposes measures to avoid contamination/pollution comprising refuelling plant and machinery away from watercourses and sediment interception measures. A detailed Construction Environmental Management Plan (CEMP) would also be produced. No assessment is made of potential hydrological changes or disturbance effects.

7.8.6 For the A497 Nefyn to Pwllheli road improvements, reference is also made to the production of a detailed CEMP. No assessment is made of potential direct habitat loss or disturbance.

Table 7-42 Predicted maximum 24-mean NOx concentration (LOOP/LOCA scenario)

European Designated Site	Critical level (AQO) (µg/m^3)	Averaging period	Background (µg/m^3)	Project (PEC) (µg/m^3)	Project (PC) (µg/m^3)	Change as a percentage of AQO (%)	Total concentration (PEC) as a percentage of AQO (%)
Corsydd Môn/Anglesey Fens SAC	75	Maximum 24-hour mean	11.4	25.8	14.4	19%	34%
Corsydd Môn a Llyn/Anglesey and Llyn Fens Ramsar	75		11.4	25.8	14.4	19%	34%
Glannau Ynys Gybi/Holy Island Coast SAC	75		12.0	31.2	19.1	26%	42%
Llyn Dinam SAC	200		12.5	32.4	19.9	10%	16%

Table 7-43 Predicted maximum 24-mean NOx concentration (MEEG operation)

European Designated Site	Critical level (AQO) (µg/m^3)	Averaging period	Background (µg/m^3)	Project (PEC) (µg/m^3)	Project (PC) (µg/m^3)	Change as a percentage of AQO (%)	Total concentration (PEC) as a percentage of AQO (%)
Corsydd Môn/Anglesey Fens SAC	75	Maximum 24-hour mean	11.4	19.4	8.0	11%	26%
Corsydd Môn a Llyn/Anglesey and Llyn Fens Ramsar	75		11.4	19.4	8.0	11%	26%
Glannau Ynys Gybi/Holy Island Coast SAC	75		12.0	24.1	12.1	16%	32%
Llyn Dinam SAC	200		12.5	22.0	9.5	5%	11%

7.8.7 In the absence of detailed proposals and associated assessment, it is not possible to undertake a detailed in-combination assessment of the Project effects with the schemes included in the North Wales Joint Local Transport Plan 2015 – 2020. However, it is assumed that the production of a CEMP for both schemes referred to above would effectively manage pollution risk during construction.

7.8.8 Given the predicted small-scale effects predicted for the creation of new and the improvement of existing fen habitat during the construction phase of the Project, it is unlikely that the potential exists for a significant in-combination effect to arise with the schemes referred to in the North Wales Joint Local Transport Plan 2015 – 2020. However, this can only be confirmed when full details of the A499 to Nefyn Link (B4417) and A497 Nefyn to Pwllheli road improvements are confirmed.

7.8.9 As detailed above, the long-term effect of the creation of new and improvement of existing fen habitat is predicted to be positive in terms of alignment with the objectives of the Core Management Plan ([RD49]) for the Corsydd Môn/Anglesey Fens SAC and the Corsydd Môn a Llyn/Anglesey and Llyn Fens Ramsar site.

7.8.10 In due course the scheme-level HRAs for the road schemes in the North Wales Joint Local Transport Plan 2015 – 2020 may need to take into account their potential effects on the new and improved fen habitat (if implemented), if the habitat is deemed to contribute to the structure and function of the Corsydd Môn/Anglesey Fens SAC and the Corsydd Môn a Llyn/Anglesey and Llyn Fens Ramsar site.

7.9 Conclusions for the other SACs and the Corsydd Môn a Llyn/Anglesey and Llyn Fens Ramsar site: construction and operation

7.9.1 It is concluded that no adverse effect on site integrity would arise due to air emissions in the construction or operational phase, either alone or in-combination, on to the qualifying interest features of the Glannau Ynys Gybi/Holy Island Coast SAC, Llyn Dinam SAC, Corsydd Môn/Anglesey Fens SAC and the Corsydd Môn a Llyn/Anglesey and Llyn Fens Ramsar site. In addition, no adverse effect in integrity of the Corsydd Môn/Anglesey Fens SAC and the Corsydd Môn a Llyn/Anglesey and Llyn Fens Ramsar site due to changes in terrestrial water quality, surface water and groundwater is predicted, either alone or in-combination with other plans and projects.

7.9.2 The basis for this conclusion is that the flora and fauna species composition, habitat condition, habitat distribution and cover, population viability of component species and presence of invasive species at any of the three SACs and Ramsar site does not have the potential to be adversely affected. These criteria are embodied within the conservation objectives for each European Designated Site (section 7.2) and it is concluded that there is no potential for an adverse effect on any conservation objective. Furthermore, there therefore is no potential for the conservation status of any of the European Designated Sites to be adversely affected.

7.9.3 In the long-term, a positive effect on the Corsydd Môn/Anglesey Fens SAC and the Corsydd Môn a Llyn/Anglesey and Llyn Fens Ramsar site is predicted due to the creation of new fen habitat and the improvement of existing fen habitat at Cae Canol-dydd and Cors Gwawr.

7.9.4 The conclusion reached for the other relevant SACs and Ramsar site interest features is summarised in table 7-44 (× = no adverse effect on integrity).

7.10 Decommissioning

7.10.1 With respect to the screening categories (potential effect categories) discussed above for the construction and operation phases of the Project, no LSE was predicted with regard to 'changes in surface and groundwater hydrology', 'change in air quality' and 'alteration of coastal processes and hydrodynamics' during the decommissioning phase (see section 5.4). A LSE was determined for this phase of the works, however, for 'changes in marine water quality'. This is considered below.

7.10.2 The potential for marine water quality to be adversely affected by the Project in the construction phase has been considered in the context of the Bae Cemlyn/Cemlyn Bay SAC and the 'coastal lagoon' and 'perennial vegetation of stony banks' interest features. As noted in section 5.6, the effects on marine water quality during decomissioning are expected to be significantly more localised than for the construction phase and, given the outcome described for construction, no adverse effect on the integrity of the Bae Cemlyn/Cemlyn Bay SAC would arise, alone or in-combination with other plans and projects. This conclusion applies for all other SACs screened into the assessment given their greater distance from the Project and lack of a pathway for a strong pathway for an effect (and, for the inland European Designated Sites, no pathway for an effect).

7.10.3 Hence, for the decommissioning phase, it can be assumed that, with equivalent risk management and mitigation measures in place, an adverse effect on site integrity similarly would not arise during the decommissioning phase.

Table 7-44 Conclusions for other SACs/Ramsar site

Site Features	Changes in air quality (emissions from plant, machinery and marine vessels)	Changes in air quality (road traffic emissions)	Changes in air quality (operational combustion)	Change in terrestrial water quality	Change in surface and groundwater hydrology
Glannau Ynys Gybi/Holy Island Coast SAC • Vegetated sea cliffs of the Atlantic and Baltic coasts. • European dry heaths. • Northern Atlantic wet heaths with *Erica tetralix*.	×	×	×		
Llyn Dinam SAC • Natural eutrophic lakes with Magnopotamion or Hydrocharition-type vegetation.	×	×	×		
Corsydd Môn/Anglesey Fens SAC • Northern Atlantic wet heaths with *Erica tetralix*. • *Molinia* meadows on calcareous, peaty or clayey-silt-laden soils • Calcareous fens with *Cladium mariscus* and species of the *Caricion davallianae* • Alkaline fens • Hard oligo-mesotrophic waters with benthic vegetation • Southern damselfly (*Coenagrion mercuriale*) • Marsh fritillary butterfly (Eurodryas, Hypodryas) • Geyer`s whorl snail (*Vertigo geyeri*) • European dry heaths	×	×	×	×	×

Site Features	Changes in air quality (emissions from plant, machinery and marine vessels)	Changes in air quality (road traffic emissions)	Changes in air quality (operational combustion)	Change in terrestrial water quality	Change in surface and groundwater hydrology
<u>Corsydd Môn a Llyn/Anglesey and Llyn Fens Ramsar site</u> • Suite of base-rich, calcareous fens which is a rare habitat type within the United Kingdom's biogeographical zone • Diverse flora and fauna with associated rare species and is of special value for maintaining the genetic and ecological diversity of the region	×	×	×	×	×

8 Appropriate Assessment: Marine mammals

8.1 Introduction

8.1.1 The Stage 1 Screening assessment concluded that LSE could not be excluded for the SACs and cSACs that include marine mammals as qualifying interest features (harbour porpoise, bottlenose dolphin, grey seal and harbour seal) listed in appendix D and tables 8-1 to 8-4 below.

8.1.2 The pathways through which the Project could affect European Designated Sites are the same for all of the marine mammal qualifying interest features. Consequently, the evidence to inform the (alone) appropriate assessment for marine mammals (for the relevant screening categories identified in chapter 4) has been presented in section 8.3 and the (in-combination) appropriate assessment in section 8.4. Conclusions are then drawn for each relevant European Designated Site separately in sections 8.5 to 8.10.

8.1.3 The marine mammal assessment assumes that all harbour porpoise, bottlenose dolphin, grey seal and harbour seal could be from a European Designated Site.

8.2 Summary of the outcomes of Screening

Alone

8.2.1 The Stage 1 Screening assessment concluded that the potential for a LSE to arise exists (or cannot be ruled out) with respect to the interest features, screening categories and European Designated Sites identified in tables 8-1 to 8-4 (✓ = potential for LSE; × = no potential for LSE) in the context of marine mammals (including prey species). These screening categories (effects) and interest features have been assessed further for the construction and operational phases of the Project in order to determine if an adverse effect on the integrity of the relevant sites could arise in view of their conservation objectives (including any potential effects on prey species). The effects of decommissioning are considered in section 8.11.

In-combination

8.2.2 The Stage 1 Screening assessment concluded that the potential for a LSIE to arise exists (or cannot be ruled out) with respect to the Project and the following other projects and screening categories (✓ = potential for LSIE; × = no potential for LSIE; and ? = unknown therefore screened into in-combination assessment) for European Designated Sites where harbour porpoise (table 8-5), bottlenose dolphin (table 8-6), grey seal (table 8-7) and harbour seal (table 8-8) are a qualifying feature. These projects and screening categories have been assessed further for the construction and operational phases of the Project in order to determine if an adverse effect on the integrity of the relevant sites could arise in view of their conservation objectives. Each of the projects has been assessed with respect to the nearest cSAC or SAC.

Table 8-1 Potential effects on SACs and cSACs where harbour porpoise are a qualifying feature

European Designated Site for harbour porpoise	Changes in visual and acoustic stimuli	Land take, including seabed or intertidal land	Changes in marine water quality	Alteration of coastal processes and hydrodynamics	Physical interaction between species and Project infra-structure
Gogledd Môn Forol / North Anglesey Marine cSAC	✓	✓	✓	✓	✓
Gorllewin Cymru Forol cSAC / West Wales Marine	✓	×	✓	×	✓
Dynesfeydd Môr Hafren / Bristol Channel Approaches cSAC	✓	×	✓	×	✓
North Channel cSAC	✓	×	✓	×	✓
Rockabill to Dalkey Island SAC (Ireland)	✓	×	✓	×	✓

✓ = potential for LSE; × = no potential for LSE

Table 8-2 Potential effects on SACs where bottlenose dolphin are a qualifying feature

European Designated Site for harbour porpoise	Changes in visual and acoustic stimuli	Land take, including seabed or intertidal land	Changes in marine water quality	Alteration of coastal processes and hydrodynamics	Physical interaction between species and Project infra-structure
Llŷn Peninsula and the Sarnau SAC / Pen Llyn a'r Sarnau SAC	✓	×	✓	×	✓
Bae Ceredigion / Cardigan Bay SAC	✓	×	✓	×	✓

✓ = potential for LSE; × = no potential for LSE

Table 8-3 Potential effects on SACs where grey seal are a qualifying feature

European Designated Site for harbour porpoise	Changes in visual and acoustic stimuli	Land take, including seabed or intertidal land	Changes in marine water quality	Alteration of coastal processes and hydrodynamics	Physical interaction between species and Project infra-structure
Llŷn Peninsula and the Sarnau SAC / Pen Llyn a'r Sarnau	✓	×	✓	×	✓
Bae Ceredigion / Cardigan Bay SAC	✓	×	✓	×	✓
Sir Benfro Forol / Pembrokeshire Marine SAC	✓	×	✓	×	✓
The Maidens SAC (Northern Island)	✓	×	✓	×	✓
Lambay Island SAC (Ireland)	✓	×	✓	×	✓
Saltee Islands SAC (Ireland)	✓	×	✓	×	✓

✓ = potential for LSE; × = no potential for LSE

Table 8-4 Potential effects on SACs where harbour seal are a qualifying feature

European Designated Site for harbour porpoise	Changes in visual and acoustic stimuli	Land take, including seabed or intertidal land	Changes in marine water quality	Alteration of coastal processes and hydrodynamics	Physical interaction between species and Project infra-structure
Murlough SAC (Northern Ireland)	✓	×	✓	×	✓
Strangford Lough SAC (Northern Ireland)	✓	×	✓	×	✓
Lambay Island SAC (Ireland)	✓	×	✓	×	✓
Slaney River Valley SAC (Ireland)	✓	×	✓	×	✓

✓ = potential for LSE; × = no potential for LSE

8.2.3 As described in chapter 5, there is no potential for LSIE with any of the plans scoped into the assessment with respect to marine mammals.

Table 8-5 Projects assessed further for any in-combination effects for SACs and cSACs where harbour porpoise are a qualifying feature

In-combination assessment	Changes in visual and acoustic stimuli	Land take, including seabed or intertidal land	Changes in marine water quality	Alteration of coastal processes and hydrodynamics	Physical interaction between species and Project infra-structure
Gogledd Môn Forol / North Anglesey Marine cSAC					
Wylfa Decommissioning	✓	×	✓	×	✓
Anglesey Eco Park	?	?	?	?	?
Amlwch LNG (Liquified Natural Gas)	✓	×	×	×	✓

✓ = potential for LSE; × = no potential for LSE; ? = unknown therefore screened into in-combination assessment

Table 8-6 Projects assessed further for any in-combination effects for SACs where bottlenose dolphin are a qualifying feature

In-combination assessment	Changes in visual and acoustic stimuli	Land take, including seabed or intertidal land	Changes in marine water quality	Alteration of coastal processes and hydrodynamics	Physical interaction between species and Project infra-structure
Pen Llyn a'r Sarnau / Llŷn Peninsula and the Sarnau SAC and Bae Ceredigion / Cardigan Bay SAC					
Afon Dysynni outfall gravel removal and relocation	✓	×	✓	×	×
Wylfa Decommissioning	✓	×	✓	×	✓
Minesto Holyhead Deep 10 MW Tidal Kite	✓	✓	✓	×	✓
Menter Môn (Morlais) West Anglesey Marine Energy Demonstration Zone	✓	✓	✓	×	✓
Swansea Bay Tidal Lagoon	✓	✓	✓	✓	✓
Cardiff Tidal Lagoon	✓	✓	✓	✓	✓
North West Coast Connections Project	✓	✓	✓	✓	✓
NuGen Moorside Project in West Cumbria	✓	✓	✓	✓	✓

✓ = potential for LSE; × = no potential for LSE; ? = unknown therefore screened into in-combination assessment

Table 8-7 Projects assessed further for any in-combination effects for SACs where grey seal are a qualifying feature

In-combination assessment	Changes in visual and acoustic stimuli	Land take, including seabed or intertidal land	Changes in marine water quality	Alteration of coastal processes and hydrodynamics	Physical interaction between species and Project infra-structure
Pen Llyn a'r Sarnau / Llŷn Peninsula and the Sarnau SAC					
Afon Dysynni outfall gravel removal and relocation	✓	×	✓	×	×
Wylfa Decommissioning	✓	×	✓	×	✓
Minesto Holyhead Deep 10 MW Tidal Kite	✓	✓	✓	×	✓
Menter Môn (Morlais) West Anglesey Marine Energy Demonstration Zone	✓	✓	✓	×	✓
North West Coast Connections Project	✓	✓	✓	✓	✓
NuGen Moorside Project in West Cumbria	✓	✓	✓	✓	✓
Bae Ceredigion / Cardigan Bay SAC					
No projects or plans identified that could have potential for in-combination LSE for this site					
Sir Benfro Forol / Pembrokeshire Marine SAC					
Swansea Bay Tidal Lagoon	✓	✓	✓	✓	✓
Cardiff Tidal Lagoon	✓	✓	✓	✓	✓
Milford Haven, Maintenance Dredge Pembrokeshire	✓	×	✓	×	×
The Maidens SAC (Northern Island)					
No projects or plans identified that could have potential for in-combination LSE for this site					
Lambay Island SAC (Ireland)					
Alexandra Basin Redevelopment Project	✓	×	✓	×	✓

In-combination assessment	Changes in visual and acoustic stimuli	Land take, including seabed or intertidal land	Changes in marine water quality	Alteration of coastal processes and hydrodynamics	Physical interaction between species and Project infra-structure
New Cruise Berth For Large Cruise Ships at Dun Laoghaire Harbour	✓	×	✓	×	✓
Saltee Islands SAC (Ireland)					
No projects or plans identified that could have potential for in-combination LSE					

✓ = potential for LSE; × = no potential for LSE; ? = unknown therefore screened into in-combination assessment

Table 8-8 Projects assessed further for any in-combination effects for SACs where harbour seal are a qualifying feature

In-combination assessment	Changes in visual and acoustic stimuli	Land take, including seabed or intertidal land	Changes in marine water quality	Alteration of coastal processes and hydrodynamics	Physical interaction between species and Project infra-structure
Murlough SAC (Northern Ireland)					
Newcastle Harbour Co. Down – relocation of sandbar from harbour entrance	✓	×	✓	?	×
Strangford Lough SAC (Northern Ireland)					
Strangford Lough Decommissioning of marine current turbine	✓	×	✓	×	✓
North West Coast Connections Project	✓	✓	✓	✓	✓
NuGen Moorside Project in West Cumbria	✓	✓	✓	✓	✓
Lambay Island SAC (Ireland)					
Alexandra Basin Redevelopment Project	✓	×	✓	?	✓
New Cruise Berth For Large Cruise Ships at Dun Laoghaire Harbour	✓	×	✓	?	✓

In-combination assessment	Changes in visual and acoustic stimuli	Land take, including seabed or intertidal land	Changes in marine water quality	Alteration of coastal processes and hydrodynamics	Physical interaction between species and Project infra-structure
Slaney River Valley SAC (Ireland)					
Swansea Bay Tidal Lagoon	✓	✓	✓	✓	✓
Cardiff Tidal Lagoon	✓	✓	✓	✓	✓

✓ = potential for LSE; × = no potential for LSE; ? = unknown therefore screened into in-combination assessment

8.3 Assessment of potential effects (alone): construction and operation

A Changes in visual and acoustic stimuli

A1 Underwater noise during marine construction works [Marine Licence]

Introduction

8.3.1 Underwater noise can have both physiological (e.g. lethal, physical injury and auditory injury) and behavioural (e.g. disturbance and masking of communication) effects on marine mammals and their prey species.

8.3.2 High peak pressure sound levels very close to the source have the potential to cause death or physical injury, with any severe injury potentially leading to death.

8.3.3 High exposure levels from underwater sound sources can cause auditory injury or hearing impairment, taking the form of a permanent loss of hearing sensitivity (Permanent Threshold Shift (PTS)) or a temporary loss in hearing sensitivity (Temporary Threshold Shift (TTS)). The level of impact on an individual is a function of the Sound Exposure Level (SEL) that an individual receives as a result of underwater noise.

8.3.4 Marine mammals and prey species may exhibit varying intensities of behavioural response at lower noise levels. For marine mammals, these can include orientation or attraction to a noise source, increased alertness, modification of characteristics of their own sounds, cessation of feeding or social interaction, alteration of movement / diving behaviour, temporary or permanent habitat abandonment and, in severe cases panic, flight stampede or stranding, sometimes resulting in injury or death. The response can vary due to exposure level, the hearing sensitivity of the individual, context, previous exposure history or habitation, motivation and ambient noise levels (e.g. [RD314]).

8.3.5 The potential effects of underwater noise will depend on a number of factors which include, but are not limited to:

- the source levels of noise;
- noise source characteristics;
- noise attenuation within the environment;
- the receptor species;
- frequency relative to the hearing bandwidth of the animal;
- duration of exposure;
- distance of the animal to the source; and,
- ambient noise levels.

8.3.6 The spatial footprint of the effect as a feature of noise propagation conditions will also depend on several factors, including but not limited to:

- sediment/sea floor composition;
- water depth; and,
- the sensitivity of marine mammal species present in the area.

Potential sources of underwater noise during construction in the Wylfa Newydd Development Area

8.3.7 Underwater noise generated during marine construction has the potential to affect marine mammals from European Designated Sites and their prey. For the marine works(those activities below Mean High Water Springs (MHWS)), the following construction activities are potential sources of underwater noise at the Wylfa Newydd Development Area:

- drilling;
- rock cutting;
- rock breaking;
- dredging; and,
- vessels.

Drilling

8.3.8 Drilling operations are required to install pre-bored piles for the MOLF and cofferdam construction. Modelling has been undertaken based on rotary drilling, percussive drilling and concurrent drilling, where two concurrent drilling rigs may be operational at the site (ES volume D, appendix D13-9, Underwater Noise Baseline and Modelling, Application Reference Number: 6.4.91).

8.3.9 Rotary drilling consists of two diameters and the rotating head is forced into the ground. Typical noise outputs from rotary drilling are characterised by a fairly continuous low pitch rumble with numerous higher levels of noise for short periods of time, as a result of the drill bit hitting inconsistencies in the rock (ES volume D, appendix D13-9; Underwater Noise Baseline and Modelling, Application Reference Number: 6.4.91).

8.3.10 Percussive drilling is different from rotary drilling as it adds a rapid hammer action to the rotating head. The noise is characterised by very rapid transient peaks associated with the hammer action of the drilling rig being used. Compared to rotary drilling, percussive drilling is a louder process overall (ES volume D, appendix D13-9, Underwater Noise Baseline and Modelling, Application Reference Number: 6.4.91). Percussive drilling could be used over rotary drilling where harder substrate exists as the hammer action of the drill head would enable penetration into the harder material.

8.3.11 Concurrent drilling whereby two drilling rigs may be in operation at the site.

Rock breaking

8.3.12 During construction, rock within the outer harbour would be fractured and removed using a rock breaker with work scheduled to extend for up to 16 months.

8.3.13 The process of rock breaking involves using a thin head that rapidly strikes the seabed to break up the rock (much like a jack-hammer). The plant used to do this has not yet been finalised.

8.3.14 For the underwater noise modelling, it has been assumed that the noise from the rock breaking machinery would be similar to a small-scale tubular piling operation, due to the similar motion of metal hitting bedrock. The underwater noise modelling has assessed a hammer diameter of approximately 0.5m, which operates with maximum hammer energy of 70kJ and has a typical strike rate of 43 strikes per minute to represent the worst case noise levels for rock breaking (ES volume D, appendix D13-9, Underwater Noise Baseline and Modelling, Application Reference Number: 6.4.91).

Rock cutting

8.3.15 During the construction of the semi-dry cofferdam a rock cutter would be used to cut a trench along the seabed prior to the placement of rock. This trench would improve the footing of the sheet piles that would be driven through the breakwater to form a seal.

8.3.16 A rock cutter is similar in design to the cutting head of a cutter suction dredger, with teeth designed to grind the rock in order to remove it. The rock cutting equipment to be used is expected to be a hydraulic cutting wheel or equivalent, which operates with an output power of approximately 261 kW based on the maximum torque and rotations per minute. Due to the similarity in design, the levels from the cutter suction dredger have been scaled based on the power of the device (ES volume D, appendix D13-9, Underwater Noise Baseline and Modelling, Application Reference Number: 6.4.91).

Dredging

8.3.17 Dredging would be used to prepare the seabed for marine construction. Soft sediments, such as those beneath the footprint of the proposed breakwaters, would be removed by dredging. Either a backhoe dredger or a cutter suction dredger would be used, with the choice of plant depending upon detailed

information on sediments from the detailed offshore geotechnical investigations.

8.3.18 Cutter suction dredging involves the use of a rotating cutter head to loosen rock in conjunction with a suction inlet that sucks up material onto the dredge vessel. Cutter suction dredgers are often used in areas with harder substrata, such as rock. The dominant noise generated is characterised by short pulses that correspond with the cutter tool on the dredger, although noise from the vessel's engines can also be heard (ES volume D, appendix D13-9, Underwater Noise Baseline and Modelling, Application Reference Number: 6.4.91).

8.3.19 Backhoe dredging removes material from the seabed with a vessel-mounted excavator which lifts material onto the vessel. Backhoe dredging has a variable noise level which relate to the various processes taking place (ES volume D, appendix D13-9, Underwater Noise Baseline and Modelling, Application Reference Number: 6.4.91).

8.3.20 Noise levels modelled for dredging operations at similar ranges indicate that cutter suction dredging produces more noise than backhoe dredging (ES volume D, appendix D13-9, Underwater Noise Baseline and Modelling, Application Reference Number: 6.4.91). Therefore, modelling of dredging has been undertaken based on cutter suction dredging as this is considered the worst case.

Vessels

8.3.21 There would be an increase in the number of vessels on site and increased vessel movements during construction, with vessels being used to bring equipment to the site and to dispose of dredged material. In addition, there would be a number of small support vessels used for staff transfers. The MOLF would be used for around seven years to enable the construction of the Power Station.

8.3.22 The peak number of vessels on site is predicted to average approximately 15 per week over a three month period. Different types of vessels would use the MOLF to transport general equipment, cement and aggregate with some vessels being up to 100m in length.

8.3.23 Vessel noise contributes to overall background noise and has the potential to disturb marine mammals; therefore it has been included in the assessment. For the purposes of modelling, vessels have been divided into two categories: medium sized and large sized. Medium sized vessels include support boats such as tugs and workboats and the large sized vessels include the dredgers and vessels transporting equipment. The noise levels measured from large vessels are of a similar magnitude to cutter suction dredgers, or slightly quieter as the dredging process increases the noise output.

8.3.24 It is important to highlight the transitory nature of underwater noise from passing vessels. An active dredger would operate over an extended period

in a defined area, so the cumulative noise exposure in a fixed position would be greater than the exposure from a vessel passing by.

8.3.25 For the modelling it is assumed that the vessels are travelling at an average speed of approximately 10 knots; the speed of the vessel would alter the sound level, with faster moving vessels generally creating more noise. The average vessel speed of 10 knots is based on the worst case scenario, with vessels in and around the construction area typically moving at slower speeds.

8.3.26 The dredging vessels and jack-up barges required for construction activities are assessed as part of the noise source for those activities, and are not included under the vessel noise assessment.

Potential sources of underwater noise at the Disposal Site

8.3.27 The following activities are potential sources of underwater noise at the Disposal Site:

- dredged material disposal; and,
- vessels.

Disposal of material

8.3.28 It is anticipated that the maximum amount of excavated material requiring marine disposal would be up to 368,000m^3 of rock and 242,000m^3 of soft material.

8.3.29 Underwater noise generated from material disposal is difficult to predict and, therefore, as a precautionary approach, the maximum modelled impact range for cutter suction dredging has been used as a proxy in the underwater noise assessment as the worst case scenario for the disposal of both rock and soft material.

Vessel movements

8.3.30 There would be an increase in the number of vessels at the Disposal Site and vessel movements between the Wylfa Newydd Development Area and the Disposal Site. The underwater noise assessment has been based on large vessels and has assumed that the vessels are travelling at an average speed of approximately 10 knots. It is assumed that two disposal events would occur during each 24 hour period.

8.3.31 The dredging works are predicted to last for duration of approximately 16 months. There would be a predicted peak of 60 vessels per month for disposal of soft sediments and a peak of 10 vessels per month for disposal of rock. These vessels movements have been assessed separately for the vessels assessed during construction at the Wylfa Newydd Development Area, as a worst case scenario.

Activities not considered as potential sources of underwater noise during construction

8.3.32 The following construction activities are not considered to be potential sources of underwater noise for marine mammals.

Dry excavation

8.3.33 Dry excavation of the inner harbour would begin onshore up to the MHWS mark. Once the cofferdam around the inner harbour is in place, rock fracturing by blasting in the dry behind the cofferdam would be carried out.

8.3.34 Blasting 'on land' effectively acts as a substantial barrier to sound in the water as little sound from the activity reaches the water either via the air or via the ground due to large reductions in transmission at the ground/water and air/water interfaces.

Piling

8.3.35 It is proposed that sheet piles would be installed as part of the breakwater and cofferdam construction; most likely this would be by vibro-piling. However, the piling would take place out of the water (i.e. dry) and through the core of the breakwater. Piling on land effectively acts as a substantial barrier to sound in the water as little sound from the activity reaches the water either via the air or via the ground due to large reductions in transmission at the ground/water and air/water interfaces (ES volume D, appendix D13-9, Underwater Noise Baseline and Modelling, Application Reference Number: 6.4.91).

Airborne noise and vibration

8.3.36 During construction, the main sources of airborne noise include:

- rock fracturing by blasting;
- piling, including sheet piling, to construct a temporary cofferdam and reinforce the southern causeway; and,
- rock cutting, to excavate the core of the temporary cofferdam and reinforce the southern causeway.

8.3.37 Vibration effects decay quickly with distance and would not result in underwater noise. As such, a pathway arising from airborne noise or vibration disturbance to cetaceans or seals underwater is negligible.

8.3.38 As very little of any sound from these activities is predicted to reach the water either via the air or via the ground due to large reductions in transmission at the ground/water and air/water interfaces (ES volume D, appendix D13-9, Underwater Noise Baseline and Modelling, Application Reference Number: 6.4.91), they have not been assessed further as potential sources of underwater noise.

Underwater noise modelling

Introduction

8.3.39 Sound and vibration are defined in terms of their frequency (pitch) and amplitude (level or loudness). Frequency is measured in Hertz (Hz) (1Hz = 1 cycle per second), amplitude is measured in units of velocity, e.g. millimetres per second (mm/s), but is often expressed in decibels (dB) in biological applications. Sound pressure level is usually reported in decibels (dB) which is a logarithmic scale that compresses the wide ranging potential source pressures to ease description.

8.3.40 An animal's sensitivity to sound varies according to the sound frequency. The response to sound depends on the presence and levels of noise within the range of frequencies to which an animal is sensitive. For most fish, sound above 1kHz is not audible. Marine mammals such as pinnipeds and cetaceans typically hear best between 1kHz and 100kHz (Nedwell and Howell, 2004).

8.3.41 Sound may be expressed in many different ways depending on the particular type of noise and the parameters of the noise that allow it to be evaluated in terms of a biological effect.

8.3.42 The attenuation of sound in the water as it propagates from the noise source must be considered in an assessment of project effects. As the measurement or receiver point moves away from the source, the sound pressure measured will decrease due to spreading. To standardise all source levels, regardless of where they are measured, they are referred back to a conceptual point 1 m away from the point of origin of the noise. Consequently, source levels should and will be presented with units of 'dB re 1 µPa @ 1 m'.

8.3.43 The sound pressure level (SPL) is normally used to characterise noise and vibration of a continuous nature such as drilling, boring, or background sea levels. To calculate the SPL, the variation in sound pressure is measured over a specific time period to determine the root mean square (RMS) level of the time varying acoustic pressure. The SPL_{RMS} therefore can be considered to be a measure of the average unweighted level of the sound over the measurement period.

8.3.44 The peak sound pressure level (SPL_{peak}) is the maximum level of sound. This form of measurement is often used to characterise underwater blasts where there is a clear positive peak following the detonation of explosives.

8.3.45 SEL is used when assessing the noise from transient sources such as impact piling. The SEL sums the acoustic energy over a measurement period, and effectively takes account of both the SPL of the sound source and the duration for which the sound is present in the acoustic environment.

Predicted source levels

8.3.46 To assess the potential effects from marine construction, underwater noise modelling was completed for all planned elements of construction. Modelling

was undertaken using the RAMSGeo software package which is designed to model any noise source where it is reasonable to assume it is a point source (ES volume D, appendix D13-9, Underwater Noise Baseline and Modelling, Application Reference Number: 6.4.91). The model allows for the incorporation of variable bathymetry and a complex seabed and, therefore, provides an accurate representation of noise propagation.

8.3.47 A point at a depth of 10m above ordinance datum was selected for the modelling as it represents the deepest point for marine operations. Therefore, this acts as a worst case for noise propagation; noise attenuation will be greater in shallow waters and therefore noise will propagate shorter distances.

8.3.48 The source levels used in the underwater noise modelling are summarised in table 8-9. These source levels have been derived using a combination of measurement data and extrapolations based on the differences in methodology, equipment and location.

Table 8-9 Summary of predicted source levels used for underwater noise modelling

Noise source	Predicted source level
Rotary drilling (242 kW)	161.2 dB re 1 µPa (RMS) @ 1 m
Rotary drilling (570 kW)	164.9 dB re 1 µPa (RMS) @ 1 m
Percussive drilling	185.3 dB re 1 µPa (RMS) @ 1 m
Cutter suction dredging	176.1 dB re 1 µPa (RMS) @ 1 m
Rock breaking	208.6 dB re 1 µPa (Peak) @ 1 m
Rock cutting	172.0 dB re 1 µPa (RMS) @ 1 m
Large vessels	168 dB re 1 µPa (RMS) @ 1 m
Medium vessels	161 dB re 1 µPa (RMS) @ 1 m

Thresholds and criteria used in underwater noise modelling

8.3.49 The following potential effects of underwater noise on marine mammals have been assessed:

- physical injury or lethal effects;
- auditory injury (PTS or TTS); and
- behavioural response or avoidance.

8.3.50 Table 8-10 outlines the criteria and thresholds used to assess any potential effects of underwater noise on harbour porpoise, bottlenose dolphin, grey seal and harbour seal. The thresholds and criteria are the most suitable and appropriate for the species, noise source and type of impact, these include:

- The Southall *et al*. (2007) [RD314] thresholds and criteria for PTS in harbour porpoise (high frequency cetacean), bottlenose dolphin (mid-frequency cetacean), grey seal and harbour seal (pinnipeds).

- The Lucke *et al*. [RD196] threshold and criteria for a behavioural response in harbour porpoise.
- The Finneran and Jenkins [RD108] threshold and criteria for a behavioural response in bottlenose dolphin, grey seal and harbour seal.

Table 8-10 Thresholds and criteria for marine mammals used in the assessment

Species or species group	Impact	Criteria and weighting			
		SPL_{peak} Unweighted (dB re 1 µPa)	SEL Weighted (dB re 1 μPa^2s)	Type I or II weighted SEL (dB re 1 μPa^2s)	Single strike Unweighted SEL (dB re 1 μPa^2s)
All	Lethal effect	240[1]	-	-	-
All	Physical injury	220[1]	-	-	-
High Frequency Cetaceans (HF) (e.g. harbour porpoise)	PTS	-	198[2] (Single and multiple pulsed over a 24hr period) 215[2] (Non-pulsed (continuous) over a 24hr period)	-	-
	TTS and fleeing response	-	183[2]	-	-
	Minor behavioural effect / response	-	-	-	145[3]
Mid Frequency (MF) Cetaceans (e.g. bottlenose dolphin)	PTS	-	198[2] (Single and multiple pulsed over a 24hr period) 215[2] (Non-pulsed (continuous) over a 24hr period)	-	-
	TTS and fleeing response	-	183[2]	-	-
	Behavioural response / potential avoidance	-	-	167[4] (Type II weighted)	-
Pinnipeds (e.g. grey and harbour seal)	PTS	-	186[2] (Single and multiple pulsed over a 24hr period) 203[2] (Non-pulsed (continuous) over a 24hr period)	-	-
	TTS and fleeing response	-	171[2]	-	-
	Behavioural response / potential avoidance	-	-	172[4] (Type I weighted)	-

Source: [1][RD253]; [2][RD314]; [3][RD196]; [4][RD108]

8.3.51 Southall *et al*. [RD314] proposed criteria for the levels of underwater noise that may lead to auditory injury in marine mammals based on M-Weighted SELs and the known or estimated auditory sensitivity at different frequencies for marine mammal groups. M-Weighted SELs are generalised frequency weighting functions which filter underwater noise data to better represent the levels of underwater noise various marine species are likely to be able to hear, and the known or estimated auditory sensitivity at different frequencies for marine mammal groups ([RD314]). The metrics and criteria [RD314] used in the underwater noise modelling are summarised in table 8-10. The [RD314] TTS criteria are only for single pulses and not multiple pulses; therefore cannot be modelled for SEL cumulatively and have therefore not been used in the assessments.

8.3.52 Lucke *et al.* [RD196] proposed a precautionary approach for the behavioural response in harbour porpoise using unweighted SELs (table 8-10). The criteria from [RD196] are derived from testing harbour porpoise hearing thresholds before and after being exposed to seismic airgun stimuli (a pulsed noise like impact piling) and field observations of harbour porpoise during the construction of Horns Rev offshore wind farm in Denmark.

8.3.53 The response of individuals to a noise stimulus will vary. To take this into account, the proportion of harbour porpoise that may show minor behavioural effect / response based on the criteria set out in [RD196] has been calculated by assuming 75% avoidance, as a worst case scenario.

8.3.54 To assess behaviour response / potential avoidance to noise in bottlenose dolphin and seals, criteria from [RD108] have been used. This criteria uses several different weightings listed as 'Type I', which is the same as M-Weighting from [RD314], and 'Type II', which is a modified version of the filter based on an alternative weighting function. The behavioural avoidance criteria used in the underwater noise modelling are summarised in table 8-10. [RD108] state that, for single pulses, behavioural disturbance is likely to be limited to a short-lived startle reaction; therefore [RD108] do not suggest any unique behavioural disturbance thresholds for marine mammals exposed to single pulse events.

8.3.55 Table 8-11 outlines the criteria used to assess any potential effects of underwater noise on marine mammal prey. Details of the prey species for harbour porpoise, bottlenose dolphin, grey seal and harbour seal are provided in chapter 6.

Table 8-11 Thresholds and criteria for prey species used in the assessment

Effect on fish	Criteria	Weighting	Species
Mortality and potential mortal injury / recoverable injury (pile driving)	> 213 dB re 1 µPa	Unweighted SPL_{peak}	Fish with no swim bladder
	> 207 dB re 1 µPa	Unweighted SPL_{peak}	Fish with swim bladder (involved and not involved in hearing)

Effect on fish	Criteria	Weighting	Species
Recoverable injury (pile driving)	203 dB re 1 μPa^2s	Cumulative Unweighted SEL	Fish with swim bladder (involved and not involved in hearing)
TTS (pile driving)	186 dB re 1 μPa^2s	Cumulative Unweighted SEL	All fish
Recoverable injury (shipping and continuous sounds)	170 dB re 1 µPa for 48 hours	Unweighted SPL_{RMS}	Fish with swim bladder involved in hearing
TTS (shipping and continuous sounds)	158 dB re 1 µPa for 12 hours	Unweighted SPL_{RMS}	

Source: [RD268]

8.3.56 Fish responses to noise are in part related to the anatomy of their hearing mechanisms. The presence of a swim bladder enhances hearing sensitivity as the bladder acts as a pressure transducer, converting sound pressure to particle velocity. Those species where the swim bladder is near to or connected to the ear have increased hearing sensitivity [RD268]. The hearing range of fish varies extensively amongst species, and it is not only related to anatomy, for example, cod and Atlantic salmon both have a swim bladder, but cod is sensitive to pressure at higher frequencies [R301].

8.3.57 The categories for fish are based on the presence or absence of a swim bladder and the potential for the swim bladder to enhance hearing sensitivity:

- Fish with no swim bladder or other gas chamber, e.g. flatfish. These species generally only detect particle motion and are less sensitive to sound pressure.
- Fish with swim bladders in which hearing does not involve the swim bladder or other gas volume, e.g. Atlantic salmon. These species hear through particle motion.
- Fish in which hearing involves a swim bladder or other gas volume, e.g. herring and cod. These species detect sound pressure and particle velocity.

Predicted underwater noise effect ranges during construction

8.3.58 The predicted underwater noise effect ranges for marine mammals and their prey, presented in the following sub-sections for each potential noise source, are based on the underwater noise modelling (ES volume D, appendix D13-9, Underwater Noise Baseline and Modelling, Application Reference Number: 6.4.91). The results presented are based on the worst case scenario for each of the activities using the thresholds and criteria summarised in table 8-10 and table 8-11.

Drilling

8.3.59 The predicted noise effect ranges for rotary drilling, percussive and concurrent drilling for marine mammals are presented in tables 8-12 to 8-14 below.

8.3.60 During rotary, percussive or concurrent drilling there is no potential risk of physical injury to harbour porpoise, bottlenose dolphin, grey seal and harbour seal as a result of underwater noise, as noise levels do not reach levels that could result in any physical injury to marine mammals (ES volume D, appendix D13-9, Underwater Noise Baseline and Modelling, Application Reference Number: 6.4.91). Therefore, the criteria in [RD253] have not been included in table 8-12 as the drilling source levels fall well below them.

Table 8-12 Maximum predicted effect ranges for PTS in marine mammals using M-Weighted SEL criteria from [RD314] for non-pulsed sounds from rotary (570kW), percussive and concurrent drilling noise for continuous 24 hours exposure

Criteria and threshold	Maximum predicted range			
	Rotary drilling	Percussive drilling	Two rotary drilling rigs	Two percussive drilling rigs
Range to PTS in high-frequency cetaceans 215 dB re 1 μPa^2s(Mhf)	<1m	2m	<1m	3m
Range to PTS in mid-frequency cetaceans 215 dB re 1 μPa^2s(Mmf)	<1m	3m	<1m	4m
Range to PTS in pinnipeds (in water) 203 dB re 1 μPa^2s(Mpw)	1m	41m	3m	71m

Table 8-13 Maximum predicted effect ranges for behavioural avoidance in bottlenose dolphin and seals using weighted SEL criteria from [RD108] for rotary (570kW), percussive and concurrent drilling noise

Criteria and threshold	Maximum predicted range			
	Rotary drilling	Percussive drilling	Two rotary drilling rigs	Two percussive drilling rigs
Behavioural avoidance in mid-frequency cetaceans (e.g. bottlenose dolphin) 167 dB re 1 μPa^2s(Type II)	16m	480m	26m	620m
Behavioural avoidance in pinnipeds (in water) 172 dB re 1 μPa^2s(Type I)	230m	4.1km	300m	5.9km

Table 8-14 Maximum predicted behavioural effect ranges in harbour porpoise using the unweighted criteria from [RD196] for rotary (570kW), percussive and concurrent drilling noise

Criteria and threshold for harbour porpoise	Maximum predicted range			
	Rotary drilling	Percussive drilling	Two rotary drilling rigs	Two percussive drilling rigs
Range to minor behavioural effect in harbour porpoise 145 dB re 1 $\mu Pa^2s(SEL_{ss})$	18m	390m	28m	530m

8.3.61 The maximum predicted range for PTS is 2m for harbour porpoise (high-frequency cetacean), 3m for bottlenose dolphin (mid-frequency cetacean) and 41m for grey and harbour seals, based on the worst-case scenario for percussive drilling (table 8-12). For concurrent drilling, the maximum predicted range for PTS is 3m for harbour porpoise, 4m for bottlenose dolphin and 71m for grey and harbour seals, based on the worst case scenario of concurrent percussive drilling (tables 8-12).

8.3.62 As noted above, there are no M-Weighted criteria for TTS given by [RD314] for non-pulsed sounds, so it has not been possible to model TTS ranges for drilling for the marine mammal species.

8.3.63 The maximum predicted range for behavioural avoidance based on the precautionary criteria from [RD108] is up to 480m for bottlenose dolphin (mid-frequency cetacean) and 4.1km for grey and harbour seals, based on the worst case scenario for percussive drilling (table 8-13). For concurrent drilling, the maximum predicted range for behavioural avoidance based on the precautionary criteria from [RD108] is up to 620m for bottlenose dolphin and 5.9km for grey and harbour seals, based on the worst case scenario for concurrent percussive drilling (table 8-13).

8.3.64 The predicted maximum range for minor behavioural effect in harbour porpoise based on the criteria from [RD196] is 390m, based on the worst case scenario for percussive drilling and 530m for concurrent drilling (table 8-14).

8.3.65 For the cumulative noise criteria (e.g. [RD314]; Finneran and Jenkins, 2012), as a worst case, a stationary animal over 24 hours of operation has been assumed. However, this is a highly unlikely scenario; if an animal moves away from the noise the effect would be greatly reduced, in most cases to a negligible level (ES volume D, appendix D13-9, Underwater Noise Baseline and Modelling, Application Reference Number: 6.4.91).

8.3.66 Concurrent drilling uses the same drilling noise criteria, but for two drilling operations occurring at the same time, assuming the same stationary animal over 24 hours. A doubling of pressure has been assumed for the noise from two rigs, which is a worst case as the two operations are unlikely to be happening side by side.

8.3.67 The predicted noise effect ranges for rotary drilling, percussive and concurrent drilling for fish (i.e. prey species) are presented in table 8-15.

Drilling noise is classed as a continuous sound and well below the levels that could cause mortality in fish (ES volume D, appendix D13-9, Underwater Noise Baseline and Modelling, Application Reference Number: 6.4.91).

8.3.68 The maximum predicted range for recoverable injury in fish with swim bladders involved in hearing is 8m for percussive drilling and 13m for concurrent percussive drilling. The maximum predicted range for TTS in fish with swim bladders involved in hearing is 67m for percussive drilling and up to 100m for concurrent percussive drilling (table 8-15).

Table 8-15 Maximum predicted SPLRMS effect ranges for fish using [RD268] criteria for continuous sounds from rotary (570kW), percussive and concurrent drilling noise

Criteria and threshold	Maximum predicted range			
	Rotary drilling	Percussive drilling	Two rotary drilling rigs	Two percussive drilling rigs
Recoverable injury (fish with swim bladders involved in hearing) (48h) 170 dB re 1 µPa (SPL_{RMS})	<1m	8m	<1m	13m
TTS (fish with swim bladders involved in hearing) (12h) 158 dB re 1 µPa (SPL_{RMS})	3m	67m	5m	100m

Rock breaking and rock cutting

8.3.69 The predicted noise effect ranges of rock breaking and rock cutting for marine mammals are presented in tables 8-16 to 8-18.

Table 8-16 Maximum predicted effect ranges for PTS in marine mammals using M-Weighted SEL criteria from [RD314] for multiple pulse sounds for rock breaking and rock cutting

Criteria and threshold	Maximum predicted range	
	Rock breaking	Rock cutting
Range to PTS in high-frequency cetaceans 198 dB re 1 μPa^2s(Mhf)	25m	<1m
Range to PTS in mid-frequency cetaceans 198 dB re 1 μPa^2s(Mmf)	36m	<1m
Range to PTS in pinnipeds (in water) 186 dB re 1 μPa^2s(Mpw)	450m	4m

Table 8-17 Maximum predicted effect ranges for behavioural avoidance of bottlenose dolphin and seals using [RD108] weighted SEL criteria for rock breaking and rock cutting

Criteria and threshold	Maximum predicted range	
	Rock breaking	Rock cutting
Behavioural avoidance in mid-frequency cetaceans (e.g. bottlenose dolphin) 167 dB re 1 μPa^2s(Type II)	600m	88m
Behavioural avoidance in pinnipeds (in water) 172 dB re 1 μPa^2s(Type I)	3.3km	320m

Table 8-18 Maximum predicted effect ranges for behavioural effect in harbour porpoise using the unweighted SEL criteria from [RD196] for rock breaking and rock cutting

Criteria and threshold for harbour porpoise	Maximum predicted range	
	Rock breaking	Rock cutting
Range to minor behavioural effect in harbour porpoise 145 dB re 1 $\mu Pa^2s(SEL_{ss})$	490m	15m

8.3.70 There is no potential risk of physical injury for harbour porpoise, bottlenose dolphin, grey seal and harbour seal as a result of underwater noise from rock breaking and cutting, as noise levels do not reach the levels that could result in any physical injury to marine mammals (ES volume D, appendix D13-9, Underwater Noise Baseline and Modelling, Application Reference Number: 6.4.91). The predicted source level for rock breaking noise is lower than the threshold given by [RD253] for injury.

8.3.71 The maximum predicted range for PTS is 25m for harbour porpoise (high-frequency cetacean), 36m for bottlenose dolphin (mid-frequency cetacean) and 450m for grey and harbour seals, based on the worst case scenario for rock breaking (table 8-16).

8.3.72 As noted above, there are no M-Weighted criteria for TTS given by [RD314] for non-pulsed sounds, so it has not been possible to model TTS ranges for rock breaking and rock cutting for marine mammal species.

8.3.73 The maximum predicted range for behavioural avoidance based on the precautionary criteria from [RD108] is up to 600m for bottlenose dolphin (mid-frequency cetacean) and 3.3km for grey and harbour seals, based on the worst case scenario for rock breaking noise (table 8-17).

8.3.74 The predicted maximum range for minor behavioural effect in harbour porpoise based on the criteria from [RD196] is 490m, using the worst case scenario for rock breaking noise (table 8-18).

8.3.75 For the multiple pulse criteria, a worst case stationary animal model was used, assuming rock breaking activity over a 24 hours period operating with strike rate of 43 strikes per minute or a continuous rock cutting operation

over the same period. A fleeing receptor or shorter rock breaking periods would greatly reduce these impact ranges.

8.3.76 The predicted maximum effect ranges for cutter suction dredging have been used as the maximum impact ranges for dredged material disposal at the Disposal Site.

8.3.77 The predicted noise effect ranges for rock breaking for fish are presented in table 8-19. The SPL_{peak} pile driving criteria from [RD268] was used to assess mortality and recoverable injury, however this could only happen at very close range to the activity. Larger ranges were predicted for the cumulative noise criteria (table 8-19).

8.3.78 For rock breaking, the maximum predicted range for mortality and potential mortal injury/recoverable injury for fish with swim bladders, eggs and larvae is 1m; for recoverable injury in fish with swim bladders it is 10m. The maximum predicted range for TTS in fish for rock breaking is 180m (table 8-19).

Table 8-19 Maximum predicted SPLpeak and SELcum impact ranges for fish using [RD268] criteria for rock breaking and rock cutting

Criteria and threshold	Maximum predicted range	
	Rock breaking	Rock cutting
Mortality and potential mortal injury / recoverable injury (fish with swim bladders, eggs and larvae) > 207 dB re 1 µPa (SPL_{peak})	1m	-
Recoverable injury (fish with swim bladders) 203 dB re 1 μPa^2s (SPL_{cum})	10m	<1m
TTS (fish) 186 dB re 1 μPa^2s (SPL_{cum})	180m	3m

Dredging

8.3.79 Dredging produces continuous, broadband sound. SPLs can vary widely, with, for example, dredger type, operational stage or environmental conditions (e.g. sediment type, water depth, salinity and seasonal phenomena such as thermoclines [RD176]). These factors will also affect the propagation of sound from dredging activities and, along with ambient sound already present, will influence the distance at which sounds can be detected.

8.3.80 The predicted noise effect ranges of cutter suction dredging for marine mammals are presented in tables 8-20 to 8-22 for a stationary animal over 24 hours.

8.3.81 The maximum predicted range for PTS is <1m for harbour porpoise (high-frequency cetacean), <1m for bottlenose dolphin (mid-frequency cetacean) and 5m for grey and harbour seals, based on the worst case scenario for cutter suction dredging operations (table 8-20). These source levels fall well below the criteria from [RD253] for injury. Therefore there is no potential risk of physical injury to harbour porpoise, bottlenose dolphin, grey seal and

harbour seal as a result of underwater noise from cutter suction dredging operations (ES volume D, appendix D13-9, Underwater Noise Baseline and Modelling, Application Reference Number: 6.4.91).

8.3.82 Moreover, the use of a stationary animal model over 24 hours represents a worst case. The use of a fleeing animal model would greatly reduce any these ranges and in most cases eliminate them completely.

Table 8-20 Maximum predicted effect ranges for PTS in marine mammals using M-Weighted SEL criteria from [RD314] for non-pulsed sounds from cutter suction dredging

Criteria and threshold	Maximum predicted range
Range to PTS in high-frequency cetaceans 215 dB re 1 μPa^2s(Mhf)	<1m
Range to PTS in mid-frequency cetaceans 215 dB re 1 μPa^2s(Mmf)	<1m
Range to PTS in pinnipeds (in water) 203 dB re 1 μPa^2s(Mpw)	5m

8.3.83 These findings are consistent with reviews of published sources of underwater noise during dredging activity (e.g. [RD338], [RD336]; [RD37]; [RD331]; [RD340]), which indicate that the sound levels that marine mammals may be exposed to during dredging activities are usually below auditory injury thresholds or PTS exposure criteria (as defined in [RD314]). Therefore the risk of any auditory injury arising in marine mammals as a result of dredging activity is very low.

8.3.84 As noted above, there are no M-Weighted criteria for TTS given by [RD314] for non-pulsed sounds, so it has not been possible to model TTS ranges.

8.3.85 Underwater noise as a result of dredging activity also has the potential to disturb marine mammals and stimulate behavioural reactions (this has been observed in other studies, e.g. [RD264]). Marine mammals may exhibit varying behavioural reaction intensities as a result of exposure to noise ([RD314]).

8.3.86 The maximum predicted range for behavioural avoidance based on the precautionary criteria from [RD108] is up to 130m for bottlenose dolphin (mid-frequency cetacean) and 500m for grey and harbour seals, based on the worst case scenario for cutter suction dredging operations (table 8-21).

Table 8-21 Maximum predicted impact ranges for behavioural avoidance in bottlenose dolphin and seals using [RD108] weighted SEL criteria for underwater noise from cutter suction dredging

Criteria and threshold	Maximum predicted range
Behavioural avoidance in mid-frequency cetaceans (e.g. bottlenose dolphin) 167 dB re 1 μPa^2s(Type II)	130m
Behavioural avoidance in pinnipeds (in water) 172 dB re 1 μPa^2s(Type I)	500m

8.3.87 The predicted maximum range for minor behavioural effect in harbour porpoise based on the criteria from [RD196] is 99m, based on the worst case scenario for cutter suction dredging (table 8-22).

Table 8-22 Maximum predicted impact ranges for behavioural effect in harbour porpoise using the unweighted criteria from [RD196] for cutter suction dredging noise

Criteria and threshold for harbour porpoise	Maximum predicted range
Range to minor behavioural effect in harbour porpoise 145 dB re 1 $\mu Pa^2s(SEL_{ss})$	99m

8.3.88 In addition to direct disturbance, the noise levels produced by dredging activity could overlap with the hearing sensitivities and communication frequencies used by marine mammals [RD340], and therefore effect marine mammals proximate to the dredging. Species such as harbour porpoise have a relatively poor sensitivity below 1kHz and are less likely to be affected by masking. By contrast, for seals, the masking of communication could occur, especially during the breeding season [RD340]. However, given the low numbers of seals in and around the proposed dredging sites (table 8-34 and table 8-35) and the distances to the nearest breeding sites (approximately 6km to nearest grey seal breeding site), the effect is unlikely to be significant

8.3.89 The predicted noise impact ranges for cutter suction dredging for fish (prey species) are presented in table 8-23. The maximum predicted range for recoverable injury for fish with swim bladders involved in hearing is 2m. The maximum predicted range for TTS in fish with swim bladders involved in hearing is 13m for cutter suction dredging operations (table 8-23).

Table 8-23 Maximum predicted SPLRMS impact ranges for fish using [RD268] for continuous sound, based on cutter suction dredging

Criteria and threshold	Maximum predicted range
Recoverable injury (fish with swim bladders involved in hearing) (48h) 170 dB re 1 µPa (SPL_{RMS})	2m
TTS (fish with swim bladders involved in hearing) (12h) 158 dB re 1 µPa (SPL_{RMS})	13m

Vessels

8.3.90 For the construction of the breakwater, if taking place from the sea, the core material would be transported using split hopper barges and/or side stone dumping vessels, and trimmed by long-reach tracked excavators working on the breakwaters or from jack-up platforms or barges in the sea.

8.3.91 During construction of the marine elements, there would be a number of small vessels required to transfer workers from land onto marine plant during the two year period of construction and during operation of the MOLF. These vessels would primarily operate within the Wylfa Newydd Development Area and would be subject to strict controls including appropriate speed restrictions. Journeys to and from other ports would not normally be required.

8.3.92 There would be increased vessel movement around the site during construction, with vessels being used to bring equipment to the site and to dispose of excavated material. In addition, there would be a number of small support vessels used for staff transfers. The peak number of vessels on site is predicted to average approximately 15 per week over a three month period. The existing baseline is estimated to be up to 25 vessels per week (ES Volume D – Wylfa Newydd Development Area Development D13 - The Marine Environment, Application Reference Number: 6.4.13).

8.3.93 Modelling results for vessel movements have been based on large vessels (such as dredgers and vessels transporting equipment) and medium vessels (such as tugs and workboats) travelling at an average speed of 10 knots. This can therefore be considered representative of ships travelling to and from the site, and a worst case scenario, as ships within the Wylfa Newydd Development Area would be moving considerably slower, and therefore are assumed to be quieter. The dredging vessels and jack-up barges required for construction activities are assessed as part of the noise source for those activities, and are not included under the vessel noise assessment.

8.3.94 Ambient underwater sound pressure levels were acquired between 2013 and 2014 to establish a baseline level of noise in the vicinity of Cemlyn Bay, Cemaes Bay and the Wylfa Newydd Development Area. This indicates that existing natural background noise levels for the area, with the mean underwater noise levels recorded between 111.4dB re 1µPa (SPL_{RMS}) and 120.9dB re 1µPa (SPL_{RMS}) (based on all transects measured). The noise

levels generated from vessel movements would not be discernible above background noise after approximately 4.4km for large vessels and 2.4km for medium vessels (ES volume D, appendix D13-9, Underwater Noise Baseline and Modelling, Application Reference Number: 6.4.91).

8.3.95 Noise from most vessels is likely to be lower frequency, associated with large, slow moving vessels and the use of dynamic positioning systems. Some of the vessels operating in and around the Wylfa Newydd Development Area and Disposal Site, depending on vessel speed, size, type, age and condition may generate noise levels, which could disturb marine mammals, with the literature indicating maximum one-third octave bands (TOB) source level of over 200dB re 1 µPa/m [RD200] for a large tanker, over 186dB re 1 µPa/m for a cargo vessel [RD7] and over 170dB re 1 µPa/m for a passenger ferry [RD200] (for the TOB where the source level is maximum). However, noise levels reported by [RD200] and [RD276] for large surface vessels indicate that physiological damage to marine mammals is unlikely.

8.3.96 The level of noise from vessels is predicted to be low compared to the other sources modelled. For example, the minor behavioural effect in harbour porpoise criteria from [RD196] is met at 10m for medium sized vessels and at 60m for large vessels. With regard to cumulative noise exposure, it is assumed that an animal stays at the same distance from the noise source over a 24 hour period, which makes these results highly precautionary.

8.3.97 The underwater modelling results indicated there is no potential risk of physical injury for harbour porpoise, bottlenose dolphin, grey seal and harbour seal as a result of underwater noise from vessels, as noise levels do not reach levels that could result in any physical injury to marine mammals (ES volume D, appendix D13-9, Underwater Noise Baseline and Modelling, Application Reference Number: 6.4.91), which is consistent with the literature.

8.3.98 The maximum predicted range for PTS is less than 1m for harbour porpoise (high-frequency cetacean), bottlenose dolphin (mid-frequency cetacean) and for both grey and harbour seals, for movements of large and medium sized vessels (table 8-24).

Table 8-24 Maximum predicted impact ranges for PTS in marine mammals using M-Weighted SEL criteria from [RD314] for non-pulsed sounds from vessel movements

Criteria and threshold	Maximum predicted range	
	Large Vessels	Medium Vessels
Range to PTS in high-frequency cetaceans 215 dB re 1 μPa^{2}s(Mhf)	<1m	<1m
Range to PTS in mid-frequency cetaceans 215 dB re 1 μPa^{2}s(Mmf)	<1m	<1m
Range to PTS in pinnipeds (in water) 203 dB re 1 μPa^{2}s(Mpw)	<1m	<1m

8.3.99 As noted above, there are no M-Weighted criteria for TTS given by [RD314] for non-pulsed sounds, so it has not been possible to model TTS ranges.

8.3.100 The maximum predicted range for behavioural avoidance based on the precautionary criteria from [RD108] is less than 1m for bottlenose dolphins (mid-frequency cetacean), grey seal and harbour seal for both medium and large sized vessels, based on the worst case scenario for vessel movements (table 8-25).

Table 8-25 Maximum predicted impact ranges for behavioural avoidance in bottlenose dolphin and seals using [RD108] weighted SEL criteria for noise from vessel movements

Criteria and threshold	Maximum predicted range	
	Large Vessels	Medium Vessels
Behavioural avoidance in mid-frequency cetaceans (e.g. bottlenose dolphin) 167 dB re 1 μPa^{2}s(Type II)	<1m	<1m
Behavioural avoidance in pinnipeds (in water) 172 dB re 1 μPa^{2}s(Type I)	<1m	<1m

8.3.101 The predicted maximum range for minor behavioural effect in harbour porpoise based on the criteria from [RD196] is 60m for large vessels and 10m for medium sized vessels, based on the worst case scenario for vessel movements (table 8-26).

8.3.102 The maximum predicated area of potential disturbance of harbour porpoise is therefore up to 0.01km^2 per vessel. Taking into account the fact that the peak number of vessels on site is predicted to average approximately 15 per week over a three month period, and the existing baseline of up to 25 vessels per week for the area (ES Volume D – Wylfa Newydd Development Area Development D13 – The Marine Environment, Application Reference Number: 6.4.13), the maximum total area of disturbance as a result of 40 vessels could be up to 0.4km^2. Therefore the maximum number of harbour porpoise that potentially could be disturbed in and around the Wylfa Newydd

Development Area is 0.5 individuals (based on density of 1.26/km^2). In and around the Disposal Site the maximum number of harbour porpoise that potentially could be disturbed is 1 porpoise (based on a density of 2.534/km^2). Based on this precautionary approach, up to 1.5 harbour porpoise could be temporarily disturbed as a result of vessel movements during construction.

Table 8-26 Maximum predicted impact ranges for behavioural effect in harbour porpoise using the unweighted criteria from [RD196] for vessels

Criteria and threshold for harbour porpoise	Maximum predicted range	
	Large Vessels	Medium Vessels
Range to minor behavioural effect in harbour porpoise 145 dB re 1 µPa^{2}s(SEL_{ss})	60m	10m

8.3.103 The maximum predicted range for recoverable injury for fish with swim bladders involved in hearing is <1m for both large and medium sized vessels. The maximum predicted range for TTS in fish with swim bladders involved in hearing is 4m for large vessels and <1m for medium sized vessels (table 8-27). The predicted noise impact ranges of large and medium vessel movements for prey species are less than those for marine mammals.

Table 8-27 Maximum predicted SPLRMS impact ranges for fish using [RD268] for continuous sound, based on cutter suction dredging operations

Criteria and threshold	Maximum predicted range	
	Large Vessels	Medium Vessels
Recoverable injury (fish with swim bladders involved in hearing) (48h) 170 dB re 1 µPa (SPL_{RMS})	<1m	<1m
TTS (fish with swim bladders involved in hearing) (12h) 158 dB re 1 µPa (SPL_{RMS})	4m	<1m

Summary of predicted effects during construction

8.3.104 The following tables summarise the maximum predicted effect ranges and areas for harbour porpoise (table 8-28), bottlenose dolphin (table 8-29), grey and harbour seal (table 8-30) and prey species (table 8-31) based on underwater noise modelling of the worst case scenarios for drilling (concurrent percussive drilling), rock breaking and rock cutting (rock breaking), dredging (cutter suction dredging operations) and vessels (large vessels).

8.3.105 The maximum predicted effect areas are overestimates as they are based on the area of a circle using the maximum range (i.e. do not take into account variation in noise propagation from the source, e.g. mean and minimum effect ranges). The predicted effect areas also do take into account the overlap with land.

8.3.106 Underwater noise from dredged material disposal was also predicted using a precautionary approach, as the maximum predicted impact ranges for cutter suction dredging modelled at the Wylfa Newydd Development Area has been used to determine the potential impact area at the Disposal Site.

8.3.107 In addition to the modelled effect range of individual vessels (for example as they move to and from the site), as a very precautionary approach, the potential area along the vessel route between the Wylfa Newydd Development Area and Disposal Site (21.7km) has been estimated, based on the area of 1km route width (42.53km^2; figure 8-1). However, any disturbance would be limited to the area around the vessels (e.g. up to 0.01km^2 for harbour porpoise, see table 8-28 and table 8-36) and not along the entire vessel route area at any one time.

8.3.108 The tables that follow tables 8-28 to 8-31 summarise the maximum predicted number of harbour porpoise (table 8-32), bottlenose dolphin (table 8-33), grey seal (table 8-34) and harbour seal (table 8-35) that could be affected by the maximum effect areas for drilling (concurrent percussive drilling), rock breaking and rock cutting (rock breaking), dredging (cutter-suction dredging operations) and individual vessels (large vessels), and the relevant species density for the area and references populations (see chapter 6). The numbers of harbour porpoise, bottlenose dolphin, grey seal and harbour seal that could be present in and around the vessel route between the Wylfa Newydd Development Area and Disposal Site are presented in table 8-36.

8.3.109 These estimates have been used to determine the percentage of the reference populations that could be affected by noise associated with the Project. Conclusions are drawn with respect to the influence of the effects on site integrity, for each relevant European Designated Site, in sections 8.5 to 8.10. The assessment assumes that all harbour porpoise, bottlenose dolphin, grey seal and harbour seal could be from a European Designated Site.

8.3.110 The total duration of the marine construction works is expected to be two years; rock breaking would occur for 16 months whilst all other activities (e.g. dredging, drilling and rock cutting) are each expected to occur for only a few months. Generally, these construction activities are not expected to occur concurrently as there would be sequential elements. In addition, they would not be undertaken continuously for the whole duration of the works and, therefore, underwater noise disturbance over the two years would be intermittent. Any displacement of marine mammals is likely to be temporary, with the area around the works available to marine mammals outside the periods of construction activity.

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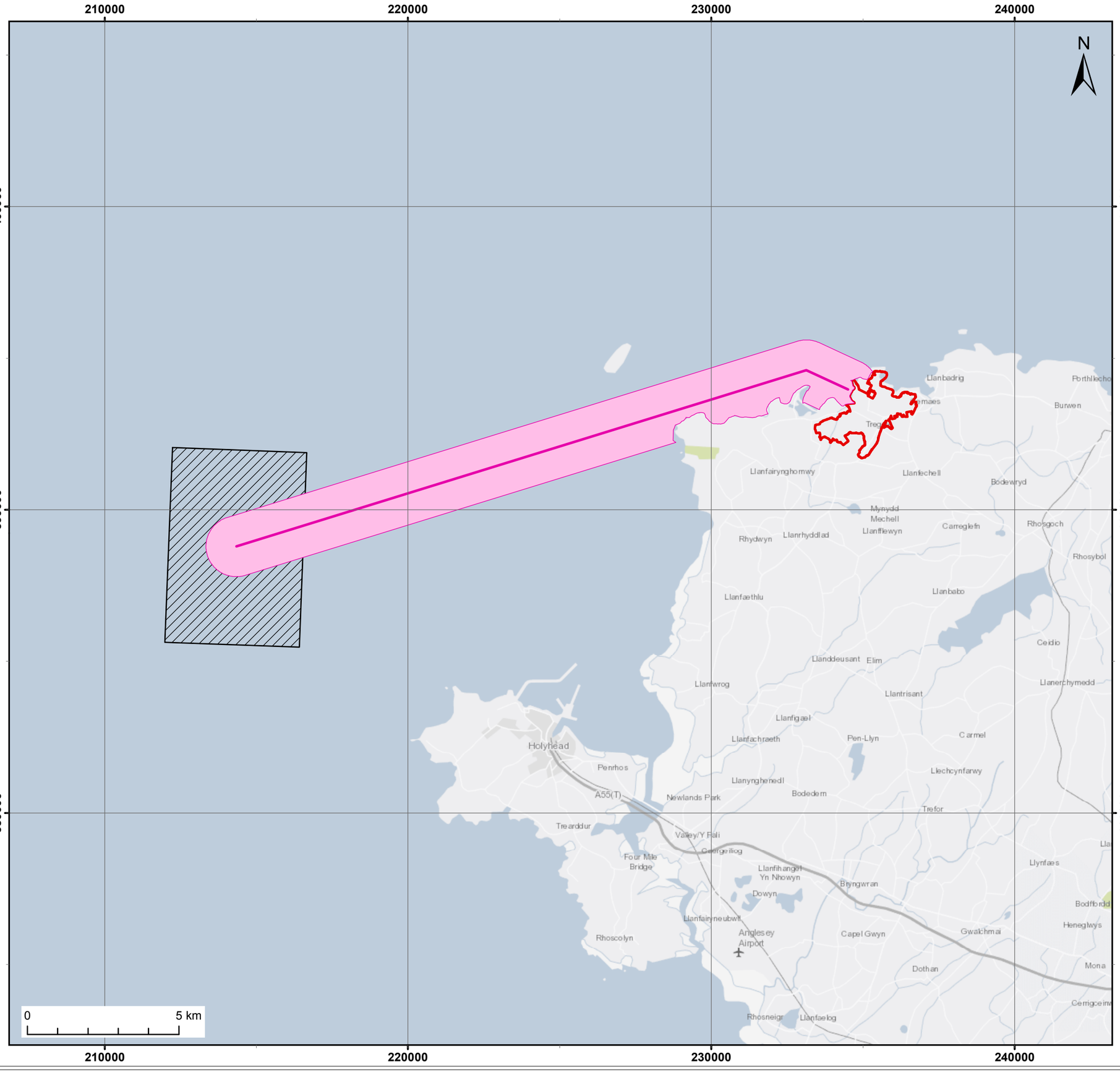

Legend

- Holyhead North disposal site
- Order limits for the purposes of DCO
- Indicative vessel route
- Indicative vessel route 1km disturbance zone

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Client: HORIZON NUCLEAR POWER

Project: Wylfa Newydd Project

Title: Indicative Vessel Route and 1km disturbance zone buffer

Figure: 8-1

Revision:	Date:	Drawn:	Checked:	Size:	Scale:
1	31/10/2017	GS	MS	A3	1:125,000
0	0	0	0	A3	1:125,000

Co-ordinate system: British National Grid

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Table 8-28 Predicted maximum effect ranges and areas for harbour porpoise during construction

Criteria and threshold	Maximum predicted range and area					
	Two percussive drilling rigs	Rock breaking	Cutter suction dredging		Large vessels	
	Wylfa Newydd Development Area	Wylfa Newydd Development Area	Wylfa Newydd Development Area	Disposal sites	Wylfa Newydd Development Area	Disposal site
PTS in high-frequency cetaceans 215 dB re 1 $\mu Pa^2s(Mhf)$[1] (non-pulsed / continuous)	3m (0.00003km^2)	N/A	<1m (0.000003km^2)	<1m (0.000003km^2)	<1m (0.000003km^2)	<1m (0.000003km^2)
PTS in high-frequency cetaceans 198 dB re 1 $\mu Pa^2s(Mhf)$[1] (single and multiple pulsed)	N/A	25m (0.00195km^2)	N/A	N/A	N/A	N/A
Minor behavioural effect in harbour porpoise 145 dB re 1 $\mu Pa^2s(SEL_{ss})$[2]	530m (0.83km^2)	490m (0.72km^2)	99m (0.03km^2)	99m (0.03km^2)	60m (0.01km^2)	60m (0.01km^2)

N/A = not applicable; Source: [1][RD314]; [2][RD196]

Table 8-29 Predicted maximum effect ranges and areas for bottlenose dolphin during construction

Criteria and threshold	Maximum predicted range and areas					
	Two percussive drilling rigs	Rock breaking	Cutter suction dredging		Large vessels	
	Wylfa Newydd Development Area	Wylfa Newydd Development Area	Wylfa Newydd Development Area	Disposal site	Wylfa Newydd Development Area	Disposal site
PTS in mid-frequency cetaceans 215 dB re 1 $\mu Pa^2s(Mmf)^1$ (non-pulsed / continuous)	4m ($0.00005km^2$)	N/A	<1m ($0.000003km^2$)	<1m ($0.000003km^2$)	<1m ($0.000003km^2$)	<1m ($0.000003km^2$)
PTS in mid-frequency cetaceans 198 dB re 1 $\mu Pa^2s(Mmf)^1$ (single and multiple pulsed)	N/A	36m ($0.004km^2$)	N/A	N/A	N/A	N/A
Behavioural avoidance in mid-frequency cetaceans 167 dB re 1 $\mu Pa^2s(Type\ II)^2$	620m ($1.11km^2$)	600m ($1.04km^2$)	130m ($0.05km^2$)	130m ($0.05km^2$)	<1m ($0.000003km^2$)	<1m ($0.000003km^2$)

N/A = not applicable; Source: [1][RD314]; [2][RD108]

Table 8-30 Predicted maximum effect ranges and areas for grey and harbour seal during construction

Criteria and threshold	Maximum predicted range and areas					
	Two percussive drilling rigs	Rock breaking	Cutter suction dredging		Large vessels	
	Wylfa Newydd Development Area	Wylfa Newydd Development Area	Wylfa Newydd Development Area	Disposal site	Wylfa Newydd Development Area	Disposal site
PTS in pinnipeds (in water) 203 dB re 1 µPa^{2}s(Mpw)[1] (non-pulsed / continuous)	71m (0.016km^2)	N/A	5m (0.00008km^2)	5m (0.00008km^2)	<1m (0.000003km^2)	<1m (0.000003km^2)
PTS in pinnipeds (in water) 186 dB re 1 µPa^{2}s(Mpw)[1] (single and multiple pulsed)	N/A	450m (0.61km^2)	N/A	N/A	N/A	N/A
Behavioural avoidance in pinnipeds (in water) 172 dB re 1 µPa^{2}s(Type I)[2]	5.9km (60.54km^2)	3.3km (20.93km^2)	500m (0.75km^2)	500m (0.78km^2)	<1m (0.000003km^2)	<1m (0.000003km^2)

N/A = not applicable; Source: [1][RD314]; [2][RD108]

Table 8-31 Predicted maximum impact ranges and areas for prey species during construction

Criteria and threshold	Maximum predicted range and areas					
	Two percussive drilling rigs	Rock breaking	Cutter suction dredging		Large vessels	
	Wylfa Newydd Development Area	Wylfa Newydd Development Area	Wylfa Newydd Development Area	Disposal site	Wylfa Newydd Development Area	Disposal site
Mortality and potential mortal injury / recoverable injury (fish with swim bladders, eggs and larvae) > 207 dB re 1 µPa (SPL_{peak})	N/A	1m ($0.000003km^2$)	N/A	N/A	N/A	N/A
Recoverable injury (fish with swim bladders involved in hearing) (48h) 170 dB re 1 µPa (SPL_{RMS})	13m ($0.0005km^2$)	10m ($0.0003km^2$)	2m ($0.00001km^2$)	2m ($0.00001km^2$)	<1m ($0.000003km^2$)	<1m ($0.000003km^2$)
TTS (fish with swim bladders involved in hearing) (12h) 158 dB re 1 µPa (SPL_{RMS})	100m ($0.03km^2$)	180m ($0.10km^2$)	13m ($0.0005km^2$)	13m ($0.0005km^2$)	4m ($0.00005km^2$)	4m ($0.00005km^2$)

Table 8-32 Estimated number of harbour porpoise and percentage of reference population (104,695 individuals)* that could be affected by underwater noise, based on the maximum area of effect (see table 8-20) and maximum estimated harbour porpoise density at Wylfa Newydd Development Area (1.26/km2)* and Disposal Site (2.534/km2)* during construction

Criteria and threshold	Estimated maximum number of harbour porpoise					
	Two percussive drilling rigs	Rock breaking	Cutter suction dredging		Large vessels	
	Wylfa Newydd Development Area	Wylfa Newydd Development Area	Wylfa Newydd Development Area	Disposal site	Wylfa Newydd Development Area	Disposal site
PTS in high-frequency cetaceans 215 dB re 1 $\mu Pa^2s(Mhf)$[1] (non-pulsed / continuous)	0.00004 (<0.00001%)	N/A	0.000004 (<0.00001%)	0.000008 (<0.00001%)	0.000004 (<0.00001%)	0.000008 (<0.00001%)
PTS in high-frequency cetaceans 198 dB re 1 $\mu Pa^2s(Mhf)$[1] (single and multiple pulsed)	N/A	0.003 (<0.00001%)	N/A	N/A	N/A	N/A
Minor behavioural effect in 100% harbour porpoise 145 dB re 1 $\mu Pa^2s(SEL_{ss})$[2]	1.05 (0.001%)	0.9 (0.0009%)	0.04 (0.00004%)	0.08 (0.00008%)	0.01 (0.00001%)	0.03 (0.00002%)
Minor behavioural effect in 75% harbour porpoise 145 dB re 1 $\mu Pa^2s(SEL_{ss})$[2]	0.8 (0.0008%)	0.7 (0.0007%)	0.03 (0.00002%)	0.06 (0.00005%)	0.008 (<0.00001%)	0.02 (0.00001%)

**See chapter 6; N/A – not applicable; Source: [1][RD314]; [2][RD196]*

Table 8-33 Estimated number of bottlenose dolphin and percentage of reference population (397 individuals)* that could be affected by underwater noise, based on the maximum area of effect (see table 8-21) and maximum estimated bottlenose dolphin density at Wylfa Newydd Development Area and Disposal Site (0.344/km2)* during construction

Criteria and threshold	Estimated maximum number of bottlenose dolphin					
	Two percussive drilling rigs	Rock breaking	Cutter suction dredging		Large vessels	
	Wylfa Newydd Development Area	Wylfa Newydd Development Area	Wylfa Newydd Development Area	Disposal site	Wylfa Newydd Development Area	Disposal site
PTS in mid-frequency cetaceans (non-pulsed / continuous) 215 dB re 1 µPa^{2}s(Mmf)[1]	0.000017 (<0.00001%)	N/A	0.000001 (<0.00001%)	0.000001 (<0.00001%)	0.000001 (<0.00001%)	0.000001 (<0.00001%)
PTS in mid-frequency cetaceans (single and multiple pulsed) 198 dB re 1 µPa^{2}s(Mmf)[1]	N/A	0.0014 (0.00035%)	N/A	N/A	N/A	N/A
100% behavioural avoidance in mid-frequency cetaceans 167 dB re 1 µPa^{2}s(Type II)[2]	0.38 (0.096%)	0.36 (0.090%)	0.018 (0.005%)	0.02 (0.005%)	0.000001 (<0.00001%)	0.000001 (<0.00001%)

**See chapter 6 table 6-3; N/A = not applicable; Source: [1][RD314]; [2][RD108]*

Table 8-34 Estimated number of grey seal and percentage of reference population (6,000 individuals)* that could be affected by underwater noise, based on the maximum area of effect (see table 8-22) and maximum estimated grey seal density at Wylfa Newydd Development Area (0.24/km2)* and Disposal Site (0.13/km2)* during construction

Criteria and threshold	Estimated maximum number of grey seal					
	Two percussive drilling rigs	Rock breaking	Cutter suction dredging		Large vessels	
	Wylfa Newydd Development Area	Wylfa Newydd Development Area	Wylfa Newydd Development Area	Disposal site	Wylfa Newydd Development Area	Disposal site
PTS in pinnipeds (in water) (non-pulsed / continuous) 203 dB re 1 µPa^{2}s(Mpw)[1]	0.004 (0.00006%)	N/A	0.00002 (<0.00001%)	0.00001 (<0.00001%)	0.0000007 (<0.00001%)	0.0000004 (<0.00001%)
PTS in pinnipeds (in water) (single and multiple pulsed) 186 dB re 1 µPa^{2}s(Mpw)[1]	N/A	0.15 (0.0025%)	N/A	N/A	N/A	N/A
100% behavioural avoidance in pinnipeds (in water) 172 dB re 1 µPa^{2}s(Type I)[2]	14.53 (0.24%)	5.02 (0.084%)	0.18 (0.003%)	0.00001 (<0.00001%)	0.0000007 (<0.00001%)	0.0000004 (<0.00001%)

**See chapter 6 table 6-4; N/A = not applicable; Source: [1][RD314]; [2][RD108]*

Table 8-35 Estimated number of harbour seal and percentage of reference population (50 individuals)* that could be affected by underwater noise, based on the maximum area of effect (see table 8-22) and maximum estimated harbour seal density at Wylfa Newydd Development Area (0.0009/km2)* and Disposal Site (0.0007/km2)* during construction

Criteria and threshold	Estimated maximum number of harbour seal					
	Two percussive drilling rigs	Rock breaking	Cutter-suction dredging		Large vessels	
	Wylfa Newydd Development Area	Wylfa Newydd Development Area	Wylfa Newydd Development Area	Disposal site	Wylfa Newydd Development Area	Disposal site
PTS in pinnipeds (in water) (non-pulsed / continuous) 203 dB re 1 µPa^{2}s(Mpw)[1]	0.00001 (0.00003%)	N/A	<0.00001 (<0.00001%)	<0.00001 (<0.00001%)	<0.00001 (<0.00001%)	<0.00001 (<0.00001%)
PTS in pinnipeds (in water) (single and multiple pulsed) 186 dB re 1 µPa^{2}s(Mpw)[1]	N/A	0.0005 (0.001%)	N/A	N/A	N/A	N/A
100% behavioural avoidance in pinnipeds (in water) 172 dB re 1 µPa^{2}s(Type I)[2]	0.05 (0.1%)	0.02 (0.04%)	0.0007 (0.001%)	0.0005 (0.001%)	<0.00001 (<0.00001%)	<0.00001 (<0.00001%)

**See chapter 6 table 6-5; it should be noted that due to the very low numbers of harbour seal in the area, the reference population is correspondingly low. As a result of the very low numbers of non-breeding harbour seal in the area it is highly unlikely that any harbour seals would be affected by the Project.*

N/A = not applicable; Source: [1][RD314]; [2][RD108]

Table 8-36 Estimated number of harbour porpoise, bottlenose dolphin, grey seal and harbour seal, and the percentage of reference population, that could be in and around the vessel route between Wylfa Newydd Development Area and the Disposal Site, based on the maximum estimated density at the Disposal Site and estimated maximum area of potential disturbance around all vessels (based on peak number of vessels on site and current baseline number of vessels)

Species	Estimated number in area 1km width of vessel route (42.53km^2)	Estimated maximum area of potential disturbance around all vessels including current baseline	Estimated maximum number of individuals potential disturbed around all vessels including current baseline
Harbour porpoise	107.77 (0.10%)	Up to 0.4km^2	1.5 (0.01%)
Bottlenose dolphin	14.63 (3.69%)	<1m per vessel	<0.001
Grey seal	5.53 (0.092%)	<1m per vessel	<0.001
Harbour seal	0.03 (0.06%)	<1m per vessel	<0.001

8.3.111 The assessment indicates that there is unlikely to be the potential for a significant effect on the reference populations for harbour porpoise, bottlenose dolphin, grey seal or harbour seal as a result of underwater noise during construction. There would be no risk of any physical or auditory injury as a result of underwater noise and the potential area for any disturbance that temporarily could be affected is very small and the number of animals low, even with the precautionary approach taken to the assessment. Therefore, an adverse effect is not predicted on the integrity of the European Designated Sites where these species are a qualifying feature.

A2 Airborne noise during construction [Marine Licence]

8.3.112 During construction, the main sources of airborne noise include:

- rock fracturing by blasting;
- piling, including sheet piling, to construct a temporary cofferdam and reinforce the southern causeway; and,
- rock cutting, to excavate the core of the temporary cofferdam and reinforce the southern causeway.

8.3.113 Seals that are hauled-out could be affected by airborne noise from land-based and marine-based construction activities. It is assumed that all seals in the area could be from a European Designated Site. However, during seal surveys conducted between 30 October 2016 and 25 January 2017, no pups or harbour seals were sighted and all grey seals spotted were in the water at the following locations: Cerrig Brith (one juvenile in water, approximately 0.5km east of the site); Porth Wnal (two juveniles in water, approximately 0.8km west of the site); Trwyn y Penrhyn (one juvenile in water, approximately 2.3km west of the site) and at Porth Padrig (one juvenile in water, approximately 2.7km west of the site) (see chapter 6).

8.3.114 Sightings of seals within the Wylfa Newydd Development Area generally represent sporadic individuals or small groups which are typically in the water rather than hauled-out. The nearest major seal haul-out sites to are located at The Skerries, approximately 8km from the Wylfa Newydd Development Area and at Middle Mouse, approximately 4km from the Wylfa Newydd Development Area. Other known haul-out sites are located Craig yr Iwrch/Harry Furlough's Rocks, approximately 2km from the Wylfa Newydd Development Area. The nearest grey seal breeding sites are located at Carmel Head, approximately 6km from Wylfa Newydd Development Area and at The Skerries, approximately 8km from the Wylfa Newydd Development Area (see chapter 6).

8.3.115 The nearest European Designated Site for grey seal is the Pen Llŷn a'r Sarnau / Llŷn Peninsula and the Sarnau SAC which is located approximately 48km from the Wylfa Newydd Development Area and nearest European Designated Site for harbour seal is the Murlough SAC approximately 118km from the Wylfa Newydd Development Area.

8.3.116 Predicted ambient noise contour modelling, without blasting, indicates that maximum noise level during construction in the Wylfa Newydd Development

Area would be 85-90dB(A). The maximum noise levels at intertidal areas immediately to the east and west of the Wylfa Newydd Development Area fall to below 65dB(A). On the intertidal areas to the west of Cemlyn Bay and to the east of Wylfa Head the noise levels fall to below 55dB(A) (ES Volume D – Wylfa Newydd Development Area Development D13 – The Marine Environment, Application Reference Number: 6.4.13).

8.3.117 Although grey and harbour seals could haul-out along the coastline, only individuals or small groups would be expected and the likelihood of them occurring within 500m of the marine works in the Wylfa Newydd Development Area is extremely low. Therefore, although airborne noise has the potential to temporally disturb a relatively small number of seals at haul-out sites in the vicinity of the Wylfa Newydd Development Area, there is no potential for any adverse effects on the integrity of any of the European Designated Sites where grey seal or harbour seal are a qualifying feature. Therefore this effect has not been assessed further in this Shadow HRA.

A3 Visual stimuli [Marine Licence]

8.3.118 The potential for any unfamiliar visual stimuli (e.g. temporary infrastructure, machinery and people) or changes in lighting levels on land to affect marine mammals in the water is unlikely and any potential effects would be temporary, restricted to a very small area and affect a very small number of individuals.

8.3.119 Seals that are hauled out on land, either resting or breeding, may be particularly sensitive to visual disturbance [RD133]. The response of seals to disturbance at haul-out site can range from increased alertness to moving into the water [RD366]. The potential impact on breeding sites can include temporary or permanent pup separation, disruption of suckling, energetic costs and energetic deficit to pups, physiological stress and sometimes enforced move to distant or suboptimal habitat. Potential impacts on moulting groups can include energy loss and stress, while impacts on other haul-out groups can cause loss of resting and digestion time and stress [RD366]. The level of response is dependent on a range of factors, such as the species at risk, age, weather conditions and the degree of habituation to the source of disturbance. The potential effects would be determined by the response of the seals, the duration and proximity of the disturbance to the seals.

8.3.120 In general, shipping traffic more than 1,500m away from a haul-out site is unlikely to evoke any reaction; between 900m and 1,500m, grey seals could be expected to detect the presence of vessels; and at closer than 900m, a flight reaction could be expected [RD364].

8.3.121 Studies on the distance of disturbance, on land or in the water, from hauled-out harbour seals have found that the closer the disturbance, the more likely seals are to move into the water. The estimated distance at which most seal movements into the water varies with site and type of disturbance, but has been estimated at typically less than 100m [RD366]. However, some studies have found that harbour seals at haul-out sites 100m away from vessels

were 25 times more likely to enter the water compared to seals that were located 500m away, with other studies recording a flight response in harbour seals by boats at a distance of around 500m [RD4].

8.3.122 For the grey seal, mothers responded by moving into the water more to boat speed than to distance, although movement into the water was generally observed to occur at distances of between 20 and 70m, with no detectable disturbance at 150m ([RD366]; [RD327]). However, grey and harbour seals have also been reported to move into the water when vessels are at a distance of approximately 200m to 300m [RD366).

8.3.123 The likelihood of grey or harbour seals hauling-out within the immediate vicinity of the Wylfa Newydd Development Area (i.e. within 500m) is considered extremely low. Visual disturbance due to the presence of human activity is therefore considered to be negligible. Therefore the effect on any grey or harbour seals from visual disturbance is also negligible.

8.3.124 As outlined above and in chapter 6, the nearest haul-out used by seals is approximately 2km from the Wylfa Newydd Development Area, therefore, unfamiliar visual stimuli (e.g. temporary infrastructure, machinery and people) or changes in lighting levels has the potential to temporally disturb only a relatively small number of seals at haul-out sites in the vicinity of the Project.

8.3.125 Therefore, the potential for any direct or indirect effect on marine mammals, including seals at haul-out sites, as a result of unfamiliar visual stimuli (e.g. temporary infrastructure, machinery and people) or changes in lighting levels is extremely low and there is no potential for any adverse effects on the integrity of any of the European Designated Sites where grey seal or harbour seal are a qualifying feature. Therefore this effect has not been assessed further in this Shadow HRA.

A4 Underwater noise during operation [Operational water discharge EP]

8.3.126 During operation, the following activities are considered to be potential sources of underwater noise:

- maintenance dredging;
- vessels; and,
- Acoustic Fish Deterrent (AFD).

Maintenance dredging

8.3.127 The quantum of maintenance dredging during operation would be less than the dredging required for construction. The assessment of the potential effects of underwater noise during dredging for construction activities indicates there is no potential for LSE to arise due to underwater noise. Therefore, during maintenance dredging there is no potential for any adverse effects on the integrity of any of the European Designated Sites where harbour porpoise, bottlenose dolphin, grey seal or harbour seal are a

qualifying feature. Based on this, this effect has not been assessed further in this Shadow HRA.

Vessels

8.3.128 All or part of the MOLF may be retained for use during Power Station operation. Whilst the bulk quay is expected not to be required, the Ro-Ro quay may be used for delivery of replacement parts (to avoid road transport). It is currently assumed that only one or two vessels per year would use the MOLF associated with the Power Station operation.

8.3.129 There is the potential for an increase in the number of vessels on site and increased vessel movements to and from the site during operation. However, during operation, vessel movements inside the harbour would be limited to periodic maintenance dredging and very infrequent movements of other vessels related to the operation of the Power Station.

8.3.130 Given the limited predicted number of vessel movements during operation, a significant effect is unlikely to occur and, therefore, no potential exists for any adverse effects on the the integrity of European Designated Sites where harbour porpoise, bottlenose dolphin, grey seal or harbour seal are a qualifying feature. Therefore this effect has not been assessed further in this Shadow HRA.

Acoustic Fish Deterrents

8.3.131 AFDs would be used to deter fish species from the cooling water intake where they are at risk from entrainment or entrapment. The AFDs would involve mounting an array of underwater sound projectors on the dividing walls of the coarse screens at the face of the CWS intake. This array would provide an adequate sound field to deflect fish hearing specialists and generalists (when coupled with low approach velocities), but not at the sound levels which could cause them injury, or that would cause injury or disturbance to marine mammal species.

8.3.132 The purpose of the AFD is to deter fish from entering the cooling water intake system. For an AFD to be effective, it must reach certain levels of noise required to deter fish species, namely:

- The sound level received by the fish at the required point of deflection typically should be at least 10 times, or >20dB, above ambient noise level (although this is dependent on the species of fish and the type of signal). Generally, to deflect fish, the sound field where deflection is needed should have an absolute minimum level of 150dB re 1µPa and a preferred level in excess of 160dB re 1µPa.
- The noise detected by the fish species must represent a rapid change from the baseline environment to give sufficient warning for movement away from the cooling water intake.

8.3.133 AFDs generally have a range of usable frequencies (for example from 20Hz – 3kHz), however, it is expected that the AFD system for Wylfa Newydd

would use a frequency range of 50-600Hz. Noise modelling has been undertaken on a single frequency of 50Hz as this provides a strong indication of the sound field that would be generated by the system.

Noise modelling

8.3.134 Noise modelling was conducted by Fish Guidance Systems [RD106] to assess the potential noise levels associated with the use of the AFD system and determine any possible effects on fish and marine mammal species. This included an assessment of the predicted sound field in relation to harbour porpoise and grey seal noise sensitivities using the dB_{ht} metric to inform an assessment on the effect of using these AFDs on both marine mammal species.

8.3.135 The model predicted the sound field at the middle of the intake openings and at two or three other levels to enable the sound field across entire water column to be assessed.

The dB_{ht} metric

8.3.136 The scale of dB_{ht} and its predicted effect on species is presented in table 8-37. Note that $0dB_{ht(species)}$ represents a sound that is at the hearing threshold for that species and is, therefore, a level at which sound will start to be 'heard'.

Table 8-37 The dBht scale (adapted from Nedwell et al., 2007)

dB_{ht} level	Effect on marine mammal or fish species
0-50	There is a low likelihood of disturbance in this range.
50-90	There may be a stronger reaction by some individuals, but habituation to the noise may lessen the impact.
90 and above	This level could cause a strong avoidance reaction by virtually all individuals
110 and above	This is the tolerance limit, after which noise will become unbearably loud
130 and above	There is the possibility of traumatic hearing damage occurring after a single event

8.3.137 To identify the dB_{ht} level of a certain noise for each species, audiograms are used to identify a species' hearing abilities (i.e. the type of sounds and frequencies that they hear) and the noise level at which they can hear them (i.e. how loud they have to be for the species to hear it, or how it quiet it has to be before it is no longer detectable). The noise to which the species is most sensitive is that which it can hear at the lowest amplitudes.

8.3.138 The audiogram used for the modelling undertaken by FGS [RD106] to assess dB_{ht} levels for harbour porpoise was from [RD181]. The audiogram for the assessment of dB_{ht} levels on grey seal was from [RD277]. The modelling utilised the sound source for the highest frequency emitted by the AFD and applied to the data available from [RD277]. As such, sound levels predicted for the assessment on grey seals may be higher than actual potential sound levels.

Results

8.3.139 The modelling predicted the dB_{ht} levels at the cooling water intake (and AFD) location and out towards the western breakwater. Figure 8-2 shows an example of the worst-case scenario, based on the modelling for the maximum 160dB re 1µPa across the whole intake at high water and at LAT.

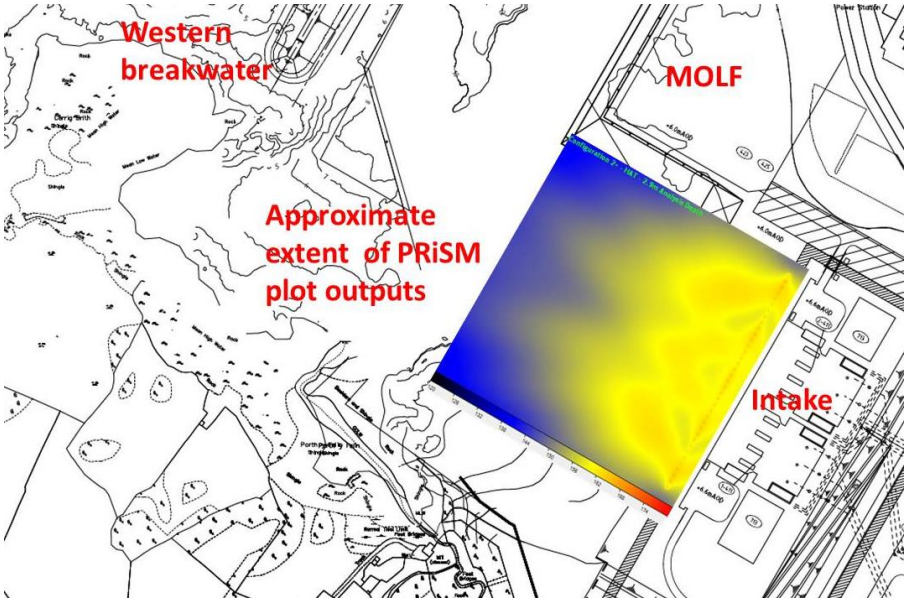

Figure 8-2 Example of the AFD noise modelling results: approximate extent of modelling outputs in relation to the intake embayment, MOLF and western breakwater

8.3.140 The results of the modelling (figure 8-2) are outlined below. The sound field was assessed at 4.9m above seal bed level (-6m AOD) and represented by the dB_{ht} scale, with the yellow shading representing a dB_{ht} of 90; the level at which a behavioural disturbance effect could be expected from most individuals.

8.3.141 Modelling of the limits of the biologically unweighted 160dB sound field has shown that at high and low water there would be no excess spreading of the 160dB re1µPa sound field contour outside of the intake embayment.

Harbour porpoise

8.3.142 The sound pressure level generated by the AFD sound projectors would be below the TTS threshold for harbour porpoise and the frequencies are expected to be around 50Hz or within the range of 20Hz to 600Hz. The majority of this frequency range is below the auditory threshold of harbour porpoise. Although the harbour porpoise is classed as a high frequency marine mammal, it is still capable of hearing sound levels at less than 1kHz. For example, [RD238] reported that the harbour porpoise can detect sounds at 92-115dB RMS re 1µPa at frequencies of below 1kHz.

8.3.143 For LAT conditions, the sound levels are predicted to reach 90 $dB_{ht(\textit{Phocoena phocoena})}$ at the intake system itself but would abate to less than 60$dB_{ht(\textit{Phocoena phocoena})}$ at 165m from the intake and the sound source.

8.3.144 For HAT conditions there is some beaming of the sound source due to the greater levels of interference caused by the system and the increase in water depth. Sound levels are still predicted to be at $90dB_{ht(Phocoena\ phocoena)}$ at the sound source (the intake) and are predicted to abate to $70dB_{ht(Phocoena\ phocoena)}$ at the breakwater 400m from the source.

8.3.145 The maximum area of any effect from the AFD device in LAT conditions is $0.086km^2$ and for HAT conditions is $0.5km^2$. The number of harbour porpoise that could have a behavioural reaction due to the AFD in LAT conditions is, therefore, 0.108 individuals (based on a worst-case density of $1.26/km^2$); which corresponds to 0.0001% of the CIS MU population. The number of harbour porpoise that could have a behavioural reaction due to the AFD in HAT conditions is 0.63 individuals, which corresponds to 0.0006% of the CIS MU population.

8.3.146 The modelling results are for a frequency of 50Hz. However if frequencies within the auditory range of harbour porpoise are utilised (e.g. 300Hz to 400Hz), then it is expected that harbour porpoise would not be able to detect sounds from the AFDs above background levels past the western breakwater.

8.3.147 Taking into account the diet of harbour porpoise and the prey species likely to be present in the area, it is unlikely to represent a key foraging area. Therefore any displacement of prey as a result of the AFDs is unlikely to have any significant effect on harbour porpoise in the area. The area over which prey maybe displaced represents a very small proportion of their foraging area.

8.3.148 Furthermore, there is likely to be very few harbour porpoise within the vicinity of the cooling water outfall, and the likelihood of them occurring within 400m of the location is considered to be low. Therefore, an adverse effect on harbour porpoise as a result of the sound generated by the AFDs, or on the integrity of any of the European Designated Sites for which harbour porpoise is a qualifying feature, is not predicted.

Bottlenose dolphin

8.3.149 Bottlenose dolphin are vulnerable to TTS at sound levels of 193dB SPL re 1 µPa at 0.4kHz ([RD314]). [RD314] state that behavioural disturbance should be assessed based on TTS levels, assuming that behaviour will change at the same level as TTS will occur.

8.3.150 As the proposed AFDs would generate a maximum noise level of 160dB re 1µPa, it is unlikely that the threshold for TTS and behavioural disturbance of bottlenose dolphins would occur as a result of the AFDs. There is likely to be very few bottlenose dolphin within the vicinity of the cooling water outfall, and the likelihood of them occurring within the range of the AFDs is considered to be very low.

8.3.151 Taking into account the diet of bottlenose dolphin and the prey species likely to be present in the area of influence of the AFDs, it is unlikely to represent a key foraging area. Therefore any displacement of prey as a result of the

AFDs is unlikely to have any significant effect on bottlenose dolphin. Furthermore, the area over which prey maybe displaced represents a very small proportion of the wider foraging area of bottlenose dolphin.

8.3.152 Therefore, there would not be an adverse effect on bottlenose dolphin or on the integrity of any of the European Designated Sites for which bottlenose dolphin is a qualifying feature.

Grey and harbour seal

8.3.153 The review by the Department for Commerce [RD74] indicates that grey and harbour seal hearing abilities are within a range of 1kHz to 180kHz with a peak sensitivity at 32kHz in water. [RD314] grouped marine mammal species based on hearing sensitivity, pinniped species in water (which includes grey and harbour seal) were listed as having a hearing range of 75Hz to 75kHz.

8.3.154 At 50Hz, the AFD sound field is below the general pinniped hearing sensitivities in water, although if the sound field is increased to between 20Hz and 600Hz it would be within the lower end of their auditory range. However, modelling has shown that the sound levels are rapidly attenuated down to around 130dB re 1µPa and to between 140dB and 150dB re 1µPa at the entrance to the intake embayment at LAT and HAT, respectively.

8.3.155 During LAT conditions, the sound source is at a level of 90dB$_{ht(pinniped)}$ at the intake and lowers to 75 dB$_{ht(pinniped)}$ at 165m from the intake. The sound field reduces further to be 65 dB$_{ht(pinniped)}$ at less than 200m from the sound source and intake.

8.3.156 For HAT conditions, the sound source is similar to that of LAT at the intake and sound source, with a more even sound coverage, with 90dB$_{ht(pinniped)}$ predicted at the source. Patches of up to 80 dB$_{ht(pinniped)}$ could be present at 400m from the sound source, with the sound levels reducing to 75-80 dB$_{ht(pinniped)}$ at the breakwater.

8.3.157 Studies of a FGS Mk I sound projector at Hartlepool Power Station (similar to the device being considered at Wylfa Newydd) have been undertaken, with a sound source level of 174dB with frequencies of 10Hz to 600Hz. These AFDs were located near both grey and harbour seal haul-out sites. Monitoring of the seals during times of sound source emission were undertaken over a period of 44 days. The AFD was operated on alternate days to ascertain the difference in seal numbers and behaviour during the operation of the AFD. Results of the monitoring study showed that there was no discernible difference in the seal behaviour during days with the AFD in operation, with no change in their haul-out behaviour and no change in their vigilance levels.

8.3.158 The sound levels generated by the AFD array which could propagate outside of the embayment would be approaching the underwater background noise levels of around 120re 1µPa and, therefore, are unlikely to result in any disturbance of grey and harbour seals. The sound pressure levels moving

away from the entrance to the intake embayment would not be high enough to result in any TTS or PTS in pinniped hearing ability.

8.3.159 Taking into account the diet of grey and harbour seal and the prey species likely to be present in the area, it is unlikely to represent a key foraging area. Therefore any displacement of prey as a result of the AFDs is unlikely to have any significant effect on grey or harbour seal in the area. Furthermore, the area over which prey maybe displaced represents a very small proportion of the foraging area of grey and harbour seal.

8.3.160 Therefore, no adverse effect is predicted for grey or harbour seal as a result of the sound generated by the AFDs or on the integrity of any of the European Designated Sites for which grey and harbour seal are a qualifying feature.

B Land take, including seabed or intertidal

B1 Change and/or loss of habitat [Marine Licence]

8.3.161 There is the potential for a change and/or loss of habitat as a result of the Project within the marine area of the Wylfa Newydd Development Area and at the Disposal Site (for example as a result of dredging activity, disposal of material and marine project infrastructure, such as the breakwater) which could have a potential effect on marine mammals and their prey species.

8.3.162 It has been estimated that a total of 0.305km^2 could be lost under the footprint of the marine works at the Wylfa Newydd Development Area, this includes the MOLF, cooling water intake, breakwaters and areas to be dredged (ES Volume D – Wylfa Newydd Development Area Development D13 – The Marine Environment, Application Reference Number: 6.4.13).

8.3.163 Therefore, adopting a precautionary approach, it has been assumed that the marine area of the Wylfa Newydd Development Area (approximately 0.35km^2) and the area of the Disposal Site that has been identified as the zone for disposal of dredged material, including a 100m buffer (approximately 0.65km^2), could experience a change or loss of area.

8.3.164 The number of harbour porpoise, bottlenose dolphin, grey seal and harbour seal that could be present (and the percentage of the reference population) in the Wylfa Newydd Development Area and Disposal Site, including a 100m buffer, has been estimated (table 8-38) based on maximum species density estimates for the area and percentage of relevant reference population (see chapter 6).

8.3.165 The maximum predicted area for any changes or loss of habitat would be the same for marine mammals and their prey (table 8-38); therefore there would be no additional impacts on marine mammals as a result of any changes or loss of habitats to prey species.

8.3.166 Taking into account the diet of marine mammal species (see chapter 6) and the prey species likely to be present in the Wylfa Newydd Development Area (ES Volume D – Wylfa Newydd Development Area Development D13 – The Marine Environment, Application Reference Number: 6.4.13), the area is

unlikely to be a key foraging area. Therefore, any displacement of marine mammals due to a loss of food resource is considered to be unlikely. The area of potential change and/or loss of habitat represents a very small proportion of the foraging area of marine mammals (for example, 1km^2 (the total area of the Wylfa Newydd Development Area and Disposal Site plus buffer) is approximately 0.0002% of the harbour porpoise Celtic and Irish Sea MU area (516,893km^2) and 0.002% of the bottlenose dolphin Irish Sea MU area (50,145km^2)).

8.3.167 The assessment assumes that all harbour porpoise, bottlenose dolphin, grey seal and harbour seal could be from a European Designated Site. Conclusions are drawn with respect to the influence of the effects on site integrity, for each relevant European Designated Site, in sections 8.5 to 8.10.

8.3.168 However, based on the low number of individuals that could be affected and the very small area of effect, in relation to the range of marine mammal species and areas covered by the reference populations, there is unlikely to be a significant effect on harbour porpoise, bottlenose dolphin, grey seal or harbour seal as a result of any change or loss of habitat. Therefore an adverse effect is not anticipated on the the integrity of European Designated Sites where these species are a qualifying feature.

Table 8-38 Estimated number of harbour porpoise, bottlenose dolphin, grey seal and harbour seal and percentage of reference population that could potentially be present in the Wylfa Newydd Development Area and Disposal Site plus 100m buffer, based on maximum estimated density at each site

Species	Estimated number in area and percentage of reference population	
	Wylfa Newydd Development Area (0.35km^2)	Disposal Site plus 100m buffer (0.651km^2)
Harbour porpoise	0.44 (0.0004%)	1.65 (0.002%)
Bottlenose dolphin	0.12 (0.03%)	0.22 (0.06%)
Grey seal	0.08 (0.001%)	0.08 (0.001%)
Harbour seal	0.0003 (0.0006%)	0.0005 (0.001%)

C Changes in marine water quality

8.3.169 This section describes the potential directs effects on marine mammals and any indirect effects on prey species from:

- an increase in suspended sediment input and change in chemical quality due to discharges from fluvial sources and sewage;

- an increase in suspended sediment concentration and contaminant re-mobilisation during dredging and disposal; and,
- operational discharge from the CWS.

C1 Increase in suspended sediment input and change in chemical quality due to discharges from fluvial sources and sewage [Marine Licence, Construction water discharge EP]

Suspended sediment

8.3.170 The discharge of suspended solids from the drainage system at all discharge points would be limited to the levels proposed in the construction Environmental Permit (i.e. either 40mg/L or 70mg/L during normal rainfall events, dependant on the receiving watercourse) (Application Reference Number: 6.4.33).

8.3.171 The Delft-3D hydrodynamic model has been used to predict the fate of the suspended sediment discharged from the surface water drainage system, dewatering and sewage discharge into the marine environment. The modelling indicates that suspended solid concentrations are low and dispersion is rapid, such that concentrations reach levels similar to background (less than 6mg/L) within 0.01km from the discharge point under normal conditions. Following a storm event there is an increase in the extent and concentration of suspended solids in the vicinity of the outfalls, although the maximum concentration is still within the intermediate turbid waters classification for WFD of <100mg/L (Application Reference Number: 6.4.90).

8.3.172 The potential for any effect as a result of increased suspended sediment from discharge sources on marine mammals or their prey would be very low, with a total predicted affected area from all discharges predicted to be 0.25km^2. The maximum extent of a plume that would occur in a 1 in 30 rainfall event is within the immediate vicinity of the discharge locations. However, for the majority of the time suspended solids concentrations would be within the existing variability of the baseline, with peaks occurring during rainfall events in line with the existing regime (Application Reference Number: 6.4.33).

8.3.173 High turbidity or suspended solids levels can diminish visibility, affect feeding behaviours and potentially cause physical harm to fish. Fish that rely on sight and speed to catch their prey are especially affected by high turbidity levels and may choose to avoid these areas. For the fish that remain in the turbid environment, suspended sediment can begin to physically affect the fish, for example by clogging of gills. In general, fish are more likely to undergo sub-lethal stress from suspended sediments rather than lethality because of their ability to move away from or out of an area of higher concentrations. The prey species of marine mammals are highly mobile and, therefore, can be expected to move out of the turbid area. The maximum predicted area of effect is small compared to the available habitat for fish and the potential areas do not represent key refuge or foraging habitat for marine mammal prey species.

8.3.174 It is considered very unlikely that an individual marine mammal would enter the very small areas that could be affected by discharges and the shallow depth of water where the discharge points are located. Water depth at the discharge points ranges from zero (water running across the foreshore in two locations) to a few metres at high water. Therefore no significant effects on marine mammals or their prey are predicted as a result of any suspended sediment discharged into the marine environment during construction.

Changes in chemical quality

8.3.175 An H1 assessment has been carried out to calculate the chemical composition of the discharges from all sources and compare the predicted quality of the discharges to EQSs (Application Reference Number: 6.4.96).

8.3.176 The H1 assessment represents the worst case scenario and concluded that, for marine waters, dissolved copper, lead, zinc and nickel required further modelling; hence Delft3d modelling was carried out for these metals.

8.3.177 The modelling predicted maximum concentrations of dissolved nickel below its annual average EQS. For copper, zinc and lead, the predicted maximum concentrations are above the relevant annual average EQS and the largest mixing zones are due to the discharge from location 3S (figure 8-3). The results of the H1 assessment are illustrated in figures 7-10 to 7-12. The mixing zones for all other discharge locations are within 500m of the discharge.

8.3.178 The mixing zones are precautionary, as soil stripping, earthworks, dewatering and mound creation would occur in different locations at different times, and the H1 assessment screening phase uses raw data from leaching tests and it assumes that the surfaces of mounds are bare soil. This is considered to be the worst case as the mounds would be seeded, reducing the leaching of substances from the soil and, therefore, the effect is not permanent. Given the above, it is considered highly unlikely that there is the potential for any effect on marine mammals and their prey from changes in chemical quality due to discharges into the marine environment during construction.

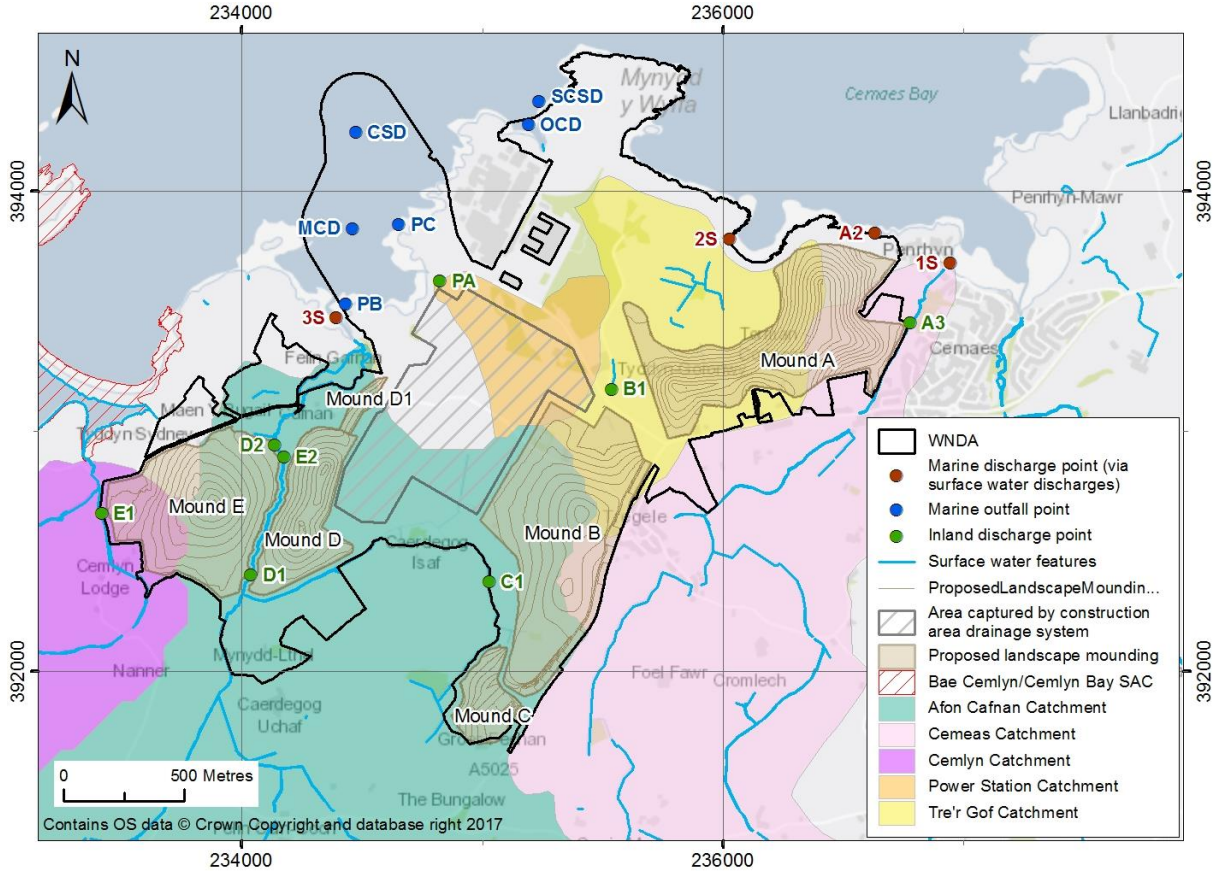

Figure 8-3Modelled marine discharge locations for the H1 construction assessment (noting location of 3S)

8.3.179 Any changes to freshwater flows, nutrient concentrations and oxygenation conditions are not predicted to vary outside of baseline conditions (Application Reference Number: 6.4.13) and, therefore, no potential effect is predicted.

C2 Increase in suspended sediment concentration and contaminant re-mobilisation during dredging and disposal [Marine Licence]

Suspended sediment - dredging

8.3.180 Dredging of soft sediments would be used to prepare the seabed for marine construction. The dredging in the Wylfa Newydd Development Area could result in an increase in suspended solids concentrations as soft sediment is removed from the seabed. Mobilisation of sediment may release sediment-bound contaminants into the water column with potential indirect effects on marine mammals and their prey.

8.3.181 It is anticipated that dredging of soft sediments would take 35 days and approximately 242,000m^3 of soft sediments would be dredged (Application Reference Number: 6.4.13). During this period it is assumed that the disposal of sediment would be continuous, without a break in operations, representing the worst case scenario.

8.3.182 The modelling of the dispersion of suspended sediment during dredging indicates that the extent of the suspended sediment concentrations within the plume are predicted to be above background levels (approximately 6.1mg/L) over a maximum area of 0.25km^2 (at mid water depth) in the Wylfa Newydd Development Area (Application Reference Number: 6.4.13).

8.3.183 However, the marine environment is characterised by strong tidal flows and the receiving marine waters have a high capacity for mixing and dilution. Upon entering the marine environment suspended solids would be rapidly dispersed.

8.3.184 Moreover, marine mammals often inhabit turbid environments, many utilize sonar to sense the environment around them and there is little evidence that turbidity affects cetaceans directly [RD340]. Pinnipeds are not known to produce sonar for prey detection purposes; however, it is likely that other senses are used instead of, or in combination with, vision. Studies have shown that vision is not essential to seal survival or their ability to forage [RD340].

8.3.185 [RD340] concluded that the limited available information indicates that increased turbidity, as a result of dredging, is unlikely to have a substantial direct impact on marine mammals that often inhabit naturally turbid or dark environments. This is likely because other senses are utilised, and vision is not relied upon solely.

8.3.186 Therefore, given the temporary nature of the dredging and the limited extent of the predicted effect, the effect due to changes in suspended sediment concentrations during dredging activities is predicted to be limited on marine water quality and there would be no effect on marine mammals.

Contaminant remobilisation

8.3.187 Sediment samples were collected in the Wylfa Newydd Development Area in 2010 and 2011. In 2011 and 2014 samples were collected from two sites in Porth-y-pistyll. The sediments collected were analysed for compounds known to be hazardous to aquatic life. The result indicated that, sediment-bound concentrations of copper, zinc, cadmium, mercury, lead and chromium were below the relevant Threshold Effect Levels (TEL). Concentrations of arsenic exceeded the TEL at three sites and the nickel TEL was also slightly exceeded at two sites. Concentrations of tributyltin in samples were below Cefas Action Level 1, with one exception, which was slightly above Action Level 1 but below the threshold for Action Level 2. All polycyclic aromatic hydrocarbons (PAH) concentrations were below the Probable Effect Levels (PEL) and the majority were lower than the TEL. All total polychlorinated biphenyl (PCB) concentrations were below Action Level 1 and the majority of individual sediment-bound PCB concentrations were less than the minimum reporting value (MRV) (Application Reference Number: 6.4.13).

8.3.188 TEL and PEL are defined by the Canadian sediment quality guidelines [RD35]. These are referred to in the absence of equivalent UK guidelines. The TEL of a substance is the concentration below which sediment

associated chemicals are not considered to represent significant hazards to aquatic organisms. The PEL represents the lowest concentration of a substance that is known to have an adverse effect on aquatic organisms. MRVs are minimum concentrations used for reporting purposes. MRVs are often higher than the statistically derived Limits of Detection method and provide higher confidence that a sample is different from a blank sample (Application Reference Number: 6.4.13).

8.3.189 Based on the worst case scenario for the modelling, the maximum incremental suspended sediment concentration in the dredge area is assumed to be 1,000mg/L. The results indicate that the maximum dissolved concentration for each contaminant resulting from dredging would be several orders of magnitude below the relevant EQS, suggesting that the potential for dredging activity within the Wylfa Newydd Development Area to affect water quality from contaminants in sediments is minimal (Application Reference Number: 6.4.13).

8.3.190 However, the potential change in the dissolved concentration of contaminants due to dredging activities within the Wylfa Newydd Development Area suggests that very small increases may occur in isolation and it is necessary to consider the resultant concentration in addition to ambient levels. The assessment indicates that sediment re-suspended during dredging activities would contain small quantities of contaminants and, assuming a proportion of this material would transfer into the dissolved phase, then it is possible that a further small temporary uplift in concentration may result. However, this short-term (localised) increase in concentrations would be less than 0.1% compared to maximum ambient levels for all metals, with the exception of nickel (1.2%). Using the maximum annual ambient metal concentration, the annual average-EQS thresholds would not be exceeded for all metals. Similar short-term, small-scale increases in concentration can be expected for other contaminants found within sediments at the Wylfa Newydd Development Area, including organotins, PCBs and PAHs, with any small uplift in concentration returning to ambient levels very quickly (Application Reference Number: 6.4.13).

8.3.191 Overall, the quality of sediment in the Wylfa Newydd Development Area is not considered to be contaminated. Therefore, it is considered highly unlikely that there would be any risk to marine mammals and their prey from contaminant re-mobilisation during dredging and disposal.

Suspended sediment - disposal

8.3.192 Disposal of sediment could also result in an increase in suspended sediment concentration at and beyond the point of disposal, with sediment dispersion subject to the hydrodynamic processes at the Disposal Site. Mobilisation of sediment at the point of disposal may also result in the release of sediment-bound contaminants into the water column with potential indirect effects on marine organisms.

8.3.193 The modelling outputs following a single disposal event showed that the plume (mostly represented by suspended sediment concentrations that

exceed typical background levels by no more than 10 mg/L) disperses to background suspended sediment concentration levels after approximately three hours. After 48 hours from the final disposal event of all material the model indicates that the sediment plume would not be discernible from the background environment (Application Reference Number: 6.4.13).

8.3.194 At the point of disposal, at zero hours, an increase from typical background suspended sediment concentrations to 1600mg/L was assumed for the modelling, based on the sediment density within the hopper. Although the disposal increase in suspended sediment concentrations is higher than that modelled for the dredging, as the dissolved concentration for each contaminant from the sediment is several orders of magnitude below the available EQS, the effect on water quality from contaminants in sediments disposed at the Disposal Site similarly would be minimal (Application Reference Number: 6.4.13).

Bioaccumulation

8.3.195 Dredging and other activities that disturb the sediments can release contaminants into the water column, which have the potential to change the chemical properties of the sediment, and reduce water quality for some time after dredging has ceased. Contaminants can become available to marine organisms and potentially bioaccumulate up the food chain [RD340].

8.3.196 Remobilisation and bioavailability of contaminants is site-specific, complex, and affected by a multitude of factors. Literature on the release of contaminants as a result of dredging suggests that as long as highly contaminated sediments are managed appropriately, concentrations should not be high enough to have detrimental effects on the environment ([RD278]; [RD340]).

8.3.197 Marine mammals are susceptible to bioaccumulation because they feed at high trophic levels, and have a large proportion of lipid-rich blubber which accumulates contaminants readily [RD350]. High contaminant levels have been linked to immune system depression, disease, reproductive effects, developmental effects and endocrine disruption ([RD218]; [RD350].

8.3.198 Marine mammals can accumulate high levels of contaminants irrespective of whether dredging occurs. Therefore, linking the remobilisation of contaminants from dredging and other activities to potential effects in marine mammals is challenging. Levels of toxins in blubber before, during, and after dredging are unknown, marine mammals are mobile and exposed to contaminants throughout their entire range, and any effects are only likely to be discovered long after dredging or other activities cease [RD340].

8.3.199 Due to the limited dispersion area, rapid dispersion and material being quickly deposited, along with low contaminant levels in sediments, any potential effects on marine mammals or their prey as a result of increased suspended sediments and contaminant re-mobilisation are highly unlikely at either the Wylfa Newydd Development Area or Disposal Site. Nevertheless, the number of harbour porpoise, bottlenose dolphin, grey seal and harbour seal that potentially could be present (and the percentage of the reference

population) in the Wylfa Newydd Development Area (0.35km^2), the Disposal Site (0.375km^2) and the Disposal Site with a 100m buffer (0.651km^2), based on maximum species density estimates for the area, are set out in table 8-39.

Table 8-39 Estimated number of harbour porpoise, bottlenose dolphin, grey seal and harbour seal, and percentage of reference population, that could be present in area of increased suspended sediment and potential contaminant re-mobilisation

Species	Estimated number in area and percentage of reference population		
	Wylfa Newydd Development Area (0.35km^2)	Disposal Site (0.375km^2)	Disposal Site plus 100m buffer (0.651km^2)
Harbour porpoise	0.44 (0.0004%)	0.95 (0.0009%)	1.65 (0.002%)
Bottlenose dolphin	0.12 (0.03%)	0.13 (0.03%)	0.22 (0.06%)
Grey seal	0.08 (0.001%)	0.05 (0.0008%)	0.08 (0.001%)
Harbour seal	0.0003 (0.0006%)	0.0003 (0.0006%)	0.0005 (0.001%)

8.3.200 The assessment assumes that all harbour porpoise, bottlenose dolphin, grey seal and harbour seal could be from a European Designated Site. Conclusions are drawn with respect to the influence of the effects on site integrity, for each relevant European Designated Site, in sections 8.5 to 8.10.

8.3.201 However, based on the low number of individuals that could be affected and the relatively small area of the effect, in relation to the range of marine mammal species and areas covered by the reference populations, there is unlikely to be a significant effect on harbour porpoise, bottlenose dolphin, grey seal or harbour seal. Therefore an adverse effect is not anticipated on the the integrity of European Designated Sites where these species are a qualifying feature.

Effects on prey species

8.3.202 Juvenile and adult fish are mobile and would be able to avoid the localised areas affected by increased suspended sediment and sediment re-deposition. If displaced, they would be able to move to adjacent, undisturbed areas within their normal habitat range. However, excessive suspended sediment either in suspension or deposited can have a range of effects on fish, from mortality to gill trauma and a reduction in reproductive success.

8.3.203 [RD12] determined that the relationship between suspended sediment concentration and the effect on fish health was dependent on life stage, sediment composition and the availability of refuges. In addition, the level of exposure, duration and frequency of the effect [RD302] and the tolerance

threshold to suspended sediment concentration has an effect on growth feeding and mortality rates [RD274].

8.3.204 As a function of their migratory behaviour, diadromous species of fish will encounter and tolerate a range of environmental conditions as they pass through fresh, brackish and seawater during their life cycle. Such environmental conditions will include very turbid waters and a range of temperature, salinity and dissolved oxygen levels. Mortality is seldom recorded in migratory species as a result of increased suspended sediment concentration, although a range of sub-lethal effects can be seen, such as clogging of gills, increased deformities, fin erosion and lesions and 'coughing' behaviour [RD302]. Turbid water can also reduce feeding rates in salmonids which are visual feeders [RD17].

8.3.205 A review of critical thresholds by [RD19] reported ranges of 4-330,000mg/L for various fish species, but the severity of effect was directly related to associated stressors as defined above. Exposure time is a key parameter determining the physiological effects and the resultant barrier to migration [RD241].

8.3.206 The potential effects on marine mammal prey species from suspended sediment during dredging and disposal would be temporary (approximately 35 days) and the area affected would be small in relation to the available refuge and foraging habitat. Therefore taking this and the low contaminant levels from any re-mobilisation during dredging and disposal, the potential effect on all fish receptors is predicted to be very small.

8.3.207 In addition, as the maximum predicted effect area for any increased suspended sediments is the same for marine mammals and their prey, there would be no additional impacts on marine mammals as a result of the effects of any increased suspended sediments on prey species, as marine mammals and their prey would be displaced from the same area.

8.3.208 Taking into account the diet of marine mammal species (see chapter 6) and the fish species likely to be present in the Wylfa Newydd Development Area (ES Volume D – Wylfa Newydd Development Area Development D13 – The Marine Environment, Application Reference Number: 6.4.13), the area is unlikely to represent a key foraging area. Therefore any displacement of marine mammals due to a loss of food resource is considered to be unlikely. Moreover, the area of the potential effect represents a very small proportion of the foraging area of marine mammals (for example, 1km^2 (the total area of Wylfa Newydd Development Area and Disposal Site plus buffer) is approximately 0.0002% of the harbour porpoise CIS MU area (516,893km^2) and 0.002% of the bottlenose dolphin IS MU area (50,145km^2)).

8.3.209 Therefore, based on the low number of individuals that could be affected and the very small area of the effect in relation to the foraging ranges of marine mammal species and areas covered by the reference populations, there is unlikely to be a significant effect on harbour porpoise, bottlenose dolphin, grey seal or harbour seal. Therefore an adverse effect is not anticipated on the the integrity of European Designated Sites where these species are a qualifying feature.

C3 Operational discharge from the cooling water system [Operational water discharge activity EP]

Effects on seawater temperature

Background

8.3.210 There is a clear seasonal pattern to the seawater temperature, with higher temperatures in summer than winter. The lowest temperature recorded in the Project surveys undertaken was 6.08°C (in March 2013) and the highest was 16.84°C (in August 2014). The results of the marine water temperature monitoring indicate a well-mixed water column, with mostly less than a 0.4°C difference in the temperature recorded at the seabed and within the water column (Application Reference Number: 6.4.13). However, there were indications of short-term effects from the cooling water discharge for the Existing Power Station, with weak thermal stratification. This is evidenced by the increase of 4.2°C from the seabed (11.0°C) to the water column (15.2°C) at 50m from the Existing Power Station cooling water outfall location (Application Reference Number: 6.4.13).

8.3.211 It is proposed that the cooling water discharge would be located adjacent to the outfall of the Existing Power Station. The discharge water would be approximately 12°C (98 percentile) warmer than the water being abstracted at the point of discharge. The volume of water discharged would vary over the tidal cycle from 113m^3/s at LAT to 126m^3/s at HAT (Application Reference Number: 6.4.13).

Modelling results

8.3.212 Modelling was conducted for simulations of the cooling water discharge using the excess temperature surface heat exchange sub model within Delft3D. The modelling methodology is described in Application Reference Number: 6.4.90.

8.3.213 The base case simulations used a fixed discharge condition of 126m^3/s and a temperature rise of 12°C (98 percentile). Four base case simulations were modelled covering summer, autumn, winter and spring seasons. These simulations used seasonally appropriate surface heat loss rates and were undertaken without the influence of wind or wave stress on the water surface.

8.3.214 The cooling water discharge is buoyant and would form a plume at the surface. The vertical profile along a north-south axis indicates that near the outfall at low water, there would be a rise of around 9°C close to the outfall, with a temperature rise of 4°C to 5°C predicted within the upper 4m to 5m of the water column. For the other tidal states, the predicted temperature rise is similar, although with less spread of the plume than at low water. The modelling indicates that the plume is limited to the upper layers of the water column, except in the vicinity of the outfall where the seabed is exposed to increased temperatures (Application Reference Number: 6.4.13).

8.3.215 Figures 8-5 to 8-12 show the vertical temperature profile at the different stages of the tide; in these plots the viewer is effectively facing east so that the shoreline is on the right hand side of each image, depicting how the plume temperatures vary throughout the vertical column. A neap tide has been presented as the temperature rise is higher on a neap than a spring tide. The horizontal and the vertical scales differ for the cross section through the outfall and through Cemlyn Bay.

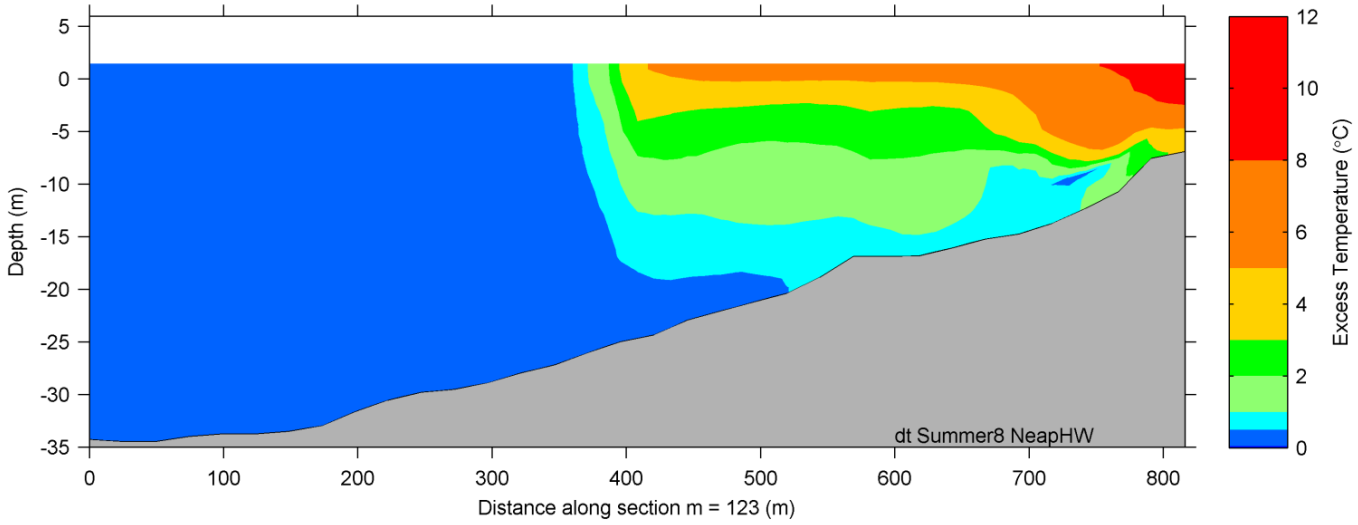

Figure 8-4 Vertical temperature profile at the outfall location at high water – neap tide

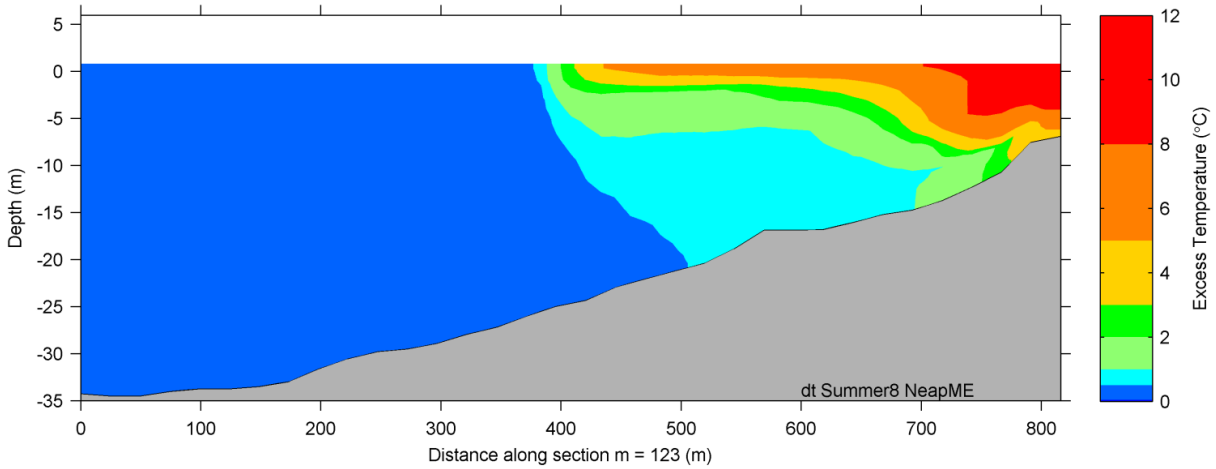

Figure 8-5 Vertical temperature profile at the outfall location at mid ebb – neap tide

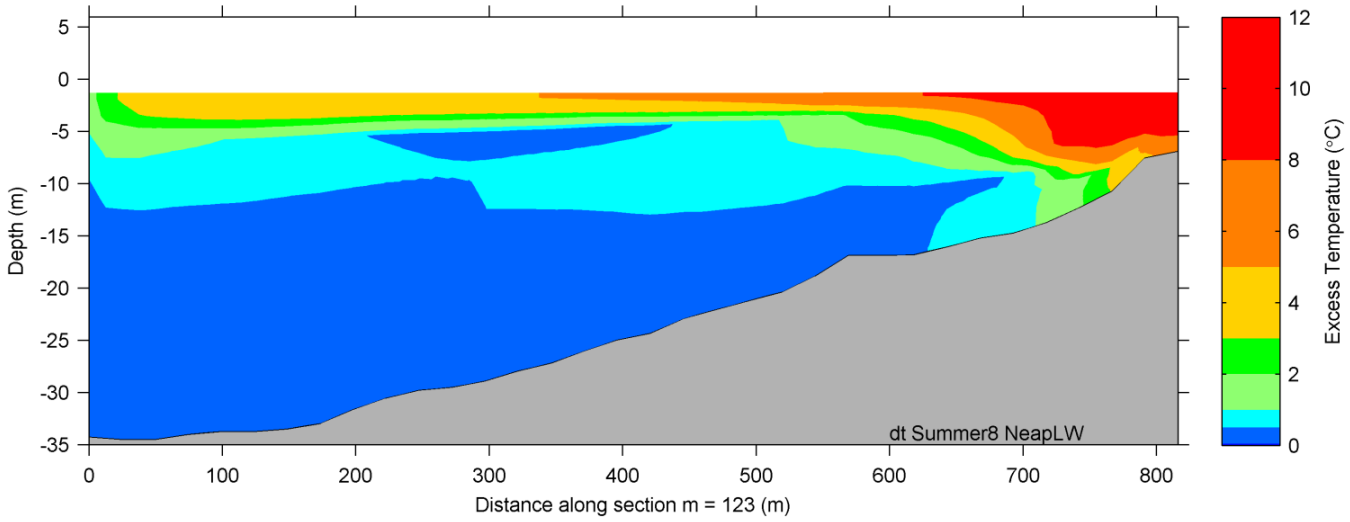

Figure 8-6 Vertical temperature profile at the outfall location at low water – neap tide

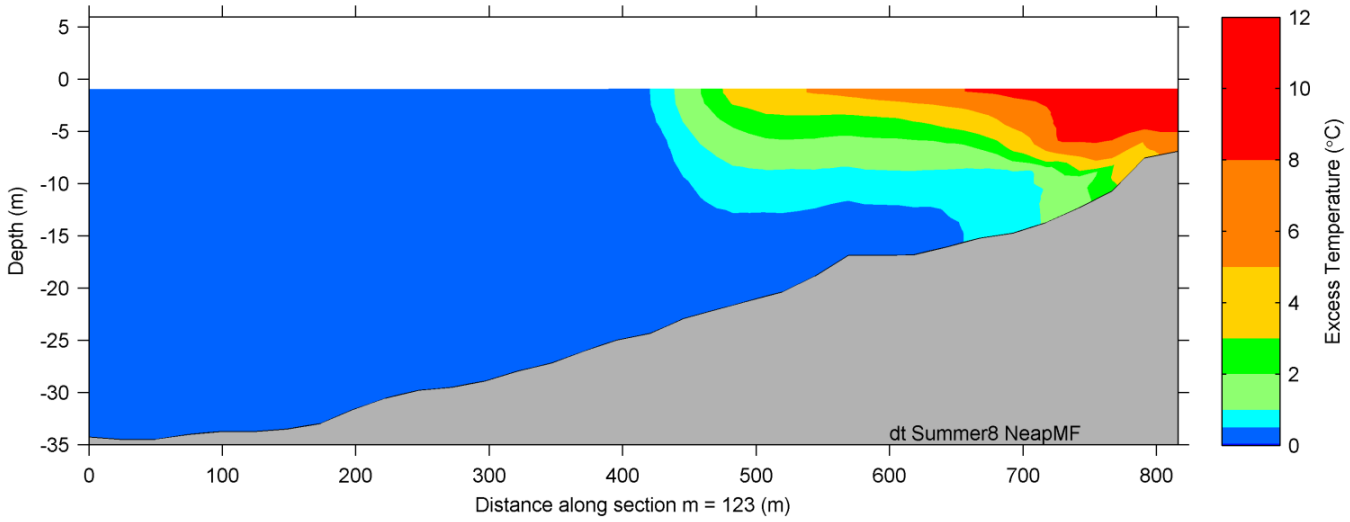

Figure 8-7 Vertical temperature profile at the outfall location at mid flood – neap tide

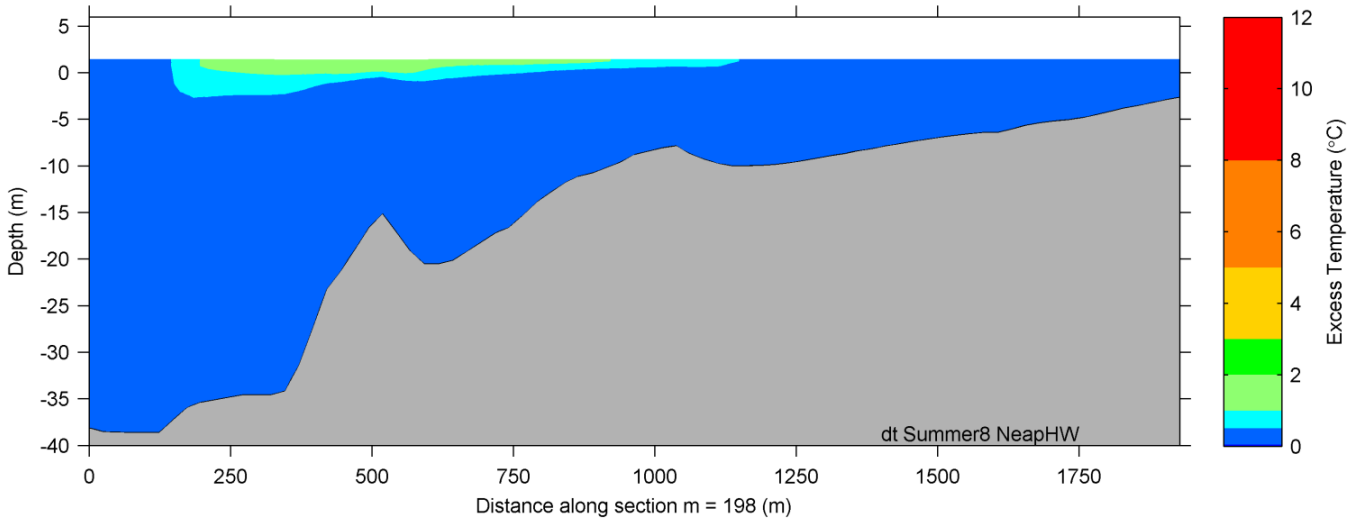

Figure 8-8 Vertical temperature profile at Cemlyn Bay at high water – neap tide

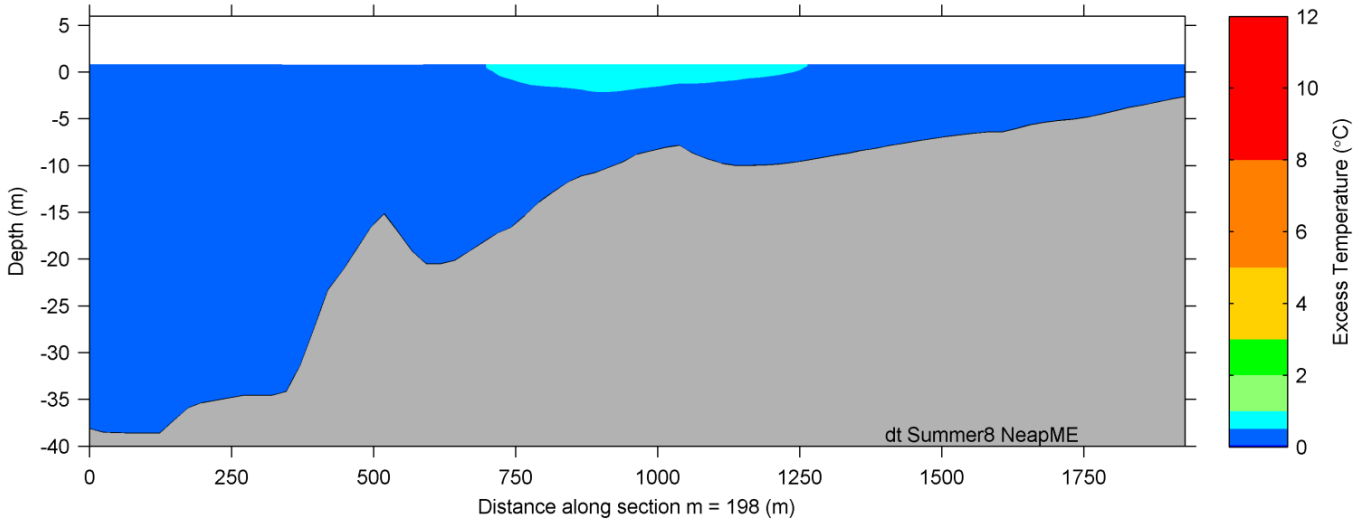

Figure 8-9 Vertical temperature profile at Cemlyn Bay at mid ebb – neap tide

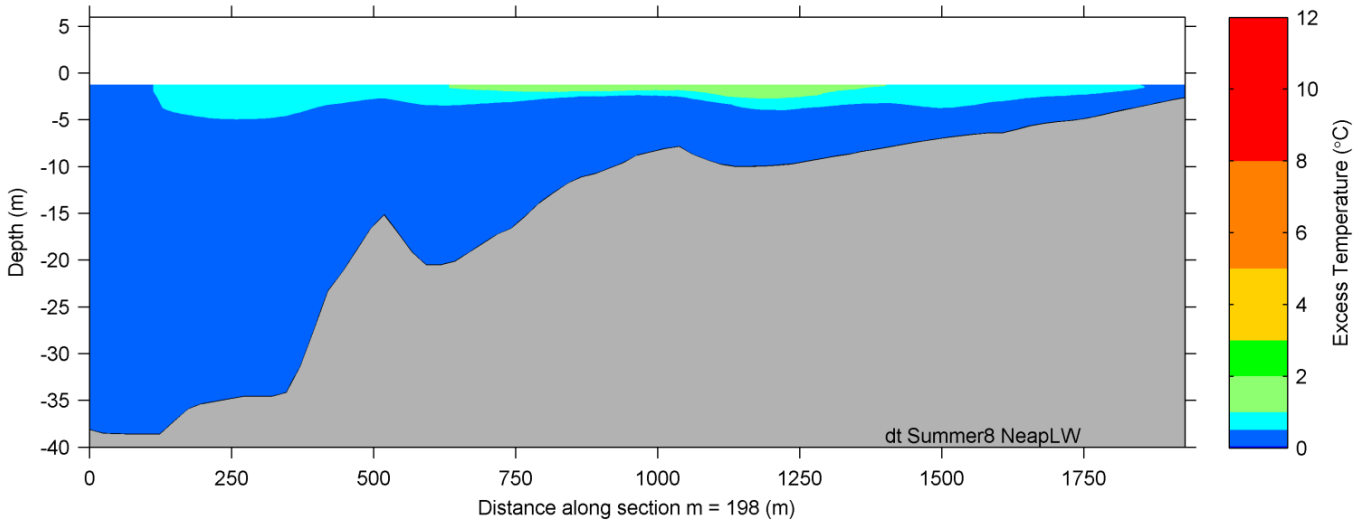

Figure 8-10 Vertical temperature profile at Cemlyn Bay at low water – neap tide

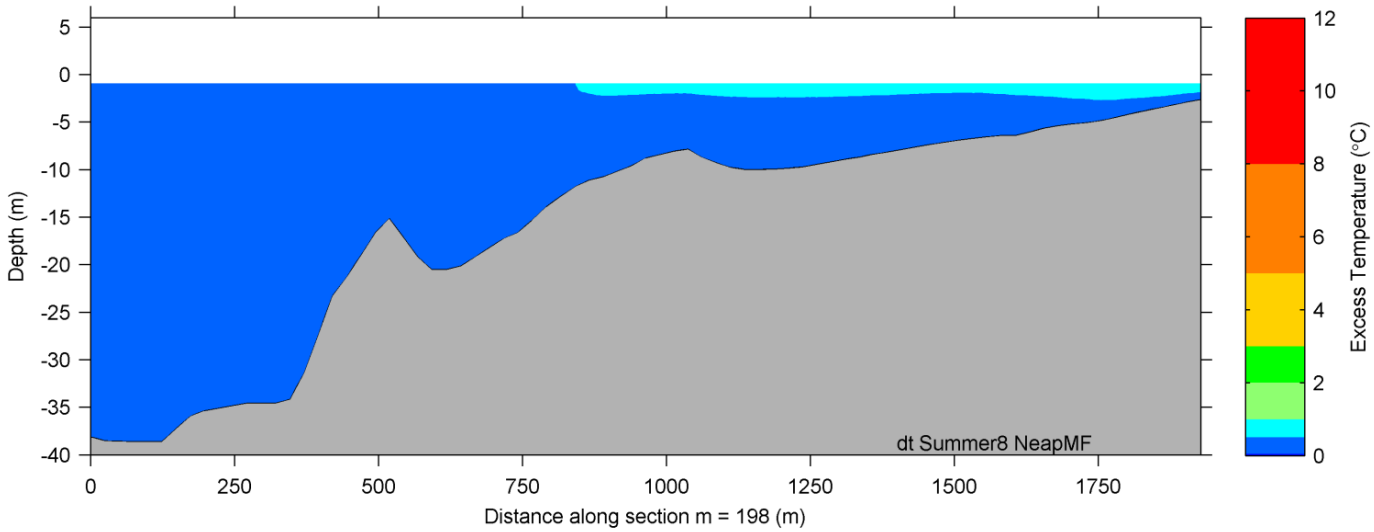

Figure 8-11 Vertical temperature profile at Cemlyn Bay at mid flood – neap tide

8.3.216 The modelling shows that temperatures in excess of 8°C (98 percentile) above ambient, up to a maximum of 12°C (98 percentile), are restricted to a small area at the outfall located at Porth Wnal and to the west of Wylfa Head (Application Reference Number: 6.4.13).

Thermal standards

8.3.217 There is little guidance on what the maximum allowable temperature for a discharge should be in a coastal or marine area. In 2006, draft guidance from Water Quality Technical Advisory Group [RD353] was developed on the temperature thresholds specific for the use in determining the threshold for impact for use within HRA for estuary embayment habitat [RD353]. Although this guidance has not been formally adopted, it remains the only relevant guidance for assessing the effect of thermal regime changes within SACs. The guidance recommended that a 2°C uplift standard at the edge of a

mixing zone (based on temperature threshold values set under the Freshwater Fish Directive (2006/44/EC)) should be adopted for marine SPAs and marine SACs (restricted to areas designated for estuary embayment habitats). No guidance was developed for SACs in open coastal locations (i.e. as is relevant to the Project location).

8.3.218 The British Energy Estuarine and Marine Studies (BEEMS) Expert Panel produced a report, *Thermal standards for Cooling Water from new build nuclear power stations*, which summarises existing temperature standards and provides evidence on the effects of thermal discharges [RD24]. This report presents detailed information regarding the thermal tolerances of a wide range of fish species resident in transitional (estuaries) and coastal waters. It also makes recommendations regarding temperature standards for thermal discharge. The key conclusion from this study was that "temperature rises up to 3°C appear to be tolerable and that resulting temperatures less than 27°C have no clear deleterious impact on species in receiving waters" [RD24].

8.3.219 The temperature boundary for transitional and coastal water bodies proposed by BEEMS [RD24] is 2°C (Maximum Allowable Temperature uplift) (for High/Good waterbody classifications under the Water Framework Directive) at the edge of the mixing zone. For the purposes of the assessment of potential effects on marine mammals and their prey, the BEEMS [RD24] guidance is considered the most relevant, particularly given the open coastal location of the Project.

8.3.220 The modelling results for the extent of the thermal mixing zone (with a cooling water abstraction rate of 126m^3/s), predicts an approximate area of 2.09km^2 for a 2°C (98% percentile) rise at the surface and 0.88km^2 for a 3°C (98% percentile) rise at the surface, based on annual base case (with no wind). Of the four seasons, the modelled results for the autumn base case (with a wind speed of 6.8m/s) had the greatest predicted extents of the thermal plume, with an area of 2.4km^2 for a 2°C (98 percentile rise) at the surface and 0.91km^2 for a 3°C (98 percentile rise) at the surface (table 8-40) (Application Reference Number: 6.4.13).

Table 8-40 Predicted area affected by an increase in temperature of 2°C and 3°C at the surface

	Annual base case	Spring base case	Summer base case	Autumn base case	Winter base case
2°C rise at surface	2.09km^2	2.12km^2	2.27km^2	2.41km^2	1.76km^2
3°C rise at surface	0.88km^2	0.89km^2	0.89km^2	0.91km^2	0.79km^2

Predicted effects on marine mammals

Direct effect

8.3.221 Marine mammals have the ability to regulate their body temperature during periods of high activity or when the ambient temperature is warm [RD208]. They do this by controlling the blood flow through their flukes, pectoral and dorsal fins to move blood from their body; this allows the blood to cool as it flows through their fins (for example, [RD294]).

8.3.222 While the change in temperature would be noticeable to marine mammal species, these species are well adapted and accustomed to the change in water temperature as they dive. Due to the evolved ability for marine mammals to naturally regulate their body temperature, it is concluded that the change in ambient temperature due to the thermal plume would have no direct impact on marine mammal species.

8.3.223 On a precautionary basis, however, the number of harbour porpoise, bottlenose dolphin, grey seal and harbour seal that could be present in the areas of the thermal plume predicted to experience a $2^{o}C$ ($2.41km^2$) temperature increase (and the percentage of the reference population affected) has been estimated (table 8-41, based on). This is based on the maximum species density estimates for the area (see chapter 6) and the maximum potential area that an increase of $2^{o}C$ in temperature could affect.

Table 8-41 Estimated number of harbour porpoise, bottlenose dolphin, grey seal and harbour seal, and percentage of reference population, that could be present in the area of water temperature change ($2^{o}C$ increase) ($2.41km^2$)

Species	Estimated number in area and percentage of reference population
Harbour porpoise	3.04 (0.003%)
Bottlenose dolphin	0.83 (0.2%)
Grey seal	0.58 (0.01%)
Harbour seal	0.002 (0.004%)

8.3.224 The area of the effect represents a very small proportion of the area available to marine mammals (for example, $2.41km^2$ is approximately 0.0005% of the harbour porpoise Celtic and Irish Sea MU area ($516,893km^2$) and 0.005% of the bottlenose dolphin Irish Sea MU area ($50,145km^2$)). However, the assessment assumes that all harbour porpoise, bottlenose dolphin, grey seal and harbour seal could be from a European Designated Site. Conclusions are drawn with respect to the influence of the effect on site integrity, for each relevant European Designated Site, in sections 8.5 to 8.10.

Indirect effect: effect on fish (prey species)

8.3.225 Depending on the species, temperature may have a positive, negative or neutral effect on fish. [RD186] examined data from power plant studies around the world and found no instance of direct fish mortalities associated with a power plant outfall. Therefore, the potential effects are active thermal

avoidance or attraction, changes in growth rate or the modification of community structure resulting from warm-water species being favoured over cold-water species.

8.3.226 It is the potential displacement of fish that could indirectly affect marine mammals.

8.3.227 The results of the marine water temperature monitoring indicate that water temperatures can vary by as much as 10^{o}C between the lowest temperature recorded in the winter and the highest temperature recorded in summer (Application Reference Number: 6.4.13). Therefore, fish species in the area are used to and able to tolerate seasonal changes in temperature.

8.3.228 As set out above, the cooling water discharge is buoyant and would form a plume at the surface, which would be advected by the tide and influenced by wind and waves. The buoyancy of the thermal plume limits the exposure of the bed to elevated temperatures, with the cross-sectional profile showing that the surface waters are more affected. Therefore, the maximum areas of potential impact on the seabed are considerably less than the potential impact areas at the surface (Application Reference Number: 6.4.13).

8.3.229 The modelling results for the extent of the thermal plume mixing zone at the surface for 2°C (98% percentile) rise and 3°C (98% percentile) rise are presented in table 8-40, and the results at the seabed are presented in table 8-42.

Table 8-42 Potential area of temperature plume impact at seabed

Thermal Plume (98% percentile	Annual base case	Spring base case	Summer base case	Autumn base case	Winter base case
2^{o}C rise at seabed	0.042km^2	0.041km^2	0.035km^2	0.039km^2	0.041km^2
3^{o}C rise at seabed	0.032km^2	0.032km^2	0.027km^2	0.031km^2	0.032km^2

8.3.230 The hydrodynamic modelling predicts that a seabed temperature rise of 2°C (98 percentile) or more would be restricted to a maximum area of 0.4km^2 in the immediate vicinity of the outfall (table 8-42). The subtidal habitat in this location is silt overlying bedrock and, therefore, any potential prey species that could be in this area would be determined by habitat preferences. For example, the area is not typically suitable sandeel habitat and therefore no effect on sandeels or their eggs are predicted (Application Reference Number: 6.4.13).

8.3.231 Due to the various unknowns in the thermal tolerance of some fish species and their larvae, it is assumed that most would avoid the highest temperature around the immediate area of the cooling water outfall. As a worst case approach it has been assumed that all marine mammal prey species could be displaced from the area within the 2^{o}C contour. It should be noted, however, that no fatalities of prey species are expected as a result of an increase in temperature and that all prey would be available to marine mammals outside of the 2^{o}C contour.

8.3.232 On a precautionary basis, the number of harbour porpoise, bottlenose dolphin, grey seal and harbour seal that could be present in the thermal plume areas from which prey species could be displaced (and the percentage of the reference population) has been estimated. However, as the maximum predicted area of effect for any changes in water temperature would be the same for marine mammals and their prey, there would be no additional impacts on marine mammals as a result of the effects of any changes in water temperature on prey species (see table 8-41).

8.3.233 Taking into account the diet of marine mammal species (see chapter 6) and the fish species likely to be present in the Wylfa Newydd Development Area (Application Reference Number: 6.4.13), the area is not expected to represent a key foraging area. Therefore the displacement of marine mammals due to a loss of food resource is predicted to be unlikely. Moreover, the area of potential impact represents a very small proportion of the foraging area of marine mammals.

Outcome

8.3.234 Therefore, based on the low number of individuals that could be affected and the very small area that the thermal plume would influence, in relation to the foraging ranges of marine mammal species and areas covered by the reference populations, there is unlikely to be a significant effect on harbour porpoise, bottlenose dolphin, grey seal or harbour seal. Consequently an adverse effect is not anticipated on the the integrity of European Designated Sites where these species are a qualifying feature.

Changes to pH and the ratio of ionised to unionised ammonia as a result of changing temperatures from cooling water discharge during operation

8.3.235 Within the water column, ammonia exists as either an ionised or unionised form; with unionised typically being more toxic the aquatic life. The ratio of ionised to unionised ammonia varies environmental conditions such as temperature and pH; with the concentration of unionised ammonia increasing with temperature; with every 9°C increase in temperature, the level of unionised ammonia approximately doubles [RD346]. The predicted change in thermal regime therefore has the potential to change this ratio.

8.3.236 Baseline levels of ionised ammonia were found to be 0.0293mg/L with unionised levels of 0.58µg/l, with a ratio of 2% unionised ammonia (Application Reference Number: 6.4.13). Modelling revealed that the unionised ammonia is predicted to remain well below the recommended WFD EQS of 21µg/L, with the highest levels predicted being 1.91µg/L for a temperature increase of 12^{o}C (i.e. at a temperature of 28^{o}C). It is therefore expected that there would not be a significant effect on water quality due to the change in pH and ratio of ionised to unionised ammonia as a result of changing temperatures from cooling water discharge during operation (Application Reference Number: 6.4.13). Therefore this effect was not assessed further for marine mammals or their prey in this Shadow HRA.

Changes to dissolved oxygen levels as a result of changing temperatures from cooling water discharge during operation

8.3.237 As water temperatures increase, the solubility of gases in the water decreases. This has the potential to reduce the amount of dissolved oxygen available to all marine organisms. The water quality surveys found levels of 90.2% to 121.1% across the surveys (Application Reference Number: 6.4.13). To assess the status of the dissolved oxygen levels, they must be related back to the salinity level. The water quality surveys reported salinity levels of between 32.8 and 35.29 (Application Reference Number: 6.4.13).

8.3.238 The WFD standard for dissolved oxygen with salinity levels of 35 are 5.7mg/L for an assessment of 'high', 4.0mg/L for 'good', 2.4mg/L for 'moderate' and 1.6mg/L for 'poor'.

8.3.239 The minimum predicted dissolved oxygen concentration, assuming an average salinity of 33.6 and a maximum temperature rise, is greater than the 'high' status boundary value of 5.7mg/L (i.e. the dissolved oxygen standard for coastal water bodies defined in Water Framework Directive (Standards and Classification) Directions (England and Wales) 2015) (ES Volume D – Wylfa Newydd Development Area Development D13 – The Marine Environment, Application Reference Number: 6.4.13). The minimum saturated dissolved oxygen concentration occurs at the discharge, where the temperature increase is greatest.

8.3.240 As the predicted dissolved oxygen concentration would remain well above the concentration required to achieve high status, it is determined that there would be no significant effect on water quality from changes to dissolved oxygen as a result of the Project's thermal discharge during operation (Application Reference Number: 6.4.13). Therefore this effect was not assessed further for marine mammals or their prey in this Shadow HRA.

Total Residual Oxidants (TRO) from cooling water discharge during operation

8.3.241 Marine organisms (such as, young mussels, tubeworms, barnacles, hydroids and sponges) can become attached to submerged structures and can cause problems with the associated function of those structures. For any power plant with seawater intake it is considered essential to use biocide to prevent this biofouling, especially for the cooling water intake system. It is proposed that sodium hypochlorite would be as the biocide used for this purpose. The biocide dosing regime will be designed to reduce biofouling risk. In line with best practice, continuous dosing would be applied during a higher fouling risk period, typically between April and December, when sea temperatures are above 10°C. Typically biocide dosing would be applied to all areas of the CWS except around screens to prevent harm to fish impinged on screens. To prevent fouling of the intake area upstream of the screens, intermittent 'shock' treatment is likely to be carried out during outage periods of the screens and pumps (Application Reference Number: 6.4.13).

8.3.242 Any residual biocide that is discharged with the cooling water is referred to as the Total Residual Oxidant (TRO). TRO is the sum of the following oxidants:

- free (available) chlorine which is that present as an equilibrium mixture of hypochlorous acid (HOCl) and hypochlorite ions (OCl-); and
- combined (available) chlorine which is available in (mainly) inorganic chloramines and in other compounds having a nitrogen-carbon link.

8.3.243 Following discharge, the concentration of TRO would diminish through dilution, additional demand introduced by the receiving water and by continuing decay reactions. Decay/demand would likely be greatest in late spring and summer when productivity and water temperatures are at their highest. However, relative dilution and dispersal may be greatest during autumn and winter when the coastal waters are subject to greater mixing from wind and wave action (Application Reference Number: 6.4.13).

8.3.244 Embedded mitigation is incorporated within the cooling water outfall design, including increasing the momentum of the outfall water which helps to propel the thermal plume and any associated biocides further into the marine environment. In addition, the strong tidal currents will promote mixing and dispersal of associated biocide products to the north of Wylfa Head where offshore currents will aid decay and dispersion. There would also be dosing and monitoring of the sodium hypochlorite to ensure it never breaches a level of 0.1mg/L at the point of cooling water discharge and 0.01mg/L (95 percentile) at the edge of the mixing zone, to ensure TRO concentrations remain as low as possible in the receiving waters (Application Reference Number: 6.4.13).

8.3.245 The WFD (Standards and Classification) Directions (England and Wales) 2015 (Part 2, Article 1) set the 'end of pipe' EQS for TRO as 0.01mg/L, as a 95 percentile.

8.3.246 Modelling results for the maximum predicted impact areas for TRO based on the seasonal worse case scenarios are presented in table 8-43.

Table 8-43 Area of the 0.01mg/L TRO (95 percentile) mixing zone

Scenario	Area at the surface exceeding 0.01mg/L TRO (95 percentile) (km^2)
Annual base case	2.49
Spring base case (9^oC ambient seawater temperature and wind speed of 6m/s)	2.22
Summer base case (14.6^oC ambient seawater temperature and wind speed of 5.6m/s)	3.13
Autumn base case (14.3^oC ambient seawater temperature and wind speed of 6.8m/s)	2.88
Winter base case	1.85

Scenario	Area at the surface exceeding 0.01mg/L TRO (95 percentile) (km^2)
(8.5°C ambient seawater temperature and wind speed of 6.9m/s)	
Summer base case with variable wind (14.6°C ambient seawater temperature and variable wind speed)	1.28

8.3.247 There is very little information currently available on any potential effects of TRO on marine mammals. However, the IMO report on a Ballast Water Management System [RD140] concluded that the bioaccumulation potential is very low; biomagnification and persistence in the food web is not considered to be a potential risk based on the results from aquatic toxicity testing, low predicted environmental concentrations (PEC) values, mammalian toxicity evaluation and bioaccumulation and biodegradation data.

8.3.248 In light of the above, no direct or indirect effects on marine mammal populations are predicted due to TRO from the cooling water discharge during operation.

8.3.249 However, the number of harbour porpoise, bottlenose dolphin, grey seal and harbour seal that could be present in the cooling water discharge area (and the percentage of the reference population) has been estimated for the maximum potential TRO mixing zone (3.13km^2) (see table 8-44, which is based on maximum species density estimates for the area (see chapter 6)).

8.3.250 The area of potential impact represents a very small proportion of the area available to marine mammals (for example, 3.13km^2 is approximately 0.0006% of the harbour porpoise Celtic and Irish Sea MU area (516,893km^2) and 0.006% of the bottlenose dolphin Irish Sea MU area (50,145km^2)).

8.3.251 The assessment assumes that all harbour porpoise, bottlenose dolphin, grey seal and harbour seal could be from a European Designated Site and conclusions are drawn with respect to the influence of the effects on site integrity, for each relevant European Designated Site, in sections 8.5 to 8.10.

Table 8-44 Estimated number of harbour porpoise, bottlenose dolphin, grey seal and harbour seal, and percentage of reference population, that could be present in area of changes in chemical parameters, based on the maximum estimated density at each site

Species	Estimated number in area and percentage of reference population
	TRO worst case modelled surface area (3.13km^2)
Harbour porpoise	3.95 (0.004%)
Bottlenose dolphin	1.08 (0.27%)
Grey seal	0.75 (0.13%)
Harbour seal	0.003 (0.006%)

8.3.252 Overall, however, taking into account the low number of individuals that could be affected and very small area of the effect, in relation to the range of marine mammal species and areas covered by the reference populations,

there is unlikely to be the potential for a significant effect on harbour porpoise, bottlenose dolphin, grey seal or harbour seal. Therefore an adverse effect is not anticipated on the the integrity of European Designated Sites where these species are a qualifying feature.

D Alteration of coastal processes and hydrodynamics

D1 Potential effect on habitat for prey species [Marine Licence]

8.3.253 Any changes as a result of the alteration of coastal processes and hydrodynamics (changes to currents, bed shear and waves) have the potential to effect marine mammal prey species.

8.3.254 Scour effects arising from changes in bed shear stress may cause physical disturbance to habitats and species through abrasive action; while physical disturbance from scour has the potential to affect benthic habitats and communities in high energy systems. However, the effects of physical disturbance may not differ greatly from the effects of natural processes and the effects of scour are likely to be relatively small, as the community is likely to consist of species with a high tolerance to abrasion (Application Reference Number: 6.4.13).

8.3.255 Changes to coastal processes associated with construction at the Power Station Site, and how these changes could lead to alteration of bed shear stress, have been identified through hydrodynamic (Delft3D) and wave (SWAN) modelling investigations.

8.3.256 The modelling indicates that the western breakwater would reflect waves from the west and northwest, causing some minor refocussing of energy but only from relatively small waves. This refocussing (reflected in a minor increase of bed shear) would affect the Cemlyn Bay seabed close to the most western part of Esgair Gemlyn in an area of relatively hard bedrock. The levels of wave height increase would be lower than the baseline wave heights from the northeast (a direction unaffected by the breakwater) (Application Reference Number: 6.4.13).

8.3.257 The generally small changes in bed shear stress predicted by the modelling would generate only minor differences in the transportable sediment fraction for both sands and gravels. Therefore, based on the potential changes in bed shear stress modelled (spatial distribution, magnitude and extent) and taking into account the type of substrata present, the effect on the seabed from bed shear stress is predicted to be limited (Application Reference Number: 6.4.13).

8.3.258 Taking into account the small changes in tidal flows and therefore bed shear stress predicted by the modelling, the spatial distribution of these changes, the types of communities present within the area of change and the wide occurrence of these communities along the north Anglesey coastline, the magnitude of change for habitats and communities (including habitats and communities of conservation importance) from scour would be very small. There would be a negligible effect on intertidal and subtidal habitats and

communities (Application Reference Number: 6.4.13) and no potential impact on marine mammal prey species.

8.3.259 Any 'coastal squeeze' effects, as a result of the introduction of new structures which interfere with the regression of the coastline, could only occur at locations where new structures are to be constructed and, therefore, would be limited to the marine area of the Wylfa Newydd Development Area (table 8-38).

8.3.260 Based on the above, it can be concluded that no potential exists for a significant alteration in intertidal or subtidal habitats out with the Wylfa Newydd Development Area and, consequently, a significant effect on prey species for marine mammals is not predicted.

E Physical interaction between species and Project infrastructure

E1 Vessel collision risk [Marine Licence]

8.3.261 Despite the potential for marine mammals to detect and avoid vessels, strikes are known to occur, possibly due to distraction whilst foraging and socially interacting, or due to the mammals' inquisitive nature [RD364].

8.3.262 Typical injuries from vessel strikes are either lacerations from the propellers (including 'corkscrew' type injuries associated with ducted propellers) or blunt traumas from impact with the hull, which can result in fractured skulls, jaws or vertebrae. Marine mammals are relatively robust with a thick sub-dermal layer of blubber that provides some protection for their vital organs in the event of a vessel strike [RD364]. However, non-fatal collisions can leave the animal vulnerable to secondary infection, other complications or predation [RD364].

8.3.263 Studies have shown that larger vessels are more likely to cause the most severe or lethal injuries, with vessels over 80m in length causing the most damage to marine mammals [RD185]. Vessels travelling at high speeds are considered to be more likely to collide with marine mammals, and those travelling at speeds below 10 knots would rarely cause any serious injury [RD185]. It is not possible to fully quantify strike rates between marine mammals and vessels because it is believed that a number go unnoticed [RD98].

8.3.264 Harbour porpoises are small and highly mobile, and given their responses to vessel noise (e.g. [RD337]; [RD99]; [RD266]), are expected to largely avoid vessel collisions. However, harbour porpoises have been observed with signs of physical trauma (blunt trauma or propeller cuts) indicating vessel strike. Approximately 4% of all harbour porpoise post mortem examinations from the Baltic, North East Atlantic, Irish and North Seas (ASCOBANS area) are thought to have evidence of interaction with vessels [RD98]. Ship strikes involving species of seal are not widely reported (with the exception of potential impacts related to ducted propellers discussed below). Typically, therefore, it is expected that the marine mammals in the area (i.e. harbour porpoise, bottlenose dolphin, harbour seal and grey seal) would be able to

detect the presence of vessels and, given that they are highly mobile, would be able to largely avoid vessel collision.

8.3.265 In recent years there has been concern and research into the potential risks of 'corkscrew' type injuries to seals associated with ducted propellers ([RD333], [RD20]). There is now incontrovertible evidence that such injuries can be caused by grey seal predation [RD335], however research by SMRU showed that similar injury patterns could be caused by ducted propellers ([RD333]; [RD300]). The advice from the SNCBs (i.e. Scottish Natural Heritage, Natural England, Natural Resources Wales, Joint Nature Conservation Committee) in February 2015, is that it is considered very likely that the use of vessels with ducted propellers may not pose any increased risk to seals over and above normal shipping activities and, therefore, mitigation measures and monitoring may not be necessary in this regard, although all possible care should be taken in the vicinity of major seal breeding and haul-out sites to avoid collisions [RD319].

8.3.266 There would be increased vessel movement around the site during construction, with vessels being used to bring equipment to the site and to dispose of excavated material. In addition, there would be a number of small support vessels used for staff transfers. The peak number of vessels on site is predicted to average approximately 15 per week over a three month period. During construction, when the vessels are on site, most of them would be stationary for long periods of time or travelling at relatively slow speeds. Work boats and safety boats may travel at faster speeds, but movement generally would be limited to the Wylfa Newydd Development Area.

8.3.267 During operation of the MOLF, vessel movement within the area would be expected to occur on average twice a day although, for most of the time, there would be fewer movements. It is currently determined that only one or two vessels per year would use the MOLF associated with the Power Station operation. Marine traffic would be comprised of primarily large slow moving vessels required to transport general equipment, cement and aggregate.

8.3.268 The bay at Porth y pistyll is not currently used by commercial vessels. Due to the navigational features in the area, large vessels typically navigate around four nautical miles from the coastline. Within the wider area, ports and harbours are located at Holyhead, Cemaes Bay and Amlwch. The Skerries Traffic Separation Scheme is regularly used by vessels transiting to and from ports on the north coast of Wales and the north-west coast of England.

8.3.269 The existing baseline for the area is estimated to be up to 25 vessels per week. Therefore, during the peak operation of the MOLF, there could be a 56% increase in the number of vessel movements, based on two vessels a day (up to a peak of 15 vessels per week) or 28% increase in vessel movements, based on one vessel a day (up to 7 vessels per week). However, this increase does not equate to a 56% increase in collision risk for marine mammals.

8.3.270 Large vessel movements to and from the site would use the most efficient, cost effective and safe route, which are likely to be part of existing long

distance vessel routes and given the relatively small increase in the number of vessels in the wider area are highly unlikely to result in a significant increase in collision risk. Therefore the potential for any increased collision risk between marine mammals and vessels would be within the Wylfa Newydd Development Area, the Disposal Site plus 100m buffer and the vessel route between the two sites (figure 8-1).

8.3.271 The assessment is based on the area where individuals could be at increased risk of collision from all vessel movements. As a precautionary worst case approach, the number of harbour porpoise, bottlenose dolphin, grey seal and harbour seal that could be at increased collision risk with vessels within the Wylfa Newydd Development Area, the Disposal Site plus 100m buffer (table 8-45) and the vessel route between the two sites, based on a 1km width of vessel route (table 8-46) has been estimated taking into account avoidance rates of 0%, 90%, 95% and 99%.

8.3.272 As outlined above, marine mammals are able to detect and avoid vessels, therefore not all the animals in the areas would be at increased risk of collision (e.g. 0% avoidance). The number of individuals that could potentially be at increased collision risk has been estimated based on avoidance rates of 90%, 95% and 99%. It is assumed that 95% avoidance is a precautionary approach and this has been used as the worst case in the assessment. An avoidance of 0% has been included to put this into context.

Table 8-45 Estimated number of harbour porpoise, bottlenose dolphin, grey seal and harbour seal, and percentage of reference population, that could have increased vessels collision risk in the Wylfa Newydd Development Area and Disposal Site plus 100m buffer, based on the maximum estimated density at each site and taking into account avoidance rates of 0%, 90%, 95% and 99%

Species	Avoidance rate	Estimated number and percentage of reference population	
		Wylfa Newydd Development Area (0.35km^2)	Disposal Site plus 100m buffer (0.651km^2)
Harbour porpoise	0%	0.44 (0.0004%)	1.65 (0.002%)
	90%	0.04 (0.00004%)	0.165 (0.0002%)
	95%	**0.02 (0.00002%)**	**0.08 (0.00007%)**
	99%	0.004 (<0.00001%)	0.016 (0.00001%)
Bottlenose dolphin	0%	0.12 (0.03%)	0.22 (0.06%)
	90%	0.01 (0.003%)	0.02 (0.006%)
	95%	**0.006 (0.0015%)**	**0.01 (0.003%)**
	99%	0.001 (0.0003%)	0.002 (0.0006%)
Grey seal	0%	0.08 (0.0014%)	0.08 (0.001%)
	90%	0.008 (0.00013%)	0.008 (0.0001%)
	95%	**0.004 (0.00007%)**	**0.004 (0.00006%)**
	99%	0.0008 (0.00001%)	0.00008 (0.00001%)

Species	Avoidance rate	Estimated number and percentage of reference population	
		Wylfa Newydd Development Area (0.35km^2)	Disposal Site plus 100m buffer (0.651km^2)
Harbour seal	0%	0.0003 (0.0006%)	0.0005 (0.001%)
	90%	0.00003 (0.00006%)	0.00005 (0.0001%)
	95%	**0.000015 (0.00003%)**	**0.000025 (0.00005%)**
	99%	0.000003 (0.000006%)	0.000005 (0.00001%)

Table 8-46 Estimated number of harbour porpoise, bottlenose dolphin, grey seal and harbour seal, and percentage of reference population, that could have increased vessels collision risk between Wylfa Newydd Development Area and Disposal Site, based precautionary 1km route width, on maximum estimated density at Disposal Site and taking into account avoidance rates of 0%, 90%, 95% and 99%

Species	Avoidance rates	Estimated number in area
		1km width of vessel route (42.53km^2)
Harbour porpoise	0%	107.77 (0.10%)
	90%	10.78 (0.010%)
	95%	**5.39 (0.005%)**
	99%	1.08 (0.001%)
Bottlenose dolphin	0%	14.63 (3.69%)
	90%	1.46 (0.37%)
	95%	**0.73 (0.18%)**
	99%	0.15 (0.037%)
Grey seal	0%	5.53 (0.092%)
	90%	0.55 (0.009%)
	95%	**0.28 (0.005%)**
	99%	0.05 (0.0009%)
Harbour seal	0%	0.03 (0.06%)
	90%	0.003 (0.006%)
	95%	**0.0015 (0.003%)**
	99%	0.0003 (0.0006%)

8.3.273 Based on a precautionary 95% avoidance rate, the potential numbers of harbour porpoise, bottlenose dolphin, grey seal and harbour seal that could be exposed to increased collision risk from all vessel movements within the Wylfa Newydd Development Area, the Disposal Site and the vessel route between the two sites during construction and operation is very low and unlikely to have any significant effect on reference populations.

8.3.274 It should be noted that these values are based on the number of animals that could have an increased risk of collision and are not the predicted number of

individuals that could have severe or lethal injuries as a result of a vessel strike.

8.3.275 Taking into account the relatively slow travelling speeds of the vessels and the relatively small increase in the numbers of vessel in comparison to the vessel density in the wider area, the increased likelihood of marine mammal strikes is also considered to be very low.

E2 Impact of impingement and entrainment of prey species during operation [Operational water discharge EP]

Introduction

8.3.276 Marine mammals are very unlikely to be at risk of impingement owing to the low approach velocities embedded into the design of the intake. In addition, coarse bar screens positioned upstream of the fine mesh screens to reduce fish intake would prevent marine mammals from entering the CWS. However, prey species could be impinged, which may have an indirect effect on marine mammals in the area.

8.3.277 Impingement is defined as the trapping of fish against the screens that prevent debris from being drawn into the cooling water intake. Entrainment is the drawing of fish and shellfish eggs and larvae into and through the condenser cooling systems of power plants, where mechanical and thermal stresses can cause high levels of mortality [RD13]. Therefore the loss of fish through impingement is more relevant than the loss of eggs and larvae through entrainment as eggs and larvae do not represent a viable food source for marine mammals. However, over time, the loss of larvae and eggs could have an effect on population levels of fish in the vicinity of the Wylfa Newydd Development Area and, therefore, have also been considered in this assessment.

8.3.278 Equivalent Adult Values (EAVs) are used to determine the actual number of adult fish a loss of eggs would create. This takes into account the high level natural mortality of fish larva and eggs and relates the number of entrained larva and eggs to a more realistic number of potential prey loss for marine mammals.

8.3.279 As embedded mitigation, the CWS is being designed to limit the impingement of marine organisms through the following measures:

- A maximum intake velocity of 0.3m/s in front of the intake opening at LAT.
- Screening in the form of coarse raked bars located in front of fine mesh drum screens (for the main cooling water intake) and band screens (for the service water intake). The proposed fine mesh screen size is 5mm. There are likely to be a minimum of four main screens at the cooling water intake and two service water (reactor service water and turbine service water) intake screens per unit; this would incorporate redundancy to allow maintenance and biocide treatment of screens and adequate and effective fish handling capacity.

- An AFD in front of the cooling water intake, designed in line with Best Available Technique. As outlined for effect A4, the sound field would be located in the most appropriate location within the intake entrance to deter fish species from the cooling water intake. It would also be designed to avoid any disturbance effects on marine mammals.
- An effective fish recovery and return (FRR) system would be installed at the cooling water intake to remove fish impinged on all screens and return them to sea. The discharge point would be located below LAT to the north of the eastern breakwater, in order to permit the best chance of fish survival and reduce the risk of re-impingement.
- Management of the biocide dosing (sodium hypochlorite) regime to control biofouling of the CWS while preventing harm to fish impinged on screens, in line with best practice.

8.3.280 The majority of these measures are intended to reduce the risk of impingement and increase the return and survival of marine organisms that would be impinged. However, the reduced mesh size (5mm) and biocide dosing regime are also intended to reduce the risk of entrainment and increase survival through the CWS of entrained marine organisms (ES Volume D – Wylfa Newydd Development Area Development D13 – The Marine Environment, Application Reference Number: 6.4.13).

8.3.281 Based on the above, the potential loss of prey through impingement and entrainment has been assessed for harbour porpoise, bottlenose dolphin, grey seal and harbour seal.

8.3.282 The potential effect area for prey species would be confined to the intake structure and the potential zone of influence in which fish could be at risk. This has been identified as 50m ZOI from the intake for adult fish (see chapter 4). Fish are highly mobile species, with relatively large ranges and are unlikely to be restricted to the immediate area of the cooling water intake. Therefore the loss of fish is likely to be very small in comparison to natural variation. However, as a precautionary measure, the amount of prey that could be impinged and the potential implications for marine mammal species in the area has been assessed using Dietary Equivalent Assessments (DEA).

Marine Mammal Dietary Equivalent Assessments

8.3.283 A DEA can be used to estimate the number of individuals of marine mammal that could potentially be affected as a result of loss of prey species through impingement. DEAs have been calculated for harbour porpoise, bottlenose dolphin and grey seal (due to the very low number of harbour seal at the site, grey seal is also used as a proxy for harbour seal). The DEAs are provided as worst case examples only and will vary for individuals within each species, between seasons, etc.

8.3.284 The percentage composition of prey by weight is the most common approach used to assess the dietary requirements of individual marine mammals (e.g. [RD261]; [RD290]), whilst bioenergetic modelling is often

used to derive annual food consumption estimates for entire populations ([RD240]; [RD131]; [RD309]). Percent composition of prey by weight is considered the most appropriate approach to assess the dietary demands of harbour porpoise, bottlenose dolphin and grey seal in this assessment.

8.3.285 Percent composition by weight is based on the total weight of prey consumed during a specified unit of time (e.g. day or year) and is the most commonly used approach as it means that all prey species can be considered.

8.3.286 The number of prey that could be lost as a result of impingement is related to the prey requirements of the marine mammal and is calculated as the proportion of an individual's annual prey intake that could be 'removed' from the environment.

Impingement and entrainment of prey species

8.3.287 The DEA uses both the impingement rates of prey species for harbour, porpoise, bottlenose dolphin, grey and harbour seal (calculated for grey seal and used as a proxy for harbour seal), as well as entrainment rates for those prey species where an EAV was available. The EAVs were used to define the associated number of adult fish that would be lost from the ecosystem as a result of the number of larvae and eggs that were entrained. The EAV number was then multiplied by estimated individual weights of each fish to generate a weight of fish lost in kg per annum. This was added to the impingement data to generate a DEA of each marine mammal species based on fish lost through both impingement and entrainment.

8.3.288 Impingement results from the most recent 2011 to 2012 impingement surveys at the Existing Power Station have been scaled up to a tidally averaged abstraction rate of 126m^3/s. This value includes a 5% contingency and represents the most realistic worst case. Fish and invertebrate abundances were extrapolated from numbers of individuals per m^3 sampled in the impingement surveys during each month and then summed to provide an annual prediction, allowing for changes in seasonal abundances. It should be noted that the intake design of the Existing Power Station does not meet current best practice; therefore, predictions are likely to represent a worst case (Application Reference Number: 6.4.13).

8.3.289 Based on data from the Existing Power Station, pelagic species such as sprat, sand smelt and herring are predicted to be impinged in the highest abundances each year (table 8-47). Impingement of fish would be expected to peak during the winter when it is likely higher numbers of sprat, herring, dragonets, scorpion fish and lesser spotted dogfish would be impinged (Application Reference Number: 6.4.13).

8.3.290 Approximately 87% of all fish species impinged during the surveys at the Existing Power Station were 11cm or below. Historically, impingement of fish at the Existing Power Station has been assessed as very low; it remains lower than at other UK power stations and is not considered to pose a threat to commercial stocks (Application Reference Number: 6.4.13).

Table 8-47 Annual fish impingement at the Existing Power Station scaled to 126m3/s (taxa shaded grey represent 95% of the catch by number)

Common name	Number	Biomass (kg)	Common name	Number	Biomass (kg)
Sprat	54,000	77	Butterfish	150	1
Sand smelt	18,000	51	Short-spined sea scorpion	140	4
Herring	7,600	43	Grey gurnard	140	0.2
Long-spined sea scorpion	6,200	98	Leopard-spotted goby	130	0.2
Whiting	5,700	34	Thornback ray	130	1
Five-bearded rockling	5,400	110	Tadpole fish	120	10
Common dragonet	5,300	26	John Dory	120	1
Pogge	4,500	52	Two-spot goby	94	0.1
Pollack	4,200	290	Bass	80	54
Lesser-spotted dogfish	3,400	1,400	Northern rockling	64	0.3
Lesser weever	3,000	14	Solenette	49	0.1
Dragonet	2,800	3	Tompot blenny	48	1
Fifteen-spined stickleback	2,700	8	Striped sea snail	47	0.3
Greater pipefish	1,900	9	Sea snail family	41	0.2
Lesser sandeel	1,800	12	Ling	41	0.04
Poor cod	1,800	22	Topknot family	41	0.2
Dab	1,600	41	Montagu's sea snail	40	0.2
Cod family (Gadoid indeterminate)	1,100	2	Spotted dragonet	35	0.2
Corkwing wrasse	1,000	28	Red gurnard	35	1
Ballan wrasse	960	150	Dover sole	35	6
Plaice	730	28	Common goby	35	0
Shanny	680	4	Conger eel	32	53
Sandeel	680	12	Blenny family	29	0.03
Herring family	640	1	Flounder	28	6
Indeterminates	420	1	Sea scorpion family	28	0.03
Pouting	410	7	River lamprey	23	1
Cod	400	70	Pearlside	17	0.02
Scaldfish	340	3	Horse mackerel	17	0.1
Snake pipefish	340	4	Haddock	15	0.05
Pipefish family	330	0.4	Grey mullet family	15	22
Goby family (Gobiidae)	320	0.3	Three-spined stickleback	15	0.03

Common name	Number	Biomass (kg)	Common name	Number	Biomass (kg)
Reticulated dragonet	320	2	Cuckoo wrasse	15	1
Lumpsucker	300	37	Spotted ray	15	15
Saithe	280	26	Golden grey mullet	12	11
Rock goby	280	1	Gurnard family	12	0.01
Nurse hound	260	92	Poor cod family	12	0.02
Three-bearded rockling	260	24	Transparent goby	12	0.01
Rock cook	250	1	Wrasse family	12	0.01
Sand goby	240	0.4	Dogfish family	12	0.02
Thick-lipped grey mullet	220	240	Nilsson's pipefish	12	0.01
Goby sp. (*Pomatoschistus* sp.)	200	0.2	**Total abundance of fish**	**143,000**	
Goldsinny wrasse	200	3	**Total biomass of fish(kg)**		**3,200**

8.3.291 Entrainment results from the most recent 2011 to 2012 entrainment surveys at the Existing Power Station have also been scaled to a constant tidally averaged abstraction rate of 126m^3/s. This value includes a 5% contingency and represents the most likely worst case. Ichthyoplankton abundances (eggs and larvae) have been extrapolated from numbers of individuals per m^3 sampled in the entrainment surveys at the Existing Power Station during each month and then summed to provide an annual prediction, allowing for changes in seasonal abundances. As above, it should be noted that the intake design of the Existing Power Station does not meet current best practice; therefore, predictions are likely to be worst case (Application Reference Number: 6.4.13).

8.3.292 A total of 49 distinct fish taxa were identified, with the most numerous being from the goby family, with dragonets and blennies being the two next highest in number. The summer months saw the highest numbers of gobies and blennies.

8.3.293 As outlined above, the natural mortality of larval fish is high and, therefore, the number entrained in the Existing Power Station cannot be used as an indicator of the number of adult fish that could be lost. EAV analysis uses species specific life history data to calculate the actual number of adult fish that could be expected to be lost as a result of entrainment.

8.3.294 Table 8-48 shows the EAVs calculated for species entrained in the Existing Power Station, scaled to 126m^3/s. The biomass of equivalent adults was calculated using the approach as outlined by [RD343], where a weight at 50% maturity is assumed. These 50% maturity weights are derived using the best available scientific evidence.

Table 8-48 EAVs for prey species entrained in the Existing Power Station, scaled to 126m^3/s and the estimated weight of each species used to calculate the potential annual loss of prey in kg

Prey species	Annual EAV	Weight at 50% maturity (g)	Estimated annual biomass lost through entrainment (kg)
Sprat	46,000	7.2	331.2
All clupeids as sprat	32,000	7.2	230.4
Goby family	24,000	0.9*	21.6
Sandeel (*Ammodytes* sp.)	4,600	7.8	35.88
Dragonet	3,700	16.6	61.42
Plaice	1,200	130.7	156.84
Whiting	690	88.9	61.34
Solenette	270	7.6	2.05
Dover sole	210	210.5	44.21
Dab	100	55.6	5.56
Corkwing wrasse	100	16.6	1.66
Goldskinny wrasse	85	14.1	1.20
All clupeids as herring	36	109	3.92
Herring	27	109	2.94
TOTAL	**81,000-110,000**		**960.22**

*based on the average weight of an impinged goby species from Table 8-47

Harbour porpoise DEA

8.3.295 As outlined in chapter 6, the diet of harbour porpoise consists of a wide variety of fish, including pelagic schooling fish, as well as demersal and benthic species, such as Gadoids, Clupeids and Ammodytes. Their diet varies geographically, seasonally, annually, over time and differences in diet between sexes or age classes may also exist, reflecting changes in available food resources ([RD18]; [RD180]; [RD23]; [RD289]; [RD291]).

8.3.296 In the Irish Sea, harbour porpoise predominately prey upon gadoids (namely whiting and haddock) and herring (table 8-49; [RD131]). Although sprat, blue whiting, cod, *Pollachius* sp., sandeel, horse mackerel, and Atlantic mackerel are also consumed, these are not considered to be key prey taxa (each contributing less than 2% to the overall weight of prey consumed). Harbour porpoise in the Irish Sea do not appear to prey upon gobies and sand smelt (table 8-49). Other studies have indicated that harbour porpoise tend to feed on small fish, typically less than 10cm [RD367].

8.3.297 Table 8-49 summarises the identified prey species of harbour porpoise in the Irish Sea using the most recent information from [RD131]. This study used the stomach contents of 67 stranded harbour porpoises to determine the prey species within the Irish Sea with sizes of individuals ranging from 86-

163 cm and 105-172cm in males and females, respectively. Harbour porpoise were found to have a relatively small prey diversity of 22 species, with 59.5% being from the order Gadiformes (36.9% of prey in this order were unidentified prey species) and 40.8% from the order Clupeiformes (38.7% of prey in this order were herring). This indicates that Gadiformes and Clupeiformes, namely herring, are the most important prey species for harbour porpoise within the Irish Sea.

8.3.298 The DEA for harbour porpoise includes all fish classified as Clupeiformes, Gadiformes and Perciformes.

8.3.299 The estimated potential annual loss of potential harbour porpoise prey from impingement and entrainment was based on the percentage of prey consumed annually by weight (table 8-49; [RD131]) as a percentage of the annual weight of prey species fish impinged (table 8-47) and entrained (table 8-48) at the Existing Power Station scaled to 126m^3/s, without any mitigation, such as AFD and FFR.

8.3.300 The estimated annual total potential prey loss for harbour porpoise could be up to 572kg (based on approximately 303kg lost through impingement and 269kg lost through entrainment; table 8-49).

Table 8-49 Harbour porpoise prey species (based on [RD131] and estimated potential annual loss from impingement (based on table 8-47) and entrainment (based on table 8-48)

Prey Species	% of prey consumed annually by weight	Weight of prey species potentially lost annually through impingement, based on % of prey consumed (kg)	Weight of prey species potentially lost annually through entrainment, based on % of prey consumed (kg)
Gadiformes	**59.50%**	**252.92**	**36.60**
Trisopterus spp.	2.30%	0.55	
Whiting	8.50%	2.89	5.21
Haddock	7.60%	0.004	
Blue whiting	1.70%	0	
Pollachius spp. (Pollack and saithe)	0.10%	0.29	
European hake	2.20%	0	
Cod	0.20%	0.14	
Silvery pout	0.00%	0	
Phycis spp. (hake)	0.00%	0	
Unidentified Gadidae	36.90%	0	
Clupeiformes	**40.80%**	**49.78**	**231.93**
Sprat	0.70%	0.55	3.93
Herring	38.70%	17.03	2.66
Unidentified Clupea	1.40%	0	0.05
Perciformes	**1.90%**	**0.02**	
Scad	0.20%	0	
Ammodytidae (sand lance)	0.10%	0.01	

Prey Species	% of prey consumed annually by weight	Weight of prey species potentially lost annually through impingement, based on % of prey consumed (kg)	Weight of prey species potentially lost annually through entrainment, based on % of prey consumed (kg)
Gobiidae	0.00%	0	
Atlantic mackerel	1.30%	0	
Atlantic horse mackerel	0.20%	0	
Argentina spp. (herring smelts)	0.10%	0	
Atheriniformes (sand smelt)	**0**	**0**	
Anguilliformes (eel)	**0**	**0**	
Unidentified fish	**0**	**0**	
Pleuronectiformes (flat fish)	**0.10%**	**0.03**	
Cephalopoda (squid/octopus)	**0**	**0**	
TOTAL		**302.74**	**268.43**

8.3.301 [RD180] and [RD194] have also investigated the daily prey consumption required for harbour porpoise, indicating that it approximately equates to between 4% and 9.5% of the individuals body weight. Assuming an adult weighs between 45kg and 60kg, this equates to a daily food intake of between 1.8kg and 5.7kg per day. Using this as a guide, it is assumed that the annual prey intake required for a harbour porpoise is between 657g and 2,081kg per annum, depending on the individual's size.

8.3.302 Therefore the estimated annual total potential prey loss for harbour porpoise of 572kg (for both impingement and entrainment), based on the percentage of prey consumed annually by weight, is the equivalent to the amount of prey required by less than one small porpoise (less than 0.001% of the CIS MU reference population).

8.3.303 The estimated total potential loss of harbour porpoise based on the annual total weight of all Clupeiformes, Gadiformes and Perciformes that could be impinged (table 8-47) and entrained (table 8-48) at the Existing Power Station scaled to 126m^3/s, without any mitigation, is approximately 1,460kg (table 8-50). This could be the equivalent to the amount of prey required by two small harbour porpoise or less than one large harbour porpoise per year.

Table 8-50 Estimated potential annual loss from impingement (table 8-47) and entrainment (table 8-48) of possible harbour porpoise prey species, based on prey species family

Prey species family	Total weight of prey species family impinged per annum (kg)	Total weight of prey species family entrained per annum (kg)
Clupeiformes	124	114.45
Gadiformes	595.41	4.13
Perciformes	563.55	58.22
TOTAL	**1,282.96**	**176.8**

8.3.304 Therefore, based on the worst-case scenario, the potential prey loss as a result of impingement and entrainment could be the equivalent of the annual prey required by two small porpoises (less than 0.002% of the CIS MU reference population).

8.3.305 However, it is important to note that this is only the potential number of individuals that could be affected due to any loss of prey, as harbour porpoise would be able to source prey from nearby areas. In addition, this assessment does not take account of mitigation.

8.3.306 Embedded mitigation, including the AFDs and FRR system, would reduce the possible mortality of fish prey species, thereby reducing the potential loss of prey species for harbour porpoise.

8.3.307 Considering the relatively small potential quantity of prey resource that could be lost, in relation to natural variations, the foraging range and wide range of prey species taken by harbour porpoise, the potential reduction of any prey as a result of impingement and entrainment is unlikely to have a significant effect on the harbour porpoise population. Therefore an adverse effect is not anticipated on the the integrity of European Designated Sites where this species is a qualifying feature.

8.3.308 The assessment assumes that all harbour porpoise could be from a European Designated Site and conclusions are drawn with respect to the influence of the effects on site integrity, for each relevant European Designated Site, in sections 8.5 and 8.6.

Bottlenose dolphin DEA

8.3.309 As outlined in chapter 6, bottlenose dolphins are opportunistic feeders and take a wide variety of benthic and pelagic fish species.

8.3.310 Table 8-51 summarises the identified prey species of bottlenose dolphin in the Irish Sea using the most recent information from [RD131]. This study used the stomach contents of 12 stranded bottlenose dolphins to determine the prey species within the Irish Sea with sizes of individuals ranging from 257kg to 632kg in weight. It should be noted that the study undertaken by Hernández-Milián [RD132] uses data collected through bottlenose dolphin stranding's along the Irish coast only and no data has been collected for the Welsh coastline. Bottlenose dolphin diet was found to consist of small amounts of the majority of prey species. Gadiformes proved to be the most important, with 76.8% of prey biomass being from this order. Significant species include saithe, pollack, common ling and European hake providing 12.4%, 12.9%, 15.5% and 20% of the biomass respectively. A further 19% of prey biomass was found to be from the order Anguilliformes, with conger eel making up 16% of the prey biomass. Therefore, Gadiformes and Anguilliformes, namely saithe, pollack, common ling, European hake and conger eel, are the most important prey species within the Irish Sea.

8.3.311 The estimated potential annual loss of potential bottlenose dolphin prey from impingement and entrainment was based on the percentage of prey consumed annually by weight (table 8-51; [RD131]) as a percentage of the

annual weight of prey species fish impinged (table 8-47) and entrained (table 8-48) at the Existing Power Station scaled to 126m^3/s, without any mitigation, such as AFD and FFR.

8.3.312 The estimated annual total potential prey loss for bottlenose dolphin could be up to 585kg (based on approximately 535kg lost through impingement and 49kg lost through entrainment; table 8-51).

Table 8-51 Bottlenose dolphin prey species (based on [RD132] and estimated potential annual loss from impingement (based on table 8-47) and entrainment (based on table 8-48)

Prey species	% of prey consumed annually by weight	Weight of prey species potentially lost annually through impingement, based on % of prey consumed (kg)	Weight of prey species potentially lost annually through entrainment, based on % of prey consumed (kg)
Chondrichthyes	**1.10%**	**0**	**0**
Catshark sp.	1.10%	0	0
Anguilliformes	19.60%	**10.4**	**0**
Unidentified eel	3.60%	0	0
Conger eel	16.00%	8.48	0
Salmoniformes	0.90%	0	**0**
Atlantic salmon	0.90%	0	0
Gadiformes	76.80%	**504.52**	**47.11**
Blue whiting	2.10%	0	0
Whiting	1.50%	1.43	0.92
Whiting/ blue whiting	0.90%	0	0
Haddock	5.30%	0.003	0
Saithe	12.40%	3.22	0
Pollack	12.90%	37.41	0
Pollachius spp.	2.90%	0	0
Pollachius spp./ haddock	1.70%	0	0
Whiting pout	0.30%	0	0
Trisopterus spp.	1.10%	0.242	0
Phycis spp. (hake)	0.10%	0	0
Common ling	15.50%	0	0
Unidentified cod sp.	0.10%	0.002	0
European hake	20.00%	0	0
Perciformes	3.10%	**17.47**	**0**
Atlantic horse mackerel	2.00%	0	0
Atlantic mackerel	1.10%	0	0
Pleuronectiformes	1.00%	**2.92**	**2.07**
European flounder	0.30%	0.02	0
European plaice	0.30%	0.55	0
American plaice	0.20%	0	0.31

Prey species	% of prey consumed annually by weight	Weight of prey species potentially lost annually through impingement, based on % of prey consumed (kg)	Weight of prey species potentially lost annually through entrainment, based on % of prey consumed (kg)
Brill	0.10%	0	0
Common sole	0.10%	0	0.04
Unidentified fish	0.00%	0	0
Cephalopods	1.23%	**0**	**0**
Myopsid squid spp.	0.23%	0	0
Shortfin squid sp../Todaropsis spp.	0.10%	0	0
Gonatus spp.	0.30%	0	0
Atlantic cranch squid	0.10%	0	0
Octopoda	0.50%	**0**	**0**
Common octopus	0.30%	0	0
Curled octopus	0.20%	0	0
TOTAL		**535.30**	**49.18**

8.3.313 [RD182] suggest that the average bottlenose dolphin may consume 2% to 4% of its body mass per day. Using the lower and higher weights of individuals assessed (257kg and 632kg) provides a daily total prey intake requirement of between 10.28kg and 25.28kg per day, respectively, based on 4% of body weight. Using this as a guide, it is assumed that the annual prey intake need for a bottlenose dolphin is between 3,752.2kg and 9,227.2kg per annum depending on the individual's size.

8.3.314 Therefore the estimated annual total potential prey loss for bottlenose dolphin of 585kg (for both impingement and entrainment), based on the percentage of prey consumed annually by weight, is the equivalent to approximately 16% of prey required by one small dolphin per year.

8.3.315 The DEA for bottlenose dolphin also considers all Anguilliformes, Clupeiformes, Salmoniformes, Gadiformes, Perciformes and Pleuronectiformes. This broad taxonomic approach is considered precautionary, taking into consideration the wide variety of prey species taken by bottlenose dolphin.

8.3.316 The estimated effect on bottlenose dolphin based on the annual total weight of all Anguilliformes, Clupeiformes, Salmoniformes, Gadiformes, Perciformes and Pleuronectiformes that could be impinged (table 8-47) and entrained (table 8-48) at the Existing Power Station scaled to 126m^3/s, without any mitigation, is approximately 2,317kg (table 8-52). This could be the equivalent to approximately 62% of prey required by one small dolphin per year.

Table 8-52 Estimated potential annual loss from impingement (table 8-47) and entrainment (table 8-48) of possible bottlenose dolphin prey species, based on prey species family

Prey species family	Total weight of prey species family impinged per annum (kg)	Total weight of prey species family entrained per annum (kg)
Anguilliformes	53	0
Clupeiformes	124	568.47
Salmoniformes	0	0
Gadiformes	595.41	61.34
Perciformes	563.55	58.88
Pleuronectiformes	84.3	208.66
TOTAL	**1,420.26**	**897.35**

8.3.317 Therefore, based on the worst-case scenario, the potential prey loss as a result of impingement and entrainment could be the equivalent of the annual prey required by less than one small bottlenose dolphin (less than 0.25% of the IS MU reference population).

8.3.318 However, as for harbour porpoise, it is important to note that this is only the potential number of individuals that could be affected due to any loss of prey, as bottlenose dolphin would be able to source prey from nearby areas. In addition, this assessment does not take account of mitigation which would reduce the possible mortality of fish prey species, thereby reducing the potential loss of prey species for bottlenose dolphin.

8.3.319 Considering the relatively small potential quantity of food resource that could be lost, in relation to natural variations, the foraging range and wide range of prey taken by bottlenose dolphin, the potential reduction of any prey as a result of impingement and entrainment is unlikely to have a significant effect on the bottlenose dolphin population. Therefore an adverse effect is not anticipated on the integrity of the European Designated Sites where this species is a qualifying feature.

8.3.320 The assessment assumes that all bottlenose dolphin could be from a European Designated Site and conclusions are drawn with respect to the influence of the effects on site integrity, for the relevant European Designated Site, in section 8.7.

Grey seal DEA

8.3.321 As outlined in chapter 6, grey seals are generalist feeders, foraging on a wide range of prey species, with diet varying with season, area and prey available [RD317].

8.3.322 Table 8-53 summarises the identified prey species of the grey seal in Irish waters, using the most recent information from [RD131]. This study focused on the investigation of prey species using 132 seal scats at the Blasket Islands. It should be noted that [RD131] uses data collected along the Irish coast only and no data in this study was collected for the Welsh coastline. The research identified 42 different prey species for grey seal, with 37.5% by weight being from the Gadidae order, with 10.8% being blue whiting and 9%

cod species. 23.8% of prey species were identified as being Salmon species and a further 14.4% species were from the Perciformes order.

8.3.323 In a study of the stomach contents of 17 by-caught grey seals within the western Irish Sea, [RD184] identified a total of 19 different prey species, with gadoids being the most prominent species. In addition to the by-caught seals, scat samples were collected at haul-out sites around the Irish and Celtic Seas and identified a total of 23 species of prey. Again, gadoids were found to be the most prominent, along with flatfish (table 8-53). This study indicates that Gadiformes and flatfish, namely plaice and whiting, are the important prey species for grey seal within the Irish Sea.

8.3.324 Table 8-53 also summarises the diet of grey seal in west Wales [RD326]. This study, based on 252 grey seal faecal samples from around the west coast of Wales, indicates two main prey families, Gadidae (mainly whiting and *Trisopterus* species) and flatfish (mainly sole), dominated the diet, making up 70% of the total prey by weight. Herring contributed a further 6% of the prey by weight, sandeels were virtually absent and dragonet contributed a relatively large proportion, approximately 11 % by weight. Therefore, Gadiformes, flatfish and herring, appear to be the important prey species grey seal along the west coast of Wales.

Table 8-53 Grey seal prey species (based on [RD131]; [RD184]; and [RD326])

Prey species	% of prey consumed [RD131]	% of prey consumed [RD184]	% of prey consumed [RD326]
Rajiformes (Raja spp.) (skates/rays)	**0.00%**	**0.00%**	**2.00%**
Anguilliformes	**6.70%**	**0.00%**	**0.50%**
European eel	0.10%	0.00%	0.00%
Conger eel	6.60%	0.00%	0.50%
Clupeiformes	**0.10%**	**0.10%**	**6.10%**
Herring	0.10%	0.10%	6.10%
Beloniformes	**1.70%**	**0.00%**	
Garfish	1.70%	0.00%	0.00%
Petromyzontiformes	**3.80%**	**0.00%**	**0.00%**
Sea lamprey	3.80%	0.00%	0.00%
Salmoniformes	**23.80%**	**0.00%**	**0.10%**
Salmo spp.	23.80%	0.00%	0.00%
Gadiformes	**37.50%**	**40.20%**	**39.20%**
Blue whiting	10.80%	0.10%	0.00%
Whiting	2.00%	10.00%	18.00%
Haddock	0.30%	2.90%	0.10%
Pollachius spp. (Pollack)	5.20%	4.70%	2.00%
Trisopterus spp. (cod)	9.00%	12.80%	13.00%
Rockling	3.50%	0.00%	3.00%
Common ling	0.60%	1.80%	0.00%

Prey species	% of prey consumed [RD131]	% of prey consumed [RD184]	% of prey consumed [RD326]
Hake	1.40%	0.60%	0.00%
Cod	0.00%	7.30%	3.00%
Tadpole fish	0.00%	0.00%	0.10%
Unidentified gadidae	4.70%	0.00%	0.00%
Perciformes	**14.40%**	**6.20%**	**17.40%**
Dragonets	2.80%	1.80%	11.00%
Scad	0.00%	0.10%	1.00%
Atlantic horse mackerel	0.50%	0.00%	0.00%
Atlantic mackerel	1.90%	0.00%	0.10%
Sandeel	0.00%	2.20%	0.50%
Eelpout	2.60%	0.00%	0.00%
European perch	0.00%	0.00%	0.00%
Labrus spp. (wrasses)	2.20%	2.00%	4.00%
Gobiidae	0.00%	0.10%	0.50%
Ammodytidae sp	4.40%	0.00%	0.00%
Seabass	0.00%	0.00%	0.10%
Black sea bream	0.00%	0.00%	0.10%
Mullet	0.00%	0.00%	0.10%
Pleuronectiformes	**10.80%**	**40.90%**	**30.80%**
Arnoglossus spp. (scaldfish)	0.00%	0.00%	0.00%
Solenette	0.20%	0.00%	0.00%
Dab	1.00%	3.10%	2.00%
Atlantic halibut	0.60%	0.00%	0.00%
American plaice	0.20%	0.00%	0.00%
Long rough dab	0.00%	1.00%	0.10%
Lemon sole	2.00%	0.00%	0.10%
Plaice	1.90%	34.50%	6.00%
Common sole	1.90%	2.00%	0.00%
Witch	0.00%	0.10%	0.10%
Flounder	0.00%	0.00%	1.00%
Sole sp.	0.00%	0.00%	20.00%
Unidentified flatfish	3.00%	0.00%	1.00%
Scorpaeniformes	**0.00%**	**1.20%**	**3.50%**
Gurnard	0.00%	0.00%	2.00%
Short-spined sea scorpion	0.00%	1.20%	0.50%
Unidentified fish†	**0**	**0**	**0.00%**
Cephalopoda	**1.50%**	**11.60%**	**3.00%**

8.3.325 The DEA for grey seal considers Clupeiformes, Gadiformes, Perciformes, Pleuronectiformes, Scorpaeniformes, Anguilliformes, Salmoniformes and

Rajiformes (cephalopods were not included as it was not possible to estimate the weight based on the numbers recorded during impingement and entrainment surveys). This broad taxonomic approach is considered precautionary, taking into consideration the degree of uncertainty associated with dietary analysis as well as possible geographical and seasonal variations in dietary composition.

8.3.326 Food requirements depend on the size of the seal and fat content (oiliness) of the prey, but an average consumption estimate of an adult is generally between 4kg and 7kg per seal per day depending on the prey species [RD317].

8.3.327 [RD131] identified that grey seal, with an average body weight of 194kg, have a daily food requirement of 4.57kg. Using this it can be assumed that a grey seal of average weight would have an annual prey consumption of 1,667kg. Smaller individuals (105kg) and larger individuals (310kg) would have annual dietary requirements of 996kg and 2,472kg, respectively.

8.3.328 The estimated effect on grey and harbour seals based on the annual total weight of all Clupeiformes, Gadiformes, Perciformes, Pleuronectiformes, Scorpaeniformes, Anguilliformes, Salmoniformes and Rajiformes that could be impinged (table 8-47) and entrained (table 8-48) at the Existing Power Station scaled to 126m^3/s, without any mitigation, is approximately 2,409kg (table 8-54). This could be the equivalent to the annual prey requirements for either 1 large seal, or 1.5 average sized seals; or up to 2.5 small seals.

8.3.329 Therefore, based on the worst-case scenario, the potential prey loss as a result of impingement and entrainment could be the equivalent of the annual prey required up to 1.5 average sized grey seals (less than 0.025% of the reference population) and 2.5 harbour seals (up to 5% of reference population).

8.3.330 It is important to note that this is only the potential number of individuals that could be affected due to any loss of prey, as grey and harbour seal would be able to source prey from nearby areas. In addition, this assessment does not take account of mitigation. It should also be noted that due to the very low numbers of harbour seal in the area, the reference population is correspondingly low. As a result of the very low numbers of harbour seal in the area it is highly unlikely that any harbour seals would be affected by any loss of prey as a result of impingement and entrainment.

Table 8-54 Estimated potential annual loss from impingement (table 8-47) and entrainment (table 8-48) of possible grey and harbour seal prey species, based on prey species family

Prey species family	Total weight of prey species family impinged per annum (kg)	Total weight of prey species family entrained per annum (kg)
Anguilliformes	53	0
Clupeiformes	124	568.47
Salmoniformes	0	0
Gadiformes	595.41	61.34

Prey species family	Total weight of prey species family impinged per annum (kg)	Total weight of prey species family entrained per annum (kg)
Perciformes	563.55	58.88
Pleuronectiformes	84.3	208.66
Scorpaeniformes	90.71	0
Rajiformes	1	0
TOTAL	**1511.97**	**897.35**

8.3.331 Embedded mitigation, including the AFDs and FRR system, would reduce the possible mortality of fish prey species, thereby reducing the potential loss of prey species for grey and harbour seal.

8.3.332 Considering the relatively small potential quantity of food resource that could be lost, in relation to natural variations, the foraging range and the food requirements of grey and harbour seal, the potential reduction of any prey as a result of impingement and entrainment is unlikely to have the potential for a significant effect on the grey or harbour seal populations. Therefore an adverse effect is not anticipated on the integrity of the European Designated Sites where grey or harbour seal are qualifying features.

8.3.333 The assessment assumes that all grey seal and harbour seal could be from a European Designated Site and conclusions are drawn with respect to the influence of the effects on site integrity, for each relevant European Designated Site, in sections 8.8 to 8.10.

Summary of the overall potential Project effects

Construction

8.3.334 During construction, temporary effects on harbour porpoise, bottlenose dolphin, grey seal and harbour seal could result from:

- Disturbance as a result of underwater noise during marine construction works and from vessels.
  - For harbour porpoise, when the predicted effects of the construction works (up to 1.05 porpoise potentially disturbed from two percussive drilling rigs, worst-case scenario), the disposal of dredged material (up to 0.08 porpoise potentially disturbed) and disturbance from vessels (up to 1.5 porpoise) are considered together, the maximum number of harbour porpoise that could have a behavioural response, assuming as a worst case that they would all be temporarily disturbed, is a up to three (approximately 0.003% of the CIS MU reference population of 104,695 harbour porpoise). In total, the maximum predicated area of behavioural response, which could lead to temporary disturbance of harbour porpoise is 1.26km^2 (based on area of 0.83km^2 for two percussive drilling rigs, 0.03km^2 for disposal of dredged material and 0.4km^2 for 40

vessels), which is approximately 0.0002% of the CIS MU area of 516,893km^2 for harbour porpoise.

- For bottlenose dolphin, the maximum number of individuals that could have a behavioural response, assuming as a worst case that they would all be temporarily disturbed, is up to one (approximately 0.25% of the IS MU reference population of 397 bottlenose dolphin), based on 0.38 dolphins being disturbed from two percussive drilling rigs, 0.2 dolphins disturbed at the disposal site and 0.00008 dolphins disturbed from vessels. In total, the maximum predicated area of behavioural response, which could lead to temporary disturbance of bottlenose dolphin is 1.16km^2 (based on area of 1.11km^2 for two percussive drilling rigs; 0.05km^2 for disposal of dredged material; and 0.0001km^2 for 40 vessels), which is approximately 0.002% of the IS MU area of 50,145km^2 for bottlenose dolphin.
- For grey seal, the maximum number of individuals that could have a behavioural response, assuming as a worst case that they would all be temporarily disturbed, is up to 14.53 (approximately 0.24% of the grey seal reference population), based on 14.53 grey seal being disturbed from two percussive drilling rigs, 0.00001 grey seal disturbed at the disposal site and 0.00005 grey seal disturbed by vessels.
- For harbour seal, the maximum number of individuals that could have a behavioural response, assuming as a worst case that they would all be temporarily disturbed, is 0.05 (approximately 0.1% of the harbour seal reference population), based on 0.05 harbour seal being disturbed from two percussive drilling rigs, 0.0005 harbour seal disturbed at the disposal site and less than 0.0008 harbour seal disturbed by vessels.
- For prey species, the maximum predicted area for any displacement would be less than the maximum area of potential disturbance for marine mammals; therefore there would be no additional effects on marine mammals as a result of any displacement of prey species in these areas.

- Any change or loss of habitat for harbour porpoise, bottlenose dolphin, grey seal, harbour seal and their prey.
  - Based on a precautionary approach, it has been assumed that the marine area of the Wylfa Newydd Development Area (approximately 0.35km^2) and of the Disposal Site, including a 100m buffer (approximately 0.65km^2), resulting in a maximum potential area of 1km2, could experience a potential change or loss of habitat.

- The maximum area of any potential change or loss of habitat is within the area of potential disturbance of harbour porpoise, bottlenose dolphin, grey seal and harbour seal during construction, as outlined above. Therefore there would be no additional or synergetic effects, as the animals would already be disturbed and would move away during the construction works.

- *Increase in suspended sediment concentration during dredging and disposal*. Due to the limited dispersion area, rapid dispersion and material being quickly deposited, along with low contaminant levels in sediments, any potential effects on marine mammals or their prey as a result of increased suspended sediments and contaminant re-mobilisation are highly unlikely at either the Wylfa Newydd Development Area or Disposal Site. However, as a very precautionary approach, the number of harbour porpoise, bottlenose dolphin, grey seal and harbour seal that could be present (and percentage of the reference population) in the Wylfa Newydd Development Area (0.35km^2), the Disposal Site (0.375km^2) and Disposal Site with 100m buffer (0.651km^2), based on maximum species density estimates for these areas has been predicted.
  - A total of 2.09 harbour porpoise (0.002% of CIS MU reference population) could be present in the Wylfa Newydd Development Area and Disposal Site plus buffer, based on the maximum species density estimates for these areas. In total, the maximum predicted area of any habitat loss or change (1km^2) represents 0.0002% of the CIS MU area of 516,893km^2 for harbour porpoise.
  - A total 0.34 bottlenose dolphin could be affected by any loss or changes of habitat at the Wylfa Newydd Development Area and Disposal Site plus buffer, this represents up to 0.09% of the IS MU reference population. The maximum predicted area of any habitat loss or change (1km^2) represents 0.002% of the IS MU area of 50,145km^2 for bottlenose dolphin.
  - A total 0.16 grey seal could be affected by any loss or changes of habitat at the Wylfa Newydd Development Area and Disposal Site plus buffer, this represents up to 0.003% of the reference population.
  - A total 0.0008 harbour seal could be affected by any loss or changes of habitat at the Wylfa Newydd Development Area and Disposal Site plus buffer, this represents up to 0.002% of the reference population.
  - For prey species, the maximum predicted area for any displacement or effects from increased suspended sediment would be the same or less than the maximum area for marine mammals;

therefore there would be no additional effects on marine mammals as a result of any effects on prey species in these areas.

8.3.335 Mitigation measures (as outlined in section 8.5 and summarised in table 11-1) would reduce the risk of any auditory injury (PTS) in harbour porpoise, bottlenose dolphin, grey seal and harbour seal, therefore, no effects are anticipated.

8.3.336 The assessment indicates that there is no potential for any significant disturbance of grey or harbour seals at haul-out sites near the Wylfa Newydd Development Area from airborne noise or visual stimuli.

8.3.337 No significant effects on marine mammals or their prey are predicted as a result of any suspended sediment or changes to chemical quality due to discharges into the marine environment during construction.

8.3.338 The quality of sediment at the Wylfa Newydd Development Area is not considered to be contaminated. Therefore, it is considered highly unlikely that there is any risk to marine mammals and their prey from contaminant re-mobilisation during dredging and disposal.

8.3.339 As a worst-case, the total number of harbour porpoise, bottlenose dolphin, grey seal and harbour seal that could be temporarily affected during construction, based on the potential disturbance as a result of underwater noise from construction activities, disturbance from vessels and the in suspended sediment concentration during dredging and disposal, has been estimated to be:

- 5 harbour porpoise (0.005% of CIS MU reference population).
- 1.5 bottlenose dolphin (0.4% of IS MU reference population).
- 15 grey seal (0.25% of the reference population).
- 0.05 harbour seal (0.1% of the reference population).

8.3.340 However, these predictions are very precautionary, as the areas of effect overlap and the effects are unlikely to be additive. Therefore an adverse effect on integrity is not anticipated during construction for any of the European Designated Sites where these species are a qualifying feature.

Operation

8.3.341 During operation, potential effects on harbour porpoise, bottlenose dolphin, grey seal and harbour seal could result from:

- *Any change or loss of habitat for harbour porpoise, bottlenose dolphin, grey seal, harbour seal and their prey*. As for construction, based on a precautionary approach it has been assumed that the marine area of the Wylfa Newydd Development Area (approximately 0.35km^2) and of the Disposal Site, including a 100m buffer (approximately 0.65km^2), resulting in a maximum potential area of 1km^2, could experience a potential change or loss of habitat.

- A total of 2.09 harbour porpoise (0.002% of CIS MU reference population) could be present in the Wylfa Newydd Development Area and Disposal Site plus buffer, based on the maximum species density estimates for these areas. In total, the maximum predicted area of any habitat loss or change (1km^2) represents 0.0002% of the CIS MU area of 516,893km^2 for harbour porpoise.
- A total 0.34 bottlenose dolphin could be affected by any loss or changes of habitat at the Wylfa Newydd Development Area and Disposal Site plus buffer, this represents up to 0.09% of the IS MU reference population. The maximum predicted area of any habitat loss or change (1km^2) represents 0.002% of the IS MU area of 50,145km^2 for bottlenose dolphin.
- A total 0.16 grey seal could be affected by any loss or changes of habitat at the Wylfa Newydd Development Area and Disposal Site plus buffer, this represents up to 0.003% of the reference population.
- A total 0.0008 harbour seal could be affected by any loss or changes of habitat at the Wylfa Newydd Development Area and Disposal Site plus buffer, this represents up to 0.002% of the reference population.
- Taking into account the diet of marine mammal species and the prey species likely to be present in the Wylfa Newydd Development Area, it is unlikely to represent a key area for foraging. Therefore any displacement of marine mammals due to a loss of food resource is considered to be unlikely. Moreover, the area of potential change and/or loss of habitat represents a very small proportion of the foraging area of marine mammals.

- *An increase in water temperature and TRO from cooling water discharge during operation*. The discharge water would be approximately 12°C (98 percentile) warmer than the water being abstracted at the point of discharge. Modelling indicates that temperatures in excess of 8°C (98 percentile) above ambient, up to a maximum of 12°C (98 percentile), is restricted a small area at the outfall. Nevertheless the number of harbour porpoise, bottlenose dolphin, grey seal and harbour seal that could be present in the areas of the thermal plume predicted to experience a 2^{o}C (2.41km^2) temperature increase was assessed. As a worst-case, the number of harbour porpoise, bottlenose dolphin, grey seal and harbour seal that could be present in the cooling water discharge area has been estimated for the maximum potential TRO mixing zone (3.13km^2).
  - A total of 3.94 harbour porpoise (0.004% of CIS MU reference population) could be present in the cooling water discharge area. In

total, the maximum predicted area represents approximately 0.0006% of the harbour porpoise CIS MU area.

- A total 1.08 bottlenose dolphin (0.3% of IS MU reference population) could be present in the cooling water discharge area. In total, the maximum predicted area represents approximately 0.006% of the bottlenose dolphin Irish Sea MU area.
- A total 0.75 grey seal (0.1% of reference population) could be present in the cooling water discharge area.
- A total 0.003 harbour seal (0.006% of reference population) could be present in the cooling water discharge area.
- Taking into account the diet of marine mammal species and the prey species likely to be present in the Wylfa Newydd Development Area, it is unlikely to represent a key area for foraging. Therefore any displacement of marine mammals due to a loss of food resource is considered to be unlikely.

- *Potential loss of prey due to impingement and entrainment at the cooling water system intake during operation*. Based on the worst-case scenario, the potential prey loss as a result of impingement and entrainment could be the equivalent of:
  - The annual prey required by two small porpoises (less than 0.002% of the CIS MU reference population).
  - Approximately 62% of prey required by one small dolphin per year (less than 0.25% of the IS MU reference population).
  - The annual prey required up to 1.5 average sized grey seals (less than 0.025% of the reference population) and 2.5 harbour seals (up to 5% of reference population).

8.3.342 As a very worst-case, the potential effects over the 60 years of operation, in theory, could be the equivalent of 120 small harbour porpoise (0.1% of the CIS MU reference population), 60 small bottlenose dolphin (15% of the IS MU reference population), 90 grey seal (1.5% of the reference population) and 150 harbour seal.

8.3.343 However, it is important to note that this is only the potential number of individuals that could be affected due to any loss of prey, as other prey would be available from nearby areas. In addition, embedded mitigation, including the AFDs and FRR system, would reduce the potential loss of prey species. It should also be noted that due to the very low numbers of harbour seal in the area, the reference population is correspondingly low. As a result it is highly unlikely that any harbour seals would be affected by any loss of prey as a result of impingement and entrainment.

8.3.344 The assessment indicates there is no potential for any significant effects due to underwater noise from maintenance dredging and vessel movements during the Project's operation. There is also no potential for any significant effect due to underwater noise from the AFDs on the cooling water intake.

8.3.345 There would not be a significant effect on water quality due to the change in pH, ratio of ionised to unionised ammonia, or dissolved oxygen levels as a result of changing temperatures from cooling water discharge during operation.

8.3.346 Any alteration of coastal processes and hydrodynamics would have a negligible effect on intertidal and subtidal habitats and communities from scour and no potential impact on marine mammal prey species.

8.3.347 As worst-case, the total number of harbour porpoise, bottlenose dolphin, grey seal and harbour seal that could be affected during operation has been estimated based on the maximum area for any change or loss of habitat, increase in water temperature and TRO from cooling water discharge and the annual potential loss of prey due to impingement and entrainment at the cooling water system intake:

- 8 harbour porpoise (0.008% of CIS MU reference population).
- 3 bottlenose dolphin (0.75% of IS MU reference population).
- 2.5 grey seal (0.04% of the reference population).
- 2.5 harbour seal (5% of the reference population).

8.3.348 However, this is very precautionary as these areas overlap and there are unlikely to be additive effects. Therefore an adverse effect on integrity is not anticipated during operation for any of the European Designated Sites where these species are a qualifying feature.

Vessel collision risk during construction and operation

8.3.349 The existing baseline for the area is estimated to be up to 25 vessels per week. During construction and operation there could be a 56% increase in the number of vessels, based on two vessels a day (up to a peak of 15 vessels per week). However, this increase does not equate to a 56% increase in collision risk for marine mammals. As a worst case, the number of harbour porpoise, bottlenose dolphin, grey seal and harbour seal that could be at increased collision risk with vessels within the Wylfa Newydd Development Area, the Disposal Site plus 100m buffer and the vessel route between the two sites, based on a 1km width of vessel route, has been estimated taking into account avoidance rates of 95%. The assessment indicates that:

- Up to 5.5 harbour porpoise could be at increased collision risk (0.005% of the CIS MU reference population).
- Up to 0.75 bottlenose dolphin could be at increased collision risk (0.2% of the IS MU reference population).
- Up to 0.3 grey seal could be at increased collision risk (0.005% of the reference population).
- Up to 0.0015 harbour seal could be at increased collision risk (0.003% of the reference population).

8.3.350 However, this is very precautionary assessment. Therefore an adverse effect on integrity is not anticipated as a result of any increased vessel collision risk for any of the European Designated Sites where these species are a qualifying feature.

8.4 Assessment of potential effects (in-combination)

A Changes in visual and acoustic stimuli

A1 Underwater noise during marine construction works

8.4.1 The potential effects of underwater noise, including any risk of auditory injury (PTS) and any disturbance / behavioural response of marine mammals and their prey have been assessed for those other projects where there is the potential for an in-combination effect with the Project during the marine construction works. Tables 8-5, 8-6, 8-7 and 8-8 indicate the projects and European Designated Sites that have been assessed further for any potential in-combination effects from underwater noise. The other projects have been assessed with respect to the nearest cSAC or SAC.

8.4.2 Where possible the number of animals and potential areas that could be affected by underwater noise from the projects, if the information is available for the individual projects in scoping reports, ESs or HRAs, has been used for the in-combination assessment. For projects where there is no detailed information, or uncertainty on what the likely impacts could be, then a precautionary approach has been taken. Where possible this includes sources of information from projects where similar operations have affected sites, although this can vary from project to project and the professional judgement of specialists.

8.4.3 In line with the precautionary principle, where there is uncertainty and/or information is lacking in relation to the capacity of an effect to undermine a site's conservation objectives it is assumed that there would be an effect, unless further information can be made available to eliminate any areas of doubt.

A2 Airborne noise during construction

8.4.4 It was concluded in section 8.3, effect A2 for alone effects, that airborne noise during construction is highly unlikely to result in any significant effects on grey seal and harbour seal and the integrity of European Designated Sites where they are a qualifying feature. As outlined in section 5.3, European Designated Sites not captured by the 'alone' LSE screening assessment do not have any potential to be affected by the Project, either alone or in-combination.Therefore there is no potential for any in-combination effects of airborne noise during construction to adversely affect the integrity of the screened in European Designated Sites in view of their conservation objectives.

A3 Visual stimuli

8.4.5 As outlined in section 8.3 effect A3 for alone effects, visual stimuli is highly unlikely to result in any significant effects on grey seal and harbour seal and the integrity of the European Designated Sites where they are a qualifying feature. As outlined in section 5.3 and above, European Designated Sites not captured by the 'alone' LSE screening assessment do not have any potential to be affected by the Project, either alone or in-combination. Therefore there is no potential for any in-combination effects of visual stimuli to adversely affect the integrity of the screened in European Designated Sites in view of their conservation objectives.

A4 Underwater noise during operation

8.4.6 As outlined in section 8.3 effect A4 for alone effects, there is no potential for any significant impacts to arise due to underwater noise from maintenance dredging and vessel movements during operation. However, the potential underwater noise from other projects during the operation of the Project has been assessed in sections 8.5 to 8.10 to determine the potential for any in-combination effect that could adversely affect the integrity of the screened in European Designated Sites in view of their conservation objectives (including any potential effects on prey species), taking into account the use of AFDs.

B Land take, including seabed or intertidal

B1 Change and/or loss of habitat

8.4.7 The potential effects of any change in and/or loss of habitat for marine mammals and their prey have been assessed for any projects located within screened in SACs and cSACs, or for the nearest SACs and cSACs, where harbour porpoise, bottlenose dolphin, grey seal or harbour seal are a qualifying feature and there is the potential for any land take, including seabed or intertidal, to have an in-combination effect with the Project. Tables 8-5, 8-6, 8-7 and 8-8 indicate the projects and designated sites that have been assessed further in sections 8.5 to 8.10 for any potential in-combination effects that could adversely affect the integrity of the screened in European Designated Sites in view of their conservation objectives (including any potential effects on prey species).

C Changes in marine water quality

8.4.8 The potential effects of changes in marine water quality on marine mammals and their prey have been assessed for any projects or plans located within screened in SACs and cSACs, or for the nearest SACs and cSACs, where harbour porpoise, bottlenose dolphin, grey seal or harbour seal are a qualifying feature. Tables 8-5, 8-6, 8-7 and 8-8 indicate the projects and European Designated sites that have been assessed further in sections 8.5 to 8.10 for any potential in-combination effects that could adversely affect the integrity of the screened in European Designated Sites in view of their

conservation objectives (including any potential effects on prey species) for changes in marine water quality, this includes:

- increases in suspended sediment, for example during dredging and disposal;
- contaminant re-mobilisation during dredging and disposal;
- any increase in seawater temperature as a result of cooling water discharge during operation;
- Total Residual Oxidants discharges as a result of cooling water discharge during operation; and
- any other discharges or potential changes in marine water quality.

D Alteration of coastal processes and hydrodynamics

D1 Potential effect on habitat for prey species

8.4.9 As outlined in section 8.3 effect D1 for alone effects, the coastal processes assessment concludes that there is no potential for an alteration in intertidal or subtidal habitats, consequently, no significant effect on prey species for marine mammals is predicted. However, the potential effect of any alteration of coastal processes and hydrodynamics on prey species from other projects has been assessed in sections 8.5 to 8.10 to determine the potential for any in-combination effect that could adversely affect the integrity of the screened in European Designated Sites in view of their conservation objectives for prey species.

E Physical interaction with project infrastructure and vessels

8.4.10 The potential effects of any physical interaction between project infrastructure, including vessels, for marine mammals and their prey have been assessed for any projects or plans located within screened in SACs and cSACs, or for the nearest SACs and cSACs, where harbour porpoise, bottlenose dolphin, grey seal or harbour seal are a qualifying feature and there is the potential for any in-combination effect with the Project. Tables 8-5, 8-6, 8-7 and 8-8 indicate the projects and designated sites that have been assessed further in sections 8.5 to 8.10 for any potential in-combination effects associated with physical interactions which could affect harbour porpoise, bottlenose dolphin, grey seal, harbour seal or their prey, and could adversely affect the integrity of the screened in European Designated Sites in view of their conservation objectives, such as:

- increased vessel collision risk;
- collision risk with tidal devices; and
- any physical interaction with project infrastructure.

8.5 Gogledd Môn Forol/North Anglesey Marine cSAC (harbour porpoise (*Phocoena phocoena*))

Conservation objectives

8.5.1 The draft conservation objectives for Gogledd Môn Forol/North Anglesey Marine cSAC [RD172] for harbour porpoise are:

- To avoid deterioration of the habitats of the harbour porpoise or significant disturbance to the harbour porpoise, thus ensuring that the integrity of the site is maintained and the site makes an appropriate contribution to maintaining favourable conservation status for the UK harbour porpoise.
- To ensure for harbour porpoise that, subject to natural change, the following attributes are maintained or restored in the long term:
  - The species is a viable component of the site.
  - There is no significant disturbance of the species.
  - The supporting habitats and processes relevant to harbour porpoises and their prey are maintained.

8.5.2 As outlined in chapter 6, the estimated Gogledd Môn Forol/North Anglesey Marine cSAC harbour porpoise population is 1,088 individuals (95% CI = 557-2,111) for at least part of the year, based on approximately 2.4% of the UK Celtic and Irish Seas MU [RD172]. However, [RD172] notes that because this estimate is from a one-month survey in a single year it cannot be considered as a specific population number for the cSAC and it is not appropriate to assign a site population estimate because of the daily and seasonal movements of the animals. Therefore, the potential effects have been assessed for the Celtic and Irish Seas MU reference population for harbour porpoise. This is in line with [RD172] draft conservation objectives and Advice on Activities, which states that it is how the impacts within the site translate into effects on the MU population that are of greatest concern. In addition, the assessment also includes a spatial assessment of the potential disturbance effects in relation to the area of the cSAC.

A Changes in visual and acoustic stimuli

Construction

A1 Underwater noise during marine construction works [Marine Licence]

8.5.3 The following summarises the predicted effects of underwater noise during the marine construction works, without mitigation, on the harbour porpoise population:

- The maximum predicted impact range for PTS, without mitigation, is 25m as a result of rock breaking (table 8-28), which has the potential to effect 0.003 harbour porpoise (<0.00001% of the CIS MU reference

population; table 8-32). However, mitigation would be put in place, as outlined below, to reduce the risk of any PTS.

- The maximum predicted range for a behavioural effect is 530m for harbour porpoise as a result of two percussive drilling rigs (table 8-28), which has the potential to effect 0.8 - 1.05 harbour porpoise (0.0008% - 0.001% of the CIS MU reference population; based on 75% to 100% of harbour porpoise responding; table 8-32).

8.5.4 The following summarises the predicted effect of underwater noise due to disposal of dredged material at the Disposal Site:

- The maximum predicted range for PTS is <1m (table 8-28), which has the potential to effect 0.000008 harbour porpoise (<0.00001% of the CIS MU reference population; table 8-32).
- The maximum predicted range for a behavioural effect is 99m for harbour porpoise (table 8-28), which has the potential to effect 0.06 – 0.08 harbour porpoise (0.00005% - 0.00008% of the CIS MU reference population; based on 75% to 100% of harbour porpoise responding; table 8-32).
- Along the vessel route between the Wylfa Newydd Development Area and Disposal Site, the maximum number of harbour porpoise that could be present is up to 108 individuals (0.1% of the CIS MU reference population; based on a very precautionary vessel route width of 1km; table 8-36). The maximum predicted area of potential disturbance of harbour porpoise is therefore up to 0.01km^2 per vessel. Taking into account the peak number of vessels on site is predicted to average approximately 15 per week over a three month period and the existing baseline of up to 25 vessels per week for the area (ES Volume D – Wylfa Newydd Development Area Development D13 – The Marine Environment, Application Reference Number: 6.4.13), the maximum total area of disturbance as a result of 40 vessels could be up to 0.4km^2. Therefore the maximum number of harbour porpoise that could be disturbed in and around the Wylfa Newydd Development Area is 0.5 individuals (based on density of 1.26/km^2) and, in and around the Disposal Site, the maximum number of harbour porpoise that could be disturbed is one porpoise (based on a density of 2.534/km^2). Therefore, based on this precautionary approach, up to 1.5 harbour porpoise could be temporarily disturbed as a result of vessels during construction.

8.5.5 When the predicted effects of the construction works (e.g. two percussive drilling rigs; one individual could be disturbed), the disposal of dredged material (less than one individual (0.08) could be disturbed) and disturbance from vessels (up to 1.5 individuals could be disturbed) are considered together, on a very precautionary basis, the maximum number of harbour porpoise that potentially could have a behavioural response, taken as a

worst case that they would all be temporarily disturbed is up to a maximum of 3 individuals (up to 0.003% of the CIS MU reference population).

8.5.6 In the context of the CIS MU reference population of harbour porpoise, the Project is predicted to affect a low proportion of the population. Any risk of PTS would be mitigated and disturbance could temporarily affect up to a maximum of 0.003% of the CIS MU reference population.

8.5.7 In the context of the Gogledd Môn Forol/North Anglesey Marine cSAC, the maximum area of predicted behavioural response, which could lead to temporary disturbance during drilling with two percussive rigs is approximately 0.83km^2 (table 8-28), which equates to approximately 0.025% of the area of the cSAC (3,249km^2). As a result of dredging material disposal at the Disposal Site, the maximum predicted area of behavioural response, which could lead to temporary disturbance of harbour porpoise is 0.03km^2 (table 8-28), approximately 0.0009% of the cSAC area. The maximum area of predicted behavioural response, which could lead to temporary disturbance of harbour porpoise around vessels (0.4km^2), is approximately 0.01% for the cSAC area. In total, the maximum predicated area of behavioural response, which could lead to temporary disturbance of harbour porpoise is 1.26km^2 which would be 0.04% of the cSAC (approximately 0.0002% of the CIS MU area (516,893km^2)).

8.5.8 The potential effect of underwater noise on prey species for harbour porpoise would not extend beyond the maximum predicted effect areas described for harbour porpoise. Consequently, the approach taken to assessing the effect on the harbour porpoise population is worst case, and there would be no additional impact as a result of the effects on prey species.

Mitigation of underwater noise during construction

8.5.9 To minimise noise and vibration disturbance at source and to reduce any potential risks of physical injury or auditory injury (PTS) and reduce the significance of disturbance to all marine mammal receptors, the following measures would be implemented where relevant depending on the construction method:

8.5.10 Construction activities, including piling, drilling, rock cutting and rock breaking, would adopt best practice guidance, where applicable, for minimising the risk of injury to marine mammals from piling noise detailed by the Joint Nature Conservation Committee (JNCC). The proposed mitigation measures (refer to table 11-1 for a summary of mitigation and securing mechanisms) include:

- Establishment of a mitigation zone around the construction site.
- Only commence construction operations during the hours of daylight and good visibility (observers should be able to monitor the full extent of the mitigation zone).
- Visual monitoring by MMOs.
- Passive Acoustic Monitoring (PAM).

- Pre–construction activity search for marine mammals.
- Delay if marine mammals detected within the mitigation zone.
- Soft-start of construction activity for a period of not less than 20 minutes.
- Pre–construction activity search and soft-start procedure should be repeated before construction activity recommences, if construction activity operations pause for a period of greater than 10 minutes.
- Clear communication between the MMOs/PAM operators and the construction activity operators.
- Reports detailing the construction activity and marine mammal mitigation, the 'MMO and PAM reports', should be sent to the relevant conservation agency after the end of the construction activity.

8.5.11 In addition, the presence of the western breakwater would provide an increasing level of underwater noise protection as construction progresses.

8.5.12 It is concluded that, with or without mitigation, any potential effects from underwater noise during construction would not result in an adverse effect on the integrity of the Gogledd Môn Forol/North Anglesey Marine cSAC in relation to the conservation objectives for harbour porpoise.

Operation

A4 Underwater noise during operation [Operational water discharge activity EP]

8.5.13 Taking into account the noise modelling for the AFD arrays, the likelihood of harbour porpoise occurring within 400m of the cooling water outfall location is considered to be low and there is no potential for any significant disturbance to arise. There is also unlikely to be any significant effects from the displacement of prey species. Therefore, it is concluded that any potential disturbance as a result of the underwater noise from the AFDs during operation would not result in an adverse effect on the integrity of the Gogledd Môn Forol/North Anglesey Marine cSAC in relation to its conservation objectives for harbour porpoise.

B Land take, including seabed or intertidal land

Construction

8.5.14 The effect of the Project on intertidal and subtidal land take would be fully realised on completion of the construction phase of the marine works and, therefore, the predicted changes are described below for the operational phase. Any intermediate effects prior to the completion of construction of the marine works would be of a lesser magnitude than the changes predicted for the operational phase; and are not expected to be significant in the short term.

Operation

B1 Change and/or loss of habitat [Marine Licence]

8.5.15 Based on a precautionary approach, it has been assumed that the marine area of the Wylfa Newydd Development Area (approximately 0.35km^2) and of the Disposal Site that has been identified as the zone for disposal of dredged material, including a 100m buffer (approximately 0.65km^2), could experience a potential change or loss of habitat. As the effect of this change / loss is difficult to predict in terms of its implications for harbour porpoise, because the usage of the area by harbour porpoise cannot be precisely stated, it is assumed that the affected area would represent a loss of supporting habitat to the harbour porpoise population.

8.5.16 The number of harbour porpoise that could be present in the Wylfa Newydd Development Area is 0.44 individuals and 1.65 individuals in the Disposal Site (table 8-38), based on the maximum species density estimates for these areas (see chapter 6). Therefore, a total of 2.09 harbour porpoise could be affected by any loss or changes of habitat at the Wylfa Newydd Development Area and Disposal Site, this represents up to 0.002% of the CIS MU reference population.

8.5.17 In context of the Gogledd Môn Forol/North Anglesey Marine cSAC, the maximum area of predicted of any change and/or habitat loss is approximately 0.01% of the cSAC area at the Wylfa Newydd Development Area and 0.02% at the Disposal Site including 100m buffer (based on cSAC area of 3,249km^2).

8.5.18 Based on the above, it is concluded that any potential effects associated with a change in or loss of habitat during operation (or construction) would not result in an adverse effect on the integrity of the Gogledd Môn Forol/North Anglesey Marine cSAC in relation to its conservation objectives for harbour porpoise.

C Changes in marine water quality

Construction

C1 Increase in suspended sediment input and change in chemical quality due to discharge from fluvial sources and sewage [Marine Licence, Construction water discharge EP]

8.5.19 The total combined area predicted to be affected by increases suspended sediments from all discharges is 0.245km^2. However, as a very precautionary approach, the number of harbour porpoise that could potentially be present (and percentage of the reference population) in the Wylfa Newydd Development Area (0.35km^2) has been estimated (table 8-39, based on maximum species density estimates for the area). The total number of harbour porpoise that could be present in the Wylfa Newydd Development Area is 0.44 individuals (table 8-39), this represents up to 0.0004% of the CIS MU reference population.

8.5.20 In context of the Gogledd Môn Forol/North Anglesey Marine cSAC, the maximum area of any potential effect (0.35km^2) is approximately 0.01% of the cSAC area (3,249km^2).

8.5.21 Given the above, it is concluded that any potential effects of changes in marine water quality during construction would not result in an adverse effect on the integrity of the Gogledd Môn Forol/North Anglesey Marine cSAC in relation to its conservation objectives for harbour porpoise.

C2 Increase in suspended sediment concentration and contaminant re-mobilisation during dredging and disposal [Marine Licence]

8.5.22 The modelling of increases in suspended sediment concentrations during the dredging and disposal of dredged material predicts that the maximum extent of the effect above baseline would be over an area extending 0.245km^2.

8.5.23 As a very precautionary approach, the number of harbour porpoise that could potentially be present (and percentage of the reference population) in the Wylfa Newydd Development Area (0.35km^2) and Disposal Site with 100m buffer (0.651km^2) has been estimated (table 8-39, based on maximum species density estimates for the area). The total number of harbour porpoise that could be present in the Wylfa Newydd Development Area and Disposal Site with 100m buffer and could be potentially affected by any increases in suspended sediment concentration is 2.09 individuals (table 8-39), this represents up to 0.002% of the CIS MU reference population.

8.5.24 In context of the Gogledd Môn Forol/North Anglesey Marine cSAC, the maximum area of any potential effect is approximately 0.03% of the cSAC area.

8.5.25 The area in which increased suspended sediment concentrations would be experienced is very small in relation the range of harbour porpoise and their prey, and any potential effects would be temporary, with dispersion of the suspended sediment to background levels predicted to occur within three hours of a dredging / disposal cycle.

8.5.26 The potential effect of increased suspended sediment on prey species for harbour porpoise would not extend beyond the maximum predicted effect areas described for harbour porpoise. Consequently, the approach taken to assessing the effect on the harbour porpoise population is worst case, and there would be no additional impact as a result of the effects on prey species.

8.5.27 Given the above, it is concluded that any potential effects of changes in marine water quality during construction would not result in an adverse effect on the integrity of the Gogledd Môn Forol / North Anglesey Marine cSAC in relation to its conservation objectives for harbour porpoise.

Operation

C3 Discharge from the CWS [Operational water discharge EP]

Change in water temperature

8.5.28 As a very precautionary approach, the number of harbour porpoise that could be present in the maximum predicted surface area for a 2°C rise in temperature (2.41km^2) has been estimated as three individuals, which represents 0.003% of the CIS MU reference population (table 8-41).

8.5.29 In context of the Gogledd Môn Forol/North Anglesey Marine cSAC, the maximum area of any potential effect is approximately 0.07% of the cSAC area.

Total Residual Oxidants

8.5.30 As a very precautionary approach, the number of harbour porpoise that could be present in the maximum potential TRO impact area (3.13km^2) is up to four individuals, which represents 0.004% of the CIS MU reference population (table 8-44).

8.5.31 In context of the Gogledd Môn Forol/North Anglesey Marine cSAC, the maximum area of any potential effect is approximately 0.1% of the cSAC area.

Effect on prey species

8.5.32 The potential effect of change in water temperature and TRO on prey species for harbour porpoise would not extend beyond the maximum predicted effect areas described for harbour porpoise. Consequently, the approach taken to assessing the effect on the harbour porpoise population is worst case, and there would be no additional impact as a result of the effects on prey species.

Effect of changes in marine water quality during operation

8.5.33 The area of increased temperature and TRO from the cooling water discharge represents the same area therefore, as a worst-case, the number of harbour porpoise that could be affected by changes in water temperature and TRO discharges, based on the maximum potential TRO impact area (3.13km^2), is up to four harbour porpoise; which represents 0.004% of the CIS MU reference population.

8.5.34 As described in section 8.3, no significant effect on harbour porpoise is predicted due to the potential effect of the Project on marine water quality. Given this lack of effect and the very small percentage of the reference population (which is considered insignificant) that could be exposed to the area of predicted change in marine water quality, there is no potential for an effect to arise on harbour porpoise populations over the operational lifetime of the Project.

8.5.35 It is therefore concluded that any potential effects of changes in marine water quality during operation would not result in an adverse effect on the

integrity of the Gogledd Môn Forol/North Anglesey Marine cSAC in relation to its conservation objectives for harbour porpoise.

D Alteration of coastal processes and hydrodynamics

Construction

8.5.36 As for land take, the effect of the Project on coastal processes would be fully realised on completion of the construction phase of the marine works and, therefore, the predicted changes are described below for the operational phase. Any intermediate effects on coastal processes and hydrodynamics prior to the completion of construction of the marine works would be of a lesser magnitude than the changes predicted for the operational phase; and are not expected to be significant in the short term.

Operation

D1 Potential effect on habitat for prey species [Marine Licence]

8.5.37 The coastal processes assessment concludes that there is no potential for any alteration of intertidal or subtidal habitats and, consequently, no significant effect on prey species for marine mammals is predicted.

8.5.38 As a worst case, a localised change in habitat within the Wylfa Newydd Development Area is assumed. This area coincides with area assessed under effect B1 above (change and/or loss of habitat) and, therefore, has not been assessed here to avoid double counting of the potential effect.

8.5.39 Based on the above, the alternation of coastal processes and hydrodynamics (effect D) is not considered further in this chapter.

E Physical interaction between species and Project infrastructure

Construction

E1 Vessel collision risk [Marine Licence]

8.5.40 As a precautionary worse-case approach, the number of harbour porpoise that could be at increased risk of collision with all vessels during construction and operation within the Wylfa Newydd Development Area, the Disposal Site plus 100m buffer (table 8-45) and the vessel route between the two sites, based on a 1km width of vessel route (table 8-46), is estimated to be up to approximately 5.5 individuals (0.005% of CIS MU reference population) based on 95% avoidance rate.

8.5.41 However, it is highly unlikely that harbour porpoise would experience a significantly increased collision risk with vessels during construction, especially taking into account the fact that any harbour porpoise in the area would be habituated to the presence of vessels and able to detect and avoid vessels.

8.5.42 Hence it is concluded that any potential interactions between species and the Project infrastructure during construction would not result in an adverse effect on the integrity of the Gogledd Môn Forol/North Anglesey Marine cSAC in relation to its conservation objectives for harbour porpoise.

Operation

E2 Impact of impingement and entrainment of prey species during operation [Operational water discharge EP]

8.5.43 The potential impact area for prey species would be confined to the intake structure and the potential zones of influence in which fish could be at risk of have been identified as 50m from the intake. Fish are highly mobile species, with relatively large areas and are unlikely to be restricted to the immediate area of the cooling water intake. Therefore the loss of fish is likely to be very small in comparison to fish populations in the area and natural variation.

8.5.44 The DEA for harbour porpoise estimates based on the worst-case scenario that the maximum number of harbour porpoise that could be affected is up to two small porpoise, which represents less than 0.002% of the CIS MU reference population. However, it is important to note that this is only potential loss of prey, as individuals would still be able to source prey from nearby areas. In addition, embedded mitigation, including the AFDs and FRR system, would reduce the potential loss of prey species.

8.5.45 Hence it is concluded that any potential loss of prey through impingement and entrainment during operation would not result in an adverse effect on the integrity of the Gogledd Môn Forol/North Anglesey Marine cSAC in relation to its conservation objectives for harbour porpoise.

In-combination for the Gogledd Môn Forol/North Anglesey Marine cSAC for harbour porpoise

A Changes in visual and acoustic stimuli

Construction

A1 Underwater noise during marine construction works

8.5.46 Eight projects have been identified as having the potential for in-combination effects on harbour porpoise in relation to the Gogledd Môn Forol / North Anglesey Marine cSAC from underwater noise during the Project marine construction works.

Auditory injury

8.5.47 The in-combination assessment (table 8-55) indicates that, with the appropriate mitigation measures that would be required for each project, there should be no potential for any auditory injury in harbour porpoise and there would be no cumulative impact with other projects. Therefore, there is no potential for an adverse effect to arise on the integrity of this European

Designated Site in view of its conservation objectives, for example 'ensure the species is a viable component of the site'.

Disturbance

8.5.48 Taking a very precautionary approach and using the worst case scenario for the in-combination assessment, that during the Project's marine construction works the maximum number of harbour porpoise that could be disturbed could be up to three individuals (e.g. cumulatively from two percussive drilling rigs, the disposal of dredged material and vessels), this would still only contribute a very small proportion to any in-combination effects, e.g. up to 0.003% of the CIS MU could be temporarily disturbed.

8.5.49 The Wylfa Decommissioning ES [RD198] did not identify any adverse impacts, including disturbance on marine mammals, and therefore would not contribute to any in-combination effects on harbour porpoise at the Gogledd Môn Forol/North Anglesey Marine cSAC from underwater noise during the Project's marine construction works.

8.5.50 There is very limited information on what the Anglesey Eco Park could involve and what, if any, potential sources for any underwater noise during the marine construction works might be. Therefore this cannot be included in the in-combination assessment at this time.

8.5.51 There is the potential for increased vessel noise as tankers import liquid gas to a mooring three kilometres from the Amlwch coast. However any potential disturbance from vessels is likely to be limited to the area around the vessels and along the vessel route, therefore the potential for any significant disturbance and in-combination effects would be very low.

8.5.52 During the operation and maintenance of the Gwynt y Môr Offshore Wind Farm, there is the potential for disturbance as a result of underwater noise from maintenance activities such as cable re-burial and vessels, however, it is likely to be limited to the wind farm site, short-term and temporary and, therefore, the potential for any in-combination effects to arise would be very low.

8.5.53 For the North West Coast Connections Project, there is currently very little information on the potential for underwater noise during the construction of underground section across the Menai Strait. It should be noted that this project is currently paused for the review of the NuGen Moorside nuclear power station development.

8.5.54 There is the potential for underwater noise during the NuGen Moorside nuclear power station development adjacent to the existing Sellafield station in Cumbria, for example during marine construction works such as for a MOLF and cooling water infrastructure. There is little information available; however, it can be assumed that the potential impacts would be similar to those assessed with regard to the Project's marine construction works and that there would only be a relatively small contribution to any in-combination effects. It should be noted that this project is currently on-hold and undergoing a review.

8.5.55 The in-combination assessment (table 8-55) has determined that, if the Minesto Holyhead Deep and Menter Môn Morlais tidal developments are constructed at the same time, there is the potential for significant disturbance to harbour porpoise, based on the maximum area of the cSAC that could be affected (e.g. up to 10% for each project based on single not concurrent installation of piled foundations). However, each project is estimated to temporarily disturb less than 1% of the CIS MU, based on worst-case scenario. As the developers of these projects are likely to work together to reduce and limit any potential impacts, it would be expected that, if required, mitigation would be put in place to reduce any significant disturbance on harbour porpoise from the cSAC.

8.5.56 Therefore of all the projects assessed (table 8-55) only the Minesto Holyhead Deep and Menter Môn Morlais tidal developments have been identified, based on currently available information, as having the potential to have in-combination effects relating to underwater noise during the Project's marine construction works that could that could affect the integrity of the cSAC in relation to its conservation objective that 'there is no significant disturbance of the species'. However, based on the number of harbour porpoise potentially affected in relation to the CIS MU reference population, the temporary effects due to disturbance from underwater noise would not be significant and would not adversely affect the integrity of the cSAC.

Operation

A4 Underwater noise during operation

8.5.57 Of the projects that were identified as having the potential for in-combination effects on harbour porpoise at the Gogledd Môn Forol/North Anglesey Marine cSAC from underwater noise during the Project's operation, only the Minesto Holyhead Deep and Menter Môn Morlais tidal developments have been determined, based on currently available information, to have the potential for any in-combination effects (table 8-56).

8.5.58 There is no potential for any significant effects due to underwater noise from maintenance dredging and vessel movements during the Project's operation. There is also no potential for any significant effect due to underwater noise from the AFDs on the cooling water intake. Therefore the potential does not exist for an adverse effect on the integrity of the cSAC in relation to its conservation objectives to arise.

Table 8-55 Assessment of potential for any in-combination effects of underwater noise during the marine construction works at the Gogledd Môn Forol/North Anglesey Marine cSAC for harbour porpoise

In-combination assessment	Potential sources of underwater noise during marine construction works	Potential to adversely affect the integrity of the European Designated Site	
		Auditory Injury (PTS)	Behavioural Response / Disturbance
The Project	Potential sources of underwater noise at the Wylfa Newydd Development Area and Disposal Site are: • drilling; • rock cutting; • rock breaking; • dredging; • disposal of material; and • vessels.	The maximum predicted impact range for PTS is 25m as a result of rock breaking without mitigation, which has the potential to affect less than one harbour porpoise. The maximum predicted range for PTS is less than 1m for the disposal of material and from vessels and is therefore highly unlikely to affect any harbour porpoise. *Therefore there is no potential to adversely affect the integrity of the site.*	The maximum predicted effects of the construction works and disposal of material (including vessel movement between the Wylfa Newydd Development Area and Disposal Site) could potentially disturb up to a maximum of three harbour porpoise (0.003% of CIS MU). Maximum predicated area of behavioural response, which could lead to temporary disturbance of harbour porpoise is 1.26km^2 which would be 0.04% of the cSAC. *Therefore there is no potential to adversely affect the integrity of the site.*
Wylfa Decommissioning	The marine decommissioning work will be associated with the jetty, offshore seawater intake structures and cooling water (CW) outfall complex [RD198]. Disturbance to cetaceans and grey seals from explosive demolition (if this is the preferred method) of the Cooling Water jetty and offshore seawater intake structures [RD198]. The effects of the removal of off-shore structures on marine fauna, including disturbance due to the work [RD198].	With mitigation it was assessed in the ES 2013 update [RD198] that there would be a 'Negligible' impact on marine mammals and this was assessed as being not significant. *Therefore there is no potential for any in-combination effects to adversely affect the integrity of the site.*	The use of explosives could cause severe but brief disturbance to marine mammals, however the potential impacts will be minimised by carrying out explosions at low tide and the other proposed mitigation measures [RD198]. No key significant adverse impacts were identified by the ecological assessment [RD198]. *Therefore there is no potential for any in-combination effects to adversely affect the integrity of the site.*
Anglesey Eco Park	No details are currently available on if there will be the potential for any	It is assumed that the potential for any	The potential for any disturbance as a result of underwater noise is currently

In-combination assessment	Potential sources of underwater noise during marine construction works	Potential to adversely affect the integrity of the European Designated Site	
		Auditory Injury (PTS)	Behavioural Response / Disturbance
	underwater noise and what the sources might be during the Project marine construction works.	auditory injury would be mitigated. *Therefore there is no potential for any in-combination effects to adversely affect the integrity of the site.*	unknown as a result of an absence of project information. No in-combination assessment can therefore be carried out.
Amlwch LNG (Liquified Natural Gas)	There is the potential for increased vessel noise as tankers import liquid gas to a mooring three kilometres from the Amlwch coast. However, there are currently no further details on the number of vessels.	There would be no potential for any auditory injury from vessel noise. *Therefore there is no potential for any in-combination effects to adversely affect the integrity of the site.*	The potential for any disturbance as a result of underwater noise from vessels is currently unknown, however it is likely to be limited to the area around the vessels and along the vessel route, therefore the potential for any significant disturbance and in-combination effects will be very low. *Therefore there is no potential for any in-combination effects to adversely affect the integrity of the site.*
Minesto Holyhead Deep 10 MW Tidal Kite	Foundation options for the 160 0.5MW Deep Green Utility (DGU) units that are being considered include 4m monopile fixed to the seabed either using piling hammers, or drilling and grouting it into position, or a combination of these two approaches [RD214]. The other installation methods that are being considered include floating gravity base structure (GBS) and mud mat foundation [RD214]. Other noise sources will include vessels, cable laying and construction of offshore substation. [RD214] proposes to develop the Array	The ES found no risk of auditory injury from vessels and drilling / vibro-hammering noise [RD212]. *Therefore there is no potential for any in-combination effects to adversely affect the integrity of the site.*	The noise modelling indicated, using a very precautionary approach that disturbance zones could extend out to 4,000m for the quieter vessels and out to a maximum of 14,000m for the louder vessels [RD212]. The ES concluded that, whilst a small number of individual animals may exhibit some form of change in behaviour for the period in which they encounter sound from the installation or support vessels, this number is likely to be small and the main noise sources present for such a short time that any changes would likely be undetectable against natural variation and would have no residual impact at the population level

In-combination assessment	Potential sources of underwater noise during marine construction works	Potential to adversely affect the integrity of the European Designated Site	
		Auditory Injury (PTS)	**Behavioural Response / Disturbance**
	Project in three phases as part of a deploy-and-monitor approach, which will allow verification of predictions made in the EIA, and confirm that mitigation strategies are working effectively.		[RD212]. The noise modelling for drilling activity indicated that disturbance zones could extend out to 375m for pile drilling and out to a maximum of 10,000m for the vibro-hammering. For the installation of one DGU piling activities are likely to be limited to approximately 5 days, the ES concluded that there is likely to be very limited interaction between the piling noise and mammals; any changes would likely be undetectable against natural variation and would have no residual impact at the population level [RD212]. *This will have to be assessed further of the Phased development and installation of 160 devices.* *However, based on the maximum predicted impact range, the potential impact area is 314km^2, which could affect **785 harbour** porpoise (0.75% of CIS MU) and approximately 10% of the cSAC area (based on single not concurrent installation and the maximum density estimate of 2.5 / km^2 – see Chapter 6). It should be noted, that this is not assessed in-combination with disturbance from vessels outlined above as both would be in the same area at the same time, with overlapping impact areas.* *Therefore, further assessment is required*

In-combination assessment	Potential sources of underwater noise during marine construction works	Potential to adversely affect the integrity of the European Designated Site	
		Auditory Injury (PTS)	Behavioural Response / Disturbance
			by Minesto to determine the potential to adversely affect the integrity of the site. As a result of an absence of detailed project information, no in-combination assessment can be carried out.
Menter Môn (Morlais) West Anglesey Marine Energy Demonstration Zone	No details are currently available as to the potential for any underwater noise and what the sources might be during the Project marine construction works, however as a worst-case scenario they have been assumed to the same / similar to the Minesto Holyhead Deep tidal array. The Morlais Project capacity may be up to, but will not exceed 100W. A number of Tidal Energy Converters (TEC) are being considered. Seabed mounted devices could be fixed using several different methods. The type of installation vessel will vary depending on the needs of the foundation, but would typically require a heavy lift crane barge or jack-up barge vessel [RD217].	It is assumed that the potential for any auditory injury would be mitigated. *Therefore there is no potential for any in-combination effects to adversely affect the integrity of the site.*	*As assessed for the Minesto Holyhead Deep tidal array, e.g. the potential impact area could be 314km^2, which could affect 785 harbour porpoise (0.75% of CIS MU) and approximately 10% of the cSAC area (based on single not concurrent installation and maximum density estimate of 2.5 / km^2 – see Chapter 6).* *Therefore, further assessment is required by Morlais to determine the potential to adversely affect the integrity of the site.* As a result of an absence of detailed project information, no in-combination assessment can be carried out.
Gwynt y Môr Offshore Wind Farm	There is potential for this project to impact on the Gogledd Môn Forol/North Anglesey Marine cSAC. Further information is required to determine the potential sources of underwater noise during the operation and maintenance activities to determine any in-combination effects with the	It is assumed that the potential for any auditory injury would be mitigated. *Therefore there is no potential for any in-combination effects to adversely affect the integrity of the site.*	The potential for any disturbance as a result of underwater noise is currently unknown, however, it is likely to be limited to the wind farm site, short-term and temporary and therefore the potential for any in-combination effects will be very low. *Therefore there is no potential for any in-combination effects to adversely affect*

In-combination assessment	Potential sources of underwater noise during marine construction works	Potential to adversely affect the integrity of the European Designated Site	
		Auditory Injury (PTS)	Behavioural Response / Disturbance
	Project marine construction works.		*the integrity of the site.*
North West Coast Connections Project	There is very little information on the potential for any underwater noise during the construction of underground section across the Menai Strait. This project is currently on hold.	It is assumed that the potential for any auditory injury would be mitigated. *Therefore there is no potential for any in-combination effects to adversely affect the integrity of the site.*	The potential for any disturbance as a result of underwater noise is currently unknown as a result of an absence of project information. No in-combination assessment can therefore be carried out.
NuGen Moorside Project in West Cumbria	There is the potential for underwater noise at the nuclear power station development adjacent to the existing Sellafield station in Cumbria, during marine construction works e.g. a Marine Off-Loading Facility and the cooling water infrastructure. This project is currently on hold.	It is assumed that the potential for any auditory injury would be mitigated. *Therefore there is no potential for any in-combination effects to adversely affect the integrity of the site.*	The potential for any disturbance as a result of underwater noise is currently unknown. Although, it can be assumed that the potential impacts would be similar to those assessed for the Project marine construction works. However, as a result of an absence of project information, no in-combination assessment can be carried out.

Table 8-56 Assessment of potential in-combination effects of underwater noise during the Project's operation at the Gogledd Môn Forol/North Anglesey Marine cSAC for harbour porpoise

In-combination assessment	Potential sources of underwater noise during operation	Potential to adversely affect the integrity of the European Designated Site	
		Auditory Injury (PTS)	Behavioural Response / Disturbance
The Project	Potential noise sources during operation are: • maintenance dredging; • vessel movements; and	*There is no potential risk of any auditory injury.* *Therefore there is no potential for any in-combination effects to adversely affect the*	There is no potential for any significant impacts due to underwater noise from maintenance dredging and vessel movements during operation.

In-combination assessment	Potential sources of underwater noise during operation	Potential to adversely affect the integrity of the European Designated Site	
		Auditory Injury (PTS)	**Behavioural Response / Disturbance**
	• AFDs	*integrity of the site.*	*Therefore there is no potential to adversely affect the integrity of the site.*
Wylfa Decommissioning	The potential for in-combination effects from underwater noise has been assessed for the marine construction works as a worst-case scenario.		
Anglesey Eco Park	As outlined above, no details are currently available on if there will be the potential for any underwater noise and what the sources might be during the Project operation.	It is assumed that the potential for any auditory injury would be mitigated. *Therefore there is no potential for any in-combination effects to adversely affect the integrity of the site.*	The potential for any disturbance as a result of underwater noise is currently unknown as a result of an absence of project information. No in-combination assessment can therefore be carried out.
Amlwch LNG (Liquified Natural Gas)	There is the potential for increased vessel noise as tankers import liquid gas to a mooring three kilometres from the Amlwch coast. However, there are currently no further details on the number of vessels.	There would be no potential for any auditory injury from vessel noise. *Therefore there is no potential for any in-combination effects to adversely affect the integrity of the site.*	The potential for any disturbance as a result of underwater noise from vessels is currently unknown as a result of an absence of project information. No in-combination assessment can therefore be carried out.
Minesto Holyhead Deep 10 MW Tidal Kite	Noise sources during operation of the tidal array which could be in-combination with the Project operation will include vessels and operation of tidal turbines.	The ES found no risk of auditory injury from the operational DGU noise emissions [RD212]. *Therefore there is no potential for any in-combination effects to adversely affect the integrity of the site.*	The ES indicates that onset for potential behavioural change is not exceeded even at distances less than 1m from the source and there will therefore be no disturbance as a result of the operational DGU noise emissions [RD212]. The Launch and Recovery System (LARS) support vessel may be present on site for up to five years during the operational stage. Based on the SCANS-II density estimate (0.335 / km^2; [RD126]) the ES predicted that the maximum number of animals to be in the behavioural change impact zone (approx.

In-combination assessment	Potential sources of underwater noise during operation	Potential to adversely affect the integrity of the European Designated Site	
		Auditory Injury (PTS)	Behavioural Response / Disturbance
			50.75km^2) at any one time was 17 harbour porpoise. However, based on maximum density estimate of 2.534 / km^2 (see Chapter 6) this could be up to 129 harbour porpoise and approximately 1.6% of cSAC area. For maintenance vessels other the LARS vessel, the ES concluded the overall impact consequence would be low and not significant [RD212]. *Therefore, based on information currently available, there is no potential for any in-combination effects to adversely affect the integrity of the site.*
Menter Môn (Morlais) West Anglesey Marine Energy Demonstration Zone	No details are currently available on if there will be the potential for any underwater noise and what the sources might be during the Project operation, however as a worst-case scenario they have been assumed to the same / similar to the Minesto Holyhead Deep tidal array.	It is assumed that the potential for any auditory injury would be mitigated. *Therefore there is no potential for any in-combination effects to adversely affect the integrity of the site.*	No details are currently available on if there will be the potential impacts from underwater noise during the Project operation, however as a worst-case scenario they have been assumed to the same / similar to the Minesto Holyhead Deep tidal array. *Therefore, based on information currently available, there is no potential for any in-combination effects to adversely affect the integrity of the site.*
Gwynt y Môr Offshore Wind Farm	There is potential for this project to impact on the Gogledd Môn Forol / North Anglesey Marine cSAC. Further information is required to determine the potential sources of	It is assumed that the potential for any auditory injury would be mitigated. *Therefore there is no potential for any in-combination effects to adversely affect the*	The potential for any disturbance as a result of underwater noise is currently unknown. However, any maintenance activities, such as cable reburial, are likely to be limited to the wind farm site, short

In-combination assessment	Potential sources of underwater noise during operation	Potential to adversely affect the integrity of the European Designated Site	
		Auditory Injury (PTS)	Behavioural Response / Disturbance
	underwater noise during the operation and maintenance activities at the wind farm to determine any in-combination effects with the Project operation. However, potential activities could include cable reburial.	*integrity of the site.*	duration and temporary. *Therefore, there would be no potential for any in-combination effects to adversely affect the integrity of the site.*
North West Coast Connections Project	There is very little information on the potential for any underwater noise during the construction of underground section across the Menai Strait. This project is currently on hold.	It is assumed that the potential for any auditory injury would be mitigated. *Therefore there is no potential for any in-combination effects to adversely affect the integrity of the site.*	The potential for any disturbance as a result of underwater noise is currently unknown as a result of an absence of project information. No in-combination assessment can therefore be carried out.
NuGen Moorside Project in West Cumbria	There is the potential for underwater noise at the nuclear power station development adjacent to the existing Sellafield station in Cumbria, during marine construction works e.g. a Marine Off-Loading Facility and the cooling water infrastructure. This project is currently on hold.	It is assumed that the potential for any auditory injury would be mitigated. *Therefore there is no potential for any in-combination effects to adversely affect the integrity of the site.*	The potential for any disturbance as a result of underwater noise is currently unknown. Although, it can be assumed that the potential impacts would be similar to those assessed for the Project operation. However, as a result of an absence of project information, no in-combination assessment can be carried out.

B Land take, including seabed or intertidal land

B1 Change and/or loss of habitat

8.5.59 For the Project during construction and operation, based on a precautionary approach, it has been assumed that the marine area of the Wylfa Newydd Development Area (approximately 0.35km^2) and of the Disposal Site including a 100m buffer (approximately 0.65km^2), could experience a potential change or loss of habitat. The number of harbour porpoise that could be present in the Wylfa Newydd Development Area and in the Disposal Site and therefore affected by any loss or changes of habitat including the potential effects on prey species, based on the maximum species density estimates for these areas, is a total of 2.09 harbour porpoise (table 8-38). This represents up to 0.002% of the CIS MU reference population. In context of the Gogledd Môn Forol/North Anglesey Marine cSAC, the maximum area predicted for any change and / or habitat loss is approximately 0.01% of the cSAC area at the Wylfa Newydd Development Area and 0.02% at the Disposal Site including 100m buffer (based on cSAC area of 3,249km^2), resulting in an overall total of 1km^2 (0.03% of cSAC area).

8.5.60 The Minesto Holyhead Deep and Menter Môn Morlais tidal developments were identified as having the potential for in-combination effects with the Project associated with habitat loss or change on harbour porpoise, including prey species, on the Gogledd Môn Forol/North Anglesey Marine cSAC, based on currently available information (table 8-57).

8.5.61 In-combination, the Wylfa Newydd Development Area (approximately 0.35km^2) and of the Disposal Site including a 100m buffer (approximately 0.65km^2), along with the 9.1km^2 area of the Minesto Holyhead Deep tidal development and the West Anglesey Demonstration Zone (WADZ) area of 37km^2, have a total area of 47.1km^2 which represents 1.4% of the total area of the cSAC. In total this level of loss or change of habitat, including any potential impacts on prey, could affect up to 119.15 harbour porpoise (0.1% of the CIS MU reference population).

8.5.62 This is a very precautionary assessment, as the entire area is unlikely to be lost or changed significantly to affect harbour porpoise or their prey. However, even as a worst-case scenario that the entire area is lost or changed significantly, it is concluded that any potential effects would not result in an adverse effect on the integrity of the Gogledd Môn Forol/North Anglesey Marine cSAC in relation to its conservation objectives for harbour porpoise.

C Changes in marine water quality

Construction

8.5.63 During the Project's construction, any increase in suspended sediment input and change in chemical quality due to discharge from fluvial sources and sewage, and any increase in suspended sediment concentration and contaminant re-mobilisation during dredging and disposal could, applying a

precautionary approach, potentially affect harbour porpoise and their prey in the Wylfa Newydd Development Area (0.35km^2) and Disposal Site with 100m buffer (0.651km^2). This represents approximately 0.03% of the Gogledd Môn Forol/North Anglesey Marine cSAC area, which could contain 2.09 harbour porpoise (0.002% of the CIS MU reference population (table 8-39); 0.2% of the potential cSAC population).

8.5.64 None of the other projects screened in have the potential to have any in-combination effects with respect to changes in marine water quality during the construction of the Project (table 8-58). Therefore, there is no potential for an adverse effect on the integrity of the Gogledd Môn Forol/North Anglesey Marine cSAC in relation to its conservation objectives for harbour porpoise (or their prey species) as a result of in-combination effects in this context.

Operation

8.5.65 During the operation of the Project, the maximum area that could be impacted by the discharge from the cooling water system is 3.13km^2 for harbour porpoise and their prey, based on maximum potential TRO impact area, which is larger than the predicted maximum surface area for a 2^{o}C rise in temperature (2.41km^2; table 8-41 and table 8-44). The 3.13km^2 area represents approximately 0.1% of the Gogledd Môn Forol/North Anglesey Marine cSAC area, which could contain up to four harbour porpoise (0.004% of the CIS MU reference population; 0.4% of the potential cSAC population).

8.5.66 None of the screened in projects included in the in-combination assessment for changes in marine water quality during operation of the Project, have the potential to have any in-combination effects on harbour porpoise, or their prey species, using the Gogledd Môn Forol/North Anglesey Marine cSAC, based on currently available information. Therefore, there is no potential for an adverse effect on the integrity of the Gogledd Môn Forol/North Anglesey Marine cSAC to arise in relation to its conservation objectives for harbour porpoise as a result of in-combination effects in this context.

D Alteration of coastal processes and hydrodynamics

D1 Potential effect on habitat for prey species

8.5.67 The coastal processes assessment concludes that there is no potential for any alteration of intertidal or subtidal habitats and, consequently, no significant effect on prey species for marine mammals is predicted. As a worst case, a localised change in habitat within the Wylfa Newydd Development Area is assumed. This area coincides with the area assessed for any change and/or loss of habitat and, therefore, has not been assessed again to avoid double counting of the potential effect.

8.5.68 None of the screened in projects (table 8-59) included in the in-combination assessment for the alteration of coastal processes and hydrodynamics have the potential to have any in-combination effects on harbour porpoise, or their prey species, using the Gogledd Môn Forol/North Anglesey Marine cSAC,

based on currently available information (see table 8-59). Therefore, there is no potential for an adverse effect on the integrity of the Gogledd Môn Forol/North Anglesey Marine cSAC to arise in relation to its conservation objectives for harbour porpoise as a result of in-combination effects in this context.

E Physical interaction between species and Project infrastructure

E1 Vessel collision risk

8.5.69 The potential for in-combination effects due to vessel collision risk (table 8-60) is currently unknown due to lack of information for other screened in projects. Therefore, based on the current lack of information, the potential for an adverse effect on the integrity of the Gogledd Môn Forol/North Anglesey Marine cSAC in relation to its conservation objectives for harbour porpoise as a result of vessel collision risk has been considered.

8.5.70 It is highly unlikely that harbour porpoise would experience a significantly increased collision risk with vessels as a result of these other projects; especially taking into account that any harbour porpoise in the area would be habituated to the presence of vessels and able to detect and avoid vessels. As a result, any potential increased collision risk as a result of in-combination effects is unlikely to result in an adverse effect on the integrity of the Gogledd Môn Forol/North Anglesey Marine cSAC in relation to its conservation objectives for harbour porpoise.

E2 Project infrastructure

8.5.71 The potential for in-combination effects for any physical interaction between species and project infrastructure are currently unknown due to lack of information for other screened in projects. Therefore, based on the current lack of information, there could be the potential for an adverse effect on the integrity of the Gogledd Môn Forol/North Anglesey Marine cSAC in relation to its conservation objectives for harbour porpoise as a result of physical interaction with project infrastructure.

8.5.72 However, it should be noted that there is no potential for any direct physical interaction between harbour porpoise and the Project infrastructure. The loss of prey due to impingement could potentially affect up to two small harbour porpoise (0.002% of the CIS MU reference population) per year, although, harbour porpoise would still be able to source prey from nearby areas and embedded mitigation, including the AFDs and FRR system, would reduce the potential loss of prey species.

Table 8-57 Assessment of potential in-combination effects of any change or loss of habitat at the Gogledd Môn Forol/North Anglesey Marine cSAC for harbour porpoise

In-combination assessment	Potential for land take, including seabed or intertidal land	Potential to adversely affect the integrity of the European Designated Site
The Project	During construction and operation, based on a precautionary approach, it has been assumed that the marine area of the Wylfa Newydd Development Area (approximately 0.35km^2) and the Disposal Site including a 100m buffer (approximately 0.65km^2), could experience a potential change or loss of habitat.	A total of 2.09 harbour porpoise could be affected by any loss or changes of habitat, this represents up to 0.002% of the CIS MU reference population. In context of the Gogledd Môn Forol / North Anglesey Marine cSAC, the maximum area of any change and / or habitat loss is approximately 0.01% of the cSAC area at the Wylfa Newydd Development Area and 0.002% at the Disposal Site including 100m buffer. *Therefore there is no potential to adversely affect the integrity of the site.*
Anglesey Eco Park	As outlined above, no details are currently available on this proposed project and if there will be the potential for land take, including seabed or intertidal land.	The potential for any change or loss of habitat as a result of this project is currently unknown as a result of an absence of project information. No in-combination assessment can therefore be carried out.
Minesto Holyhead Deep 10 MW Tidal Kite	The 9.1km^2 AfL area could accommodate an array of up to 80 MW (160 0.5 MW DGUs). Minesto is collaborating with Morlais to jointly develop grid and cable infrastructure, which will help minimise the combined environmental footprint of the two projects [RD214].	The 9.1km^2 AfL area represents 0.3% of the cSAC area and based on maximum density estimate of 2.534 / km^2 (see Chapter 6) this could potentially affect up to 23 harbour porpoise (0.02% of the CIS MU reference population). *Therefore there is no potential for any in-combination effects to adversely affect the integrity of the site.*
Menter Môn (Morlais) West Anglesey Marine Energy Demonstration Zone	The Morlais Project will be located in the WADZ over an area of 37km^2.	The exact area of the Morlais project is currently unknown. However the WADZ area of 37km^2 represents 1% of the cSAC and based on maximum density estimate of 2.534/km^2 (see chapter 6) this could potentially affect up to 94 harbour porpoise (0.09% of the CIS MU reference population). *Therefore there is no potential for any in-combination effects to adversely affect the integrity of the site.*
North West Coast Connections Project	As outlined above, no details are currently available if there will be the potential for land take, including	The potential for any change or loss of habitat as a result of this project is currently unknown as a result of an absence of project information. No in-combination assessment can

In-combination assessment	Potential for land take, including seabed or intertidal land	Potential to adversely affect the integrity of the European Designated Site
	seabed or intertidal land. This project is currently on hold.	therefore be carried out.
NuGen Moorside Project in West Cumbria	There is the potential for land take, including seabed or intertidal land during marine construction works for the Marine Off-Loading Facility and the cooling water infrastructure. However, further details are currently not available. This project is currently on hold.	The potential for any change or loss of habitat as a result of this project is currently unknown. Although, it can be assumed that the potential impacts would be similar to those assessed for the Project marine construction works. However, as a result of an absence of project information, no in-combination assessment can be carried out.

Table 8-58 Assessment of potential in-combination effects of any changes in marine water quality at the Gogledd Môn Forol/North Anglesey Marine cSAC for harbour porpoise

In-combination assessment	Potential for changes in marine water quality	Potential to adversely affect the integrity of the European Designated Site
The Project	Increase in suspended sediment input and change in chemical quality due to discharge from fluvial sources and sewage during construction	The total combined area predicted to be affected by increases suspended sediments from all discharges is 0.245km^2. However, as a precautionary approach, the 0.44 harbour porpoise (0.0004% of the CIS MU reference population) that could potentially be present in the Wylfa Newydd Development Area (0.35km^2) was used in the assessment. In context of the Gogledd Môn Forol/North Anglesey Marine cSAC, the maximum area of any potential effect (0.35km^2) is approximately 0.01% of the cSAC area. *Therefore there is no potential to adversely affect the integrity of the site.*
	Increase in suspended sediment concentration and contaminant re-mobilisation during dredging and disposal during construction	The modelling of increases in suspended sediment concentrations during the dredging and disposal of dredged material predicts that the maximum extent of the effect above baseline would be over an area extending 0.245km^2. However, as a precautionary approach, the 2.15 harbour porpoise

In-combination assessment	Potential for changes in marine water quality	Potential to adversely affect the integrity of the European Designated Site
		(0.002% of the CIS MU reference population) that could potentially be present in the Wylfa Newydd Development Area (0.35km^2) and Disposal Site with 100m buffer (0.651km^2) was used in the assessment. In context of the Gogledd Môn Forol/North Anglesey Marine cSAC, the maximum area of any potential effect is approximately 0.03% of the cSAC area. This would be the same area as for increased suspended sediments from all discharges, above, and therefore not additional effects. *Therefore there is no potential to adversely affect the integrity of the site.*
	Discharge from the cooling water system during operation - change in water temperature	The number of harbour porpoise that could be present in the maximum predicted surface area for a 2^{o}C rise in temperature (2.41km^2) is estimated as three individuals (0.003% of the CIS MU reference population). In context of the Gogledd Môn Forol/North Anglesey Marine cSAC, the maximum area of any potential effect is approximately 0.07% of the cSAC area. This would be the same area for any impacts on prey species. This would be the same area as for TRO, below, and therefore not additional effects. *Therefore there is no potential to adversely affect the integrity of the site.*
	Discharge from the cooling water system during operation - Total Residual Oxidants	The number of harbour porpoise that could be present in the maximum potential TRO impact area (3.13km^2) is four individuals (0.004% of the CIS MU reference population). In context of the Gogledd Môn Forol / North Anglesey Marine cSAC, the maximum area of any potential effect is approximately 0.1% of the cSAC area. This would be the same area for any impacts on prey species. *Therefore there is no potential to adversely affect the integrity of the site.*

In-combination assessment	Potential for changes in marine water quality	Potential to adversely affect the integrity of the European Designated Site
Wylfa Decommissioning	Potential effects of accidental spills or pollution on nearby water bodies and watercourses where there is a pollutant pathway from the site [RD198].	No key significant adverse impacts were identified by the ecological assessment [RD198]. *Therefore there should be no risk and no potential for any in-combination effects to adversely affect the integrity of the site.*
	The ES update [RD198] identified the following as potential cumulative impacts: • Dust.; • Disturbance and mobilisation of contaminants in soils. • Disruption of groundwater interfaces.	It is predicted that potential adverse impacts will arise during the Care and Maintenance Preparations phase and/or the Final Site Clearance phases. Therefore, mitigation measures have been proposed following best practice and/or all applicable British Standards (BS) or Environment Agency Pollution Prevention Guidance Notes. With these in place none of the residual impacts are predicted to be significant. *Therefore there is no potential for any in-combination effects to adversely affect the integrity of the site.*
	Potential impacts on surface waters ([RD198]) include: • The removal of off shore structures. • Impacts on surface water quality from changes in the non-radioactive content of routine discharges from the site. • Changes in the non-radioactive content of routine discharges of operational effluents associated with decommissioning. • The potential release of turbid and/or contaminated water (e.g. via storm drains) due to decommissioning activities on site. • Changes in the risk of on- or off-site flooding as a result of decommissioning (e.g. due to changes made to storm drains, construction of new buildings or hardstandings or removal of existing buildings or hardstandings). • Impacts to water quality in bathing areas. • Changes to the site's runoff characteristics. • The non-radioactive content of discharges of	Mitigation will minimise the magnitude of these impacts so that there will not be any significant impacts on surface waters arising from the decommissioning process. With mitigation in place the impacts relating to minor spills and leaks on the surface waters environment will not be significant. It is also considered that the potential for adverse cumulative impacts could be mitigated by the implementation of appropriate environmental management measures e.g. drainage management plans, and through the adoption of environmental best practice working methods [RD198]. The update ES [RD198], concluded that the proposed mitigation measures outlined in the 2008 ES are still relevant and appropriate in line with current best practice. *Therefore there is no potential for any in-combination effects to adversely affect the integrity of the site.*

In-combination assessment	Potential for changes in marine water quality	Potential to adversely affect the integrity of the European Designated Site
	operational effluents. • Radioactive discharges. • Sediments released due to movements of HGVs and heavy plant. • Changes to coastal erosion processes caused by the cessation of cooling water discharges. • Flood risk. • Impacts relating to potential spills and leaks of radioactive and non-radioactive substances to nearby waterbodies.	
Anglesey Eco Park	As outlined above, no details are currently available on this proposed project and if there will be the potential for any changes in marine water quality.	The potential for any changes in marine water quality as a result of this project is currently unknown. As a result of an absence of project information, no in-combination assessment can be carried out.
Minesto Holyhead Deep 10 MW Tidal Kite	Increased turbidity during installation activities.	Any increase in turbidity or suspended sediment levels is expected to be temporally and spatially restricted, largely due to the small volumes released and the high energy environment [RD212]. The ES concluded that for cetaceans the overall impact was considered to be negligible and not significant. *This will have to be assessed further of the Phased development and installation of 160 devices.* *However, taking into account the high energy environment into which they will be discharged, any increased suspended sediment will be dispersed rapidly and any elevated turbidity in the immediate vicinity of the discharge point will be very short lived.* *Therefore there is no potential for any in-combination effects to adversely affect the integrity of the site.*
	There is potential for accidental release from vessels to occur as a result of collision. The release of a large inventory of fuel oil from a vessel was considered to represent the greatest potential accidental pollution	Cetaceans were considered to be of low sensitivity and the overall impact was also considered to be low and therefore not significant [RD212]. *This assessment is unlikely to change for the Phased*

In-combination assessment	Potential for changes in marine water quality	Potential to adversely affect the integrity of the European Designated Site
	[RD212].	*development and installation of 160 devices.* *Therefore there is no potential for any in-combination effects to adversely affect the integrity of the site.*
Menter Môn (Morlais) West Anglesey Marine Energy Demonstration Zone	No details are currently available on any potential changes to water quality, however as a worst-case scenario they have been assumed to the same / similar to the Minesto Holyhead Deep tidal array.	*Therefore there is no potential for any in-combination effects to adversely affect the integrity of the site.*
Gwynt y Môr Offshore Wind Farm	There is potential for this project to impact on the Gogledd Môn Forol/North Anglesey Marine cSAC. Further information is required to determine the potential for any changes to marine water quality during the operation and maintenance activities to determine any in-combination effects with the Project.	The potential for any changes to marine water quality is currently unknown, however, it is likely to be limited to the wind farm site, short-term and temporary and therefore the potential for any in-combination effects will be very low. *However, based on available information, there is no potential for any in-combination effects to adversely affect the integrity of the site.*
North West Coast Connections Project	There is very little information on the potential for any changes to marine water quality during the construction of underground section across the Menai Strait. This project is currently on hold.	The potential for any changes to marine water quality is currently unknown. Therefore, as a result of an absence of project information, no in-combination assessment can be carried out.
NuGen Moorside Project in West Cumbria	There is the potential for changes to marine water quality during operation and construction. This project is currently on hold.	The potential for any changes to marine water quality during operation and construction is currently unknown. Although, it can be assumed that the potential impacts would be similar to those assessed for the Project marine construction works and operation. However, as a result of an absence of project information, no in-combination assessment can be carried out.

Table 8-59 Assessment of potential in-combination effects of any alteration of coastal processes and hydrodynamics on prey species at the Gogledd Môn Forol / North Anglesey Marine cSAC for harbour porpoise

In-combination assessment	Potential effects of any alteration of coastal processes and hydrodynamics on prey species	Potential to adversely affect the integrity of the European Designated Site
The Project	The coastal processes assessment concludes that there is no potential for any alteration of intertidal or subtidal habitats and, consequently, no significant effect on prey species for marine mammals is predicted.	As a worst case, a localised change in habitat within the Wylfa Newydd Development Area is assumed. This area coincides with area assessed under for any change and/or loss of habitat and, therefore, has not been assessed here to avoid double counting of the potential effect. *Therefore there is no potential to adversely affect the integrity of the site.*
Anglesey Eco Park	As outlined above, no details are currently available on this proposed project and if there will be the potential for any alteration of coastal processes and hydrodynamics on prey species.	The potential effects of any alteration of coastal processes and hydrodynamics on prey species as a result of this project are currently unknown. Therefore, as a result of an absence of project information, no in-combination assessment can be carried out..
North West Coast Connections Project	There is very little information on the potential for any alteration of coastal processes and hydrodynamics on prey species during the construction of underground section across the Menai Strait. This project is currently on hold.	The potential for any alteration of coastal processes and hydrodynamics on prey species is currently unknown. Therefore, as a result of an absence of project information, no in-combination assessment can be carried out.
NuGen Moorside Project in West Cumbria	There is the potential for alteration of coastal processes and hydrodynamics on prey species. This project is currently on hold.	The potential for any alteration of coastal processes and hydrodynamics on prey species during operation and construction is currently unknown. Although, it can be assumed that the potential impacts would be similar to those assessed for the

In-combination assessment	Potential effects of any alteration of coastal processes and hydrodynamics on prey species	Potential to adversely affect the integrity of the European Designated Site
		Project. However, as a result of an absence of project information, no in-combination assessment can be carried out.

Table 8-60 Assessment of potential in-combination effects of any physical interaction with project infrastructure and vessels at the Gogledd Môn Forol/North Anglesey Marine cSAC for harbour porpoise

In-combination assessment	Potential for physical interaction with project infrastructure and vessels	Potential to adversely affect the integrity of the European Designated Site
The Project	Vessel collision risk	As a precautionary case approach, the number of harbour porpoise that could be at increased risk of collision with all vessels during construction and operation within the Wylfa Newydd Development Area, the Disposal Site plus 100m buffer and 1km wide the vessel route between the two sites, was estimated to be up to approximately 5.5 individuals (0.005% of CIS MU reference population) based on 95% avoidance rate. *Therefore there is no potential to adversely affect the integrity of the site.*
	Project infrastructure	No direct impacts on harbour porpoise as a result of project infrastructure. However, the loss of prey due to impingement could potentially affect up to two small harbour porpoise (0.002% of the CIS MU reference population) per year. However, individuals would still be able to source prey from nearby areas. *Therefore there is no potential to adversely affect the*

In-combination assessment	Potential for physical interaction with project infrastructure and vessels	Potential to adversely affect the integrity of the European Designated Site
		integrity of the site.
Wylfa Decommissioning	The basis of the environmental impact assessment is transport of wastes and materials will by road only [RD198]. *The ES update does not indicate any significant increase in vessel movements or any increased risk of physical interaction with project infrastructure.* *Therefore there is no potential for any in-combination effects to adversely affect the integrity of the site.*	No key significant adverse impacts were identified by the ecological assessment [RD198]. *Therefore there is no potential for any in-combination effects to adversely affect the integrity of the site.*
Anglesey Eco Park	As outlined above, no details are currently available on this proposed project and if there will be the potential for any physical interaction with project infrastructure and vessels.	The potential for any physical interaction with project infrastructure and vessels as a result of this project is currently unknown as a result of an absence of project information. No in-combination assessment can therefore be carried out.
Amlwch LNG (Liquefied Natural Gas)	There is the potential for increased vessel collision risk as tankers import liquid gas to a mooring three kilometres from the Amlwch coast. However, there are currently no further details on the number of vessels.	The potential for any physical interaction with project infrastructure and vessels as a result of this project is currently unknown as a result of an absence of project information. No in-combination assessment can therefore be carried out.
Minesto Holyhead Deep 10 MW Tidal Kite	Physical interaction with barge mooring systems and subsea umbilical	Considering their small body size and the absence of historical cases of entanglement at renewables deployments or FPSOs, small cetaceans are considered of negligible sensitivity to physical interaction with mooring systems. Therefore, the ES [RD213] assessed the impacts to be of negligible consequence regardless of magnitude and this impact was assessed as not significant. *This assessment is unlikely to change for the Phased development and installation of 160 devices.* *Therefore there is no potential for any in-combination effects to adversely affect the integrity of the site.*
	Physical interaction with vessels	The operations and maintenance activities associated with the Project will not involve significant numbers of

In-combination assessment	Potential for physical interaction with project infrastructure and vessels	Potential to adversely affect the integrity of the European Designated Site
		vessels (LARS support vessel a maximum of once per week and additional maintenance vessels up to six days per year) and therefore it is not considered the Project will present any additional impacts to marine mammals over and above normal shipping activities. Overall the ES [RD212] deemed extremely unlikely that vessel collision will occur, let alone to a sufficient extent to cause population level effects. Therefore the impact was considered to be low and not significant. *This assessment will have to be reviewed for the Phased development and installation of 160 devices. However, the outcome is unlikely to change.* *Therefore there is no potential for any in-combination effects to adversely affect the integrity of the site.*
	Physical interaction with DGU (excluding tether)	In the ES for a single device [RD212], harbour porpoise were considered to be of medium sensitivity to physical interaction with the DGU, vulnerability is considered low on the basis that the number of passages of animals through the Project area required to bring about population level effects is beyond that which the baseline data suggests is feasible. As such, the magnitude was considered minor and the overall impact consequence was defined as low, and therefore not significant. *This assessment will have to be reviewed for the Phased development and installation of 160 devices. However, it should be noted that the assessment was based on the number of passages of animals through the Project area required to bring about population level effects and [RD214] proposes to develop the Array Project in three phases as part of a deploy-and-monitor approach, which will allow verification of predictions made in the EIA, and confirm that mitigation strategies, if required, are working*

In-combination assessment	Potential for physical interaction with project infrastructure and vessels	Potential to adversely affect the integrity of the European Designated Site
		effectively. The potential for any physical interaction with project infrastructure as a result of this project is currently unknown and as a result no in-combination assessment can therefore be carried out.
	Physical interaction with DGU mooring systems. There exists the potential for marine mammals to become entangled with device components: • Mooring tether between the DGU and the anchor block (or barge) during normal operation; • Mooring tether between the DGU and the anchor block (or barge) during periods of slack water or when in failsafe mode; and • Mooring tether between the anchor block and the marker buoy used to record the tether's location when the DGU is removed from the water. The DGU mooring tether presents a novel potential mechanism of interaction with marine mammals, being much more taught than ropes associated with fisheries and moving much more than anchor chains associated with vessels [RD212].	In the ES [RD212] harbour porpoise were considered to have negligible sensitivity to physical interactions with mooring systems, vulnerability was considered to be low on the basis that it is inconceivable that there would be a sufficient number of entanglement events to bring about a population level effect, especially considering the absence of historical data on entanglement at renewables deployments. The magnitude is considered low on the basis that the tether will occupy a small area, will only be slack for short periods of time (approximately 23% of the day). Furthermore, the tether is smooth, streamlined and designed not to form loops, thereby reducing the chance of entanglement. Although the value is high, the vulnerability is considered to be low, therefore impacts are considered to be of low consequence and not significant. *As above, this assessment will have to be reviewed for the Phased development and installation of 160 devices. However, it should be noted that the assessment was based on the number of passages of animals through the Project area required to bring about population level effects and [RD214] proposes to develop the Array Project in three phases as part of a deploy-and-monitor approach, which will allow verification of predictions made in the EIA, and confirm that mitigation strategies, if required, are working effectively.* The potential for any physical interaction with project

In-combination assessment	Potential for physical interaction with project infrastructure and vessels	Potential to adversely affect the integrity of the European Designated Site
		infrastructure as a result of this project is currently unknown and as a result of an no in-combination assessment can therefore be carried out.
Menter Môn (Morlais) West Anglesey Marine Energy Demonstration Zone	No details are currently available, however as a worst-case scenario they have been assumed to the same / similar to the Minesto Holyhead Deep tidal array.	The potential for any physical interaction with project infrastructure and vessels as a result of this project is currently unknown as a result of an absence of project information. No in-combination assessment can therefore be carried out.
Gwynt y Môr Offshore Wind Farm	There could be the potential for increased vessel movements and increased collision risk.	The potential for any physical interaction vessels as a result of this project is currently unknown as a result of an absence of project information. No in-combination assessment can therefore be carried out.
North West Coast Connections Project	There could be the potential for increased vessel movements and increased collision risk. This project is currently on hold.	The potential for any physical interaction vessels as a result of this project is currently unknown as a result of an absence of project information. No in-combination assessment can therefore be carried out.
NuGen Moorside Project in West Cumbria	There could be the potential for increased vessel movements and increased collision risk. This project is currently on hold.	The potential for any physical interaction vessels as a result of this project is currently unknown. Although, it can be assumed that the potential impacts would be similar to those assessed the Project. However, as a result of an absence of project information, no in-combination assessment can be carried out

8.5.73 In addition, if any project alone is likely to have a significant effect on harbour porpoise as a result of physical interaction with the infrastructure, for example at the proposed tidal developments, then mitigation and monitoring would be required at these sites to reduce the risk.

8.5.74 As a result, any potential for physical interaction with project infrastructure as a result of in-combination effects is unlikely to result in an adverse effect on the integrity of the Gogledd Môn Forol/North Anglesey Marine cSAC in relation to its conservation objectives for harbour porpoise.

Conclusions for the Gogledd Môn Forol/North Anglesey Marine cSAC for harbour porpoise

Alone

8.5.75 In conclusion, there is no potential for any adverse effects on the integrity of the Gogledd Môn Forol/North Anglesey Marine cSAC from the Project alone during its construction and operation in relation to the conservation objectives for harbour porpoise (table 8-61).

Table 8-61 Summary of the assessment of the potential effects on the Gogledd Môn Forol/North Anglesey Marine cSAC in relation to the draft conservation objectives for harbour porpoise

Conservation objectives	Changes in visual and acoustic stimuli	Land take, including seabed or intertidal land	Changes in marine water quality	Alteration of coastal processes and hydrodynamics	Physical interaction between species and Project infra-structure
The species is a viable component of the site	×	×	×	×	×
There is no significant disturbance of the species	×	×	×	×	×
The supporting habitats and processes relevant to harbour porpoises and their prey are maintained	×	×	×	×	×

× = no potential for any adverse effect on the integrity of the site in relation to the conservation objectives

In-combination

8.5.76 In conclusion, based on the information presently available, there is no potential for any adverse effect on the integrity of the Gogledd Môn Forol/North Anglesey Marine cSAC from in-combination effects associated with land take, including seabed or intertidal land; changes in marine water quality; or changes in prey resources during construction and operation in

relation to the conservation objectives for harbour porpoise (table 8-62). There is also unlikely to be any in-combination effects from underwater noise or any physical interaction with project infra-structure or vessels, recognising that information is lacking for the effects of some other projects due to their current status (table 8-62).

Table 8-62 Summary of the in-combination assessment for the Gogledd Môn Forol/North Anglesey Marine cSAC in relation to the draft conservation objectives for harbour porpoise

Conservation objectives	Changes in visual and acoustic stimuli	Land take, including seabed or intertidal land	Changes in marine water quality	Alteration of coastal processes and hydrodynamics	Physical interaction between species and Project infra-structure
The species is a viable component of the site	×	×	×	×	×
There is no significant disturbance of the species	×	×	×	×	×
The supporting habitats and processes relevant to harbour porpoises and their prey are maintained	×	×	×	×	×

× = no potential for any adverse effect on the integrity of the site in relation to the conservation objectives;

8.6 Other European Designated Sites for harbour porpoise

Introduction

8.6.1 Other European Designated Sites ‘screened in’ for harbour porpoise are:

- Gorllewin Cymru Forol/West Wales Marine cSAC.
- Dynesfeydd Môr Hafren/Bristol Channel Approaches cSAC.
- North Channel cSAC.
- Rockabill to Dalkey Island SAC (Ireland).

Conservation objectives

8.6.2 The draft conservation objectives for the Gorllewin Cymru Forol/West Wales Marine cSAC [RD173], the Dynesfeydd Môr Hafren/Bristol Channel Approaches cSAC [RD235] and the North Channel cSAC [RD80] for harbour porpoise are:

- To avoid deterioration of the habitats of the harbour porpoise or significant disturbance to the harbour porpoise, thus ensuring that the integrity of the site is maintained and the site makes an appropriate contribution to maintaining favourable conservation status for the UK harbour porpoise.
- To ensure for harbour porpoise that, subject to natural change, the following attributes are maintained or restored in the long term:
  - The species is a viable component of the site.
  - There is no significant disturbance of the species.
  - The supporting habitats and processes relevant to harbour porpoises and their prey are maintained.

8.6.3 The conservation objective for the Rockabill to Dalkey Island SAC [RD224] for harbour porpoise is:

- To maintain the favourable conservation condition of harbour porpoise in Rockabill to Dalkey Island SAC, which is defined by the following list of attributes and targets:
  - Species range within the site should not be restricted by artificial barriers to site use; and,
  - Human activities should occur at levels that do not adversely affect the harbour porpoise community at the site.

Assessment (alone)

8.6.4 The assessment of the Gogledd Môn Forol/North Anglesey Marine cSAC for harbour porpoise is based on the Celtic and Irish Seas MU. All the other European Designated Sites for harbour porpoise are also located within the CIS MU, therefore, the assessment and conclusions for all of the SACs/cSACs listed above would be the same as or smaller than the results for the CIS MU for the Gogledd Môn Forol/North Anglesey Marine cSAC. For these other sites, there is no potential for any direct effects and the only pathway for a potential effect is on the population of the CIS MU (i.e. the individuals associated with the SACs/cSACs).

8.6.5 That is, it is concluded that any potential effects associated with the Project during its construction (taking into account planned mitigation) and operation are unlikely to result in an adverse effect on the integrity of the Gogledd Môn Forol/North Anglesey Marine cSAC, Gorllewin Cymru Forol/West Wales Marine cSAC, Dynesfeydd Môr Hafren/Bristol Channel Approaches cSAC and the North Channel cSAC in relation to their conservation objectives for harbour porpoise.

In-combination assessment for the Gorllewin Cymru Forol/West Wales Marine cSAC, Dynesfeydd Môr Hafren/Bristol Channel Approaches cSAC and North Channel cSAC for harbour porpoise

A Changes in visual and acoustic stimuli

Construction

A1 Underwater noise during marine construction works

8.6.6 Of the projects (see table 8-63) that were initially identified as having the potential for in-combination effects on harbour porpoise using the Gorllewin Cymru Forol/West Wales Marine cSAC, Dynesfeydd Môr Hafren/Bristol Channel Approaches cSAC and North Channel cSAC from underwater noise during the Project's marine construction works, the Swansea Bay Tidal Lagoon, Cardiff Tidal Lagoon and Belfast Harbour D3 terminal cruise ship facility have been determined, based on currently available information, to actually have the potential for in-combination effects (table 8-63).

8.6.7 There is limited detailed information on potential impacts from underwater noise during the Project's marine construction works for the Cardiff Tidal Lagoon and Belfast Harbour D3 terminal cruise ship facility. Therefore it is currently not possible to conduct a quantitative assessment. However, based on available information, there is no potential for any in-combination effects with the Swansea Bay Tidal Lagoon to adversely affect the integrity of the European Designated Sites.

Operation

A4 Underwater noise during operation

8.6.8 Of the projects (see table 8-63) that were initially identified as having the potential for in-combination effects on harbour porpoise using the West Wales Marine/Gorllewin Cymru Forol cSAC, Dynesfeydd Môr Hafren / Bristol Channel Approaches cSAC and North Channel cSAC from underwater noise during the Project's operation, the Swansea Bay Tidal Lagoon, Cardiff Tidal Lagoon and Belfast Harbour D3 terminal cruise ship facility have been determined, based on currently available information, to actually have the potential for in-combination effects (table 8-62).

8.6.9 There is no potential for any significant effects to arise due to underwater noise from maintenance dredging and vessel movements during the Project's operation. There is also no potential for any significant effects to arise as a result of the installation of AFDs on the cooling water intake. Therefore there is no potential for any in-combination effects to adversely affect the integrity of the cSAC in relation to its conservation objectives.

B Land take, including seabed or intertidal

Construction and operation

B1 Change and/or loss of habitat

8.6.10 During the construction and operation of the Project, based on a precautionary approach, it has been assumed that the marine area of the Wylfa Newydd Development Area (approximately 0.35km^2) and of the Disposal Site including a 100m buffer (approximately 0.65km^2), could experience a potential change or loss of habitat.

8.6.11 The Fishguard Marina Development, Swansea Bay Tidal Lagoon and Cardiff Tidal Lagoon were determined, based on currently available information, to have the potential to cause in-combination effects to arise (table 8-64).

8.6.12 In-combination, the Wylfa Newydd Development Area (approximately 0.35km^2) and of the Disposal Site including a 100m buffer (approximately 0.65km^2), along with the 0.08km^2 reclamation area at the Fishguard Marina Development, 11.5km^2 area of the Swansea Bay Tidal Lagoon and 70km^2 area of the Cardiff Tidal Lagoon, plus as assessed for the Gogledd Môn Forol/North Anglesey Marine cSAC, the 9.1km^2 area of the Minesto Holyhead Deep tidal development and the West Anglesey Demonstration Zone (WADZ) area of 37km^2, have a total estimated area of 129km^2. This is a relatively small area, approximately 0.04% of the harbour porpoise CIS MU area.

8.6.13 Taking into account the location of these projects and relatively small area of the potential change or loss of habitat compared to the range and available habitat for harbour porpoise and their prey. It is unlikely that the loss or change of habitat would significantly affect harbour porpoise or their prey. Therefore, it is concluded that any potential effects associated with a change or loss of habitat would not result in an adverse effect on the integrity of these cSACs in relation to their conservation objectives for harbour porpoise.

C Changes in marine water quality

Construction

8.6.14 During the Project's construction, any increase in suspended sediment input and change in chemical quality due to discharge from fluvial sources and sewage, and any increase in suspended sediment concentration and contaminant re-mobilisation during dredging and disposal, could potentially affect harbour porpoise and their prey in the Wylfa Newydd Development Area (0.35km^2) and Disposal Site, with a 100m buffer (0.651km^2).

8.6.15 None of the other screened in projects have the potential to have any in-combination effects with respect to changes in marine water quality during the construction of the Project (table 8-65). Therefore, there is no potential for an adverse effect on the integrity of these cSACs in relation to their conservation objectives for harbour porpoise and their prey.

Operation

8.6.16 During the operation of the Project, the maximum area that could be impacted by the discharge from the CWS is 3.13km^2 for harbour porpoise and their prey, based on maximum potential TRO impact area, which is larger than the predicted maximum surface area for a 2^{o}C rise in temperature (2.41km^2; table 8-41 and table 8-44).

8.6.17 None of the other screened in projects (table 8-5) included in the in-combination assessment for changes in marine water quality during the operation of the Project, have the potential to have any in-combination effects on harbour porpoise, including their prey species, using these cSACs, based on currently available information (table 8-65). Therefore, there is no potential for an adverse effect on the integrity of the cSACs to arise in relation to their conservation objectives for harbour porpoise.

D Alteration of coastal processes and hydrodynamics

D1 Potential effect on habitat for prey species

8.6.18 The coastal process assessment concludes that there is no potential for any alteration of intertidal or subtidal habitats and, consequently, no significant effect on prey species for marine mammals is predicted. As a worst case, a localised change in habitat within the Wylfa Newydd Development Area is assumed. However, this area coincides with the area assessed for any change and/or loss of habitat and, therefore, has not been assessed to avoid double counting of the potential effect.

8.6.19 None of the projects (table 8-66) currently included in the in-combination assessment for the alteration of coastal processes and hydrodynamics have the potential to have any in-combination effects on harbour porpoise prey species at these cSACs, based on currently available information (table 8-66). Therefore, there is no potential for an adverse effect to arise on the integrity of the cSACs in relation to their conservation objectives for harbour porpoise.

E Physical interaction between species and Project infrastructure

E1 Vessel collision risk

8.6.20 The potential for in-combination effects associated with vessel collision risk (table 8-67) are currently unknown. However, it is highly unlikely that harbour porpoise would experience a significantly increased collision risk with vessels as a result of these projects; especially taking into account that any harbour porpoise in the area will be habituated to the presence of vessels and able to detect and avoid vessels. As a result, any potential increased collision risk as a result of in-combination effects are unlikely to result in an adverse effect on the integrity of the cSACs in relation to their conservation objectives for harbour porpoise.

Table 8-63 Assessment of potential for any in-combination effects of underwater noise at the Gorllewin Cymru Forol/West Wales Marine cSAC, Dynesfeydd Môr Hafren/Bristol Channel Approaches cSAC and North Channel cSAC for harbour porpoise during the marine construction works and operation

In-combination assessment	Potential sources of underwater noise during marine construction works	Potential to adversely affect the integrity of the European Designated Sites	
		Auditory Injury (PTS)	Behavioural Response / Disturbance
The Project	See table 8-55 and table 8-56 for Gogledd Môn Forol/North Anglesey Marine cSAC in-combination assessment		
Milford Haven, Maintenance Dredge Pembrokeshire	The removal of maintenance dredge material from berths and channels within the limits of Milford Haven Port Authority, Pembrokeshire. There is the potential for increased underwater noise from vessels and dredging activity.	There would be no potential for any auditory injury from vessel or dredging noise. *Therefore there is no potential for any in-combination effects to adversely affect the integrity of the sites.*	The potential for any disturbance as a result of underwater noise from vessels and dredging is likely to be limited to the area around the vessels and within the dredge area, therefore the potential for any significant disturbance and in-combination effects will be very low. *Based on available information, there is no potential for any in-combination effects to adversely affect the integrity of the sites.*
Fishguard Marina Development	Marina Development including dredge of marina basin and approach channel. An 8.28ha reclamation platform between the marina basin and the shore. The licence has identified that there will be no potential impacts on the designated sites however the site is immediately adjacent to the Gorllewin Cymru Forol/West Wales Marine cSAC.	There would be no potential for any auditory injury from vessel or dredging noise. *Therefore there is no potential for any in-combination effects to adversely affect the integrity of the sites.* It is assumed that the potential for any auditory injury from any other activities would be mitigated. *Therefore there is no potential for any in-combination effects to adversely affect the integrity of the sites.*	The potential for any disturbance as a result of underwater noise from vessels and dredging is likely to be limited to the area around the vessels and within the dredge area, therefore the potential for any significant disturbance and in-combination effects will be limited to the development area. *Based on available information, there is no potential for any in-combination effects to adversely affect the integrity of the site.*
Swansea Bay Tidal Lagoon	Construction of a tidal lagoon generating station with a maximum capacity of 320MW within Swansea Bay, with seawalls enclosing an area of 11.5km^2.	There would be no potential for any auditory injury from vessel or dredging noise. *Therefore there is no potential for any in-combination effects to adversely affect the*	During percussive piling which will be used during construction on an ‘as required basis only’, no significant physiological effects (PTS or TTS) are predicted to

In-combination assessment	Potential sources of underwater noise during marine construction works	Potential to adversely affect the integrity of the European Designated Sites	
		Auditory Injury (PTS)	Behavioural Response / Disturbance
	Construction of a substation, lighting, maintenance facilities, slipways and jetties, turbine and sluice gates housing structures with 16 variable speed hydro turbines and 10 sluice gates. Sources of underwater noise could include piling, dredging, vessels and general construction activity.	*integrity of the sites.* The potential for any auditory injury from any other activities would be mitigated. *Therefore there is no potential for any in-combination effects to adversely affect the integrity of the sites.*	occur, although a strong behavioural response in harbour porpoise will occur over a relatively small area (approximately 0.4%) in the context of the 10380ha of subtidal habitat comprising Swansea Bay. *Therefore, based on available information, there is no potential for any in-combination effects to adversely affect the integrity of the site.*
Cardiff Tidal Lagoon	Construction of a tidal lagoon with a capacity of 1,800 to 2,800 MW using hydro-turbines. The breakwater is expected to be 25km long with the lagoon area being approximately 70km^2. Sources of underwater noise could include piling, dredging, general construction activity, vessels and turbines.	It is assumed that the potential for any auditory injury would be mitigated. *Therefore there is no potential for any in-combination effects to adversely affect the integrity of the sites.*	The potential for any disturbance as a result of underwater noise from piling, construction activity, dredging and vessels is currently unknown as a result of an absence of detailed project information. However, the impacts are likely to be similar to those assessed for the Swansea Bay Tidal Lagoon. *Therefore, based on available information, there is no potential for any in-combination effects to adversely affect the integrity of the site.*
Belfast Harbour D3 terminal cruise ship facility	Potential sources of underwater noise include piling, dredging, general construction activity and vessels.	It is assumed that the potential for any auditory injury would be mitigated. *Therefore there is no potential for any in-combination effects to adversely affect the integrity of the sites.*	The potential for any disturbance as a result of underwater noise from piling, construction activity, dredging and vessels is currently unknown as a result of an absence of project information. No in-combination assessment can therefore be carried out..
Disposal of dredge material from the D3	Potential sources of underwater noise include dredging, disposal of dredge material and vessels.	There would be no potential for any auditory injury from vessel, disposal of dredge material or dredging noise.	The potential for any disturbance as a result of underwater noise from disposal of dredge material, vessels and dredging is

In-combination assessment	Potential sources of underwater noise during marine construction works	Potential to adversely affect the integrity of the European Designated Sites	
		Auditory Injury (PTS)	Behavioural Response / Disturbance
approach channel		*Therefore there is no potential for any in-combination effects to adversely affect the integrity of the sites.*	likely to be limited to the area around the vessels and within the dredge area, therefore the potential for any significant disturbance and in-combination effects will be very low. *Therefore, based on available information, there is no potential for any in-combination effects to adversely affect the integrity of the sites.*

Table 8-64 Assessment of potential in-combination effects of any change or loss of habitat at the Gorllewin Cymru Forol/West Wales Marine cSAC, Dynesfeydd Môr Hafren/Bristol Channel Approaches cSAC and North Channel cSAC for harbour porpoise

In-combination assessment	Potential for land take, including seabed or intertidal land	Potential to adversely affect the integrity of the European Designated Sites
The Project	See table 8-57 for Gogledd Môn Forol/North Anglesey Marine cSAC in-combination assessment	
Fishguard Marina Development	Dredge area and 8.28ha (0.0828km^2) reclamation platform between the marina basin and the shore. The licence has identified that there will be no potential impacts on the designated sites however the site is immediately adjacent to the Gorllewin Cymru Forol/West Wales Marine cSAC.	Taking into account the location and relatively small area of the potential change or loss of habitat compared to the range and available habitat for harbour porpoise and their prey. *Therefore, based on available information, there is no potential for any in-combination effects to adversely affect the integrity of the sites.*
Swansea Bay Tidal Lagoon	Construction of a tidal lagoon enclosing an area of 11.5km^2.	Taking into account the location and relatively small area of the potential change or loss of habitat compared to the range and available habitat for harbour porpoise and their prey. *Therefore, based on available information, there is no potential for any in-combination effects to adversely affect the integrity*

In-combination assessment	Potential for land take, including seabed or intertidal land	Potential to adversely affect the integrity of the European Designated Sites
		of the sites.
Cardiff Tidal Lagoon	Construction of a tidal lagoon with area of approximately 70km^2.	Taking into account the location and relatively small area of the potential change or loss of habitat compared to the range and available habitat for harbour porpoise and their prey. *Therefore, based on available information, there is no potential for any in-combination effects to adversely affect the integrity of the sites.*

Table 8-65 Assessment of potential in-combination effects of any changes in marine water quality at the Gorllewin Cymru Forol/West Wales Marine cSAC, Dynesfeydd Môr Hafren/Bristol Channel Approaches cSAC and North Channel cSAC for harbour porpoise

In-combination assessment	Potential for changes in marine water quality	Potential to adversely affect the integrity of the European Designated Sites
The Project	See table 8-58 for Gogledd Môn Forol/North Anglesey Marine cSAC in-combination assessment	
Milford Haven, Maintenance Dredge Pembrokeshire	There is the potential for increase in suspended sediment concentration and contaminant re-mobilisation during dredging.	Any increase in turbidity or suspended sediment levels is expected to be temporally and spatially restricted. If there is the potential for any contaminant re-mobilisation it is anticipated that mitigation measures would be required. *Therefore, based on available information, there is no potential for any in-combination effects to adversely affect the integrity of the site.*
Fishguard Marina Development	There is the potential for increase in suspended sediment concentration and contaminant re-mobilisation during dredging and disposal.	Any increase in turbidity or suspended sediment levels is expected to be temporally and spatially restricted. If there is the potential for any contaminant re-mobilisation it is anticipated that mitigation measures would be required. *Therefore, based on available information, there is no potential for any in-combination effects to adversely affect the integrity of the site.*

In-combination assessment	Potential for changes in marine water quality	Potential to adversely affect the integrity of the European Designated Sites
Swansea Bay Tidal Lagoon	There is the potential for increase in suspended sediment concentration and contaminant re-mobilisation during dredging and construction; potential of accidental spills and discharges.	Any increase in turbidity or suspended sediment levels is expected to be temporally and spatially restricted, largely due to the high energy environment. Mitigation measures will reduce the risk of any accidental spills and discharges. The overall probability of contamination occurring as a result of the release of contaminants associated with the dispersion of suspended sediments during construction is considered to be low while the magnitude of any change, should it occur, would vary from negligible to small depending upon the scale of the pollution event that occurs. This translates to an overall exposure level that is negligible. *Therefore, based on available information, there is no potential for any in-combination effects to adversely affect the integrity of the site.*
Cardiff Tidal Lagoon	There is the potential for increase in suspended sediment concentration and contaminant re-mobilisation during dredging and construction; potential of accidental spills and discharges.	Any increase in turbidity or suspended sediment levels is expected to be temporally and spatially restricted, largely due to the high energy environment. If there is the potential for any contaminant re-mobilisation it is anticipated that mitigation measures would be required. Mitigation measures will also reduce the risk of any accidental spills and discharges. *Therefore, based on available information, there is no potential for any in-combination effects to adversely affect the integrity of the site.*
Belfast Harbour D3 terminal cruise ship facility	There is the potential for increase in suspended sediment concentration and contaminant re-mobilisation during dredging and construction; potential of accidental spills and discharges.	Any increase in turbidity or suspended sediment levels is expected to be temporally and spatially restricted. If there is the potential for any contaminant re-mobilisation it is anticipated that mitigation measures would be required. Mitigation measures will also reduce the risk of any accidental spills and discharges. *Therefore, based on available information, there is no potential for any in-combination effects to adversely affect the integrity of the site.*

In-combination assessment	Potential for changes in marine water quality	Potential to adversely affect the integrity of the European Designated Sites
Disposal of dredge material from the D3 approach channel	There is the potential for increase in suspended sediment concentration and contaminant re-mobilisation during dredging and disposal.	Any increase in turbidity or suspended sediment levels is expected to be temporally and spatially restricted. If there is the potential for any contaminant re-mobilisation it is anticipated that mitigation measures would be required. *Therefore, based on available information, there is no potential for any in-combination effects to adversely affect the integrity of the site.*

Table 8-66 Assessment of potential in-combination effects of any alteration of coastal processes and hydrodynamics on prey species at the Gorllewin Cymru Forol/West Wales Marine cSAC, Dynesfeydd Môr Hafren/Bristol Channel Approaches cSAC and North Channel cSAC for harbour porpoise

In-combination assessment	Potential effects of any alteration of coastal processes and hydrodynamics on prey species	Potential to adversely affect the integrity of the European Designated Sites
The Project	See table 8-59 for Gogledd Môn Forol/North Anglesey Marine cSAC in-combination assessment	
Fishguard Marina Development	There is the potential for alteration of coastal processes and hydrodynamics on prey species.	The potential for any alteration of coastal processes and hydrodynamics on prey species is currently unknown. Therefore, as a result of an absence of project information, no in-combination assessment can be carried out.
Swansea Bay Tidal Lagoon	There is the potential for alteration of coastal processes and hydrodynamics on prey species.	The potential for any alteration of coastal processes and hydrodynamics on prey species would be limited to the area in the vicinity of the tidal lagoon. Overall, the assessment for the Swansea Bay Tidal Lagoon concluded that, in combination, the residual effects from the construction, operation and decommissioning of the Swansea Bay Tidal Lagoon, are not considered to have a significant effect on the majority of fish receptors identified. *Therefore, based on available information, there is no potential for any in-combination effects to*

In-combination assessment	Potential effects of any alteration of coastal processes and hydrodynamics on prey species	Potential to adversely affect the integrity of the European Designated Sites
		adversely affect the integrity of the sites.
Cardiff Tidal Lagoon	There is the potential for alteration of coastal processes and hydrodynamics on prey species.	The potential for any alteration of coastal processes and hydrodynamics on prey species is currently unknown. However, the impacts are likely to be similar to those assessed for the Swansea Bay Tidal Lagoon. *Therefore, based on available information, there is no potential for any in-combination effects to adversely affect the integrity of the sites.*

Table 8-67 Assessment of potential in-combination effects of any physical interaction with project infrastructure and vessels at the Gorllewin Cymru Forol/West Wales Marine cSAC, Dynesfeydd Môr Hafren/Bristol Channel Approaches cSAC and North Channel cSAC for harbour porpoise

In-combination assessment	Potential for physical interaction with project infrastructure and vessels	Potential to adversely affect the integrity of the European Designated Sites
The Project	See table 8-60 for Gogledd Môn Forol/North Anglesey Marine cSAC in-combination assessment	
Fishguard Marina Development	There could be the potential for increased vessel movements.	The potential for any physical interaction with project infrastructure and vessels as a result of this project is currently unknown as a result of an absence of project information. No in-combination assessment can therefore be carried out.
Swansea Bay Tidal Lagoon	Collision risk with vessels and machinery during construction	The probability of a collision occurring is considered to be low as, while collision incidents have been recorded in the UK (including Swansea Bay), they are generally considered to be a rare occurrence. The risk of collision will be restricted mainly to the Project footprint. In addition, construction activities are only short term and temporary. *Therefore, based on available information, there is no potential for any in-combination effects to adversely*

In-combination assessment	Potential for physical interaction with project infrastructure and vessels	Potential to adversely affect the integrity of the European Designated Sites
		affect the integrity of the site.
	Collision risk with turbines during operation	Overall, the probability of a collision occurring is considered to be low as the risk of collision will be restricted to a relatively small area (i.e. the turbines) but will be present during the entire operational phase. The project proposes an appropriate package of adaptive mitigation and monitoring measures to reduce significance levels. Therefore, with appropriate measures in place, residual collision impacts on marine mammals are assessed as insignificant to minor adverse significant.
Cardiff Tidal Lagoon	There could be the potential for increased vessel movements and increased collision risk with the turbines, including prey impingement.	The potential for any physical interaction with project infrastructure and vessels as a result of this project is currently unknown as a result of an absence of project information. No in-combination assessment can therefore be carried out. However, the impacts are likely to be similar to those assessed for the Swansea Bay Tidal Lagoon. *Therefore, based on available information, there is no potential for any in-combination effects to adversely affect the integrity of the site*.
Belfast Harbour D3 terminal cruise ship facility	There could be the potential for increased vessel movements and increased collision risk.	The potential for any physical interaction vessels as a result of this project is currently unknown as a result of an absence of project information. No in-combination assessment can therefore be carried out.
Disposal of dredge material from the D3 approach channel	There could be the potential for increased vessel movements and increased collision risk.	The potential for any physical interaction vessels as a result of this project is currently unknown as a result of an absence of project information. No in-combination assessment can therefore be carried out.

E2 Project infrastructure

8.6.21 The potential for in-combination effects to arise due to physical interactions between species and project infrastructure (table 8-67) are currently unknown. However, it should be noted that there is no potential for any direct physical interaction between harbour porpoise and the Project infrastructure. The loss of prey due to impingement could potentially affect up to two small harbour porpoise (0.002% of the CIS MU reference population) per year, although, harbour porpoise would still be able to source prey from nearby areas.

8.6.22 In addition, if any project alone is likely to have a significant effect on harbour porpoise as a result of physical interaction with the infrastructure, for example at the proposed tidal arrays, then mitigation and monitoring would be required at these sites to reduce the risk.

8.6.23 As a result, any potential for physical interaction with project infrastructure as a result of in-combination effects would be unlikely to result in an adverse effect on the integrity of the cSACs in relation to their conservation objectives for harbour porpoise.

Conclusions for the Gorllewin Cymru Forol/West Wales Marine cSAC, Dynesfeydd Môr Hafren/Bristol Channel Approaches cSAC and North Channel cSAC for harbour porpoise

Alone

8.6.24 In conclusion, there is no potential for any adverse effect on the integrity of the Gorllewin Cymru Forol/West Wales Marine cSAC, Dynesfeydd Môr Hafren/Bristol Channel Approaches cSAC and North Channel cSAC from the Project alone during its construction and operation in relation to the conservation objectives for harbour porpoise (table 8-68).

Table 8-68 Summary of the assessment of the potential effects on the Gorllewin Cymru Forol/West Wales Marine cSAC, Dynesfeydd Môr Hafren/Bristol Channel Approaches cSAC and North Channel cSAC in relation to the draft Conservation Objectives for harbour porpoise

Conservation objectives	Changes in visual and acoustic stimuli	Land take, including seabed or intertidal land	Changes in marine water quality	Physical interaction between species and Project infra-structure	Changes in prey resources
The species is a viable component of the site	×	×	×	×	×
There is no significant disturbance of the species	×	×	×	×	×

Conservation objectives	Changes in visual and acoustic stimuli	Land take, including seabed or intertidal land	Changes in marine water quality	Physical interaction between species and Project infra-structure	Changes in prey resources
The supporting habitats and processes relevant to harbour porpoises and their prey are maintained	×	×	×	×	×

× = no potential for any adverse effect on the integrity of the site in relation to the conservation objectives

In-combination

8.6.25 In conclusion, based on the information currently available, there is no potential for any adverse effect on the integrity of the Gorllewin Cymru Forol/West Wales Marine cSAC, Dynesfeydd Môr Hafren/Bristol Channel Approaches cSAC and North Channel cSAC from in-combination effects associated with land take, including seabed or intertidal land; changes in marine water quality; or changes in prey resources during the Project's construction and operation in relation to the conservation objectives for harbour porpoise (table 8-69). There is also unlikely to be any in-combination effects from underwater noise or any physical interaction with project infrastructure or vessels, recognising that information is lacking for the effects of some other projects due to their current status (table 8-69).

Table 8-69 Summary of the in-combination assessment for the West Wales Marine/Gorllewin Cymru Forol cSAC, Bristol Channel Approaches/Dynesfeydd Môr Hafren cSAC and North Channel cSAC in relation to the draft conservation objectives for harbour porpoise

Conservation objectives	Changes in visual and acoustic stimuli	Land take, including seabed or intertidal land	Changes in marine water quality	Physical interaction between species and Project infra-structure	Changes in prey resources
The species is a viable component of the site	×	×	×	×	×
There is no significant disturbance of the species	×	×	×	×	×
The supporting habitats and processes relevant to harbour porpoises and their prey are maintained	×	×	×	×	×

× = no potential for any adverse effect on the integrity of the site in relation to the conservation objectives

Conclusions for the Rockabill to Dalkey Island SAC (Ireland) for harbour porpoise

Alone

8.6.26 There is no potential for any adverse effect on the integrity of the Rockabill to Dalkey Island SAC from the Project alone during construction and operation in relation to the conservation objectives for harbour porpoise (table 8-70).

Table 8-70 Summary of the assessment of the potential effects on the Rockabill to Dalkey Island SAC (Ireland) in relation to the conservation objectives for harbour porpoise

Conservation objectives	Changes in visual and acoustic stimuli	Land take, including seabed or intertidal land	Changes in marine water quality	Physical interaction between species and Project infra-structure	Changes in prey resources
Species range within the site should not be restricted by artificial barriers to site use	×	×	×	×	×
Human activities should occur at levels that do not adversely affect the harbour porpoise community at the site	×	×	×	×	×

× = no potential for any adverse effect on the integrity of the site in relation to the conservation objectives

In-combination

8.6.27 No projects or plans were identified that have potential to have in-combination effects that could affect the integrity of the Rockabill to Dalkey Island SAC (Ireland) in relation to the conservation objectives for harbour porpoise (table 8-71).

Table 8-71 Summary of the in-combination assessment for the Rockabill to Dalkey Island SAC (Ireland) in relation to the Conservation Objectives for harbour porpoise

Conservation objectives	Changes in visual and acoustic stimuli	Land take, including seabed or intertidal land	Changes in marine water quality	Physical interaction between species and Project infra-structure	Changes in prey resources
Species range within the site should not be restricted by artificial barriers to site use	×	×	×	×	×
Human activities should occur at levels that do not adversely affect the harbour porpoise community at the site	×	×	×	×	×

× = no potential for any adverse effect on the integrity of the site in relation to the conservation objectives

8.7 Pen Llyn a'r Sarnau/Llŷn Peninsula and the Sarnau SAC and Bae Ceredigion/Cardigan Bay SAC - bottlenose dolphin (*Tursiops truncatus*)

8.7.1 [RD56] recommends that the Bae Ceredigion/Cardigan Bay SAC and Pen Llyn a'r Sarnau/Llŷn Peninsula and the Sarnau SAC should be considered together due to the strong connectivity between the two. Therefore, as the same bottlenose dolphin population characterises both sites, the two sites have been assessed together.

Conservation objectives

8.7.2 The conservation objectives for the Pen Llyn a'r Sarnau/Llŷn Peninsula and Sarnau SAC [RD56] for bottlenose dolphin and grey seal are:

- The population is maintaining itself on a long-term basis as a viable component of its natural habitat. Important elements are population size, structure, production, and condition of the species within the site. As part of this objective it should be noted that:
  - For bottlenose dolphin and grey seal, contaminant burdens derived from human activity are below levels that may cause physiological damage, or immune or reproductive suppression.
  - Grey seal populations should not be reduced as a consequence of human activity.
- The bottlenose dolphin and grey seal species population within the site is such that the natural range of the population is not being reduced or

likely to be reduced for the foreseeable future. As part of this objective it should be noted that:

- Their range within the SAC and adjacent inter-connected areas is not constrained or hindered;
- There are appropriate and sufficient food resources within the SAC and beyond; and
- The sites and amount of supporting habitat used by these species are accessible and their extent and quality is stable or increasing.

- The presence, abundance, condition and diversity of habitats and species required to support this species is such that the distribution, abundance and populations dynamics of the species within the site and population beyond the site is stable or increasing. Important considerations include:
  - distribution;
  - extent;
  - structure;
  - function and quality of habitat; and
  - prey availability and quality.
- As part of this objective it should be noted that:
  - The abundance of prey species subject to existing commercial fisheries needs to be equal to or greater than that required to achieve maximum sustainable yield and secure in the long term.
  - The management and control of activities or operations likely to adversely affect the species feature, is appropriate for maintaining it in favourable condition and is secure in the long term.
  - Contamination of potential prey species should be below concentrations potentially harmful to their physiological health.
  - Disturbance by human activity is below levels that suppress reproductive success, physiological health or long-term behaviour.
- As part of the restoration and recovery objective for the bottlenose dolphin, it should be noted that populations should be increasing.

8.7.3 The conservation objective for the Bae Ceredigion/Cardigan Bay SAC [RD56] for the bottlenose dolphin and grey seal is to maintain at favourable conservation status its long-term population viability, natural range and the structure and function of its habitat within the site.

- The bottlenose dolphin feature will be at favourable conservation status when:
  - The size of the population utilising the site and its contribution to the south-west UK and Ireland population is determined by natural biotic and abiotic factors, no more degraded as a consequence of

human action than at the time the site was classified a candidate SAC.

- Calf production and survival is determined by inherent reproductive capacity, biotic and abiotic processes, no more degraded or suppressed as a consequence of human action than at the time the site was classified a candidate SAC; and
- Calf production is unsuppressed by suboptimal physiological health caused by human action.

- The grey seal feature will be at favourable conservation status when:
  - The part of the south-west Wales grey seal population utilising the site is maintaining itself at a size determined by natural biotic and abiotic factors, no more degraded or inhibited as a consequence of human action than at the time the site was classified a candidate SAC.
  - Pup production and survival is determined by inherent reproductive capacity, biotic and abiotic processes, no more degraded or suppressed as a consequence of human action than at the time the site was classified a candidate SAC.
  - Pup production is unsuppressed by sub-optimal physiological health caused by human action.
- The bottlenose dolphin and grey seal features will be at favourable conservation status when:
  - The population structure is:
    - determined by natural density dependent and independent processes, reproductive success and physiological health, no more degraded as a consequence of human action than at the time the site was classified a candidate SAC; and
    - not selectively modified by human action.
  - The physiological health and reproductive capacity of the population is determined by natural physiological and environmental processes, no more degraded by human action than at the time the site was classified a candidate SAC.
  - Contaminant burdens derived from human activity remain below levels that may cause physiological damage, or immune or reproductive suppression.
  - The range, access to and use of natural habitat throughout the site necessary for the bottlenose dolphin population at any stage of its biological cycle are:
    - determined by natural habitat structure, function and quality; and
    - no more degraded by human action than at the time the site was classified a candidate SAC.

- The distribution and extent of habitat necessary for the bottlenose dolphin population at any stage of its biological cycle are determined by natural environmental processes, no more degraded by human action than at the time the site was classified a candidate SAC.
- The habitat structures and environmental processes necessary for the bottlenose dolphin population are determined by natural geomorphological, hydrological, meteorological and ecological processes, no more degraded by human action than at the time the site was classified a candidate SAC.
- Bottlenose dolphin and grey seal habitat remains no more degraded by human action than at the time the site was classified a candidate SAC.
- The degree of hazard to the bottlenose dolphin and grey seal populations from material of anthropogenic origin is at or below that at the time the site origin is at or below that at the time the site was classified a candidate SAC.
- Disturbance by human activity that suppresses reproductive success, physiological health or modifies long- term behaviour is no greater than at the time the site was classified a candidate SAC.
- Bottlenose dolphin and grey seal prey availability is determined by inherent population dynamics and distribution of prey species, no more degraded as a result of human action than at the time the site was classified a candidate SAC.
- The ability of the bottlenose dolphin and grey seal populations to maintain itself in the long-term is not inhibited by human exploitation of potential bottlenose dolphin and grey seal prey species.
- Populations of bottlenose dolphin and grey seal prey species subject to existing commercial fisheries are within safe biological limits.
- Contamination of potential prey species by contaminants derived from human activity is below concentrations potentially harmful to bottlenose dolphin and grey seal physiological health and reproductive capability.
- The management of activities or operations likely to degrade the population dynamics, range or habitat of the bottlenose dolphin and grey seal populations, is appropriate for maintaining favourable conservation status and is secure in the long term.
- The management commercial fisheries for bottlenose dolphin and grey seal prey species is appropriate for maintaining prey species populations within safe biological limits and is secure in the long term.

A Changes in visual and acoustic stimuli

Construction

A1 Underwater noise during marine construction works [Marine Licence]

8.7.4 During construction the potential sources of underwater noise at the Wylfa Newydd Development Area are:

- drilling;
- rock breaking;
- dredging; and
- vessels.

8.7.5 The underwater noise modelling indicates that there is no potential risk of physical injury to marine mammals as a result of underwater noise from any of these activities.

8.7.6 The maximum predicted range for PTS is 36m as a result of rock breaking, without mitigation (table 8-29), which has the potential to effect 0.0014 bottlenose dolphin (0.00035% of the IS MU reference population; table 8-33). However, mitigation measures (outlined in section 8.5) would reduce the risk of any auditory injury in marine mammals.

8.7.7 The maximum predicted range for disturbance is 620m for bottlenose dolphin as a result of concurrent drilling (table 8-29), which has the potential to effect 0.38 bottlenose dolphin (0.96% of the IS MU reference population (397); table 8-33). Taking into account the temporary nature of underwater noise during construction and the relatively low percentage of bottlenose dolphin from the reference population that could be impacted, an adverse effect on the integrity of these sites is not predicted.

8.7.8 During construction the potential sources of underwater noise at the Disposal Site are:

- rock disposal; and
- vessels.

8.7.9 Underwater noise modelling indicates that there is no potential risk of physical injury as a result of underwater noise from either of these activities. The maximum predicted range for PTS is <1m (table 8-29), which has the potential to effect 0.000001 bottlenose dolphin (<0.00001% of the IS MU reference population; table 8-33). The maximum predicted range for disturbance is 130m (table 8-29), which has the potential to effect 0.02 bottlenose dolphin (0.005% of the IS MU reference population; table 8-33).

8.7.10 Along the vessel route between the Wylfa Newydd Development Area and Disposal Site, the maximum number of bottlenose dolphin that potentially could be disturbed is 15 individuals (table 8-36; up to 4% of the IS MU reference population). Taking into account the temporary nature of underwater noise and the very precautionary approach to the assessment, it

is highly unlikely that this percentage of bottlenose dolphin from the reference population would actually be disturbed. The noise modelling indicates that the range of disturbance around vessels for bottlenose dolphins is less than 1m. Taking into account the peak number of vessels on site is predicted to average approximately 15 per week over a three month period and the existing baseline of up to 25 vessels per week for the area (ES Volume D – Wylfa Newydd Development Area Development D13 – The Marine Environment, Application Reference Number: 6.4.13). The maximum total area of disturbance as a result of 40 vessels could be up to 0.0001km^2. The maximum number of bottlenose dolphin that could be disturbed is 0.00008 (0.00002% of the IS MU reference population).

8.7.11 During construction the maximum number of bottlenose dolphin that potentially could be temporarily disturbed as a result of underwater noise at the Wylfa Newydd Development Area and Disposal Site and from vessels would be up to one individual (up to 0.25% of the IS MU reference population).

8.7.12 Therefore, any potential effect from underwater noise during construction is highly unlikely to result in an adverse effect on the integrity of the sites in relation to their conservation objectives.

Operation

A4 Underwater noise during operation [Operational water discharge EP]

8.7.13 Taking into account the noise modelling of the AFD arrays, any potential effect as a result of underwater noise from the AFDs during operation would not result in any significant disturbance of bottlenose dolphin or have an adverse effect on the integrity of the Pen Llyn a'r Sarnau/Llŷn Peninsula and the Sarnau SAC and Bae Ceredigion/Cardigan Bay SAC in relation to their conservation objectives for bottlenose dolphin.

B Land take, including seabed or intertidal land

Construction and operation

B1 Change and/or loss of habitat [Marine Licence]

8.7.14 Based on a very precautionary approach it has been assumed that the marine area of the Wylfa Newydd Development Area (approximately 0.35km^2) and the area of the Disposal Site plus 100m buffer (approximately 0.651km^2) could experience a potential change or loss of habitat during the operation of the Project.

8.7.15 A total of 0.12 bottlenose dolphin could be present in the Wylfa Newydd Development Area area and 0.22 individuals in the Disposal Site plus 100m buffer (table 8-38), based on the maximum species density estimates for these areas (see chapter 6). Therefore, a total 0.34 bottlenose dolphin could be affected by any loss or changes of habitat at the Wylfa Newydd

Development Area and Disposal Site during construction; this represents approximately 0.09% of the IS MU reference population.

8.7.16 Taking into account the precautionary approach to the assessment and the relatively low percentage of bottlenose dolphin from the reference population that could be impacted, any potential effect as a result of change and/or loss of habitat during operation is highly unlikely to result in an adverse effect on the integrity of these two sites in relation to their conservation objectives for bottlenose dolphin.

C Changes in marine water quality

Construction

C1 Increase in suspended sediment input and change in chemical quality due to discharge from fluvial sources and sewage [Marine Licence; Construction water discharge EP]

8.7.17 The total combined area predicted to be affected by increases suspended sediments from all discharges is 0.245km^2. However, as a precautionary approach, the number of bottlenose dolphin that could potentially be present (and percentage of the reference population) in the Wylfa Newydd Development Area (0.35km^2) has been estimated (table 8-39, based on maximum species density estimates for the area). The total number of bottlenose dolphin that could be present in the Wylfa Newydd Development Area is 0.12 individuals (table 8-39), this represents up to 0.03% of the IS MU reference population.

C2 Increase in suspended sediment concentration and contaminant re-mobilisation during dredging and disposal [Marine Licence]

8.7.18 The modelling of increases in suspended sediment concentrations during the dredging and disposal of dredged material predicts that the maximum extent of the effect above baseline would be over an area extending 0.245km^2.

8.7.19 As a precautionary approach, the number of bottlenose dolphin that could potentially be present (and percentage of the reference population) in the Wylfa Newydd Development Area (0.35km^2) and Disposal Site with 100m buffer (0.651km^2) has been estimated (table 8-39, based on maximum species density estimates for the area). The total number of bottlenose dolphin that could be present in the Wylfa Newydd Development Area and Disposal Site with 100m buffer and could be potentially affected by any increases in suspended sediment concentration is 0.34 individuals (table 8-39), this represents up to 0.09% of the IS MU reference population.

8.7.20 The area in which increased suspended sediment concentrations would be experienced is very small in relation the range of bottlenose dolphin and their prey and any potential effects would be temporary, with dispersion of the suspended sediment to background levels predicted to occur within three hours of a dredging / disposal cycle.

8.7.21 Therefore, taking into account the limited dispersion area and the rapid dispersion and deposition predicted, along with the relatively low contaminant levels in sediments and the low percentage of bottlenose dolphin from the reference population that could be impacted, any potential effect as result of increases in suspended sediment concentration from the dredging and disposal during construction is highly unlikely to result in an adverse effect on the integrity of these two sites in relation to their conservation objectives for bottlenose dolphin.

Operation

C3 Discharge from the cooling water system [Operational water discharge EP]

Temperature increase

8.7.22 Any changes or increases in temperature are unlikely to affect bottlenose dolphin, as they are well adapted to the changes in water temperature throughout their range.

8.7.23 However, as a very precautionary approach, the number of bottlenose dolphin that could be present in the maximum predicted surface area for a $2^{o}C$ rise in temperature ($2.41km^2$) has been estimated as up to one individual, which represents up to 0.25% of the IS MU reference population (table 8-41).

Total Residual Oxidants

8.7.24 There is no predicted potential direct or indirect effects on marine mammals due to TRO from cooling water discharge during operation.

8.7.25 However, as a very precautionary approach, the number of bottlenose dolphin that could be present in the maximum potential TRO impact area ($3.13km^2$) is up to two individuals, which represents 0.5% of the IS MU reference population (table 8-44).

8.7.26 Taking into account the small potential impact area for TRO and potential temperature increase, and the low percentage of bottlenose dolphin from the reference population that could be impacted, any potential effects as result of increases in temperature during operational discharge or the discharge of TRO from the cooling water system are highly unlikely to result in an adverse effect on the integrity of these two sites in relation to their conservation objectives for bottlenose dolphin.

Effect on prey species

8.7.27 The potential effect of change in water temperature and TRO on prey species would not extend beyond the maximum predicted effect areas described for bottlenose dolphin. Consequently, the approach taken to assessing the effect on the bottlenose dolphin population is worst case, and there would be no additional impact as a result of the effects on prey species.

Effect of changes in marine water quality during operation

8.7.28 The area of increased temperature and TRO from the cooling water discharge represents the same area therefore, as a worst-case scenario, the number of bottlenose dolphin that could be affected by changes in water temperature and TRO discharges, based on the maximum potential TRO impact area (3.13km^2), is up to two individuals; which represents 0.5% of the IS MU reference population.

8.7.29 As described in section 8.3, no significant effect on bottlenose dolphin is predicted due to the potential effect of the Project on marine water quality. Given this lack of effect and the very small percentage of the reference population (which is considered insignificant) that could be exposed to the area of predicted change in marine water quality, there is no potential for an effect on bottlenose dolphin populations to arise over the operational lifetime of the Project.

8.7.30 It is therefore concluded that any potential effects of changes in marine water quality during operation would not result in an adverse effect on the integrity of the Pen Llyn a'r Sarnau/Llŷn Peninsula and the Sarnau SAC and Bae Ceredigion/Cardigan Bay SAC in relation to their conservation objectives for bottlenose dolphin.

D Alteration of coastal processes and hydrodynamics

D1 Potential effect on habitat for prey species [Marine Licence]

8.7.31 The coastal processes assessment concludes that there is no potential for any alteration of intertidal or subtidal habitats and, consequently, no significant effect on prey species for marine mammals is predicted. As a worst case, a localised change in habitat within the Wylfa Newydd Development Area is assumed. This area coincides with area assessed for any change and/or loss of habitat (effect B1) and, therefore, has not been assessed here to avoid double counting of the potential effect on marine mammals.

E Physical interaction between species and Project infrastructure

Construction

E1 Vessel collision risk [Marine Licence]

8.7.32 As a precautionary worse-case approach, the number of bottlenose dolphin that could be at increased risk of collision with vessels all vessels during construction and operation within the Wylfa Newydd Development Area, the Disposal Site plus 100m buffer (table 8-45) and the vessel route between the two sites, based on a very precautionary vessel route width of 1km (table 8-46), is estimated to be up to one individual (0.25% of IS MU reference population) based on a precautionary 95% avoidance rate.

8.7.33 However, it is highly unlikely that bottlenose dolphin would be at increased collision risk with vessels during construction, especially taking into account the small increase in the number of vessel movements predicted compared to existing vessel movements in the area and the fact that any bottlenose dolphin in the area will be habituated to the presence of vessels and able to detect and avoid vessels. Taking this into account, along with the low percentage of bottlenose dolphin from the reference population that could be at increased collision risk with vessels during construction, any potential effect would be highly unlikely to result in an adverse effect on the integrity of these two sites in relation to their conservation objectives for bottlenose dolphin.

Operation

E2 Impact of impingement and entrainment of prey species during operation [Operational water discharge EP]

8.7.34 The potential impact area for prey species would be confined to the intake structure and the potential zone of influence in which fish could be at risk of has been identified as 50m from the intake. However, fish are highly mobile species, with relatively large ranges and are unlikely to be restricted to the immediate area of the cooling water intake. Therefore the loss of fish is likely to be very small in comparison to natural variation.

8.7.35 The DEA estimated, based on the worst-case scenario, that the maximum number of bottlenose dolphin that could potentially be impact is less than one small individual (approximately 62% of prey required by one small dolphin per year), which represents less 0.25% of the IS MU reference population. However, this is only potential loss of prey, as individuals would still be able to source prey from nearby areas. In addition, embedded mitigation, including the AFDs and FRR system, would reduce the potential loss of prey species.

8.7.36 Hence any potential effect would not result in an adverse effect on the integrity of these two sites in relation to their conservation objectives for bottlenose dolphin.

In-combination for the Pen Llyn a'r Sarnau/Llŷn Peninsula and the Sarnau SAC and Bae Ceredigion/Cardigan Bay SAC for bottlenose dolphin

A Changes in visual and acoustic stimuli

Construction

A1 Underwater noise during marine construction works

Auditory injury

8.7.37 The in-combination assessment (table 8-72) indicates that there should be no potential for any auditory injury to bottlenose dolphin as appropriate

mitigation measures are expected to be implemented for each other screened in project. Therefore, an adverse effect the integrity of these sites is not predicted in view of the conservation objectives.

Disturbance

8.7.38 Taking a very precautionary approach and using the worst case scenario for the in-combination assessment that during the Project marine construction works, the maximum number of bottlenose dolphin that potentially could be temporarily disturbed as a result of underwater noise at the Wylfa Newydd Development Area and Disposal Site and from vessels, would be up to a maximum of one individual (up to 0.25% of the IS MU reference population).

8.7.39 The Wylfa Decommissioning ES [RD198] did not identify any adverse impacts, including disturbance on marine mammals, and would therefore not contribute to any in-combination effects on bottlenose dolphin at the Pen Llyn a'r Sarnau/Llŷn Peninsula and the Sarnau SAC and Bae Ceredigion/Cardigan Bay SAC from underwater noise during the Project marine construction works.

8.7.40 During the Afon Dysynni outfall gravel removal and relocation the potential for any disturbance as a result of underwater noise from vessels and dredging is likely to be limited to the area around the vessels and within the dredge area, therefore the potential for any significant disturbance and in-combination effects would be very low.

8.7.41 For the North West Coast Connections Project, which is currently on hold, there is currently very little information on the potential for underwater noise during the construction of underground section across the Menai Strait.

8.7.42 There is the potential for underwater noise during the NuGen Moorside nuclear power station development adjacent to the existing Sellafield station in Cumbria, for example during marine construction works such as the MOLF and the cooling water infrastructure. This project is currently on-hold, when further information becomes available this will be assessed to determine the potential for any in-combination effects. However, it can be assumed that the potential impacts would be similar to those assessed the Project marine construction works and that there would only be a relatively small contribution to any in-combination effects.

8.7.43 Bottlenose dolphin were determined to occur very rarely within Swansea Bay and therefore potential impacts from the Swansea Bay Tidal Lagoon were not assessed in the Swansea Bay Tidal Lagoon ES. There is limited detailed information on potential impacts from underwater noise during the Project marine construction works for the Cardiff Tidal Lagoon project. Therefore it is currently not possible to conduct a quantitative assessment.

8.7.44 The in-combination assessment (table 8-72) has determined that there is the potential for disturbance of up to 108 bottlenose dolphin at both the Minesto Holyhead Deep and Menter Môn Morlais tidal developments. As these projects are likely to work together to reduce and limit any potential impacts, it would be expected that, if required, mitigation would be put in place to

reduce any significant disturbance to bottlenose dolphin. Therefore, an adverse effect the integrity of these European Designated Sites is not predicted in view of the conservation objectives.

Operation

A4 Underwater noise during operation

8.7.45 There is no potential for any significant effects due to underwater noise from maintenance dredging and vessel movements during the Project operation. There is also no potential for any significant effects due to underwater noise from the installation and use of the AFDs on the cooling water intake. Therefore there no potential exists for the integrity of the SACs for bottlenose dolphin to be adversely affected in relation to their conservation objectives.

B Land take, including seabed or intertidal land

B1 Change and/or loss of habitat

8.7.46 For the Project during construction and operation, based on a precautionary approach, it has been assumed that the marine area of the Wylfa Newydd Development Area (approximately 0.35km^2) and of the Disposal Site including a 100m buffer (approximately 0.65km^2), could experience a potential change or loss of habitat. A total 0.34 bottlenose dolphin could be affected by any loss or changes of habitat at the Wylfa Newydd Development Area and Disposal Site, this represents up to 0.09% of the IS MU reference population.

8.7.47 In-combination, the Wylfa Newydd Development Area (approximately 0.35km^2) and of the Disposal Site including a 100m buffer (approximately 0.65km^2), along with the 9.1km^2 area of the Minesto Holyhead Deep tidal development, the West Anglesey Demonstration Zone (WADZ) area of 37km^2, the 11.5km^2 area of the Swansea Bay Tidal Lagoon and 70km^2 area of the Cardiff Tidal Lagoon, have a total estimated area of 129km^2. This is a relatively small area, approximately 0.3% of the bottlenose dolphin IS MU area (44,779km^2).

8.7.48 Taking into account the location of these projects and relatively small area of the potential change or loss of habitat compared to the range and available habitat for bottlenose dolphin and their prey. It is unlikely that the loss or change of habitat could significantly affect bottlenose dolphin or their prey, therefore, it is concluded that any potential effects associated with a change or loss of habitat would not result in an adverse effect on the integrity of the SACs in relation to their conservation objectives for bottlenose dolphin.

C Changes in marine water quality

Construction

8.7.49 During the Project construction, any increase in suspended sediment input and change in chemical quality due to discharge from fluvial sources and

sewage and any increase in suspended sediment concentration and contaminant re-mobilisation during dredging and disposal could potentially effect, based on a precautionary approach, bottlenose dolphin and their prey in the in the Wylfa Newydd Development Area (0.35km^2) and Disposal Site with 100m buffer (0.651km^2). The total number of bottlenose dolphin that could be potentially affected by any increases in suspended sediment concentration is 0.34 individuals, this represents up to 0.09% of the IS MU reference population.

8.7.50 None of the projects identified have the potential for any in-combination effects for changes in marine water quality during the construction of the Project (table 8-74). Therefore, there is no potential for an adverse effect on the integrity of the SACs in relation to their conservation objectives for bottlenose dolphin or prey species as a result of in-combination effects of any changes to marine water quality during construction.

Operation

8.7.51 During the operation of the Project, the maximum area that could be impacted by the discharge from the cooling water system is 3.13km^2 for bottlenose dolphin and their prey, based on maximum potential TRO impact area, which is larger than the predicted maximum surface area for a 2^{o}C rise in temperature (2.41km^2; table 8-41 and table 8-44). The 3.13km^2 area could contain 1.08 bottlenose dolphin, which represents 0.3% of the IS MU reference population.

8.7.52 None of the projects (table 8-74) currently included in the in-combination assessment for changes in marine water quality during operation of the Project, have the potential for any in-combination effects on bottlenose dolphin, including prey species, at the Pen Llyn a'r Sarnau/Llŷn Peninsula and the Sarnau SAC and Bae Ceredigion/Cardigan Bay SAC, based on currently available information (table 8-74). Therefore, there is no potential for an adverse effect on the integrity of these SACs in relation to their conservation objectives for bottlenose dolphin as a result of in-combination effects of changes to marine water quality during construction.

D Alteration of coastal processes and hydrodynamics

D1 Potential effect on habitat for prey species

8.7.53 The coastal processes assessment concludes that there is no potential for any alteration of intertidal or subtidal habitats and, consequently, no significant effect on prey species for marine mammals is predicted. As a worst case, a localised change in habitat within the Wylfa Newydd Development Area is assumed. This area coincides with area assessed for any change and/or loss of habitat and, therefore, has not been assessed here to avoid double counting of the potential effect.

8.7.54 None of the projects currently included in the in-combination assessment for any alteration of coastal processes and hydrodynamics have the potential for any in-combination effects (table 8-75). Therefore, there is no potential for an

adverse effect on the integrity of the Pen Llyn a'r Sarnau/Llŷn Peninsula and the Sarnau SAC and Bae Ceredigion/Cardigan Bay SAC in relation to its conservation objectives for bottlenose dolphin as a result of in-combination effects any alteration of coastal processes and hydrodynamics on prey species.

E Physical interaction between species and Project infrastructure

E1 Vessel collision risk

8.7.55 The potential for in-combination effects for vessel collision risk (table 8-76) are currently unknown. However, it is highly unlikely that bottlenose dolphin would experience a significantly increased collision risk with vessels as a result of these projects, especially taking into account that any animals in the area will be habituated to the presence of vessels and able to detect and avoid vessels. As a result, any potential increased collision risk as a result of in-combination effects are unlikely to result in an adverse effect on the integrity of the Pen Llyn a'r Sarnau/Llŷn Peninsula and the Sarnau SAC and Bae Ceredigion/Cardigan Bay SAC in relation to their conservation objectives for bottlenose dolphin.

E2 Project infrastructure

8.7.56 The potential for in-combination effects for any physical interaction between species and project infrastructure (table 8-76) are currently unknown. However, it should be noted that there is no potential for any direct physical interaction between bottlenose dolphin and the Project infrastructure. The loss of prey due to impingement and entrainment could potentially affect less than one small bottlenose dolphin (less than 0.25% of the IS MU reference population) per year, although, bottlenose dolphin would still be able to source prey from nearby areas. In addition, embedded mitigation, including the AFDs and FRR system, would reduce the potential loss of prey species.

8.7.57 In addition, if any project alone is likely to have a significant effect on bottlenose dolphin as a result of physical interaction with the infrastructure, for example at the proposed tidal developments, then mitigation and monitoring would be required at these sites to reduce the risk.

8.7.58 As a result, any potential for physical interaction with project infrastructure as a result of in-combination effects should be unlikely to result in an adverse effect on the integrity of the SACs in relation to their conservation objectives for bottlenose dolphin.

Table 8-72 Assessment of potential for any in-combination effects of underwater noise at the Pen Llyn a'r Sarnau/Llŷn Peninsula and the Sarnau SAC and Bae Ceredigion/Cardigan Bay SAC for bottlenose dolphin during the marine construction works and operation

In-combination assessment	Potential sources of underwater noise during marine construction works	Potential to adversely affect the integrity of the European Designated Sites	
		Auditory Injury (PTS)	Behavioural Response / Disturbance
The Project	Potential sources of underwater noise at the Wylfa Newydd Development Area and Disposal Site are: • drilling; • rock cutting; • rock breaking; • dredging; • disposal of material; and • vessels.	The maximum predicted range for PTS is 36m as a result of rock breaking, without mitigation, which has the potential to effect 0.0014 bottlenose dolphin (0.00035% of the IS MU reference population) The maximum predicted range for PTS is less than 1m for the disposal of material and from vessels and is therefore highly unlikely to affect any bottlenose dolphin. *Taking into account proposed mitigation would reduce the risk of any auditory injury. Therefore there is no potential for any in-combination effects to adversely affect the integrity of the site.*	During construction the maximum number of bottlenose dolphin that potentially could be temporarily disturbed as a result of underwater noise at the Wylfa Newydd Development Area and Disposal Site and along the vessel route would be up to a maximum of one individual (up to 0.25% of the IS MU reference population). *Therefore there is no potential to adversely affect the integrity of the site.*
	Potential noise sources during operation are: • maintenance dredging; • vessel movements; and • AFDs	There is no potential risk of any auditory injury. *Therefore there is no potential for any in-combination effects to adversely affect the integrity of the site.*	There is no potential for any significant impacts due to underwater noise from maintenance dredging and vessel movements during operation. *Therefore there is no potential to adversely affect the integrity of the site.*
Afon Dysynni outfall gravel removal and relocation	Removal of accumulated stone river channel material via excavation and deposit of material on right river bank on the north shore. Potential sources of noise include dredging and vessels.	There would be no potential for any auditory injury from vessel or dredging noise. *Therefore there is no potential for any in-combination effects to adversely affect the integrity of the sites.*	The potential for any disturbance as a result of underwater noise from vessels and dredging is likely to be limited to the area around the vessels and within the dredge area, therefore the potential for any significant disturbance and in-combination effects will be very low.

In-combination assessment	Potential sources of underwater noise during marine construction works	Potential to adversely affect the integrity of the European Designated Sites	
		Auditory Injury (PTS)	**Behavioural Response / Disturbance**
			Based on available information, there is no potential for any in-combination effects to adversely affect the integrity of the sites.
Wylfa Decommissioning	Same as assessment in table 8-55 and table 8-56 for Gogledd Môn Forol/North Anglesey Marine cSAC. *There is no potential for any in-combination effects to adversely affect the integrity of the sites.*		
Minesto Holyhead Deep 10 MW Tidal Kite	Foundation options for the 160 0.5MW DGU units that are being considered include 4m monopile fixed to the seabed either using piling hammers, or drilling and grouting it into position, or a combination of these two approaches [RD214]. The other installation methods that are being considered include floating GBS and mud mat foundation [RD214]. Other noise sources will include vessels, cable laying and construction of offshore substation. [RD214] proposes to develop the Array Project in three phases as part of a deploy-and-monitor approach, which will allow verification of predictions made in the EIA, and confirm that mitigation strategies are working effectively.	The ES found no risk of auditory injury from vessels and drilling / vibro-hammering noise [RD212]. *Therefore there is no potential for any in-combination effects to adversely affect the integrity of the site.*	The noise modelling indicated, using a very precautionary approach that disturbance zones could extend out to 4,000m for the quieter vessels and out to a maximum of 14,000m for the louder vessels [RD212]. The ES concluded that, whilst a small number of individual animals may exhibit some form of change in behaviour for the period in which they encounter sound from the installation or support vessels, this number is likely to be small and the main noise sources present for such a short time that any changes would likely be undetectable against natural variation and would have no residual impact at the population level [RD212]. The noise modelling for drilling activity indicated that disturbance zones could extend out to 375m for pile drilling and out to a maximum of 10,000m for the vibro-hammering. For the installation of one DGU piling activities are likely to be limited to approximately 5 days, the ES concluded that there is likely to be very limited interaction between the piling noise and

In-combination assessment	Potential sources of underwater noise during marine construction works	Potential to adversely affect the integrity of the European Designated Sites	
		Auditory Injury (PTS)	Behavioural Response / Disturbance
			mammals; any changes would likely be undetectable against natural variation and would have no residual impact at the population level [RD212]. *This will have to be assessed further of the Phased development and installation of 160 devices.* *However, based on the maximum predicted impact range, the potential impact area is 314km^2, which could affect 108 bottlenose dolphin (27% of IS MU; based on single not concurrent installation and the maximum density estimate of 0.344/km^2 – see chapter 6). It should be noted, that this is not assessed in-combination with disturbance from vessels outlined above as both would be in the same area at the same time, with overlapping impact areas.* *Therefore, further assessment is required by Minesto to determine the potential to adversely affect the integrity of the site.* As a result of an absence of detailed project information, no in-combination assessment can be carried out.
Menter Môn (Morlais) West Anglesey Marine Energy Demonstration Zone	No details are currently available on if there will be the potential for any underwater noise and what the sources might be during the Project marine construction works, however as a worst-case scenario they have been assumed to	It is assumed that the potential for any auditory injury would be mitigated. *Therefore there is no potential for any in-combination effects to adversely affect the integrity of the site.*	*As assessed for the Minesto Holyhead Deep tidal array, e.g. the potential impact area could be 314km^2, which could affect 108 bottlenose dolphin (27% of IS MU; (based on single not concurrent installation and maximum density estimate of 2.5/km^2*

In-combination assessment	Potential sources of underwater noise during marine construction works	Potential to adversely affect the integrity of the European Designated Sites	
		Auditory Injury (PTS)	Behavioural Response / Disturbance
	the same / similar to the Minesto Holyhead Deep tidal array. The Morlais Project capacity may be up to, but will not exceed 100W. A number of TEC are being considered. Seabed mounted devices could be fixed using several different methods. The type of installation vessel will vary depending on the needs of the foundation, but would typically require a heavy lift crane barge or jack-up barge vessel [RD217].		– *see chapter 6).* *Therefore, further assessment is required by Morlais to determine the potential to adversely affect the integrity of the site.* As a result of an absence of detailed project information, no in-combination assessment can be carried out.
Swansea Bay Tidal Lagoon	Same as assessment in table 8-63 for harbour porpoise cSACs		
Cardiff Tidal Lagoon	Same as assessment in table 8-63 for harbour porpoise cSACs		
North West Coast Connections Project	Same as assessment in table 8-54 and table 8-56 for Gogledd Môn Forol/North Anglesey Marine cSAC		
NuGen Moorside Project in West Cumbria	Same as assessment in table 8-54 and table 8-56 for Gogledd Môn Forol/North Anglesey Marine cSAC		

Table 8-73 Assessment of potential in-combination effects of any change or loss of habitat at the Pen Llyn a'r Sarnau/Llŷn Peninsula and the Sarnau SAC and Bae Ceredigion/Cardigan Bay SAC for bottlenose dolphin

In-combination assessment	Potential for land take, including seabed or intertidal land	Potential to adversely affect the integrity of the European Designated Sites
The Project	During construction and operation, based on a precautionary approach, it has been assumed that the marine area of the Wylfa Newydd Development Area (approximately 0.35km^2) and the Disposal Site including a 100m buffer (approximately 0.65km^2), could experience a potential change or loss of habitat.	A total 0.34 bottlenose dolphin could be affected by any loss or changes of habitat at the Wylfa Newydd Development Area and Disposal Site, this represents up to 0.09% of the IS MU reference population. *Therefore there is no potential to adversely affect the integrity of the site.*
Minesto Holyhead Deep 10 MW Tidal Kite	The 9.1km^2 area could accommodate an array of up to 80 MW (160 0.5 MW DGUs). Minesto is collaborating with Morlais to jointly develop grid and cable infrastructure, which will help minimise the combined environmental footprint of the two projects [RD214].	The 9.1km^2 area this could potentially effect up to 3.1 bottlenose dolphin (0.08% of the IS MU reference population, based on maximum density estimate of 0.344/km^2 (see chapter 6)). *Therefore there is no potential to adversely affect the integrity of the site.*
Menter Môn (Morlais) West Anglesey Marine Energy Demonstration Zone	The Morlais Project will be located in the WADZ, with an area of 37km^2.	The exact area of the Morlais project is currently unknown. However the WADZ area of 37km^2 could potentially effect up to 13 bottlenose dolphin (3.3% of the IS MU reference population, based on maximum density estimate of 0.344/km^2 (see chapter 6)) *Therefore there is no potential to adversely affect the integrity of the site.*
Swansea Bay Tidal Lagoon	Same as assessment in table 8-64 for harbour porpoise cSACs	
Cardiff Tidal Lagoon	Same as assessment in table 8-64 for harbour porpoise cSACs	
North West Coast Connections Project	Same as assessment in table 8-57 for Gogledd Môn Forol/North Anglesey Marine cSAC	
NuGen Moorside Project in West Cumbria	Same as assessment in table 8-57 for Gogledd Môn Forol/North Anglesey Marine cSAC	

Table 8-74 Assessment of potential in-combination effects of any changes in marine water quality at the Pen Llyn a'r Sarnau/Llŷn Peninsula and the Sarnau SAC and Bae Ceredigion/Cardigan Bay SAC for bottlenose dolphin

In-combination assessment	Potential for changes in marine water quality	Potential to adversely affect the integrity of the European Designated Sites
The Project	Increase in suspended sediment input and change in chemical quality due to discharge from fluvial sources and sewage during construction	The total number of bottlenose dolphin that could be present in the Wylfa Newydd Development Area is 0.12 individuals, this represents up to 0.03% of the IS MU reference population. This is the same area as for any increase in suspended sediments during dredging, below, and therefore does not represent an additional effect. *Therefore there is no potential to adversely affect the integrity of the site.*
	Increase in suspended sediment concentration and contaminant re-mobilisation during dredging and disposal during construction	The total number of bottlenose dolphin that could be present in the Wylfa Newydd Development Area and Disposal Site with 100m buffer and could be potentially affected by any increases in suspended sediment concentration is 0.34 individuals, this represents up to 0.09% of the IS MU reference population. *Therefore there is no potential to adversely affect the integrity of the site.*
	Discharge from the cooling water system during operation - change in water temperature	The number of bottlenose dolphin that could be present in the maximum predicted surface area for a $2^{o}C$ rise in temperature ($2.41km^2$) has been estimated as up to one individual, which represents up to 0.25% of the IS MU reference population. This is the same area as for TRO discharge, below, and therefore does not represent an additional effect. *Therefore there is no potential to adversely affect the integrity of the site.*
	Discharge from the cooling water system during operation - Total Residual Oxidants	The number of bottlenose dolphin that could be present in the maximum potential TRO impact area ($3.13km^2$) is up to two individuals, which represents 0.5% of the IS MU reference population. *Therefore there is no potential to adversely affect the integrity of the site.*

In-combination assessment	Potential for changes in marine water quality	Potential to adversely affect the integrity of the European Designated Sites
Afon Dysynni outfall gravel removal and relocation	There is the potential for increase in suspended sediment concentration and contaminant re-mobilisation during dredging.	Any increase in turbidity or suspended sediment levels is expected to be temporally and spatially restricted. If there is the potential for any contaminant re-mobilisation it is anticipated that mitigation measures would be required. *Therefore, based on available information, there is no potential for any in-combination effects to adversely affect the integrity of the site.*
Wylfa Decommissioning	Same as assessment in table 8-58 for Gogledd Môn Forol/North Anglesey Marine cSAC. *There is no potential for any in-combination effects to adversely affect the integrity of the sites.*	
Minesto Holyhead Deep 10 MW Tidal Kite	Same as assessment in table 8-58 for Gogledd Môn Forol/North Anglesey Marine cSAC. *There is no potential for any in-combination effects to adversely affect the integrity of the sites.*	
Menter Môn (Morlais) West Anglesey Marine Energy Demonstration Zone	Same as assessment in table 8-58 for Gogledd Môn Forol/North Anglesey Marine cSAC. *There is no potential for any in-combination effects to adversely affect the integrity of the sites.*	
Swansea Bay Tidal Lagoon	Same as assessment in table 8-65 for harbour porpoise cSACs. *There is no potential for any in-combination effects to adversely affect the integrity of the sites.*	
Cardiff Tidal Lagoon	Same as assessment in table 8-64 for harbour porpoise cSACs. *There is no potential for any in-combination effects to adversely affect the integrity of the sites.*	
North West Coast Connections Project	Same as assessment in table 8-58 for Gogledd Môn Forol/North Anglesey Marine cSAC. *There is no potential for any in-combination effects to adversely affect the integrity of the sites.*	
NuGen Moorside Project in West Cumbria	Same as assessment in table 8-58 for Gogledd Môn Forol/North Anglesey Marine cSAC. *There is no potential for any in-combination effects to adversely affect the integrity of the sites.*	

Table 8-75 Assessment of potential in-combination effects of any alteration of coastal processes and hydrodynamics on prey species at the Pen Llyn a'r Sarnau/Llŷn Peninsula and the Sarnau SAC and Bae Ceredigion/Cardigan Bay SAC for bottlenose dolphin

In-combination assessment	Potential effects of any alteration of coastal processes and hydrodynamics on prey species	Potential to adversely affect the integrity of the European Designated Sites
The Project	See **table 8-59** for Gogledd Môn Forol/North Anglesey Marine cSAC in-combination assessment. *Therefore there is no potential to adversely affect the integrity of the site.*	
Swansea Bay Tidal Lagoon	Same as assessment in table 8-66 for harbour porpoise cSACs. *There is no potential for any in-combination effects to adversely affect the integrity of the sites.*	
Cardiff Tidal Lagoon	Same as assessment in table 8-66 for harbour porpoise cSACs. *There is no potential for any in-combination effects to adversely affect the integrity of the sites.*	
North West Coast Connections Project	Same as assessment in table 8-59 for Gogledd Môn Forol/North Anglesey Marine cSAC. *There is no potential for any in-combination effects to adversely affect the integrity of the sites.*	
NuGen Moorside Project in West Cumbria	Same as assessment in table 8-59 for Gogledd Môn Forol/North Anglesey Marine cSAC. *There is no potential for any in-combination effects to adversely affect the integrity of the sites.*	

Table 8-76 Assessment of potential in-combination effects of any physical interaction with project infrastructure and vessels at the Pen Llyn a'r Sarnau/Llŷn Peninsula and the Sarnau SAC and Bae Ceredigion/Cardigan Bay SAC for bottlenose dolphin

In-combination assessment	Potential for physical interaction with project infrastructure and vessels	Potential to adversely affect the integrity of the European Designated Sites
The Project	Vessel collision risk	The number of bottlenose dolphin that could be at increased risk of collision with vessels all vessels during construction and operation within the Wylfa Newydd Development Area, the Disposal Site plus 100m buffer and the 1km wide vessel route between the two sites, is estimated to be up to 0.75 individuals (0.2% of IS MU reference population) based on a precautionary 95% avoidance rate. *Therefore there is no potential to adversely affect the integrity of the site.*
	Project infrastructure	No direct impacts on bottlenose dolphin as a result of project infrastructure. However, the loss of prey due to impingement

In-combination assessment	Potential for physical interaction with project infrastructure and vessels	Potential to adversely affect the integrity of the European Designated Sites
		could potentially affect less than one small bottlenose dolphin (0.25% of the IS MU reference population) per year. However, individuals would still be able to source prey from nearby areas. *Therefore there is no potential to adversely affect the integrity of the site.*
Afon Dysynni outfall gravel removal and relocation	There could be the potential for increased vessel movements.	The potential for any physical interaction with vessels as a result of this project is currently unknown. However, any increase risk for collision risk with vessels is expected to be temporally and spatially restricted. *Therefore, based on available information, there is limited potential for any in-combination effects to adversely affect the integrity of the sites.*
Wylfa Decommissioning	Same as assessment in table 8-60 for Gogledd Môn Forol/North Anglesey Marine cSAC. *There is no potential for any in-combination effects to adversely affect the integrity of the sites.*	
Minesto Holyhead Deep 10 MW Tidal Kite	Same as assessment in table 8-60 for Gogledd Môn Forol/North Anglesey Marine cSAC.	
Menter Môn (Morlais) West Anglesey Marine Energy Demonstration Zone	Same as assessment in table 8-60 for Gogledd Môn Forol/North Anglesey Marine cSAC.	
Swansea Bay Tidal Lagoon	Same as assessment in table 8-67 for harbour porpoise cSACs.	
Cardiff Tidal Lagoon	Same as assessment in table 8-67 for harbour porpoise cSACs.	
North West Coast Connections Project	Same as assessment in table 8-58 for Gogledd Môn Forol/North Anglesey Marine cSAC.	
NuGen Moorside Project in West Cumbria	Same as assessment in table 8-58 for Gogledd Môn Forol/North Anglesey Marine cSAC.	

Conclusion for the Pen Llyn a'r Sarnau/Llŷn Peninsula and the Sarnau SAC and Bae Ceredigion/Cardigan Bay SAC for bottlenose dolphin

Alone

8.7.59 In conclusion, there is no potential for any adverse effect on the integrity of the Pen Llyn a'r Sarnau/Llŷn Peninsula and the Sarnau SAC and Bae Ceredigion/Cardigan Bay SAC from the Project alone during its construction and operation in relation to the conservation objectives for bottlenose dolphin (table 8-77).

Table 8-77 Summary of the assessment of the potential effects on the Pen Llyn a'r Sarnau/Llŷn Peninsula and the Sarnau SAC and Bae Ceredigion/Cardigan Bay SAC in relation to the conservation objectives for bottlenose dolphin

Conservation objectives	Changes in visual and acoustic stimuli	Land take, including seabed or intertidal land	Changes in marine water quality	Physical interaction between species and Project infra-structure	Changes in prey resources
The population is maintaining itself on a long-term basis as a viable component of its natural habitat	×	×	×	×	×
The population within the site is such that the natural range of the population is not being reduced or likely to be reduced for the foreseeable future	×	×	×	×	×

Conservation objectives	Changes in visual and acoustic stimuli	Land take, including seabed or intertidal land	Changes in marine water quality	Physical interaction between species and Project infra-structure	Changes in prey resources
The presence, abundance, condition and diversity of habitats and species required to support this species is such that the distribution, abundance and populations dynamics of the species within the site and population beyond the site is stable or increasing	×	×	×	×	×
To maintain at favourable conservation status its long-term population viability, natural range and the structure and function of its habitat within the site	×	×	×	×	×

× = no potential for any adverse effect on the integrity of the site in relation to the conservation objectives

In-combination

8.7.60 In conclusion, based on the information currently available, there is no potential for any adverse effect on the integrity of the Pen Llyn a'r Sarnau/Llŷn Peninsula and the Sarnau SAC and Bae Ceredigion Cardigan Bay SAC from in-combination effects associated with land take, including seabed or intertidal land; changes in marine water quality; or changes in prey resources during construction and operation in relation to the conservation objectives for bottlenose dolphin (table 8-78). There is also unlikely to be any in-combination effects from underwater noise or any physical interaction with project infrastructure or vessels.

Table 8-78 Summary of the in-combination assessment for the Pen Llyn a'r Sarnau/Llŷn Peninsula and the Sarnau SAC and Bae Ceredigion/Cardigan Bay SAC in relation to the Conservation Objectives for bottlenose dolphin

Conservation objectives	Changes in visual and acoustic stimuli	Land take, including seabed or intertidal land	Changes in marine water quality	Physical interaction between species and Project infra-structure	Changes in prey resources
The population is maintaining itself on a long-term basis as a viable component of its natural habitat	×	×	×	×	×
The population within the site is such that the natural range of the population is not being reduced or likely to be reduced for the foreseeable future	×	×	×	×	×
The presence, abundance, condition and diversity of habitats and species required to support this species is such that the distribution, abundance and populations dynamics of the species within the site and population beyond the site is stable or increasing	×	×	×	×	×
To maintain at favourable conservation status its long-term population viability, natural range and the structure and function of its habitat within the site	×	×	×	×	×

× = no potential for any adverse effect on the integrity of the site in relation to the conservation objectives

8.8 Pen Llyn a'r Sarnau/Llŷn Peninsula and the Sarnau SAC - grey seal (*Halichoerus grypus*)

Conservation objectives

8.8.1 The conservation objectives for the Pen Llyn a'r Sarnau/Llŷn Peninsula and Sarnau SAC [RD56] for grey seal are set out in section 8.7 (combined with those for bottlenose dolphin).

A Changes in visual and acoustic stimuli

Construction

A1 Underwater noise during marine construction works [Marine Licence]

8.8.2 The potential sources of underwater noise at the Wylfa Newydd Development Area and at the Disposal Site are as set out above.

8.8.3 Underwater noise modelling indicates that there is no potential risk of physical injury as a result of underwater noise from any of these activities.

8.8.4 Mitigation measures would reduce the risk of auditory injury in marine mammals (see section 8.5). However, the maximum predicted range for PTS at the Wylfa Newydd Development Area is 450m as a result of rock breaking (table 8-30), which has the potential to effect 0.15 grey seal (0.0025% of the reference population of 6,000 grey seal; table 8-34). There is not a recent count for the SAC and in 2002 the estimated population was 365 grey seal, (0.15 grey seal represents 0.4% of this SAC population), although as seals at this site are part of the wider population, the reference population is more appropriate to use in the assessment (see chapter 6).

8.8.5 The maximum predicted range for disturbance at the Wylfa Newydd Development Area is 5.9km for grey seal as a result of concurrent drilling (table 8-30), which has the potential to temporarily effect 14.5 grey seal (0.24% of the reference population; table 8-34; which represents 4% of the estimated SAC population).

8.8.6 The maximum predicted range for PTS at the Disposal Site is 5m (table 8-30), which has the potential to effect 0.00001 grey seal (<0.00001% of the reference population; table 8-34; and represents <0.0001% of the possible SAC population). The maximum predicted range for disturbance is 500m (table 8-30), which has the potential to temporarily effect 0.00001 grey seal (<0.00001% of the reference population; table 8-34).

8.8.7 Along the vessel route between the Wylfa Newydd Development Area and Disposal Site, the maximum number of grey seal that potentially could be temporarily disturbed is 6 individuals (up to 0.1% of the reference population; table 8-36; which represents 1.6% of the estimated SAC population). Taking into account the temporary nature of underwater noise and the very precautionary approach to the assessment, it is highly unlikely that this percentage of grey seal from the reference population actually would be

disturbed. The noise modelling indicates that the range of disturbance around vessels for grey seal is less than 1m. Therefore, based on the peak number of vessels on site is predicted to average approximately 15 per week over a three month period and the existing baseline of up to 25 vessels per week for the area (ES Volume D – Wylfa Newydd Development Area Development D13 – The Marine Environment, Application Reference Number: 6.4.13). The maximum total area of disturbance as a result of 40 vessels could be up to 0.0001km^2. The maximum number of bottlenose dolphin that could be disturbed is 0.00005 (<0.000001% of the reference population).

8.8.8 Therefore, during construction, the maximum number of grey seal that could be temporarily disturbed as a result of underwater noise at the Wylfa Newydd Development Area and Disposal Site, and vessels, would be up to a maximum of 14.53 individuals (up to 0.24% of the reference population; which could represent up to 6% of the estimated SAC population).

8.8.9 Taking into account the temporary nature of underwater noise and the relatively low percentage of grey seal from the reference population that could be impacted, any potential effect from underwater noise during construction is highly unlikely to result in an adverse effect on the integrity of this site in relation to its conservation objectives for grey seal.

A2 Airborne noise during construction [Marine Licence]

8.8.10 Taking into account the requirements to ensure the protection of human receptors and the distance to known grey seal haul-out sites (approximately 2km), the distance to the nearest grey seal breeding sites (approximately 6km) and the distance to the nearest European Designated Sites for grey seal, the potential for any significant impacts is highly unlikely. Although grey seal could haul-out along the coastline, only individuals or small groups would be expected and the likelihood of them occurring within 500m of the marine works in the Wylfa Newydd Development Area is extremely low. Therefore, although airborne noise has the potential to temporally disturb a relatively small number of seals at haul-out sites in the vicinity of the Wylfa Newydd Development Area, any population effects are highly unlikely and any potential effect during construction is highly unlikely to result in an adverse effect on the integrity of this site in relation to its conservation objectives for grey seal.

A3 Visual stimuli [Marine Licence]

8.8.11 The likelihood of grey seals hauling-out within the immediate vicinity of the Wylfa Newydd Development Area (i.e. within 500m) is considered extremely low. Visual disturbance due to the presence of human activity is therefore considered to be negligible. Therefore the effect on any grey seals from visual disturbance is also negligible.

8.8.12 The nearest haul-out used by seals is approximately 2km from the development site, therefore, although unfamiliar visual stimuli (e.g. temporary infrastructure, machinery and people) or changes in lighting levels

has the potential to temporally disturb a relatively small number of seals at haul-out sites in the vicinity of the Project, the potential for any population effects or any adverse effects on the integrity of the SAC or any other European Designated Site for grey seal is highly unlikely.

8.8.13 Therefore, any potential direct or indirect effect on marine mammals, including seals at haul-out sites, as a result of unfamiliar visual stimuli (e.g. temporary infrastructure, machinery and people) or changes in lighting levels are unlikely to be significant and highly unlikely to result in an adverse effect on the integrity of this site in relation to its conservation objectives for grey seal.

Operation

A4 Underwater noise during operation [Operational water discharge EP]

8.8.14 Taking into account the noise modelling for the AFD arrays, any potential effect as a result of underwater noise from the AFDs would not result in an adverse effect on the integrity of the Pen Llyn a'r Sarnau/Llŷn Peninsula and the Sarnau SAC in relation to its conservation objectives for grey seal.

B Land take, including seabed or intertidal land

Construction and operation

B1 Change and/or loss of habitat [Marine Licence]

8.8.15 As set out above, based on a very precautionary approach, it has been assumed that the marine area of the Wylfa Newydd Development Area (approximately 0.35km^2) and the area of the Disposal Site (approximately 0.651km^2) could experience a potential change or loss of habitat during construction and operation.

8.8.16 The number of grey seal that could be present in the Wylfa Newydd Development Area is 0.08 individuals and 0.08 individuals in the Disposal Site plus 100m buffer (table 8-38), based on the maximum species density estimates for these areas (see chapter 6). Therefore, 0.16 grey seal could be affected by any loss of or changes in habitat at the Wylfa Newydd Development Area and Disposal Site, this represents up to 0.003% of the reference population (which could represent up to 0.04% of the estimated SAC population).

8.8.17 Taking into account the very low percentage of grey seal from the reference population that could be affected, any potential effect as a result of change and/or loss of habitat would be highly unlikely to result in an adverse effect on the integrity of the site in relation to its conservation objectives for grey seal.

C Changes in marine water quality

Construction

C1 Increase in suspended sediment input and change in chemical quality due to discharge from fluvial sources and sewage [Marine Licence; Construction water discharge EP]

8.8.18 The total combined area predicted to be affected by increases suspended sediments from all discharges sources is 0.245km^2. However, as a precautionary approach, the number of grey seal that could potentially be present (and percentage of the reference population) in the Wylfa Newydd Development Area (0.35km^2) has been estimated (table 8-39, based on maximum species density estimates for the area). The total number of grey seal that could be present in the Wylfa Newydd Development Area is 0.08 individuals (table 8-39); this represents up to 0.001% of the reference population (which could represent up to 0.02% of the estimated SAC population). Hence no adverse effect on the integrity of the site is predicted.

C2 Increases in suspended sediment concentrations during dredging and disposal [Marine Licence]

8.8.19 As set out above, the modelling of increases in suspended sediment concentrations during the dredging and disposal of dredged material predicts that the maximum extent of the effect above baseline would be over an area extending 0.245km^2.

8.8.20 As a precautionary approach, the number of grey seal that could potentially be present (and percentage of the reference population) in the Wylfa Newydd Development Area (0.35km^2) and Disposal Site with 100m buffer (0.651km^2) has been estimated (table 8-39, based on maximum species density estimates for the area). The total number of grey seal that could be present in the Wylfa Newydd Development Area and Disposal Site with 100m buffer and could be potentially affected by any increases in suspended sediment concentration is 0.16 individuals (table 8-39), this represents up to 0.003% of the reference population (which could represent up to 0.04% of the estimated SAC population).

8.8.21 The area in which increased suspended sediment concentrations would be experienced is very small in relation the range of grey seal and their prey and any potential effects would be temporary, with dispersion of the suspended sediment to background levels predicted to occur within three hours of a dredging / disposal cycle.

8.8.22 Therefore, taking into account the limited dispersion area and the rapid dispersion and deposition, along with relatively low contaminant levels in sediments and the very low percentage of grey seal from the reference population that could be impacted, any potential effect as result of increases in suspended sediment concentration from the dredging and disposal of dredged material is highly unlikely to result in an adverse effect on the integrity of this site in relation to its conservation objectives for grey seal.

Operation

C3 Discharge from the cooling water system [Operational water discharge EP]

Temperature increase

8.8.23 Any changes or increases in temperature are unlikely to affect grey seal, as they are well adapted to changes in water temperature throughout their range.

8.8.24 However, on a very precautionary basis, the number of grey seal that could be present in the maximum predicted surface area for a 2^{o}C rise in temperature (2.41km^{2}) has been estimated as up to one individual, which represents up to 0.02% of the reference population (table 8-41).

Total Residual Oxidants

8.8.25 There is no predicted potential direct or indirect effects on marine mammals due to TRO from cooling water discharge during operation.

8.8.26 However, as a very precautionary approach, the number of grey seal that could be present in the maximum potential TRO impact area (3.13km^{2}) is up to two individuals, which represents 0.3% of the reference population (table 8-44).

Effect on prey species

8.8.27 The potential effect of change in water temperature and TRO on prey species would not extend beyond the maximum predicted effect areas described for grey seal. Consequently, the approach taken to assessing the effect on the grey seal population is worst case, and there would be no additional impact as a result of the effects on prey species.

Effect of changes in marine water quality during operation

8.8.28 The area of increased temperature and TRO from the cooling water discharge represents the same area therefore, as a worst-case scenario, the number of grey seal that could be affected by changes in water temperature and TRO discharges, based on the maximum potential TRO impact area (3.13km^{2}), is up to two seals; which represents 0.3% of the reference population.

8.8.29 As described in section 8.3, no significant effect on grey seal is predicted due to the potential effect of the Project on marine water quality. Given this lack of effect and the very small percentage of the reference population (which is considered insignificant) that could be exposed to the area of predicted change in marine water quality, there is no potential for an effect on grey seal populations to arise over the operational lifetime of the Project.

8.8.30 Therefore, any potential effect as result of increases in temperature and operational discharge of TRO from the cooling water system are highly unlikely to result in an adverse effect on the integrity of this site in relation to its conservation objectives for grey seal.

D Alteration of coastal processes and hydrodynamics

D1 Potential effect on habitat for prey species [Marine Licence]

8.8.31 The coastal processes assessment concludes that there is no potential for any alteration of intertidal or subtidal habitats and, consequently, no significant effect on prey species for marine mammals is predicted. As a worst case, a localised change in habitat within the Wylfa Newydd Development Area is assumed. This area coincides with area assessed for any change and/or loss of habitat (item B1) and, therefore, has not been assessed here to avoid double counting of the potential effect on marine mammals.

E Physical interactions

Construction

E1 Vessel collision risk [Marine Licence]

8.8.32 As a precautionary worse-case approach, the number of grey seal that could be at increased collision with vessels within the Wylfa Newydd Development Area, the Disposal Site plus 100m buffer (table 8-45) and the vessel route between the two sites, based on a 1km width of vessel route (table 8-46), is estimated to be 0.3 individuals (0.005% of reference population) based on a precautionary 95% avoidance rate.

8.8.33 However, it is highly unlikely that grey seal would be at increased collision risk with vessels during construction, especially taking into account the small increase in the number of vessel movements compared to existing vessel movements in the area and the fact that any grey seal in the area would be habituated to the presence of vessels and able to detect and avoid them.

8.8.34 Taking this into account, along with the low percentage of grey seal from the reference population that could be at increased collision risk with vessels during construction, any potential effect is highly unlikely to result in an adverse effect on the integrity of this site in relation to its conservation objectives for grey seal.

Operation

8.8.35 ***E2 Effect of impingement and entrainment of prey species during operation [Operational water discharge EP]***

8.8.36 The potential effect area for prey species would be confined to the intake structure and the potential zone of influence in which fish could be at risk of has been identified as 50m from the intake. However, fish are highly mobile species, with relatively large ranges and are unlikely to be restricted to the immediate area of the cooling water intake. Therefore the loss of fish is likely to be very small in comparison to natural variation.

8.8.37 The DEA estimated, based on the worst-case scenario, that the maximum number of grey seal that could potentially be impact is up to 1.5 averaged

sized seals, which represents less than 0.025% of the reference population. However, it is important to note that this is only potential loss of prey, as individuals would still be able to source prey from nearby areas. In addition, embedded mitigation, including the AFDs and FRR system, would reduce the potential loss of prey species.

8.8.38 Hence any potential effect would be unlikely to result in an adverse effect on the integrity of the site in relation to the conservation objectives for grey seal.

In-combination assessment for Pen Llyn a'r Sarnau/Llŷn Peninsula and the Sarnau SAC and other grey seal SACs

A Changes in visual and acoustic stimuli

Construction

A1 Underwater noise during marine construction works

8.8.39 The in-combination assessment (table 8-79) indicates that there should be no potential for any auditory injury in grey seal as appropriate mitigation measures should be undertaken for each project and there would be no in-combination effect with other developments. Therefore, there is no potential to adversely affect the integrity of the sites in view of the conservation objectives.

8.8.40 There is limited detailed information on potential effects from underwater noise during the Project marine construction works for some of the projects listed in table 8-79. Therefore it is currently not possible to conduct a quantitative assessment.

8.8.41 The in-combination assessment (table 8-79) has determined that there is the potential for disturbance of up to 96.5 grey seal (1.6% of reference population) if the construction at both the Minesto Holyhead Deep and Menter Môn Morlais tidal developments was at the same time as the Project marine construction works. As these projects are likely to work together to reduce and limit any potential effects, it would be expected that, if required, mitigation would be put in place to reduce any significant disturbance on marine mammals. Consequently, no adverse effect on integrity is predicted.

Operation

A4 Underwater noise during operation

8.8.42 There is no potential for any significant effects to arise due to underwater noise from maintenance dredging and vessel movements during the Project operation. There is also no potential for any significant effects to arise due to underwater noise from the AFDs on the cooling water intake. Therefore, no in-combination effects and no adverse effects on the integrity of the SACs for grey seal in relation to their conservation objectives are predicted.

B Land take, including seabed or intertidal land

B1 Change and/or loss of habitat

8.8.43 For the Project during construction and operation, based on a precautionary approach, it has been assumed that the marine area of the Wylfa Newydd Development Area (approximately 0.35km^2) and of the Disposal Site including a 100m buffer (approximately 0.65km^2), could experience a potential change or loss of habitat. A total of 0.16 grey seal could be affected by any loss of or changes in habitat at the Wylfa Newydd Development Area and Disposal Site, this represents up to 0.003% of the reference population.

8.8.44 In-combination, the Wylfa Newydd Development Area (approximately 0.35km^2) and of the Disposal Site including a 100m buffer (approximately 0.65km^2), along with the 9.1km^2 area of the Minesto Holyhead Deep tidal development, the West Anglesey Demonstration Zone (WADZ) area of 37km^2, the 11.5km^2 area of the Swansea Bay Tidal Lagoon and 70km^2 area of the Cardiff Tidal Lagoon, have a total estimated area of 129km^2 (table 8-80).

8.8.45 Taking into account the location of these projects and relatively small area of the potential change or loss of habitat compared to the range and available habitat for grey seal and their prey, it is unlikely that the loss or change of habitat could significantly affect grey seal or their prey, therefore, it is concluded that any potential effects associated with a change or loss of habitat would not result in an adverse effect on the integrity of the SACs in relation to their conservation objectives for grey seal.

C Changes in marine water quality

Construction

8.8.46 During the Project construction, any increase in suspended sediment input and change in chemical quality due to discharge from fluvial sources and sewage and any increase in suspended sediment concentration and contaminant re-mobilisation during dredging and disposal could, applying a precautionary approach, potentially affect grey seal and their prey in the in the Wylfa Newydd Development Area (0.35km^2) and Disposal Site with 100m buffer (0.651km^2). The total number of grey seal that could be present in the Wylfa Newydd Development Area and Disposal Site with 100m buffer and could be potentially affected by any increases in suspended sediment concentration is 0.16 individuals, this represents up to 0.003% of the reference population.

8.8.47 None of the projects have the potential for any in-combination effects for changes in marine water quality during the construction of the Project (table 8-81). Therefore, there is no potential for an adverse effect on the integrity of the SACs in relation to their conservation objectives for grey seal or prey species as a result of in-combination effects of any changes to marine water quality during construction.

Operation

8.8.48 During the operation of the Project, the maximum area that could be impacted by the discharge from the cooling water system is 3.13km^2 for grey seal and their prey, based on maximum potential TRO impact area, which is larger than the predicted maximum surface area for a 2^{o}C rise in temperature (2.41km^2; table 8-41 and table 8-44). The number of grey seal that could be present in the maximum potential impact area (3.13km^2) is up to two individuals, which represents 0.3% of the reference population

8.8.49 None of the projects (table 8-81) currently included in the in-combination assessment for changes in marine water quality during operation of the Project, have the potential for any in-combination effects on grey seal, including prey species, at the SACs, based on currently available information (table 8-81). Therefore, there is no potential for an adverse effect on the integrity of these SACs in relation to their conservation objectives for grey seal as a result of in-combination effects of changes to marine water quality during construction.

D Alteration of coastal processes and hydrodynamics

D1 Potential effect on habitat for prey species

8.8.50 The coastal processes assessment concludes that there is no potential for any alteration of intertidal or subtidal habitats and, consequently, no significant effect on prey species for marine mammals is predicted. As a worst case, a localised change in habitat within the Wylfa Newydd Development Area is assumed. This area coincides with area assessed for any change and/or loss of habitat and, therefore, has not been assessed here to avoid double counting of the potential effect.

8.8.51 None of the projects currently included in the in-combination assessment for any alteration of coastal processes and hydrodynamics have the potential for any in-combination effects (table 8-82). Therefore, there is no potential for an adverse effect on the integrity of the SACs in relation to their conservation objectives for grey seal as a result of in-combination effects arising from any alteration of coastal processes and hydrodynamics on prey species.

E Physical interaction between species and Project infrastructure

E1 Vessel collision risk

8.8.52 The potential for in-combination effects for vessel collision risk (table 8-83) are currently unknown. However, it is highly unlikely that grey seal would experience a significantly increased collision risk with vessels as a result of these projects, especially taking into account that any animals in the area will be habituated to the presence of vessels and able to detect and avoid vessels. As a result, any potential increased collision risk as a result of in-combination effects are unlikely to result in an adverse effect on the integrity of the SACs in relation to their conservation objectives for grey seal.

Table 8-79 Assessment of potential for any in-combination effects of underwater noise at the Pen Llyn a'r Sarnau/Llŷn Peninsula and the Sarnau SAC and other SACs for grey seal during the marine construction works and operation

In-combination assessment	Potential sources of underwater noise during marine construction works	Potential to adversely affect the integrity of the site	
		Auditory Injury (PTS)	Behavioural Response / Disturbance
The Project	Potential sources of underwater noise at the Wylfa Newydd Development Area and Disposal Site are: • drilling; • rock cutting; • rock breaking; • dredging; • disposal of material; and • vessels.	The maximum predicted range for PTS is 450m as a result of rock breaking, which has the potential to effect 0.15 grey seal (0.0025% of the reference population). The maximum predicted range for PTS at the Disposal Site is 5m, which has the potential to effect 0.00001 grey seal (<0.00001% of the reference population). *Taking into account proposed mitigation would reduce the risk of any auditory injury. Therefore there is no potential for any in-combination effects to adversely affect the integrity of the site.*	During construction, the maximum number of grey seal that could be temporarily disturbed as a result of underwater noise at the Wylfa Newydd Development Area and Disposal Site, and from vessels, would be up to a maximum of 14.5 individuals (up to 0.24% of the reference population). *Therefore there is no potential to adversely affect the integrity of the site.*
	Potential noise sources during operation are: • maintenance dredging; • vessel movements; and • AFDs.	*There is no potential risk of any auditory injury.* *Therefore there is no potential for any in-combination effects to adversely affect the integrity of the site.*	There is no potential for any significant impacts due to underwater noise from maintenance dredging and vessel movements during operation. *Therefore there is no potential to adversely affect the integrity of the site.*
Afon Dysynni outfall gravel removal and relocation	Removal of accumulated stone river channel material via excavation and deposit of material on right river bank on the north shore. Potential sources of noise include dredging and vessels.	There would be no potential for any auditory injury from vessel or dredging noise. *Therefore there is no potential for any in-combination effects to adversely affect the integrity of the sites.*	The potential for any disturbance as a result of underwater noise from vessels and dredging is likely to be limited to the area around the vessels and within the dredge area, therefore the potential for any significant disturbance and in-combination effects will be very low. *Based on available information, there is no potential for any in-combination effects to*

In-combination assessment	Potential sources of underwater noise during marine construction works	Potential to adversely affect the integrity of the site	
		Auditory Injury (PTS)	**Behavioural Response / Disturbance**
			adversely affect the integrity of the sites.
Wylfa Decommissioning	Same as assessment in **table 8-55** and **table 8-56** for Gogledd Môn Forol/North Anglesey Marine cSAC. *There is no potential for any in-combination effects to adversely affect the integrity of the sites.*		
Minesto Holyhead Deep 10 MW Tidal Kite	Foundation options for the 160 0.5MW DGU units that are being considered include 4m monopile fixed to the seabed either using piling hammers, or drilling and grouting it into position, or a combination of these two approaches [RD214]. The other installation methods that are being considered include floating GBS and mud mat foundation [RD214]. Other noise sources will include vessels, cable laying and construction of offshore substation. [RD214] proposes to develop the Array Project in three phases as part of a deploy-and-monitor approach, which will allow verification of predictions made in the EIA, and confirm that mitigation strategies are working effectively.	The ES found no risk of auditory injury from vessels and drilling / vibro-hammering noise [RD212]. *Therefore there is no potential for any in-combination effects to adversely affect the integrity of the site.*	The noise modelling indicated, using a very precautionary approach that disturbance zones could extend out to 4,000m for the quieter vessels and out to a maximum of 14,000m for the louder vessels [RD212]. The ES concluded that, whilst a small number of individual animals may exhibit some form of change in behaviour for the period in which they encounter sound from the installation or support vessels, this number is likely to be small and the main noise sources present for such a short time that any changes would likely be undetectable against natural variation and would have no residual impact at the population level [RD212]. The noise modelling for drilling activity indicated that disturbance zones could extend out to 375m for pile drilling and out to a maximum of 10,000m for the vibro-hammering. For the installation of one DGU piling activities are likely to be limited to approximately 5 days, the ES concluded that there is likely to be very limited interaction between the piling noise and mammals; any changes would likely be

In-combination assessment	Potential sources of underwater noise during marine construction works	Potential to adversely affect the integrity of the site	
		Auditory Injury (PTS)	Behavioural Response / Disturbance
			undetectable against natural variation and would have no residual impact at the population level [RD212]. *This will have to be assessed further of the Phased development and installation of 160 devices.* *However, based on the maximum predicted impact range, the potential impact area is 314km^2, which could affect 41 grey seal (0.7% of MU; based on single not concurrent installation and the density estimate of 0.13/km^2 – see chapter 6). It should be noted, that this is not assessed in-combination with disturbance from vessels outlined above as both would be in the same area at the same time, with overlapping impact areas.* *Therefore, further assessment is required by Minesto to determine the potential to adversely affect the integrity of the site.* As a result of an absence of detailed project information, no in-combination assessment can be carried out.
Menter Môn (Morlais) West Anglesey Marine Energy Demonstration Zone	No details are currently available on if there will be the potential for any underwater noise and what the sources might be during the Project marine construction works, however as a worst-case scenario they have been assumed to the same / similar to the Minesto Holyhead	It is assumed that the potential for any auditory injury would be mitigated. *Therefore there is no potential for any in-combination effects to adversely affect the integrity of the site.*	*As assessed for the Minesto Holyhead Deep tidal array, e.g. the potential impact area could be 314km^2, which could affect 41 grey seal (0.7% of MU; based on single not concurrent installation and the density estimate of 0.13/km^2 – see chapter 6).* *Therefore, further assessment is required*

In-combination assessment	Potential sources of underwater noise during marine construction works	Potential to adversely affect the integrity of the site	
		Auditory Injury (PTS)	**Behavioural Response / Disturbance**
	Deep tidal array. The Morlais Project capacity may be up to, but will not exceed 100W. A number of TEC are being considered. Seabed mounted devices could be fixed using several different methods. The type of installation vessel will vary depending on the needs of the foundation, but would typically require a heavy lift crane barge or jack-up barge vessel [RD217].		*by Morlais to determine the potential to adversely affect the integrity of the site.* As a result of an absence of detailed project information, no in-combination assessment can be carried out.
Swansea Bay Tidal Lagoon	Same as assessment in table 8-63 for harbour porpoise cSACs		
Cardiff Tidal Lagoon	Same as assessment in table 8-63 for harbour porpoise cSACs		
North West Coast Connections Project	Same as assessment in table 8-55 and table 8-56 for Gogledd Môn Forol/North Anglesey Marine cSAC		
NuGen Moorside Project in West Cumbria	Same as assessment in table 8-55 and table 8-56 for Gogledd Môn Forol/North Anglesey Marine cSAC		
Milford Haven, Maintenance Dredge Pembrokeshire	Same as assessment in table 8-63 for harbour porpoise cSACs		
Alexandra Basin Redevelopment Project	Extension of infrastructure to open up Dublin Port to larger cruise and cargo ships. The port will dredge the river Liffey to increase the depth of its berths and the entrance channel. There is the potential for increased underwater noise from vessels and	There would be no potential for any auditory injury from vessel or dredging noise. *Therefore there is no potential for any in-combination effects to adversely affect the integrity of the sites.*	The potential for any disturbance as a result of underwater noise from vessels and dredging is likely to be limited to the area around the vessels and within the dredge area, therefore the potential for any significant disturbance and in-combination effects will be very low.

In-combination assessment	Potential sources of underwater noise during marine construction works	Potential to adversely affect the integrity of the site	
		Auditory Injury (PTS)	Behavioural Response / Disturbance
	dredging activity.		*Therefore, based on available information, there is no potential for any in-combination effects to adversely affect the integrity of the sites.*
New Cruise Berth For Large Cruise Ships at Dun Laoghaire Harbour	Potential sources of underwater noise include piling, dredging, general construction activity and vessels.	It is assumed that the potential for any auditory injury would be mitigated. *Therefore there is no potential for any in-combination effects to adversely affect the integrity of the sites.*	The potential for disturbance as a result of underwater noise from piling, dredging, general construction activity and vessels is likely to be limited to the development area, therefore the potential for any significant disturbance and in-combination effects will be very low. *Therefore, based on available information, there is no potential for any in-combination effects to adversely affect the integrity of the sites.*

Table 8-80 Assessment of potential in-combination effects of any change or loss of habitat at the Pen Llyn a'r Sarnau/Llŷn Peninsula and the Sarnau SAC and other SAC for grey seal

In-combination assessment	Potential for land take, including seabed or intertidal land	Potential to adversely affect the integrity of the site
The Project	During construction and operation, based on a precautionary approach, it has been assumed that the marine area of the Wylfa Newydd Development Area (approximately 0.35km^2) and the Disposal Site including a 100m buffer (approximately 0.65km^2), could experience a potential change or loss of habitat.	A total of 0.16 grey seal could be affected by any loss of or changes in habitat at the Wylfa Newydd Development Area and Disposal Site, this represents up to 0.003% of the reference population. *Therefore there is no potential to adversely affect the integrity of the site.*
Minesto Holyhead Deep 10 MW Tidal Kite	The 9.1km^2 area could accommodate an array of up to 80 MW (160 0.5 MW DGUs).	The 9.1km^2 area this could potentially effect up to 1.2 grey seal (0.02% of the reference population, based on maximum

In-combination assessment	Potential for land take, including seabed or intertidal land	Potential to adversely affect the integrity of the site
	Minesto is collaborating with Morlais to jointly develop grid and cable infrastructure, which will help minimise the combined environmental footprint of the two projects [RD214].	density estimate of 0.13 / km^2 (see Chapter 6)). *Therefore there is no potential to adversely affect the integrity of the site.*
Menter Môn (Morlais) West Anglesey Marine Energy Demonstration Zone	The Morlais Project will be located in the West Anglesey Demonstration Zone (WADZ) an area of 37km^2.	The exact area of the Morlais project is currently unknown. However the WADZ area of 37km^2 could potentially effect up to 5 grey seal (0.08% of the reference population, based on maximum density estimate of 0.13/km^2 (see chapter 6)) *Therefore there is no potential to adversely affect the integrity of the site.*
Swansea Bay Tidal Lagoon	Same as assessment in table 8-64 for harbour porpoise cSACs	
Cardiff Tidal Lagoon	Same as assessment in table 8-64 for harbour porpoise cSACs	
North West Coast Connections Project	Same as assessment in table 8-57 for Gogledd Môn Forol/North Anglesey Marine cSAC	
NuGen Moorside Project in West Cumbria	Same as assessment in table 8-57 for Gogledd Môn Forol/North Anglesey Marine cSAC	

Table 8-81 Assessment of potential in-combination effects of any changes in marine water quality at the Pen Llyn a'r Sarnau/Llŷn Peninsula and the Sarnau SAC and other SAC for grey seal

In-combination assessment	Potential for changes in marine water quality	Potential to adversely affect the integrity of the site
The Project	Increase in suspended sediment input and change in chemical quality due to discharge from fluvial sources and sewage during construction	The total number of grey seal that could be present in the Wylfa Newydd Development Area is 0.08 individuals, this represents up to 0.001% of the reference population. *Therefore there is no potential to adversely affect the integrity of the site.*
	Increase in suspended sediment concentration and contaminant re-mobilisation during dredging and disposal during construction	The total number of grey seal that could be present in the Wylfa Newydd Development Area and Disposal Site with 100m buffer and could be potentially affected by any increases in suspended sediment concentration is 0.16 individuals, this

In-combination assessment	Potential for changes in marine water quality	Potential to adversely affect the integrity of the site
		represents up to 0.003% of the reference population. *Therefore there is no potential to adversely affect the integrity of the site.*
	Discharge from the cooling water system during operation - change in water temperature	The number of grey seal that could be present in the maximum predicted surface area for a 2^{o}C rise in temperature (2.41km^{2}) has been estimated as up to one individual, which represents up to 0.02% of the reference population. *Therefore there is no potential to adversely affect the integrity of the site.*
	Discharge from the cooling water system during operation - Total Residual Oxidants	The number of grey seal that could be present in the maximum potential TRO impact area (3.13km^{2}) is up to two individuals, which represents 0.3% of the reference population. *Therefore there is no potential to adversely affect the integrity of the site.*
Afon Dysynni outfall gravel removal and relocation	There is the potential for increase in suspended sediment concentration and contaminant re-mobilisation during dredging.	Any increase in turbidity or suspended sediment levels is expected to be temporally and spatially restricted. If there is the potential for any contaminant re-mobilisation it is anticipated that mitigation measures would be required. *Therefore, based on available information, there is no potential for any in-combination effects to adversely affect the integrity of the site.*
Alexandra Basin Redevelopment Project	There is the potential for increase in suspended sediment concentration and contaminant re-mobilisation during dredging.	Any increase in turbidity or suspended sediment levels is expected to be temporally and spatially restricted. If there is the potential for any contaminant re-mobilisation it is anticipated that mitigation measures would be required. *Therefore, based on available information, there is no potential for any in-combination effects to adversely affect the integrity of the site.*
New Cruise Berth For Large Cruise Ships at Dun Laoghaire	There is the potential for increase in suspended sediment concentration and contaminant re-	Any increase in turbidity or suspended sediment levels is expected to be temporally and spatially restricted.

In-combination assessment	Potential for changes in marine water quality	Potential to adversely affect the integrity of the site
Harbour	mobilisation during dredging.	If there is the potential for any contaminant re-mobilisation it is anticipated that mitigation measures would be required. *Therefore, based on available information, there is no potential for any in-combination effects to adversely affect the integrity of the site.*
Milford Haven, Maintenance Dredge Pembrokeshire	Same as assessment in table 8-65 for harbour porpoise cSACs. *There is no potential for any in-combination effects to adversely affect the integrity of the sites.*	
Wylfa Decommissioning	Same as assessment in table 8-58 for Gogledd Môn Forol/North Anglesey Marine cSAC. *There is no potential for any in-combination effects to adversely affect the integrity of the sites.*	
Minesto Holyhead Deep 10 MW Tidal Kite	Same as assessment in table 8-58 for Gogledd Môn Forol/North Anglesey Marine cSAC. *There is no potential for any in-combination effects to adversely affect the integrity of the sites.*	
Menter Môn (Morlais) West Anglesey Marine Energy Demonstration Zone	Same as assessment in table 8-58 for Gogledd Môn Forol/North Anglesey Marine cSAC. *There is no potential for any in-combination effects to adversely affect the integrity of the sites.*	
Swansea Bay Tidal Lagoon	Same as assessment in table 8-65 for harbour porpoise cSACs. *There is no potential for any in-combination effects to adversely affect the integrity of the sites.*	
Cardiff Tidal Lagoon	Same as assessment in table 8-65 for harbour porpoise cSACs. *There is no potential for any in-combination effects to adversely affect the integrity of the sites.*	
North West Coast Connections Project	Same as assessment in table 8-58 for Gogledd Môn Forol/North Anglesey Marine cSAC. *There is no potential for any in-combination effects to adversely affect the integrity of the sites.*	
NuGen Moorside Project in West Cumbria	Same as assessment in table 8-58 for Gogledd Môn Forol/North Anglesey Marine cSAC. *There is no potential for any in-combination effects to adversely affect the integrity of the sites.*	

Table 8-82 Assessment of potential in-combination effects of any alteration of coastal processes and hydrodynamics on prey species at the Pen Llyn a'r Sarnau/Llŷn Peninsula and the Sarnau SAC and other SAC for grey seal

In-combination assessment	Potential effects of any alteration of coastal processes and hydrodynamics on prey species	Potential to adversely affect the integrity of the site
The Project	See table 8-59 for Gogledd Môn Forol/North Anglesey Marine cSAC in-combination assessment. *Therefore there is no potential to adversely affect the integrity of the site.*	
Swansea Bay Tidal Lagoon	Same as assessment in table 8-66 for harbour porpoise cSACs. *There is no potential for any in-combination effects to adversely affect the integrity of the sites.*	
Cardiff Tidal Lagoon	Same as assessment in table 8-66 for harbour porpoise cSACs. *There is no potential for any in-combination effects to adversely affect the integrity of the sites.*	
North West Coast Connections Project	Same as assessment in table 8-59 for Gogledd Môn Forol/North Anglesey Marine cSAC. *There is no potential for any in-combination effects to adversely affect the integrity of the sites.*	
NuGen Moorside Project in West Cumbria	Same as assessment in table 8-59 for Gogledd Môn Forol/North Anglesey Marine cSAC. *There is no potential for any in-combination effects to adversely affect the integrity of the sites.*	

Table 8-83 Assessment of potential in-combination effects of any physical interaction with project infrastructure and vessels at the Pen Llyn a'r Sarnau/Llŷn Peninsula and the Sarnau SAC and other SAC for grey seal

In-combination assessment	Potential for physical interaction with project infrastructure and vessels	Potential to adversely affect the integrity of the site
The Project	Vessel collision risk	The number of grey seal that could be at increased risk of collision with vessels all vessels during construction and operation within the Wylfa Newydd Development Area, the Disposal Site plus 100m buffer and the 1km wide vessel route between the two sites, is estimated to be 0.3 individuals (0.005% of reference population) based on a precautionary 95% avoidance rate.
	Project infrastructure	Therefore there is no potential to adversely affect the integrity of the site.
Afon Dysynni outfall gravel removal and relocation	There could be the potential for increased vessel movements.	No direct impacts on grey seal as a result of project infrastructure. However, the loss of prey due to impingement and entrainment could potentially affect up to 1.5 grey seal (less than 0.025% of the reference population) per year. However,

In-combination assessment	Potential for physical interaction with project infrastructure and vessels	Potential to adversely affect the integrity of the site
		individuals would still be able to source prey from nearby areas.
Alexandra Basin Redevelopment Project	There could be the potential for increased vessel movements.	Therefore there is no potential to adversely affect the integrity of the site.
New Cruise Berth For Large Cruise Ships at Dun Laoghaire Harbour	There could be the potential for increased vessel movements.	The potential for any physical interaction with vessels as a result of this project is currently unknown. However, any increase risk for collision risk with vessels is expected to be temporally and spatially restricted.
Milford Haven, Maintenance Dredge Pembrokeshire	There could be the potential for increased vessel movements.	Therefore, based on available information, there is limited potential for any in-combination effects to adversely affect the integrity of the sites.
Wylfa Decommissioning	Same as assessment in table 8-60 for Gogledd Môn Forol/North Anglesey Marine cSAC. *There is no potential for any in-combination effects to adversely affect the integrity of the sites.*	
Minesto Holyhead Deep 10 MW Tidal Kite	Same as assessment in table 8-60 for Gogledd Môn Forol/North Anglesey Marine cSAC.	
Menter Môn (Morlais) West Anglesey Marine Energy Demonstration Zone	Same as assessment in table 8-60 for Gogledd Môn Forol/North Anglesey Marine cSAC.	
Swansea Bay Tidal Lagoon	Same as assessment in table 8-67 for harbour porpoise cSACs.	
Cardiff Tidal Lagoon	Same as assessment in table 8-67 for harbour porpoise cSACs.	
North West Coast Connections Project	Same as assessment in table 8-58 for Gogledd Môn Forol/North Anglesey Marine cSAC.	
NuGen Moorside Project in West Cumbria	Same as assessment in table 8-58 for Gogledd Môn Forol North Anglesey Marine cSAC.	

E2 Project infrastructure

8.8.53 The potential for in-combination effects for any physical interaction between grey seal and project infrastructure (table 8-83) is currently unknown. However, it should be noted that there is no potential for any direct physical interaction between grey seal and the Project infrastructure. In addition, if any project alone is likely to have a significant effect on grey seal as a result of physical interaction with the infrastructure, for example at the proposed tidal developments, then mitigation and monitoring would be required at these sites to reduce the risk.

8.8.54 As a result, any potential for physical interaction with project infrastructure as a result of in-combination effects should be unlikely to result in an adverse effect on the integrity of the SACs in relation to their conservation objectives for grey seal.

Conclusions for the Pen Llyn a'r Sarnau Llŷn Peninsula and the Sarnau SAC for grey seal

Alone

8.8.55 In conclusion, there is no potential for any adverse effect on the integrity of the Pen Llyn a'r Sarnau/Llŷn Peninsula and the Sarnau SAC from the Project alone during construction and operation in relation to the conservation objectives for grey seal (table 8-84).

Table 8-84 Summary of the assessment of the potential effects on the Pen Llyn a'r Sarnau/Llŷn Peninsula and the Sarnau SAC in relation to the conservation objectives for grey seal

Conservation objectives	Changes in visual and acoustic stimuli	Land take, including seabed or intertidal land	Changes in marine water quality	Physical interaction between species and Project infra-structure	Changes in prey resources
The population is maintaining itself on a long-term basis as a viable component of its natural habitat	×	×	×	×	×
The population within the site is such that the natural range of the population is not being reduced or likely to be reduced for the foreseeable future	×	×	×	×	×

Conservation objectives	Changes in visual and acoustic stimuli	Land take, including seabed or intertidal land	Changes in marine water quality	Physical interaction between species and Project infra-structure	Changes in prey resources
The presence, abundance, condition and diversity of habitats and species required to support this species is such that the distribution, abundance and populations dynamics of the species within the site and population beyond the site is stable or increasing	×	×	×	×	×
To maintain at favourable conservation status its long-term population viability, natural range and the structure and function of its habitat within the site	×	×	×	×	×

× = no potential for any adverse effect on the integrity of the site in relation to the conservation objectives

In-combination

8.8.56 In conclusion, based on the information currently available, there is no potential for any adverse effect on the integrity of the Pen Llyn a'r Sarnau/Llŷn Peninsula and the Sarnau SAC from in-combination effects of any land take, including seabed or intertidal land; changes in marine water quality; or changes in prey resources during construction and operation in relation to the conservation objectives for grey seal (table 8-85). There is also unlikely to be any in-combination effects from underwater noise or any physical interaction with project infrastructure or vessels.

Table 8-85 Summary of the in-combination assessment for the Pen Llyn a'r Sarnau/Llŷn Peninsula and the Sarnau SAC in relation to the conservation objectives for grey seal

Conservation objectives	Changes in visual and acoustic stimuli	Land take, including seabed or intertidal land	Changes in marine water quality	Physical interaction between species and Project infra-structure	Changes in prey resources
The population is maintaining itself on a long-term basis as a viable component of its natural habitat	×	×	×	×	×
The population within the site is such that the natural range of the population is not being reduced or likely to be reduced for the foreseeable future	×	×	×	×	×
The presence, abundance, condition and diversity of habitats and species required to support this species is such that the distribution, abundance and populations dynamics of the species within the site and population beyond the site is stable or increasing	×	×	×	×	×
To maintain at favourable conservation status its long-term population viability, natural range and the structure and function of its habitat within the site	×	×	×	×	×

× = no potential for any adverse effect on the integrity of the site in relation to the conservation objectives

8.9 Other European Designated Sites for grey seal

Introduction

8.9.1 Other European Designated Sites 'screened in' for grey seal are:

- Bae Ceredigion/Cardigan Bay SAC.
- Sir Benfro Forol/Pembrokeshire Marine SAC.
- The Maidens SAC (Northern Island).
- Lambay Island SAC (Ireland).
- Saltee Islands SAC (Ireland).

Conservation Objectives

8.9.2 The conservation objectives for the Bae Ceredigion/Cardigan Bay SAC [RD55] for grey seal are set out in section 8.7 (combined with those for bottlenose dolphin).

8.9.3 The conservation objectives for Sir Benfro Forol/Pembrokeshire Marine SAC [RD54] for grey seal are:

- To maintain at favourable conservation status its long-term population viability, natural range and the structure and function of its habitat within the site. This means that:
  - The population is maintaining itself on a long-term basis as a viable component of its natural habitat. Important elements are population size, structure, production, and condition of the species within the site.
- As part of this objective it should be noted that:
  - contaminant burdens derived from human activity are below levels that may cause physiological damage, or immune or reproductive suppression.
- Populations should not be reduced as a consequence of human activity.
- The species population within the site is such that the natural range of the population is not being reduced or likely to be reduced for the foreseeable future.
- As part of this objective it should be noted that for grey seal:
  - their range within the SAC and adjacent inter-connected areas is not constrained or hindered;
  - there are appropriate and sufficient food resources within the SAC and beyond; and
  - the sites and amount of supporting habitat used by these species are accessible and their extent and quality is stable or increasing.

- The presence, abundance, condition and diversity of habitats and species required to support this species is such that the distribution, abundance and populations dynamics of the species within the site and population beyond the site is stable or increasing. Important considerations include:
  - distribution;
  - extent;
  - structure;
  - function and quality of habitat; and
  - prey availability and quality.
- As part of this objective it should be noted that:
  - The abundance of prey species subject to existing commercial fisheries needs to be equal to or greater than that required to achieve maximum sustainable yield and secure in the long term.
  - The management and control of activities or operations likely to adversely affect the species feature is appropriate for maintaining it in favourable condition and is secure in the long term.
  - Contamination of potential prey species should be below concentrations potentially harmful to their physiological health.
  - Disturbance by human activity is below levels that suppress reproductive success, physiological health or long-term behaviour.

8.9.4 The conservation objectives for The Maidens SAC [RD69] for grey seal are:

- To maintain (or restore where appropriate) the grey seal *Halichoerus grypus* to favourable condition.
- To maintain (and if feasible enhance) population numbers and the distribution of grey seal.
- To maintain and enhance, as appropriate, physical features used by grey seal within the site.

8.9.5 The conservation objectives for the Lambay Island SAC [RD225] for grey seal and harbour seal are:

- To maintain the favourable conservation condition of grey seal and harbour seal in Lambay Island SAC by:
  - species range within the site should not be restricted by artificial barriers to site use;
  - the breeding sites should be maintained in a natural condition;
  - the moult haul-out sites should be maintained in a natural condition;
  - the resting haul-out sites should be maintained in a natural condition; and
  - human activities should occur at levels that do not adversely affect the grey seal population at the site.

8.9.6 The conservation objective for the Saltee Islands SAC [RD220] for grey seal is also:

- To maintain the favourable conservation condition of grey seal in the Saltee Islands SAC, which is defined by the following list of attributes and targets:
  - species range within the site should not be restricted by artificial barriers to site use;
  - the breeding sites should be maintained in a natural condition;
  - the moult haul-out sites should be maintained in a natural condition;
  - the resting haul-out sites should be maintained in a natural condition;
  - the grey seal population occurring within this site should contain adult, juvenile and pup cohorts annually; and
  - human activities should occur at levels that do not adversely affect the grey seal population.

Assessment

8.9.7 The assessment of the Pen Llyn a'r Sarnau/Llŷn Peninsula and the Sarnau SAC set out above for grey seal is based on South and West England and Wales MU. Bae Ceredigion/Cardigan Bay SAC and Sir Benfro Forol/ Pembrokeshire Marine SAC are also located within the MU, therefore, the assessment and conclusions for the Pen Llyn a'r Sarnau/Llŷn Peninsula and the Sarnau SAC will be the same for the other European Designated Sites screened in for grey seal.

8.9.8 The other European Designated Sites screened in for grey seal are located out with the reference MU, however, the assessment and conclusions based for the Pen Llyn a'r Sarnau/Llŷn Peninsula and the Sarnau SAC will apply to the same extent or less for these sites, taking into account the larger MU for the wider area and the distance between the designated sites and the Project.

8.9.9 However, the potential effects of the Project alone on the integrity of each of the SACs have been assessed in relation to their conservation objectives (table 8-86).

In-combination

8.9.10 The in-combination assessment for the Pen Llyn a'r Sarnau/Llŷn Peninsula and the Sarnau SAC set out above for grey seal is based on South and West England and Wales MU. Therefore all projects, including those near the Bae Ceredigion/Cardigan Bay SAC, Sir Benfro Forol/Pembrokeshire Marine SAC, The Maidens SAC (Northern Island), Lambay Island SAC (Ireland) and Saltee Islands SAC (Ireland) have been assessed in-combination, as a worst-case scenario for the Pen Llyn a'r Sarnau/Llŷn Peninsula and the Sarnau SAC.

8.9.11 However, the potential for any in-combination effects on the integrity of each of the SACs have been assessed in relation to their conservation objectives (table 8-86).

Conclusions for the other SACs for grey seal

Alone and in-combination

8.9.12 In conclusion, there is no potential for any adverse effect on the integrity of the Bae Ceredigion/Cardigan Bay SAC, Sir Benfro Forol/Pembrokeshire Marine SAC, The Maidens SAC (Northern Island), Lambay Island SAC (Ireland) or Saltee Islands SAC (Ireland) from the Project alone during construction and operation in relation to the conservation objectives for grey seal (table 8-86).

8.9.13 There is also no potential for any adverse effect on the integrity of the Bae Ceredigion/Cardigan Bay SAC, Sir Benfro Forol/Pembrokeshire Marine SAC, The Maidens SAC (Northern Island), Lambay Island SAC (Ireland) or Saltee Islands SAC (Ireland) from in-combination effects of any land take, including seabed or intertidal land; changes in marine water quality; or changes in prey resources during construction and operation in relation to the conservation objectives for grey seal (table 8-86). There is also unlikely to be any in-combination effects from underwater noise or any physical interaction with project infrastructure or vessels.

Table 8-86 Summary of the assessment of the potential alone and in-combination effects on the other SACs in relation to the conservation objectives for grey seal

Conservation objectives	Changes in visual and acoustic stimuli	Land take, including seabed or intertidal land	Changes in marine water quality	Physical interaction between species and Project infra-structure	Changes in prey resources	In-combination
Bae Ceredigion / Cardigan Bay SAC and Sir Benfro Forol / Pembrokeshire Marine SAC						
To maintain at favourable conservation status its long-term population viability, natural range and the structure and function of its habitat within the site	×	×	×	×	×	×
Populations should not be reduced as a consequence of human activity.	×	×	×	×	×	×

Conservation objectives	Changes in visual and acoustic stimuli	Land take, including seabed or intertidal land	Changes in marine water quality	Physical interaction between species and Project infra-structure	Changes in prey resources	In-combination
The species population within the site is such that the natural range of the population is not being reduced or likely to be reduced for the foreseeable future	×	×	×	×	×	×
The presence, abundance, condition and diversity of habitats and species required to support this species is such that the distribution, abundance and populations dynamics of the species within the site and population beyond the site is stable or increasing	×	×	×	×	×	×
The Maidens SAC						
To maintain (or restore where appropriate) the grey seal to favourable condition.	×	×	×	×	×	×
To maintain (and if feasible enhance) population numbers and the distribution of grey seal.	×	×	×	×	×	×
To maintain and enhance, as appropriate, physical features used by grey seal within the site	×	×	×	×	×	×

Conservation objectives	Changes in visual and acoustic stimuli	Land take, including seabed or intertidal land	Changes in marine water quality	Physical interaction between species and Project infra-structure	Changes in prey resources	In-combination
Lambay Island SAC and Saltee Islands SAC						
Species range within the site should not be restricted by artificial barriers to site use	×	×	×	×	×	×
The breeding sites should be maintained in a natural condition	×	×	×	×	×	×
The moult haul-out sites should be maintained in a natural condition	×	×	×	×	×	×
The resting haul-out sites should be maintained in a natural condition	×	×	×	×	×	×
Human activities should occur at levels that do not adversely affect the grey seal population at the site.	×	×	×	×	×	×

× = no potential for any adverse effect on the integrity of the site in relation to the conservation objectives

8.10 European Designated Sites for harbour seal (*Phoca vitulina*)

Introduction

8.10.1 European Designated Sites 'screened in' for harbour seal were:

- Murlough SAC (Northern Ireland).
- Strangford Lough SAC (Northern Ireland).
- Lambay Island SAC (Ireland).
- Slaney River Valley SAC (Ireland).

Conservation Objectives

8.10.2 The conservation objectives for the Murlough SAC [RD70] for harbour seal are:

- To maintain (or restore where appropriate) the harbour seal to favourable condition.
- To maintain (and if feasible enhance) population numbers and distribution of harbour seal.
- To maintain and enhance, as appropriate, physical features used by harbour seals within the site.

8.10.3 The conservation objectives for Strangford Lough SAC [RD71] for harbour seal is:

- To maintain the population of harbour seal in favourable condition, allowing for natural change.
- The following targets are associated with this objective:
  - The number of adults to be at least 200 individuals.
  - Number of pups to be at least 25% of the population.
  - Resident time to be at least 3 weeks.
  - Maintain the number of suitable sites for moulting, haul-out and breeding.

8.10.4 The conservation objectives for the Lambay Island SAC [RD225] for grey seal are set out in section 8.9 above and are the same for both harbour seal and grey seal.

8.10.5 The conservation objective for the Slaney River Valley SAC [RD221] for harbour seal is also:

- To maintain the favourable conservation condition of harbour seal in the Slaney River Valley SAC, which is defined by the following list of attributes and targets:
  - species range within the site should not be restricted by artificial barriers to site use;
  - the breeding sites should be maintained in a natural condition;
  - the moult haul-out sites should be maintained in a natural condition;
  - the resting haul-out sites should be maintained in a natural condition; and,
  - human activities should occur at levels that do not adversely affect the harbour seal population at the site.

Assessment

8.10.6 Taking into account the location of the SACs for harbour seal in relation to the Project and the similarity in the Conservation Objectives of the SACs for harbour seal, the potential effects of the Project on these sites have been assessed together.

8.10.7 As a very precautionary approach, the potential effects have been assessed based on the West England and Wales MU (approximately 50 individuals;

[RD316]), however, the number of harbour seal present in the Celtic and Irish Sea area is a lot greater, for example, the most recent count for Northern Ireland was 948 individuals [RD317].

8.10.8 It should be noted that due to the very low numbers of (non-breeding) harbour seal in the area, the reference population of approximately 50 individuals is correspondingly low. As a result it is highly unlikely that any harbour seals would be affected by the Project.

A Changes in visual and acoustic stimuli

Construction

A1 Underwater noise during marine construction works [Marine Licence]

8.10.9 As set out above, the underwater noise modelling undertaken for the Project indicates that there is no potential risk of physical injury as a result of underwater noise from any of the activities during construction.

8.10.10 The maximum predicted range for PTS is 450m as a result of rock breaking at the Wylfa Newydd Development Area (table 8-30), which has the potential to effect 0.0005 harbour seal (0.001% of the reference population; table 8-35). However, mitigation measures would reduce the risk of auditory injury in marine mammals (see section 8.5).

8.10.11 The maximum predicted range for disturbance is 5.9km for harbour seal as a result of concurrent drilling at the Wylfa Newydd Development Area (table 8-30), which has the potential to effect 0.05 harbour seal (0.1% of the reference population; table 8-35).

8.10.12 At the Disposal Site, the maximum predicted range for PTS is 5m (table 8-30), which has the potential to effect <0.00001 harbour seal (<0.00001% of the reference population; table 8-35). The maximum predicted range for disturbance is 500m (table 8-30), which has the potential to effect 0.0005 harbour seal (0.001% of the reference population; table 8-35).

8.10.13 Along the vessel route between the Wylfa Newydd Development Area and Disposal Site, the maximum number of harbour seal that potentially could be disturbed is 0.03 individuals (up to 0.06% of the reference population; table 8-36). Taking into account the temporary nature of underwater noise and the very precautionary approach to the assessment, it is highly unlikely that this percentage of harbour seal from the reference population actually would be disturbed. The noise modelling indicates that the range of disturbance around vessels for harbour seal is less than 1m. Taking into account the peak number of vessels on site is predicted to average approximately 15 per week over a three month period and the existing baseline of up to 25 vessels per week for the area (Application Reference Number: 6.4.13). The maximum potentially be disturbed is less than 0.00008 (0.0002% of the reference population).

8.10.14 Therefore, during construction, the maximum number of harbour seal that potentially could be disturbed as a result of underwater noise at the Wylfa Newydd Development Area and Disposal Site, and along the vessel route, could be 0.05 individuals (0.1% of the reference population). However, taking into account the temporary nature of underwater noise, the very precautionary approach to the assessment and the very low numbers of harbour seal in and around the area, it is highly unlikely that this percentage of harbour seal from the reference population actually would be disturbed. Given the distance to the SACs as well, any potential effect from underwater noise during construction is highly unlikely to result in an adverse effect on the integrity of the sites in relation to their conservation objectives for harbour seal.

A2 Airborne noise during construction [Marine Licence]

8.10.15 Taking into account the requirements to ensure the protection of human receptors and the distance to known seal haul-out sites (approximately 2km) and the distance to the nearest European Designated Sites for harbour seal, the potential for any significant impacts is highly unlikely. Although harbour seal could haul-out along the coastline, only individuals or small groups would be expected and the likelihood of them occurring within 500m of the marine works in the Wylfa Newydd Development Area is extremely low. Therefore, although airborne noise has the potential to temporally disturb a relatively small number of seals at haul-out sites in the vicinity of the Wylfa Newydd Development Area, any population effects are highly unlikely and any potential effect during construction is highly unlikely to result in an adverse effect on the integrity of this site in relation to its conservation objectives for harbour seal.

A3 Visual stimuli [Marine Licence]

8.10.16 The likelihood of harbour seals hauling-out within the immediate vicinity of the Wylfa Newydd Development Area (i.e. within 500m) is considered extremely low. Visual disturbance due to the presence of human activity is therefore considered to be negligible. Therefore the effect on any harbour seals from visual disturbance is also negligible.

8.10.17 The nearest haul-out used by seals is approximately 2km from the development site, therefore, although unfamiliar visual stimuli (e.g. temporary infrastructure, machinery and people) or changes in lighting levels has the potential to temporally disturb a relatively small number of seals at haul-out sites in the vicinity of the Project, the potential for any population effects or any adverse effects on the site integrity of any European Designated Sites, is highly unlikely.

8.10.18 Therefore, any potential direct or indirect effect on marine mammals, including seals at haul-out sites, as a result of unfamiliar visual stimuli (e.g. temporary infrastructure, machinery and people) or changes in lighting levels are unlikely to be significant and highly unlikely to result in an adverse effect on the integrity of this site in relation to its conservation objectives for harbour seal.

Operation

A4 Underwater noise during operation [Operational water discharge EP]

8.10.19 Taking into account the noise modelling for the AFD arrays, the very low numbers of harbour seal in and around the area and the distance to the SACs, any potential effects would not result in an adverse effect on the integrity of Murlough SAC, Strangford Lough SAC, Lambay Island SAC or Slaney River Valley SAC in relation to their conservation objectives for harbour seal.

B Land take, including seabed or intertidal land

Construction and operation

B1 Change and/or loss of habitat [Marine Licence]

8.10.20 Based on a very precautionary approach it has been assumed that the marine area of the Wylfa Newydd Development Area (approximately 0.35km^2) and the area of the Disposal Site plus 100m buffer (approximately 0.651km^2) could experience a potential change to or loss of habitat.

8.10.21 The number of harbour seal that could be present is 0.0003 individuals and 0.0005 individuals in the Wylfa Newydd Development Area area and in the Disposal Site, respectively (table 8-38), based on the maximum species density estimates for these areas (see chapter 6). Therefore, 0.0008 harbour seal could potentially be affected by any loss or changes of habitat at the Wylfa Newydd Development Area and Disposal Site during construction and operation; this represents 0.002% of the reference population.

8.10.22 Taking into account the very low numbers of harbour seal in and around the area and the distance to the SACs, any potential effects are highly unlikely to result in an adverse effect on the integrity of the sites in relation to their conservation objectives for harbour seal.

C Changes in marine water quality

Construction

C1 Increase in suspended sediment input and change in chemical quality due to discharge from fluvial sources and sewage [Marine Licence, Construction water discharge EP]

8.10.23 The total combined area predicted to be affected by increases suspended sediments from all discharges is 0.245km^2. However, as a precautionary approach, the number of harbour seal that could potentially be present (and percentage of the reference population) in the Wylfa Newydd Development Area (0.35km^2) has been estimated (table 8-39, based on maximum species density estimates for the area). The total number of harbour seal that could be present in the Wylfa Newydd Development Area is 0.0003 individuals (table 8-39), this represents up to 0.0006% of the reference population.

C2 Increase in suspended sediment concentration and contaminant re-mobilisation during dredging and disposal [Marine Licence]

8.10.24 As set out above, the modelling of increases in suspended sediment concentrations during the dredging and disposal of dredged material predicts that the maximum extent of the effect above baseline would be over an area extending 0.245km^2.

8.10.25 As a precautionary approach, the number of harbour seal that could potentially be present (and percentage of the reference population) in the Wylfa Newydd Development Area (0.35km^2) and Disposal Site with 100m buffer (0.651km^2) has been estimated (table 8-39, based on maximum species density estimates for the area). The total number of harbour seal that could be present in the Wylfa Newydd Development Area and Disposal Site with 100m buffer and could be potentially affected by any increases in suspended sediment concentration is 0.0008 individuals (Table 8-31), this represents up to 0.002% of the reference population.

8.10.26 The area in which increased suspended sediment concentrations would be experienced is very small in relation the range of harbour seal and their prey, and any potential effects would be temporary, with dispersion of the suspended sediment to background levels predicted to occur within three hours of a dredging / disposal cycle.

8.10.27 Therefore, taking into account the limited dispersion area and the rapid dispersion and deposition, along with relatively low contaminant levels in the sediments and the very low percentage of harbour seal from the reference population that could be impacted, any potential effect as a result of increases in suspended sediment concentrations from the dredging and disposal of dredged material is highly unlikely to result in an adverse effect on the integrity of these sites in relation to their conservation objectives for harbour seal.

Operation

C3 Discharge from the cooling water system [Operational water discharge EP]

Temperature increase

8.10.28 Any changes or increases in temperature are unlikely to affect harbour seal, as they are well adapted to the changes in water temperature throughout their range.

8.10.29 However, on a very precautionary basis, the number of harbour seal that could be present in the maximum predicted surface area for a 2^{o}C rise in temperature (2.41km^2) has been estimated as less than one individual (0.002), which represents 0.004% of the reference population (table 8-41).

Total Residual Oxidants

8.10.30 There is no predicted potential direct or indirect effects on marine mammals due to TRO from cooling water discharge during operation.

8.10.31 However, as a very precautionary approach, the number of harbour seal that could be present in the maximum potential TRO impact area (3.13km^2) is less than one individual (0.003), which represents 0.006% of the reference population (table 8-44).

Effect on prey species

8.10.32 The potential effect of change in water temperature and TRO on prey species would not extend beyond the maximum predicted effect areas described for harbour seal. Consequently, the approach taken to assessing the effect on the harbour seal population is worst case, and there would be no additional effect as a result of the effects on prey species.

Effect of changes in marine water quality during operation

8.10.33 The area of increased temperature and TRO from the cooling water discharge represents the same area therefore, as a worst-case, the number of harbour seal that could be affected by changes in water temperature and TRO discharges, based on the maximum potential TRO impact area (3.13km^2), would be less than one seal; which represents 0.006% of the reference population.

8.10.34 As described in section 8.3, no significant effect on harbour seal is predicted due to the potential effect of the Project on marine water quality. Given this lack of effect and the very small percentage of the reference population (which is considered insignificant) that could be exposed to the area of predicted change in marine water quality, there is no potential for an effect on harbour seal populations to arise over the operational lifetime of the Project.

8.10.35 Therefore, any potential effect as result of temperature increases and the operational discharge of TRO from the cooling water system is highly unlikely to result in an adverse effect on the integrity of these sites in relation to their conservation objectives for harbour seal.

D Alteration of coastal processes and hydrodynamics

D1 Potential effect on habitat for prey species [Marine Licence]

8.10.36 The coastal processes assessment concludes that there is no potential for any alteration of intertidal or subtidal habitats and, consequently, no significant effect on prey species for marine mammals is predicted. As a worst case, a localised change in habitat within the Wylfa Newydd Development Area is assumed. This area coincides with area assessed for any change and/or loss of habitat (effect B1) and, therefore, has not been assessed here to avoid double counting of the potential effect on marine mammals.

E Physical interactions between species and Project infrastructure

Construction

E1 Vessel collision risk [Marine Licence]

8.10.37 As a precautionary worse-case approach, the number of harbour seal that could be at increased collision with all vessels during construction and operation within the Wylfa Newydd Development Area, the Disposal Site plus 100m buffer (table 8-45) and the vessel route between the two sites, based on a 1km width of vessel route (table 8-46), is estimated to be 0.0015 (0.003% of reference population) based on a precautionary 95% avoidance rate.

8.10.38 However, it is highly unlikely that harbour seal would be at increased collision risk with vessels during construction or operation, especially taking into account the small increase in the number of vessel movements proposed compared to existing vessel movements in the area and the fact that any harbour seal in the area would be habituated to the presence of vessels and able to detect and avoid them. Taking this into account, along with the very low number of harbour seal in the area that could be at increased collision risk with vessels during construction, any potential effect is highly unlikely to result in an adverse effect on the integrity of these sites in relation to their conservation objectives for harbour deal.

Operation

E2 Effect of impingement and entrainment of prey species during operation [Operational water discharge EP]

8.10.39 The potential area of effect for prey species would be confined to the intake structure and the potential zone of influence in which fish could be at risk of has been identified as 50m from the intake. Fish are highly mobile species, with relatively large ranges and are unlikely to be restricted to the immediate area of the cooling water intake. Therefore, the loss of fish is likely to be very small in comparison to natural variation.

8.10.40 The DEA, based on the worst-case scenario and assessment for small grey seal, estimated that the maximum number of harbour seal that could potentially be impact is up to 2.5 individuals, which represents up to 5% of the reference population (50 individuals). However, given the very low number of harbour seal in the area it is highly unlikely that this number of harbour seal could actually be impacted. In addition, it is important to note that this is only potential loss of prey, as individuals would still be able to source prey from nearby areas. In addition, embedded mitigation, including the AFDs and FRR system, would reduce the potential loss of prey species.

8.10.41 Hence any potential effect would not result in an adverse effect on the integrity of the European Designated Sites in relation to the conservation objectives for harbour seal.

In-combination assessment for harbour seal SACs

A Changes in visual and acoustic stimuli

Construction

A1 Underwater noise during marine construction works

8.10.42 The in-combination assessment (table 8-87) indicates that there should be no potential for any auditory injury in harbour seal as appropriate mitigation measures should be undertaken for each project and there would be no cumulative effect with other developments. Therefore, there is no potential to adversely affect the integrity of the sites in view of the conservation objectives.

8.10.43 There is limited detailed information on potential impacts from underwater noise during the Project marine construction works for some of the projects listed in table 8-87.

8.10.44 The in-combination assessment (table 8-87) has determined that there is the potential for disturbance of up to 0.5 harbour seal (1.4% of reference population) if the construction at both the Minesto Holyhead Deep and Menter Môn Morlais tidal developments was at the same time as the Project marine construction works. As these projects are likely to work together to reduce and limit any potential impacts, it would be expected that, if required, mitigation would be put in place to reduce any significant disturbance on marine mammals. Therefore, there is no potential to adversely affect the integrity of the sites in view of the conservation objectives.

Operation

A4 Underwater noise during operation

8.10.45 There is no potential for any significant effects to arise due to underwater noise from maintenance dredging and vessel movements during the Project operation. There is also no potential for any significant effects to arise due to underwater noise from the AFDs on the cooling water intake. Therefore, no adverse effects on the integrity of the SACs for harbour seal in relation to their conservation objectives are predicted.

B Land take, including seabed or intertidal land

B1 Change and/or loss of habitat

8.10.46 For the Project during construction and operation, based on a precautionary approach, it has been assumed that the marine area of the Wylfa Newydd Development Area (approximately 0.35km^2) and of the Disposal Site including a 100m buffer (approximately 0.65km^2), could experience a potential change or loss of habitat. A total of 0.0008 harbour seal could be affected by any loss of or changes in habitat at the Wylfa Newydd

Development Area and Disposal Site, this represents up to 0.002% of the reference population.

8.10.47 In-combination, the Wylfa Newydd Development Area (approximately 0.35km^2) and of the Disposal Site including a 100m buffer (approximately 0.65km^2), along with the 9.1km2 area of the Minesto Holyhead Deep tidal development, the West Anglesey Demonstration Zone (WADZ) area of 37km^2, the 11.5km^2 area of the Swansea Bay Tidal Lagoon and 70km^2 area of the Cardiff Tidal Lagoon, have a total estimated area of 129km^2 (table 8-88).

8.10.48 Taking into account the location of these projects and relatively small area of the potential change or loss of habitat compared to the range and available habitat for harbour seal and their prey. It is unlikely that the loss or change of habitat could significantly affect harbour seal or their prey, therefore, it is concluded that any potential effects associated with a change or loss of habitat would not result in an adverse effect on the integrity of the SACs in relation to their conservation objectives for harbour seal.

C Changes in marine water quality

Construction

8.10.49 During the Project construction, any increase in suspended sediment input and change in chemical quality due to discharge from fluvial sources and sewage and any increase in suspended sediment concentration and contaminant re-mobilisation during dredging and disposal could potentially effect, based on a precautionary approach, harbour seal and their prey in the in the Wylfa Newydd Development Area (0.35km^2) and Disposal Site with 100m buffer (0.651km^2). The total number of harbour seal that could be present in the Wylfa Newydd Development Area and Disposal Site with 100m buffer and could be potentially affected by any increases in suspended sediment concentration is 0.0008 individuals, this represents up to 0.002% of the reference population.

8.10.50 None of the projects have the potential for any in-combination effects for changes in marine water quality during the construction of the Project (table 8-89). Therefore, there is no potential for an adverse effect on the integrity of the SACs in relation to their conservation objectives for harbour seal or prey species as a result of in-combination effects of any changes to marine water quality during construction.

Operation

8.10.51 During the operation of the Project, the maximum area that could be impacted by the discharge from the cooling water system is 3.13km^2 for harbour seal and their prey, based on maximum potential TRO impact area, which is larger than the predicted maximum surface area for a 2^{o}C rise in temperature (2.41km^2; table 8-41 and table 8-44). The number of harbour seal that could be present in the maximum potential impact area (3.13km^2) is

up to less than one individual (0.003), which represents 0.006% of the reference population.

8.10.52 None of the projects (table 8-89) currently included in the in-combination assessment for changes in marine water quality during operation of the Project, have the potential for any in-combination effects on harbour seal, including prey species, at the SACs, based on currently available information (table 8-89). Therefore, there is no potential for an adverse effect on the integrity of these SACs in relation to their conservation objectives for harbour seal as a result of in-combination effects of changes to marine water quality during construction.

D Alteration of coastal processes and hydrodynamics

D1 Potential effect on habitat for prey species

8.10.53 The coastal processes assessment concludes that there is no potential for any alteration of intertidal or subtidal habitats and, consequently, no significant effect on prey species for marine mammals is predicted. As a worst case, a localised change in habitat within the Wylfa Newydd Development Area is assumed. This area coincides with area assessed for any change and/or loss of habitat and, therefore, has not been assessed here to avoid double counting of the potential effect.

8.10.54 None of the projects included in the in-combination assessment for any alteration of coastal processes and hydrodynamics have the potential for any in-combination effects (table 8-90). Therefore, there is no potential for adverse effects on the integrity of the SACs in question in relation to their conservation objectives for harbour seal as a result of in-combination effects due to the alteration of coastal processes and hydrodynamics on prey species.

E Physical interaction between species and Project infrastructure

E1 Vessel collision risk

8.10.55 The potential for in-combination effects for vessel collision risk (table 8-91) are currently unknown. However, it is highly unlikely that harbour seal would experience a significantly increased collision risk with vessels as a result of these projects, especially taking into account that any animals in the area will be habituated to the presence of vessels and able to detect and avoid vessels. As a result, any potential increased collision risk as a result of in-combination effects are unlikely to result in an adverse effect on the integrity of the SACs in relation to their conservation objectives for harbour seal.

Table 8-87 Assessment of potential for any in-combination effects of underwater noise at the SACs for harbour seal during the marine construction works and operation

In-combination assessment	Potential sources of underwater noise during marine construction works	Potential to adversely affect the integrity of the site	
		Auditory Injury (PTS)	Behavioural Response / Disturbance
The Project	Potential sources of underwater noise at the Wylfa Newydd Development Area and Disposal Site are: • drilling; • rock cutting; • rock breaking; • dredging; • disposal of material; and • vessels.	The maximum predicted range for PTS is 450m as a result of rock breaking, which has the potential to affect 0.0005 harbour seal (0.001% of the reference population). The maximum predicted range for PTS at the Disposal Site is 5m, which has the potential to effect <0.00001 harbour seal (<0.00001% of the reference population; *Taking into account proposed mitigation would reduce the risk of any auditory injury. Therefore there is no potential for any in-combination effects to adversely affect the integrity of the site.*	During construction, the maximum number of harbour seal that potentially could be temporarily disturbed as a result of underwater noise at the Wylfa Newydd Development Area and Disposal Site, and from vessels, could be up to 0.05 individuals (0.1% of the reference population). *Therefore there is no potential to adversely affect the integrity of the site.*
	Potential noise sources during operation are: • maintenance dredging; • vessel movements; and • AFDs.	*There is no potential risk of any auditory injury.* *Therefore there is no potential for any in-combination effects to adversely affect the integrity of the site.*	There is no potential for any significant impacts due to underwater noise from maintenance dredging and vessel movements during operation. *Therefore there is no potential to adversely affect the integrity of the site.*
Newcastle Harbour Co. Down – relocation of sandbar from harbour entrance.	Potential sources of noise include dredging and vessels.	There would be no potential for any auditory injury from vessel or dredging noise. *Therefore there is no potential for any in-combination effects to adversely affect the integrity of the sites.*	The potential for any disturbance as a result of underwater noise from vessels and dredging is likely to be limited to the area around the vessels and within the dredge area, therefore the potential for any significant disturbance and in-combination effects will be very low. *Based on available information, there is*

In-combination assessment	Potential sources of underwater noise during marine construction works	Potential to adversely affect the integrity of the site	
		Auditory Injury (PTS)	Behavioural Response / Disturbance
			no potential for any in-combination effects to adversely affect the integrity of the sites.
Strangford Lough Decommissioning of marine current turbine	Potential sources of noise include removal activities (no blasting) and vessels.	It is assumed that the potential for any auditory injury would be mitigated. *Therefore there is no potential for any in-combination effects to adversely affect the integrity of the sites.*	The potential for any disturbance as a result of underwater noise is likely to be limited to the area around the site, therefore the potential for any in-combination effects will be very low. *Based on available information, there is no potential for any in-combination effects to adversely affect the integrity of the sites.*
Minesto Holyhead Deep 10 MW Tidal Kite	Foundation options for the 160 0.5MW DGU units that are being considered include 4m monopile fixed to the seabed either using piling hammers, or drilling and grouting it into position, or a combination of these two approaches [RD214]. The other installation methods that are being considered include floating GBS and mud mat foundation [RD214]. Other noise sources will include vessels, cable laying and construction of offshore substation. [RD214] proposes to develop the Array Project in three phases as part of a deploy-and-monitor approach, which will allow verification of predictions made in the EIA, and confirm that mitigation	The ES found no risk of auditory injury from vessels and drilling / vibro-hammering noise [RD212]. *Therefore there is no potential for any in-combination effects to adversely affect the integrity of the site.*	The noise modelling indicated, using a very precautionary approach that disturbance zones could extend out to 4,000m for the quieter vessels and out to a maximum of 14,000m for the louder vessels [RD212]. The ES concluded that, whilst a small number of individual animals may exhibit some form of change in behaviour for the period in which they encounter sound from the installation or support vessels, this number is likely to be small and the main noise sources present for such a short time that any changes would likely be undetectable against natural variation and would have no residual impact at the population level [RD212]. The noise modelling for drilling activity

In-combination assessment	Potential sources of underwater noise during marine construction works	Potential to adversely affect the integrity of the site	
		Auditory Injury (PTS)	Behavioural Response / Disturbance
	strategies are working effectively.		indicated that disturbance zones could extend out to 375m for pile drilling and out to a maximum of 10,000m for the vibro-hammering. For the installation of one DGU piling activities are likely to be limited to approximately 5 days, the ES concluded that there is likely to be very limited interaction between the piling noise and mammals; any changes would likely be undetectable against natural variation and would have no residual impact at the population level ([RD212]). *This will have to be assessed further of the Phased development and installation of 160 devices.* *However, based on the maximum predicted impact range, the potential impact area is 314km^2, which could affect 0.2 harbour seal (0.6% of MU; based on single not concurrent installation and the density estimate of 0.007/km^2 – see chapter 6). It should be noted, that this is not assessed in-combination with disturbance from vessels outlined above as both would be in the same area at the same time, with overlapping impact areas.* *Therefore, further assessment is required by Minesto to determine the potential to adversely affect the integrity of the site.* As a result of an absence of detailed

In-combination assessment	Potential sources of underwater noise during marine construction works	Potential to adversely affect the integrity of the site	
		Auditory Injury (PTS)	Behavioural Response / Disturbance
			project information, no in-combination assessment can be carried out.
Menter Môn (Morlais) West Anglesey Marine Energy Demonstration Zone	No details are currently available on if there will be the potential for any underwater noise and what the sources might be during the Project marine construction works, however as a worst-case scenario they have been assumed to the same / similar to the Minesto Holyhead Deep tidal array. The Morlais Project capacity may be up to, but will not exceed 100W. A number of TEC are being considered. Seabed mounted devices could be fixed using several different methods. The type of installation vessel will vary depending on the needs of the foundation, but would typically require a heavy lift crane barge or jack-up barge vessel [RD217].	It is assumed that the potential for any auditory injury would be mitigated. *Therefore there is no potential for any in-combination effects to adversely affect the integrity of the site.*	*As assessed for the Minesto Holyhead Deep tidal array, e.g. the potential impact area could be 314km^2, which could affect 0.2 harbour seal (0.6% of MU; based on single not concurrent installation and the density estimate of 0.007/km^2 – see chapter 6).* *Therefore, further assessment is required by Morlais to determine the potential to adversely affect the integrity of the site.* As a result of an absence of detailed project information, no in-combination assessment can be carried out.
Swansea Bay Tidal Lagoon	Same as assessment in table 8-63 for harbour porpoise cSACs		
Cardiff Tidal Lagoon	Same as assessment in table 8-63 for harbour porpoise cSACs		
North West Coast Connections Project	Same as assessment in table 8-55 and table 8-56 for Gogledd Môn Forol/North Anglesey Marine cSAC		
NuGen Moorside	Same as assessment in table 8-55 and table 8-56 for Gogledd Môn Forol/North Anglesey Marine cSAC		

In-combination assessment	Potential sources of underwater noise during marine construction works	Potential to adversely affect the integrity of the site	
		Auditory Injury (PTS)	Behavioural Response / Disturbance
Project in West Cumbria			
Alexandra Basin Redevelopment Project	Extension of infrastructure to open up Dublin Port to larger cruise and cargo ships. The port will dredge the river Liffey to increase the depth of its berths and the entrance channel. There is the potential for increased underwater noise from vessels and dredging activity.	There would be no potential for any auditory injury from vessel or dredging noise. *Therefore there is no potential for any in-combination effects to adversely affect the integrity of the sites.*	The potential for any disturbance as a result of underwater noise from vessels and dredging is likely to be limited to the area around the vessels and within the dredge area, therefore the potential for any significant disturbance and in-combination effects will be very low. *Therefore, based on available information, there is no potential for any in-combination effects to adversely affect the integrity of the sites.*
New Cruise Berth For Large Cruise Ships at Dun Laoghaire Harbour	Potential sources of underwater noise include piling, dredging, general construction activity and vessels.	It is assumed that the potential for any auditory injury would be mitigated. *Therefore there is no potential for any in-combination effects to adversely affect the integrity of the sites.*	The potential for disturbance as a result of underwater noise from piling, dredging, general construction activity and vessels is likely to be limited to the development area, therefore the potential for any significant disturbance and in-combination effects will be very low. *Therefore, based on available information, there is no potential for any in-combination effects to adversely affect the integrity of the sites.*

Table 8-88 Assessment of potential in-combination effects of any change or loss of habitat at the SACs for harbour seal

In-combination assessment	Potential for land take, including seabed or intertidal land	Potential to adversely affect the integrity of the site
The Project	During construction and operation, based on a precautionary approach, it has been assumed that the marine area of the Wylfa Newydd Development Area (approximately 0.35km^2) and the Disposal Site including a 100m buffer (approximately 0.65km^2), could experience a potential change or loss of habitat.	A total 0.0008 harbour seal could potentially be affected by any loss or changes of habitat at the Wylfa Newydd Development Area and Disposal Site, this represents 0.002% of the reference population. *Therefore there is no potential to adversely affect the integrity of the site.*
Minesto Holyhead Deep 10 MW Tidal Kite	The 9.1km^2 area could accommodate an array of up to 80 MW (160 0.5 MW DGUs). Minesto is collaborating with Morlais to jointly develop grid and cable infrastructure, which will help minimise the combined environmental footprint of the two projects [RD214].	The 9.1km^2 area this could potentially effect up to 0.006 harbour seal (0.02% of the reference population, based on maximum density estimate of 0.0007/km^2 (see chapter 6)). *Therefore there is no potential to adversely affect the integrity of the site.*
Menter Môn (Morlais) West Anglesey Marine Energy Demonstration Zone	The Morlais Project will be located in the WADZ, which has an area of 37km^2.	The exact area of the Morlais project is currently unknown. However the WADZ area of 37km^2 could potentially effect up to 0.03 harbour seal (0.09% of the reference population, based on maximum density estimate of 0.0007/km^2 (see chapter 6)) *Therefore there is no potential to adversely affect the integrity of the site.*
Swansea Bay Tidal Lagoon	Same as assessment in table 8-64 for harbour porpoise cSACs	
Cardiff Tidal Lagoon	Same as assessment in table 8-64 for harbour porpoise cSACs	
North West Coast Connections Project	Same as assessment in table 8-57 for Gogledd Môn Forol/North Anglesey Marine cSAC	
NuGen Moorside Project in West Cumbria	Same as assessment in table 8-57 for Gogledd Môn Forol/North Anglesey Marine cSAC	

Table 8-89 Assessment of potential in-combination effects of any changes in marine water quality at the SACs for harbour seal

In-combination assessment	Potential for changes in marine water quality	Potential to adversely affect the integrity of the site
The Project	Increase in suspended sediment input and change in chemical quality due to discharge from fluvial sources and sewage during construction	The total number of harbour seal that could be present in the Wylfa Newydd Development Area is 0.0003 individuals, this represents up to 0.0006% of the reference population. *Therefore there is no potential to adversely affect the integrity of the site.*
	Increase in suspended sediment concentration and contaminant re-mobilisation during dredging and disposal during construction	The total number of harbour seal that could be present in the Wylfa Newydd Development Area and Disposal Site with 100m buffer and could be potentially affected by any increases in suspended sediment concentration is 0.0008 individuals, this represents up to 0.002% of the reference population. *Therefore there is no potential to adversely affect the integrity of the site.*
	Discharge from the cooling water system during operation - change in water temperature	The number of harbour seal that could be present in the maximum predicted surface area for a $2^{o}C$ rise in temperature ($2.41km^2$) has been estimated as less than one individual (0.002), which represents 0.004% of the reference population. *Therefore there is no potential to adversely affect the integrity of the site.*
	Discharge from the cooling water system during operation - Total Residual Oxidants	The number of harbour seal that could be present in the maximum potential TRO impact area ($3.13km^2$) is less than one individual (0.003), which represents 0.006% of the reference population. *Therefore there is no potential to adversely affect the integrity of the site.*
Newcastle Harbour Co. Down – relocation of sandbar from	There is the potential for increase in suspended sediment concentration and contaminant re-mobilisation during dredging.	Any increase in turbidity or suspended sediment levels is expected to be temporally and spatially restricted.

In-combination assessment	Potential for changes in marine water quality	Potential to adversely affect the integrity of the site
harbour entrance		If there is the potential for any contaminant re-mobilisation it is anticipated that mitigation measures would be required. *Therefore, based on available information, there is no potential for any in-combination effects to adversely affect the integrity of the site.*
Strangford Lough Decommissioning of marine current turbine	There is the potential for increase in suspended sediment concentration and contaminant.	Any increase in turbidity or suspended sediment levels is expected to be temporally and spatially restricted. If there is the potential for any contaminant re-mobilisation it is anticipated that mitigation measures would be required. *Therefore, based on available information, there is no potential for any in-combination effects to adversely affect the integrity of the site.*
Alexandra Basin Redevelopment Project	There is the potential for increase in suspended sediment concentration and contaminant re-mobilisation.	Any increase in turbidity or suspended sediment levels is expected to be temporally and spatially restricted. If there is the potential for any contaminant re-mobilisation it is anticipated that mitigation measures would be required. *Therefore, based on available information, there is no potential for any in-combination effects to adversely affect the integrity of the site.*
New Cruise Berth For Large Cruise Ships at Dun Laoghaire Harbour	There is the potential for increase in suspended sediment concentration and contaminant re-mobilisation during dredging.	Any increase in turbidity or suspended sediment levels is expected to be temporally and spatially restricted. If there is the potential for any contaminant re-mobilisation it is anticipated that mitigation measures would be required. *Therefore, based on available information, there is no potential for any in-combination effects to adversely affect the integrity of the site.*
Wylfa Decommissioning	Same as assessment in table 8-58 for Gogledd Môn Forol/North Anglesey Marine cSAC. *There is no potential for any in-combination effects to adversely affect the integrity of the sites.*	

In-combination assessment	Potential for changes in marine water quality	Potential to adversely affect the integrity of the site
Minesto Holyhead Deep 10 MW Tidal Kite	Same as assessment in table 8-58 for Gogledd Môn Forol/North Anglesey Marine cSAC. *There is no potential for any in-combination effects to adversely affect the integrity of the sites.*	
Menter Môn (Morlais) West Anglesey Marine Energy Demonstration Zone	Same as assessment in table 8-58 for Gogledd Môn Forol/North Anglesey Marine cSAC. *There is no potential for any in-combination effects to adversely affect the integrity of the sites.*	
Swansea Bay Tidal Lagoon	Same as assessment in table 8-65 for harbour porpoise cSACs. *There is no potential for any in-combination effects to adversely affect the integrity of the sites.*	
Cardiff Tidal Lagoon	Same as assessment in table 8-65 for harbour porpoise cSACs. *There is no potential for any in-combination effects to adversely affect the integrity of the sites.*	
North West Coast Connections Project	Same as assessment in table 8-58 for Gogledd Môn Forol/North Anglesey Marine cSAC. *There is no potential for any in-combination effects to adversely affect the integrity of the sites.*	
NuGen Moorside Project in West Cumbria	Same as assessment in table 8-58 for Gogledd Môn Forol/North Anglesey Marine cSAC. *There is no potential for any in-combination effects to adversely affect the integrity of the sites.*	

Table 8-90 Assessment of potential in-combination effects of any alteration of coastal processes and hydrodynamics on prey species at the SACs for harbour seal

In-combination assessment	Potential effects of any alteration of coastal processes and hydrodynamics on prey species	Potential to adversely affect the integrity of the site
The Project	See table 8-58 for Gogledd Môn Forol/North Anglesey Marine cSAC in-combination assessment. *Therefore there is no potential to adversely affect the integrity of the site.*	
Newcastle Harbour Co. Down – relocation of sandbar from harbour entrance	*There is no potential for any in-combination effects to adversely affect the integrity of the sites.*	

In-combination assessment	Potential effects of any alteration of coastal processes and hydrodynamics on prey species	Potential to adversely affect the integrity of the site
Strangford Lough Decommissioning of marine current turbine	*There is no potential for any in-combination effects to adversely affect the integrity of the sites.*	
Alexandra Basin Redevelopment Project	*There is no potential for any in-combination effects to adversely affect the integrity of the sites.*	
Swansea Bay Tidal Lagoon	Same as assessment in table 8-66 for harbour porpoise cSACs. *There is no potential for any in-combination effects to adversely affect the integrity of the sites.*	
Cardiff Tidal Lagoon	Same as assessment in table 8-66 for harbour porpoise cSACs. *There is no potential for any in-combination effects to adversely affect the integrity of the sites.*	
North West Coast Connections Project	Same as assessment in table 8-59 for Gogledd Môn Forol/North Anglesey Marine cSAC. *There is no potential for any in-combination effects to adversely affect the integrity of the sites.*	
NuGen Moorside Project in West Cumbria	Same as assessment in table 8-59 for Gogledd Môn Forol/North Anglesey Marine cSAC. *There is no potential for any in-combination effects to adversely affect the integrity of the sites.*	

Table 8-91 Assessment of potential in-combination effects of any physical interaction with project infrastructure and vessels at the SACs for harbour seal

In-combination assessment	Potential for physical interaction with project infrastructure and vessels	Potential to adversely affect the integrity of the site
The Project	Vessel collision risk	The number of harbour seal that could be at increased risk of collision with vessels all vessels during construction and operation within the Wylfa Newydd Development Area, the Disposal Site plus 100m buffer and the 1km wide vessel route between the two sites, is estimated to be 0.0015 (0.003% of reference population) based on a precautionary

In-combination assessment	Potential for physical interaction with project infrastructure and vessels	Potential to adversely affect the integrity of the site
		95% avoidance rate. *Therefore there is no potential to adversely affect the integrity of the site.*
	Project infrastructure	No direct impacts on harbour seal as a result of project infrastructure. However, the loss of prey due to impingement could potentially affect up to 2.5 small harbour seal (5% of the reference population) per year. However, individuals would still be able to source prey from nearby areas. *Therefore there is no potential to adversely affect the integrity of the site.*
Newcastle Harbour Co. Down – relocation of sandbar from harbour entrance	There could be the potential for increased vessel movements.	The potential for any physical interaction with vessels as a result of this project is currently unknown. However, any increase risk for collision risk with vessels is expected to be temporally and spatially restricted. *Therefore, based on available information, there is limited potential for any in-combination effects to adversely affect the integrity of the sites.*
Alexandra Basin Redevelopment Project	There could be the potential for increased vessel movements.	The potential for any physical interaction with vessels as a result of this project is currently unknown. However, any increase risk for collision risk with vessels is expected to be temporally and spatially restricted to the port area. *Therefore, based on available information, there is limited potential for any in-combination effects to adversely affect the integrity of the sites.*
New Cruise Berth For Large Cruise Ships at Dun Laoghaire Harbour	There could be the potential for increased vessel movements.	The potential for any physical interaction with vessels as a result of this project is currently unknown. However, any increase risk for collision risk with vessels is expected to be temporally and spatially restricted to the port area. *Therefore, based on available information, there is limited*

In-combination assessment	Potential for physical interaction with project infrastructure and vessels	Potential to adversely affect the integrity of the site
		potential for any in-combination effects to adversely affect the integrity of the sites.
Wylfa Decommissioning	Same as assessment in table 8-60 for Gogledd Môn Forol/North Anglesey Marine cSAC. *There is no potential for any in-combination effects to adversely affect the integrity of the sites.*	
Minesto Holyhead Deep 10 MW Tidal Kite	Same as assessment in table 8-60 for Gogledd Môn Forol/North Anglesey Marine cSAC.	
Menter Môn (Morlais) West Anglesey Marine Energy Demonstration Zone	Same as assessment in table 8-60 for Gogledd Môn Forol/North Anglesey Marine cSAC.	
Swansea Bay Tidal Lagoon	Same as assessment in table 8-67 for harbour porpoise cSACs.	
Cardiff Tidal Lagoon	Same as assessment in table 8-67 for harbour porpoise cSACs.	
North West Coast Connections Project	Same as assessment in table 8-58 for Gogledd Môn Forol/North Anglesey Marine cSAC.	
NuGen Moorside Project in West Cumbria	Same as assessment in table 8-58 for Gogledd Môn Forol/North Anglesey Marine cSAC.	

E2 Project infrastructure

8.10.56 The potential for in-combination effects for any physical interaction between harbour seal and project infrastructure (table 8-91) are currently unknown. However, it should be noted that there is no potential for any direct physical interaction between harbour seal and the Project infrastructure. In addition, if any project alone is likely to have a significant effect on harbour seal as a result of physical interaction with the infrastructure, for example at the proposed tidal developments, then mitigation and monitoring would be required at these sites to reduce the risk.

8.10.57 As a result, any potential for physical interaction with project infrastructure as a result of in-combination effects should be unlikely to result in an adverse effect on the integrity of the SACs in relation to their conservation objectives for harbour seal.

Conclusions for the SACs for harbour seal

Alone and in-combination

8.10.58 In conclusion, there is no potential for any adverse effect on the integrity of the Murlough SAC (Northern Ireland), Strangford Lough SAC (Northern Ireland), Lambay Island SAC (Ireland) and Slaney River Valley SAC (Ireland) from the Project alone during construction and operation in relation to the conservation objectives for harbour seal (table 8-91).

8.10.59 There is also no potential for any adverse effect on the integrity of the SACs from in-combination effects of any land take, including seabed or intertidal land; changes in marine water quality; or changes in prey resources during construction and operation in relation to the conservation objectives for harbour seal (table 8-91). There are also unlikely to be any in-combination effects from underwater noise or any physical interaction with project infra-structure or vessels, but further information is required. Any contribution to the in-combination effects of the Project would be small relative to the other projects.

Table 8-92 Summary of the assessment of the potential alone and in-combination effects on the SACs in relation to the conservation objectives for harbour seal

Conservation objectives	Changes in visual and acoustic stimuli	Land take, including seabed or intertidal land	Changes in marine water quality	Physical interaction between species and Project infra-structure	Changes in prey resources	In-combination
The Murlough SAC, Strangford Lough SAC, Lambay Island SAC and Slaney River Valley SAC						
To maintain (or restore where appropriate) the harbour seal to favourable condition.	×	×	×	×	×	×
To maintain (and if feasible enhance) population numbers and the distribution of harbour seal.	×	×	×	×	×	×
To maintain and enhance, as appropriate, physical features used by harbour seal within the site	×	×	×	×	×	×

× = no potential for any adverse effect on the integrity of the site in relation to the conservation objectives

8.11 Decommissioning

8.11.1 With respect to the screening categories (potential effect categories) discussed above for the construction and operation phases of the Project, no LSE has been predicted with regard to 'land take, including seabed or intertidal land', 'alteration of coastal processes and hydrodynamics' and 'physical interaction between species and Project infrastructure' during the decommissioning phase (see section 5.4). A LSE was determined for this phase of the works, however, for 'changes in visual and acoustic stimuli' and 'changes in marine water quality'. These are considered below.

8.11.2 The potential for marine water quality to be adversely affected by the Project has been considered in the context of the European Designated Sites with marine mammal qualifying interest features. This assessment concluded that, based on the information presently available, no adverse effect on the integrity of the sites would arise, alone or in-combination with other plans and projects.

8.11.3 Hence, for the decommissioning phase, it can be assumed that, with equivalent risk management and mitigation measures in place, an adverse effect on site integrity similarly would not arise during the decommissioning phase for any European Designated Site with marine mammal qualifying interest features.

9 Appropriate Assessment: Atlantic salmon and freshwater pearl mussel

9.1 Introduction

9.1.1 There are four SACs for which the Shadow HRA Stage 1 Screening assessment concluded that LSE could not be excluded for migratory fish (all of which have Atlantic salmon as the qualifying interest feature), as follows (section 5.3 provides further details):

- Afon Gwyrfai a Llŷn Cwellyn SAC.
- Afon Eden – Cors Goch Trawsfynydd SAC.
- Afon Dyfrdwy a Llŷn Tegid/River Dee and Bala Lake SAC.
- Afon Teifi/River Teifi SAC.

9.1.2 In addition to Atlantic salmon, the freshwater pearl mussel *Margaritifera margaritifera* is an interest feature of the Afon Eden – Cors Goch Trawsfynydd SAC. Freshwater pearl mussel spends its larval stage attached to the gills of salmonid fishes. Research undertaken by NRW has demonstrated that brown trout (including sea trout) *Salmo trutta* is the host species for the Afon Eden population [RD116]. Given this relationship, effects on sea trout and freshwater pearl mussel have also been assessed.

9.1.3 Brief descriptions of these SACs are provided in section 6.4, along with a figure (figure 2, appendix C) that shows their locations relative to the Wylfa Newydd Development Area.

9.1.4 Given the similarity between the qualifying interest features of these SACs, the implications of the Project for Atlantic salmon have been assessed together for all four SACs (in sections 9.4 - alone - and 9.5 - in-combination), with separate consideration of the freshwater pearl mussel for the Afon Eden–Cors Goch Trawsfynydd SAC (in section 9.6). The potential effects on sea trout are assessed together with Atlantic salmon given that the pathways for the Project to affect these two fish species are the same. However, given that sea trout is not an SAC qualifying feature, the implications of any predicted effects of the Project on sea trout and, hence, potentially the freshwater pearl mussel population of the Afon Eden–Cors Goch Trawsfynydd SAC are assessed in section 9.6.

9.1.5 Section 9.2 below sets out the conservation objectives for these four sites and section 9.3 provides a summary of the outcomes of screening. Sections 9.4 and 9.5 provide the shadow Appropriate Assessment for Atlantic salmon alone and in-combination, with respect to changes in visual and acoustic stimuli, changes in marine water quality, alteration of coastal processes and physical interactions.

9.2 Conservation objectives

Afon Gwyrfai a Llŷn Cwellyn SAC

9.2.1 The conservation objectives for the Afon Gwyrfai a Llŷn Cwellyn SAC are presented in section 4.4 of the SAC Core Management Plan ([RD44]). The vision for this feature is for it to be in a favourable conservation status, where all of the following conditions are satisfied:

- The conservation objective for the water course as defined in the Core Management Plan must be met.
- The population of the feature in the SAC is stable or increasing over the long term.
- The natural range of the feature in the SAC is neither being reduced nor is likely to be reduced for the foreseeable future. The natural range is taken to mean those reaches where predominantly suitable habitat for each life stage exists over the long term. Suitable habitat is defined in terms of near-natural hydrological and geomorphological processes and forms, e.g. suitable flows to allow upstream migration, depth of water and substrate type at spawning sites, and ecosystem structure and functions. Suitable habitat need not be present throughout the SAC but where present must be secured for the foreseeable future. Natural factors such as waterfalls may limit the natural range of individual species. Existing artificial influences on natural range that cause an adverse effect on site integrity, such as physical barriers to migration, will be assessed.
- The Gwyrfai will continue to be a sufficiently large habitat to maintain the feature's population in the SAC on a long-term basis.

9.2.2 [RD44] states that Atlantic salmon has an unfavourable conservation status in this SAC. This results from a precautionary assessment of the distribution of the feature and abundance, and in particular the results of salmon catches and juvenile surveys. In addition, the presence of adverse factors, including flow depletion, contributes to this condition assessment ([RD44]).

Afon Eden–Cors Goch Trawsfynydd SAC

9.2.3 The conservation objectives for the Afon Eden–Cors Goch Trawsfynydd SAC are presented in section 4.4 of the SAC Core Management Plan [RD45]. The vision for this feature is for it to be in a favourable conservation status, where all of the following conditions are satisfied:

- The Atlantic salmon population must be viable throughout its distribution in the river and maintaining itself on a long-term basis.
- There will be no contraction of the number or age range of the Atlantic salmon population.
- There will be sufficient habitat to support a viable population.

- All factors affecting the achievement of these conditions are under control.

9.2.4 The conservation objectives for the freshwater pearl mussel *Margaritifera margaritifera* are:

- The freshwater pearl mussel population must be viable throughout its distribution in the river and maintaining itself on a long-term basis.
- There will be no contraction of the number, age range, distribution or size of mussel beds found within the population.
- Within the distribution of these beds there will be sufficient habitat to support a viable population.
- The transference of pearl mussel glochidia (larvae) is facilitated by an abundant and self-sustaining Atlantic salmon population (this conservation objective was developed prior to the NRW research suggesting that sea trout *Salmo trutta* is the host species for the Afon Eden freshwater pearl mussel population).
- All factors affecting the achievement of these conditions are under control.

9.2.5 [RD45] states that Atlantic salmon has an unfavourable conservation status in this SAC. The current population is maintained by stocking from the Mawddach hatchery, so this population is artificially maintained and the genetic profile of the population is therefore altered as a result. [RD45] also notes that the impact of removing/mitigating artificial barriers needs to be assessed.

9.2.6 [RD45] states that the freshwater pearl mussel has an unfavourable conservation status in this SAC due to a declining population.

Afon Dyfrdwy a llyn Tegid/River Dee and Bala Lake SAC

9.2.7 The conservation objectives for the Afon Dyfrdwy a llyn Tegid/River Dee and Bala Lake SAC are presented in section 4.3 of the SAC Core Management Plan [RD46]. The vision for this feature is for it to be in a favourable conservation status, where all of the following conditions are satisfied:

- The parameters defined in the vision for the water course as defined in the Core Management Plan must be met.
- The SAC feature populations will be stable or increasing over the long term.
- The natural range of the features in the SAC is neither being reduced nor is likely to be reduced for the foreseeable future.
- There will be no reduction in the area or quality of habitat for the feature populations in the SAC on a long-term basis.
- All known, controllable factors affecting the achievement of these conditions are under control (many factors may be unknown or beyond human control).

9.2.8 [RD46] states that Atlantic salmon has an unfavourable conservation status in this SAC. The reasons for this condition assessment are summarised as the population size (adult run), water quality and 'environmental disturbance', with exploitation specifically referenced.

Afon Teifi/River Teifi SAC

9.2.9 The existing conservation objectives for Afon Teifi/River Teifi SAC are presented in section 4.2 of the SAC Core Management Plan [RD58]. The vision for this feature is for it to be in a favourable conservation status, where all of the following conditions are satisfied:

- The population of the feature in the SAC is stable or increasing over the long term.
- The natural range of the feature in the SAC is neither being reduced nor is likely to be reduced for the foreseeable future. The natural range is taken to mean those reaches where predominantly suitable habitat for each life stage exists over the long term. Suitable habitat is defined in terms of near-natural hydrological and geomorphological processes and forms e.g. suitable flows to allow upstream migration, depth of water and substrate type at spawning sites, and ecosystem structure and functions e.g. food supply. Suitable habitat need not be present throughout the SAC but where present must be secured for the foreseeable future. Natural factors such as waterfalls may limit the natural range of individual species. Existing artificial influences on natural range that cause an adverse effect on site integrity, such as physical barriers to migration, will be assessed.
- There is, and will continue to be, a sufficiently large habitat to maintain the feature's population in the SAC on a long-term basis.

9.2.1 [RD58] states that Atlantic salmon also has an unfavourable conservation status in this SAC. This unfavourable status results from a precautionary assessment of juvenile distribution and abundance, and the presence of adverse factors.

9.3 Summary of screening outcomes

Alone

9.3.1 The Stage 1 Screening assessment concluded that the potential for a LSE to arise exists (or cannot be ruled out) with respect to the screening categories and interest features (✓ = LSE) set out in table 9-1 in the context of migratory fish.

Table 9-1 Potential for LSE for Atlantic salmon SACs

Site Features	Changes in visual and acoustic stimuli	Changes in marine water quality	Alteration of coastal processes and hydro-dynamics	Physical interaction between species and Project infra-structure
Atlantic salmon *(Salmo salar)*	✓	✓	✓	✓
Freshwater pearl mussel (*Margaritifera margaritifera*)*	✓	✓	✓	✓

* Only relevant to the Afon Eden–Cors Goch Trawsfynydd SAC; the potential for an LSE to arise for freshwater pearl mussel is linked to potential effects on sea trout, the host species for Afon Eden freshwater pearl mussel population.

In-combination

9.3.2 The in-combination scoping assessment (see appendix B) did not identify any projects that could result in in-combination effect on the SACs with Atlantic salmon as qualifying features that are screened into the Shadow HRA.

9.3.3 As described in chapter 5, there is no potential for LSIE for the Atlantic salmon SACs with any of the plans scoped into the assessment.

9.3.4 The potential for LSIE with the NSIPs that are scoped into the assessment, and have the potential to influence the SACs under consideration (the Burbo Bank Extension Offshore Wind Farm and Glyn Rhonwy Pumped Storage scheme), has been examined below.

9.3.5 DECC's HRA for the Burbo Bank Extension Offshore Wind Farm [RD78] identified the potential for LSE on the Afon Dyfrdwy a llyn Tegid/River Dee and Bala Lake SAC because of the potential for piling activity to prevent Atlantic salmon from undertaking their migration during construction work. The concern was that the noise would result in fish exhibiting a behavioural response which would prevent them from making their seaward migration. However, the Burbo Bank Extension Offshore Wind Farm has now been constructed and, therefore, there is no potential for this scheme to result in an in-combination effect with the Project. Consequently it is not considered any further in this assessment.

9.3.6 The potential effects of the Glyn Rhonwy Pumped Storage scheme were considered given that the HRA for that project identified a potential effect on the Afon Gwyrfai a Llŷn Cwellyn SAC. The Examining Authority's recommendation to the Secretary of State with respect to European Designated Sites identified a potential effect due to pollution, alteration of flow regime, nutrient enrichment and reduction in water quality. However, all of these effects are within the freshwater environment, in relatively close proximity to the Afon Gwyrfai a Llŷn Cwellyn SAC (the Glyn Rhonwy

Pumped Storage scheme is 1.8km from the SAC). The Examining Authority was satisfied that with the secured mitigation measures and Environmental Permits in place there are unlikely to be any significant effects on fish.

9.3.7 As the Project will not directly affect the SAC or have effects that could interact with the Glyn Rhonwy Pumped Storage scheme, the pathway for LSIE is weak. However, given that the Glyn Rhonwy Pumped Storage scheme is predicted to have some effect on the SAC, further consideration has been given (in section 9.5) to the potential for LSIE with the Project.

9.4 Assessment of potential effects (alone)

All SACs screened in for Atlantic salmon

A Changes in visual and acoustic stimuli

Construction

A1 Underwater noise during marine construction works [Marine Licence]

Introduction

9.4.1 Although Atlantic salmon are fish with swim bladders, this species hears through particle motion (i.e. hearing does not involve the swim bladder or other gas volume) and is classed as a 'hearing generalist' [RD267]. However, the presence of a swim bladder makes this species more susceptible to pressure-related injury (such as rupture of the swim bladder) associated with sudden changes in hydrostatic pressure (water depth) or sound pressure. [RD239] reports that the audiogram for the brown trout indicated that the hearing of *Salmo trutta* was less sensitive than that of the salmon.

Predicted effects

9.4.2 The outputs of the underwater noise modelling (ES volume D, appendix D13.09) indicate that a temporary threshold shift (TTS) in fish could occur up to 180m from the Project's noise sources (186dB re 1µPa^{2}s (SELcum), based on the maximum predicted impact range for rock breaking). Recoverable injury (fish with swim bladders) is predicted to occur in an area up to 10m from the noise (203dB re 1µPa^{2}s (SELcum)) and mortality at 1m from the noise source (>207dB re 1µPa (SPLpeak)). The noise thresholds quoted are derived from [RD268].

9.4.3 Although thresholds for TTS, recoverable injury and mortality can be defined, there are no defined sound levels for which behavioural (e.g. avoidance) effects are determined to be likely in marine fish; instead the prediction of effects is based on the risk to fish at different distances. For multiple pulse sounds, the risk of behavioural effects for generalists is considered to be high near to the source, moderate in the intermediate zone (hundreds of metres) and low at distance [RD268].

9.4.4 It is concluded on the basis of the above that there is a moderate risk of behavioural effects occurring (e.g. deviation of migration) up to 1km away from the marine construction works, and a low risk of an effect on Atlantic salmon and sea trout beyond this distance. TTS could occur up to 180m from the noise source.

9.4.5 Noise modelling of vessel movements (the peak number of vessels on site is predicted to average approximately 15 per week over a 3 month period in addition to existing vessels) (Application Reference Number: 6.4.91) indicates that the noise levels generated will not be discernible above background noise (115.2dB re 1µPa (RMS), based on the baseline underwater noise survey (Application Reference Number: 6.4.91)) after approximately 4.4km for large vessels (>60m length) and 2.4km for medium vessels (>10m). TTS is predicted within 4m for large vessels and 1m for medium vessels (recoverable injury is predicted within 1m in both cases). Noise generated by vessels moving within the construction zone and to and from the Disposal Site is predicted (through the noise modelling) to be lower than the worst case noise generated by the marine construction works and, therefore, no behavioural effects beyond hundreds of metres (as a worst case) are expected on Atlantic salmon or sea trout.

9.4.6 For the purpose of assessing potential effects of construction phase noise on ability to migrate, as a worst case, it is assumed that Atlantic salmon and sea trout would entirely avoid the area where TTS has the potential to occur due to the increased underwater noise described above. In this scenario, the worst case effect (exclusion) is not predicted to represent a barrier to migration as the magnitude of the worst case effect would not be significant in the context of the available migration route. However, assuming that migration occurs immediately adjacent to the coastline through the Wylfa Newydd Development Area, the scenario whereby Atlantic salmon and sea trout avoid the area where TTS has the potential to occur means that these species would divert from their preferred migration route. Given that TTS could occur up to 180m from the noise source, the net additional migration path and associated energetic cost is not predicted to be significant in the context of Atlantic salmon and sea trout migration.

9.4.7 Moreover, the baseline surveys (Application Reference Number: 6.4.86) do not indicate the presence of salmon in this zone, which is at some distance from most spawning rivers (the closest SAC designated for Atlantic salmon considered in this Shadow HRA is 58km distant). Taking into account the very small area over which recoverable injury or mortality has the potential to occur (based on the underwater noise modelling predictions), the distance of the effect from the closest SAC and the lack of significant numbers of Atlantic salmon in the TTS zone (from the survey data), the risk of mortality or injury is considered to be very low for Atlantic salmon.

9.4.8 Sea trout smolts, however, have been reported in baseline surveys for the coastal environment; between 2010 and 2015, a total of 16 sea trout were recorded. Although sea trout were recorded in greater numbers than Atlantic salmon and are more likely to be exposed to the effects of the Project due to their more restricted migration than Atlantic salmon, the same conclusion is

drawn for sea trout (i.e. the risk of mortality or injury is considered to be very low). Given the above, no effect on the Atlantic salmon population of any of the SACs included in the assessment is predicted and, therefore, an adverse effect on the integrity of the interest feature or the relevant European Designated Sites is not predicted. Similarly, no adverse effect on the sea trout population is predicted.

A2 Light spill during construction [Marine Licence]

Predicted effects

9.4.9 Modelling of indicative light spill during the construction of the marine works (including the MOLF, breakwaters and cooling water intake structure) indicates that 0.1 Lux light spill from the construction of the marine works typically would not extend more than 50m over the water area from the location of the works. For context, a full moon on a clear night produces about 0.1 Lux of light.

9.4.10 For the operation of the MOLF (that is, during the construction of other elements of the Project), a 0.1 Lux contour would extend no more than 125m across the water. This is predominantly from the MOLF cranes and would only occur at three specific locations. Typically the 0.1 Lux extends no more than 100m across the water when the cranes are not in use.

9.4.11 Given the very limited area of light spill predicted during construction in the context of the large area through which Atlantic salmon and sea trout can migrate, there is no risk of construction lighting adversely influencing the migration of these species. Hence an adverse effect on the integrity of the Atlantic salmon qualifying feature or the relevant European Designated Sites is not predicted.

Operation

A3 Underwater noise due to vessel movements

Predicted effects

9.4.12 During the operational phase, the number of vessel movements associated with the Project would be very infrequent (predicted to be one per month) and no discernible change to background noise levels is predicted to occur after approximately 4.4km for large vessels (>60m length) and 2.4km for medium vessels (>10m) based on the baseline underwater noise survey (Application Reference Number: 6.4.91).

9.4.13 No further assessment of underwater noise is therefore considered necessary for the operational phase and no effect on the integrity of the qualifying feature or the relevant European Designated Sites is predicted.

A4 Noise due to the AFD [Operational water discharge EP]

Predicted effects

9.4.14 The AFD is designed to provide a sufficient sound field to deflect fish hearing specialists and generalists (Atlantic salmon and sea trout fall within the latter category), whilst not extending beyond the intake embayment. Assuming that migration occurs immediately adjacent to the coastline through the Wylfa Newydd Development Area, the effect of any deflection due to the AFD would only result in a very localised diversion of the migration route.

9.4.15 The assessment of potential entrapment within the CWS is assessed below (effect D). That assessment is undertaken on the basis that fish within 250m (for juvenile fish) of the intake are assumed to be at risk of entrapment. On a worst case basis, given that Atlantic salmon and sea trout are hearing generalists, it has therefore been assumed that the AFD could result in the deflection of Atlantic salmon and sea trout by up to 250m (assuming Atlantic salmon and sea trout migrate immediately adjacent to the coastline). In reality, these species would be less likely to respond to the AFD than hearing specialists and so the assumed deflection of 250m is considered precautionary. As noted above, there is no evidence of Atlantic salmon in this zone from the baseline surveys, but there are records of sea trout.

9.4.16 The net additional migration path and associated energetic cost is not predicted to be significant in the context of Atlantic salmon or sea trout migration, and no adverse effect is predicted. It is also important to note that the AFD represents a key mitigation measure to reduce the risk of Atlantic salmon (and other fish) being entrapped within the CWS.

B Changes in marine water quality

Construction

B1 Suspended sediment input to the marine environment (drainage, dewatering, sewage discharge and capital dredging) [Marine Licence; Construction water discharge EP]

Input sources

9.4.17 During the construction phase there would be a number of sources of suspended sediment input to the marine environment, as discussed below.

9.4.18 A Delft-3D hydrodynamic model has been used to assess the cumulative effects of all sources of suspended sediment (i.e. fluvial sources drainage, dewatering and sewage as well as dredging) and predict the fate of the suspended sediment discharged in the marine environment. Sediment plume dispersion and sediment settlement rates have been modelled. Full results of the modelling are presented in Application Reference Number: 6.4.12.

9.4.19 There would be periods where soils are exposed and drainage patterns altered. To control suspended sediment from fluvial run-off, a multi-stage treatment solution has been incorporated into the design which would

consist of best practice soil management, SuDS and polyelectrolyte coagulant dosing to treat drainage water prior to it entering watercourses that ultimately discharge to the marine environment. The multi-stage treatment solution has been designed to limit the suspended solids at the point of discharge into the watercourses to 70mg/L. Mitigation measures are proposed to minimise and manage this predicted effect (and are described in section 7.4).

9.4.20 During the construction phase, treated sewage would be discharged into the north of the Porth-y-pistyll at a rate of approximately 1,598m^3 per day. The sewage discharge would be limited to 30mg/L of suspended sediment.

9.4.21 There would also be discharge from dewatering (from deep excavations and from cofferdams); suspended sediment would be limited to 70mg/L from this activity and was modelled as a continuous discharge.

9.4.22 The dominant source of suspended sediment introduced into the marine environment would be spill from capital dredging activity. During capital dredging a maximum area of approximately 25ha is predicted to experience an increase in suspended sediment concentration of greater than 6.1mg/L (equal to the low end of observed ambient average annual concentrations), as shown in figure 9-1. Within this area, suspended sediment concentration increases up to approximately 60mg/L (figure 9-1). This area would reduce between dredging events as the suspended sediment disperses.

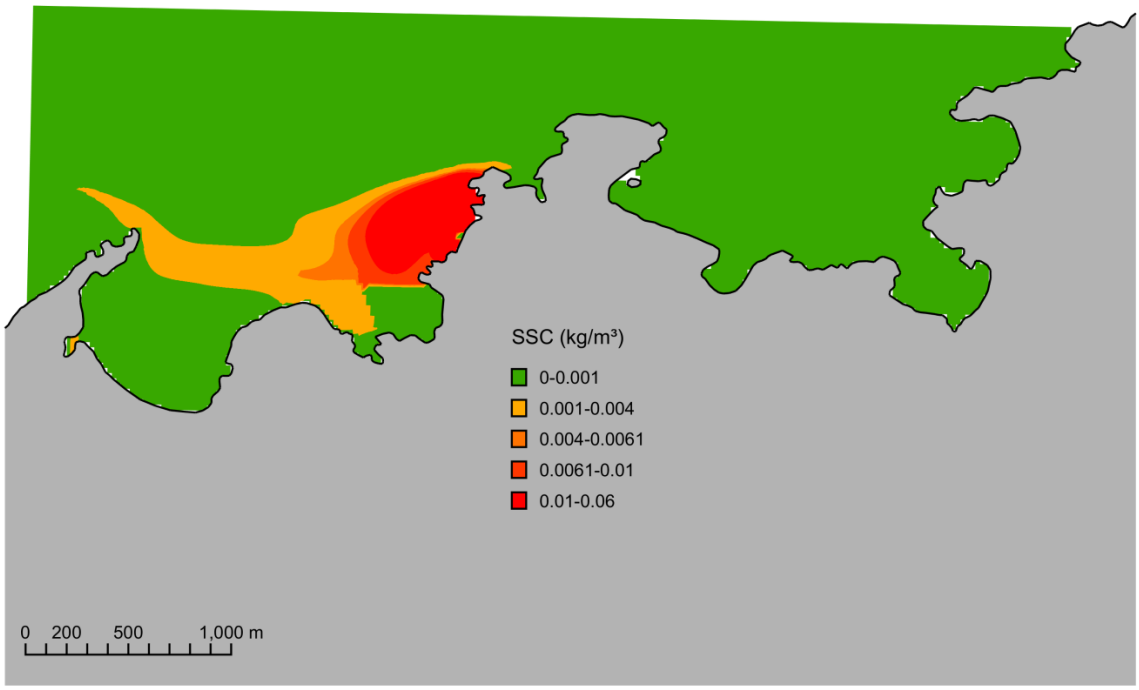

Figure 9-1 Suspended solids concentration (kg/m^3) an hour after the final dredge (mid-depth) (note 1mg/L = 0.001kg/m^3)

9.4.23 After the suspended sediment generated by dredging has dispersed, the suspended solids concentrations from the drainage flows would be low (figure 9-2). Predicted suspended solid concentrations in the marine environment from fluvial sources as depicted by the modelling are shown to

be below baseline concentrations are shown to be below baseline concentrations within approximately 500m from the discharge points.

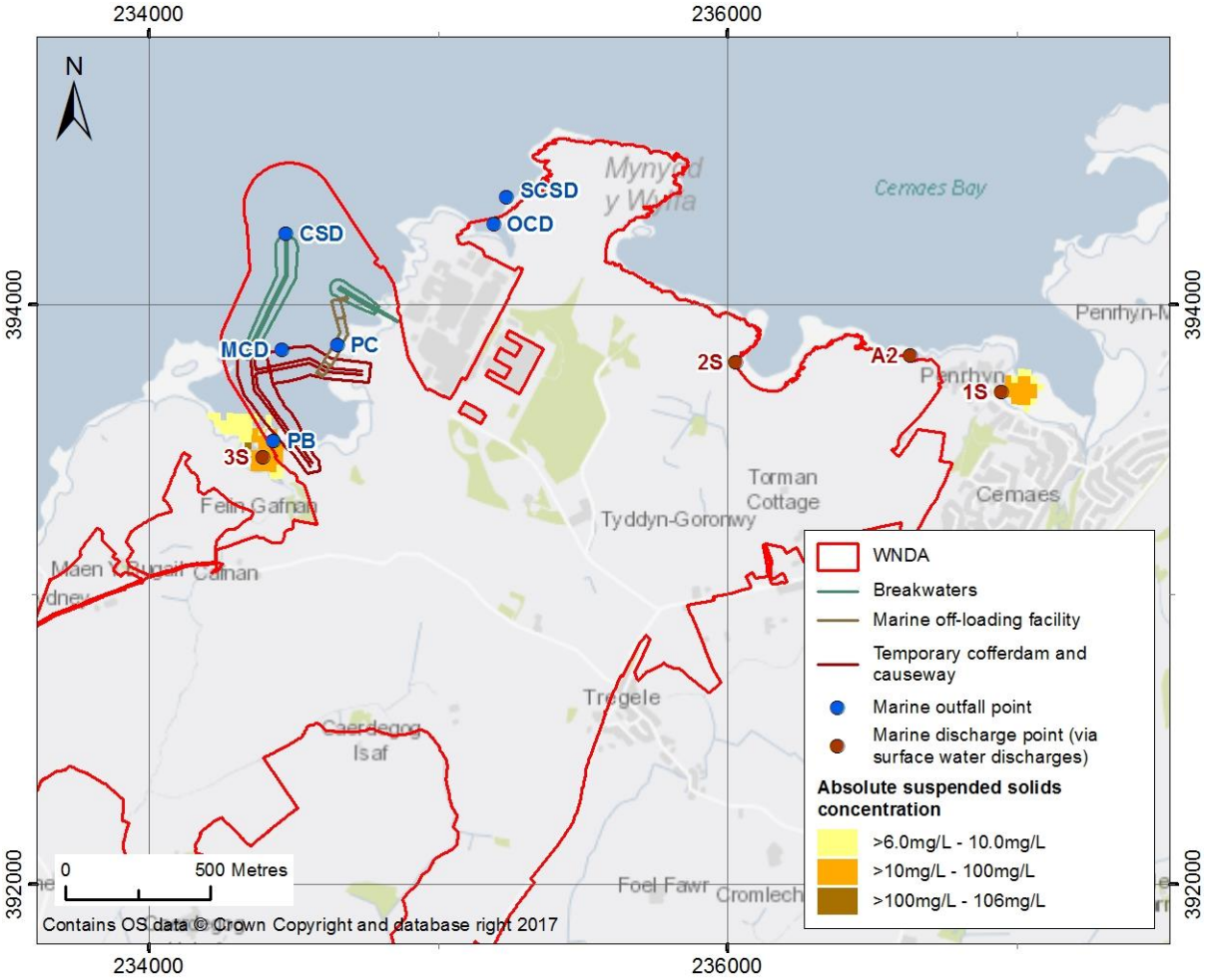

Figure 9-2 Suspended solids concentration resulting from land drainage

9.4.24 Figure 9-2 shows absolute suspended sediment concentration. This is the total suspended sediment in the water column (i.e. background plus predicted inputs). The modelled results are for mid-depth in the water column.

9.4.25 The discharge of suspended sediment at 2S is predicted to be below 6mg/L (background) (i.e. sediment is dispersed within one 23m grid cell, so does not appear in figure 9-2).

9.4.26 The modelling included suspended sediment inputs at 70mg/L at each discharge point, with the corresponding flow for each particular discharge point.

Predicted effect

9.4.27 The effect of increased suspended sediment due to the construction phase on Atlantic salmon and sea trout, therefore, is not predicted to be adverse because of its rapid dilution to background concentrations within a short distance (relative to the area of the potential migratory route for Atlantic salmon and sea trout and the likely low numbers of these species in the zone where this effect is predicted (based on the results of survey work)). Furthermore, Atlantic salmon and sea trout have the ability to detect and avoid areas of elevated suspended solids, and the restricted area of predicted effect means that fish would not be prevented from avoiding areas where conditions are unfavourable.

9.4.28 Consequently an adverse effect on the integrity of the interest feature or the relevant European Designated Sites is not predicted.

B2 Increase in suspended sediment concentration during disposal of dredged material [Marine Licence]

Modelling outputs

9.4.29 For the disposal of dredged material, the modelling of all sediment fractions (coarse sand, medium sand, fine sand and fines fractions) for the whole period of disposal (disposal of up to 242,000m^3 over 35 days) predicts that, in the upper 10% of the water column (where the highest concentrations occur), the suspended sediment concentration increase above typical background concentration would occur in a zone of approximately 1km around the disposal location (figure 9-3). The typical background suspended sediment concentration is 5.5 x 10-3kgm^{-3}, with values ranging from <3 x 10-3kgm^{-3} to 10 x 10-3kgm^{-3}.

9.4.30 Figure 9-4 shows the predicted increase in suspended sediment (for the finest sediment fraction only (0.063mm diameter)) 48 hours after the final disposal event. This sediment fraction is expected to remain in suspension for the longest period of time and, therefore, is indicative of the duration over which the effect of the disposal on suspended sediment concentrations would be evident. Figure 9-4 shows that suspended sediment concentrations fall below the typical background concentration within 48 hours and, therefore, the effect on water quality associated with disposal would be of short duration following completion of disposal. The modelling predicts that the sediment plume disperses to background suspended sediment concentrations after approximately 3 hours.

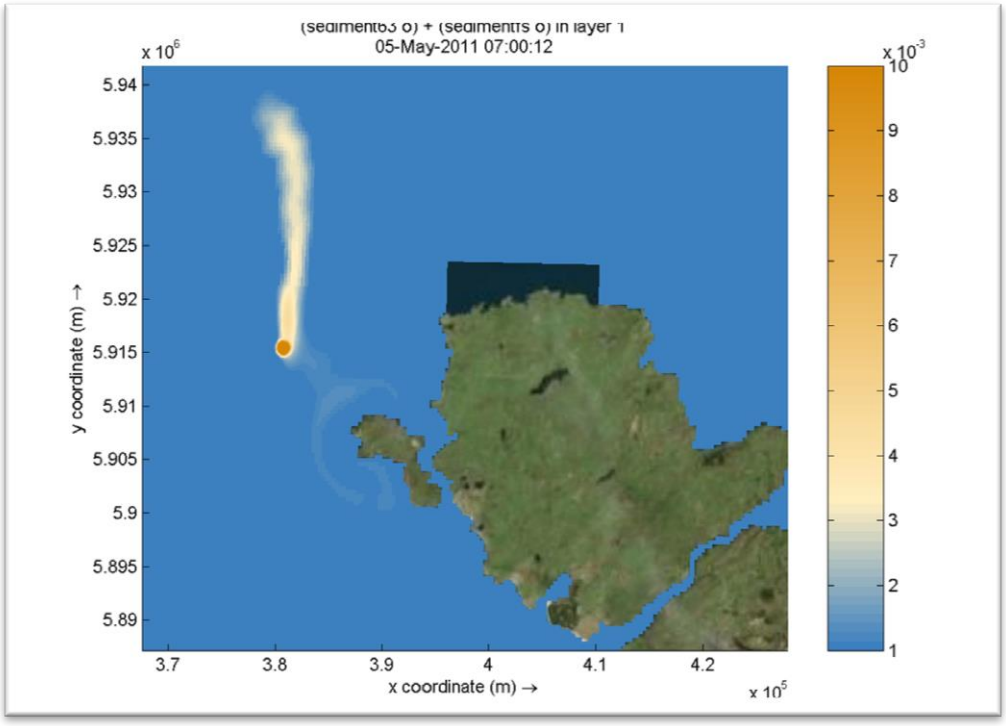

Figure 9-3 Suspended sediment concentrations (kgm^{-3}), full programme final disposal +1h, all fractions (coarse sand, medium sand, fine sand and fines fractions in summation)

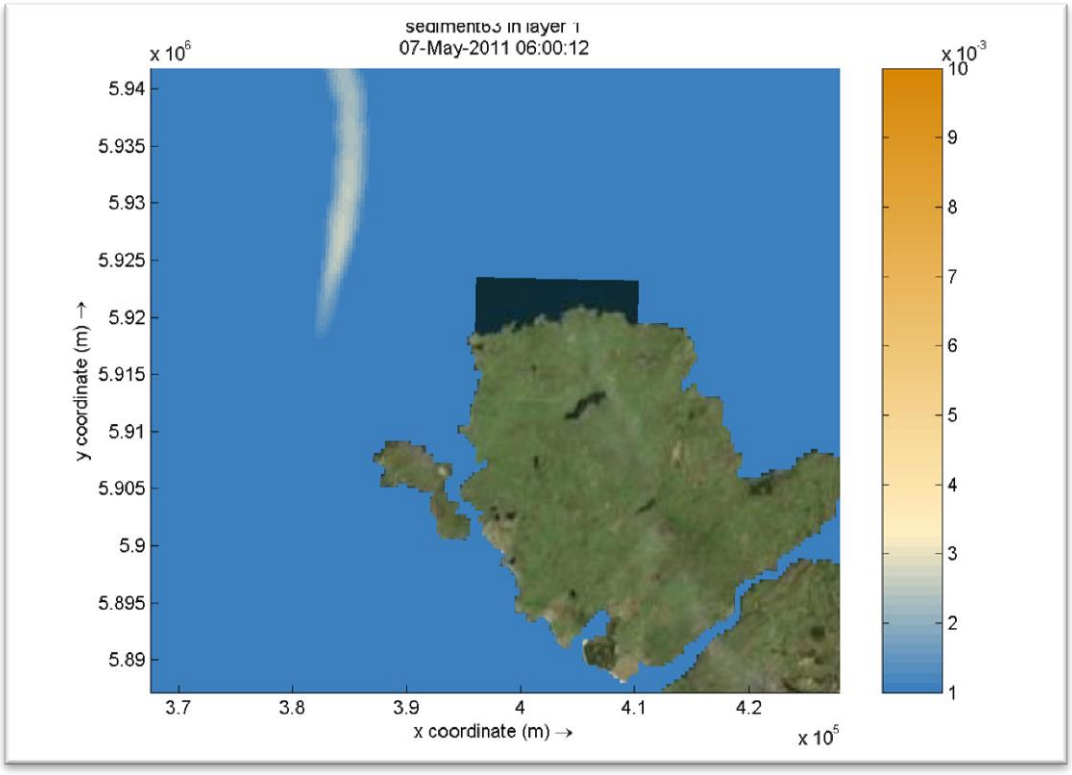

Figure 9-4 Suspended sediment concentrations (kgm^{-3}), full programme final disposal +48h (fine sediment fraction, 0.063mm diameter)

Predicted effect

9.4.31 Given the above, it is apparent that the area in which increased suspended sediment concentrations would be experienced would be very small in the context of the migratory pathway available for Atlantic salmon and sea trout, and the effect would be transitory, with dispersion of the suspended sediment to levels similar to typical background levels predicted to occur within 48 hours of a dredging/disposal cycle.

9.4.32 As a worst case, even if it is assumed that Atlantic salmon and sea trout avoid all areas of increased suspended sediment concentration, this effect would not represent a barrier to migration.

9.4.33 Potential effects on Atlantic salmon and sea trout of increases in suspended sediment could include gill clogging, reduced ability to detect prey and avoid predation and, in extreme cases, mortality. However, in an unconstrained environment, such as that through which these species would be migrating, their ability to detect and avoid areas of elevated suspended solids mean that they would avoid areas where conditions are unfavourable. As such, it is highly unlikely that the behaviour of Atlantic salmon and sea trout would be influenced by suspended sediment beyond the area where the greatest increases are predicted (i.e. within 1km). Hence, in this context an adverse effect on the integrity of the Atlantic salmon qualifying feature or the four SACs screened into the assessment is not predicted.

B3 Changes in water chemistry [Construction water discharge EP]

9.4.34 Full details of the predicted effect on water chemistry of the construction phase of the Project are presented in Application Reference Number: 6.4.96. The following summarises the key findings of the assessment as relevant to the HRA.

Chemical discharges from the drainage system

9.4.35 An H1 assessment has been carried out to calculate the chemical composition of discharges from all sources to the drainage system and compare the predicted discharge qualities to relevant EQSs. The H1 assessment concluded that, for marine waters, dissolved copper, lead, zinc and nickel required further modelling, and Delft3d modelling was carried out for these metals.

9.4.36 The modelling predicts maximum concentrations of dissolved nickel below its annual average EQS. For copper, zinc and lead, the predicted maximum concentrations are above the relevant annual average EQS; the results of the H1 assessment are illustrated in figures 7-10 to 7-12.

9.4.37 The mixing zones are precautionary as soil stripping, earthworks, dewatering and mound creation would occur in different locations at different times. Mounds would be reseeded, reducing the leaching of substances from the soil and, therefore, the effect is not permanent.

9.4.38 On the basis of the H1 assessment, it is concluded that there is no significant risk of a water quality effect occurring and adversely influencing migrating Atlantic salmon and sea trout given the limited spatial extent of the predicted EQS exceedances in the context of the water area available for migration, even if it is assumed that these species entirely avoid the area of EQS exceedance.

9.4.39 No process water would be discharged from the proposed concrete batching into the marine environment.

Change to nutrient conditions

9.4.40 The combined total ammonia concentration due to the discharge of treated sewage into the north of the Porth-y-pistyll (baseline plus the process contribution from sewage discharge) is predicted by the modelling to result in a non-ionised ammonia concentration after initial dilution of <1.57µg/L; which is significantly below the EQS for coastal waters (21µg/L). Consequently, there is no risk of an adverse effect on Atlantic salmon and sea trout due to change in nutrient conditions due to sewage discharge.

9.4.41 Nitrates and phosphates in soils could enter the marine environment during construction. Dissolved inorganic nitrogen is the key growth-limiting nutrient in marine waters and is, therefore, a key indicator for which standards are set in coastal waters. However, the levels of nitrates in the soils in the affected area are likely to be low due to the nature of existing land use and the H1 assessment concludes that there would be no change to the nutrient concentrations in the run-off reaching the marine environment.

9.4.42 There is no EQS for phosphates in the marine environment because phosphate is not a growth-limiting nutrient in this environment.

9.4.43 The H1 assessment modelling predicts that the annual average EQS for orthophosphate is likely to be exceeded in the receiving waters downstream of the discharges in all relevant watercourses. However, in all cases the upstream concentration already exceeds the EQS and the discharge only slightly increases the concentration in the receiving watercourse (table 9-2). The H1 assessment does not predict orthophosphate in the marine environment because there is no EQS for marine waters, so the results for the predicted freshwater concentrations (i.e. upstream of the marine discharge point) can be considered to be conservative in this context.

Table 9-2 Summary of model results (test of deterioration receiving water quality) for orthophosphate (as P); annual average discharges (Application Reference Number: 6.4.96)

Discharge Point	AA EQS (μg/l)	Mean upstream quality (μg/l)	Mean predicted concentration in receiving stream (μg/l)
B1 (Tre'r Gof)	78	130	134
C1 (Nant Caerdegog Isaf - Afon Cafnan tributary)	78	110	123
A3 (Nant Cemaes)	78	80	84
A1(Tre'r Gof)	78	130	134

Changes to oxygenation conditions

9.4.44 Depletion of dissolved oxygen potentially can occur due to an increase in biological productivity as a result of elevated nutrient concentrations. However, the assessment of changes to nutrient conditions indicates that no significant change in oxygenation conditions is predicted.

Predicted effect

9.4.45 In summary, the effect of changes in nutrient concentrations as predicted by the H1 assessment is considered to be insignificant in the context of water quality standards and existing background concentration (in the case of orthophosphate). Based on the above assessments of chemical discharges to the drainage system and changes to nutrient and oxygenation conditions an adverse effect on the integrity of the Atlantic salmon qualifying feature, or the four SACs screened into the assessment, is not predicted.

Operation

B4 Operational water discharge from the Cooling Water System [Operational water discharge EP]

Temperature increase and absolute temperature

Introduction

9.4.46 In 2006 draft guidance (WQTAG 160) on temperature thresholds was developed for HRA [RD353], although it was not formally adopted. This guidance recommended that a 2°C uplift standard at the edge of a mixing zone (based on temperature threshold values set under the Freshwater Fish Directive (2006/44/EC)) should be adopted for marine SPAs and marine SACs (but restricted to areas designated for estuary embayment habitats and/or salmonid species). A maximum temperature threshold of 21.5^{o}C for SACs designated for estuary or embayment habitat and/or salmonid species and 28^{o}C for SPAs was recommended (see table 9-3). No guidance was

developed for SPAs or SACs in open coastal locations (i.e. as is relevant to the Project location).

Table 9-3 Draft temperature thresholds developed by WQTAG for HRA, which were not adopted

Designation	Maximum temperature	Deviation from ambient
Special Areas of Conservation – any area designated for estuary or embayment habitat and/or salmonid species.	21.5°C as a 98 percentile at the edge of the mixing zone	2°C as a Maximum Allowable Temperature at the edge of the mixing zone
Special Protection Area	28°C as a 98 percentile at the edge of the mixing zone	2°C as a Maximum Allowable Temperature at the edge of the mixing zone

9.4.47 Due to the absence of agreed temperature standards, work was subsequently carried out by the British Energy Estuarine and Marine Studies (BEEMS) Expert Panel who produced a report, *Thermal standards for Cooling Water from new build nuclear power stations*, which summarises existing temperature standards and provides evidence on the effects of thermal discharges [RD24].

9.4.48 Using data from numerous laboratory and field studies, BEEMS [RD24] presents detailed information regarding the thermal tolerances of a wide range of fish species resident in transitional (estuaries) and coastal waters. It also makes recommendations regarding temperature standards for thermal discharge (see table 9-3). The key conclusion drawn from this study was that "*temperature rises up to 3°C appear to be tolerable and that resulting temperatures less than 27°C have no clear deleterious impact on species in receiving waters*".

9.4.49 [RD368] provides an independent academic review of literature relating to the thermal tolerance range of transitional and coastal water fish species. Existing thermal standards for heated effluents are also reviewed and, where appropriate, the authors have provided recommendations for the amendment of these. A key observation is that previous thermal standards in Europe distinguished between salmonid and cyprinid waters. As the standards were developed primarily for application to freshwaters, it is a distinction [RD368] considers inappropriate for transitional and coastal waters. As a wider variety of fish species may be found in transitional and coastal waters, [RD368] suggests that a more appropriate distinction would reference species' thermal responses on a zoogeographic basis. That is, for example, to consider the distinction between cold and warm-water species. In this scenario, the proposed boundary values are defined by the more sensitive cold water species that are well represented. Such an approach would be consistent with the requirements of the WFD that specifies that boundary values have to be established to protect the most sensitive taxa; a tenet that would apply equally to the EU Habitats Directive [RD368].

9.4.50 The temperature boundaries for transitional and coastal water bodies proposed by both BEEMS [RD24] and [RD368] are shown in table 9-4.

Table 9-4 Proposed temperature boundary values for estuarine and coastal waters outside the mixing zone ([RD24] and [RD368]); temperatures not to be exceeded 98% of the time at the edge of the mixing zone

	High/Good*	Good/Moderate*	Moderate/Poor*	Poor*
Maximum Allowable Temperature	23°C	23°C	28°C	30°C
Maximum Allowable Temperature Uplift	+2°C	+3°C	+3°C	+3°C

* Waterbody classifications under the Water Framework Directive

9.4.51 Atlantic salmon and sea trout are considered to be Arctic-Boreal species, found in water temperatures ranging from ice to 23.5°C (for Atlantic salmon) and from ice to 24.6°C (for sea trout) [RD24].

9.4.52 Production and growth of juvenile Atlantic salmon is considered optimum at water temperatures of 15°C–19°C, although they are known to tolerate temperatures up to 27°C, at which point they will move to colder water [RD65]. [RD142] who summarised available literature at that time reported a similar preference range (14°C–18°C), with a temperature of 23°C considered lethal to larvae [RD142].

9.4.53 In the Thames estuary, temperatures of 21.5ºC and above have been linked to avoidance behaviour ([RD3]; [RD2]; both cited in [RD24]). Reduced migration in estuaries and rivers may be related to temperatures above 16°C, with very little migration at temperatures above 20ºC to 23ºC. Atlantic salmon smolts have been reported to exhibit avoidance behaviour at temperatures of 4ºC above ambient; however, BEEMS [RD24] reports that adult Atlantic salmon have been known to pass through temperature differentials of up to 10ºC during highly motivated upstream migrations, although the original source of this information was not presented.

9.4.54 For sea trout, the literature states a temperature preference of 8-17ºC [RD24], with an avoidance of temperatures of 20ºC (adults) and 25ºC (juveniles).

9.4.55 For the purposes of the assessment of the potential effect on migratory Atlantic salmon and sea trout, the BEEMS [RD24] guidance is considered the most relevant, particularly given the open coastal location of the Project and the fact that the area is not designated for salmonid species. The maximum temperature threshold of 21.5^{o}C set out in draft guidance (WQTAG 160) [RD353] is not considered applicable in this case because this was developed for areas designated for estuary embayment habitats and/or salmonid species; none of these situations apply for the area affected by the thermal discharge.

Predicted effects

Temperature increase

9.4.56 The modelling results for the extent of the thermal mixing zone (with a Cooling Water abstraction rate of 126m^3/s), predicts an approximate area of

2.09km^2 for a 2°C 98 percentile rise at the surface and 0.88km^2 for a 3°C 98 percentile rise at the surface, based on annual base case (with no wind). Of the four seasons, the modelled results for the autumn base case has the greatest predicted extent of the thermal plume, with an area of 2.4km^2 for a 2°C 98 percentile rise at the surface and 0.91km^2 for a 3°C 98 percentile rise at the surface (table 9-5 and figure 9-5).

Table 9-5 Predicted area affected by an increase in temperature of 2°C and 3°C at the surface

	Annual base case	Spring base case	Summer base case	Autumn base case	Winter base case
2°C rise at surface	2.09km^2	2.12km^2	2.27km^2	2.41km^2	1.76km^2
3°C rise at surface	0.88km^2	0.89km^2	0.89km^2	0.91km^2	0.79km^2

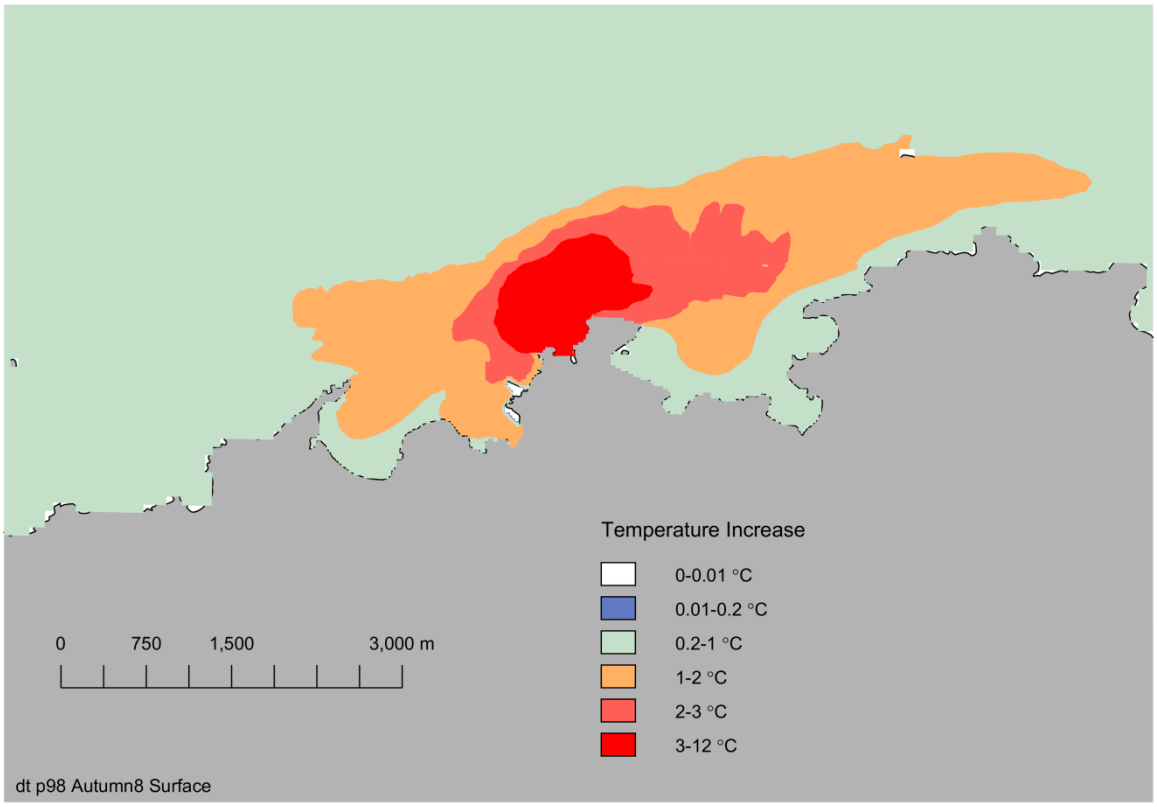

Figure 9-5 Surface temperature rise (98 percentile, autumn base case)

9.4.57 The largest area predicted to experience a 2°C 98 percentile rise at the seabed is associated with the annual base case (figure 9-6). It can be seen that this area is significantly smaller than the area affected at the sea surface (figure 9-5).

9.4.58 The vertical distribution of the temperature plume through the water column is relevant when assessing the effect on Atlantic salmon and sea trout migration. A series of north-south cross-section plots at high water, mid ebb, low water and mid flood through i) the outfall and ii) Cemlyn Bay on a neap

tide have been produced. The location of the two cross sections is shown in figure 9-7. Figures 9-8 to 9-15 show the vertical temperature profile at the different stages of the tide; in these plots, the viewer is effectively facing east so that the shoreline is on the right hand side of each image, giving a depiction of the how the plume temperatures vary throughout the vertical column. A neap tide has been presented as the temperature rise is higher on a neap than a spring tide. The horizontal and the vertical scales differ for the cross section through the outfall and through Cemlyn Bay.

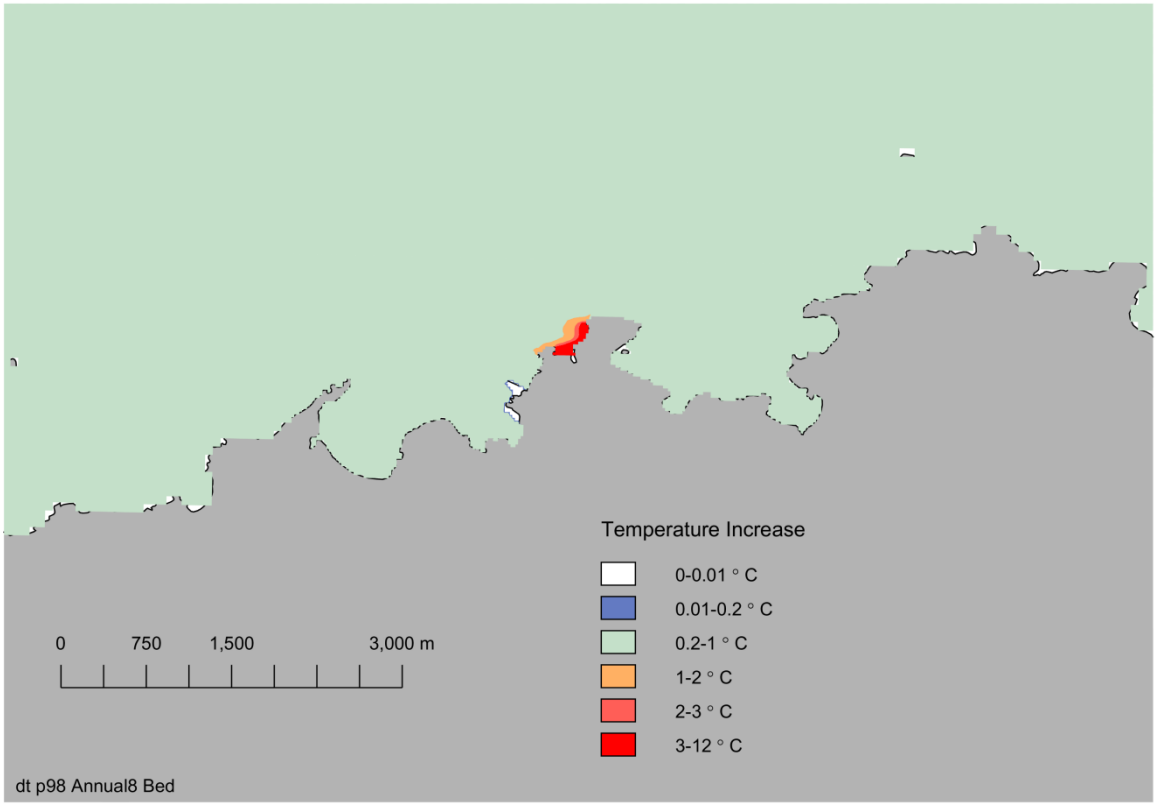

Figure 9-6 Seabed temperature rise (98 percentile, annual base case)

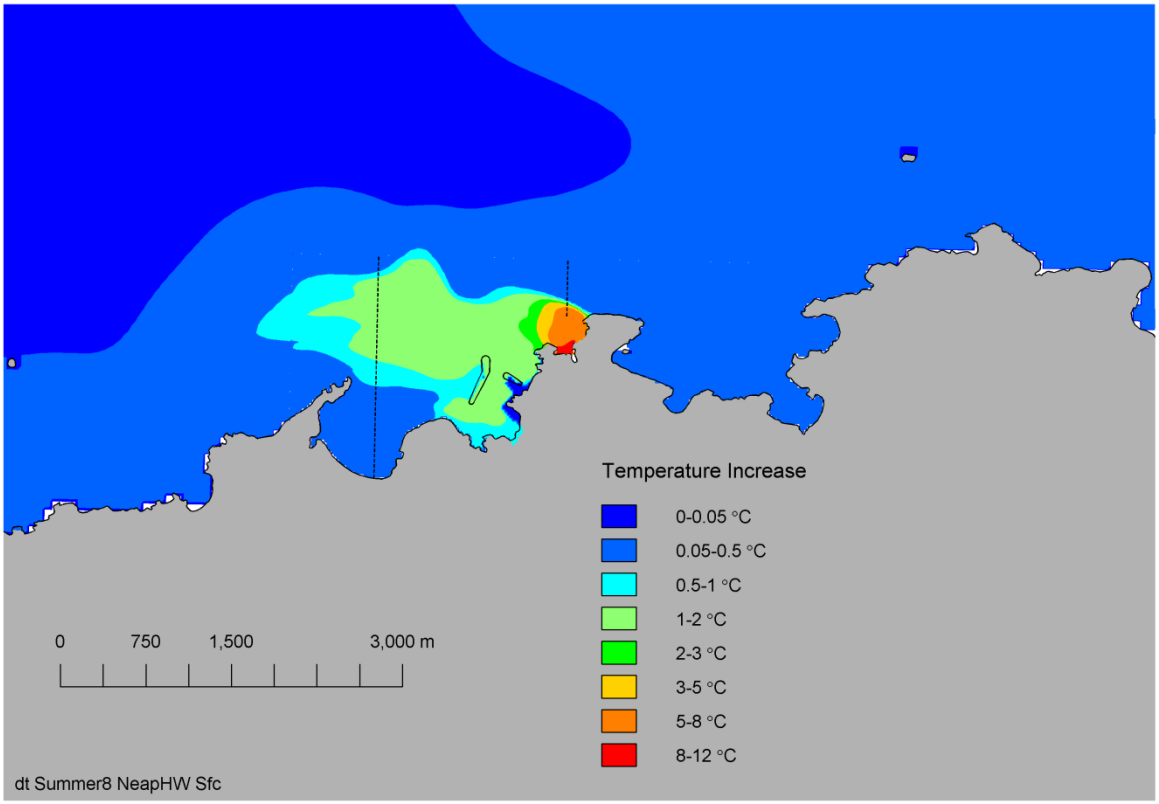

Figure 9-7 Location of cross-sections (dotted lines) (this figure shows rise in surface temperature at high water on a neap tide)

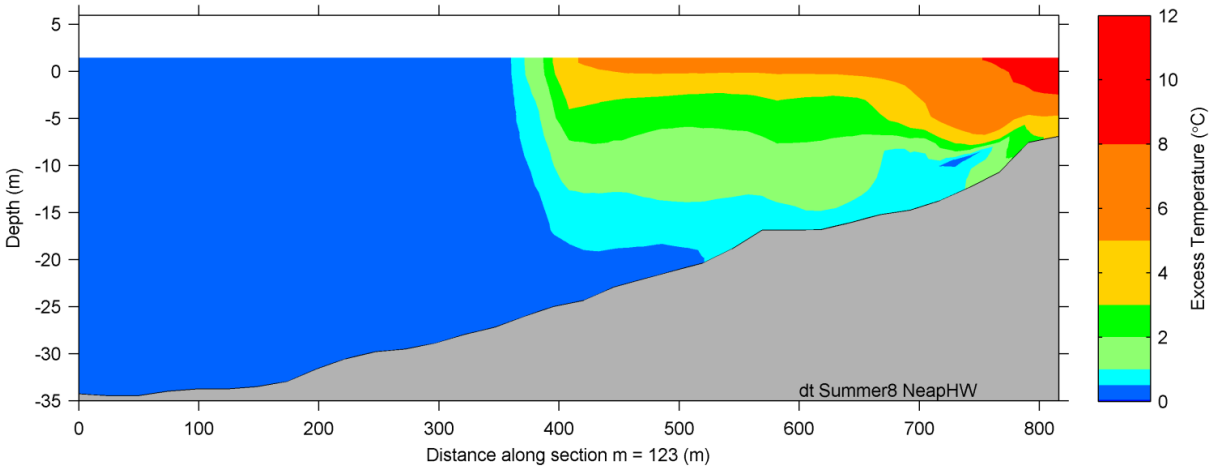

Figure 9-8 Vertical temperature profile at the outfall location at high water – neap tide

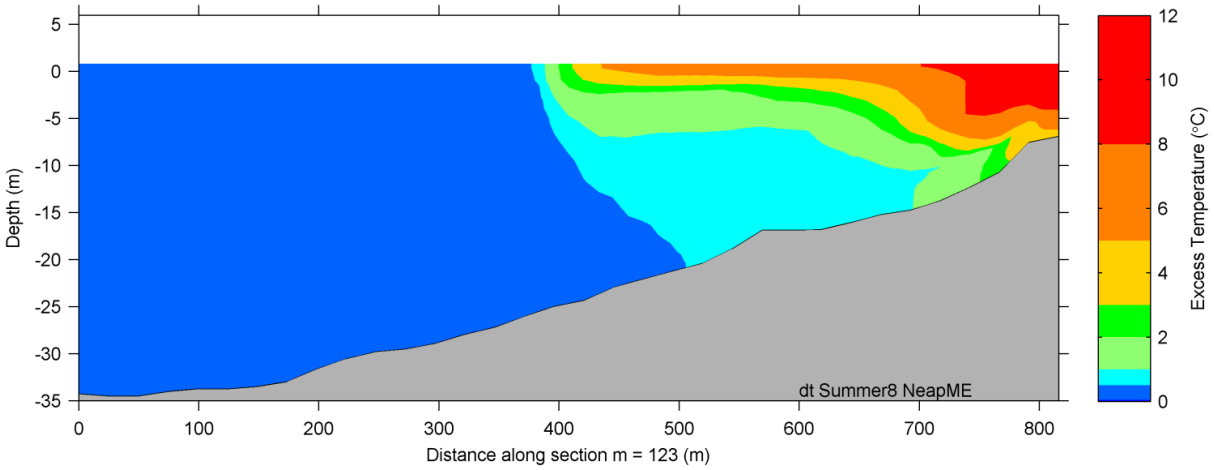

Figure 9-9 Vertical temperature profile at the outfall location at mid ebb – neap tide

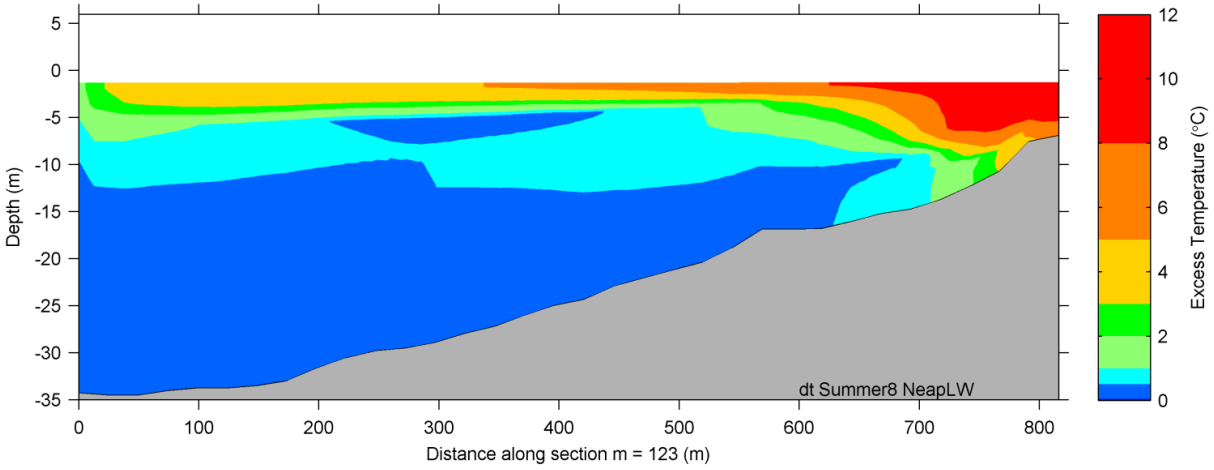

Figure 9-10 Vertical temperature profile at the outfall location at low water – neap tide

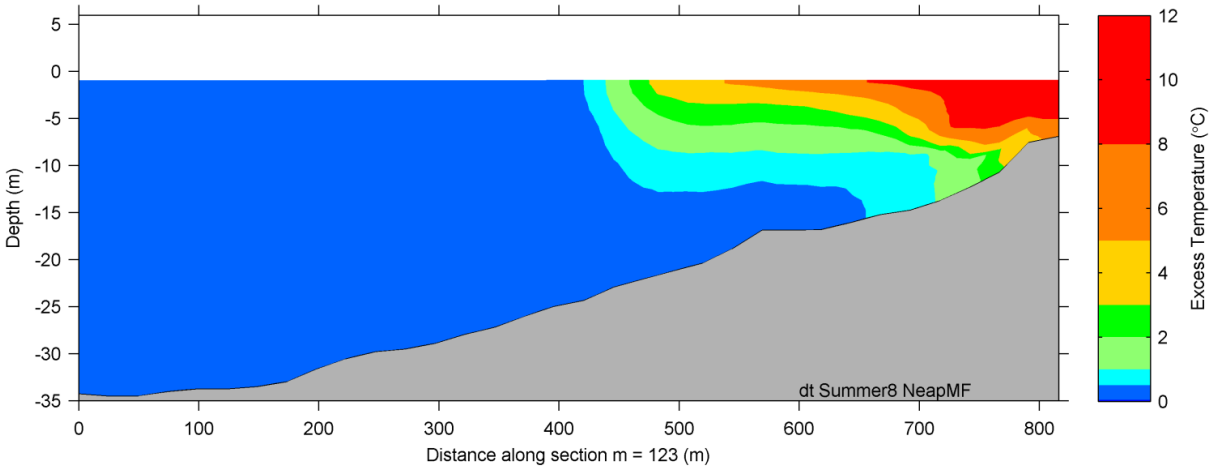

Figure 9-11 Vertical temperature profile at the outfall location at mid flood – neap tide

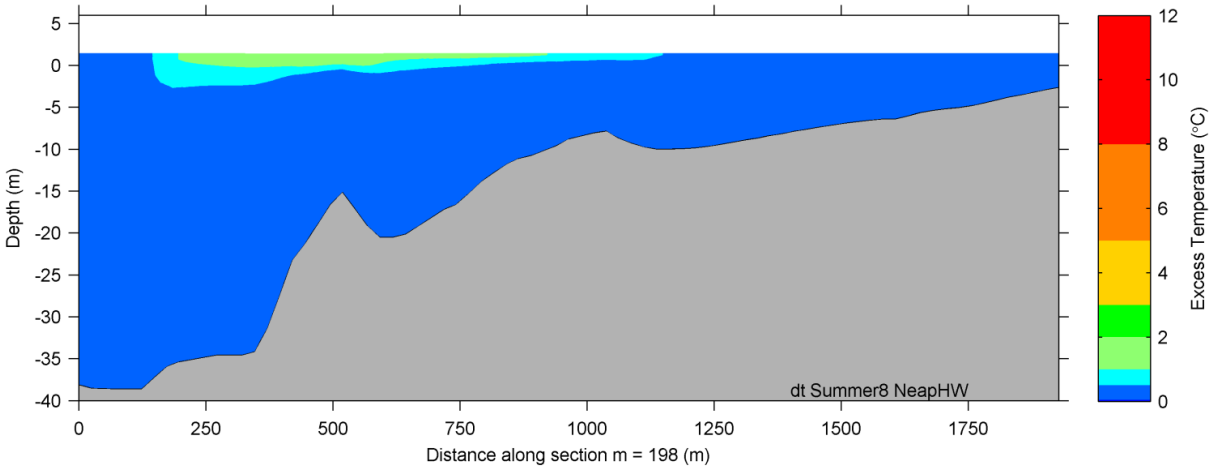

Figure 9-12 Vertical temperature profile at Cemlyn Bay at high water – neap tide

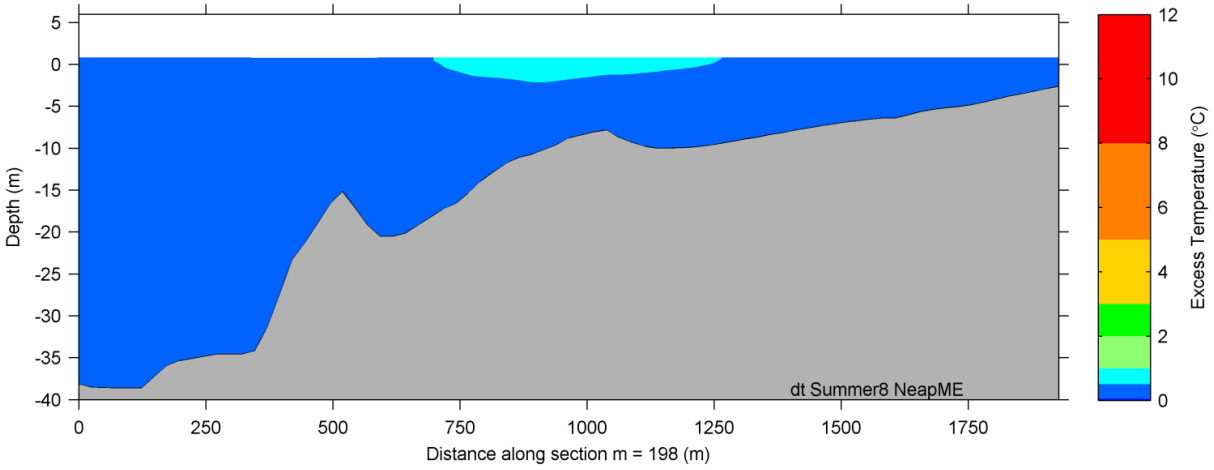

Figure 9-13 Vertical temperature profile at Cemlyn Bay at mid ebb – neap tide

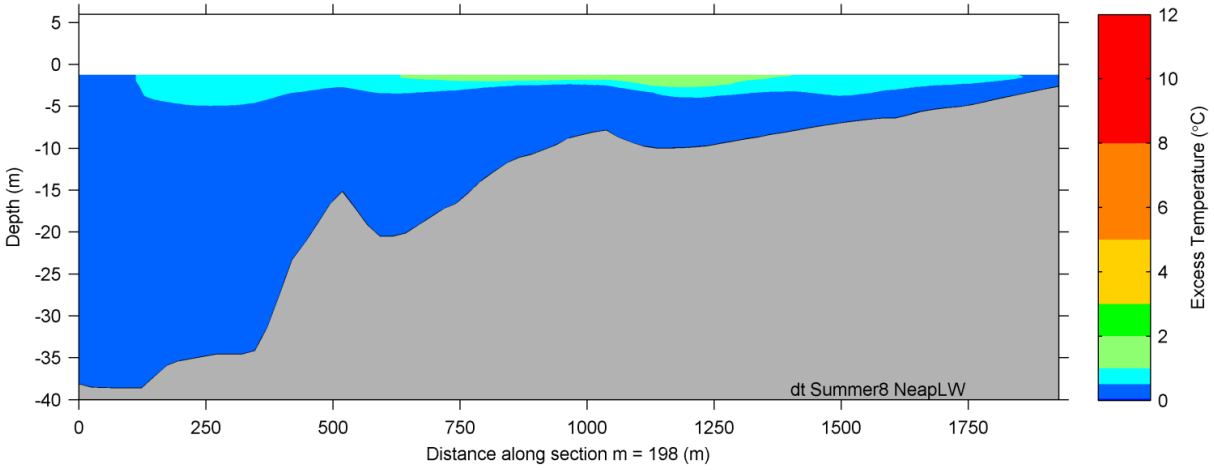

Figure 9-14 Vertical temperature profile at Cemlyn Bay at low water – neap tide

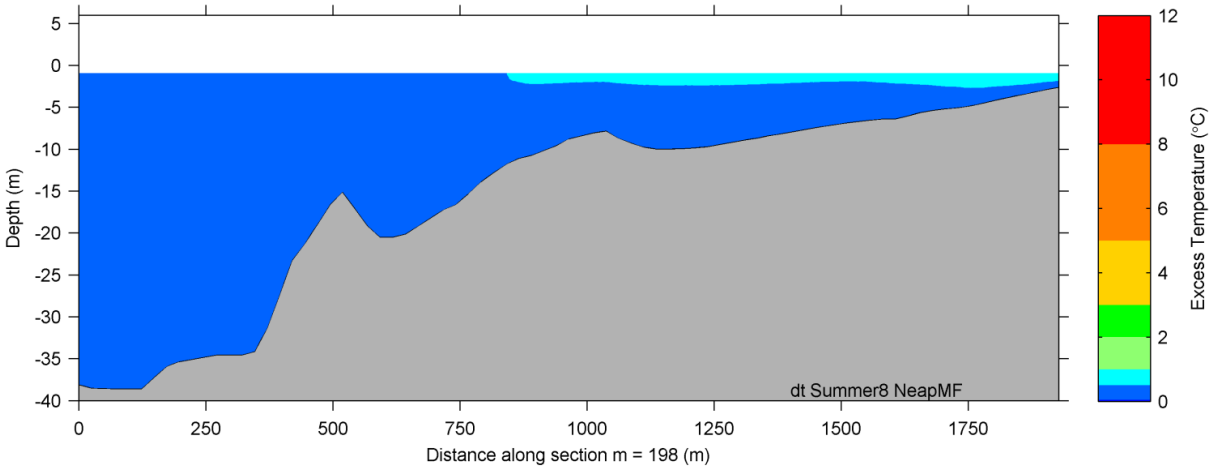

Figure 9-15 Vertical temperature profile at Cemlyn Bay at mid flood – neap tide

Absolute temperature

9.4.59 The predicted annual 98 percentile total (absolute) temperature at the surface and bed are plotted on figure 9-16 and figure 9-17 respectively. The 98 percentile mixing zones with a temperature greater than 21.5°C and 23°C are approximately 26.1 and 13.6 hectares respectively. The area of the 21.5°C and 23°C 98 percentile mixing zones at the bed are limited to the immediate vicinity of the outfall in Porth Wnal.

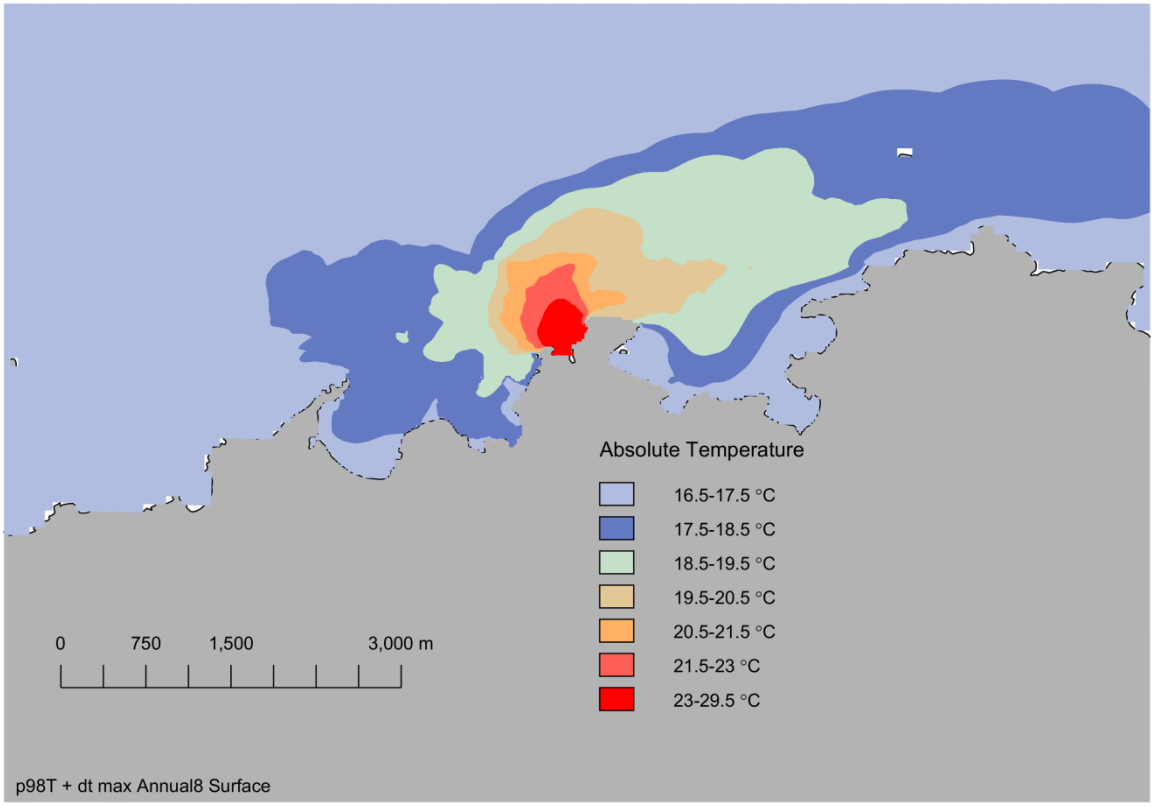

Figure 9-16 98 percentile ambient water temperature with maximum temperature rise (surface)

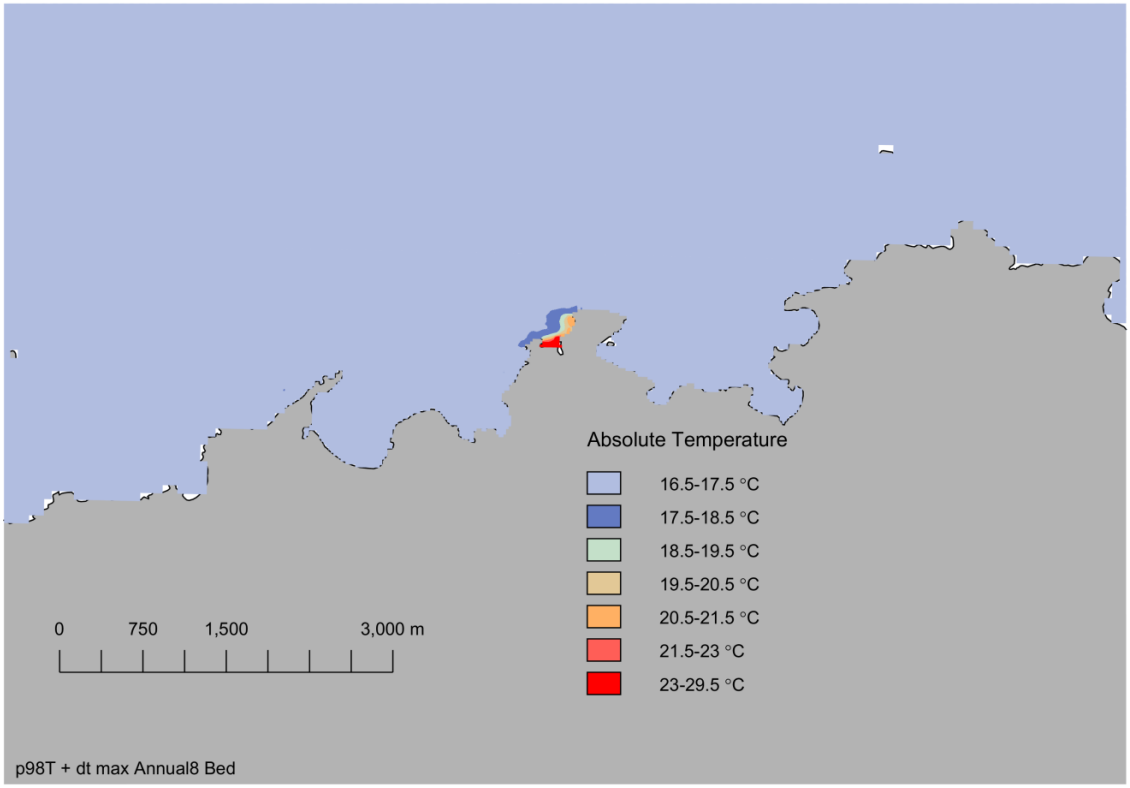

Figure 9-17 98 percentile ambient water temperature with maximum temperature rise (bed)

9.4.60 The thermal tolerance data for Atlantic salmon and sea trout suggests that some effect on the migration pathway may be experienced in the zone where a Maximum Allowable Temperature of 23°C is exceeded. According to the thermal tolerance information for Atlantic salmon and sea trout and the Maximum Allowable Temperature uplift defined by BEEMS [RD24], Atlantic salmon and sea trout are not expected in this case to be influenced by a temperature increase above ambient of 2°C. However, even assuming that Atlantic salmon and sea trout migrating to or from natal rivers were closely following the coastline and did react to an increase in temperature of 2°C, the thermal plume only extends up to approximately 1.1km from the shore at the sea surface and up to approximately 300m from the shore at the seabed at the location on the proposed Cooling Water System outfall. If it is assumed, as a worst case, that Atlantic salmon and sea trout avoid the zone entirely, given the very large unrestricted area that would be available for migration (both horizontally and vertically in the water column), no adverse effects on the energetics or ability to reach/leave natal rivers are predicted. .

Thermal effects on dissolved oxygen

9.4.61 The minimum predicted dissolved oxygen concentration, assuming average salinity of 33.6 and a maximum temperature rise, is greater than the 'high' status boundary value of 5.7mg/L (i.e. the dissolved oxygen standard for coastal water bodies defined in WFD). The minimum saturated dissolved oxygen concentration occurs at the discharge, where the temperature increase is greatest.

9.4.62 As the predicted dissolved oxygen concentration would remain well above the concentration required to achieve high status, it is determined that there would be no significant effect on water quality from changes to dissolved oxygen as a result of the Project's thermal discharge and, consequently, no effect on Atlantic salmon and sea trout.

Thermal effects on pH and on the ratio of ionised to unionised ammonia

9.4.63 Ammonia in water can exist in either an ionised or an unionised form. The unionised form is typically more toxic to aquatic life. The ratio of ionised to unionised ammonia varies with temperature and pH; the concentration of unionised ammonia increases as the temperature increases. The temperature increase from the operation of the Cooling Water discharge could therefore alter the natural ratio.

9.4.64 For all conditions modelled, the unionised ammonia is predicted to remain well below the EQS of 21µg/L for saltwater (WFD). Consequently, there would be no effect on water quality or Atlantic salmon and sea trout from effects on pH and on the ratio of ionised to unionised ammonia as a result of the Project's thermal discharge.

Total Residual Oxidants

9.4.65 The assessment of effects of TRO takes into account embedded mitigation which includes the following:

- The Cooling Water outfall has been designed to maximise the momentum of the discharge to help propel the thermal plume, promote mixing and dispersal of associated biocide products to the north of Wylfa Head, where the offshore currents will aid decay and dispersion, and reduce the risk of recirculation.
- To control biofouling, treatment of the CWS is required. Sodium hypochlorite would be used for this purpose. In line with best practice, continuous dosing would be applied during a higher fouling risk period, typically between April and December, when sea temperatures are above 10°C. Generally biocide dosing would be applied to all areas of the CWS, except around screens to prevent harm to fish impinged on screens. To prevent fouling of the intake area upstream of the screens, intermittent 'shock' treatment is likely to be carried out during outage periods of the screens and pumps. It is intended that the maximum TRO would be no greater than 0.1mg/l at the point of discharge and 0.01mg/l (95 percentile) at the edge of the mixing zone.

9.4.66 The areas of the 0.01mg/L mixing zones' (95 percentile) rise at the surface are presented in table 9-6 for both the annual base case and all seasonal scenarios.

Table 9-6 Area of the 0.01mg/L TRO (95 percentile) mixing zone

Scenario	Area at the surface exceeding 0.01mg/L TRO (95 percentile) (km^2)
Annual base case	2.49
Spring base case (9^oC ambient seawater temperature and wind speed of 6m/s)	2.22
Summer base case (14.6^oC ambient seawater temperature and wind speed of 5.6m/s)	3.13
Autumn base case (14.3^oC ambient seawater temperature and wind speed of 6.8m/s)	2.88
Winter base case (8.5^oC ambient seawater temperature and wind speed of 6.9m/s)	1.85
Summer base case with variable wind (14.6^oC ambient seawater temperature and variable wind speed)	1.28

9.4.67 For the summer base case, the model predicted that the mixing zone at the surface would extend approximately 1km north and 3.9km from east to west (figure 9-18).

9.4.68 The largest area predicted to exceed 0.01mg/L TRO (95 percentile) at the seabed is associated with the winter base case (figure 9-19). Once again, it can be seen that this area is significantly smaller that the area affected at the sea surface (figure 9-18).

9.4.69 There is some evidence regarding the effect of TRO on fish. [RD186] examined data from power plant studies around the world and found no instance of direct fish mortalities associated with a power plant outfall. As fish are motile species and can avoid sub-optimal habitat conditions, the main effects to consider are therefore sub-lethal. This may include changes in local distribution and reduction in feeding opportunities in areas affected.

9.4.70 [RD16] found adult ocean spot (*Leiostomus xanthurus*) had a 96 hour LC_{50} (a measure of toxicity that will kill half the sample population) of 0.09mg/L TRO in a through flow experiment [RD95]. Although not found in UK waters, it provides an example of an adult fish tolerance.

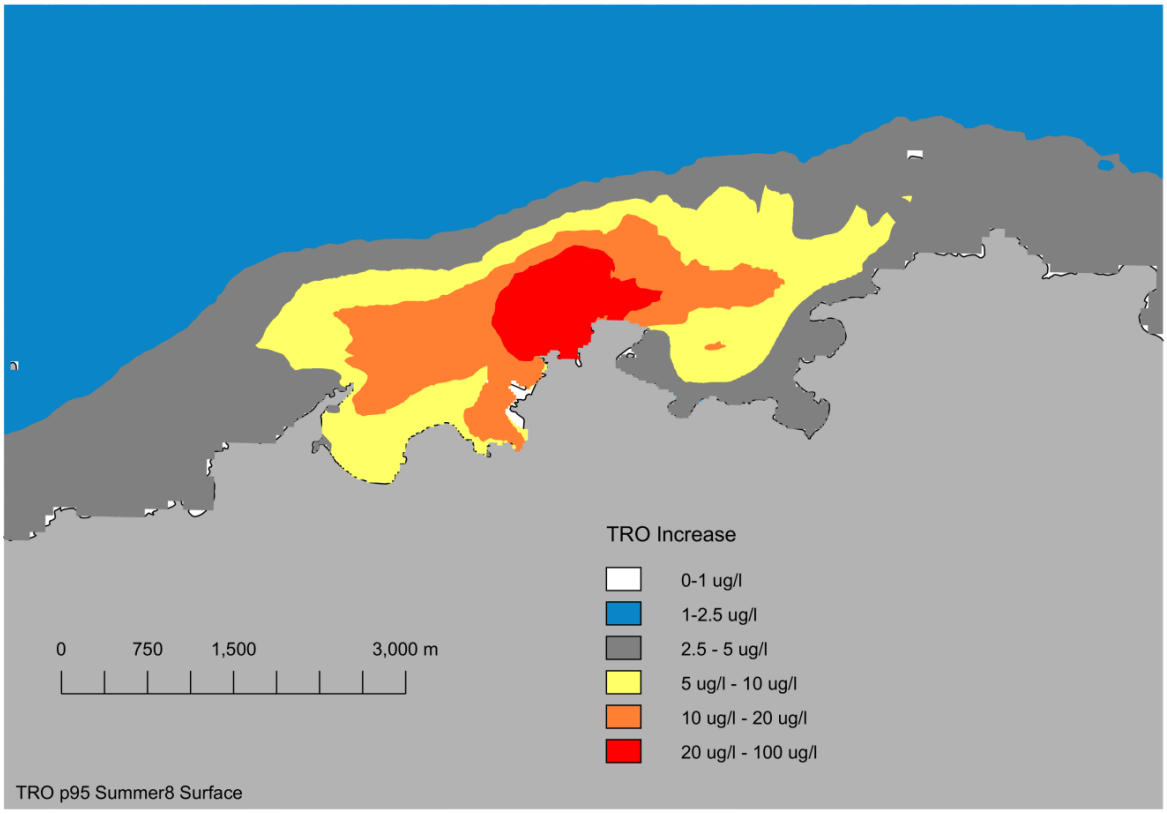

Figure 9-18 Surface TRO concentration (95 percentile, summer base case)

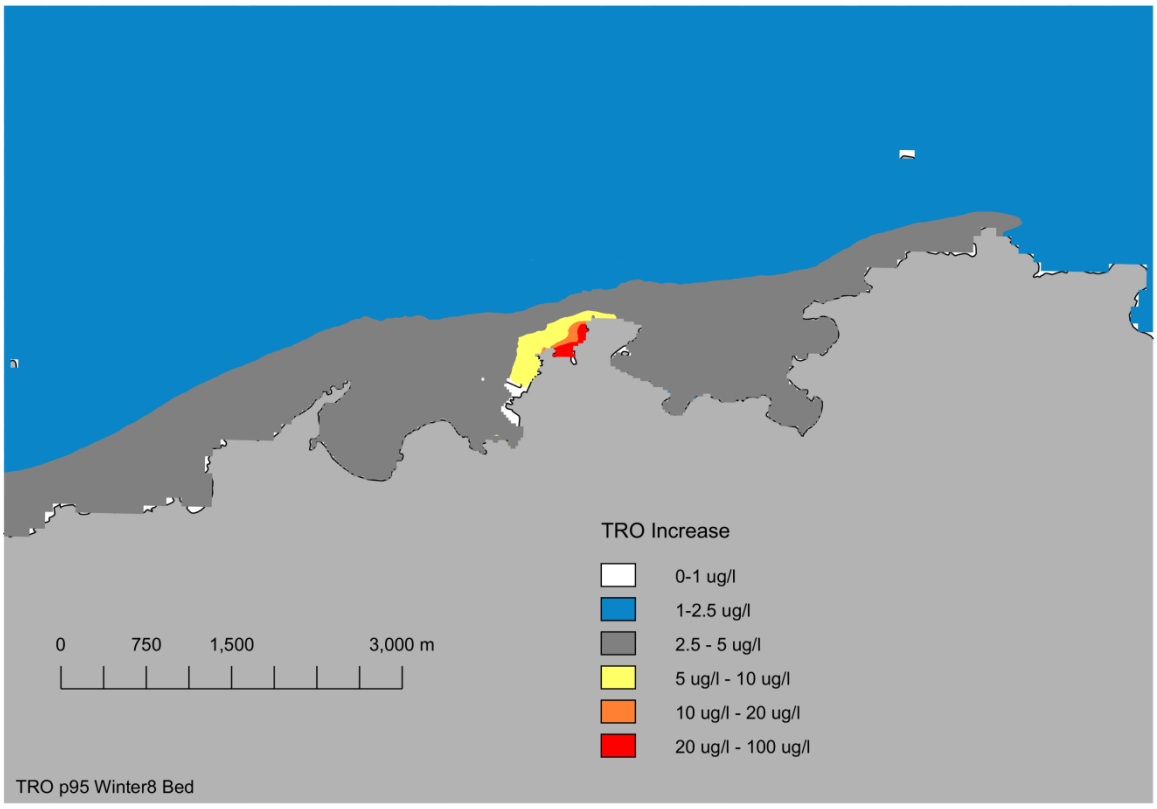

Figure 9-19 Seabed TRO concentration (95 percentile, winter base case)

9.4.71 European eel elvers exposed to TRO concentrations of 0.102mg/L for seven days at 22ºC exhibited 100% mortality [RD344]. This concentration is just above that expected at the point of discharge, therefore, if elvers remained in areas subject to maximum concentration (which is highly unlikely) then mortalities could, in theory, occur. In reality, fish would be able to avoid areas of increased TRO, therefore, mortalities are unlikely. In the absence of specific data for Atlantic salmon and sea trout, the above evidence has been taken as the best proxy evidence to support the assessment for Atlantic salmon and sea trout smolt, and it is assumed that adult fish would be far less susceptible and more able to avoid unfavourable areas.

9.4.72 Areas close to the outfall experiencing the highest TRO are unlikely to have a high density of juvenile or adult salmon or sea trout; this conclusion is supported by the results of the fish surveys and the entrapment surveys at the Existing Power Station.

9.4.73 As Atlantic salmon and sea trout are able to move away from the source and given the predicted extent of the effect, the effect on them is not expected to be significant.

9.4.74 In terms of the potential effect on the Atlantic salmon and sea trout population, the basis for the expectation referred to is that if it is assumed that fish can detect and avoid the mixing zone for TRO, the displacement effect and the effect on ability to migrate would be the same as described above for avoidance of the thermal plume, given the similar area of extent of the thermal and TRO mixing zone. Even if no avoidance takes place, the exposure time for fish migrating through the mixing zone would be limited and not expected to result in adverse effect at the population level.

9.4.75 Given the above, it is concluded there is no potential for an adverse effect on Atlantic salmon, sea trout or the integrity of European Designated Sites in question to arise due to operational discharges from the Cooling Water System.

Discharge of sodium nitrite from the Cooling Water System

9.4.76 An H1 assessment of the operational discharge from the CWS has been undertaken and the screening stage of the H1 assessment concluded that sodium nitrite should be subject to further assessment. Sodium nitrite is listed in the OSPAR List of Substances Used and Discharged Offshore which are Considered to Pose Little or No Risk to the Environment.

9.4.77 The maximum sodium nitrite concentration in the effluent at the point of discharge (i.e. before any mixing taking place) is predicted to be 22.045µg/L. In the absence of an EQS for sodium nitrite, the predicted no effect concentration (PNEC) value of 6µg/L was been used in the H1 assessment.

9.4.78 ES volume D, chapter D13 (Application Reference Number: 6.4.13) includes a literature review of the predicted effects of sodium nitrite on a range of species, including marine fish species, one of which is sea trout. The literature review collates the 96-h LC_{50} thresholds (i.e. the concentration at which 50% of the test sample suffer mortality after 96 hours) for these species.

9.4.79 For sea trout, the 96-h LC_{50} nitrite concentration reported in the literature is 980mg/L (i.e. approximately 44,545 times greater than the predicted maximum sodium nitrite concentration).

9.4.80 Although not relevant to Atlantic salmon or sea trout, but reported here to provide a sensitivity test on a precautionary basis, the most sensitive fish species identified from the literature review was rainbow trout (noting that this is a freshwater species). The maximum concentration of sodium nitrite will be over six times lower than the 96-h LC_{50} for this species.

9.4.81 The literature review reports that saline water has a toxicity-reducing effect for sodium nitrite in that it inhibits nitrite uptake by organisms.

9.4.82 A combination of the predicted concentration of sodium nitrite with the likely response of Atlantic salmon and sea trout means that no significant effect on these species is predicted to occur and, therefore, no potential exists for an adverse effect on the integrity of European Designated Sites to arise.

C Alteration of coastal processes and hydrodynamics

Construction and operation

C1 Alteration in coastal processes and hydrodynamic effect [Marine Licence]

Predicted effects

9.4.83 The coastal processes and geomorphology assessment (Application Reference Number: 6.4.12) provides a full assessment of the predicted effects of the Project during the construction and operational phases. Two scenarios in the construction phase have been assessed – a partially built scenario and a fully built scenario. Both of these scenarios are assessed for present day (defined as 2023) conditions. The longer term potential operational effects are assessed as a foreseeable future scenario (2087).

9.4.84 The results of the coastal processes assessment for the construction and operational phases are summarised in chapter 7 (effect D). The assessment concludes that effects on waves, tidal currents, bed shear stress and sediment regime are localised and of low magnitude. In terms of the potential effect on Atlantic salmon and sea trout, the predicted changes are considered very unlikely to affect behaviour and would not affect their ability to migrate due to the very small zone where changes are predicted to occur in the context of the migration pathway. No effect on supporting habitat for Atlantic salmon or sea trout is predicted to occur.

9.4.85 Consequently, an adverse effect on Atlantic salmon or sea trout, or the integrity of the European Designated Sites in question, is not predicted to occur.

D Physical interaction between species and Project infrastructure

Construction

9.4.86 No hazards during the construction phase were identified in the screening assessment for Atlantic salmon or sea trout or the related European Designated Sites for this screening category.

Operation

D1 Entrapment within the Cooling Water System [Operational water discharge EP]

Introduction

9.4.87 There is the potential for fish, including the smolt, juvenile and adult stages of Atlantic salmon (not fry and parr as these are the freshwater stages of the life history) and sea trout, to be entrapped (impinged or entrained) within the Cooling Water abstraction system. For entrapment to occur, fish would have to be migrating past the intake structure (which will be located at the southern end of Porth-y-pistyll); the Stage 1 Screening assessment assumed, on a precautionary basis using professional judgement, that adult fish would need to pass within 50m of the intake and juvenile fish would need to pass within 250m of the intake to be at risk of entrapment.

Predicted effects

9.4.88 The likelihood of adult Atlantic salmon migrating through Porth-y-pistyll (i.e. hugging the immediate coast within tens of metres of the intake) is considered to be extremely low based on the results of the fish surveys undertaken. Application Reference Number: 6.4.13 states that Atlantic salmon were not recorded in the marine surveys undertaken for the EIA from 2010 to 2015, nor in the entrapment surveys at the Existing Power Station undertaken between 2011 and 2012. There is a greater likelihood of sea trout being present on the basis of the survey information.

9.4.89 Juvenile Atlantic salmon and sea trout could be entrapped if migrating at greater distances from the intake (up to 250m). However (as set out above), the entrapment surveys undertaken at the Existing Power Station (2011 – 2012) (see Application Reference Number: 6.4.86), noting that the Existing Power Station did not have mitigation measures incorporated into the CWS, did not record any adult or juvenile Atlantic salmon, and only one historic record exists. The risk of entrapment of sea trout is greater than for Atlantic salmon as they appear to be more numerous (although they are present in relatively low abundance) and have more localised migration than Atlantic salmon.

9.4.90 The CWS includes mitigation measures embedded into the design, comprising the following:

- Screens, in the form of coarse raked bars located in front of fine mesh drum screens (for the main Cooling Water intake) and band screens (for

the service water intake), would be used. The proposed fine mesh screen size would be 5mm. There are likely to be a minimum of three main screens at the cooling water intake and two service water screens per unit; this would incorporate redundancy to allow maintenance and biocide treatment of screens and adequate and effective fish handling capacity.

- An acoustic fish deterrent would be provided in front of the Cooling Water intake, which would be designed in line with the Best Available Technique. The sound field would be located in the most appropriate location within the intake entrance; it will be specified to allow redundancy in the system and supported by modelling to demonstrate a uniform sound field. It will also be designed to avoid effects on marine mammals.
- An effective recovery and return system will be designed and provided in line with the Best Available Technique that would remove fish impinged on all screens and return them to sea.

9.4.91 If it is assumed that Atlantic salmon and sea trout are migrating along the coastline in this location, the above mitigation measures provide confidence that there would be a low risk of entrapment. These in-built mitigation measures provide confidence that no effect on Atlantic salmon or sea trout populations is likely as a result of entrapment.

9.4.92 Consequently, an adverse effect on Atlantic salmon and sea trout, and the integrity of the European Designated Sites in question, is not predicted to occur.

E Interactions between species – freshwater pearl mussel

Construction and operation

Introduction

9.4.93 The only route for a potential effect on freshwater pearl mussel (Afon Eden–Cors Goch Trawsfynydd SAC) is via an effect on sea trout populations given the relationship between these two species. Freshwater pearl mussel larvae are either ingested or inhaled by the host fish species in the river; hence the only potential impact pathway on this species relates to sea trout populations being adversely affected in their natal river.

Predicted effects

9.4.94 The Project does not have the potential to have any direct effects on the freshwater pearl mussel within the boundary of the Afon Eden–Cors Goch Trawsfynydd SAC. The Afon Eden–Cors Goch Trawsfynydd SAC is approximately 180km from the Wylfa Newydd Development Area. The assessment provided above does not predict that sea trout stock will be denuded due to the Project in its construction or operational phase.

9.4.95 Hence, in light of the conclusions of this Shadow HRA for sea trout (summarised in section 9.6), where no effect on the sea trout population is predicted, it is concluded that there is no potential for the Project to have an adverse effect on freshwater pearl mussel or the integrity of the Afon Eden–Cors Goch Trawsfynydd SAC in relation to this qualifying feature.

9.5 Assessment of potential effects (in-combination)

9.5.1 There is the potential that the Project could have an effect on Atlantic salmon in-combination with the effects of the Glyn Rhonwy Pumped Storage scheme, resulting in a combined effect on the population of the Afon Gwyrfai a Llŷn Cwellyn SAC. However, the effect of the Project is predicted to be insignificant in the context of the migration of Atlantic salmon and the Project is not predicted to have any effect on the Atlantic salmon population. Given this, and in light of the Examining Authority's conclusion with respect to the Atlantic salmon population of the Afon Gwyrfai a Llŷn Cwellyn SAC (that with the secured mitigation measures and Environmental Permits in place there are unlikely to be any significant effects on fish), no LSIE is predicted.

9.6 Conclusion for the SACs

9.6.1 The conservation objectives for the SACs refer to Atlantic salmon population stability and viability, the natural range of the qualifying feature not being reduced and no reduction in habitat area and quality.

9.6.2 For the freshwater pearl mussel qualifying feature of the Afon Eden–Cors Goch Trawsfynydd SAC, the conservation objectives refer to maintaining a viable population on a long term basis; no contraction in the number, age range, distribution or size of mussel beds found within the population; sufficient habitat being available to support a viable population; and the transference of pearl mussel glochidia (larvae) is being facilitated by an abundant and self-sustaining Atlantic salmon population.

9.6.3 Given that the conservation objectives were written before the NRW research confirming that sea trout is the host species for freshwater pearl mussel for the Afon Eden population, the conservation objective for Atlantic salmon has been assumed to apply for sea trout.

9.6.4 In this context it is concluded that an adverse effect on integrity would not arise (either alone or in-combination with other plans and projects) with respect to the Atlantic salmon interest feature of the Afon Gwyrfai a Llŷn Cwellyn SAC, Afon Eden–Cors Goch Trawsfynydd SAC, Afon Dyfrdwy a llyn Tegid/River Dee and Bala Lake SAC and Afon Teifi/River Teifi SAC (nor the freshwater pearl mussel interest feature of the Afon Eden–Cors Goch Trawsfynydd SAC) and therefore for the sites themselves. In addition, no adverse effect on the conservation status of the SACs is predicted. In reaching this conclusion, the combined effect of the individual Project effects has been considered.

9.6.5 The basis for this conclusion is that the predicted effects of the Project on underwater noise, coastal processes and water quality during its construction and operational phases are not significant in the context of the

migration pathways for juvenile and adult Atlantic salmon or sea trout. In addition, no significant entrapment in the CWS is predicted to occur due to very low potential for entrapment based on survey data from the Existing Power Station and the embedded mitigation designed into the Cooling Water System to reduce any impact on fish.

9.6.6 For the decommissioning phase, there is the potential for an effect on marine water quality and changes in visual and acoustic stimuli. However, on the basis of the assumptions made regarding the effects associated with decommissioning (described in section 5.4) (i.e. that the effect of the works would be within that associated with the construction phase), no adverse effect during decommissioning is predicted.

9.6.7 The conclusion reached for the Afon Gwyrfai a Llŷn Cwellyn SAC, Afon Eden–Cors Goch Trawsfynydd SAC, Afon Dyfrdwy a llyn Tegid/River Dee and Bala Lake SAC and Afon Teifi/River Teifi SAC is summarised in table 9-7 (× = no adverse effect on integrity).

Table 9-7 Conclusions for Atlantic salmon and freshwater pearl mussel

Site Features	Changes in visual and acoustic stimuli	Changes in marine water quality	Alteration of coastal processes and hydro-dynamics	Physical interaction between species and Project infra-structure
Atlantic salmon *(Salmo salar)*	×	×	×	×
Freshwater pearl mussel (*Margaritifera margaritifera*)*	×	×	×	×

* Only relevant to the Afon Eden–Cors Goch Trawsfynydd SAC.

10 Appropriate Assessment: birds

10.1 Introduction

10.1.1 The Stage 1 Screening assessment concluded that LSE could not be excluded for a total of 23 SPAs and pSPAs, of which four are also Ramsar sites. The full list of these European Designated Sites is:

- Morwenoliaid Ynys Môn/Anglesey Terns SPA;
- Glannau Ynys Gybi/Holy Island Coast SPA;
- Ynys Seiriol/Puffin Island SPA;
- Glannau Aberdaron and Ynys Enlli/Aberdaron Coast and Bardsey Island SPA;
- Mynydd Cilan, Trwyn y Wylfa ac Ynysoedd Sant Tudwal/Mynydd Cilan, Trwyn y Wylfa and the St. Tudwal Islands SPA;
- Aber Afen Dyfrdwy/Dee Estuary SPA and Ramsar site;
- Sgomer, Gogwm a moroedd Benfro/Skomer, Skokholm and the seas off Pembrokeshire SPA;
- Grassholm SPA;
- Mersey Narrows and North Wirral Foreshore SPA and Ramsar site;
- Ribble and Alt Estuaries SPA and Ramsar site;
- Bowland Fells SPA;
- Morecambe Bay SPA and Ramsar site;
- Morecambe Bay and Duddon Estuary pSPA;
- Lambay Island SPA;
- Ireland's Eye SPA;
- East Coast (Northern Ireland) Marine pSPA;
- Copeland Islands SPA;
- Saltee Islands SPA;
- Rathlin Island SPA;
- Horn Head to Fanad Head SPA;
- West Donegal Coast SPA;
- Tory Island SPA; and,
- Ailsa Craig SPA.

10.1.2 LSE has been determined for the majority of these sites on the basis of breeding seabird populations which may use the marine environment within the ZOIs associated with the Wylfa Newydd Development Area (and the Disposal Site) as foraging habitat and, in the case of the Morwenoliaid Ynys Môn/Anglesey Terns SPA, because they also nest in close proximity to the Wylfa Newydd Development Area. However, LSE has been determined for

two of the SPAs and Ramsar sites (i.e. Dee Estuary and Mersey Narrows and Wirral Foreshore) on the basis of passage seabird species; whilst LSE has been determined for the Glannau Ynys Gybi/Holy Island Coast SPA, the Glannau Aberdaron and Ynys Enlli/Aberdaron Coast and Bardsey Island SPA and Mynydd Cilan, Trwyn y Wylfa ac Ynysoedd Sant Tudwal/Mynydd Cilan, Trwyn y Wylfa and the St Tudwal Islands SPA on the basis of breeding and non-breeding chough populations (LSE being determined for the Glannau Aberdaron and Ynys Enlli/Aberdaron Coast and Bardsey Island SPA on the basis of both seabird and chough qualifying features).

10.1.3 The implications of the Project for these European Designated Sites are considered in this chapter. This begins with an assessment of the predicted effects on the Morwenoliaid Ynys Môn/Anglesey Terns SPA (section 10.3), before considering the wide range of European Designated Sites for which LSE has been determined on the basis of other breeding and passage seabird qualifying features. For those European Designated Sites for which other breeding seabirds are qualifying features, the assessment considers the findings derived from the apportionment exercise undertaken on the breeding seabird populations in chapter 6 as the first stage. The final section of the assessment considers the predicted effects of the Project on those SPAs for which LSE has been determined on the basis of chough as a qualifying feature.

10.2 Summary of Screening outcomes

Alone

10.2.1 The Stage 1 Screening assessment concluded that the potential for a LSE to arise exists (or cannot be ruled out) with respect to the screening categories and interest features set out in table 10-1 (✓ = LSE, × = no LSE).

Table 10-1 Screening outcomes for birds

Site Features	Changes in visual and acoustic stimuli	Land-take (including seabed or inter-tidal)	Changes in marine water quality	Changes in surface and ground-water hydrology	Change in air quality	Alteration of coastal processes and hydro-dynamics	Physical interaction between species and Project infra-structure
Sandwich tern (*Sterna sandvicensis*)	✓	✓	✓	✓	✓	✓	✓
Common tern (*Sterna hirundo*)	✓	✓	✓	✓	✓	✓	✓
Arctic tern (*Sterna paradisaea*)	✓	✓	✓	✓	✓	✓	✓
Roseate tern (*Sterna dougallii*)	✓	✓	✓	✓	✓	✓	✓

Site Features	Changes in visual and acoustic stimuli	Land-take (including seabed or inter-tidal)	Changes in marine water quality	Changes in surface and ground-water hydrology	Change in air quality	Alteration of coastal processes and hydro-dynamics	Physical interaction between species and Project infra-structure
Cormorant (*Phalacrocorax carbo*)	✓	✓	✓	×	×	✓	✓
Manx shearwater (*Puffinus puffinus*)	✓	✓	✓	×	×	✓	✓
Gannet (*Morus bassanus*)	✓	✓	✓	×	×	✓	✓
Lesser black-backed gull (*Larus fuscus*)	✓	✓	✓	×	×	✓	✓
Fulmar (*Fulmarus glacialis*)	✓	✓	✓	×	×	✓	✓
Guillemot (*Uria aalge*)	✓	✓	✓	×	×	✓	✓
Puffin (*Fratercula arctica*)	✓	✓	✓	×	×	✓	✓
Red-billed chough (*Pyrrhocorax pyrrhocorax*)	✓	✓	×	×	✓	×	×

In-combination

10.2.2 The in-combination screening assessment concluded that the potential for a LSIE to arise exists (or cannot be ruled out) for the Morwenoliaid Ynys Mön/Anglesey Terns SPA with respect to the projects and screening categories identified in table 10-2 (✓ = potential for LSIE; × = no potential for LSIE). Therefore they have been assessed further to determine the potential for any in-combination effect with the Project that could adversely affect the integrity of the European Designated Site in question.

10.2.3 For the remaining SPAs for which LSE was determined, it was concluded that there were no realistic pathways for significant in-combination effects with other projects in most instances. This was on the basis of the conclusions of the Project-alone assessment that the Wylfa Newydd Development Area (and associated ZOIs) was likely to support such low numbers of birds from the relevant SPA populations that there was no potential for adverse effects. However, the potential for in-combination LSIE to arise was identified for the Aberdaron and Ynys Enlli/Aberdaron Coast and Bardsey Island SPA in relation to the Manx shearwater qualifying feature and for the Glannau Ynys Gybi/Holy Island Coast SPA in relation to the chough qualifying feature (table 10-2).

10.2.4 As described in chapter 5, there is no potential for LSIE in relation to any of the SPAs, pSPAs or Ramsar sites screened into Stage 2 of the Shadow HRA with any of the plans scoped into the assessment.

Table 10-2 Projects relevant to the in-combination assessment (i.e. where there is potential for LSIE with the Project)

Site Features	Changes in visual and acoustic stimuli	Land-take (including seabed or inter-tidal)	Changes in marine water quality	Changes in surface and ground-water hydrology	Change in air quality	Alteration of coastal processes and hydro-dynamics	Physical interaction between species and Project infra-structure
Morwenoliaid Ynys Mön/Anglesey Terns SPA							
Wylfa Decommissioning	✓	×	✓	×	×	×	×
Anglesey Eco Park	✓	×	✓	×	×	✓	✓
North Wales Connection Project	✓	×	×	×	×	×	×
Rhyd-y-groes Re-power	✓	×	×	×	×	×	✓
Almwch LNG (Liquified Natural Gas)	✓	×	×	×	×	×	×
Holyhead Deep 10MW Tidal kite installation	✓	✓	✓	×	×	✓	✓
West Anglesey Demonstration Zone	✓	✓	✓	×	×	✓	✓
Visitor and Media Centre (Horizon)	✓	×	✓	×	×	×	×
Aberdaron and Ynys Enlli/Aberdaron Coast and Bardsey Island SPA							
Holyhead Deep 10MW tidal kite installation (or 'Minesto' project)	✓	✓	✓	×	×	✓	✓
West Anglesey Demonstration Zone	✓	✓	✓	×	×	✓	✓
Glannau Ynys Gybi/Holy Island Coast SPA							
Wylfa Decommissioning	✓	✓	×	×	×	×	×
Anglesey Eco Park	✓	✓	×	×	×	×	×
North Wales Connection Project	✓	✓	×	×	×	×	✓
Holyhead waterfront Deevlopment	✓	✓	×	×	×	×	×

Site Features	Changes in visual and acoustic stimuli	Land-take (including seabed or inter-tidal)	Changes in marine water quality	Changes in surface and ground-water hydrology	Change in air quality	Alteration of coastal processes and hydro-dynamics	Physical interaction between species and Project infra-structure
Rhyd-y-groes Re-power	✓	✓	×	×	×	×	✓
Almwch LNG (Liquified Natural Gas)	✓	✓	×	×	×	×	×
Visitor and Media Centre (Horizon)	✓	✓	×	×	×	×	×

10.3 Morwenoliaid Ynys Môn/Anglesey Terns SPA

Conservation Objectives

10.3.1 The existing conservation objectives for the Morwenoliaid Ynys Môn/Anglesey Terns SPA presented in section 4.1 of the SPA Core Management Plan [RD43] are as follows:

- The number of breeding terns within the SPA is stable or increasing.
- The number of chicks successfully fledged in the SPA and beyond is sufficient to help sustain the population.
- The range and distribution of terns within the SPA and beyond is not constrained or hindered.
- The extent of supporting habitats used by terns is stable or increasing.
- Supporting habitats are of sufficient quality to support the requirements of terns.
- There are appropriate and sufficient food sources for terns within access of the SPA.
- Actions or events likely to impinge on the sustainability of the population are under control.

10.3.2 As specified in the Core Management Plan [RD43], the conservation status of Arctic tern (*Sterna paradisaea*), Sandwich tern (*Sterna sandvicensis*) and common tern (*Sterna hirundo*) is 'favourable: maintained'. The conservation status of roseate tern (*Sterna dougallii*) is 'Unfavourable: no change'.

Effects on Sandwich tern (Sterna sandvicensis) (alone)

10.3.3 A range of pathways exist for potential effects from the Project on the Morwenoliaid Ynys Môn/Anglesey Terns SPA population of breeding Sandwich terns (as summarised in table 10-1). These include effects that have the potential to affect the population at the nesting colony (e.g. changes in air quality), within the supporting marine foraging habitats (e.g. changes in marine water quality or prey abundance, composition and

distribution) or both at the colony and in their marine foraging habitats (e.g. changes in visual and acoustic stimuli).

10.3.4 The pathways by which these potential effects operate may affect the first three conservation objectives for the SPA (as listed above) via direct effects on numbers, breeding success and distribution, or indirectly via effects on those conservation objectives concerned with the quality and extent of supporting habitats (either at the colony or in the marine environment) and access to food sources. Both the direct and indirect effects are relevant to the conservation objective concerned with the control of actions or events that may impinge on population sustainability.

10.3.5 The entire SPA population of Sandwich tern nests at the Cemlyn Bay colony, with the exception of occasional pairs recorded at Ynys Feurig (table 6-6). The Cemlyn Bay colony is the closest of the three SPA colonies to the Project. The Sandwich tern SPA population has increased since it was designated in 1992 (as Ynys Feurig, Cemlyn Bay and The Skerries). The estimate for the SPA at designation is 460 pairs ([RD236], [RD328]) whilst the most recent five-year mean population estimate is 2,398 pairs (table 6-6).

A Changes in visual and acoustic stimuli

10.3.6 In relation to the Morwenoliaid Ynys Môn/Anglesey Terns SPA Sandwich tern population, visual and acoustic stimuli could affect the population as a result of either disturbance to breeding birds when they are present at the Cemlyn Bay colony (during pre-laying, or in attendance of nests or chicks), or disturbance to breeding birds from the colony when they are commuting or foraging in the marine environment. Disturbance to birds present at the colony could potentially reduce breeding success (e.g. by causing birds to fly up and temporarily leave nests or chicks unattended, making them more vulnerable to predation) and/or directly affecting colony attendance. Disturbance to birds foraging or commuting in the marine environment could reduce the available foraging habitat, foraging efficiency and/or increase energetic demands when commuting between the colony and foraging areas.

10.3.7 These two possible routes via which effects could potentially arise are considered separately below.

Construction

A1 Disturbance at the breeding colony [Marine Licence]

Anthropogenic disturbance and nesting terns

10.3.8 Noise, vibration and visual disturbance resulting from the construction activities associated with the Project are considered to have the potential to cause Sandwich terns using the Cemlyn Bay colony to experience reduced breeding success or to even abandon the colony. Reduced breeding success could arise as a result of disturbance causing birds to fly up and leave their nests or chicks unattended for longer causing increased exposure

to predation (e.g. [RD29], [RD211) and potentially chilling (and subsequent mortality) of eggs and chicks. Colony abandonment can occur as a consequence of breeding failure, or conceivably even as a direct result of high levels of disturbance ([RD27], [RD215], [RD257]).

10.3.9 Anthropogenic disturbance (as a source of noise and visual stimuli) can cause detrimental effects on bird populations [RD323] and has often been implicated as a cause of reduced breeding success and sometimes colony abandonment in tern populations ([RD27], [RD29], [RD36]), including those of Sandwich tern [RD59]. However, much of the evidence for such effects does not withstand scientific scrutiny, with effects of anthropogenic disturbance often difficult to disentangle from other effects, such as predation or changes in prey supply (e.g. [RD243]).

10.3.10 In terms of providing general context and background, it is worth noting that terns may breed in situations where there are high levels of human activity, and where there is a high potential for noise and visual disturbance. For example, some of the largest common tern colonies in the UK and Ireland currently occur at industrial sites. At the time of the Seabird 2000 census, the third and fourth largest common tern colonies in the UK were to be found at Imperial Dock, Leith and within the Shotton Steel Works complex in North Wales, respectively [RD215]. The Imperial Dock colony occurs within a fully operational port where vessels of between approximately 30 – 190m length pass within inches of the colony, short and infrequent bursts of loud noise occur (e.g. from ship horns and movement of industrial equipment), two large gantry cranes operate nearby, and vehicles and people frequent [RD141].

10.3.11 Tern colonies within urban or industrial sites have been recorded from a wide range of locations in Europe and North America [RD141]. This includes Sandwich terns in the outer port of Zeebrugge in Belgium, where they historically nested in large numbers in a mixed species colony on a man-made peninsula on the eastern breakwater [RD102]. Counts of Sandwich terns at this site ranged from 46 to 4,067 breeding pairs per year between 2001 and 2005, with 4,067 and 2,538 breeding pairs in 2004 and 2005, respectively [RD102]. Currently, no Sandwich terns nest at this location and this has been the case for several years.

10.3.12 Direct extrapolation from tern colonies in areas with a high potential for noise and visual disturbance to the situation for Sandwich terns at Cemlyn Bay cannot be assumed. This is because habituation can be critical to how birds respond to disturbance stimuli (e.g. [RD93], [RD243]). However, the existence of colonies in areas with a high potential for noise and visual disturbance does demonstrate the ability of tern species (including Sandwich tern) to adapt to such conditions, in some circumstances at least.

10.3.13 In other situations, breeding Sandwich terns may be subjected to disturbance as a result of undertaking scientific studies, without notable detrimental effects being apparent on the colony and with no reported occurrences of wide-scale breeding failure or colony abandonment. Such studies can involve relatively frequent (e.g. more than weekly) visits to the

colony by research staff and the trapping of birds on their nests (or young chicks) for purposes of fitting GPS tags or other marks (e.g. [RD107]). It is acknowledged that detailed investigations of the potential effects of such activities on the breeding success and behaviour of the terns within study-colonies do not appear to have been reported but, nonetheless, it is considered highly unlikely that such studies would have proceeded had marked detrimental effects been apparent.

10.3.14 In relation to the Sandwich terns breeding in the Morwenoliaid Ynys Môn/Anglesey Terns SPA, it is relevant to consider that the Cemlyn Bay colony is currently subject to a range of anthropogenic disturbances that produce both noise and visual stimuli to which the nesting terns are exposed (see chapter 6, section 6.5). The colony itself is within 50m of a shingle ridge which is frequented by walkers and from which the colony can be viewed without any apparent disturbance to the nesting terns.

Disturbance from noise and vibration stimuli

10.3.15 During the construction period there are two potential sources of disturbance from noise and vibration stimuli to the Sandwich terns when they are present at the Cemlyn Bay colony. These are the airborne noise and vibration associated with, firstly, the plant and machinery used for the Main Site construction and, secondly, the surface blasting of rock required as part of the construction activities. Airborne noise from plant and machinery is considered separately for both impulsive (e.g. piling) and non-impulsive (e.g. engine revving) sources, with the non-impulsive noise also modelled separately for daytime and night-time periods (defined as 0700 – 2300 hours and 2300 – 0700 hours, respectively).

Plant and machinery

10.3.16 The assessment of the potential impacts from non-impulsive airborne noise and vibration associated with plant and machinery during the daytime period is based upon a scenario with all of the plant fully operational (100% on time) and with the plant for the Wylfa Newydd Development Area working zones closest to the Cemlyn Bay colony concentrated along the nearest boundary to the colony. The noise predictions are also based on the maximum number of plant that would be present in any single construction year and uses a baseline (largely flat) terrain model (giving no screening for plant in deep excavations) under light downwind conditions (as noise propagates well in such conditions, with higher winds creating more masking of the noise sources of interest). This is a highly unlikely scenario representing the highest continuous equivalent noise levels that could theoretically occur for short periods of time, rather than typical noise levels. Essentially, the modelled outputs represent the highest noise levels possible for 5 minutes in a day or night. As such, it can be considered as an extreme worst case (or a ‘bounding case’).

10.3.17 Night-time modelling of non-impulsive noise from plant and machinery used the same approaches as for the daytime scenario but with reduced amounts

of operating plant to reflect the situation that will occur during night-time hours.

10.3.18 The modelled contours for non-impulsive noise during daytime show predicted levels at the Cemlyn Bay colony from the main construction works to be 55 – 60 dB LA_{eq} (figure 10-1), with the specific level at the colony predicted to be 58.6 dB LA_{eq}. With the noise modelling modified to limit the work on Mound E to the east side, and with the plant in zone 10 concentrated along the breakwater, the predicted noise level at the colony is 57.5dB. To illustrate the basis on which this prediction is derived, the distribution of the plant used in the modelling of this scenario is shown in figure 10-2. It should also be noted that these levels of noise are only predicted to occur at the colony during the period when works on Mound E are coincident with the construction of the MOLF and the on-site concreting works. It is expected that the period of most extensive construction works, generating the highest noise levels will extend over the first two breeding seasons of the main construction programme.

10.3.19 During night-time hours, there will be a substantial reduction in construction activities so that noise levels at the Cemlyn Bay colony are predicted to fall to 44.6 dB LAeq. As for modelling of construction noise during the daytime period, this prediction is based upon a bounding case with all plant fully operational.

10.3.20 Predictions of impulsive noise from construction plant and machinery are based upon similarly precautionary assumptions as those for non-impulsive noise, including:

- All plant assumed to be located at closest point of construction zone to the colony.
- A downwind correction of +2dB applied.
- No correction for barriers or screening.
- No account of sound attenuation due to factors such as reflection of sound waves, terrain effects and atmospheric absorption.

10.3.21 The contributions of multiple sources of impulsive noise are not summated because the $L_{AF,max}$ noise is assessed over a timeframe of $1/8^{th}$ of a second, during which it is considered highly unlikely that more than one impulsive noise event would occur. Predicted levels of impulsive noise at the Cemlyn Bay colony resulting from construction plant range between 47.0 and 58.4 dB $L_{AF,max}$, with the highest value being attributable to mobile plant in zone E (i.e. the closest working zone to the colony).

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232000 234000 236000

396000 394000

N

0 1 Kilometres

Legend

- WNDA
- Tern colony

Noise contours for plant and machinery (db)

- 35
- 40
- 45
- 50
- 55
- 60
- 65
- 70
- 75
- 80
- 85

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Client: HORIZON NUCLEAR POWER

Project: Wylfa Newydd Project

Title: Predicted noise levels from plant and machinery during construction in relation to the location of the Cemlyn Bay tern colony. Noise levels based on the plant at edge scenario.

Figure: 10-1

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234000

236000

394000

392000

N

0

1 Kilometres

Legend

- WNDA
- Tern colony
- Assumed locations of plant and

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Client: HORIZON NUCLEAR POWER

Project: Wylfa Newydd Project

Title: Location of construction plant and machinery for the noise modelling scenario used to predict daytime noise levels at the Cemlyn Bay tern colony

Figure: 10-2

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Blasting (air overpressure)

10.3.22 The A-weighted maximum sound level ($L_{AF,max}$) predicted to be generated by surface rock blasting has been modelled from the maximum instantaneous charge weight used for the blasting together with the confinement of the blasts (Application Reference Number; 6.4.95). The predictions from this modelling were validated using a series of trial blasts carried out within the Wylfa Newydd Development Area using a range of instantaneous charge weights. Associated noise measurements were made at 11 locations of varying distance and direction (to account for wind effects) from the blast site, including at the Cemlyn Bay colony location (Application Reference Number; 6.4.95). The trial blasting was undertaken outside the tern breeding season in late March 2017.

10.3.23 Based upon the validated model predictions for blast noise, blasts in confined situations (i.e. where the surrounding rock and stemming material offer a high resistance to the expansion of the explosive) are predicted to produce noise levels of less than 60dB $L_{AF,max}$ in the large majority of cases at distances beyond 1.5km (table 10-3 and Application Reference Number; 6.4.95). Unconstrained blasts are predicted to generate considerably higher noise levels, and these would remain above 80dB $L_{AF,max}$ in the majority of cases, even at distances beyond 1.5km from the blast site. The Cemlyn Bay colony is beyond 1.5km of the locations at which blasting is required, except in the case Port-y-pistyll where blasting sites will be 1.1km from the colony, giving predicted noise levels of 62.9dB $L_{AF,max}$ in confined situations with a 150kg charge weight (figure 10-3).

Table 10-3 Noise levels (dB LAF, max) predicted at different distances from the blast site from unconstrained and highly confined blasts of different instantaneous charge weights

Distance (m)	Unconstrained blast			Highly confined blast		
	Maximum instantaneous charge (kg)			Maximum instantaneous charge (kg)		
	150	125	100	150	125	100
1000	86.8	86.2	85.5	63.8	63.2	62.5
1100	85.9	85.3	84.6	62.9	62.3	61.6
1200	85.1	84.5	83.8	62.1	61.5	60.8
1300	84.3	83.7	83.0	61.3	60.7	60.0
1400	83.6	83.0	82.3	60.6	60.0	59.3
1500	83.0	82.4	81.7	60.0	59.4	58.7
1600	82.3	81.8	81.0	59.3	58.8	58.0
2000	80.2	79.6	78.9	57.2	56.6	55.9

Evidence for effects of disturbance to nesting terns from noise stimuli

Evidence from the literature relating to wintering waterbirds

10.3.24 Much of the work undertaken on bird response to noise disturbance in the UK has focussed on wintering estuarine waterbirds ([RD63], [RD64], [RD371]). These studies tend to suggest that bird response to noise disturbance is likely to be minor at levels of 60 dB(A). Thus, tests of the effects of impulsive noise on four species of waterbird found the likelihood of birds flying away and abandoning the area was low (less than 10%) at noise levels of 60 dB(A), increasing to almost 30% at noise levels of 70 dB(A) and being close to 100% at 80 dB(A). More minor behavioural responses, including flight but with return to the area, tended to be most likely from approximately 65 - 75 dB(A).

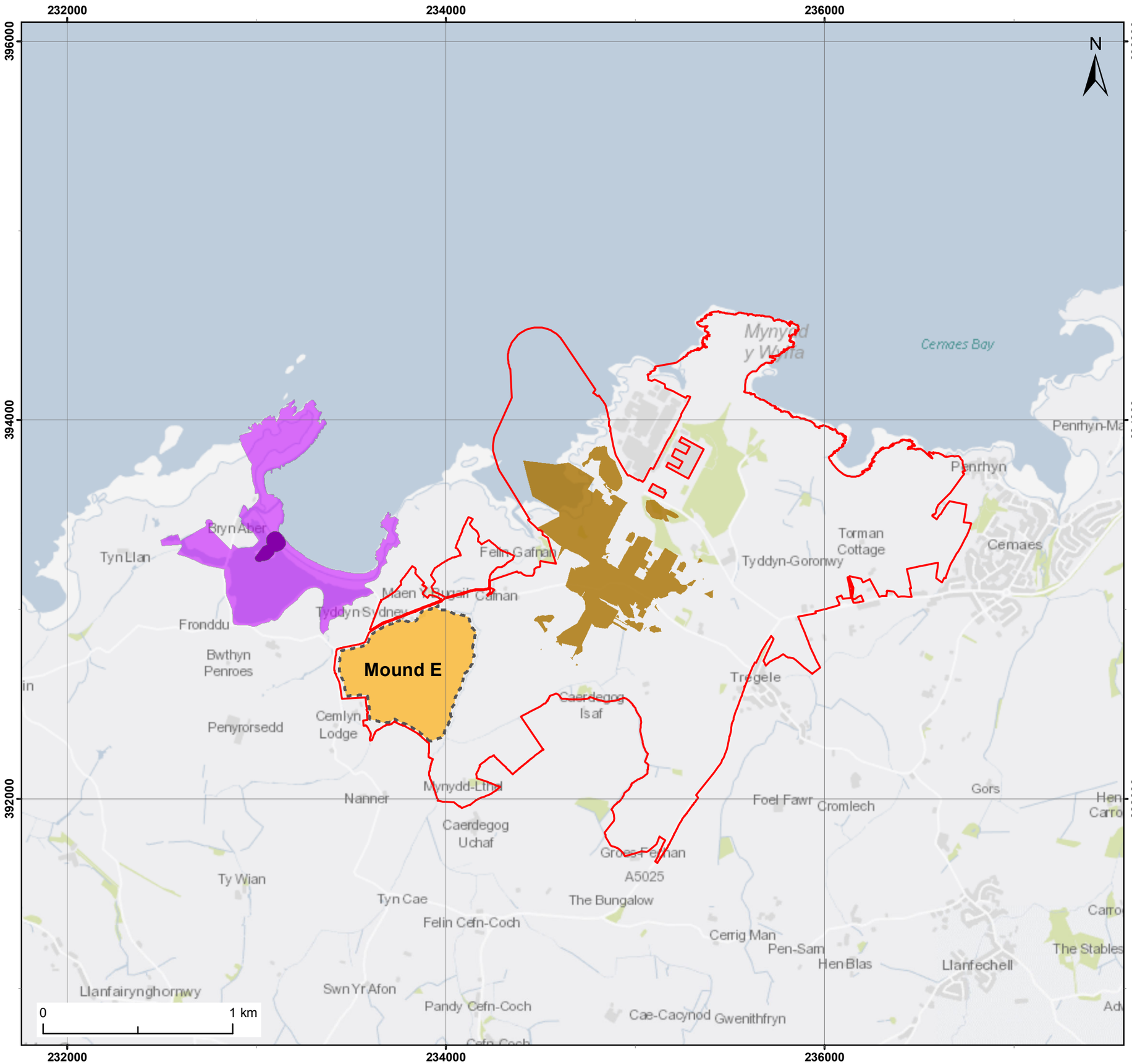
10.3.25 Similarly, [RD63] and [RD64] classified construction noise disturbance to wintering waterbirds as follows, based upon observed behavioural or flight responses:

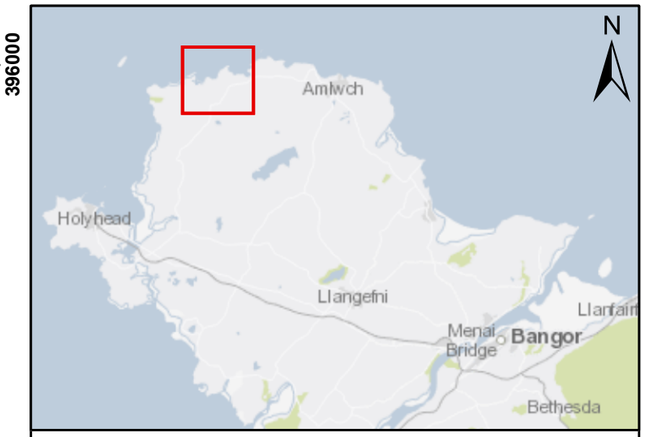
- Noise below 50 dB – low.
- Regular noise at 50 – 70 dB – moderate to low.
- Irregular noise at 50 – 70 dB – moderate.
- Regular piling noise (below 70 dB) – moderate.
- Irregular piling noise (above 70 dB) – high to moderate.

10.3.26 In this classification, low response was defined as ‘no effect’, moderate and moderate to high as ‘head turning, scanning, reduced feeding or movement to nearby areas’ and high as ‘preparing to fly, flight or abandonment of the area’. [RD64] notes that *“data availability is poor for differing noise sources, receptors and times of year"*, and this caveat should be recognised when applying the conclusions of the study.

Evidence from the literature relating to breeding terns

10.3.27 The findings from these studies on wintering waterbirds can only be regarded as providing general context to the current assessment as they apply to different species during the non-breeding season (when behavioural responses may differ markedly). A study of more direct relevance to the current assessment was undertaken on crested terns (a close relative of Sandwich terns) at a breeding colony in the Great Barrier Marine Park, Australia [RD32]. In this study, the effects of recorded aircraft noise on behaviour during the mid to late incubation period were tested experimentally. The study population was not habituated to such noise impacts and the experimental design meant that the effects of the noise stimuli were not confounded by associated visual stimuli. In this case the noise source was derived from recordings of a single propeller aircraft.





Legend

- WNDA
- Mound E
- Potential locations for rock excavation
- Tern colony
- Cemlyn Bay SSSI/SAC

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Client: HORIZON NUCLEAR POWER

Project: Wylfa Newydd Project

Title: The WNDA zones with potential locations for rock blasting in relation to the location of Cemlyn Bay tern colony

Figure: 10-3

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10.3.28 During the crested tern study, the noise recordings were played at seven different levels at 5dB intervals between 65 dB(A) and 95 dB(A), with each treatment extending over a 30–35 second period. The nesting terns responded to the experimental noise generation by showing marked increases in scan or alert behaviours (relative to the control situation) at the lowest levels of noise generation (i.e. at 65 – 70 dB(A)). However, the higher level responses of 'startle' (involving a momentary movement away from the nest) or 'escape' (involving birds flying up from the nest) occurred only at exposures to noise levels of 90 or 95 dB(A). Even at the highest generated noise levels, the proportion of birds exhibiting such responses remained low, with fewer than 20% of birds in the study colonies showing 'startle' or 'escape' responses, and fewer than 10% showing 'escape' responses [RD32].

Evidence from data collection at Cemlyn Bay – responses of roosting black-headed gulls to trial blasts

10.3.29 A series of 15 trial blasts were undertaken within the Wylfa Newydd Development Area on 28 and 29 March 2017, with the resulting noise levels and bird response at Cemlyn Bay monitored. This was before the start of the breeding season and no terns were present at the site during the trials. Between 250 and 300 roosting black-headed gulls were present at Cemlyn Bay during these trials, along with several other species of waterbird (Application Reference Number: 6.4.89).

10.3.30 The 15 blasts generated noise levels of 56.0 dB to 72.1 dB, with the roosting black-headed gulls undertaking short 'fly up' responses on five occasions. These responses occurred at noise levels of 68.2 dB to 72.1 dB. Responses involved between 1% and 60% of the birds present alighting to a height of less than 5m and for a period of less than one minute. None of the other species of waterbird present at Cemlyn Bay during this time exhibited any discernible response to the blasts (Application Reference Number: 6.4.89).

Evidence from data collection at Cemlyn Bay – responses of breeding Sandwich terns to anthropogenic noise disturbance

10.3.31 Findings from the monitoring of baseline noise disturbance and the associated tern responses at the Cemlyn Bay colony (undertaken during the 2017 breeding season) are detailed in chapter 6 and Application Reference Number: 6.4.89. This monitoring involved a total of 38 surveys, each of two hours duration, encompassing the main egg laying to early chick-rearing period of the tern species breeding at the Cemlyn Bay colony. As described in chapter 6, the tern colony at Cemlyn Bay was abandoned in 2017 after 23 June (probably as a result of nocturnal predation by otters). However, the majority of these surveys were undertaken before the start of the colony decline, and with a relatively small proportion (c.20%) undertaken after the numbers of Sandwich tern at the colony had declined below 1000 birds (as estimated by counts of birds present at the colony at any one time).

10.3.32 Overall, these surveys recorded a total of 121 tern responses, involving an average of c.65% of the terns at the colony. This equated to an average of 25.5 responses per day (based on a 16 hour day). Of these, 98% involved

Sandwich terns and all but three were 'fly up' responses (chapter 6). These responses occurred in relation to a wide range of causes but were highly consistent in that they involved birds rising to a height of 5 – 10m for a period of 35 – 45 seconds and adopting an 'umbrella' formation over the nesting island before descending again (chapter 6, Application Reference Number: 6.4.89). Only 11% of these responses were attributed to anthropogenic disturbance (from either noise or visual stimuli), with 66% occurring in relation to unidentified causes and over 20% in relation to the presence of other bird species (chapter 6).

10.3.33 Overhead aircraft (often fast flying jets) were the most frequent source of potential noise disturbance, being recorded on a total of 40 occasions and from 13 of the 34 surveys for which noise levels were monitored. 'Fly up' responses from the terns were associated with overhead aircraft in three instances, with evidence in each case that the response was due to increased noise levels (as determined from the associated noise sonograms). Based on the extent to which the associated noise spike on the sonogram differed from those for residual noise, this evidence was stronger for the two events associated with highest noise levels (at 78.2 dB and 88.8 dB) than for the third event for which the maximum noise was 73.4 dB, (chapter 6, Application Reference Number: 6.4.89).

10.3.34 The peak noise levels associated with the 37 aircraft events to which there were no recorded responses by the terns ranged from 57.2 dB to 83.5 dB and averaged 71.3 dB. Coincident spikes in the noise sonograms were apparent in the majority of these 37 instances, and these were often markedly higher than for residual noise during the same surveys (chapter 6, Application Reference Number: 6.4.89).

10.3.35 No other tern responses recorded during these baseline disturbance surveys were considered to result from anthropogenic noise disturbance. Other events which had the potential to cause such disturbance included passing road vehicles, agricultural activities and activities on the sea. Although three such events appeared to cause 'fly up' responses from the terns, none of these were associated with a marked increase in noise above residual levels (with the noise levels for these events ranging from 50.8 dB to 69.7 dB and averaging 62.3 dB). However, noise levels for the 12 such events that did not elicit responses ranged from 50.1dB to 83.0dB, averaging 67.7dB. Coincident spikes in the noise sonograms were apparent for ten of these 12 events, with these spikes markedly higher than for residual noise in three cases (chapter 6, Application Reference Number: 6.4.89).

10.3.36 Amongst the potential disturbance events which were recorded during the baseline disturbance surveys, three were identified as sources of impulsive noise with particularly sharp rise times but no tern responses were recorded in relation to these events (chapter 6). These events were:

- Distant gunshot (with no associated spike in the noise sonogram)
- Slamming of tractor door (with an associated spike of 75.6 dB in the noise sonogram)
- Slamming of grain door (with an associated spike of 65.3 dB)

10.3.37 A breakdown of the noise sonograms according to high frequencies, low to mid frequencies and infra-sound failed to reveal any greater correlation with tern responses than that identified in relation to the full sonograms (Application Reference Number: 6.4.89).

10.3.38 In an attempt to further inform the assessment of noise impacts from surface rock blasting on nesting Sandwich terns at the Cemlyn colony, trials were proposed at the colony based upon generating low frequency noise from a loud speaker (European Protected Species disturbance licence application made by Horizon to NRW). As detailed in the supporting methodology document for these trials, they would have been closely controlled, with appropriate measures in place to ensure that the resultant noise generation would cease as soon as it reached levels that might cause 'fly up' responses from the nesting terns. However, NRW was unable to reach a conclusion of no adverse effects on site integrity in its appropriate assessment, and this trial was not permitted to proceed.

Assessment of predicted airborne noise impacts on Sandwich terns at the breeding colony

Construction noise disturbance and tern response

10.3.39 The studies described above suggest that Sandwich terns at the breeding colony are highly unlikely to exhibit responses involving any temporary departure from their nests or chicks (invariably 'fly ups' or more extreme flight response in the case of terns – see chapter 6) as a result of impulsive or non-impulsive noise generated by the operating plant and machinery during the construction period. The noise levels that are predicted to occur at the Cemlyn Bay colony from these sources are below 60 dB, whilst the available evidence demonstrates that:

- Birds, in general, tend to show a low to (at most) moderate degree of behavioural response to noise levels of 60 dB(A) or less, including from sources of impulsive noise. This evidence includes the documented responses of roosting black-headed gulls at Cemlyn Bay to the trial blasts.
- Breeding crested terns undertook momentary movements away, or 'fly ups', from the nest only when experimentally generated noise reached levels of 90 or 95 dB(A).
- 'Fly up' responses by Sandwich terns at Cemlyn Bay during the 2017 breeding season were rarely associated with events generating potential noise disturbance, even when the recorded noise levels were high (close to or above 80 dB) and produced marked spikes on the sonograms. Noise levels were between 73.4 dB and 88.8 dB for the three events considered to be potential sources of anthropogenic noise disturbance and which were associated with 'fly ups', but with the evidence that the response was due to noise being strongest for the two events with noise levels of 78.2 dB and 88.8 dB.

10.3.40 Furthermore, the predictions of noise disturbance from construction plant and machinery are based upon the highly precautionary (and highly unlikely) scenario where all the plant is running (100% on time) and, for those working zones closest to the colony, is concentrated along the nearest boundary to the colony. Consequently, noise levels from the construction plant and machinery at the Cemlyn Bay colony are rarely, if ever, likely to be as high as the predicted values on which this assessment is based.

10.3.41 Noise at the colony from surface rock blasting is also likely to be less than 60 dB(A) in most cases where blasts are undertaken in highly confined situations (table 10-3). However, noise levels at the colony from blasts in unconstrained situations are predicted to be 80 dB(A) or above in most cases, whilst there are circumstances in which wind conditions could cause the noise levels at the colony from highly confined blasts to exceed 60 dB(A). Therefore, the potential exists for this activity to cause flight responses amongst nesting terns.

Mitigation

10.3.42 Appropriate mitigation is proposed (to be secured via the Main Power Station Site CoCP and Marine works sub-CoCP; refer to table 11-1) to further ensure that noise levels at the colony from construction works (including from blasts) remain below those considered likely to elicit flight responses by the terns at the Cemlyn Bay colony. This mitigation is set out below, and will apply from 15th April to 15th August unless otherwise stated [15th April date to be guided by information from the NWWT on when the first terns/black-headed gulls typically arrive to set up a colony; see 10.3.49 below].

Monitoring

10.3.43 During construction works noise levels would be measured at the tern colony either through direct monitoring on the island or calculations based on monitoring adjacent locations.

10.3.44 Where monitored noise levels are found to be above the committed noise levels (see below), the following actions would be undertaken immediately (for further detail see ‘Reactive monitoring’ below):

- review works in the area likely to be causing the breach and consider any necessary mitigation actions (including, if necessary, temporary suspension of works);
- confirm that monitored levels are not being impacted by other noise or vibration sources;
- determine whether the exceedance is due to a particular activity or item of equipment and, if so, identify if the equipment can be substituted for an alternative piece of equipment;
- implement other feasible and reasonable measures (which may include modifying time of works, using an alternate construction methodology, or a combination of these); and

- continue monitoring (including additional monitoring, if required) to verify that the control measures have reduced the noise levels to acceptable level at the relevant receptors

Main earthworks (anticipated to be for the first two years, but to be kept under review to account for changes to the construction programme)

10.3.45 Horizon will commit that:

- Blasting on the site would only be undertaken when, taking into account wind factors, noise shielding and other mitigation, the predicted blast noise at the colony would be less than 60 dB or daily ambient noise at the colony (whichever is higher) [the relevance of 60 dB is described the assessment provided].
- Day-time construction noise at the colony would not exceed 59 dB $L_{Aeq, 1\text{-hour}}$ [Reason: based on modelled noise level of 58.6 dB LAeq, 1-hour].
- Night-time (7pm to 7am) maximum construction noise at the colony would not exceed 43 dB $L_{Aeq, 1\text{-hour}}$ [Reason: based on modelled noise level of 42.8 dB $L_{Aeq, 1\text{-hour}}$].

Subsequent seasons (anticipated to be year 3 onwards)

10.3.46 Day-time modelling of construction activities predicts level of 43.7 dB $_{LAeq, 1\text{-hour.}}$ Night-time (7pm to 7am) modelling of construction activities predicts level of 42.4 dB $L_{Aeq, 1\text{-hour.}}$ Therefore no specific general construction noise commitments are proposed.

10.3.47 However, Horizon will commit to the following for subsequent nesting season establishment periods (as defined below):

- Blasting would only be undertaken when blast noise calculations (including weather conditions) predict noise levels at the colony of less than 54 dB $L_{AF,max}$. [Reason: main blasting would be complete and only minor or unforeseen blasting requirements would remain.]

Establishment period

10.3.48 During main earthworks, in order to allow for the sensitivity of terns arriving and establishing their nesting colony, additional construction constraints (below) would be applied during the ‘establishment period’.

10.3.49 The ‘establishment period’ is to be defined as follows:

- The tern nesting site would be monitored from 1st April each year (historically only very few terns arrive before early April each year).
- The establishment period would be four weeks, to be taken as starting on 15th April unless significant nest establishment is observed ahead of this date, in which case it would begin earlier.
- The activities that constitute the establishment of nesting territories by any tern species that is a qualifying feature of the Morwenoliaid Ynys

Môn/Anglesey Terns SPA are aerial display flights over the nesting islands and/or performing courtship behaviour on the ground by scrape making. In addition to these activities taking place, the frequency of occurrence of such activity is important in defining the establishment period, and Horizon would agree the basis for determining the start of the establishment period (including observed activity and frequency of occurrence) with NRW.

- Trained observers (who would be professional, independent ornithologists with detailed knowledge of terns) would monitor black-headed gull to determine if their nesting behaviour appears to be affected by construction noise. If there is a lack or low numbers (based on black-headed gull status and trends) of recorded black-headed gull nesting attempts at the Cemlyn colony, the mitigation defined below would be initiated at an earlier point in time (i.e. prior to 15th April).

10.3.50 The constraint period would be as the 'establishment period' and apply for no more than four weeks but would end earlier if [>c.50%] of the terns expected to be present in the colony are considered to have begun egg-laying and be sitting on nests [quantum to be agreed with NRW].

10.3.51 During the establishment period for the first two years of construction, Horizon will commit to:

- Blasting on the site would only be undertaken when, taking in account wind factors, noise shielding and other mitigation, the predicted blast noise at the colony would be less than 55 dB $L_{AF,max}$ (which the assessment predicts is an achievable noise level). [Reason: this allows some blasting in favourable wind conditions (i.e. when the wind direction is such that the tern colony is not downwind of the construction works), any further constraint in blast size is likely to prevent any meaningful work on the site.]
- Day-time construction noise at the colony would not exceed 55 dB $L_{Aeq, 1\text{-hour}}$. [Reason: during this period Horizon will commit to only undertaking works on the far side of Mound E that are not visible from the colony and minimising reworking of dumped material in this area. Noise modelling (based on typical wind conditions) of this working pattern predicts 57.5 dB $L_{Aeq, 1\text{-hour}}$. In order to achieve 55 dB $L_{Aeq, 1\text{-hour}}$, works would avoid the most adverse wind conditions (light downwind) for noise transfer to the colony.]
- Night-time (7pm to 7am) construction noise at the colony would not exceed 43 dB $L_{Aeq, 1\text{-hour}}$ [Reason: based on modelled noise level of 42.8 dB $L_{Aeq, 1\text{-hour}}$].

Reactive monitoring

10.3.52 The above mitigation provides further assurance that noise levels at the colony from construction works (including from blasts) would remain below

those considered likely to elicit flight responses by the terns at the Cemlyn Bay colony. However, on a precautionary basis, ongoing monitoring of the terns throughout the nesting period would be undertaken (by independent, professional observers) to understand whether there is any increase in fly-ups.

10.3.53 If this occurs and is directly related to the noise from construction, further measures would be taken to reduce noise. It is not possible to identify these further measures in advance because the assessment (including the mitigation set out above) demonstrates that there would be no effect. The monitoring is included as a precautionary measure to account for the fact that characteristics of noise other than loudness may eliciting a response from the terns at the colony and to allow the issue to be revisited in the light of experience during the construction works. The approach proposed is summarised as:

- Throughout the nesting periods during the construction phase, if the colony exhibits fly-up disturbance reactions [to be quantified]* as a direct result of attributable noise events or shows a measurable increase in the incidence of disturbance events above those recorded during baseline observation works (undertaken over the 2017 and 2018 breeding seasons), then alternative methods of working or additional constraints would be applied (including the option of temporary suspension of works following the protocol defined in the footnote below).
- In order to attribute noise events responsible for an observed disturbance reaction of the type defined in the footnote below to the construction works, Horizon would establish a real time feedback mechanism between the observers and a nominated, dedicated site manager. The site manager would have full knowledge of all construction activities being undertaken and the authority to instigate the measures necessary on site to prevent recurrence of the disturbing activity (in accordance with the parameters defined in the following footnote). This feedback mechanism would also allow for consideration of other potentially disturbing factors not related to the construction works (e.g. aircraft noise) and, if such third party disturbance is deemed to be responsible in its entirety for the observed disturbance, no action would be taken.

  * From the 2017/2018 observational surveys, Horizon will have an agreed baseline incidence of [circa 1.6] fly ups per hour. If the independent observers record more than three fly ups per hour for which there is no obvious non-Horizon cause, Horizon would cease the most obvious disturbing activity; if the observers record more than two fly-ups in the next hour Horizon would stop the next most disturbing activity. The following days works would be planned based on this experience of the reaction of terns to the disturbing activity. Ceased activities would start again seven days later, under observation.

Consequences for breeding success as a result of responses to construction noise

10.3.54 Notwithstanding the above conclusion that construction noise is highly unlikely to result in any increase in 'fly ups', or other responses, by Sandwich terns breeding at the Cemlyn Bay colony, consideration has been given to the likely consequences of an increase in 'fly up' responses.

10.3.55 As described above, 'fly up' or similar responses by Sandwich terns result in the birds being absent from their nests or chicks for a period of time and so they could reduce breeding success as a result of increased exposure to predation and potentially chilling of eggs and chicks (e.g. [RD29], [RD211]). The disturbance surveys undertaken at Cemlyn Bay in 2017 indicated that Sandwich terns show a reasonably high frequency of such 'fly ups' under baseline conditions (25.5 per day) but that these 'fly ups' usually extend over a 35 – 45 second period only, with a maximum recorded duration of 3 minutes (if the visit to the nesting island by the reserve wardens is omitted) (chapter 6, Application Reference Number: 6.4.89). Given the consistency of these responses, it is reasonable to propose that any responses by Sandwich terns to blasting or other construction noise would most likely constitute similar 'fly ups', involving a short time away from eggs or chicks.

10.3.56 Such short term absences of terns are highly unlikely to result in any chilling of eggs or chicks, and contrast markedly with the documented effects of prolonged (6.5–8 hours), overnight, absence by common terns in Massachusetts (due to nocturnal predation on the adult terns by great-horned owls), resulting in extended incubation periods and death of some chicks due to exposure [RD244]. Losses of eggs or chicks to opportunistic predators (e.g. gulls) could potentially occur during such short absences, but the frequency with which 'fly ups' occurred under baseline conditions combined with the short duration of these responses suggests that any additional losses resulting from an increase in 'fly ups' would be small.

10.3.57 Other, more subtle, effects of construction noise disturbance on Sandwich tern breeding success, which are not apparent from visible behavioural responses (such as 'fly ups'), are conceivable. Thus, disturbance can cause a physiological stress response in birds which might impact on breeding success. Such a mechanism was identified as the cause of decreased nesting success in kittiwakes and guillemots, associated with human disturbance from visitors to the breeding colonies [RD15]. In this study, a predicted 8.5% increase in visitor levels resulted in a 22% and 13% increase in nest failure rates for kittiwake and guillemots, respectively. However, such physiological stress responses have been demonstrated in relation to disturbance from the direct presence of people and not to construction noise or other causes ([RD15], [RD5]). People are likely to be perceived as potential predators by birds, and as such are more likely to cause such responses. Heart rates of common terns were shown to increase when recorded sounds associated with disturbance (alarm calls of terns or shorebirds, or aircraft noise) were played to them, but these responses declined in intensity after the stimulus was repeated about twenty times ([RD372], after [RD243]). Therefore, the likelihood of such subtle effects is lower as a result of disturbance from construction noise than from the

presence of people, and it is highly unlikely that any responses to construction noise would lead to such high reductions in breeding success as have been reported in relation disturbance associated with the presence of people.

10.3.58 Given the above, any responses by the Sandwich terns breeding at the Cemlyn Bay colony to construction noise are likely to result in, at most, small effects on breeding success. Furthermore, any such effects would extend over a small number of breeding seasons only (probably limited to the first two seasons of the main construction, as detailed above under 'Mitigation').

10.3.59 This conclusion should also be considered in the context of the conservation objectives of the SPA and, specifically, that the population size should be stable or increasing. The SPA Sandwich tern population is currently approximately five times larger than at designation. The population is stable and even in the very unlikely worst case result of a very minor reduction in breeding success over two breeding seasons, the breeding tern population within the SPA would remain stable and it can be concluded that there would be no adverse effect on the integrity of the SPA in view of its conservation objectives.

Conclusion on potential noise impacts on Sandwich terns at the Cemlyn Bay colony

10.3.60 Considering the available evidence on noise disturbance and responses by breeding Sandwich terns and other bird species, together with the proposed mitigation during the tern breeding season, it is considered highly unlikely that noise disturbance from surface rock blasting and other construction activities will have detrimental effects on nesting Sandwich terns, and no adverse effects on the integrity of the SPA population are predicted.

Black-headed gulls

10.3.61 As often occurs at Sandwich tern colonies, the birds in the Cemlyn colony nest in association with black-headed gulls, which appear to confer benefits to nesting Sandwich terns as a result of their more aggressive anti-predator behaviour, although this is at the cost of kleptoparasitism of prey intended for Sandwich tern chicks and some predation of the chicks themselves (e.g. [RD320], [RD321]). It is also possible that Arctic and common terns may confer similar anti-predator benefits to nesting Sandwich terns but the potential for this is considered to be substantially lower given their smaller size and substantially lower numbers (as well as the lack of documented relationships of the type that have been established between Sandwich terns and black-headed gulls).

10.3.62 In light of the above, potential indirect impacts of noise disturbance on Sandwich terns at the nesting colony could arise if the nesting black-headed gulls are more susceptible than Sandwich terns to noise disturbance, or if noise disturbance detrimentally affects important foraging areas for black-headed gulls from the Cemlyn colony. The potential effects of the Project on Arctic and common terns are assessed in the Shadow HRA.

10.3.63 However, neither of these possibilities for indirect effects on the terns appears to be likely. Black-headed gulls sometimes nest in urban environments and can be associated with areas of high human activity ([RD215], [RD33]). No evidence was obtained during the baseline disturbance surveys to suggest that the black-headed gulls nesting at Cemlyn Bay are any more susceptible to noise disturbance than are the Sandwich terns, and during these surveys they were only ever recorded as being disturbed off their nests on one occasion (i.e. when reserve wardens walked onto the nesting island – Application Reference Number: 6.4.89). Furthermore, as detailed above, 'fly up' responses by roosting black-headed gulls at Cemlyn Bay to the trial blasts (undertaken in March 2017) occurred only when the noise levels exceeded 68 dB(A) (Application Reference Number: 6.4.89).

10.3.64 Breeding season transect surveys of the Wylfa Newydd Development Area revealed no parts of the site that regularly or frequently held any sizeable concentrations of black-headed gulls, whilst the boat-based surveys demonstrated low densities of this species in the offshore areas around the Wylfa Newydd Development Area (Application Reference Number: 6.4.89).

10.3.65 Therefore, it is considered that no detrimental impacts on Sandwich terns would arise from impacts of noise disturbance on foraging black headed gulls, and that an adverse effect on the interest feature would not arise.

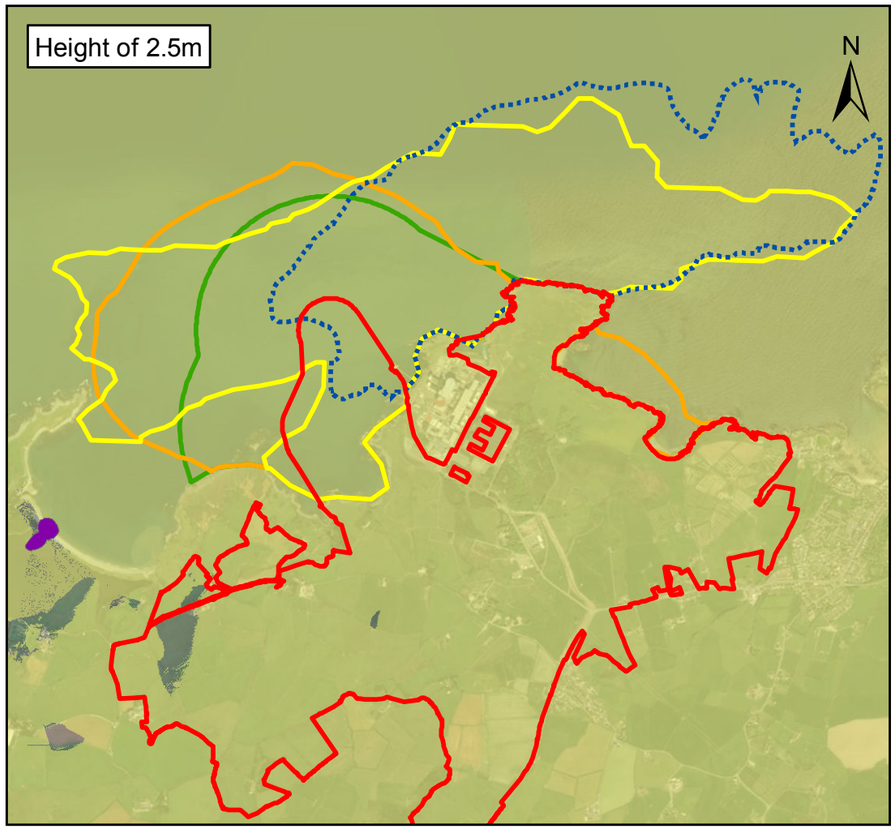
Disturbance from visual stimuli

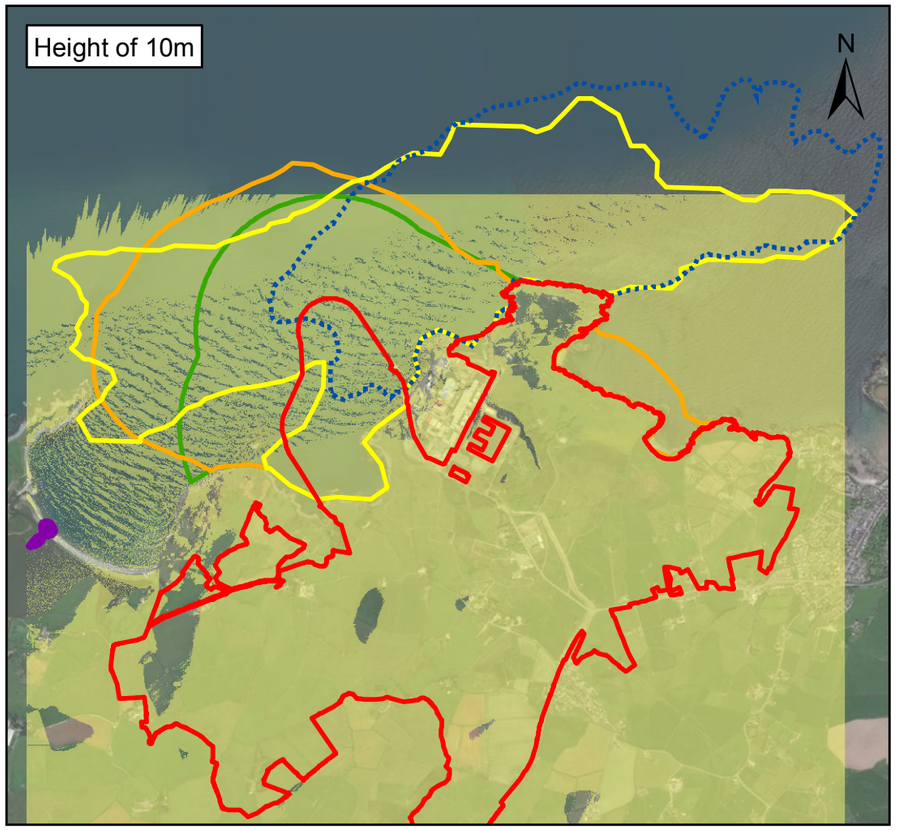
Visibility of construction activity to the terns

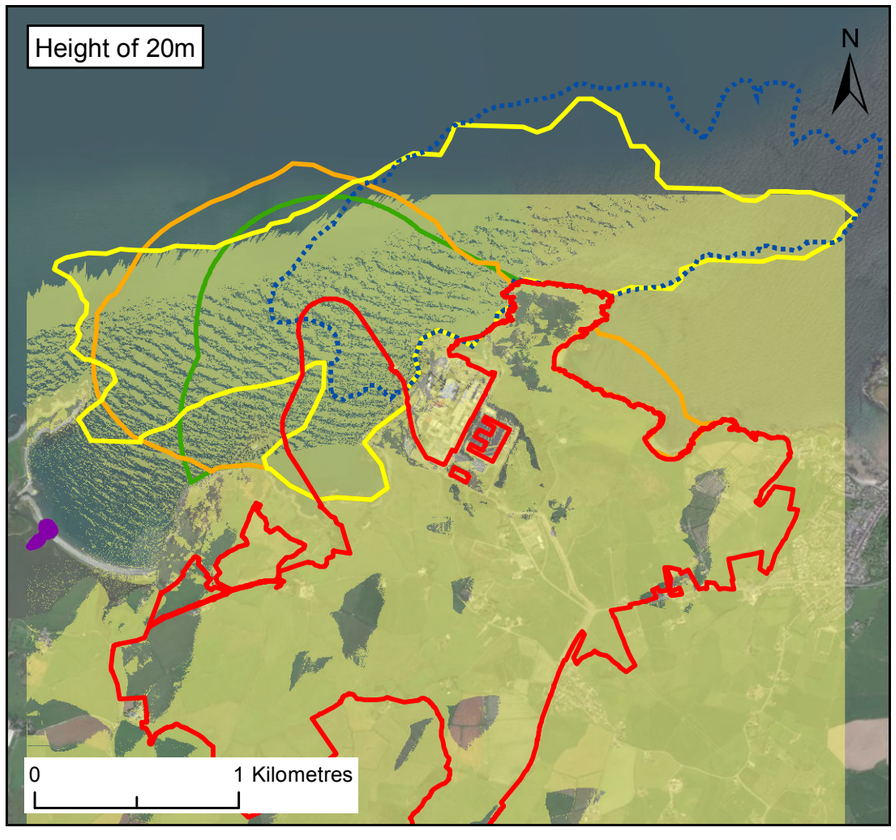
10.3.66 The Wylfa Newydd Development Area boundary is in excess of 500m at its closest point from the islands within Cemlyn lagoon on which the Sandwich terns nest. The construction activities that would occur within the area of closest proximity to the colony are those associated with the creation of Mound E (figure 10-3). Zones of theoretical visibility as estimated at different heights above the Cemlyn Bay nesting colony show the extent to which the Wylfa Newydd Development Area theoretically would be visible to the terns whilst they are at the colony (figure 10-4).

10.3.67 Thus, for birds sitting on their nests or roosting on the ground only a small part of the area where Mound E would be constructed is currently estimated to be visible, with this area including only a very small part of the haul route. At a height of 20m above the colony, most of the north-west facing slope of what would be Mound E is likely to be visible.

The baseline disturbance monitoring undertaken at Cemlyn Bay demonstrates that the terns rarely reach heights of more than 10m (and more usually 5 to 10m) during 'fly up' responses. Therefore, for the largest part of the breeding season (i.e. the period when birds are in attendance of nests and chicks), this extent of the Wylfa Newydd Development Area is likely to be visible to the terns only when they are flying in and out of the colony during the course of their foraging trips, at least until such a time as Mound E has begun to be formed.







Legend

- WNDA
- Temperature ZOI (sea surface autumn base case)
- TRO ZOI (surface summer base case)
- Noise ZOI (65db)
- 500m visual ZOI
- Tern colony
- ZTV at heights as shown (shaded area = not visible)

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Client: HORIZON NUCLEAR POWER

Project: Wylfa Newydd Project

Title: Zones of theoretical visibility from a height of 2.5m, 10m and 20m at the Cemlyn Bay nesting colony

Figure: 10-4

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10.3.68 The effects of artificial lighting during construction could also affect the visible environment to terns at the colony and this is considered in the assessment below.

Evidence from the literature relating to terns and gulls

10.3.69 Various studies of nesting terns or gulls have determined the distances at which birds in the colony will fly up in response to a disturbance source (i.e. flight initiation distances – FIDs). In relation to visual disturbance, buffer zones or set-back distances may be established around breeding colonies as a conservation or protection measure. Such buffer zones are usually determined on the basis of the distances at which particular behavioural responses occur to visual disturbances such as approaching walkers, vehicles or motorboats. For terns and gulls these buffer distances rarely exceed 200m ([RD28], [RD93], [RD283], [RD282]), although distances of 200 to 300m were recommended for colonies of terns and skimmers during the early part of the season before birds have laid and become established on the colony [RD93].

10.3.70 In a review of published FIDs for bird responses to human disturbance, data from three different studies involving seven tern species gave mean FID values of 0.1 to 70m, whilst a fourth study on white terns gave individual FID values ranging from 0.5 to 58m [RD192]. In all four of these studies the disturbance source was approaching walkers. The same review provided similar data for four gull species from three different studies, which gave mean FID values that ranged from 1 to 10m in one study, and individual FID values of 5 to 78m or of less than 100m in the other studies. The disturbance sources in these studies on gulls were approaching walkers in two cases and aircraft in the third.

10.3.71 Given the wide range of species and situations encompassed by the studies detailed above, it is considered that they provide strong evidence that nesting terns are unlikely to show flight responses to visual disturbance at distances of more than few hundred metres. Although none of these studies concern Sandwich terns, they do include very close relatives (i.e. species of the same genus) and other tern species that frequently nest in broadly similar environments to Sandwich terns and sometimes in association with them (e.g. common tern and Roseate tern).

Evidence from data collection at Cemlyn Bay – responses of breeding Sandwich terns to anthropogenic visual disturbance

10.3.72 Findings from the baseline disturbance monitoring at the Cemlyn Bay colony recorded ‘fly up’ responses by Sandwich terns in relation to 10 events that could be attributed to visual disturbance, as opposed to noise disturbance (or some combination of visual and noise, such as may occur from overhead aircraft). This distinction was made on the basis of the attributes of the event itself (as recorded during the surveys) and visual inspection of the associated noise sonograms to determine whether there was a coincident increase in noise levels (as detailed in chapter 6).

10.3.73 Of the 10 responses that were attributed to visual disturbance, seven involved people and/or dogs at distances of 0 to 50m from the colony. By contrast, the closest approach distances to the colony recorded for people and/or dogs in each of the 34 instances where there was no 'fly up' response ranged from 50 – 550m, averaging 74m (chapter 6, Application Reference Number: 6.4.89). Three instances where passing road vehicles were associated with 'fly up' responses each occurred at distances of approximately 150m from the colony (with no coincident spike in the sonograms occurring for any of these three events). By contrast, other events associated with road vehicles, agricultural activities or activities on the sea which did not appear to elicit responses occurred at distances of 150 - 875m (averaging 504m) from the colony (chapter 6, Application Reference Number: 6.4.89).

10.3.74 As detailed above (and in chapter 6), the sonograms for each of the three overhead aircraft events associated with 'fly up' responses strongly suggest that noise was the cause of the response in two instances (where the closest distances of approach to the colony were approximately 400m and 500m), and possibly in the third instance (where the aircraft came to within approximately 300m of the colony). The approximate distances of overhead aircraft to the colony for events that did not elicit 'fly up' responses were up to 1500m, and averaged 560m (Application Reference Number: 6.4.89).

10.3.75 The above studies that define FIDs and buffer zones for nesting terns and gulls are based upon visual disturbance from pedestrians, various types of watercraft and from aircraft. The visual disturbance sources recorded during the baseline monitoring at the Cemlyn Bay colony were broadly similar but also included agricultural activities and passing motor vehicles. Although sources of visual disturbance arising from the construction works within the Wylfa Newydd Development Area will differ from these in several respects (e.g. involving the use of large machinery and equipment), FIDs based upon human approach distances often form the basis for guidance on the construction of onshore wind farms and other developments ([RD286]; [RD297], [RD299]).

Predicted effects

10.3.76 Based upon the existing knowledge of responses by nesting terns to visual disturbance it is considered highly unlikely that the construction works within the Wylfa Newydd Development Area would cause flight responses by breeding Sandwich terns at Cemlyn Bay, as these works would occur at a distance of more than 500m from the colony. This is particularly so given the small extent of the construction area that would be visible to the terns when present at the colony, at least for the period during which they are attending nests and chicks (which comprises the vast majority of the time they are present at the colony). The extent to which this distance represents an appropriate buffer zone in relation to visual disturbance is illustrated by the fact that of the 53 bird species for which a mean FID value, or range of FID values, was obtained in the review of [RD192], only two had values in excess of 500m (i.e. bald eagle and bearded vulture, both of which are large raptors). Similarly, a review of FIDs for 26 'priority' breeding bird species in

Scotland (which does not include any tern or gull species), identified no species for which the median values exceeded 500m (although for five species of divers or medium to large sized raptors the upper end of the range encompassing 80% of the values exceeded 500m) [RD286].

10.3.77 For the purposes of adding further precaution in relation to potential visual disturbance at the colony, mitigation is proposed which would mean that between 15th April and 15th May there would be no works undertaken within 500m of the nesting islands plus the areas on the shingle ridge that are known to be used occasionally by nesting terns. This increases the minimum distance to any works by 200m – 300m during this period (figure 10-5). This period encompasses the main pre-laying and nest establishment period for all three tern species at Cemlyn Bay (Application Reference Number: 6.4.89). Thereafter, there would be no earthworks undertaken within 500m of any known active tern nests within the SPA.

10.3.78 As for noise disturbance, it is conceivable that Sandwich terns could be affected by visual disturbance indirectly, via impacts on the black-headed gull population that nests at Cemlyn Bay. However, it is apparent that FID values for gulls are similar to those for terns and, for broadly the same reasons as for noise disturbance, it is considered that no detrimental impacts on Sandwich terns would arise from effects associated with visual stimuli on black headed gulls.

10.3.79 Modelling of indicative light spill during the construction of the Marine Works (including the MOLF, breakwaters and cooling water intake structure) indicates that 0.1 Lux light spill from the construction of the Marine Works typically would not extend more than 50m over the water area from the location of the works. Levels as low as 0.05 Lux would not extend to within 1km of the colony (figure 10-6). For context, a full moon on a clear night produces about 0.1 Lux of light.

10.3.80 During operation of the MOLF (which would be operational during the construction of other elements of the Project), a 0.1 Lux contour extends no more than 125m across the water. This is predominantly from the MOLF cranes and would only occur at three specific locations. Typically the 0.1 Lux extends no more than 100m across the water when the cranes are not in use. Therefore, light spill during the construction phase would not reach the Cemlyn Bay colony.

10.3.81 Based on the above assessments, it is considered that disturbance at the Cemlyn Bay breeding colony from noise, vibration and visual stimuli alone and in-combination would not have adverse effects on the integrity of the Morwenoliaid Ynys Môn/Anglesey Terns SPA Sandwich tern population.

A2 Disturbance in the marine environment [Marine Licence]

Disturbance from airborne noise and vibration

Evidence

10.3.82 The evidence considered above on bird (and specifically tern) response to noise disturbance suggests that noise levels below approximately 70 dB(A)

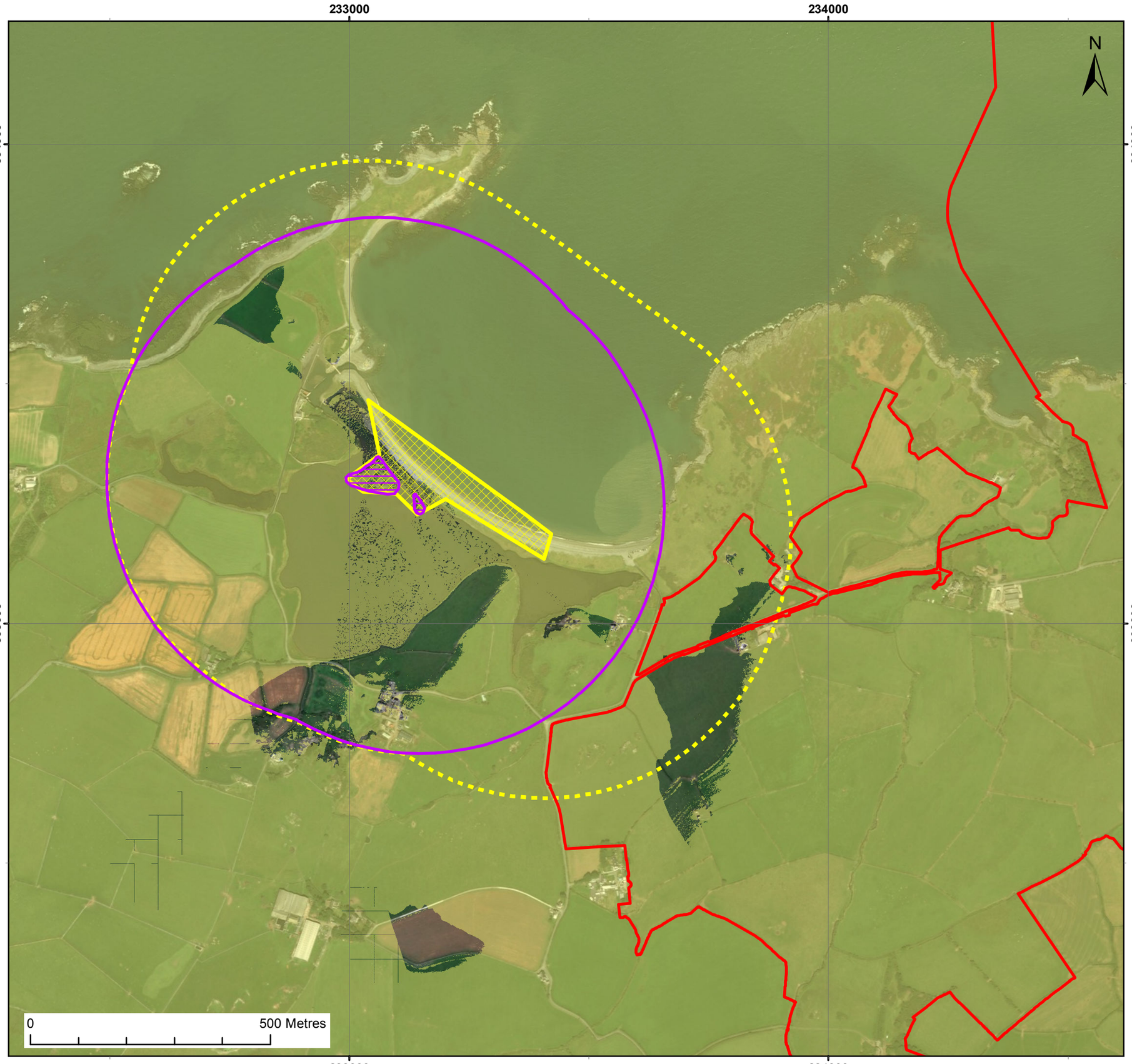
will usually elicit low to moderate responses only. This evidence relates to birds that are present in estuarine habitats or at breeding colonies and little direct evidence is available on the response of terns to noise stimuli when they are commuting or foraging in offshore environments.

10.3.83 However, broad-based and qualitative consideration has been given to how different seabird species respond to anthropogenic disturbance in offshore environments ([RD117], [RD115]). These two, related, studies have scored bird responses to ship, aircraft and helicopter traffic based upon experience from extensive survey work at sea and information from the peer-reviewed literature, with scores then moderated by experts. Sandwich terns are ranked as a 2 on a five-point scale, where 1 represents 'hardly any escape/avoidance behaviour and/or none/very low fleeing distance' and 5 'strong escape/avoidance behaviour and/or large fleeing distance'. This categorisation does not distinguish between noise and visual stimuli but, nonetheless, suggests that Sandwich terns are relatively insensitive to anthropogenic disturbance in the offshore environment.

10.3.84 Support for this conclusion is derived from studies of tern behaviour in relation to piling for installation of turbine foundations at Teeside offshore wind farm in April and May 2012, as well as the observations of tern flight behaviour undertaken in relation to the offshore ground investigation works in the Porth-y-pistyll area between 24th and 29th July 2016.

10.3.85 Piling required for turbine foundations at offshore wind farms can generate high levels of airborne noise as well as being a source of underwater noise [RD347]. At Teeside offshore wind farm, the numbers of Sandwich terns (which were likely to be birds on passage) recorded in surveys undertaken during piling operations were higher than those during pre- or post-piling surveys on the same day, whilst the distances of birds to the piling rigs did not differ according to whether they were operating or not [RD84]. Furthermore, common terns (which were likely to be locally breeding birds) were found to be attracted to the vicinity of the piling rig during piling operations (as opposed to being displaced), with the attraction being associated with increased feeding activity (a likely consequence of the increase in injured and dead fish from the piling).

10.3.86 The observations at Porth-y-pistyll demonstrated very limited flight avoidance behaviour by Sandwich terns in response to the offshore ground investigation works, with the majority of the 308 mapped flights (involving 539 birds on both outward and return flights from the Cemlyn Bay colony) that passed close to the works showing no deviations in either flight directions or heights (Application Reference Number: 6.4.89). Approximately 10% of these flights showed small deviations in direction and/or height where the rigs occurred on their original flight trajectory, with the approximate maximum deviations being 200m laterally and 30m vertically.



Legend

- WNDA
- Likely nesting zone
- 500m buffer around likely nesting zone
- Potential nesting zone
- 500m buffer around potential nesting zone
- ZTV 2.5m (shaded area = not visible)

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Client: HORIZON NUCLEAR POWER

Project: Wylfa Newydd Project

Title: The likely and potential nesting zones used to establish the 500m buffers for construction works between 15th April and 15th May

Figure: 10-5

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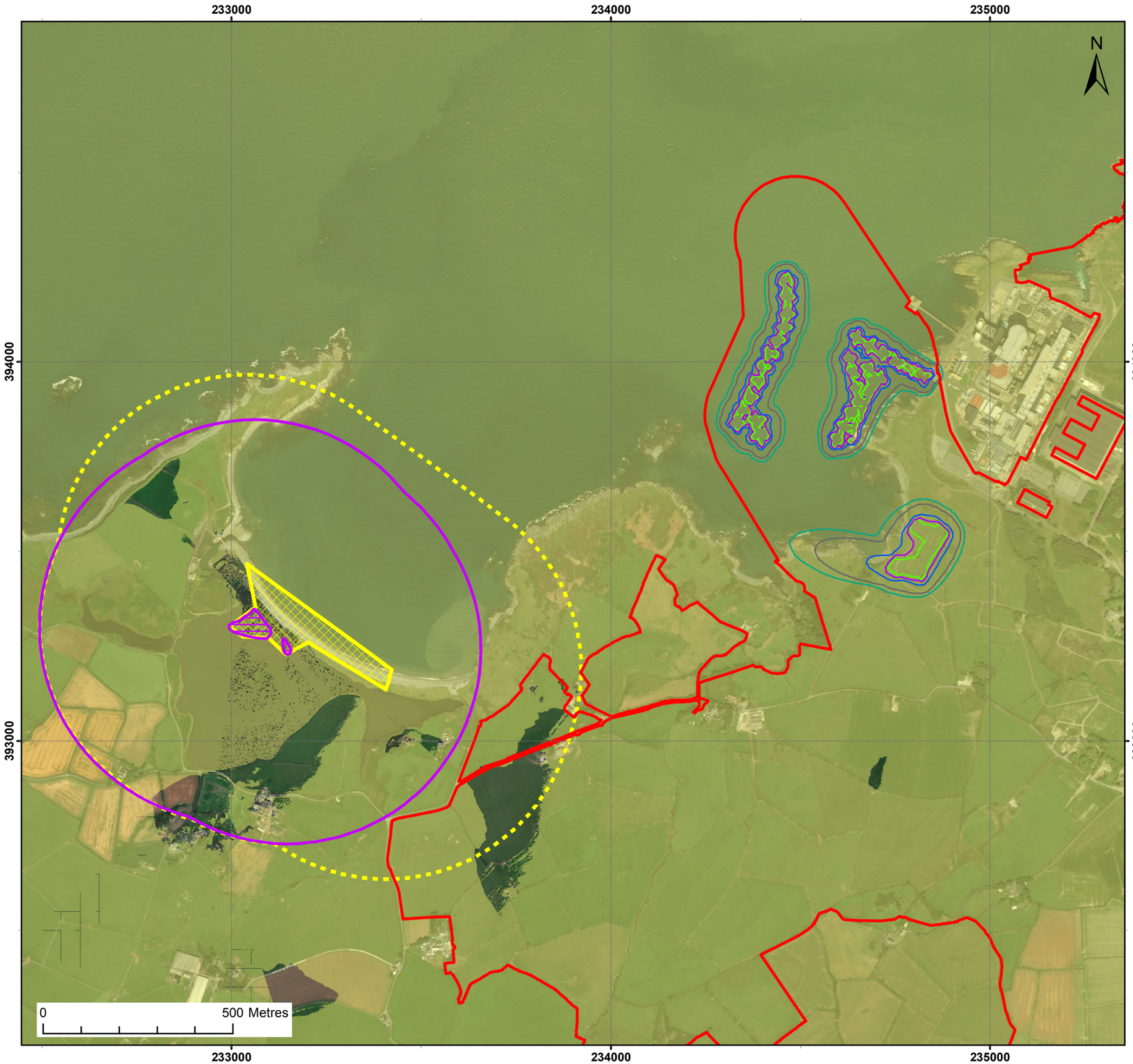

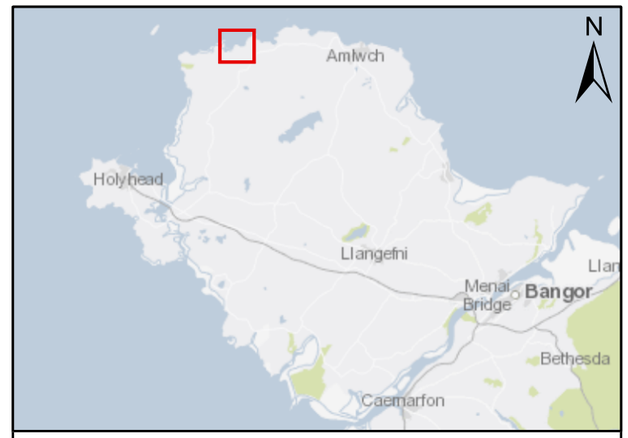

Legend

- WNDA

Isolux Contours

- Isolux Contour 0.05 lux
- Isolux Contour 0.1 lux
- Isolux Contour 1.0 lux
- Isolux Contour 5.0 lux
- Isolux Contour 20 lux
- Likely nesting zone
- 500m buffer around likely nesting zone
- Potential nesting zone
- 500m buffer around potential nesting zone
- ZTV 2.5m

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Client: HORIZON NUCLEAR POWER

Project: Wylfa Newydd Project

Title: Indicative external isoline contours for artificial lighting in the marine environment (construction phase) and tern nesting areas

Figure: 10-6

Revision:	Date:	Drawn:	Checked:	Size:	Scale:
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Co-ordinate system: British National Grid

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Predicted effects

10.3.87 Based on the available evidence that suggests Sandwich terns are unlikely to show marked responses to noise levels below 70 dB(A), combined with their reported low sensitivity to anthropogenic disturbance sources in the offshore environment, for the purposes of undertaking this assessment a highly precautionary assumption has been made that birds would avoid offshore areas where the noise levels from plant and machinery during the construction period are predicted to exceed 65 dB(A) (figure 10-7). As for noise disturbance at the colony, this is based upon a precautionary scenario where all the plant is running (100% on time). The area defined by noise levels in excess of 65 dB(A) is subsequently referred to as the offshore noise ZOI.

10.3.88 The avoidance of the offshore noise ZOI would mean that Sandwich terns are displaced from foraging within this ZOI. The relatively broad-scale ESAS transect data suggest that this effect would be of limited importance to the Sandwich terns, given that the areas of higher Sandwich tern densities during those surveys are consistently outside this ZOI (figures 6-20 to 6-24). A separate potential effect of avoidance is that terns would have to detour around the ZOI (i.e. change the desired flight path) when flying to and from the colony.

10.3.89 The potential consequences of the avoidance of the offshore noise ZOI by Sandwich terns are considered in more detail using the information on modelled foraging range [RD362] and the tracking data (for which the methods are detailed in chapter 6, section 6.5).

10.3.90 The predicted foraging range for the Sandwich tern SPA population extends across an area of approximately 7,882km^2, with the area accounting for approximately 95% of the predicted usage encompassing an area of 69km^2 (figure 6-18, [RD362]). The area of the offshore noise ZOI (i.e. 2.3km^2) represents 0.03% of the total predicted foraging range and 3% of the area predicted to account for 95% of usage.

10.3.91 Based on the data from the three different tern tracking surveys, approximately 1.5–2.5% of all Sandwich tern foraging attempts are estimated to occur within the offshore noise ZOI, depending on whether estimates are based on the complete tracks only or on all tracks (table 10-4, figure 10-8). Unsurprisingly, given the perimeter of the offshore noise ZOI extends across the entrance to Cemlyn Bay, a high percentage (approximately 75%) of Sandwich tern flights to and from the colony are estimated to pass through the offshore noise ZOI (table 10-4).

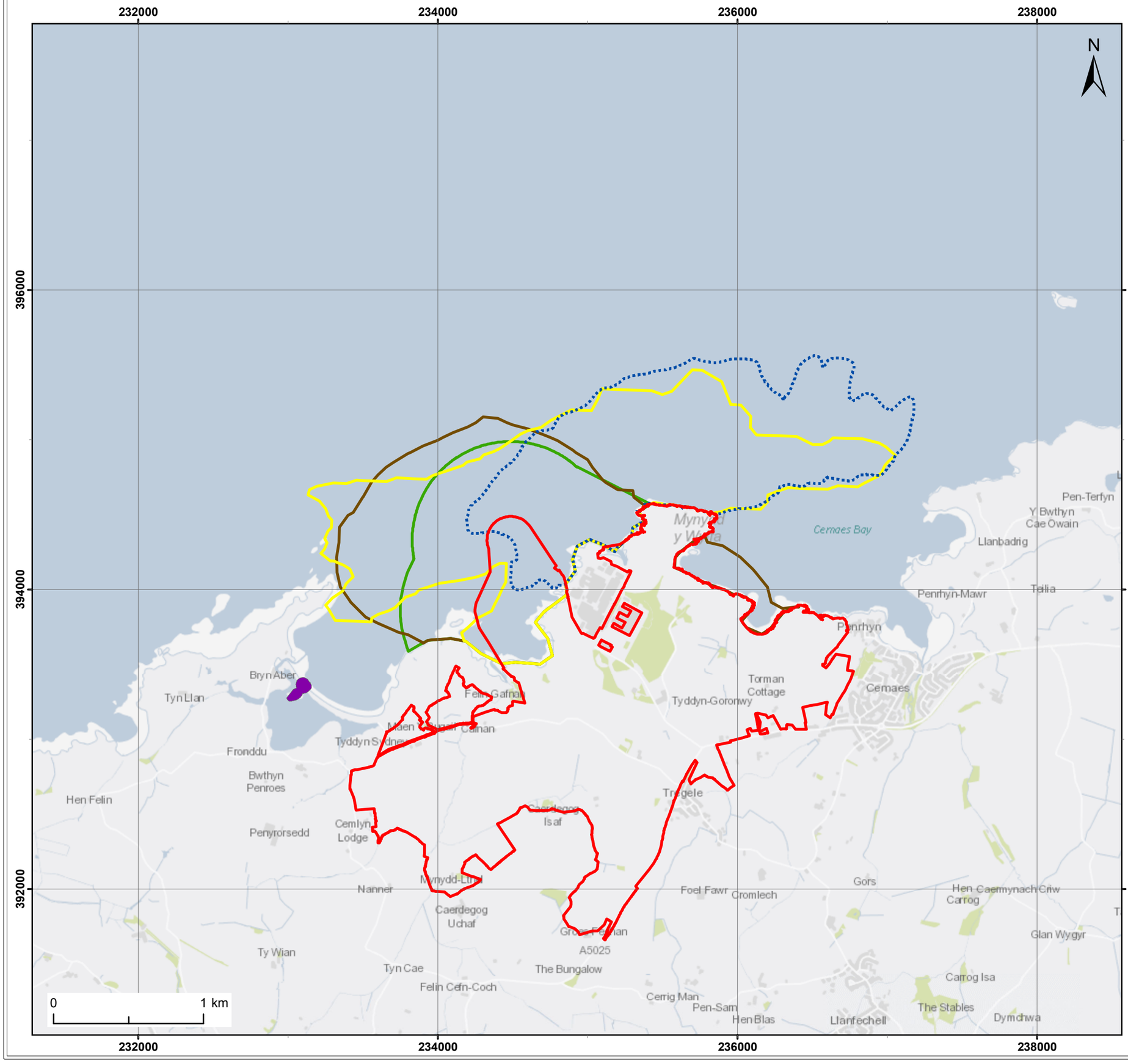
Table 10-4 The percentage of Sandwich tern foraging locations and tracks occurring within the offshore noise ZOI. Sample sizes (n) upon which the percentage estimates are based are given

Survey	Foraging locations (%)		Tracks (%)	
	Complete tracks*	All tracks	Complete tracks*	All tracks
2016 Jacobs	1.25% (n=1040)	0.96% (n=2081)	77.14% (n=35)	82.14% (n=84)
2009 JNCC	1.00% (n=603)	4.22% (n=1255)	72.00% (n=25)	68.75% (n=112)
2009 ECON	1.82% (n=329)	2.13% (n=1127)	81.25% (n=16)	75.84% (n=149)
Mean value	1.36%	2.44%	76.80%	75.58%

*Complete tracks are those where birds were followed from, and back to, the colony

10.3.92 The additional flight distance incurred by avoiding the offshore noise ZOI was estimated using the 2016 Jacobs tracking data (the data from all three tracking surveys showing similar distributions of flight lines through the offshore noise ZOI – figures 10-8 and 10-9). The required calculation was undertaken by:

(i) Assuming that all tracks passing through the ZOI were straight lines from the point of entry to the point of exit.
(ii) Calculating the approximate proportional increase in flight distance incurred by assuming that each of the flights in (i) above had passed around the perimeter of the ZOI from the point of entry to the point of exit, as opposed to following a straight line through the ZOI (with this undertaken for both the inbound and outbound sections of complete tracks).
(iii) Measuring the actual flight distance (as estimated from the tracks) within the ZOI for each track in (i) above (with this again measured for both the inbound and outbound sections of complete tracks).
(iv) Increasing the mean flight distance as measured in (iii) above by the mean proportional increase in the measurements between stages (i) and (ii) above.
(v) Expressing this increase in mean flight distance as a percentage of the average flight distance for Sandwich terns from the colony, based on the full sample of (a) complete and (b) all tracks, irrespective of whether or not they passed through the ZOI.



Legend

- WNDA
- Tern colony
- Temperature ZOI (sea surface autumn base case)
- TRO ZOI (surface summer base case)
- Noise ZOI (65db)
- 500m visual ZOI

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Client: HORIZON NUCLEAR POWER

Project: Wylfa Newydd Project

Title: Offshore ZOIs for airborne noise disturbance and visual disturbance during construction, and for water temperature change and total oxidant levels during operation

Figure: 10-7

Revision:	Date:	Drawn:	Checked:	Size:	Scale:
3	17/01/2018	TC	MG	A3	1:25,000
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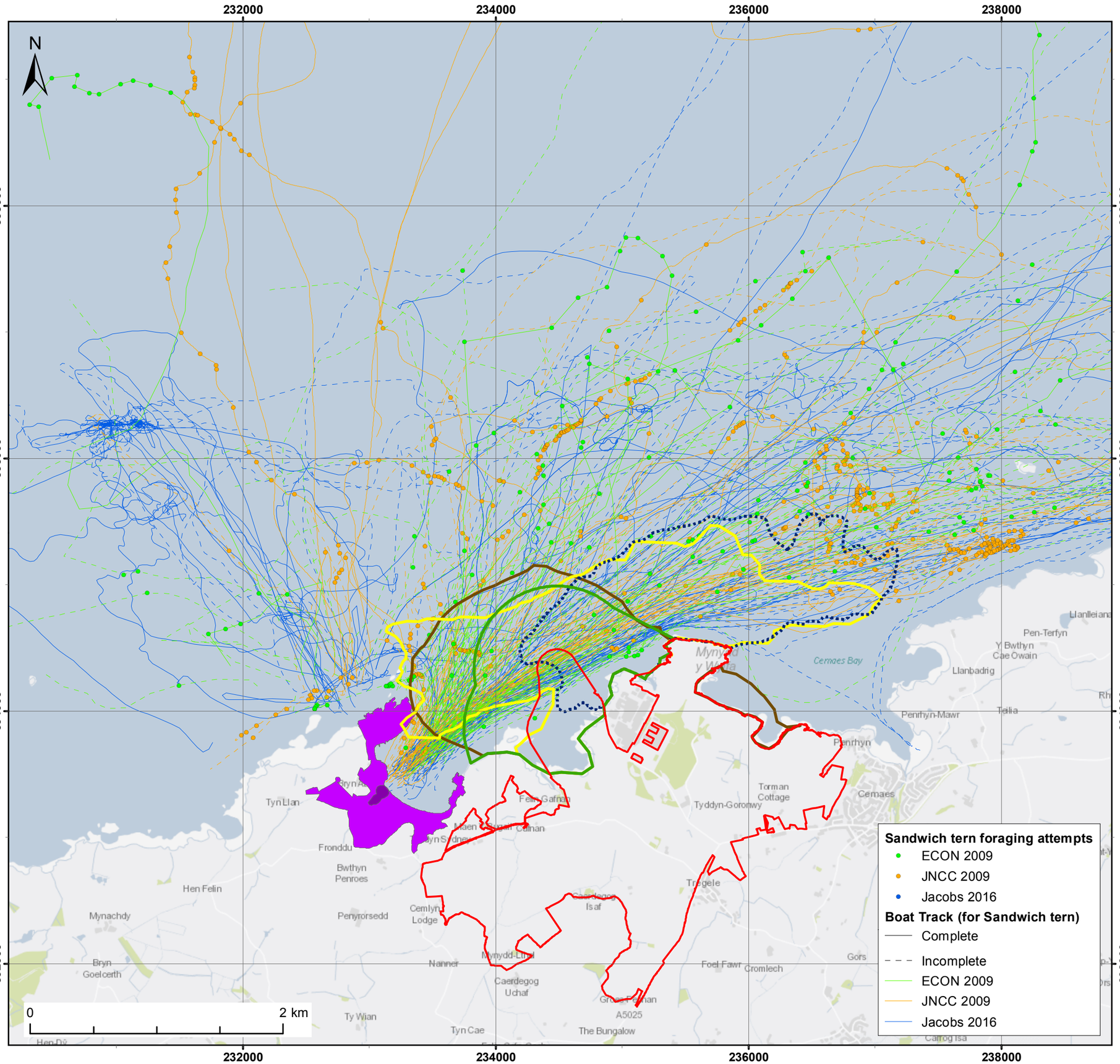

Legend

- WNDA
- Disposal Site
- Temperature ZOI (sea surface autumn base case)
- TRO ZOI (surface summer base case)
- Noise ZOI (65db)
- 500m visual ZOI
- Cemlyn Bay SSSI/SAC
- Tern colony

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Client: HORIZON NUCLEAR POWER

Project: Wylfa Newydd Project

Title: Sandwich tern tracking results from within the vicinity of the offshore ZOIs for the Jacobs (2016), JNCC (2009) and ECON (2009) surveys

Figure: 10-8

Revision:	Date:	Drawn:	Checked:	Size:	Scale:
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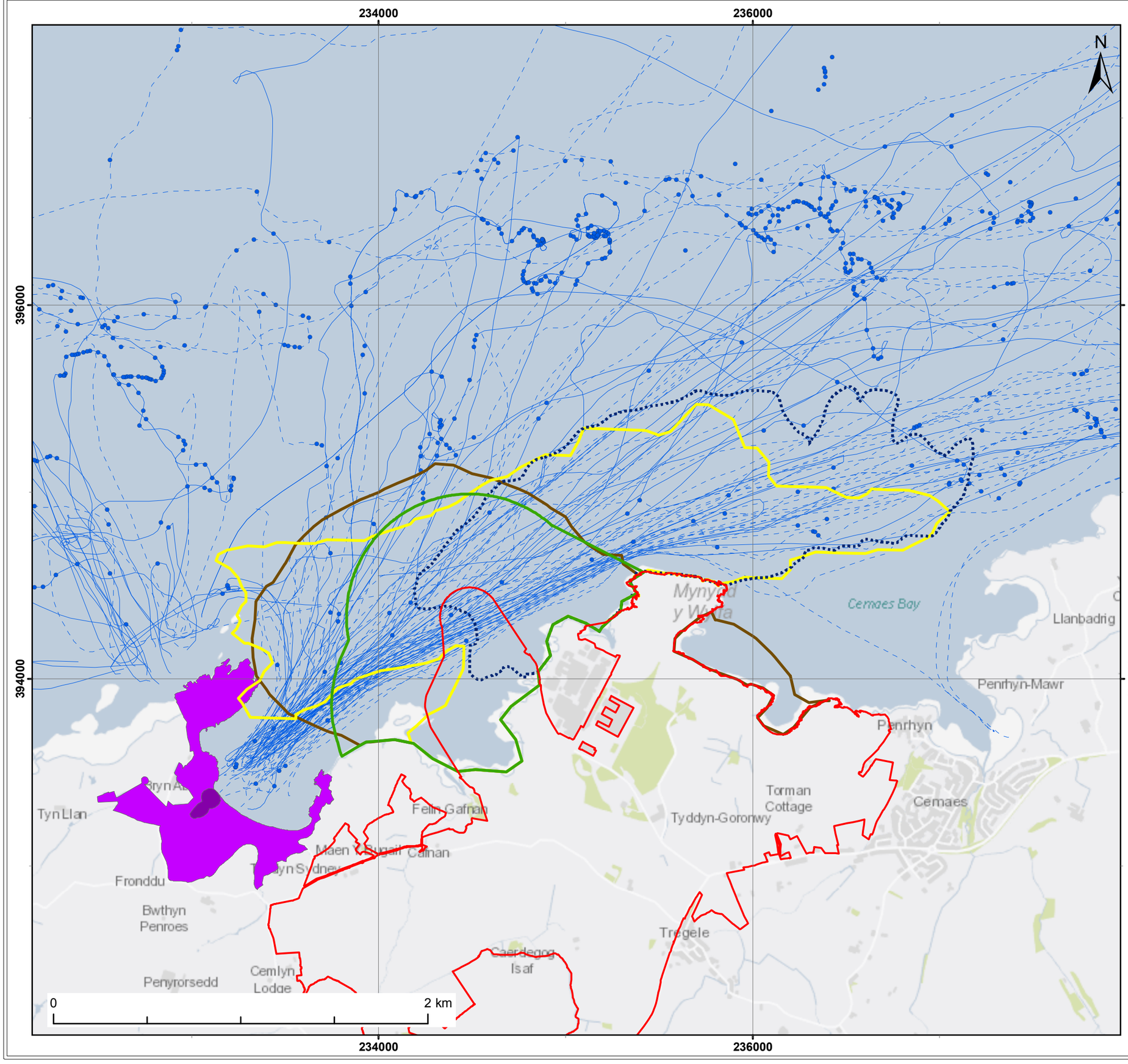

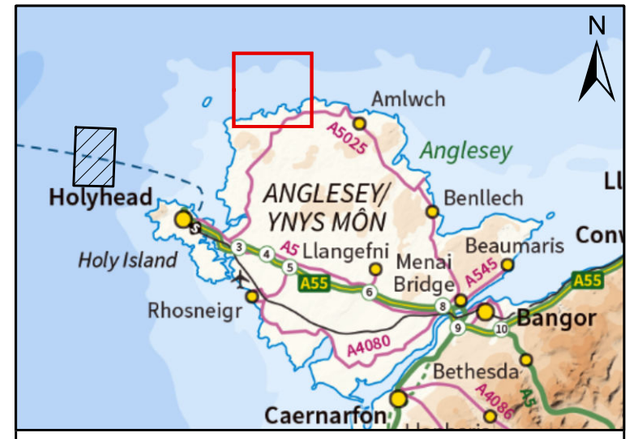

Legend

- WNDA
- Disposal Site
- Temperature ZOI (sea surface autumn base case)
- TRO ZOI (surface summer base case)
- Noise ZOI (65db)
- 500m visual ZOI
- Cemlyn Bay SSSI/SAC
- Tern colony
- Sandwich terns foraging attempts

Boat Track (for Sandwich tern)

- Complete
- Incomplete

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Client: HORIZON NUCLEAR POWER

Project: Wylfa Newydd Project

Title: Sandwich tern tracking results from within the vicinity of the offshore ZOIs for the Jacobs (2016) surveys only

Figure: 10-9

Revision:	Date:	Drawn:	Checked:	Size:	Scale:
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10.3.93 Therefore, the above calculation relates the additional trip length that is estimated to be incurred by the flights passing through the offshore noise ZOI to the total trip length for all tracks in the sample. A potential bias could arise if the proportion of tracks comprising either inbound or outbound flights (but not both) in the sample that pass through the offshore noise ZOI differs from that in the total sample (with a higher proportion of such tracks within the sample passing through the offshore noise ZOI causing the additional trip length to be underestimated). However, the possibility that such a bias may have caused an underestimation of the additional trip length is accounted for by relating the estimated additional trip length to both the full sample of tracks and the subset of complete tracks (see below). This addresses the potential bias because the total estimated additional trip length for all tracks passing through the offshore noise ZOI must be greater than would be estimated from the subset of complete tracks.

10.3.94 Based upon the above calculations, the average flight distance for Sandwich terns undertaking commuting and foraging trips from the colony was estimated to increase by approximately 530m. This represented a 3.8% increase in flight distance for the complete tracks and 3.2% for all tracks. These figures overestimate the increase in flight distance that would result from an avoidance of the offshore noise ZOI because the tracking studies were unable to follow all tern tracks over the full trip to and from the colony, and hence the average trip distance is underestimated. In the 2016 Jacobs surveys, the average distance for the complete tracks was 13.9km, compared to 17.8km for those that were incomplete, demonstrating that the sample of complete tracks was biased towards the shorter trips.

10.3.95 The additional energy costs resulting from an average detour of 500m on foraging trips is likely to represent no more than an additional 1 to 2% increase in daily energy expenditure [RD204] (the estimate of the increase in daily energy expenditure is derived using Figure 2b in [RD204]. This shows the estimated additional energy cost for additional distance travelled per foraging trip for common terns (as explained in section 2.3 of [RD204]) when differences in foraging flight frequency per day and foraging distance for each species are accounted for (as given by the values presented in Table 1 of [RD204]). Such an increase in daily energy expenditure is likely to be much less than what may be imposed by low food abundance or adverse weather (although it would be additive to any such effects). Furthermore, the calculated increase in additional flight distance is based upon precautionary assumptions concerning the predicted noise levels, extreme assumptions on tern response and an overestimation of effect sizes.

10.3.96 Therefore, even when based on highly precautionary assumptions, it is predicted that a small extent only of the potential foraging range would be affected, within which relatively little foraging has been recorded during the tracking surveys, and that the additional energy costs incurred by detours to foraging trips would be minor. As such, noise disturbance from construction plant and machinery is not predicted to result in adverse effects on the SPA Sandwich tern population via impacts on foraging and commuting birds.

Disturbance from underwater noise

10.3.97 The construction works that would occur within Porth-y-pistyll would also result in the generation of underwater noise disturbance. This could have indirect effects on Sandwich terns as a result of impacts on their fish prey, which may suffer injury or direct mortality when in close proximity to the noise sources or be displaced from the affected waters. These effects would be greatest on hearing specialist fish, including some of the key prey groups of the Sandwich terns at Cemlyn Bay, notably clupeids [RD268]. However, other important prey groups (most notably sandeels) lack swim bladders and so are less affected by underwater noise.

10.3.98 A range of the activities during construction would generate underwater noise, most notably dredging, rock cutting, rotary drilling (including with two rigs), percussive drilling (including with two rigs) and rock breaking. Of these, the four former activities produce continuous noise at levels which are predicted to lead to recoverable injury in hearing specialist fish at distances of <1m to 13m, and Temporary Threshold Shifts (TTS) (defined as any change in hearing of 6dB or greater that persists [RD268]) at distances of 2m to 100m (tables 8-15, 8-19 and 8-23). This is on the basis that sound levels known to cause TTS in hearing specialist fish are in the region of 158dB re 1µPa (SPL_{RMS}), whilst those causing recoverable injury are in the region of 170dB re 1µPa (SPL_{RMS}) [RD268].

10.3.99 The rock breaking operations are required for the marine construction works within the outer harbour and are considered to generate multiple pulse sounds which are predicted to produce the highest levels of underwater noise (Application Reference Number: 6.4.91). These operations are scheduled to extend for up to 16 months. Outputs from the underwater noise modelling indicate that, as result of the rock breaking operations, a TTS in fish with swim bladders could occur up to a distance of 180m, with more extreme effects of recoverable injury and mortality at distances of less than 10m (table 10-5).

Table 10-5 Summary of modelled impact ranges for fish with swim bladders involved in hearing (based on thresholds and criteria from [RD268] to sound levels for rock breaking

Range to effect		
Mortality and potential mortal injury >207 dB re 1 µPa (SPL_{peak})	**Recoverable injury 203 dB re 1 μPa^2s (SEL_{cum})**	**TTS (12 h) 186 dB re 1 μPa^2s (SEL_{cum})**
1m	10m	180m

10.3.100 Behavioural effects on fish from underwater noise are not defined and are considered in relation to arbitrary distances. For hearing sensitive fish, the risks of behavioural effects to continuous sound is considered high within tens of metres of the source, medium at distances of hundreds of metres and low at distances of kilometres. In relation to multiple pulse sounds, the risks of behavioural effects on hearing sensitive fish are considered high up

to distances of hundreds of metres and moderate at distances of kilometres, and low at distance. For fish without swim bladders, risks of behavioural effects to multiple pulse sounds are considered to be high near the source, moderate at distances of hundreds of metres and low at distance [RD268].

10.3.101 If it is assumed that the effects of underwater noise on fish will occur within the areas where TTS is predicted to occur for hearing specialists, this restricts potential impacts to a relatively small area of c.0.10km^2, based on a maximum distance of 180m from the marine construction activities to which TTS is predicted to occur (table 10-5). This area lies entirely within the offshore noise ZOI (where only 1.5% to 2.5% of foraging attempts by Sandwich terns are estimated to occur – table 10-4) and represents approximately 5% of the extent of this ZOI.

10.3.102 Risks of behavioural effects on fish extend considerably further than 180m from the noise sources, and for hearing specialists (including clupeids), there is considered to be a moderate risk that these could extend out to, and beyond, the boundaries of the offshore noise ZOI (which would be close to, or greater, than 1km from the underwater noise sources – figure 10-7). This level of risk applies only to the rock breaking operations, which are expected to extend over two breeding seasons at most. For the other activities that generate underwater noise, a low risk of behavioural effects on fish is unlikely to extend even as far as the boundaries of the offshore noise ZOI.

10.3.103 As stated above, such behavioural effects are not defined and cannot be assumed to necessarily equate to displacement, as they would also include short-term movements and minor, 'startle-type' responses. For cetaceans, the displacement effects from rock breaking are predicted to extend to approximately 500–600m only (table 8-17) and, as such, it is considered highly unlikely that such effects on fish would extend beyond these distances.

10.3.104 Therefore, the main effects of underwater noise from construction on the fish prey of Sandwich terns are predicted to occur within an area that represents a small part of the offshore noise ZOI only. Behavioural effects on fish will extend further than this but any displacement is considered highly unlikely to extend beyond this ZOI. Given this, no adverse effects on the integrity of the SPA Sandwich tern population are predicted as a result of underwater noise.

Disturbance from visual stimuli

Evidence

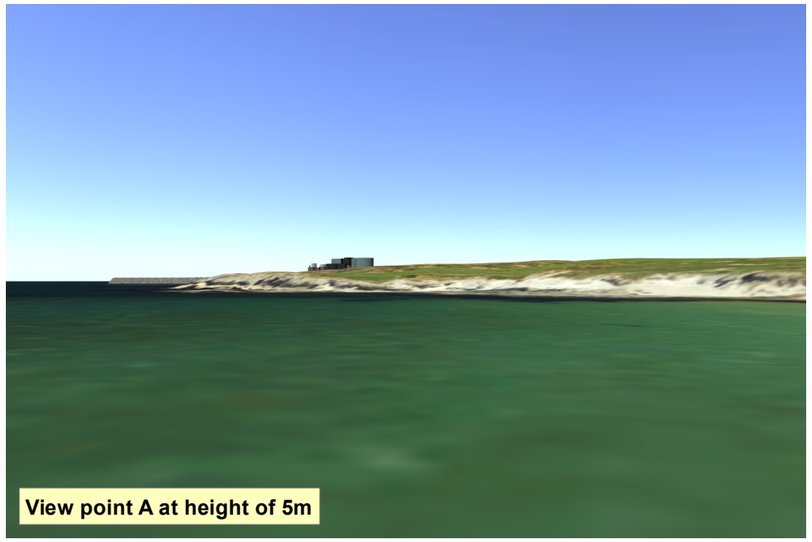
10.3.105 Visual disturbance to Sandwich terns when foraging offshore or when commuting between the colony and their foraging areas could potentially arise as a result of the construction activities in Porth-y-pistyll and at the cooling water outfall, as well as from the increased vessel traffic that would be associated with the construction works.

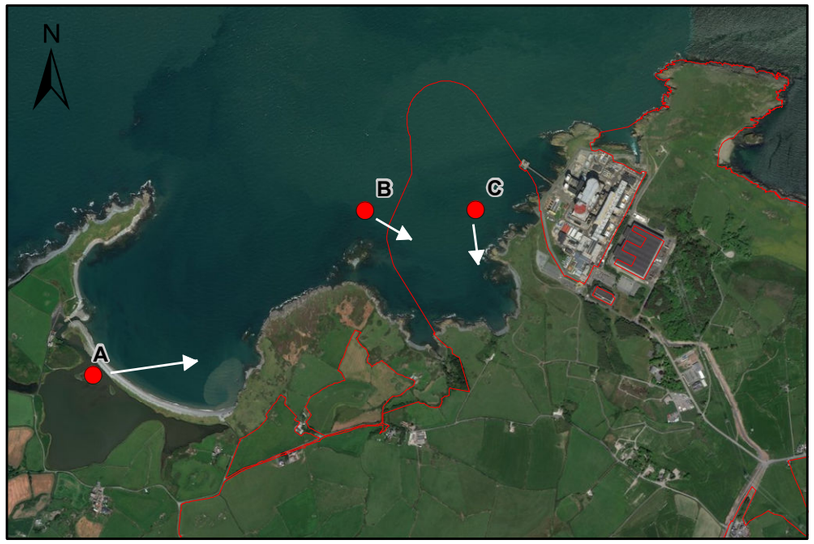
10.3.106 As detailed above, Sandwich terns are regarded as being relatively insensitive to sources of anthropogenic disturbance within offshore

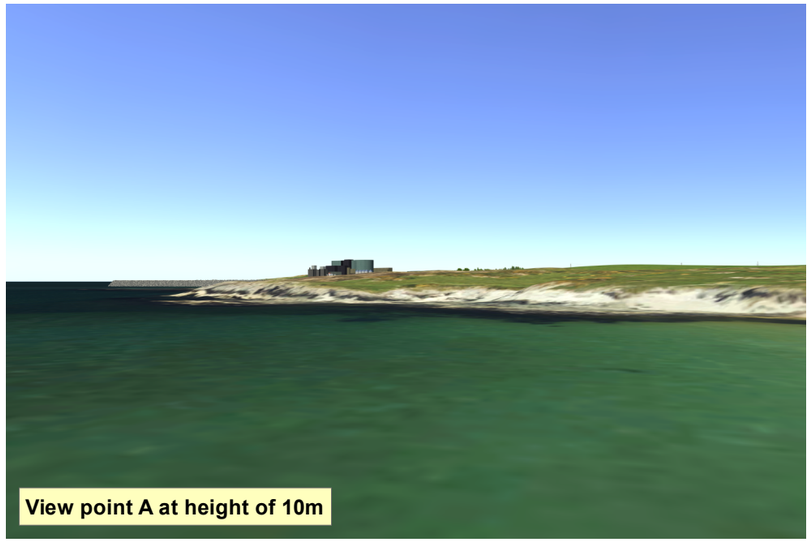
environments ([RD117], [RD115]), suggesting that impacts on foraging and commuting birds from construction-related visual disturbance may be minimal. However, further insight into the likely responses of Sandwich terns to this disturbance source may be gained from consideration of the evidence that is available on their responses to other developments in the offshore environment, most notably wind farms.

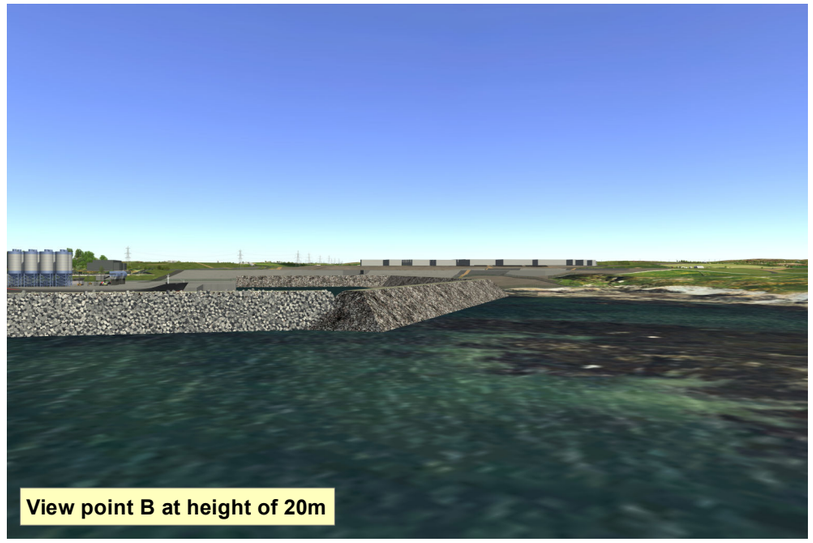
10.3.107 Within waters commonly frequented by breeding Sandwich terns, offshore wind farms often extend over areas of 20 to 40km^2, involve considerable construction activity at sea and (when constructed) comprise a substantial number of large structures (often 100 to 150m in height) that contrast sharply with the surrounding landscape (i.e. open sea). Therefore, it would seem highly likely that they will represent a considerably greater source of visual disturbance than will the offshore construction activities associated with the Project. These will be largely limited to the breakwaters, MOLF and inner harbour, which encompass 0.35km^2 and extend 0.7km out from the shore (figure 10-7). Visualisations of the view of the Wylfa Newydd Development Area at mid-construction stage from Cemlyn Bay (at heights of 0, 5, 10 and 20m) and from just offshore immediately west and east of Port-y-pistyll (both at heights of 20m) are shown in figure 10-10.

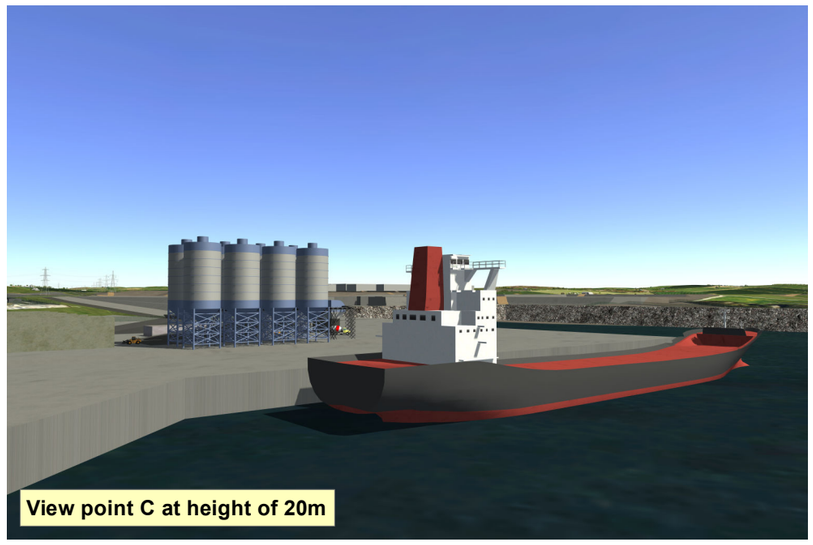
10.3.108 Evidence from monitoring at 10 offshore wind farms in the North Sea indicates that Sandwich terns show an overall weak avoidance of these developments, although the documented response at individual sites varied from no detectable effect (in three cases) to strong avoidance (in two cases) [RD81]. Tracking of Sandwich terns during the breeding season demonstrated that the percentage of tracked birds entering the Sheringham Shoal wind farm site declined from 95% during pre-construction to 65% by the time turbines were being installed [RD129]. The extent to which such a response is attributable entirely to visual disturbance as opposed to other effects (e.g. possible reductions in prey densities during construction due to impacts from piling noise) is unclear but deviations in the flight paths of birds avoiding the site are considered to occur at distances of 0.5 to 1km from the wind farm (M. Perrow – HNP-NRW Birds Technical Workshop, 16th March 2017).











Legend

WNDA

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Client: HORIZON NUCLEAR POWER

Project: Wylfa Newydd Project

Title: Visualisations of the view of the WNDA from three offshore locations at different heights for the mid-construction period

Figure: 10-10

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Predicted effect

10.3.109 Based upon the above evidence it is assumed that foraging and commuting Sandwich terns would be affected by visual disturbance from the construction works up to a distance of 500m from the Project construction activities. Thus, the potential effects that could arise from visual disturbance in the offshore environment are assessed in relation to an area that extends 500m out from the Wylfa Newydd Development Area boundary from where it enters the offshore environment at the west of Porth-y-pistyll east across to the point at which the cooling water outlet would be constructed (figure10-7). This area is subsequently referred to as the offshore visual ZOI.

10.3.110 The offshore visual ZOI is encompassed by the offshore noise ZOI. Consequently, the potential impacts predicted to result from the visual disturbance associated with the construction works in Porth-y-pistyll and at the cooling water outlet would be less than those predicted by the assumed exclusion of foraging and commuting Sandwich terns from the offshore noise ZOI. They are also fully incorporated within the impacts predicted by the exclusion of foraging and commuting birds from the offshore noise ZOI.

10.3.111 Fewer than half of the foraging attempts recorded within the offshore noise ZOI occurred within the offshore visual ZOI, whilst the occurrence of tracks was reduced by approximately 25% relative to the offshore noise ZOI (table 10-6).

Table 10-6 The percentage of Sandwich tern foraging locations and tracks occurring within the offshore visual ZOI. Sample sizes (n) upon which the percentage estimates are based are given.

Survey	Foraging locations (%)		Tracks (%)	
	Complete tracks*	All tracks	Complete tracks*	All tracks
2016 Jacobs	0.48% (n=1040)	0.43% (n=2081)	60.00% (n=35)	71.43% (n=84)
2009 JNCC	0.83% (n=603)	1.20% (n=1255)	56.00% (n=25)	50.89% (n=112)
2009 ECON	0.61% (n=329)	1.69% (n=1127)	50.00% (n=16)	51.68% (n=149)
Mean value	0.64%	1.11%	55.33%	58.00%

*Complete tracks are those where birds were followed from, and back to, the colony

10.3.112 In addition to the actual construction works, there would be an associated increase in vessel movements during the construction period. This would include vessels bringing equipment to the site and transporting the dredged material to Holyhead North, as well as support vessels and jack-up barges.

10.3.113 During construction and on completion of the marine works, marine plant and vessels will be required to transit to and from the Wylfa Newydd Development Area. The peak number of vessels on site is predicted to average approximately 15 per week over a three month period; this is in addition to an existing level of up to 25 vessels per week [RD202]. However,

once on site, much of the marine plant would be stationary for long periods of time or travelling at relatively slow speeds. Work boats and safety boats may travel at faster speeds, but movement would generally be limited to the Wylfa Newydd Development Area.

10.3.114 The duration of the dredging works is predicted to be approximately 18 months. There would be a predicted peak of 60 vessels per month (120 two-way movements) for disposal of soft sediments and a peak of 10 vessels per month (20 two-way movements) for disposal of rock.

10.3.115 Given the relatively low sensitivity of Sandwich terns to vessel traffic [RD117], [RD115]) this source of visual disturbance is considered unlikely to have more than minor effects on foraging or commuting behaviour, which would be inconsequential in terms of any population-level effect.

10.3.116 As detailed above, modelling of indicative light spill during the construction of the marine works indicates that the 0.1 Lux light spill typically does not extend more than 50m over the water area from the location of the works (with 0.1 Lux being approximately equivalent to a full moon on a clear night). During operation of the MOLF, a 0.1 Lux contour extends no more than 125m across the water. This is predominantly from the MOLF cranes and would only occur at three specific locations. Typically the 0.1 Lux extends no more than 100m across the water when the cranes are not in use (figure 10-6).

10.3.117 Given the low levels of light spillage involved, the small areas which would be affected and the fact that Sandwich terns show very little nocturnal flight activity [RD117], there is no risk that construction lighting would adversely affect foraging Sandwich terns.

10.3.118 Visual disturbance from construction activities is considered highly unlikely to have adverse effects on the SPA Sandwich tern population as a result of impacts in the offshore environment. The extent to which potential foraging habitat may be affected and the potential effects of avoidance on foraging trip distances are less than those predicted for noise disturbance in the offshore environment. Other than the predicted minor effects of increased vessel movements, there are also no cumulative effects predicted from visual and noise disturbance within the offshore environment. This is because the ZOI within which potential noise disturbance impacts have been predicted incorporates the ZOI for visual disturbance (and considers the extreme case in which Sandwich terns are excluded from the offshore noise disturbance ZOI, which is highly precautionary). In addition, visual disturbance from the construction activities in Porth-y-pistyll and at the cooling water outlet would be temporary.

10.3.119 Based on the above, disturbance in the marine environment as a result of the construction activities of the Project is not predicted to have an adverse effect on the integrity of the Morwenoliaid Ynys Môn/Anglesey Terns SPA Sandwich tern population.

Operation

A3 Noise and visual disturbance during operation [Operational combustion activity EP]

10.3.120 Modelling of airborne noise for the operational phase demonstrates that even noise levels of 35dB (the lowest levels shown in the modelled outputs) do not extend as far as the breeding colony, whilst levels above 35 dB(A) do not extend into the offshore environment (figure D6-12 in Appplication Reference Number: 6.4.6).

10.3.121 In terms of visual stimuli, potential impacts are essentially limited to the vessel movements associated with the Project and spillage from artificial lighting. Vessel movements are predicted to be very infrequent (one per month) and so would not represent any discernible change to existing background levels. During operation of the MOLF a 0.1 Lux extends no more than 125m across the water (figure 10-11). This is predominantly from the MOLF cranes and would only occur at three specific locations. Typically the 0.1 Lux extends no more than 100m across the water when the cranes are not in use.

10.3.122 During operation of the Power Station, the 0.1 Lux spill from the perimeter is less than 50m and around 30m along the road leading to the site.

10.3.123 Visualisations of the view of the Wylfa Newydd Development Area during operation from Cemlyn Bay (at heights of 0, 5, 10 and 20m) and from just offshore immediately west and east of Port-y-pistyll (both at heights of 20m) are shown in figure 10-12.

10.3.124 No adverse effects on integrity from changes in visual and acoustic stimuli are predicted on the SPA breeding Sandwich tern population during the operational phase of the Project.

B Land-take, including seabed or intertidal land

Construction

B1 Change and/or loss of habitat [Marine Licence]

10.3.125 Potential impacts on the SPA Sandwich tern population during the construction period could arise from land take within the Porth-y-pistyll area and as a result of the disposal of dredge material at the Disposal Site. These could have indirect effects on foraging terns via impacts on fish prey populations.

10.3.126 The potential for indirect effects as a result of land-take affecting terrestrial habitats upon which black-headed gulls (which nest in association with Sandwich terns at Cemlyn Bay) depend can be discounted. As stated above, there is no evidence from the breeding season surveys to suggest that any parts of the Wylfa Newydd Development Area are of particular importance to foraging black-headed gulls (Application Reference Number: 6.4.89).

10.3.127 Construction activities within Porth-y-pistyll would involve the construction of the MOLF, cofferdams and the breakwater, all of which would lead to a loss of seabed habitat. However, this would occur within an area of only 0.35km^2, which represents an insignificant proportion of the foraging area available to Sandwich terns from the Cemlyn Bay colony (i.e. 7,882km^2 as determined from the modelled foraging range [RD362]). Furthermore, the tern tracking surveys demonstrate the limited extent to which this area is used for foraging with only three of a total 4,463 foraging attempts recorded within the area (figures 10-8 and 10-9).

10.3.128 The Disposal Site is approximately 20km from the Cemlyn Bay colony and within the foraging range of the Sandwich terns ([RD330], [RD107]). However, the Disposal Site is a considerable distance from the area of core usage by Sandwich terns (figure 6-18). The results of the Sandwich tern tracking studies undertaken in 2016 and 2009 (figure 6-30), the outputs from the modelling on the usage of the marine environment (figure 6-18, [RD362]), and the earlier JNCC boat-based snapshot point count data (figure 3-4, appendix A of Application Reference Number: 6.4.89), all demonstrate that Sandwich terns from the Cemlyn Bay colony make little, if any, use of the waters in the vicinity of the Disposal Site.

10.3.129 Hence, land-take during construction is not predicted to have an adverse effect on the integrity of the Morwenoliaid Ynys Môn/Anglesey Terns SPA Sandwich tern population.

Operation

B2 Change and/or loss of habitat [Marine Licence]

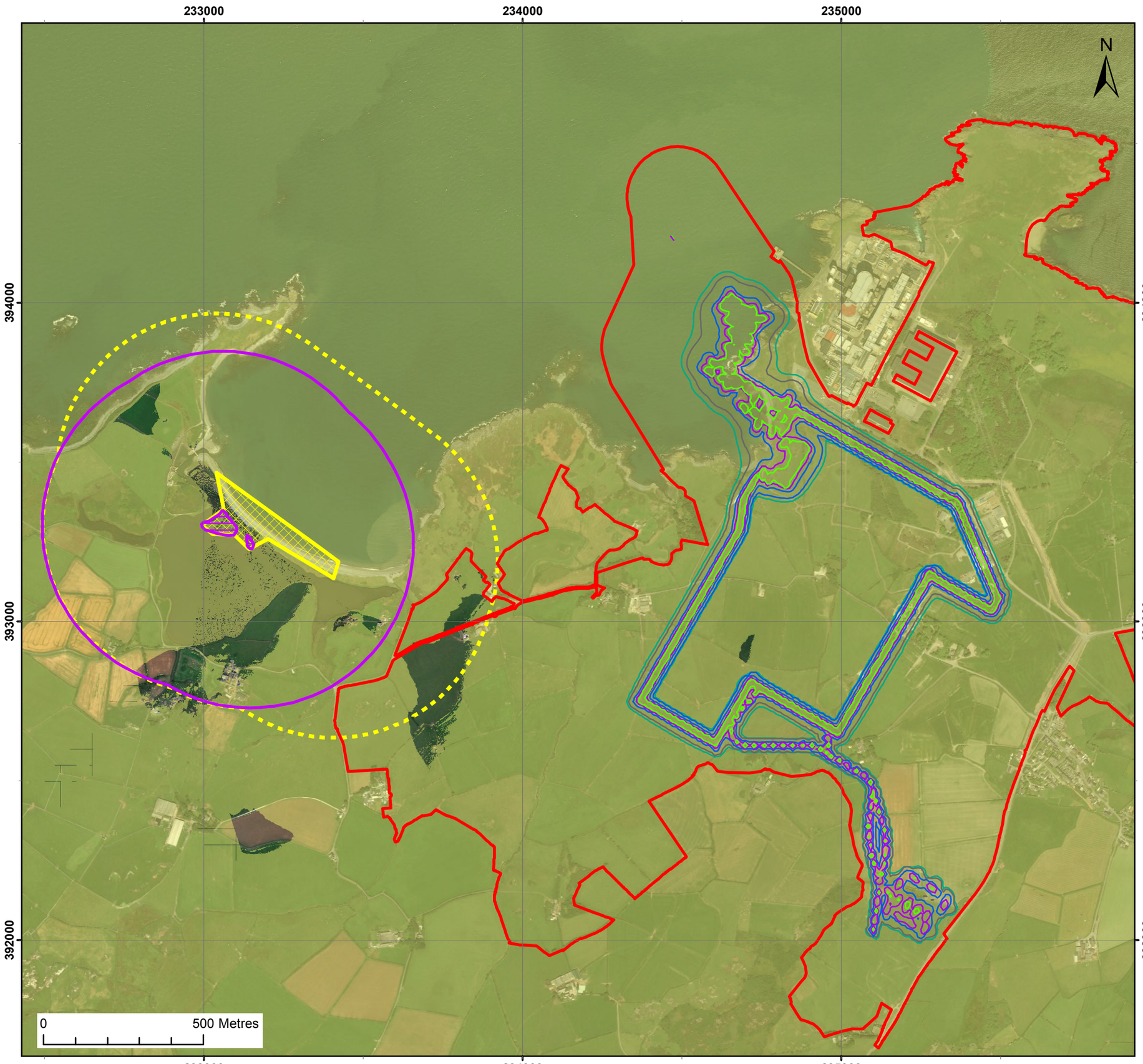
10.3.130 The marine structures would be retained during the operational phase and would essentially represent a permanent loss of seabed habitat. However, as detailed above, the extent of this habitat loss is insignificant relative to the foraging area available to Sandwich terns from the Cemlyn Bay colony.

10.3.131 As such, land-take is not predicted to have impacts on the SPA Sandwich tern population during the operational phase.

C Changes in marine water quality

10.3.132 Changes in marine water quality could potentially affect the availability of the fish prey of Sandwich terns leading to impacts on the SPA population. Such effects could arise via:

- Suspended sediment input to the marine environment (drainage, dewatering, sewage discharge and capital dredging).
- Increase in suspended sediment concentration during disposal of dredged material.
- Changes in water chemistry.
- Discharge from the CWS.



Legend

- WNDA

Isolux Contours

- Isolux Contour 0.05 lux
- Isolux Contour 0.1 lux
- Isolux Contour 1.0 lux
- Isolux Contour 5.0 lux
- Isolux Contour 20 lux
- Likely nesting zone
- 500m buffer around likely nesting zone
- Potential nesting zone
- 500m buffer around potential nesting zone
- ZTV 2.5m

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Client: HORIZON NUCLEAR POWER

Project: Wylfa Newydd Project

Title: Indicative external isoline contours for artificial lighting in the marine environment (operational phase) and tern nesting areas

Figure: 10-11

Revision:	Date:	Drawn:	Checked:	Size:	Scale:
0	20/07/2017	TC	AR	A3	1:12,000

Co-ordinate system: British National Grid

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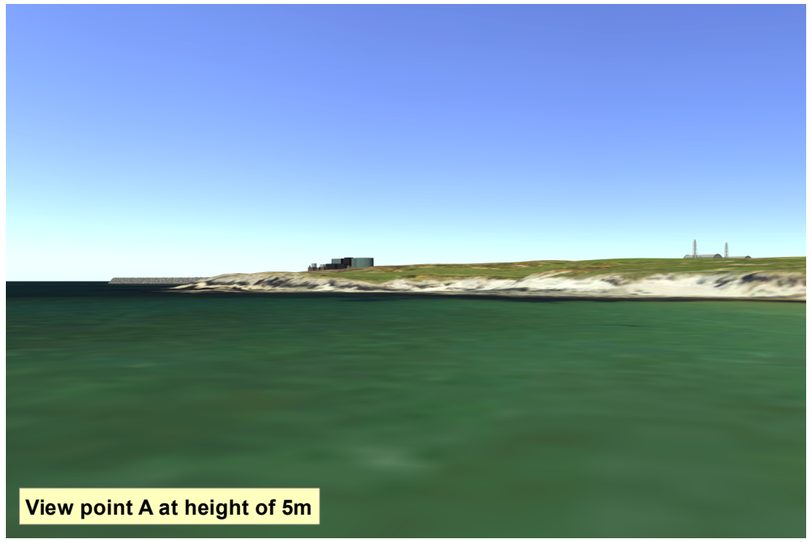

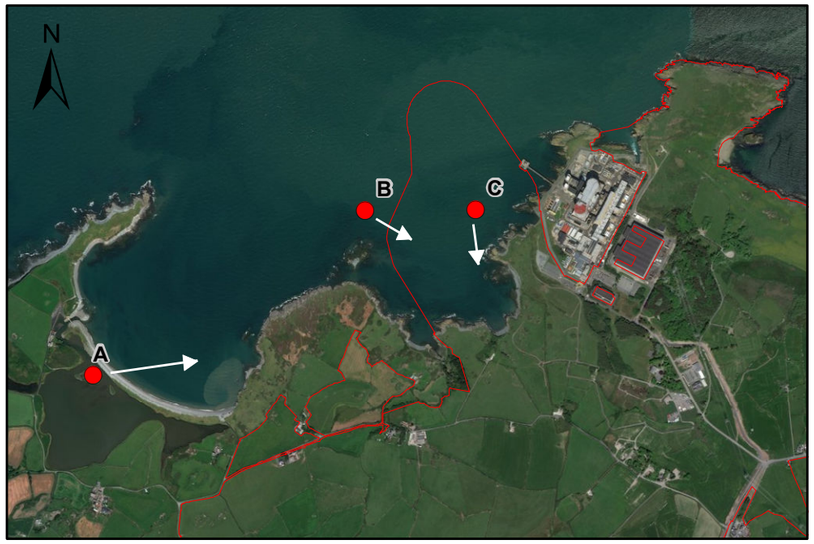

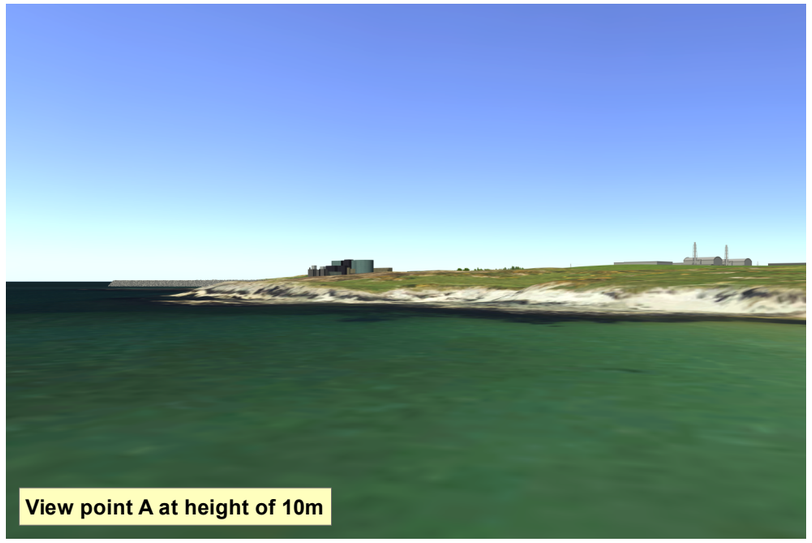

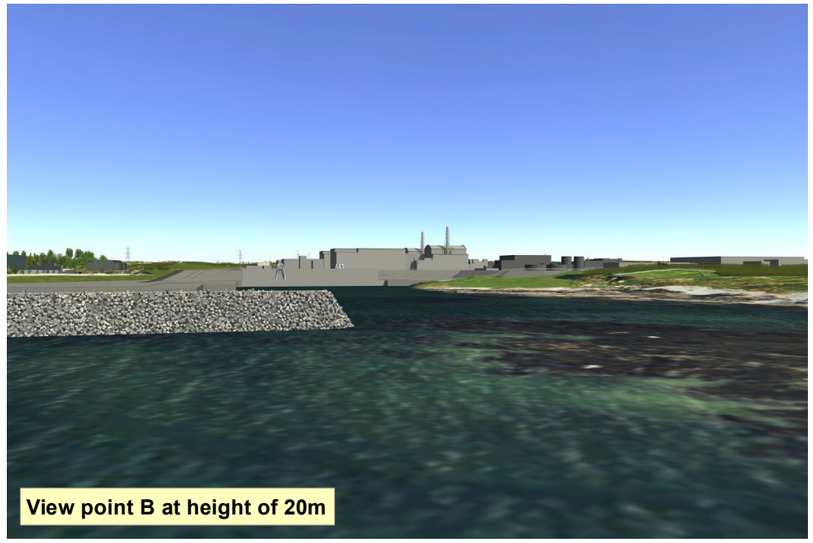

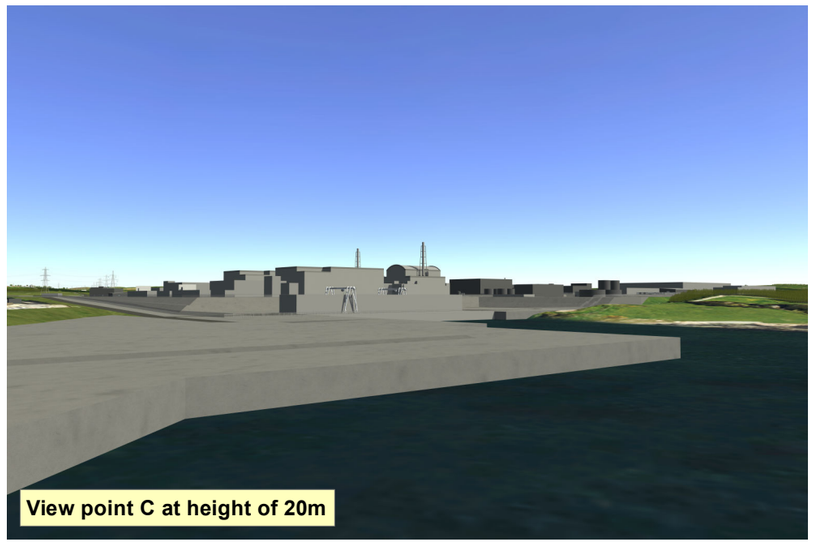

Legend

- WNDA
- 3D model view points

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Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

Client: HORIZON NUCLEAR POWER

Project: Wylfa Newydd Project

Title: Visualisations of the view of the WNDA from three offshore locations at different heights for the operation period

Figure: 10-12

Revision:	Date:	Drawn:	Checked:	Size:	Scale:
3	17/01/2018	TC	MG	A3	NTS
2	11/12/2017	TC	AR	A3	NTS

Co-ordinate system: British National Grid

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10.3.133 The first three of the above impacts are relevant to the construction phase, whilst the latter is relevant to operation.

Construction

C1 Suspended sediment input to the marine environment (drainage, dewatering, sewage discharge and capital dredging) [Marine Licence; Construction water discharge EP]

10.3.134 During the construction phase there would be a number of sources of suspended sediment input to the marine environment, as discussed below.

10.3.135 A Delft-3D hydrodynamic model has been used to assess the cumulative effects of all sources of suspended sediment (i.e. fluvial sources drainage, dewatering and sewage as well as dredging) and predict the fate of the suspended sediment discharged in the marine environment. Sediment plume dispersion and sediment settlement rates have been modelled. Full results of the modelling are presented in Application Reference Number: 6.4.90.

10.3.136 There would be periods where soils are exposed and drainage patterns altered. To control suspended sediment from fluvial run-off, a multi-stage treatment solution has been incorporated into the design which would consist of best practice soil management, SuDS and polyelectrolyte coagulant dosing to treat drainage water prior to it entering watercourses that ultimately discharge to the marine environment. The multi-stage treatment solution has been designed to limit the suspended solids at the point of discharge into the watercourses to either 40mg/L or 70mg/L, depending on the watercourse (the proposed limit is based on the background concentration in the receiving watercourse) (Application Reference Number: 6.4.33). The measures are proposed to minimise and manage this predicted effect are described in section 7.4.

10.3.137 During the construction phase, treated sewage would be discharged into the north of the Porth-y-pistyll at a rate of approximately 1,598m^3 per day. The sewage discharge would be limited to 30mg/L of suspended sediment.

10.3.138 There would also be discharge from dewatering (from deep excavations and from cofferdams); suspended sediment would be limited to 70mg/L from this activity, and was modelled as a continuous discharge.

10.3.139 The dominant source of suspended sediment introduced into the marine environment would be spill from capital dredging activity. During capital dredging a maximum area of approximately 25ha is predicted to experience an increase in suspended sediment concentration of greater than 6.1mg/L (equal to the low end of observed ambient concentrations). Within this area, suspended sediment concentrations would increase by up to approximately 60mg/L (figure 10-13). This area would reduce between dredging events as the suspended sediment disperses.

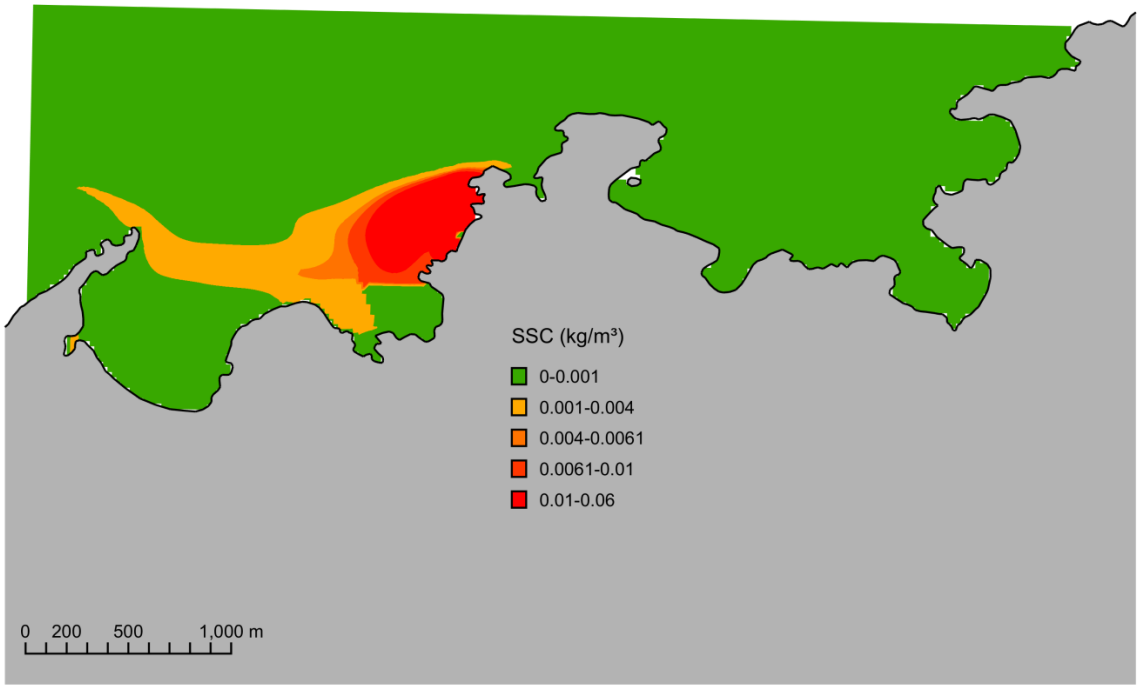


Figure 10-13 Suspended solids concentration (kg/m^3) an hour after the final dredge (mid-depth) (note 1mg/L = 0.001kg/m^3)

10.3.140 After the suspended sediment generated by dredging has dispersed, the suspended solids concentrations from the drainage flows would be low (figure 10-14). Predicted suspended solid concentrations in the marine environment from fluvial sources as depicted by the modelling are shown to be below baseline concentrations within approximately 500m from the discharge points.

10.3.141 Figure 10-14 shows absolute suspended sediment concentration. This is the total suspended sediment in the water column (i.e. background plus predicted inputs). The modelled results are for mid-depth in the water column.

10.3.142 The discharge of suspended sediment at 2S is below 6mg/L (background) (i.e. sediment is dispersed within one 23m grid cell, so does not appear in figure 10-14).

10.3.143 The modelling included suspended sediment inputs at either 40mg/L or 70mg/L at each discharge point, with the corresponding flow for each particular discharge point.

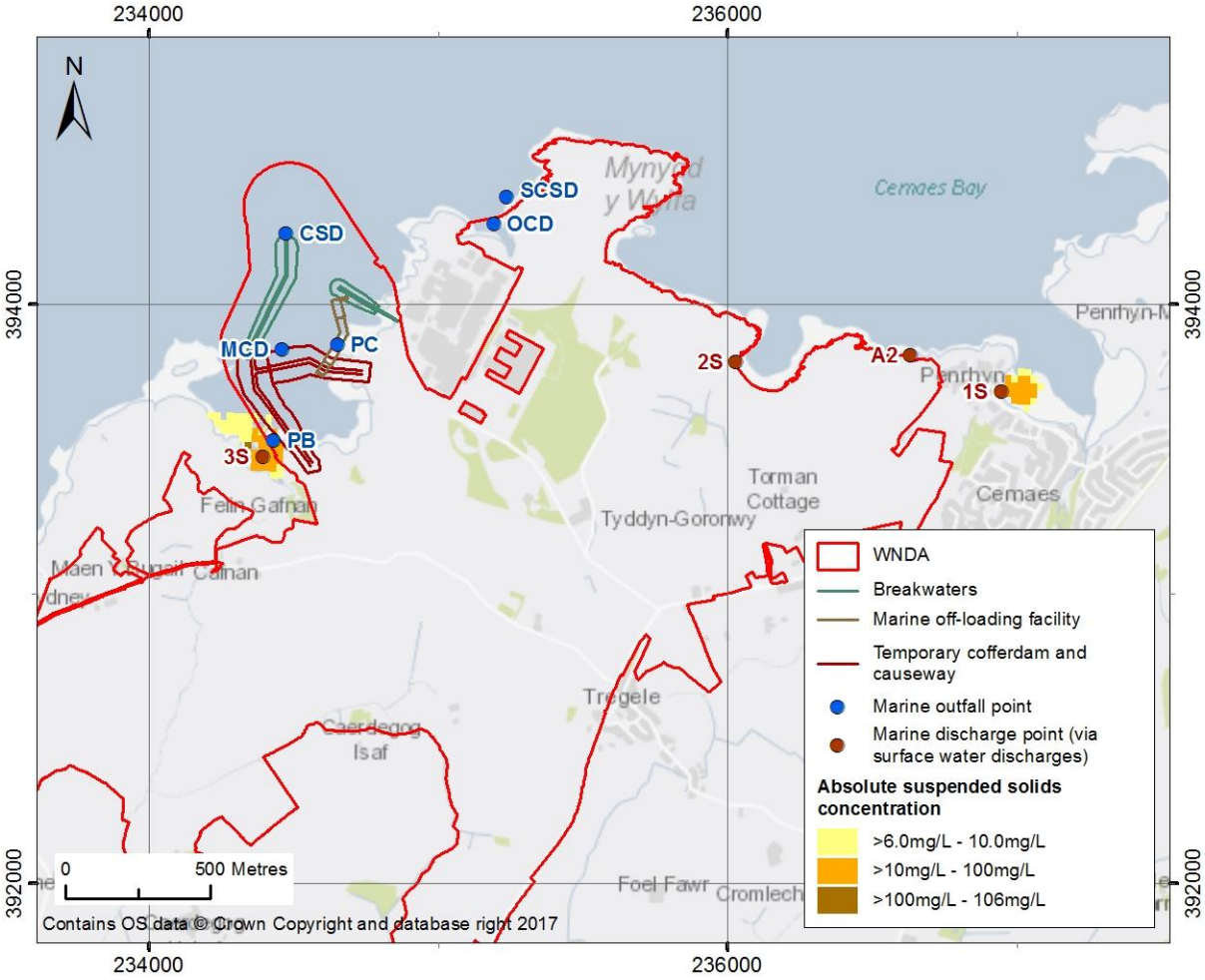


Figure 10-14 Suspended solids concentration resulting from land drainage

10.3.144 As such, the extent of the overall area that is affected would be inconsequential relative to the marine area that is available to foraging SPA Sandwich terns, whilst any such effects would not coincide with areas of importance to foraging Sandwich terns (as determined from the findings of the Sandwich tern tracking – figure 10-8).

10.3.145 Changes in terrestrial water quality, and consequent changes in marine water quality have the potential to affect Sandwich tern prey species. However, the potential zone of influence for any changes via these pathways is less than the potential impact areas assessed for changes in water temperature and chemical quality (see below) and, given the precautionary approach adopted to the assessment of these potential effects on prey species, there would be no additional impacts on Sandwich terns as a result of the effects on terrestrial water quality on prey species.

10.3.146 Therefore, it is considered that suspended sediment input to the marine environment from fluvial sources during the construction period would have no discernible impact on the SPA Sandwich tern population, and no adverse effects on the SPA Sandwich tern population are predicted.

C2 Increase in suspended sediment concentration during disposal of dredged material [Marine Licence]

10.3.147 For the disposal of dredged material, the modelling of all sediment fractions (coarse sand, medium sand, fine sand and fines fractions) for the whole period of disposal (i.e. up to 242,000m^3 over 35 days) predicts that in the upper 10% of the water column (where the highest concentrations occur), the suspended sediment concentration increase above typical background concentration would occur in a zone of approximately 1km around the disposal location (figure 10-15). The typical background suspended sediment concentration is 5.5 x 10-3kgm^{-3}, with values ranging from <3 x 10-3kgm^{-3} to 10 x 10-3kgm^{-3}.

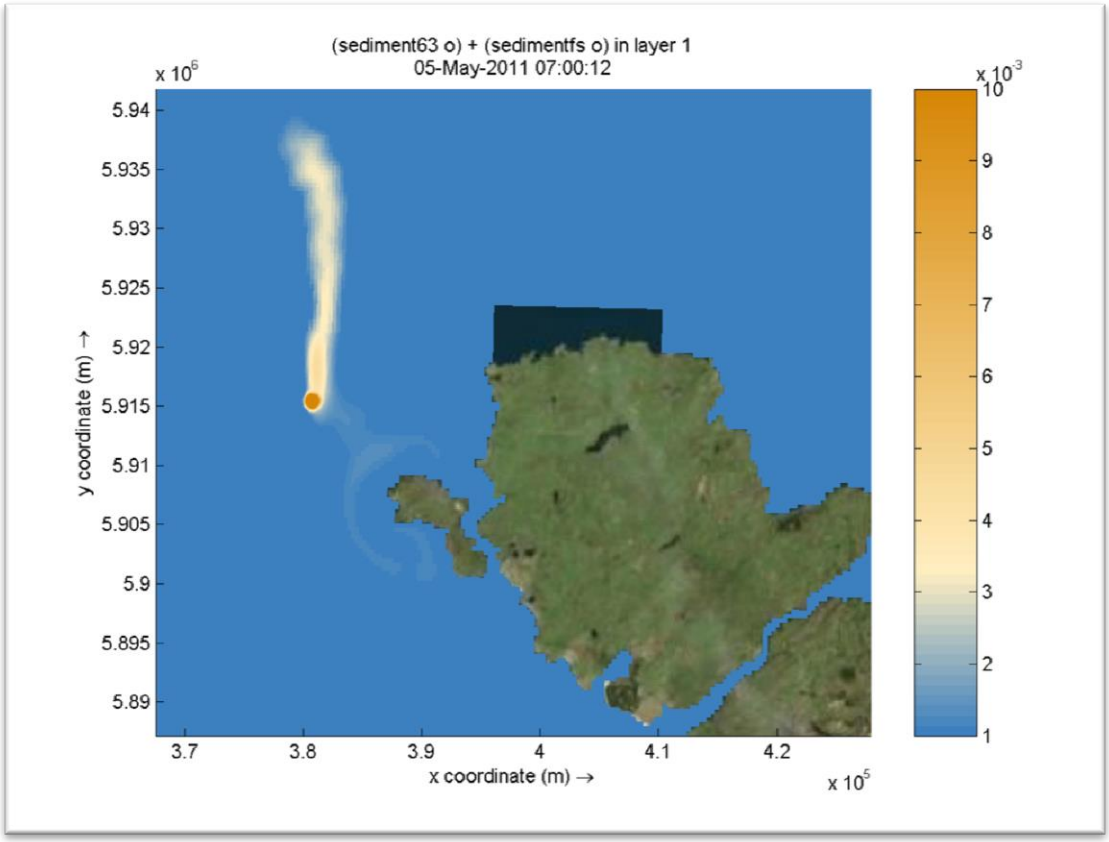


Figure 10-15 Suspended sediment concentrations (kgm^{-3}), full programme final disposal +1h, all fractions (coarse sand, medium sand, fine sand and fines fractions in summation)

10.3.148 Figure 10-16 shows the predicted increase in suspended sediment (for the finest sediment fraction only (0.063mm diameter)) 48 hours after the final disposal event. This sediment fraction is expected to remain in suspension for the longest period of time and, therefore, is indicative of the duration over which the effect of the disposal on suspended sediment concentrations would be evident. Figure 10-16 shows that suspended sediment concentrations fall below the typical background concentration within 48 hours and, therefore, the effect on water quality associated with disposal would be of short duration following completion of disposal. The modelling

predicts that the sediment plume disperses to background suspended sediment concentrations after approximately 3 hours.

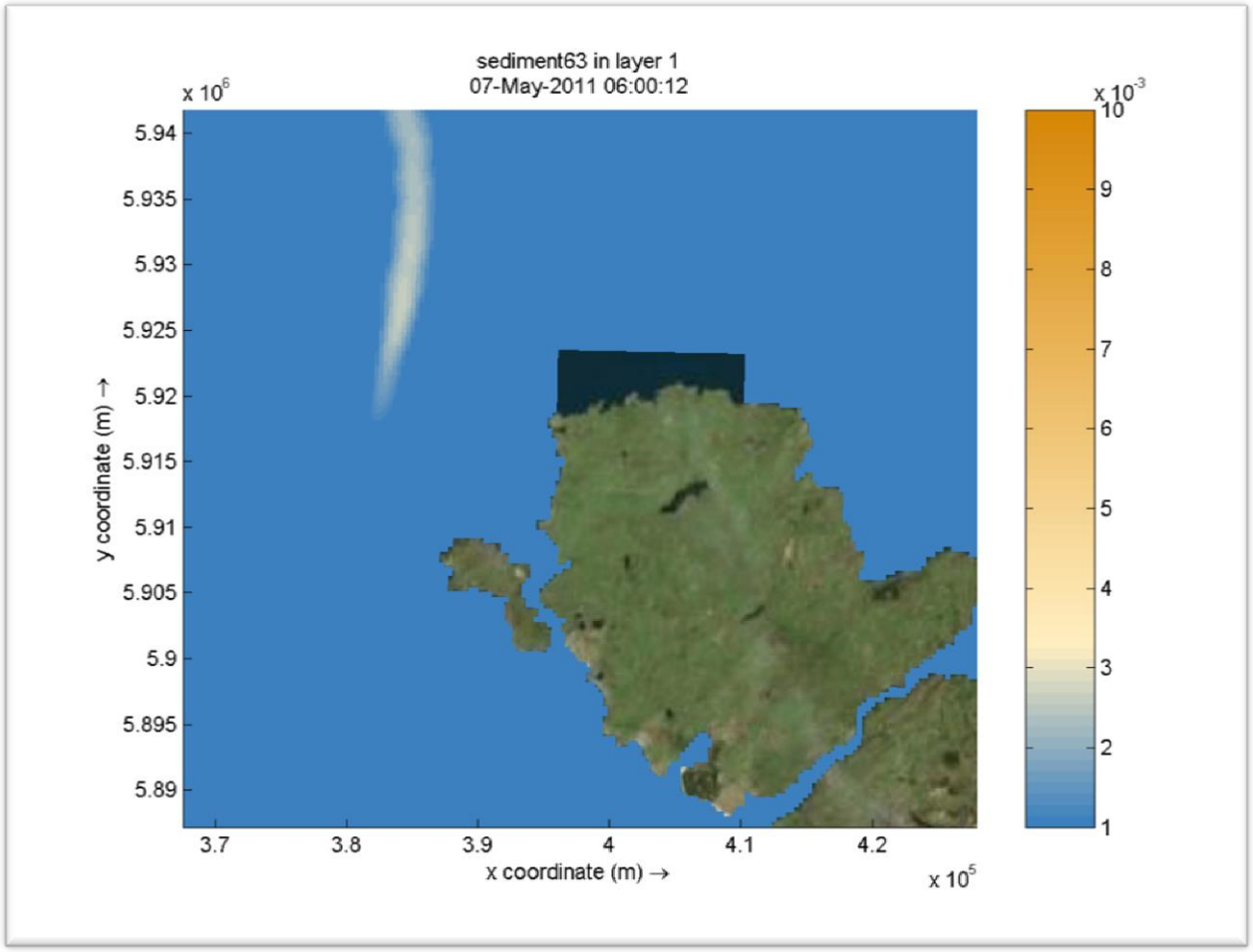


Figure 10-16 Suspended sediment concentrations (kgm^{-3}), full programme final disposal +48h (fine sediment fraction, 0.063mm diameter)

10.3.149 The area over which increases in suspended sediment concentrations would be experienced is small in the context of the area that is available to foraging Sandwich terns, and the effect would be transitory, with dispersion of the suspended sediment to background levels predicted to occur within 48 hours of a dredging / disposal cycle. Furthermore, the Disposal Site is in an area that is of little importance to foraging Sandwich terns (as determined by the considerable body of information on Sandwich tern distribution in and around the SPA area – see B1 above).

10.3.150 Given this, an adverse effect is not predicted with respect to Sandwich terns due to increases in suspended sediment concentrations or contaminant remobilisation during dredging.

C3 Changes in water chemistry

Chemical discharges from the drainage system [Construction water discharge EP]

10.3.151 An H1 assessment has been carried out to calculate the chemical composition of discharges from all sources to the drainage system and compare the predicted discharge qualities to relevant EQSs. For marine waters, and the potential for an indirect effect to arise, the H1 assessment (Application Reference Number: 6.4.96) concluded that dissolved copper, lead, zinc and nickel required further modelling, and Delft3d modelling was carried out for these metals.

10.3.152 The modelling predicted that the maximum concentrations of dissolved nickel would be below its annual average EQS of 8.6µg/L and the dispersion occurs in very close proximity (within a few metres) of the discharge. For zinc, lead and copper the predicted maximum concentrations are above the relevant annual average EQSs.

10.3.153 The predicted maximum concentration for dissolved zinc is predicted to occur in proximity to discharge point 3S, downstream of the Afon Cafnan, and the zinc AA EQS exceedance would be limited to the area shown in figure 7-10.

10.3.154 For dissolved lead the predicted maximum concentration is predicted to occur in proximity to discharge point 3S and the dissolved lead AA EQS exceedance would be limited to the area shown in figure 7-11.

10.3.155 For dissolved copper the predicted maximum concentration is predicted to occur in proximity to discharge point 3S and the dissolved copper AA EQS exceedance would be limited to the area shown in figure 7-12.

10.3.156 No process water will be discharged from the proposed concrete batching into the marine environment.

Change to nutrient conditions

10.3.157 The combined total ammonia concentration due to the discharge of treated sewage into the north of the Porth-y-pistyll (baseline plus the process contribution from sewage discharge) is predicted by the modelling to result in a non-ionised ammonia concentration after initial dilution of <1.57µg/L, which is significantly below the EQS for coastal waters (21µg/L).

10.3.158 Nitrates and phosphates in soils could enter the marine environment during construction. Dissolved inorganic nitrogen is the key growth-limiting nutrient in marine waters and is, therefore, a key indicator for which standards are set in coastal waters. However, the levels of nitrates in the soils in the affected area are likely to be low due to the nature of existing land use and the H1 assessment concludes that there will be no change to the nutrient concentrations in the run-off reaching the marine environment.

10.3.159 There is no EQS for phosphates in the marine environment because phosphate is not a growth-limiting nutrient in the marine environment.

10.3.160 The H1 assessment modelling predicts that the annual average EQS for orthophosphate is likely to be exceeded in the receiving waters downstream of the discharges in all watercourses. However, in all cases the upstream concentration already exceeds the EQS and the discharge only slightly increases the concentration in the receiving watercourse (table 10-7). The H1 assessment does not predict orthophosphate in the marine environment because there is no EQS for marine waters, so the results for the predicted freshwater concentrations (i.e. upstream of the marine discharge point) can be considered conservative.

Table 10-7 Summary of model results (test of deterioration receiving water quality) for orthophosphate (as P); annual average discharges (Application Reference Number: 6.4.96)

Discharge Point	AA EQS (µg/l)	Mean upstream quality (µg/l)	Mean predicted concentration in receiving stream (µg/l)
B1 (Tre'r Gof)	78	130	134
C1 (Nant Caerdegog Isaf - Afon Cafnan tributary)	78	110	123
A3 (Nant Cemaes)	78	80	84
A1(Tre'r Gof)	78	130	134

Changes to oxygenation conditions

10.3.161 Depletion of dissolved oxygen potentially can occur due to an increase in biological productivity as a result of elevated nutrient concentrations. However, the assessment of changes to nutrient conditions indicates that no significant change in oxygenation conditions is predicted.

Predicted effects

10.3.162 In summary, the effect of changes in nutrient concentrations as predicted by the H1 assessment is considered insignificant in the context of water quality standards and existing background concentration (in the case of orthophosphate).

10.3.163 Based on the above assessments of chemical discharges to the drainage system and changes to nutrient and oxygenation conditions, no adverse effect on the integrity of the Morwenoliaid Ynys Môn/Anglesey Terns SPA Sandwich tern population via an effect chemical discharges on prey species is predicted.

Operation

C4 Water discharge from the cooling water system [Operational water discharge EP]

Thermal effects

10.3.164 The cooling water discharge for the Power Station would be located at Porth Wnal, adjacent to the outfall of the Existing Power Station. The discharge water would be approximately 12°C (based upon the 98 percentile) warmer than the water being abstracted. Impacts to the marine environment due to a rise in temperature can include fatality to fish and other organisms and disturbance of key habitats for fish, which could potentially affect prey availability for Sandwich terns.

Evidence

10.3.165 There is little guidance on what the maximum allowable temperature for a discharge should be in a coastal or marine area. In 2006 draft guidance (WQTAG 160) on temperature thresholds was developed for HRA [RD353], although it was not formally adopted. This guidance recommended that a 2°C uplift standard at the edge of a mixing zone (based on temperature threshold values set under the Freshwater Fish Directive (2006/44/EC)) should be adopted for marine SPAs and marine SACs (but restricted to areas designated for estuary embayment habitats and/or salmonid species). A maximum temperature threshold of 21.5^{o}C for SACs designated for estuary or embayment habitat and/or salmonid species and 28^{o}C for SPAs (both as 98 percentiles) was recommended (table 9-1). No guidance was developed for SPAs or SACs in open coastal locations (i.e. as is relevant to the Project location).

10.3.166 Subsequent work by the BEEMS Expert Panel summarised existing temperature standards and provided evidence on the effects of thermal discharges [RD24]. This used data from numerous laboratory and field studies and presented detailed information on the thermal tolerances of a wide range of fish species resident in transitional (estuaries) and coastal waters. [RD24] also made recommendations regarding temperature standards for thermal discharge (table 9-2), with the key conclusion from the study being that *"temperature rises up to 3°C appear to be tolerable and that resulting temperatures less than 27°C have no clear deleterious impact on species in receiving waters*". For the purposes of the assessment of potential effects on the fish prey of Sandwich terns, the BEEMS guidance [RD24] is considered to be most relevant, particularly given the open coastal location of the Project.

10.3.167 Hydrodynamic modelling has been undertaken based on cooling water being discharged at a rate of 126m^3/s, which represents the tidal average value plus 5% allowance for potential inefficiencies over the lifetime of the CWS (Application Reference Number: 6.4.90). The outputs from this modelling indicate that, for the annual base case (with no wind), a 2°C (or greater) 98 percentile rise in water surface temperature would extend over an area of approximately 2.09km^2, whilst the 3°C (or greater) 98 percentile

increase extends over approximately 0.88km^2. Considering the predictions on a seasonal basis, the modelled results indicate that the thermal plume extends across the largest area for the autumn base case (with a wind speed of 6.8m/s). For autumn, the thermal plume extends over an area of approximately 2.4km^2 for a 2°C (or greater) 98 percentile rise at the surface and 0.91km^2 for a 3°C (or greater) 98 percentile rise at the surface (table 8-32). The extent of the predicted thermal plume for the 2°C 98 percentile rise at the surface for the autumn base case is shown in figure 10-7.

10.3.168 The area affected by the cooling water discharge decreases with depth through the water column. The area affected by a 2^{o}C increase at the seabed may be approximately 2% to 4% of the area affected at the surface, although the extent of reduction varies between different modelled scenarios, so that impacts in the deeper waters are highly localised around the outfall.

10.3.169 Changes in water temperature can have positive, negative or neutral effects on fish depending on species. Sandwich terns are regarded as specialist feeders, often dependent on dense shoals of clupeids and sandeels within foraging range of the colony to enable successful breeding [RD215].

10.3.170 In common with findings from other breeding colonies, studies of the diet of breeding Sandwich terns at Cemlyn Bay (undertaken in 2009) demonstrate the importance of these two prey groups. Thus, 52% of prey items delivered to Sandwich tern chicks at Cemlyn Bay were sandeels, whilst 31% were clupeids [RD256]. Less information is available on the diet of the breeding adult birds due to the difficulties of identifying prey items that are consumed when the birds are out at sea. However, during the studies at Cemlyn Bay, 12% of prey items were confirmed as sandeels and clupeids, with just over 20% being unidentified fish (that could incorporate sandeels and clupeids), 30% larval fish (that could also incorporate sandeels and clupeids), 12% invertebrates, and approximately 5%, 1% and 15% being gadoids, rockling and unidentified items respectively. Other studies that have determined the diet of breeding adult Sandwich tern indicate the importance of sandeels and clupeids (e.g. sandeels and clupeids comprised 61% and 24%, respectively, by weight of the diet of adult Sandwich tern on the Farne Islands in Northumberland, with gadoids (at 9% of the diet) also relatively important in this study RD254]).

Predicted effects

10.3.171 The assessment of the potential thermal effects from the cooling water discharge predicts negligible effects on the fish groups that are of importance as prey to breeding Sandwich terns. Sandeel eggs are restricted to the seabed, and the substrates in the areas where bed temperatures are predicted to increase by more than 2^{o}C provide unsuitable habitat, so that no effects are predicted on sandeel eggs. Sea surface temperatures outside the known tolerance of sandeel larvae are predicted to be restricted to the immediate vicinity of the outfall, whilst the baseline surveys found that adult sandeel densities were highest in the areas to the east of Wylfa Head, where

more suitable seabed substrates occur (Application Reference Number: 6.4.13); this may, in part, explain the distribution of foraging Sandwich terns. Similarly, higher numbers of herring (one of the two main clupeid species recorded during the baseline fish surveys) were recorded at sites on the east coast of Anglesey than on the west and north coasts (Application Reference Number: 6.4.13).

10.3.172 Potential effects of displacement on some fish groups, such as sandeels, may be limited because they may alter their behaviour to avoid the warmer water at the surface, so reducing the extent to which they are displaced from the area encompassed by the 2^{o}C thermal plume. Such behaviour, combined with displacement of some fish species from the area of sea encompassed by the 2^{o}C thermal plume, could cause a reduction in the foraging efficiency of Sandwich terns (e.g. because fewer sandeels are present at depths at which they are available to Sandwich terns). However, these effects would not, in themselves, result in the loss of this area as foraging habitat for Sandwich terns.

10.3.173 For the purposes of assessing the potential impacts of the thermal effects from the cooling water system discharge, the autumn base case (with a wind speed of 6.8m/s) for a 2°C (or greater) 98 percentile increase in temperature at the sea surface is taken to represent the thermal ZOI (figure 10-7). This is on the basis that the predicted sea surface temperature change extends across the largest area under this scenario and, as such, represents a worst case in terms of the spatial extent, although it is recognised that this season does not coincide with the presence of breeding terns.

10.3.174 The area encompassed by the thermal ZOI (2.38km^2) represents 0.03% of the total predicted foraging range of the Sandwich tern SPA population and 3% of the area predicted to account for 95% of usage.(figure 6-18, [RD362]). Based on the data from the different tracking studies, approximately 1.5% - 3% of all Sandwich tern foraging attempts are estimated to occur within this thermal ZOI, depending on whether estimates are based on the complete tracks only or on all tracks (table 10-8, figure 10-8). Within this ZOI, it is considered that any detrimental effects from the increase in sea surface temperatures would be limited to a reduction in foraging efficiency only, as opposed to the entire loss of the area as potential foraging habitat (there being no mechanism for the exclusion of birds from this ZOI and the potential effects being limited to a reduction in prey availability). Therefore, any impact would be substantially less than a loss of 1.5% to 3% of the potential foraging opportunities for Sandwich terns, and as there would be no exclusion from the thermal ZOI there would be no additional energetic costs from deviations to preferred flight routes between the colony and foraging sites.

10.3.175 As such, no adverse effects on the SPA Sandwich tern population are expected to occur as a result of water temperature increases from the thermal effects of the cooling water system discharge during operation.

Table 10-8 The percentage of Sandwich tern foraging locations and tracks occurring within the thermal ZOI. Sample sizes (n) upon which the percentage estimates are based are given.

Survey	Foraging locations (%)		Tracks (%)	
	Complete tracks*	All tracks	Complete tracks*	All tracks
2016 Jacobs	1.53% (n=1040)	1.25% (n=2081)	51.43% (n=35)	63.10% (n=84)
2009 JNCC	1.65% (n=603)	2.71% (n=1255)	48.00% (n=25)	40.18% (n=112)
2009 ECON	0.91% (n=329)	3.81% (n=1127)	37.50% (n=16)	34.23% (n=149)
Mean value	1.37%	2.59%	45.64%	45.83%

***Complete tracks are those where birds were followed from, and back to, the colony.

10.3.176 In addition to increases in water temperature, thermal effects from the CWS discharge potentially could arise as a result of changes to the dissolved oxygen concentration in the water column and/or to pH and the ratio of ionised to unionised ammonia. Both of these mechanisms could lead to indirect impacts on the SPA Sandwich tern population, via effects on their fish prey.

10.3.177 In the case of dissolved oxygen concentration, this is predicted to remain well above the concentration required for 'high' status as defined for coastal water bodies in the Water Framework Directive (Standards and Classification) Directions (England and Wales) 2015) (Application Reference Number: 6.4.13).

10.3.178 Ammonia is typically more toxic to aquatic life in its unionised state than its ionised state, and concentrations of unionised ammonia increase with temperature. However, for all modelled scenarios, unionised ammonia is predicted to remain well below the Environmental Quality Standard (EQS) of 21µg/L for saltwater (Water Framework Directive (Standards and Classification) Directions (England and Wales) 2015).

10.3.179 Consequently, it is considered that no adverse effects on the integrity of the SPA Sandwich tern population would arise from changes to dissolved oxygen concentration or to pH and changes in the ratio of ionised to unionised ammonia that may result from the thermal effects of the cooling water discharge.

Effects from Total Residual Oxidants

10.3.180 Marine organisms (such as, young mussels, tubeworms, barnacles, hydroids and sponges) can become attached to submerged structures and cause problems with the associated function of those structures. For a nuclear power plant it is considered essential to use biocide to prevent such biofouling, especially for the cooling water intake system. It is proposed that Sodium hypochlorite would be the biocide used for this purpose. In line with best practice, continuous biocide dosing would be applied during higher

fouling risk periods, typically between April and December, when sea temperatures are above 10°C. Typically biocide dosing would be applied to all areas of the CWS around screens (to prevent harm to fish impinged on screens). To prevent fouling of the intake area upstream of the screens, intermittent 'shock' treatment is likely to be carried out during outage periods of the screens and pumps.

10.3.181 Any residual biocide that is discharged with the cooling water is referred to as the TRO. TRO is the sum of the following oxidants:

- free (available) chlorine which is that present as an equilibrium mixture of HOCl and OCl-; and
- combined (available) chlorine which is available in (mainly) inorganic chloramines and in other compounds having a nitrogen-carbon link.

10.3.182 Natural waters have a 'chlorine demand' consisting primarily of oxidisable material – organic and non-organic, living and dead – that rapidly reduces the applied biocide concentration. Following discharge, the concentration of TRO would diminish through dilution, additional demand introduced by the receiving water and by continuing decay reactions. Decay/demand will likely be greatest in late spring and summer when productivity and water temperatures are at their highest. However, relative dilution and dispersal may be greatest during autumn and winter when the coastal waters are subject to greater mixing from wind and wave action.

10.3.183 Embedded mitigation is included within the cooling water outfall design, including maximising the momentum of the outfall water which helps to propel the thermal plume and any associated biocides further into the marine environment and, most importantly, north of Wylfa Head, where the strong tidal currents would aid in the decay and dispersion of the biocides. There would also be dosing and monitoring of the sodium hypochlorite to ensure it never breaches a level of 0.1mg/L at the point of cooling water discharge and 0.01mg/L (95 percentile) at the edge of the mixing zone, to ensure TRO concentrations remain as low as possible in the receiving waters.

Predicted effects

10.3.184 The Water Framework Directive (Standards and Classification) Directions (England and Wales) 2015 (Part 2, Article 1) set the 'end of pipe' EQS for TRO as 0.01mg/L, as a 95 percentile. Modelling results for the maximum predicted impact areas for TRO based on the seasonal worst case scenarios are presented in table 8-35. These show that the area at the sea surface exceeding 0.01mg/L TRO, as a 95 percentile, is greatest for the summer base case, for which it extends across an area of 3.13km^2. Therefore, the summer base case is used to define a TRO ZOI, given that it is the scenario which has the largest predicted impact area.

10.3.185 There is no known direct pathway for impacts on seabirds to arise as a result of TRO, and any impacts would be via effects on their fish prey. Only a small proportion of the ichthyoplankton (i.e. larval fish) community would be affected, whilst the mobility of adult fish in conjunction with the relatively small spatial scale over which TRO effects are predicted to occur means that

the potential effects of TRO from the Project on fish populations are predicted to be negligible. Therefore, any indirect impacts on the SPA Sandwich tern population as a result of effects on fish prey are also highly unlikely.

10.3.186 Based on the data from the different tracking studies, approximately 2%-3.5% of all Sandwich tern foraging attempts are estimated to occur within the area that is encompassed by the summer base case within which TRO exceeds 0.01mg/L at the sea surface (table 10-9, figure 10-8). This area encompasses some 3.0km^2, representing 0.04% of the total predicted foraging range of the Sandwich tern SPA population and 4% of the area predicted to account for 95% of usage (figure 6-18, [RD362]).

Table 10-9 The percentage of Sandwich tern foraging locations and tracks occurring within the TRO ZOI (sample sizes (n) upon which the percentage estimates are based are given)

Survey	Foraging locations (%)		Tracks (%)	
	Complete tracks*	All tracks	Complete tracks*	All tracks
2016 Jacobs	1.83% (n=1040)	1.39% (n=2081)	77.14% (n=35)	83.33% (n=84)
2009 JNCC	1.66% (n=603)	5.34% (n=1255)	72.00% (n=25)	72.32% (n=112)
2009 ECON	1.82% (n=329)	3.99% (n=1127)	81.25% (n=16)	77.18% (n=149)
Mean value	1.77%	3.58%	76.80%	77.61%

*Complete tracks are those where birds were followed from, and back to, the colony.

10.3.187 Therefore, the effects of TRO are predicted to be negligible on the fish populations that provide the main of prey sources for Sandwich terns, whilst the area that is predicted to be affected is of relatively minor importance to foraging Sandwich terns. Given this, no adverse effects on the integrity of the SPA Sandwich tern population are predicted to arise as a result of TRO from the cooling water system discharge during operation.

D Changes in surface and groundwater hydrology [Construction water discharge EP]

10.3.188 Effects from changes in surface and groundwater hydrology have been screened into the assessment for the Morwenoliaid Ynys Môn/Anglesey Terns SPA on the basis of the potential for effects on the nesting habitat at the Cemlyn Bay lagoon on which the SPA Sandwich terns are dependent.

10.3.189 The potential effects of changes in surface and groundwater hydrology during both the construction and operation periods on the habitats at the Cemlyn Bay lagoon have been considered in chapter 7, with the conclusion of no adverse effects on these habitats. Given the nature of the changes predicted, there is no potential for an adverse effect on terns or their habitats.

E Changes in air quality [Marine Licence; Operational combustion activity EP]

10.3.190 Effects from changes in air quality have been screened into the assessment for the Morwenoliaid Ynys Môn/Anglesey Terns SPA on the basis of the potential for effects on the nesting habitat at the Cemlyn Bay lagoon on which the SPA Sandwich terns are dependent.

10.3.191 The potential effects of changes in air quality during both the construction and operation periods on the habitats at the Cemlyn Bay lagoon (i.e. coastal lagoon and perennial vegetation of stony banks) have been considered in chapter 7, with the conclusion being reached that no adverse effects on these habitats would arise. The perennial vegetation of stony banks qualifying feature is the most sensitive habitat in terms of changes in air quality.

10.3.192 Terns are not dependant on, or influenced by, this qualifying feature. For terns, changes in air quality and potential effects on vegetation are considered in the context of the vegetation on the islands used by breeding terns. Specifically, the vegetation height and structure on the islands can influence the suitability of the islands as a habitat for breeding terns, and the vegetation on the islands is not sensitive as a habitat in its own right.

10.3.193 In light of the findings of the assessment for the perennial vegetation of stony banks, changes in air quality are not predicted to affect the vegetation on which Sandwich terns are dependent for the provision of nesting habitat on the islands. As such, changes in air quality are not predicted to affect either the use of the islands by terns or their breeding success, and it follows that changes in air quality would not result in adverse effects on the integrity of the SPA Sandwich tern population.

F Alteration of coastal processes and hydrodynamics

Construction

F1 Change in waves, tidal currents, bed shear stress and sediment regime and effect on Esgair Gemlyn [Marine Licence]

10.3.194 Any changes as a result of coastal processes and hydrodynamics (e.g. scour, smothering, changes to currents and waves) have the potential to cause indirect impacts on the SPA Sandwich tern population via effects on prey species. In addition, an effect on the structure of Esgair Gemlyn could affect the integrity of the lagoon and the nesting habitat for terns within the lagoon.

10.3.195 Any coastal squeeze, for example as a result of the introduction of new structures which interfere with the regression of the coastline, could only occur at locations where new structures are constructed and therefore is limited to the marine area of the Wylfa Newydd Development Area as a maximum. As described above in relation to land-take, this area represents an insignificant proportion of the foraging area available to Sandwich terns

from the Cemlyn Bay colony, whilst only three of a total 4,463 foraging attempts were recorded within this area (figure 10-8).

10.3.196 The coastal processes and geomorphology assessment (Application Reference Number: 6.4.12) provides a full assessment of the predicted effects of the Project during the construction and operational phases. Two scenarios in the construction phase has been assessed – a partially built scenario and a fully built scenario. Both these scenarios are assessed for present day (defined as 2023) conditions. The longer term potential operational effects are assessed as a foreseeable future scenario (2087).

10.3.197 During periods of high tides and stormy weather, waves are able to break over the shingle ridge. This feature is continually changing in shape and profile (Application Reference Number: 6.4.12). Previous studies ([RD269], [RD270]) mention that the frequency and severity of overtopping are predicted to increase at Cemlyn lagoon over the next few decades. This effect may be counterbalanced by vertical growth of the shingle ridges in line with rising water levels, but the extent to which this can occur (without ridge narrowing) will be dependent on sediment availability.

10.3.198 Analyses of the scale of potential changes to waves, currents and bed shear stresses leading to effects upon the sediment regime (including fine sediment plumes) has informed the assessment of potential effects on coastal geomorphology receptors. Changes to coastal and marine processes have been identified through hydrodynamic (Delft3D) and wave (SWAN) modelling investigations (Application Reference Number: 6.4.94).

Waves

10.3.199 Within the wave (SWAN) model, a set of points were chosen to investigate modelled data outputs through time series generated by the 35.5 year model run. Table 10-10 presents the predicted effect on wave climate for the modelled location within Cemlyn Bay, adjacent to Esgair Gemlyn for the 50th and the 99th percentile values, representing the average and worst case, respectively.

Table 10-10 Changes in wave height (SWAN model results) for worst case (winter, 99th percentile wave) present day (2023) scenarios over 35.5 year model period

Difference (partially built minus baseline) in significant wave heights for present day winter wave from north-west sector		Difference (fully built minus baseline) in significant wave heights for present day winter wave from north-east sector	
Difference as mean significant wave height (%)	Difference as 99%ile significant wave height (%)	Difference as mean significant wave height (%)	Difference as 99%ile significant wave height (%)
+2%	+1%	+1%	-1%

10.3.200 As shown in table 10-10, for a partially built scenario, when the coffer dam is in place, with storm waves approaching from the north-west, it is predicted that there could be a change in wave height ranging between -1%

and +2%. For a fully built scenario, with storm waves approaching from the north-east, it is predicted that there could be a change in wave height ranging between -1% and +1%.

Bed shear stress

10.3.201 Alterations to combined waves and tidal current patterns indicated by the Delft3D hydrodynamic model have been used to investigate potential changes to sediment mobilisation and sediment transport processes which could affect geomorphological receptors. The focus of this assessment was on Esgair Gemlyn and Cemlyn lagoon. The potential effect of fine sediment deposition from combined natural and artificial (dredging) sources during the construction period has also been investigated.

10.3.202 Bed shear stress under spring ebb tidal conditions are the most dynamic and have been assessed to represent a worst case scenario.

10.3.203 Within Cemlyn Bay and Porth-y-pistyll the changes to bed shear stress are minimal (Application Reference Number: 6.4.12). In the head region of Cemlyn Bay near to Esgair Gemlyn, no change in bed stress is predicted except for a small localised zone to the north and associated with the ebb tidal delta of the lagoon drainage system.

10.3.204 The geomorphological assessment for Esgair Gemlyn (Application Reference Number: 6.4.12) takes into account the combined effects described above.

10.3.205 For worst case scenarios, such as rare (99th percentile) winter waves arising from north-westerly directions during construction activities, this could represent a potential increase in wave height up to approximately 1%, or 2% for mean conditions. Baseline wave height is in the range of 1.0m to 1.2m, resulting in an increase of up to approximately +0.03m under present day winter storm conditions. The increased wave height is lower than that of baseline storm waves arising from the north-east, consequently this change is within the range of natural variation.

10.3.206 Given the above conclusion, no effect on the integrity of Esgair Gemlyn, or the coastal lagoon feature, is predicted during the construction phase. Longer term operational phase effects are discussed below

10.3.207 In light of the above findings, no significant effects on the prey species for Sandwich terns or the integrity of Esgair Gemlyn are predicted and, consequently, no adverse effects on the integrity of the SPA population.

Operation

F2 Change in waves, tidal currents, bed shear stress and sediment regime and effect on Esgair Gemlyn [Marine Licence]

10.3.208 The potential changes to waves during the operational phase have been investigated in comparison with the current and evolving baseline using the SWAN modelling results (Application Reference Number: 6.4.94).

10.3.209 For the worst case winter storm scenario (represented by the 2087 reasonably foreseeable winter 99th percentile, north-west sector results), no discernible change in wave heights is predicted.

10.3.210 Table 10-11 summarises predicted percentage changes in wave height at the head of Cemlyn Bay adjacent to Esgair Gemlyn.

Table 10-11 Changes in wave height (SWAN model results) for reasonably foreseeable (2087) scenarios over 35.5 year model period adjacent to Esgair Gemlyn

Difference (fully built minus baseline) in significant wave heights for reasonably foreseeable (2087) winter wave from north-west		Difference (fully built minus baseline) in significant wave heights for reasonably foreseeable (2087) winter wave from north-east	
Difference in mean significant wave height (%)	Difference in 99% significant wave height (%)	Difference in mean significant wave height (%)	Difference in 99% significant wave height (%)
+4%	0.8%	0%	0%

10.3.211 The largest waves are expected to be observed for the NW sector (worst case scenario); the differences in wave height may extend up to Cemlyn Bay due to the reflection of waves from the structures; as they approach the coast, refraction and shoaling effects will occur. For this sector, the directions and heights of the reflected waves combined with other effects are likely to cause a small amount of refocussing of the wave energy in Cemlyn Bay (figure 10-17).

10.3.212 Adjacent to the Esgair Gemlyn within Cemlyn Bay, for a fully built scenario with storm waves approaching from the north-west, it is predicted that there could be a change in wave height ranging between +4% and 0.8% on a baseline wave height of 1.2m to 1.4m, respectively, or an increase of up to +0.05m.

10.3.213 With storm waves approaching from the north-east, no change in wave height is predicted.

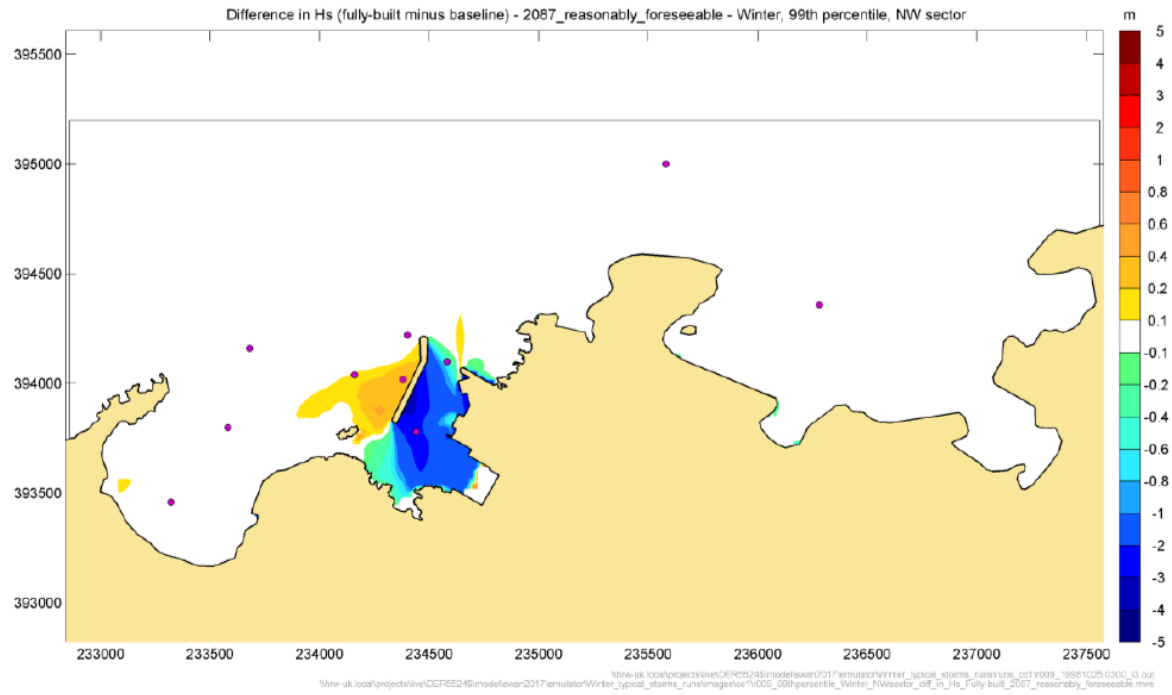


Figure 10-17 Difference in significant wave height, fully-built compared to baseline, "2087 reasonably foreseeable" conditions – 99th percentile winter wave conditions, NW sector

10.3.214 The magnitude of the predicted change due to the Project is very small in the context of the evolving baseline conditions are not considered to have the potential to alter the evolution of Esgair Gemlyn.

10.3.215 Changes in bed shear stress arising in construction (described above) would be expected to continue during the operational phase.

10.3.216 Based on these findings, it is not expected that the Project will influence the future trend for sediment transport at Esgair Gemlyn or will have a direct or indirect effect on this geomorphological receptor. On this basis, an adverse effect on the integrity of Esgair Gemlyn is not predicted to occur in the operational phase and no adverse effects on the SPA population are predicted.

G Physical interaction between species and Project infrastructure

Construction

10.3.217 No pathways were identified for construction-related effects on the SPA Sandwich tern population from physical interaction between species and Project infrastructure. Therefore, no effects on the SPA Sandwich tern population are predicted from physical interactions between species and Project infrastructure during the construction period.

Operation

G1 Entrapment of prey [Operational water discharge EP]

Impingement and entrainment

Introduction

10.3.218 Populations of the fish (and invertebrate) prey of Sandwich terns may be affected by impingement and entrainment within the cooling water intake, leading to potential indirect impacts on the SPA Sandwich tern population.

10.3.219 Impingement occurs as a result of biota, such as fish and invertebrates, being drawn into the cooling water intake as water is abstracted from the sea. The cooling water system design incorporates fish protection measures, including deterrents, coarse and fine screens on the intake, and a fish and invertebrate recovery and return system. Fish and invertebrates small enough to pass through the cooling water system coarse screens, but large enough to be impinged on the fine screens, would be taken through the recovery and return system before being discharged back to the sea. During these stages of impingement and subsequent handling fish and invertebrates are vulnerable to mortality, whilst there may also be an increased predation risk on discharge from the recovery and return system.

10.3.220 The susceptibility of biota to impingement on the cooling water intake screens depends on factors such as water temperature, the life stage of the organism, species-specific hearing ability and swimming ability. Once impinged, the subsequent survival of biota depends on the life stage and their tolerance of stressors experienced and the effectiveness of the return and recovery system.

10.3.221 Entrainment affects biota that are small enough to pass through the fine screens of the cooling water system, so that they are drawn in and transit the entire cooling water system, as opposed to entering the recovery and return system (as for the impinged biota). Such organisms are unable to swim against the intake currents and are particularly at risk of being drawn into the cooling water system. In transiting the cooling water system they are vulnerable to mortality from a range of factors including pressure and temperature changes, mechanical effects and abrasion, hydraulic shear stress and biocide toxicity, whilst there may also be an increased predation risk on discharge from the system. Ichthyoplankton are susceptible to entrainment.

10.3.222 Predictions of the potential losses of fish and invertebrates as a result of impingement and entrainment have been made, based in large part on data for impingement and entrainment rates at the Existing Power Station, for which the intake design does not meet current best practice. The new intake will be designed to limit the entrapment of marine organisms, including through the following measures:

- A maximum intake velocity of 0.3m/s in front of the intake opening at lowest astronomical tide.

- Screening in the form of coarse raked bars located in front of fine mesh drum screens (for the main cooling water intake) and band screens (for the service water intake). The proposed fine mesh screen size is 5mm.
- An Acoustic Fish Deterrent (AFD) in front of the cooling water intake, designed in line with the Best Available Techniques. The sound field will be located in the most appropriate location within the intake entrance; it will be specified to allow redundancy in the system and will be supported by modelling to demonstrate a uniform sound field. It will also be designed to avoid effects on marine mammals.
- An effective Fish Recovery and Return system, discharge point located below Lowest Astronomical Tide (LAT), designed in line with the Best Available Technique that would remove fish impinged on all screens and return them to sea.

10.3.223 In this respect, the predicted impingement and entrainment rates can be regarded as worst-case and precautionary, as they do not account for the above embedded mitigation. At the same time it is acknowledged that differences in the locations of the new intake and the intake for the Existing Power Station may mean that the abundance, biomass and species complement impinged and entrained may differ from that predicted.

Predicted impingement and entrainment rates for main Sandwich tern prey

10.3.224 Amongst the main prey groups of Sandwich terns, the predicted impingement rates of sprat and herring were amongst the highest for fish (these being the two main clupeid species recorded during the baseline fish surveys). Thus, predictions were for 54,000 sprat and 7,600 herring (equivalent to a biomass of 77kg and 43kg, respectively) to be impinged per annum (Application Reference Number: 6.4.13), with impingement varying seasonally and peaking in the winter. Although these values appear high, when converted to the equivalent adult values (EAVs) they represent a small proportion of commercial landings (0.001%-0.01% of the North Irish Sea or English Channel catches of herring and sprat). Furthermore, data collected at other operational power stations suggest that the efficacy of low approach velocities and AFDs in reducing impingement rates can be between 88%->95% in each case, for both herring and sprat, and this is not taken into account in the above estimates.

10.3.225 Predicted impingement rates for sandeels were lower at 680 fish per annum (equivalent to 12kg by biomass). For sandeels, no data on the effects of low approach velocity and AFD has been found from studies at other power stations so it is not possible to estimate the efficiency of mitigation. In relation to AFD, sandeel have low hearing sensitivity, as they lack a swim bladder (much like flat fish for which AFD efficiency has been estimated as 16–38%). Considering the locality of the cooling water intake in Porth-y-pistyll, a heavily modified, sheltered rocky bay, it is possible that taxa such as sandeel, typically associated with soft sediments, will be less prevalent in impingement catches than predicted. Abundances of sandeel on the west coast of the United Kingdom are too low to sustain a commercial

fishery, so that no direct comparison can be made of predicted impingement relative to commercial landings.

10.3.226 A total of 151 million fish larvae and 1.6 billion eggs are predicted to be entrained per annum (Application Reference Number: 6.4.13). Sandeels (*Ammodytes* spp.) are amongst the groups for which the predicted larval entrainment values are highest, being 14 million per annum. The predicted entrainment values for sprat and herring larvae are in the hundreds of thousands per annum. These values have to be considered in the context of the size of the source populations and the life-history strategies of these fish. As r-selected species, reproductive rates are high, as are rates of natural mortality, particularly amongst the egg and larval life-stages. Each individual adult female will spawn thousands to millions of eggs each year, and the entrainment values represent a small fraction of the ichthyoplankton abundances within the eastern Irish Sea.

10.3.227 Conversion of the predicted annual larval entrainment values to annual EAVs equates to 46,000 sprat, 4,600 sandeel (*Ammodytes* spp.) and 27 herring (Application Reference Number: 6.4.13). As with impingement, it should also be noted that a proportion of the entrained larvae will survive passage through the cooling water system. Although survival estimates appear to be unavailable for herring, sprat and sandeel larvae, the estimated entrainment survival rates of planktonic stages (eggs, post-larvae and fry) of Dover sole, turbot and bass are 65%, 15-30% and 54-60%, respectively.

Assessing the potential impacts of impingement and entrainment on the SPA Sandwich tern population

10.3.228 Context to the potential scale of the losses of available prey from impingement and entrainment to the SPA Sandwich tern population was provided by considering the dietary equivalence for Sandwich terns, using a bioenergetics approach (Application Reference Number: 6.4.13). This focussed on clupeids (i.e. largely herring and sprat in the waters in the vicinity of the Wylfa Newydd Development Area) and sandeels as the two main prey groups of the SPA Sandwich terns. It was assumed that these two groups occurred within the diet of the adult birds in the same proportion as for the chicks (i.e. 52% and 31%, respectively) ([RD256], see above).

10.3.229 Estimates of the daily energy requirements of Sandwich tern adults and chicks were obtained from the literature, using a surrogate value from Arctic and common terns for the adult birds [RD352]; [RD256]. The calorific values for clupeids and sandeels were obtained from the equations presented in [RD320] for the modal prey length of 6cm recorded at the Cemlyn Bay colony [RD256], whilst digestive efficiency was assumed to be 75% [RD134]. Assuming that adult Sandwich terns are present at the breeding colony between 1st April and 31st July (i.e. 122 days) and that chicks were present for half of that period, the per capita energy requirements of adults and chicks over the breeding season were estimated as 42,334kJ and 22,570kJ, respectively.

10.3.230 On the basis that sandeels and clupeids accounted for 52% and 31%, respectively, of prey taken by Sandwich terns (and given a digestive

efficiency of 75%), the above energetic requirements equated to the consumption of:

- 9,362 (or 5,796g of) sandeels and 2,285 (or 3,342g of) clupeids by each adult bird during the breeding season.
- 4,991 (or 3,090g of) sandeels and 1,218 (or 1,782g of) clupeids by each chick during the breeding season.

10.3.231 Predictions on the impingement rates suggest that a total of 1.9kg of sandeel and clupeids will be impinged during the breeding season, as estimated without accounting for any of the mitigation measures that would be incorporated (Application Reference Number: 6.4.13). This represents approximately 20% of the biomass of sandeels and clupeids estimated to be consumed by an adult Sandwich tern during the breeding season. With reference to the SPA population size at designation, the impingement rates are equivalent to 0.02% of the sandeel and clupeid biomass consumed during the breeding season by a population of 460 pairs ([RD328, [RD236]), whilst they are equivalent to 0.004% of that consumed by the current SPA Sandwich tern population (based on the most recent five-year mean population size of 2,398 breeding pairs – see table 6-6).

10.3.232 Based on the values of the predicted entrainment rates as converted to EAVs (see above), the estimated number of sandeels and clupeids entrained during the breeding season is equivalent to the numbers consumed by approximately 57 adult Sandwich terns. This represents approximately 6% of the sandeel and clupeid biomass consumed during the breeding season by the adult Sandwich terns in the SPA population at designation (460 pairs, as above), and approximately 1% of the total biomass consumed during the breeding season on the basis of the most recent five-year mean population estimate i.e. 2,398 breeding pairs).

10.3.233 When the predicted losses to impingement and entrainment are combined (without accounting for proposed mitigation measures) they are equivalent to approximately 6% of the sandeel and clupeid biomass consumed during the breeding season by the adult Sandwich terns in the SPA population at designation, and approximately 1% of the total biomass consumed during the breeding season on the basis of the most recent five-year mean population estimate. These values are as for entrainment alone (to the nearest 1%) as the predicted biomass of fish prey subject to entrainment (converted to EAV) is greater than for impingement by two to three orders of magnitude. In years of moderate to high breeding success, these losses would represent a substantially smaller percentage than 1% of the current population size (due to the additional consumption by the chicks). Furthermore, given that clupeids and sandeels are likely to form the bulk of the diet of all three tern species currently breeding in the Morwenoliaid Ynys Môn/Anglesey Terns SPA, then the predicted number of sandeels and clupeids entrained during the breeding season would represent a substantially smaller percentage (less than 0.5%) of the biomass consumed by the adult birds from the three SPA tern populations combined.

10.3.234 The dietary equivalence values estimated above provide a means by which the scale of the potential losses from impingement and entrainment can be assessed relative to the quantities consumed by the SPA Sandwich tern population. However, they cannot be interpreted as a direct loss of the prey that would be available to the SPA population because it cannot be assumed that all of the potential prey items lost to impingement and entrainment would otherwise become available as prey. It is likely that the potential prey that are predicted to be impinged and entrained would derive from a wider population of which only a proportion is ever available as prey to the Sandwich terns.

10.3.235 The impact of these potential losses to the prey resource of Sandwich terns also needs to be considered in relation to the conservation objectives of the SPA and, specifically, that the population size should be stable or increasing (relative to the population size at designation). The SPA population size has increased substantially since designation, with the current prey resource supporting a population that is approximately five times that at designation. Therefore, the scale of reduction in the prey resource which would be required to cause the population to decline to below the size at designation is many times greater than that predicted on the basis of the dietary equivalence calculations (even when it is assumed that all prey items lost to impingement and entrainment would otherwise be available as prey). Notably, the increase in the SPA population size has coincided with the period when entrainment of fish was occurring from the water intake cooling system of the Existing Power Station, which operated from 1971 to 2015 (Application Reference Number: 6.4.13).

10.3.236 Finally, the dietary equivalence calculations treat the predicted impingement and entrainment estimates as representing 100% mortality, whereas only a proportion of the potential prey that are impinged or entrained would die as a result of these processes.

10.3.237 On the basis of the above dietary equivalence calculations and the associated considerations, it is concluded that the entrapment of prey in the cooling water intake would have no adverse effects on the integrity of the SPA Sandwich tern population.

Potential for intra-Project effects

10.3.238 Effects from the Project may not operate in isolation but instead may combine to cause adverse effects on the Morwenoliaid Ynys Môn/Anglesey Terns SPA Sandwich tern population. The potential for this is considered below.

Construction

10.3.239 A range of pathways exist for potential impacts to the SPA Sandwich tern population from the construction activities associated with the Project, as outlined above. Disturbance from noise and visual stimuli may occur both at the colony and in the offshore environment. It is concluded above that the combined impacts from noise, vibration and visual disturbance at the colony will have no adverse effects on the SPA population, whilst the main potential

effects from visual disturbance within the offshore environment are essentially incorporated within the assessment for noise disturbance (because the offshore visual ZOI is encompassed within the offshore noise ZOI).

10.3.240 With the proposed mitigation to limit noise levels from construction works (including from blasts) in place, it is considered that any effect of noise and visual disturbance at the colony would be minimal, with little likelihood of any detectable effects on breeding success. Similarly, population-level effects resulting from the predicted disturbance in the offshore environment are highly unlikely, with there being only a small loss of the potential foraging habitat of the SPA Sandwich terns (with less than 2.5% of the recorded foraging locations in the offshore noise ZOI) and small additional energetic costs (less than 1% – 2% of daily energy expenditure) in the event that foraging and commuting birds circumvented the offshore noise ZOI. Other potential effects from construction activities are also considered unlikely and would give rise to, at most, small-scale effects (e.g. losses of offshore habitat during construction will occur within an area of 0.35km^2, which is itself encompassed within the offshore noise ZOI).

10.3.241 Given this, it is concluded that the intra-Project effects from the Project during construction would have no adverse effects on the integrity of the Morwenoliaid Ynys Môn/Anglesey Terns SPA Sandwich tern population.

Operation

10.3.242 During operation there is little potential for effect to the SPA Sandwich tern population from disturbance, whilst the permanent loss of foraging habitat extends over an area of less than 0.01% of the modelled foraging range of the SPA Sandwich tern population. The main potential effects during operation relate to potential reductions in prey availability. This could arise from discharges from the CWS (causing increases in sea temperature and TRO levels) and losses of potential prey as a result of impingement and entrainment. Both the thermal ZOI and TRO ZOI held few records of Sandwich tern foraging attempts (each less than 2%). Effects on prey are limited to a likely reduction in availability within the thermal ZOI, whilst the effects of TRO on fish populations are considered to be negligible (although there may be detrimental effects to a small proportion of the ichthyoplankton within this ZOI).

10.3.243 Mortality of fish from impingement and entrainment will have greatest effects on the egg and larval life-stages. As r-selected species, fish reproductive rates are high, as are the levels of natural mortality, particularly amongst the egg and larval life-stages. Estimation of the losses of potential prey as a result of impingement and entrainment (calculated without accounting for the mitigation measures which will be put in place) suggests that these would represent a small proportion of the prey resource available to the SPA Sandwich tern population.

10.3.244 Considering these potential effects together suggests that depletion of the Sandwich tern prey resource as a result of their cumulative action is unlikely. Furthermore, the SPA currently supports a Sandwich tern

population that is considerably larger than at designation. Thus, a major reduction in the prey resource would be required to cause the population to decline to below the size at designation (and so affect the conservation objective concerned with population status). Given this, it is concluded that the in-combination effects from the Project during operation would not have an adverse effect on the integrity of the Morwenoliaid Ynys Môn/Anglesey Terns SPA Sandwich tern population.

Sandwich tern (Sterna sandvicensis) (in-combination)

10.3.245 A total of eight other projects have been identified that have the potential to contribute to in-combination effects on the Morwenoliaid Ynys Môn/Anglesey Terns SPA Sandwich tern population (table 10-2). As described in chapter 5, there is no potential for LSIE in the context of this SPA with any of the plans scoped into the assessment.

10.3.246 The potential for in-combination effects has been identified for changes in visual and acoustic stimuli (all eight other projects), land-take (including seabed or inter-tidal) (two other projects), changes in marine water quality (five other projects), alteration of coastal processes and hydro-dynamics (three other projects) and physical interaction between species and Project infrastructure (four other projects).

10.3.247 The assessment for these potential in-combination effects is presented in table 10-12, Based on the conclusions described in table 10-12, no adverse effects from the Project in-combination with these other projects are predicted in relation to the Morwenoliaid Ynys Môn/Anglesey Terns SPA Sandwich tern population.

Common tern (Sterna hirundo) (alone)

Introduction

10.3.248 The Morwenoliaid Ynys Môn/Anglesey Terns SPA population of breeding common terns would be subject to the same potential effects from the Project as the SPA population of Sandwich terns. Also, as for the Sandwich tern population, the pathways by which these potential effects operate may affect the first three conservation objectives for the SPA via direct effects on numbers, breeding success and distribution, or indirectly via effects on those conservation objectives concerned with the quality and extent of supporting habitats (either at the colony or in the marine environment) and access to food sources.

10.3.249 However, in contrast to the SPA Sandwich tern population, the common tern population is not restricted to the Cemlyn Bay colony but is distributed across all three colonies within the SPA (chapter 6). Numbers of common terns nesting at Cemlyn Bay represent approximately 13% of the SPA population (based on the most recent five-year mean counts for each colony which are readily available) and, as such, are lower than at either of the other two colonies (table 6-6).

Table 10-12 Assessment of potential in-combination effects on the Morwenoliaid Ynys Môn/Anglesey Terns SPA Sandwich tern population

Project	Visual and acoustic stimuli	Assessment of potential in-combination effects on the SPA Sandwich tern population
Wylfa Decommissioning	The project's ES identifies that potential disturbance to bird populations, including the SPA Sandwich tern population, could result from visual and acoustic stimuli associated with the decommissioning works.	At the time of the 2008 ES for the Wylfa Decommissioning project it was not possible to produce an accurate assessment of the cumulative noise impacts from these decommissioning works and from the construction works that would be associated with the Project, due to the lack of detailed information available at that time. However, it is intended that a noise impact assessment for the Wylfa Decommissioning, including consideration of the cumulative impacts, would be presented as part of a Section 61 Consent Application. The Section 61 Consent Application would allow for the appointed contractors to prepare definitive method statements that would allow more accurate prediction of noise impacts, and the resulting agreement would be a formal agreement between the developer / contractor and the Isle of Anglesey County Council where noise levels, hours of work and any mitigation are agreed upon. In relation to potential impacts to the SPA Sandwich tern population, some of the major works associated with the Wylfa Decommissioning (e.g. construction of the coffer dam at the Outfall Gatehouse location and the demolition of various structures) will be restricted to periods outside the bird breeding season. With this mitigation in place, disturbance impact to birds from the Wylfa Decommissioning is assessed as Slight to Moderate in the 2013 update of the Wylfa Decommissioning ES update. Based on the assumptions that: (i) much of the activity from the Wylfa Decommissioning with the potential to generate high levels of noise and visual disturbance to the SPA Sandwich terns will occur outside the breeding season, and (ii) potential noise and visual disturbance to the SPA Sandwich tern population from the Wylfa Decommissioning would not add significantly to levels predicted from the Project alone it is considered that there would be no adverse in-combination effect with the Wylfa Decommissioning on the SPA Sandwich tern population.

Anglesey Eco Park	No Environmental Statement or HRA is currently available for the Anglesey Eco Park to inform the in-combination assessment. The potential effects of this project have been identified based on the outline planning permission.	Given the current status of the Anglesey Eco Park, an assumption has been made that its construction and operation can be managed and mitigated in such a way that there is no effect on noise and acoustic stimuli that could influence the SPA Sandwich tern population, and no adverse in-combination effect is predicted.
North Wales Connection Project	For the North Wales Connection project, there is no Environmental Statement or HRA available to inform the in-combination assessment. The potential effects of this project have been identified based on the scoping report (National Grid, 2016) which only identifies a general pathway for effect.	Given the current status of the North Wales Connection, an assumption has been made that its construction and operation can be managed and mitigated in such a way that there is no effect on noise and acoustic stimuli that could influence the SPA Sandwich tern population, and no adverse in-combination effect is predicted.
Rhyd-y-groes re-power	This project involves the replacement of the existing 24 wind turbine generators (WTGs) at this site by 11 more modern WTGs. Planning consent was granted in 2016. The timing of decommissioning of the existing wind farm and construction of the new wind farm could coincide with the construction phase for the Project. The potential effects of this project have been identified based on the Environmental Statement.	The Rhyd-y-groes wind farm is approximately 1 – 3km to the southeast of Cemaes Bay, and lies to the south of the A5025 road. As such, it is sufficiently far from the Cemlyn Bay colony that any noise and visual disturbance associated with the decommissioning of the existing wind farm and construction of the new wind farm would be highly unlikely to affect Sandwich terns present at the colony. It is also sufficiently far from the coast that potential impacts on noise and visual disturbance to foraging and commuting SPA Sandwich terns can be excluded. Sandwich tern were not recorded within 500m of the wind farm during baseline surveys to inform that Environmental Statement, which concludes that there will be no likely effect on the SPA Sandwich tern population. Therefore, it is considered that there is no effect on noise and acoustic stimuli that could influence the SPA Sandwich tern population, and no adverse in-combination effect is predicted.

Holyhead Deep 10MW Tidal kite installation (or 'Minesto project')	This proposed tidal turbine development is sited in the Holyhead Deep. Planning consent has not yet been granted. The potential effects of this project have been identified based on the HRA for this project.	It is conceivable that Sandwich terns from the SPA population may forage in the area for the proposed Holyhead Deep project (although the Project baseline data suggest this is highly unlikely). The HRA for the Holyhead Deep project identifies no effects of disturbance on seabird populations. Furthermore, it concludes no LSE in relation to the Morwenoliaid Ynys Môn / Anglesey Terns SPA. Therefore, it is considered that there is no effect on noise and acoustic stimuli that could influence the SPA Sandwich tern population, and no adverse in-combination effect is predicted.
West Anglesey Demonstration Zone	This proposed marine energy development, involving a tidal array, is sited off the Holyhead coast. It has not yet submitted applications for marine and land planning.	Given the current status of the West Anglesey Demonstration Zone, an assumption has been made that its construction and operation can be managed and mitigated in such a way that there is no effect on noise and acoustic stimuli that could influence the SPA Sandwich tern population, and no adverse in-combination effect is predicted.
Almwch LNG (Liquid Natural Gas)	Although the existing planning consent for the Alnwch LNG (Liquid Natural Gas) was renewed in 2013, the future plans and timescales of this project are unclear and, at the time of writing, no Environmental Statement is available online.	Given the current status of the North Wales Connection, an assumption has been made that its construction and operation can be managed and mitigated in such a way that there is no effect on noise and acoustic stimuli that could influence the SPA Sandwich tern population, and no adverse in-combination effect is predicted.
Visitor and Media Reception Centre (Horizon)	When the Wylfa Newydd Project is operational, Horizon intends to apply for planning permission for a Visitor and Media Reception Centre. There is no potential for a temporal link, but there is potential for a spatial link with the Wylfa Newydd Project. Given that this is a future planning application, there are currently no details or environmental assessments available for the Visitor and Media Reception Centre.	Given the current status of the Visitor and Media Reception Centre, an assumption has been made that its construction and operation can be managed and mitigated in such a way that there is no effect on noise and acoustic stimuli that could influence the SPA Sandwich tern population, and no adverse in-combination effect is predicted.

Project	Potential effect on land-take (including seabed or intertidal)	Assessment of potential in-combination effect
Holyhead Deep 10MW Tidal kite installation	This proposed tidal turbine development is sited in the Holyhead Deep. Planning consent has not yet been granted. The potential effects of this project have been identified based on the HRA for this project.	It is conceivable that Sandwich terns from the SPA population may forage in the area for the proposed Holyhead Deep project (although the Project baseline data suggest this is highly unlikely). The HRA for the Holyhead Deep project identifies no effects of habitat change on seabird populations. Furthermore, it concludes no LSE in relation to the Morwenoliaid Ynys Môn / Anglesey Terns SPA. Therefore, it is considered that there is no effect on land-take and habitat change that could influence the SPA Sandwich tern population and no adverse in-combination effect is predicted.
West Anglesey Demonstration Zone	This proposed marine energy development, involving a tidal array, is sited off the Holyhead coast. It has not yet submitted applications for marine and planning consent.	Given the current status of the West Anglesey Demonstration Zone, an assumption has been made that its construction and operation can be managed and mitigated in such a way that there is no effect on land-take or habitat change that could influence the SPA Sandwich tern population, and no adverse in-combination effect is predicted.
Project	**Potential effect on marine water quality**	**Assessment of potential in-combination effect**
Wylfa Decommissioning	The Environmental Statement identifies that pathways exist that could cause impacts to the terrestrial water environment (and, consequently on marine water quality through inputs from fluvial sources). The pathways identified comprise demolition, excavation, soil handling, construction and movement of plant/traffic which have the potential to release sediments into terrestrial waters. In addition, the potential impact of spills and leaks of non-radioactive substances was assessed.	The assessment for the Wylfa Decommissioning concludes that any potential risks to the terrestrial and coastal water environment can be effectively mitigated through adherence to pollution prevention measures and measures to avoid the risk of leaks and spillages. The Environmental Statement concludes that any effects on the terrestrial and coastal water environment will not be significant on this basis. It should also be noted that the Wylfa Decommissioning project will not have an effect on Nant Cemlyn and consequently there is no potential for a direct in-combination effect with the Project. A longer term beneficial impact is predicted due to the end of all site discharges and the removal of any need for discharge permits. The HRA for the Wylfa Decommissioning concluded that the decommissioning will not result in a “significant adverse impact” and a ‘no significant effects report’ was produced. On the basis of the above, it is concluded that there would not be an adverse in-combination

		effect on marine water quality in-combination with the Wylfa Decommissioning.
Anglesey Eco Park	No Environmental Statement or HRA is currently available for the Anglesey Eco Park to inform the in-combination assessment. The potential effects of this project have been identified based on the outline planning permission.	Given the current status of the Anglesey Eco Park, an assumption has been made that its construction and operation can be managed and mitigated in such a way that there is no effect on marine water quality that could influence the SPA Sandwich tern population, and no adverse in-combination effect is predicted.
Holyhead Deep 10MW Tidal kite installation	This proposed tidal turbine development is sited in the Holyhead Deep. Planning consent has not yet been granted. The potential effects of this project have been identified based on the HRA for this project.	It is conceivable that Sandwich terns from the SPA population may forage in the area for the proposed Holyhead Deep project (although the Project baseline data suggest this is highly unlikely). The HRA for the Holyhead Deep project identifies no effects of changes in marine water quality on seabird populations. Furthermore, it concludes no LSE in relation to the Morwenoliaid Ynys Môn/Anglesey Terns SPA. Therefore, it is considered that there is no effect on marine water quality that could influence the SPA Sandwich tern population, and no adverse in-combination effect is predicted.
West Anglesey Demonstration Zone	This proposed marine energy development, involving a tidal array, is sited off the Holyhead coast. It has not yet submitted applications for marine and planning consent.	Given the current status of the West Anglesey Demonstration Zone, an assumption has been made that its construction and operation can be managed and mitigated in such a way that there is no effect on marine water quality that could influence the SPA Sandwich tern population, and no adverse in-combination effect is predicted.
Visitor and Media Reception Centre (Horizon)	When the Project is operational, Horizon intends to apply for planning permission for a Visitor and Media Reception Centre. There is no potential for a temporal link, but there is potential for a spatial link with the Project. Given that this is a future planning application, there are currently no details or environmental assessments available for the Visitor and Media Reception Centre.	Given the current status of the Visitor and Media Reception Centre, an assumption has been made that its construction and operation can be managed and mitigated in such a way that there is no effect on marine water quality that could influence the SPA Sandwich tern population, and no adverse in-combination effect is predicted.

Project	Potential effect on coastal processes and hydrodynamics	Assessment of potential in-combination effect
Anglesey Eco Park	No Environmental Statement or HRA is currently available for the Anglesey Eco Park to inform the in-combination assessment. The potential effects of this project have been identified based on the outline planning permission.	Given the current status of the Anglesey Eco Park, an assumption has been made that its construction and operation can be managed and mitigated in such a way that there is no effect on coastal processes and hydro-dynamics that could influence the SPA Sandwich tern population, and no adverse in-combination effect is predicted.
Holyhead Deep 10MW Tidal kite installation	This proposed tidal turbine development is sited in the Holyhead Deep. Planning consent has not yet been granted. The potential effects of this project have been identified based on the HRA for this project.	It is conceivable that Sandwich terns from the SPA population may forage in the area for the proposed Holyhead Deep project (although the Project baseline data suggest this is highly unlikely). The HRA for the Holyhead Deep project identifies no effects of changes to coastal processes and hydro-dynamics on seabird populations. Furthermore, it concludes no LSE in relation to the Morwenoliaid Ynys Môn/Anglesey Terns SPA. Therefore, it is considered that there is no effect on coastal processes that could influence the SPA Sandwich tern population, and no adverse in-combination effect is predicted.
West Anglesey Demonstration Zone	This proposed marine energy development, involving a tidal array, is sited off the Holyhead coast. It has not yet submitted applications for marine and planning consent.	Given the current status of the West Anglesey Demonstration Zone, an assumption has been made that its construction and operation can be managed and mitigated in such a way that there is no effect on coastal processes that could influence the SPA Sandwich tern population, and no adverse in-combination effect is predicted.
Project	**Potential effect on physical interaction between species and project infra-structure**	**Assessment of potential in-combination effect**
Anglesey Eco Park	No Environmental Statement or HRA is currently available for the Anglesey Eco Park to inform the in-combination assessment. The potential effects of this project have been identified based on the outline planning permission.	Given the current status of the Anglesey Eco Park, an assumption has been made that its construction and operation can be managed and mitigated in such a way that there is no effect on physical interaction between species and project infra-structure that could influence the SPA Sandwich tern population, and no adverse in-combination effect is predicted.
Rhyd-y-groes re-	This project involves the replacement of the existing 24 wind turbine generators	It is conceivable that Sandwich terns from the SPA population could occur within the area of the wind farm and therefore be at risk of collision with the WTGs. However, this is highly

power	(WTGs) at this site by 11 more modern WTGs. Planning consent was granted in 2016. The timing of decommissioning of the existing wind farm and construction of the new wind farm could coincide with the construction phase for the Project. The potential effects of this project have been identified based on the Environmental Statement.	unlikely, given that the wind farm is not immediately adjacent to the coast. During baseline surveys to inform that Environmental Statement, no Sandwich tern were recorded within 500m of the wind farm and the Environmental Statement concludes that there will be no likely significant effect on the SPA Sandwich tern population. Therefore, it is considered that there is no effect on physical interaction between species and project infra-structure that could influence the SPA Sandwich tern population, and no adverse in-combination effect is predicted.
Holyhead Deep 10MW Tidal kite installation	This proposed tidal turbine development is sited in the Holyhead Deep. Planning consent has not yet been granted. The potential effects of this project have been identified based on the HRA for this project.	It is conceivable that Sandwich terns from the SPA population may forage in the area for the proposed Holyhead Deep project (although the Project baseline data suggest this is highly unlikely). The HRA for the Holyhead Deep project identifies no effects of physical interactions between species and project infra-structure on tern populations. Furthermore, it concludes no LSE in relation to the Morwenoliaid Ynys Môn / Anglesey Terns SPA. Therefore, it is considered that there is no effect of physical interaction between species and project infra-structure that could influence the SPA Sandwich tern population, and no adverse in-combination effect is predicted.
West Anglesey Demonstration Zone	This proposed marine energy development, involving a tidal array, is sited off the Holyhead coast. It has not yet submitted applications for marine and planning consent.	Given the current status of the West Anglesey Demonstration Zone, an assumption has been made that its construction and operation can be managed and mitigated in such a way that there is no effect on physical interactions between species and project infra-structure that could influence the SPA Sandwich tern population, and no adverse in-combination effect is predicted.

10.3.250 The common tern SPA population has increased since designation in 1992 (as Ynys Feurig, Cemlyn Bay and The Skerries). The estimate for the SPA at designation is 189 pairs [RD236], [RD328]), whilst the most recent five-year mean population estimate is 510 pairs (based upon summing the most recent five-year mean estimates that are available for each of the three colonies, which span slightly different time periods - table 6-5).

10.3.251 At 5km and 20km from the Wylfa Newydd Development Area, respectively, the Skerries and Ynys Feurig colonies are beyond the distance at which potential impacts of the Project from noise and visual disturbance could affect birds when attending the colony. Also, any changes in surface and groundwater hydrology or in air pollution resulting from the Project are not considered to have the potential to affect the nesting habitats at either Ynys Feurig or the Skerries.

10.3.252 Associated with their wider nesting distribution within the SPA, the at-sea distribution of common terns around the Anglesey coast is more westerly than that of Sandwich terns, with areas of high densities tending to be further from the offshore ZOIs associated with the Wylfa Newydd Development Area. This is demonstrated by the findings from both the ESAS boat-based surveys of Blocks 1 and 2 (figures 6-25 to 6-29 and figures 6-21 to 6-24, noting that common and Arctic terns were not distinguished in these surveys but recorded together as ‘commic’ terns) and the earlier JNCC boat-based surveys from 2009 (figures 3-4 and 3-5, appendix A of Application Reference Number: 6.4.89). These broad-scale survey data are supported by the findings of the modelling of the usage of the marine environment by common terns from the different colonies within the Morwenoliaid Ynys Môn/Anglesey Terns SPA. This predicts that birds from Ynys Feurig make relatively little use of the waters around the offshore ZOIs associated with the Wylfa Newydd Development Area, whilst those from the Skerries and Cemlyn Bay show low to moderate and high relative usage, respectively (figures 6-15 to 6-17, [RD362]).

10.3.253 Although it is acknowledged that the common tern population at Cemlyn Bay is small relative to the overall SPA population of this species (and therefore could be seen to be at greater risk of an effect locally), the above considerations suggest that in relation to common terns the effects of the Project have less potential to affect the SPA conservation objectives concerned with maintaining numbers and breeding success than they do for Sandwich terns. However, the potential for effects from the Project to affect the SPA conservation objective concerned with not constraining or hindering the range and distribution of terns within the SPA is likely to be similar between the species.

A Changes in visual and acoustic stimuli

10.3.254 As for the Morwenoliaid Ynys Môn/Anglesey Terns SPA Sandwich tern population, visual and acoustic stimuli could affect the SPA common tern population as a result of either disturbance to breeding birds when they are present at the Cemlyn Bay colony (during pre-laying, or in attendance of nests or chicks), or disturbance to SPA birds when they are commuting or

foraging in the marine environment. Effects of disturbance could arise via the same means as for Sandwich terns (see above).

Construction

A1 Disturbance at the breeding colony [Marine Licence]

10.3.255 In terms of considering the potential effects of anthropogenic disturbance on nesting terns, the wider context is set out above in the section on Sandwich terns and much of this context applies equally to common terns. Amongst the species of tern that breed in the UK, common terns are most commonly associated with breeding at industrial sites where there can be high levels of anthropogenic disturbance ([RD215], [RD141]).

10.3.256 The sources of visual and acoustic stimuli that could potentially affect common terns breeding at the Cemlyn Bay colony as a result of the Project construction activities are as described for Sandwich terns above. This is also the case for the associated evidence base that is used to inform the assessment.

10.3.257 In relation to the monitoring of baseline disturbance levels and the associated tern responses, there were fewer responses to potential disturbance events from common terns than from Sandwich terns (table 6-8). However, this difference was likely to be due solely to the greater abundance of Sandwich tern at the colony (meaning there was more chance of individuals of this species responding than of the other tern species) than to any real behavioural difference between the two species.

10.3.258 The assessment in relation to common terns is concerned with the same effects as for Sandwich tern and relies upon the same evidence base. As outlined above, the potential for effects in the case of common terns is concerned, essentially, with maintaining range and distribution within the SPA. On the basis of the levels of disturbance predicted to occur and the evidence relating to the likely responses of breeding terns to such disturbance, the findings of the assessment on the potential effects to breeding Sandwich terns from noise and visual disturbance during construction are considered to apply equally to breeding common terns at Cemlyn Bay. Therefore, it is considered that disturbance at the Cemlyn Bay breeding colony from noise, vibration and visual stimuli alone and in-combination will have no adverse effects on the Morwenoliaid Ynys Môn/Anglesey Terns SPA with respect to common terns.

A2 Disturbance in the marine environment [Marine Licence]

10.3.259 As for disturbance at the breeding colony, the basis for the assessment of disturbance to common terns in the marine environment follows the approach used for Sandwich terns above.

10.3.260 Thus, it is considered that the offshore noise ZOI, as defined by the areas where the predicted noise levels from construction plant and machinery are in excess of 65 dB(A), is equally appropriate (and precautionary) for common terns. As above, the noise predictions are based upon a precautionary scenario where all the plant is running (100% on time)

and is located at the closest point to the ecological receptors in each working zone within the Wylfa Newydd Development Area. In relation to the application of the offshore noise ZOI to common terns, broad-based and qualitative consideration of responses to anthropogenic disturbance in the offshore environment suggests that, like Sandwich tern, the species is relatively insensitive (with the two species assigned the same ranking ([RD117], [RD115]). This is supported by the findings of common tern response to piling for turbine foundations at the Teeside offshore wind farm, where birds were attracted to the vicinity of the activity despite the high levels of airborne noise that would have been associated with this activity (see above, [RD84]).

10.3.261 Similarly, it is considered that the offshore visual ZOI established for Sandwich terns is also appropriate for common terns, given that both species are considered relatively insensitive to anthropogenic disturbance in the offshore environment, and that monitoring at six offshore wind farms in the North Sea provides no evidence of strong avoidance by this species to these sites (although at several of these sites data for common and Arctic terns are combined, so any difference in the responses between these two species may be masked) [RD81].

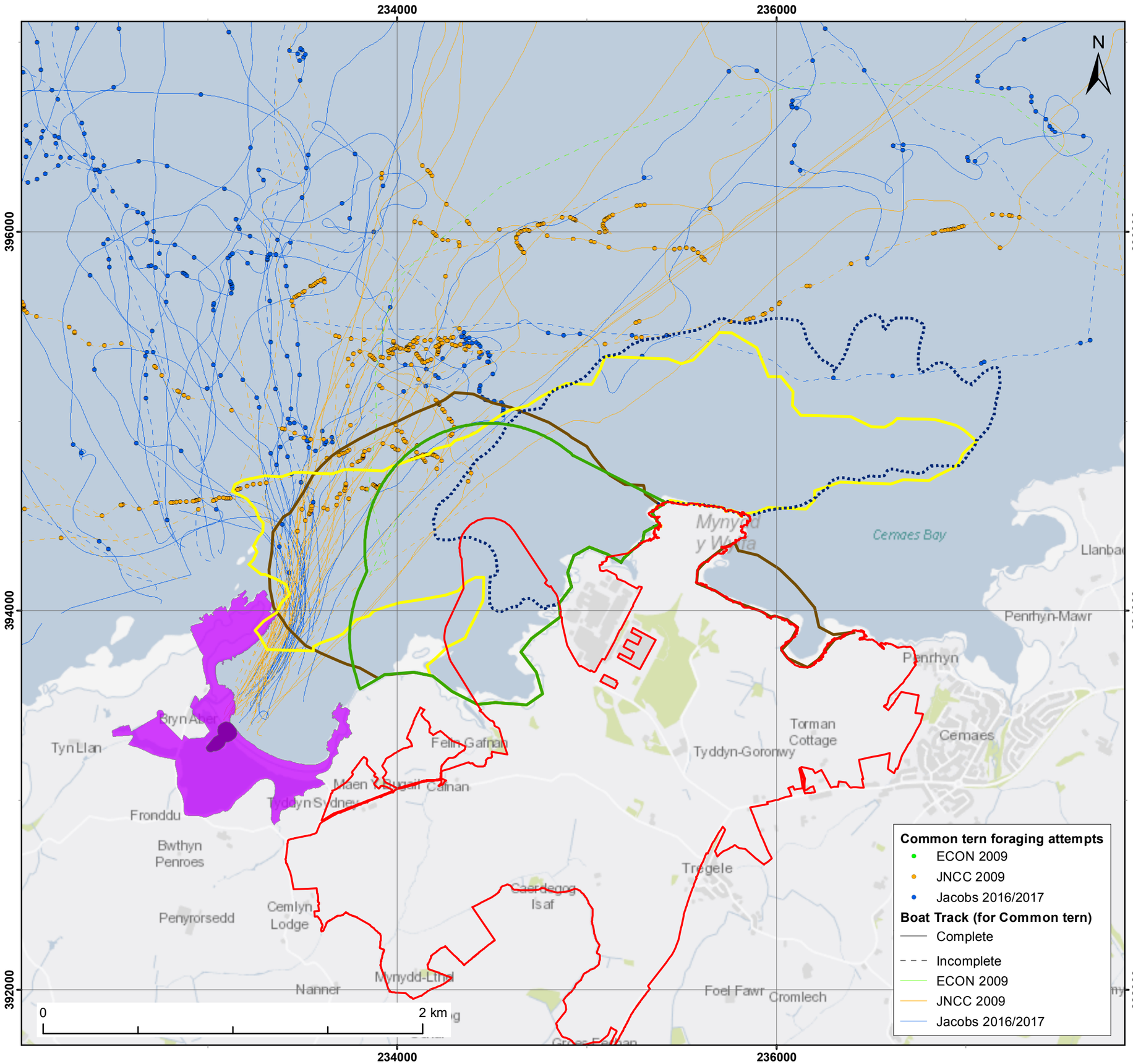
10.3.262 For the purposes of undertaking the assessment for common tern, the highly precautionary assumption is made that birds will show complete avoidance of the offshore noise and visual ZOIs (as assumed for Sandwich tern above).

10.3.263 The avoidance of the offshore noise ZOI would mean that common terns are displaced from foraging within this ZOI and also have to detour around it when flying to and from the Cemlyn Bay colony (bearing in mind that a relatively small proportion only of the SPA population breed at Cemlyn Bay). The relatively broad-scale ESAS transect data suggest that any such effects would be of limited importance to the SPA common tern population, given that only two of the five breeding season surveys recorded birds in relatively close proximity to this ZOI and none recorded high densities close to the ZOI (figures 6-25 to 6-29) (common and Arctic terns were not distinguished during the ESAS boat-based transect surveys (Application Reference Number: 6.4.89), so that the records referred to could be of either species).

10.3.264 In terms of the extent of overlap with the predicted foraging ranges of common terns from the different colonies within the SPA, the offshore noise ZOI represents approximately 0.10% of the total modelled range in each case (figures 6-15 to 6-17, [RD362]). However, as indicated above, there are marked differences in the extent to which common terns from the different colonies are predicted to use the waters around the Wylfa Newydd Development Area. Thus, there was no overlap between the offshore noise ZOI and the zone predicted to account for 95% of usage by birds from either Ynys Feurig or the Skerries, although the zone of 95% usage by Skerries birds adjoins this ZOI. The offshore noise ZOI represents approximately 10% of the 95% usage zone for the Cemlyn Bay common terns (figures 6-15 to 6-17).

10.3.265 Considering the potential consequences of the avoidance of the offshore noise ZOI in more detail, data from the different tracking surveys estimate that approximately 6–8% of all foraging attempts occur within the offshore noise ZOI, depending on whether estimates are based on the complete tracks only or on all tracks (table 10-13, figure 10-18). These estimates are considerably higher than the equivalent estimates for Sandwich tern (at 1.5 to 2.5%), but two factors are important to consider in this respect:

- First, the common tern data are derived from a considerably smaller sample of tracked birds in each of the different surveys and this may affect the reliability of the estimates (the sample of tracks is considerably smaller for common terns than Sandwich terns, and represents 0.05 tracks per adult bird in the SPA population (and 0.4 tracks per adult bird at Cemlyn Bay) compared to 0.07 tracks per adult bird for Sandwich terns (as calculated using the most recent five-year mean population size estimates available in each case). The estimates obtained from the 2009 JNCC survey are markedly higher than those from the 2016 and 2017 Jacobs surveys (table 10-13). This may reflect a true difference (perhaps related to between-year variation in foraging behaviour), but could also result from the small sample sizes in one or more of the surveys producing non-representative findings.
- Second, given that the tracking method was based on following birds that appeared to be associated with the Cemlyn Bay colony (Application Reference Number: 6.4.89), these estimates should be regarded as reflecting foraging behaviour of Cemlyn Bay breeding birds largely but not exclusively (e.g. one of the common terns in the 2017 surveys was tracked to the Skerries colony – figure 6-33). This would accord broadly with the above comparisons of the extent to which the predicted core foraging ranges overlap with the offshore noise ZOI. These show that this ZOI lies within the core foraging area for the Cemlyn Bay birds but also that a small proportion of foraging by the (much larger) Skerries population will occur in this ZOI.



Legend

- WNDA
- Disposal Site
- Temperature ZOI (sea surface autumn base case)
- TRO ZOI (surface summer base case)
- Noise ZOI (65db)
- 500m visual ZOI
- Cemlyn Bay SSSI/SAC
- Tern colony

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Client: HORIZON NUCLEAR POWER

Project: Wylfa Newydd Project

Title: Common tern tracking results from within the vicinity of the offshore ZOIs for the Jacobs (2016 and 2017), JNCC (2009) and ECON (2009) surveys

Figure: 10-18

Revision:	Date:	Drawn:	Checked:	Size:	Scale:
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Co-ordinate system: British National Grid

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Table 10-13 The percentage of common tern foraging locations and tracks occurring within the offshore noise ZOI. Sample sizes (n) upon which the percentage estimates are based are given

Survey	Foraging locations (%)		Tracks (%)	
	Complete tracks[1]	All tracks	Complete tracks[1]	All tracks
2016 Jacobs	1.04% (n=96)	0.31% (n=324)	50.00% (n=4)	44.44% (n=9)
2017 Jacobs	2.36% (n=297)	1.89% (n=370)	100% (n=8)	91.67% (n=12)
2009 JNCC	20.56% (n=248)	16.61% (n=548)	100% (n=9)	86.67% (n=30)
2009 ECON	- (n=0)	0.00% (n=2)	- (n=0)	50.00% (n=2)
Mean value[2]	7.99%	6.27%	83.33%	74.26%

[1] Complete tracks are those where birds were followed from, and back to, the colony
[2] Mean value calculated excluding ECON survey data due to small sample sizes

10.3.266 Approximately 75% to 83% of all tracked birds were estimated to pass through the offshore noise ZOI, largely on commuting flights to and from the colony and the foraging areas (table 10-13). This high percentage is unsurprising, because the perimeter of the offshore noise ZOI extends across the entrance to Cemlyn Bay. As for Sandwich terns, the implications for flight distance resulting from commuting birds avoiding the offshore noise ZOI were investigated using the Horizon survey data (from 2016 and 2017 in the case of common terns). In contrast to Sandwich terns, where the tracked flight lines to and from Cemlyn Bay tended to lie on a southwest-northeast axis (meaning that they often crossed almost the full length of the offshore noise ZOI), the majority of the common tern tracks out of (or into) Cemlyn Bay were orientated along a north-south axis. This meant that they tended to bisect the western edge of the offshore noise ZOI. This is true for the data from the 2009 JNCC surveys as well as from the two years of Horizon surveys (figure 10-18).

10.3.267 Consequently, the additional flight distance incurred by detouring around the perimeter of the offshore noise ZOI will be small in most cases. To give an indication of this, the total flight distance around the perimeter of the offshore noise ZOI for flights that actually transited it represents approximately 4% and 7% of the total flight length of all tracks and of complete tracks, respectively, from the Horizon surveys (as calculated from their points of entry and exit to and from this ZOI). Therefore, the additional distance incurred by any deviation in flight routes around the offshore noise ZOI would be trivial relative to the overall distances involved in the commuting flights of common terns from the Cemlyn Bay colony, and represents a fraction of the 3-4% increase in flight length calculated for Sandwich tern.

10.3.268 The offshore visual ZOI is encompassed by the offshore noise ZOI, so that potential effects predicted to result from the visual disturbance associated with the construction works in Porth-y-pistyll and at the cooling water outfall will be less than those predicted by the assumed exclusion of foraging and commuting common terns from the offshore noise ZOI. They are also fully incorporated within the effects predicted by the exclusion of foraging and commuting birds from the offshore noise ZOI.

10.3.269 Fewer than half of the foraging attempts recorded within the offshore noise ZOI occurred within the offshore visual ZOI, with only the 2009 JNCC tracking surveys recording foraging attempts in the latter ZOI (table 10-14). Similarly, the percentage of tracks occurring within the offshore visual ZOI was greatly reduced compared with the offshore noise ZOI, reflecting the preponderance of flights to and from the Cemlyn Bay colony that transited the western edge of the offshore noise ZOI, so avoiding the offshore visual ZOI (table 10-14, figure 10-18).

Table 10-14 The percentage of common tern foraging locations and tracks occurring within the offshore visual ZOI (sample sizes (n) upon which the percentage estimates are based are given)

Survey	Foraging locations (%)		Tracks (%)	
	Complete tracks[1]	All tracks	Complete tracks[1]	All tracks
2016 Jacobs	0.00% (n=96)	0.00% (n=324)	0.00% (n=4)	0.00% (n=9)
2017 Jacobs	0.00% (n=297)	0.00% (n=370)	25.00% (n=8)	16.67% (n=12)
2009 JNCC	8.47% (n=248)	4.56% (n=548)	44.44% (n=9)	23.33% (n=30)
2009 ECON	- (n=0)	0.00% (n=2)	- (n=0)	50.00% (n=2)
Mean value[2]	2.82%	1.52%	23.15%	13.33%

[1] Complete tracks are those where birds were followed from, and back to, the colony
[2] Mean value calculated excluding the ECON survey data due to small sample sizes

10.3.270 Details of the increase in vessel traffic that is predicted during construction is given above in relation to the potential effects on Sandwich terns. Given the relatively low sensitivity of common terns to vessel traffic ([RD117], [RD115]) this source of visual disturbance is not considered likely to result in more than minor effects on foraging or commuting birds. Similarly light spillage during construction of the Marine Works would not affect areas that are heavily used by foraging common terns, whilst the species shows little nocturnal flight activity anyhow (figure10-6, [RD117]).

10.3.271 The assessment for the effects of underwater noise on common tern resulting from the construction activities is as for Sandwich tern (see above), with the potential effects being encompassed within both the offshore noise and offshore visual ZOIs. Therefore, the main indirect effects from underwater noise which may arise via impacts on prey species will affect an

area within which considerably less than 1.5% to 3% of the foraging attempts recorded for common tern during the tracking surveys occurred (table 10-14). However, this is a considerable overestimate of the importance of this area to the SPA common tern population, and relates more to the small population at Cemlyn Bay, because the surveys focussed on sampling birds that were likely to derive from the Cemlyn Bay colony, which holds approximately 13% of the SPA population only.

10.3.272 Based on the above considerations, the effects from construction-related noise and visual disturbance in the marine environment would not result in adverse effects on the integrity of the Morwenoliaid Ynys Môn/Anglesey Terns SPA common tern population. Although a relatively high percentage (approximately 6% to 8%) of foraging attempts were recorded within the offshore noise ZOI, this is associated largely (but not exclusively) with the relatively small part of the SPA population that breeds at the Cemlyn Bay colony. The overall importance of the offshore noise ZOI as a foraging area for the SPA population will be substantially lower. At the same time, the area of sea encompassed by the offshore noise ZOI is not of such importance to the Cemlyn Bay common terns that an avoidance of this ZOI is likely to have a substantive detrimental effect on this population. Although the offshore noise ZOI accounted for 10% of the area of greatest predicted use by the Cemlyn Bay common terns (as defined by the 95% usage zone), this is in relation to an extensive foraging area within which the vast majority of foraging occurs to the north of this ZOI (figure 10-18). Furthermore, the assessment of offshore noise effects is based upon highly precautionary assumptions concerning the operation of the plant and machinery (for the prediction of noise levels) and the complete exclusion of common terns from the offshore noise ZOI (which, based on other studies of the effects of airborne noise on the behaviour of this species in offshore environments, is highly unlikely).

Operation

A3 Noise and visual disturbance during operation [Operational combustion activity EP]

10.3.273 Modelling of airborne noise for the operational phase demonstrates that even noise levels of 35dB (the lowest levels shown in the modelled outputs) do not extend as far as the Cemlyn Bay breeding colony, whilst levels above 35 dB(A) do not extend into the offshore environment (figure 6-12 in Application Reference Number: 6.4.6).

10.3.274 In terms of visual stimuli, potential impacts are essentially limited to the vessel movements associated with the Project and spillage from artificial lighting. Vessel movements are predicted to be very infrequent (one per month) and so will not represent any discernible change to existing background levels.

10.3.275 During operation of the MOLF, a 0.1 Lux contour extends no more than 125m across the water. This is predominantly from the MOLF cranes and would only occur at three specific locations. Typically the 0.1 Lux extends no

more than 100m across the water when the cranes are not in use (figure 10-11).

10.3.276 No adverse effects from changes in visual and acoustic stimuli are predicted on the SPA common tern population during the operational phase of the Project.

B Land-take, including seabed or intertidal land

Construction

B1 Change and/or loss of habitat [Marine Licence]

10.3.277 Potential effects on the SPA common tern population during the construction period could arise from land take within the Porth-y-pistyll area and as a result of the disposal of dredge material at the Disposal Site. These could have indirect effects on foraging terns via impacts on fish prey populations.

10.3.278 As described in the section on Sandwich terns, construction activities within Porth-y-pistyll would involve the construction of the MOLF, cofferdams and the breakwater. This would cause a loss of seabed habitat within an area of only 0.35km^2, which represents an insignificant proportion of the foraging area available to common terns, even when considering those from the Cemlyn Bay colony only. The tern tracking surveys demonstrate the limited extent to which this area is used for foraging with none of the total 1,244 foraging attempts recorded within the area (figure 10-18).

10.3.279 The Disposal Site is approximately 10km, 20km and 25km from the Skerries, Cemlyn Bay and Ynys Feurig colonies, respectively. As such, only the Skerries colony is within the mean maximum foraging range of 15.2km for common tern [RD330]. Habitat-association models predict that common terns from each of these three colonies will make little, if any, use of the waters around the Disposal Site (figures 6-15 to 6-17, [RD362]). Furthermore, the data obtained from the ESAS surveys undertaken for the Minesto project (http://minesto.com/projects/holyhead-deep), and encompassing the southern part of the Disposal Site, included only four definite common tern records. All were recorded during the August 2016 survey and were therefore most likely passage birds.

10.3.280 Hence, land-take during construction is not predicted to have an adverse effect on the integrity of the Morwenoliaid Ynys Môn/Anglesey Terns SPA common tern population.

Operation

B2 Change and/or loss of habitat [Marine Licence]

10.3.281 The marine structures would be retained during the operational phase and would essentially represent a permanent loss of seabed habitat. However, as detailed above, the extent of this habitat loss is insignificant relative to the foraging area available to common terns from the SPA colonies.

10.3.282 As such, land-take is not predicted to have an adverse effect on the SPA breeding common tern population during the operational phase.

C Changes in marine water quality [Marine Licence; Construction water discharge EP]

10.3.283 Changes in marine water quality could potentially affect the availability of the fish prey of common terns leading to impacts on the SPA population. As for Sandwich terns, such effects could arise during construction as a result of suspended sediment input to the marine environment from fluvial sources and increases in suspended sediment concentration and contaminant re-mobilisation during dredging and disposal, or during operation via discharge from the CWS.

Construction

10.3.284 As outlined above for Sandwich tern, the input of suspended sediment to the marine environment from fluvial sources, dewatering and sewage and increases in suspended sediment concentration and contaminant re-mobilisation during dredging and disposal are predicted to occur on small spatial scales relative to the areas used by, and available to, foraging terns. Also, the areas over which these effects would extend do not coincide with areas of importance to foraging common terns, whilst they would also be temporary and of relatively short duration.

10.3.285 Therefore, changes in water quality as a result of construction activities are not predicted to lead to adverse effects on the SPA common tern population.

Operation

10.3.286 Discharge from the CWS during operation would have thermal effects on the adjacent marine area, whilst there may also be effects of TRO from the residual biocide (used for the treatment of biofouling on the submerged structures, especially the cooling water system). These effects have the potential to lead to effects on the SPA common tern population via indirect effects on their fish prey.

10.3.287 Details of the potential for thermal effects and for effects from TRO on the fish prey species of Sandwich tern, along with the basis for defining ZOIs for both of these potential effects have been outlined above in the section on Sandwich terns. During the breeding season common terns tend to depend on a broadly similar range of prey types to those of Sandwich terns. A review of studies providing information on the diet of common terns breeding in Britain and Ireland [RD85] indicated that clupeids and sandeels generally predominate (as described above for Sandwich terns), although common terns tend to take more clupeids than sandeels, whilst some studies also indicate that gadoids can be important (e.g. [RD254]). Detailed data on the diet of common terns at Cemlyn Bay are not available, but observations made during the visual tracking surveys in 2008 and 2009 indicated that both species were feeding on small shoaling clupeids, other small fish and invertebrates. Common terns were not observed feeding on sandeels at sea,

but did bring some sandeels back to feed chicks [RD256]. Given the likely overlap in prey between these two species, it is considered reasonable to apply the same thermal and TRO ZOIs to common terns as used for Sandwich terns (figure 10-7).

10.3.288 In terms of the extent of overlap with the predicted foraging ranges of common terns from the different colonies within the SPA, the thermal ZOI and TRO ZOI represent approximately 0.12% and 0.15%, respectively, of the total modelled range for each colony (figures 6-15 to 6-17, [RD362]). However, there is no overlap between either of these ZOIs and the zone predicted to account for 95% of the usage by birds from either Ynys Feurig or the Skerries (although both ZOIs are in close proximity to the zone of 95% usage for the Skerries). The thermal ZOI and TRO ZOI accounted for 10% and 12%, respectively, of the 95% usage zone for the Cemlyn Bay common terns (figures 6-15 to 6-17).

10.3.289 Based on the data from the different tracking studies, less than 1% of common tern foraging attempts are estimated to occur within the thermal ZOI (table 10-15, figure 10-18). Given that any detrimental effects within this ZOI would be limited to a reduction in foraging efficiency, as opposed to the entire loss of the ZOI as potential foraging habitat, the findings from the tracking surveys suggest that the thermal effects from the cooling water discharge would be of little consequence to foraging common terns, either from the SPA overall or from Cemlyn Bay specifically. This is particularly so, given that the tracking data are largely representative of the foraging areas used by the relatively small part of the SPA population that breeds at the Cemlyn Bay colony, and that they indicate that the main foraging areas of the Cemlyn Bay common terns lie to the north and west of the thermal ZOI (figure 10-18).

10.3.290 A higher percentage of foraging locations was recorded within the TRO ZOI than within the thermal ZOI, in keeping with the more westerly distribution of the former (and the tendency of the common tern flights departing and entering Cemlyn Bay to occur along a north-south trajectory) (figure 10-18). Thus, approximately 3% to 4% of foraging attempts were estimated to occur within the TRO ZOI (table 10-16). As for the offshore noise ZOI, the percentage of foraging attempts recorded within the TRO ZOI was notably higher for the 2009 JNCC surveys than for the 2016 and 2017 Horizon surveys, but the combined data from all three survey years are likely to provide the most representative estimate of usage of this ZOI (particularly given the small sample of individual tracks available for any single year).

Table 10-15 The percentage of common tern foraging locations and tracks occurring within the thermal ZOI. Sample sizes (n) upon which the percentage estimates are based are given.

Survey	Foraging locations (%)		Tracks (%)	
	Complete tracks[1]	All tracks	Complete tracks[1]	All tracks
2016 Jacobs	0.00% (n=96)	0.62% (n=324)	0.00% (n=4)	11.11% (n=9)
2017 Jacobs	0.34% (n=297)	0.27% (n=370)	12.50% (n=8)	8.33% (n=12)
2009 JNCC	0.81% (n=248)	0.55% (n=548)	22.22% (n=9)	13.33% (n=30)
2009 ECON	- (n=0)	0.00% (n=2)	- (n=0)	0.00% (n=2)
Mean value[2]	0.38%	0.48%	11.57%	10.91%

[1] Complete tracks are those where birds were followed from, and back to, the colony
[2] Mean value calculated excluding the ECON survey data due to small sample sizes

Table 10-16The percentage of common tern foraging locations and tracks occurring within the TRO ZOI (sample sizes (n) upon which the percentage estimates are based are given)

Survey	Foraging locations (%)		Tracks (%)	
	Complete tracks[1]	All tracks	Complete tracks[1]	All tracks
2016 Jacobs	1.04% (n=96)	0.31% (n=324)	50.00% (n=4)	44.44% (n=9)
2017 Jacobs	2.02% (n=297)	1.62% (n=370)	100% (n=8)	91.67% (n=12)
2009 JNCC	6.85% (n=248)	9.49% (n=548)	100% (n=9)	90.00% (n=30)
2009 ECON	- (n=0)	0.00% (n=2)	- (n=0)	50.00% (n=2)
Mean value[2]	3.30%	3.81%	83.33%	75.37%

[1] Complete tracks are those where birds were followed from, and back to, the colony
[2] Mean value calculated excluding the ECON survey data due to small sample sizes

10.3.291 As for the other offshore ZOIs, the estimated use of the TRO ZOI by common terns is associated largely with the Cemlyn Bay colony and not with the overall SPA population, although a small proportion of foraging by the larger Skerries population is also likely to occur within this ZOI (figure 6-16). As such, findings from the tracking surveys will overestimate the extent to which this ZOI is used by foraging common terns from the SPA population. Considering the potential for impacts to the common terns at Cemlyn Bay (and, hence, the consequences in terms of maintaining range and distribution), the tracking data demonstrate relatively little use of the TRO ZOI overall. These data indicate that most foraging occurs to the north of this ZOI, and that foraging within the TRO ZOI is essentially restricted to its

north-western periphery. This, together with the predicted negligible effects of TRO on fish populations (Application Reference Number: 6.4.13), suggests that the effects of TRO from the CWS would be of little consequence to foraging common terns, either from the SPA overall or from Cemlyn Bay specifically.

10.3.292 Based on the above considerations, changes in marine water quality as a result of discharge from the cooling water system during operation are not predicted to result in adverse effects on the SPA common tern population.

D Changes in surface and groundwater hydrology [Construction water discharge EP]

10.3.293 Effects from changes in surface and groundwater hydrology have been screened into the assessment for the Morwenoliaid Ynys Môn/Anglesey Terns SPA on the basis of the potential for effects on the nesting habitat at the Cemlyn Bay lagoon on which a proportion of the SPA common tern population are dependent.

10.3.294 The potential effects of changes in surface and groundwater hydrology during both the construction and operation periods on the habitats at the Cemlyn Bay lagoon have been considered in chapter 7, with the conclusion of no adverse effects on these habitats. Given the nature of the changes predicted, there is no potential for an adverse effect on terns or their habitats.

E Changes in air quality [Marine Licence; Operational combustion activity EP]

10.3.295 Effects from changes in air quality have been screened into the assessment for the Morwenoliaid Ynys Môn/Anglesey Terns SPA on the basis of the potential for effects on the nesting habitat at the Cemlyn Bay lagoon on which a proportion of the SPA common tern population are dependent.

10.3.296 The potential impacts of changes in air quality during both the construction and operation periods on the habitats at the Cemlyn Bay lagoon have been considered in chapter 7, with the conclusion of no adverse effects on these habitats. However, terns are not dependant on this qualifying feature; changes in air quality and potential effects on vegetation are considered for terns in the context of vegetation on the islands used by breeding terns. Changes in air quality are not predicted to affect the vegetation on which common terns are dependent for the provision of nesting habitat on the islands. As such, changes in air quality are not predicted to affect either the use of the islands by terns or their breeding success, and it follows that changes in air quality would not result in adverse effects on the SPA common tern population.

F Alteration of coastal processes and hydrodynamics [Marine Licence]

Construction and operation

10.3.297 Any changes as a result of coastal processes and hydrodynamics (e.g. scour, smothering, changes to currents and waves) have the potential to cause indirect impacts on the SPA common tern population via effects on prey species.

10.3.298 Any coastal squeeze could only occur at locations where new structures are constructed and therefore is limited to the marine area of the Wylfa Newydd Development Area as a maximum. As described above in relation to land-take, this area represents an insignificant proportion of the foraging area available to common terns from the Cemlyn Bay colony (and more so for the whole SPA population), whilst none of the total 1,244 foraging attempts recorded were within this area (figure 10-18).

10.3.299 The maximum predicted effect area for deposition of sediment on the seabed is shown in figure 7-9. The coastal processes assessment (Application Reference Number: 6.4.12) concludes that there is no potential for an alteration in intertidal or subtidal habitats across this area and, consequently, no significant effect on the prey species for common terns, so that no adverse effects on the SPA population are predicted.

G Physical interaction between species and Project infrastructure

Construction

10.3.300 No pathways were identified for construction-related effects on the SPA common tern population from physical interaction between species and Project infrastructure (chapter 5). Therefore, no effects on the SPA common tern population are predicted from physical interactions between species and Project infrastructure during the construction period.

Operation

G1 Entrapment of prey [Operational water discharge EP]

10.3.301 As outlined above in the section relating to Sandwich tern, fish (and invertebrate) populations which are prey for terns would suffer mortality from impingement and entrainment within the cooling water intake. Such mortality potentially could have population-level consequences, and therefore could lead to indirect impacts on the SPA common tern population.

10.3.302 As for Sandwich tern, clupeids and sandeels are key prey groups for common tern during the breeding season ([RD85], and as detailed above), and the levels of mortality predicted to affect these prey groups as a result of impingement and entrainment are detailed in the Sandwich tern section above. Context to the potential scale of the losses of available prey from impingement and entrainment to the SPA Sandwich tern population was

provided by considering the dietary equivalence for Sandwich terns, using a bioenergetics approach (Application Reference Number: 6.4.13). This approach was also applied in relation to the SPA common tern population, based on evidence that that the key prey species taken during the breeding season are similar, but with different assumptions in relation to the proportions of prey items in the diet. It is noted that compared with Sandwich terns, common terns tend to take smaller prey, but there is considerable overlap in the size of prey items taken by both species. Typical and maximum weights of fish fed to chicks by common terns are 2.5g and 16g, compared with 6g and 30g for Sandwich tern [RD32].

10.3.303 For common tern, clupeids were assumed to comprise 66% and 23% of the chick and adult diets, respectively, with sandeels assumed to comprise 4% and 59% of the chick and adult diets, respectively. With each adult common tern assumed to be present on the breeding grounds for 122 days and each chick for 40 days, and with daily energy requirements assumed to be 347kJ d^{-1} for adults and 356kJ d^{-1} for chicks, the per capita energy requirements of adults and chicks over the breeding season were estimated as 42,334kJ and 14,240kJ, respectively. This was estimated to equate to the consumption of:

- 5,012 (or 7,330g of) sandeels and 1,800 (or 1,115g of) clupeids by each adult bird during the breeding season.
- 99 (or 145g of) sandeels and 3,997 (or 2,474g of) clupeids by each chick during the breeding season.

10.3.304 Predictions on the impingement rates suggest that a total of 1.9kg of sandeel and clupeids will be impinged during the breeding season, as estimated without accounting for any of the mitigation measures that would be incorporated (Application Reference Number: 6.4.13). This represents approximately 20% of the biomass of sandeels and clupeids estimated to be consumed by an adult common tern during the breeding season. With reference to the SPA population size at designation, the impingement rates represent 0.06% of the sandeel and clupeid biomass consumed during the breeding season by a population of 189 pairs ([RD328], [RD236]), whilst they represent 0.02% of that consumed by the current SPA common tern population (based on the most recent five-year mean population size of 510 breeding pairs – see table 6-6). Considering the Cemlyn Bay colony in isolation, the impingement rates represent 0.2% of the sandeel and clupeid biomass consumed by the current population (based on the most recent five-year mean estimate of 67 breeding pairs (this is similar to the estimated 57 breeding pairs at Cemlyn Bay at the time of designation ([RD164] table 6-6).

10.3.305 Based on the values of the predicted entrainment rates as converted to EAVs (and as detailed above in the section on Sandwich tern), the number of sandeels and clupeids entrained during the breeding season is equivalent to the numbers consumed by approximately 62 adult common terns (Application Reference Number: 6.4.13). This represents approximately 15% of the sandeel and clupeid biomass consumed during the breeding season by the adult common terns in the SPA population at designation (189 pairs, as above), and approximately 6% of the biomass consumed during the

breeding season on the basis of the most recent five-year mean population estimate (i.e. 510 breeding pairs). Considering the Cemlyn Bay colony in isolation, the estimated losses to entrainment would represent 46% of the biomass consumed by the current adult population (i.e. 67 breeding pairs).

10.3.306 As in the analogous calculations for Sandwich terns above, the combined estimates for impingement and entrainment (without accounting for proposed mitigation measures) are equivalent in each case to those calculated for entrainment alone (to the nearest 1%). This is because the predicted biomass of fish prey subject to entrainment (converted to EAV) is greater than for impingement by two to three orders of magnitude. In years of moderate to high breeding success, these losses would represent a substantially smaller percentage than 6% of the current common tern SPA population size (or 46% of the current Cemlyn Bay population size) due to the additional consumption by the chicks. Furthermore, given that clupeids and sandeels are likely to form the bulk of the diet of all three tern species currently breeding in the Morwenoliaid Ynys Môn/Anglesey Terns SPA, then the predicted number of sandeels and clupeids impinged and entrained during the breeding season would represent a substantially smaller percentage (less than 0.5%) of the biomass consumed by the adult birds from the three SPA tern populations combined. When considering the Cemlyn Bay colony alone, the estimated losses to impingement and entrainment would represent less than 1% of the biomass consumed by all three tern populations at this colony.

10.3.307 The dietary equivalence values estimated above provide a means by which the scale of the potential losses from impingement and entrainment can be assessed relative to the quantities consumed by the SPA common tern population. However, they cannot be interpreted as a direct loss of the prey that would be available to the SPA population because it cannot be assumed that all of the potential prey items lost to impingement and entrainment would otherwise become available as prey. This is clearly demonstrated by considering the dietary equivalence values in the context of the total number of adult terns from all three SPA populations combined.

10.3.308 The impact of these potential losses to the prey resource of common terns also needs to be considered in relation to the conservation objectives of the SPA. In relation to the objective that the population size should be stable or increasing (relative to the population size at designation), the common tern SPA population size has increased substantially since designation and the current prey resource supports a population that is approximately two and a half times that at designation. Therefore, the scale of reduction in the prey resource which would be required to cause the population to decline to below the size at designation is many times greater than that predicted on the basis of the dietary equivalence calculations (even when it is assumed that all prey items lost to impingement and entrainment would otherwise be available as prey).

10.3.309 For the conservation objective concerned with the maintenance of range and distribution, consideration needs to be given to the Cemlyn Bay colony and whether there is a disproportionate risk of potential impacts to the

common terns at this colony. Such a scenario is highly unlikely because fish are highly mobile species and any effects are likely to manifest across a much wider area than the immediate vicinity of the cooling water intake. However, if effects on fish populations were localised, impacts to the common tern population at Cemlyn Bay remain unlikely. This is because the tracking surveys demonstrate that most foraging by the Cemlyn Bay common terns occurs to the north of the colony, with few tracks following relatively inshore routes east that pass close to the cooling water intake (figure 6-33). Therefore, the waters in the vicinity of the cooling water intake do not appear to be particularly important as a foraging area for common terns.

10.3.310 As for Sandwich tern, it is also worth noting that the increase in the common tern SPA population size has coincided with the period when entrainment of fish was occurring from the water intake cooling system of the Existing Power Station, which operated from 1971 to 2015 (Application Reference Number: 6.4.13). Over this same period, the numbers of breeding pairs of common terns at Cemlyn Bay has remained approximately stable overall (albeit with some fluctuations), and there has been no associated decline (Application Reference Number: 6.4.89, [RD164]).

10.3.311 Finally, the dietary equivalence calculations treat the predicted impingement and entrainment estimates as representing 100% mortality, whereas only a proportion of the potential prey that are impinged or entrained will die as a result of these processes.

10.3.312 On the basis of the above dietary equivalence calculations and the associated considerations, it is concluded that the entrapment of prey in the cooling water intake will have no adverse effects on the SPA common tern population.

H Potential for intra-Project effects

10.3.313 Effects from the Project may not operate in isolation but instead may combine to cause adverse effects on the Morwenoliaid Ynys Môn/Anglesey Terns SPA common tern population. The potential for this is considered below.

10.3.314 Common terns are distributed across all three colonies within the SPA, with only 13% of the SPA population estimated to currently breed at the Cemlyn Bay colony (chapter 6). Effects from the Project are most likely to affect common terns from the Cemlyn Bay colony (with considerably less potential for effects on the other colonies). As such, the potential for effects in the case of common terns is concerned more with the conservation objective to maintain range and distribution within the SPA, than with the conservation objectives related to maintaining numbers and breeding success.

Construction

10.3.315 As for Sandwich tern, a range of pathways exist for potential effecs to common terns during construction (as outlined above). In relation to

disturbance, it is concluded above that the combined effects from noise, vibration and visual disturbance at the colony would have no adverse effects on the SPA population, whilst the main potential effects from visual disturbance within the offshore environment are essentially incorporated within the assessment for noise disturbance (because the offshore visual ZOI is encompassed within the offshore noise ZOI).

10.3.316 With the proposed mitigation in place, it is considered that any effect of noise and visual disturbance at the Cemlyn Bay colony would be minimal, with little likelihood of any detectable effects on breeding success. In relation to the offshore environment, the offshore noise ZOI appeared to be of more importance to the Cemlyn Bay common terns than to Sandwich terns. This was on the basis that a greater percentage of common tern foraging attempts were recorded within this ZOI (6% to 8%), and that this ZOI accounted for approximately 10% of the area with greatest predicted use by the Cemlyn Bay common terns (as defined by the zone of 95% usage within the modelled range – figure 6-17). However, the overall foraging area available to the Cemlyn Bay common terns is extensive (with the tracking data suggesting that most foraging occurs to the north of offshore noise ZOI), whilst the additional energetic costs of having to circumvent the offshore noise ZOI would be less than for Sandwich terns. Furthermore, other studies of common tern response to noise disturbance in the offshore environment highlight that the assumed exclusion from the offshore ZOI is highly precautionary [RD84]. Therefore, population-level effects from disturbance in the offshore environment are considered to be highly unlikely.

10.3.317 Other potential effects from construction activities are considered unlikely and would give rise to, at most, minor effects (as detailed above). Given this, it is concluded that the intra-Project effects during construction would have no adverse effects on the integrity of the Morwenoliaid Ynys Môn/Anglesey Terns SPA common tern population.

Operation

10.3.318 During operation there is little potential for effects to the SPA common tern population from disturbance, whilst the permanent loss of foraging habitat extends over an area of approximately 0.01% of the modelled foraging range of the Cemlyn Bay common terns (and approximately 1.5% of the zone of 95% usage within this predicted range). The main potential effects during operation relate to potential reductions in prey availability. This could arise from discharges from the CWS (causing increases in sea temperature and TRO levels) and losses of potential prey as a result of impingement and entrainment.

10.3.319 Both the thermal ZOI and TRO ZOI held few records of common tern foraging attempts (less than 0.5% and 3% to 4% for the thermal ZOI and TRO ZOI, respectively). Effects on prey are limited to a likely reduction in availability within the thermal ZOI, whilst the effects of TRO on fish populations are considered to be negligible (although there may be detrimental effects to a small proportion of the ichthyoplankton within this ZOI).

10.3.320 Mortality of fish from impingement and entrainment will have greatest effects on the egg and larval life-stages. As r-selected species, fish reproductive rates are high, as are the levels of natural mortality, particularly amongst the egg and larval life-stages. Estimation of the losses of potential prey as a result of impingement and entrainment (calculated without accounting for the mitigation measures which would be put in place) suggests that these would represent a small proportion of the prey resource available to the SPA common tern population.

10.3.321 In relation to the Cemlyn Bay colony specifically, these losses represent approximately 46% of the prey biomass estimated to be consumed by the adult common terns at this colony, but less than 1% of the biomass consumed by the adults of all three species at this colony (which is likely to be a more relevant value, given the similarity in the main prey types of the different species, at least in terms of the items fed to chicks). Furthermore, the tracking studies demonstrate that most foraging occurs to the north of the colony, with few tracks following relatively inshore routes that pass close to the cooling water intake (suggesting little potential for effects in the event that effects on the fish populations are localised).

10.3.322 Considering these potential effects together suggests that depletion of the common tern prey resource as a result of their in-combination action is unlikely. Given this, it is concluded that the intra-Project effects during operation would have no adverse effects on the integrity of the Morwenoliaid Ynys Môn/Anglesey Terns SPA common tern population.

Common tern (Sterna hirundo) (in-combination)

10.3.323 Projects identified with the potential to contribute to in-combination effects on the Morwenoliaid Ynys Môn/Anglesey Terns SPA common tern population are as for Sandwich tern (table 10-2). As described in chapter 5, there is no potential for LSIE for this SPA with any of the plans scoped into the assessment.

10.3.324 The potential for in-combination effects is identified for the same combination of effects and projects as for Sandwich terns, with the same conclusions reached regarding in-combination effects (see table 10-12). In relation to the Rhyd-y-groes Re-power project and the potential for effects on visual and acoustic stimuli and physical interaction between species and project infrastructure, the conclusions of the Environmental Statement in relation to the SPA common tern population were as for Sandwich tern.

10.3.325 Therefore, no adverse effects from the Project in-combination with the other projects considered in table 10-12 are predicted in relation to the Morwenoliaid Ynys Môn/Anglesey Terns SPA common tern population.

Arctic tern (Sterna paradisaea) (alone)

10.3.326 The Morwenoliaid Ynys Môn/Anglesey Terns SPA population of breeding Arctic terns would be subject to the same potential effects from the Project as the SPA population of Sandwich terns. Also, as for the Sandwich tern population, the pathways by which these potential effects operate may

affect the first three conservation objectives for the SPA via direct effects on numbers, breeding success and distribution, or indirectly via effects on those conservation objectives concerned with the quality and extent of supporting habitats (either at the colony or in the marine environment) and access to food sources.

10.3.327 However, in contrast to the SPA Sandwich tern population, the Arctic tern population is distributed across all three colonies within the SPA, with the lowest numbers at the Cemlyn Bay colony (chapter 6). Thus, for Arctic tern, numbers at Cemlyn Bay represent approximately 1% of the SPA population, based upon the most recent five-year mean counts for each colony (table 6-6). In terms of numbers, the SPA Arctic tern population is dominated by the Skerries colony, with approximately 85% of the population (table 6-6).

10.3.328 The Arctic tern SPA population has increased since designation in 1992 (as Ynys Feurig, Cemlyn Bay and The Skerries). The estimate for the SPA at designation is 1,290 pairs ([RD236], [RD328]), whilst the most recent five-year mean population estimate is 4,206 pairs (based upon summing the most recent five-year mean estimates that are available for each of the three colonies, which span slightly different time periods - table 6-6). As for common tern, the bulk of the SPA population breeds at colonies which are beyond the distance at which potential effects of the Project from noise and visual disturbance could affect birds when attending the colony (but with the proportion of the population that potentially could be affected by these effects being considerably smaller than in the case of common tern). Also, any changes in surface and groundwater hydrology or in air pollution resulting from the Project are not considered to have the potential to affect the nesting habitats at either Ynys Feurig or the Skerries.

10.3.329 Associated with their wider nesting distribution within the SPA, the at-sea distribution of Arctic terns around the Anglesey coast is more westerly than that of Sandwich terns, with areas of highest densities tending to be further from the offshore ZOIs associated with the Wylfa Newydd Development Area (noting that due to the problems of distinguishing common and Arctic terns during boat surveys, these species were recorded together as ‘commic’ terns). This is demonstrated by the findings from both the ESAS boat-based surveys of Blocks 1 and 2 (figures 6-25 to 6-29 and figures 6-21 to 6-24) and the earlier JNCC boat-based surveys from 2009 (figures 3-4 and 3-6, appendix A of Application Reference Number: 6.4.89). These broad-scale survey data are supported by the findings from both the modelling of the usage of the marine environment by Arctic terns from the different colonies within the Morwenoliaid Ynys Môn/Anglesey Terns SPA (figures 6-12 to 6-14 and 6-18, [RD362]), and the RSPB/BTO Arctic tern GPS tracking data from the Skerries (figure 6-35). The modelling outputs predict that birds from Ynys Feurig make relatively little use of the waters around the offshore ZOIs associated with the Wylfa Newydd Development Area, whilst those from the Skerries and Cemlyn Bay show low to moderate and high relative usage, respectively (figures 6-12 to 6-14). The analyses of the GPS tracking data show that the offshore ZOIs are beyond the predicted

50% utilisation distribution of Arctic terns from the Skerries but within the predicted 95% utilisation distribution, also indicating a low to moderate likelihood of use by Skerries' birds (figure 6-35).

10.3.330 The above considerations suggest that in relation to Arctic terns the effects from the Project have less potential to affect the SPA conservation objectives concerned with maintaining numbers and breeding success than they do for Sandwich terns. However, the potential for effects from the Project to affect the SPA conservation objective concerned with not constraining or hindering the range and distribution of terns within the SPA is likely to be similar between the species, and (as for common tern) the Arctic tern population at Cemlyn Bay is small relative to the overall SPA population of this species (and therefore could be seen to be at greater risk of an effect locally).

A Changes in visual and acoustic stimuli

10.3.331 As for the Morwenoliaid Ynys Môn/Anglesey Terns SPA Sandwich tern population, visual and acoustic stimuli could affect the SPA Arctic tern population as a result of either disturbance to breeding birds when they are present at the Cemlyn Bay colony (during pre-laying, or in attendance of nests or chicks), or disturbance to SPA birds when they are commuting or foraging in the marine environment. Effects of disturbance could arise via the same means as for Sandwich terns.

Construction

A1 Disturbance at the breeding colony [Marine Licence]

10.3.332 In terms of considering the potential effects of anthropogenic disturbance on nesting terns, the wider context is set out above in the section on Sandwich terns and much of this context applies equally to Arctic terns.

10.3.333 The sources of visual and acoustic stimuli that could potentially affect Arctic terns breeding at the Cemlyn Bay colony as a result of the Project construction activities are as described for Sandwich terns above. This is also the case for the associated evidence base that is used to inform the assessment.

10.3.334 In relation to the monitoring of baseline disturbance levels and the associated tern responses, there were fewer responses to potential disturbance events from Arctic terns than from Sandwich terns (table 6-8). However, this difference was likely to be due solely to the greater abundance of Sandwich terns at the colony (meaning there was more chance of individuals of this species responding than of the other tern species) than to any real behavioural difference between the two species.

10.3.335 The assessment in relation to Arctic terns is concerned with the same effects as for Sandwich tern and relies upon the same evidence base. As outlined above, the potential for effects in the case of Arctic terns is concerned, essentially, with maintaining range and distribution within the

SPA. On the basis of the levels of disturbance predicted to occur and the evidence relating to the likely responses of breeding terns to such disturbance, the findings of the assessment on the potential effects to breeding Sandwich terns from noise and visual disturbance during construction are considered to apply equally to breeding Arctic terns at Cemlyn Bay. Therefore, it is concluded that disturbance at the Cemlyn Bay breeding colony from noise, vibration and visual stimuli alone and in-combination would have no adverse effects on the Morwenoliaid Ynys Môn/Anglesey Terns SPA with respect to Arctic terns.

A2 Disturbance in the marine environment [Marine Licence]

10.3.336 As for disturbance at the breeding colony, the basis for the assessment of disturbance to Arctic terns in the marine environment follows the approach used for Sandwich terns above.

10.3.337 Thus, it is considered that the offshore noise ZOI, as defined by the areas where the predicted noise levels from construction plant and machinery are in excess of 65 dB(A), is equally appropriate (and precautionary) for Arctic terns. As above, the noise predictions are based upon a precautionary scenario where all the plant is running (100% on time) and is located at the closest point to the ecological receptors in each working zone within the Wylfa Newydd Development Area. In relation to the application of the offshore noise ZOI to Arctic terns, broad-based and qualitative consideration of responses to anthropogenic disturbance in the offshore environment suggests that, like Sandwich tern and common tern, the species is relatively insensitive (with the three species assigned the same ranking ([RD117], [RD115]).

10.3.338 Similarly, it is considered that the offshore visual ZOI established for Sandwich terns is also appropriate for Arctic terns, given that both species are considered relatively insensitive to anthropogenic disturbance in the offshore environment, and that monitoring at five offshore wind farms in the North Sea provides no evidence of strong avoidance by this species to these sites (although at three of these sites data for Arctic and common terns are combined, so any difference in the responses between these two species may be masked) [RD81].

10.3.339 For the purposes of undertaking the assessment for Arctic tern, the highly precautionary assumption is made that birds would show complete avoidance of the offshore noise and visual ZOIs (as assumed for Sandwich tern and common tern above).

10.3.340 The avoidance of the offshore noise ZOI would mean that Arctic terns are displaced from foraging within this ZOI and also have to detour around it when flying to and from the Cemlyn Bay colony (bearing in mind that approximately only 1% of the SPA population breed at Cemlyn Bay). The relatively broad-scale ESAS transect data suggest that any such effects would be of limited importance to the SPA Arctic tern population, given that only two of the five breeding season surveys recorded birds in relatively close proximity to this ZOI and none recorded high densities close to the ZOI (figures 6-25 to 6-29).

10.3.341 To consider the potential consequences of the avoidance of the offshore noise ZOI in more detail, the information on modelled foraging ranges [RD362] and the data from the different tracking surveys were examined as for Sandwich tern and common tern above.

10.3.342 The predicted foraging ranges for Arctic terns from the three different colonies each extend over areas of approximately 2,500km^2, with the offshore noise ZOI representing approximately 0.10% of the total modelled range in each case (figures 6-12 to 6-14). However, as indicated above, there are marked differences in the extent to which Arctic terns from the different colonies are predicted to use the waters around the Wylfa Newydd Development Area. Thus, there was no overlap between the offshore noise ZOI and the zone predicted to account for 95% of usage by birds from both Ynys Feurig and the Skerries, although the zone of 95% usage by Skerries birds lies close to this ZOI. The offshore noise ZOI represents approximately 3% of the 95% usage zone for the Cemlyn Bay Arctic terns (figures 6-12 to 6-14). These comparisons suggest that, as with common tern, the offshore noise ZOI lies within the core foraging area for Arctic terns from Cemlyn Bay, but that a small proportion of foraging by the (much larger) Skerries Arctic tern population will occur within this ZOI. This conclusion is supported by the small number of the Arctic tern tracks which were associated with the Skerries, as well as by the findings from the GPS tracking of Arctic terns from the Skerries (figures 6-34 and 6-35).

10.3.343 In terms of the tracking data, sample sizes for Arctic terns were smaller than for either of the other two species (the sample of tracks is considerably smaller for Arctic tern than Sandwich tern, and represents 0.003 tracks per adult bird in the SPA population (and 0.3 tracks per adult bird at Cemlyn Bay) compared to 0.07 tracks per adult bird for Sandwich tern (as calculated using the most recent five-year mean population size estimates available in each case) with only the 2016 Horizon surveys comprising more than 10 individual tracks (table 10-17). Overall, approximately 2% of all recorded foraging attempts occurred within the offshore noise ZOI, whilst 50 – 60% of all tracked birds passed through this ZOI, depending on whether estimates are based on the complete tracks only or on all tracks (figure 10-19, table 10-17) (due to the small sample of tracks available for Arctic terns, the percentages of foraging locations and of tracks are expressed in relation to the total sample (from across all surveys), as opposed to calculating values separately for each survey and taking the mean of these).

Table 10-17The percentage of Arctic tern foraging locations and tracks occurring within the offshore noise ZOI (sample sizes (n) upon which the percentage estimates are based are given)

Survey	Foraging locations (%)		Tracks (%)	
	Complete tracks[1]	All tracks	Complete tracks[1]	All tracks
2016 Jacobs	0.00% (n=176)	1.57% (n=255)	44.44% (n=9)	41.18% (n=17)
2017 Jacobs	4.76% (n=42)	4.65% (n=43)	100% (n=3)	75.00% (n=4)
2009 JNCC	100% (n=2)	1.39% (n=144)	100% (n=1)	100% (n=2)
2009 ECON	- (n=0)	- (n=0)	- (n=0)	0.00% (n=1)

[1] Complete tracks are those where birds were followed from and back to the colony

10.3.344 As for Sandwich terns and common terns, the implications for flight distance resulting from commuting birds avoiding the offshore noise ZOI were investigated using the Horizon survey data from 2016 and 2017. Amongst the small number of Arctic tern tracks, there appeared to be a similar tendency to that of common terns for the flights out of (or into) Cemlyn Bay to be orientated along an approximate north-south axis (figure 10-19). Thus, several of the tracks passing through the offshore noise ZOI crossed a relatively small distance on the western edge of this ZOI. Consequently, the additional flight distance incurred by detouring around the perimeter of the offshore noise ZOI would be small in most cases. To give an indication of this, the total flight distance around the perimeter of the offshore noise ZOI for flights that actually transited it represents approximately 8% of the total flight length of all tracks from the Jacobs surveys (as calculated from their points of entry and exit to and from this ZOI). Therefore, the additional distance incurred by any deviation in flight routes around the offshore noise ZOI would be trivial relative to the overall distances involved in the commuting flights of Arctic terns from the Cemlyn Bay colony, and represents a fraction of the 3%-4% increase in flight length as calculated for Sandwich tern.

10.3.345 The offshore visual ZOI is encompassed by the offshore noise ZOI, so that potential effects predicted to result from the visual disturbance associated with the construction works in Porth-y-pistyll and at the cooling water outfall would be less than those predicted by the assumed exclusion of foraging and commuting Arctic terns from the offshore noise ZOI. They are also fully incorporated within the effects predicted by the exclusion of foraging and commuting birds from the offshore noise ZOI. Only one of the 442 recorded Arctic tern foraging attempts occurred within the offshore visual ZOI, whilst less than 25% of the recorded tracks passed through it (table 10-18).

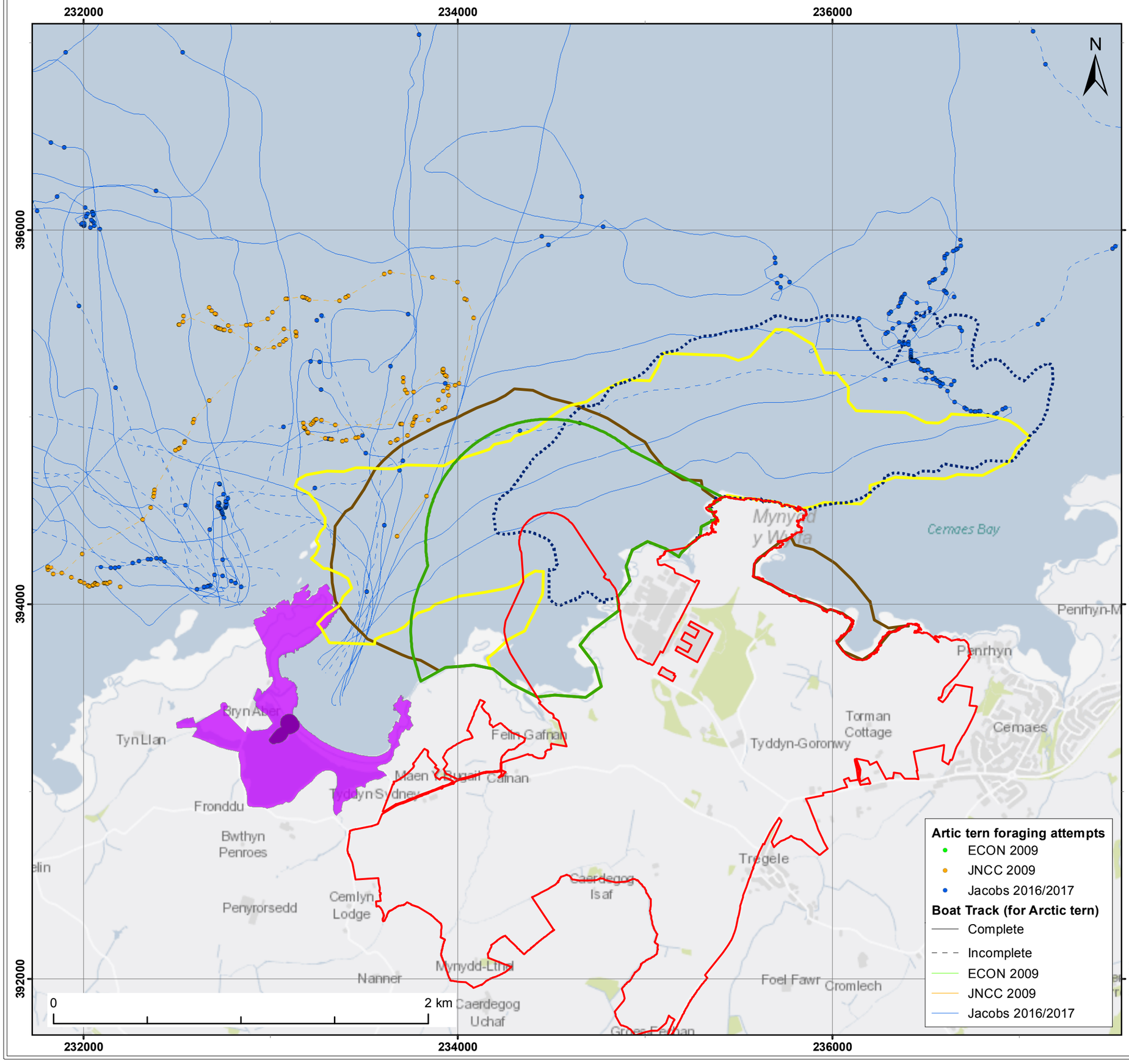
Table 10-18The percentage of Arctic tern foraging locations and tracks occurring within the offshore visual ZOI (sample sizes (n) upon which the percentage estimates are based are given)

Survey	Foraging locations (%)		Tracks (%)	
	Complete tracks[1]	All tracks	Complete tracks[1]	All tracks
2016 Jacobs	0.00% (n=176)	0.39% (n=255)	33.33% (n=9)	23.53% (n=17)
2017 Jacobs	0.00% (n=42)	0.00% (n=43)	0.00% (n=3)	0.00% (n=4)
2009 JNCC	0.00% (n=2)	0.00% (n=144)	0.00% (n=1)	0.00% (n=2)
2009 ECON	- (n=0)	- (n=0)	- (n=0)	0.00% (n=1)

[1] Complete tracks are those where birds were followed from, and back to, the colony

10.3.346 Details of the increase in vessel traffic that is predicted during construction is given above in relation to the potential effects on Sandwich terns. Given the relatively low sensitivity of Arctic terns to vessel traffic ([RD117], [RD115]) this source of visual disturbance is not considered likely to result in more than minor effects on foraging or commuting birds. Similarly light spillage during construction of the marine works will not affect areas that are heavily used by foraging Arctic terns, whilst the species shows little nocturnal flight activity anyhow (figure 10-6, [RD117]).

10.3.347 The assessment for the effects of underwater noise on Arctic tern resulting from the construction activities is as for Sandwich tern, with the potential effects being encompassed within both the offshore noise and offshore visual ZOIs. Therefore, the main indirect effects from underwater noise which may arise via impacts on prey species will affect an area within which considerably less than 1% of the foraging attempts recorded for Arctic tern during the tracking surveys occurred (table 10-17). However, this is a considerable overestimate of the importance of this area to the SPA Arctic tern population, and relates largely (but not exclusively) to the small population at Cemlyn Bay, because the surveys focussed on sampling birds that were likely to derive from the Cemlyn Bay colony, and this colony holds approximately 1% of the SPA population only.



Legend

- WNDA
- Disposal Site
- Temperature ZOI (sea surface autumn base case)
- TRO ZOI (surface summer base case)
- Noise ZOI (65db)
- 500m visual ZOI
- Cemlyn Bay SSSI/SAC
- Tern colony

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Client: HORIZON NUCLEAR POWER

Project: Wylfa Newydd Project

Title: Arctic tern tracking results from within the vicinity of the offshore ZOIs for the Jacobs (2016), JNCC (2009) and ECON (2009) surveys

Figure: 10-19

Revision:	Date:	Drawn:	Checked:	Size:	Scale:
3	17/01/2018	TC	MG	A3	1:20,000
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Co-ordinate system: British National Grid

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10.3.348 Based on the above considerations, the effects from construction-related noise and visual disturbance in the marine environment will not result in adverse effects on the Morwenoliaid Ynys Môn/Anglesey Terns SPA Arctic tern population. A relatively small percentage (approximately 2%) of foraging attempts was recorded within the offshore noise ZOI (which also encompasses predicted effects from underwater noise and visual disturbance), whilst the additional flight distances that would be incurred by an avoidance of this ZOI are small. Although these conclusions derive from a small sample of tracked birds, they are in keeping with the overall trend for most activity and foraging to occur to the north of the offshore noise ZOI (figures 6-34 and 10-19).

10.3.349 Furthermore, these potential effects are associated largely (but not exclusively) with the small part of the SPA population that breeds at the Cemlyn Bay colony. At the same time, the area of sea encompassed by the offshore noise ZOI is not of such importance to the Cemlyn Bay Arctic terns that an avoidance of this ZOI is likely to have any substantive detrimental effects on these birds. The offshore noise ZOI accounts for just 3% of the area of greatest predicted use by the Cemlyn Bay Arctic terns (as defined by the 95% usage zone), whilst the foraging area available to the Cemlyn Bay population is extensive. Also, as stated above, the majority of Arctic tern foraging records occurred to the north of the offshore noise ZOI.

Operation

A3 Noise and visual disturbance during operation [Operational combustion activity EP]

10.3.350 Modelling of airborne noise for the operational phase demonstrates that even noise levels of 35dB (the lowest levels shown in the modelled outputs) do not extend as far as the Cemlyn Bay breeding colony, whilst levels above 35 dB(A) do not extend into the offshore environment (figure 6-12 in Application Referece Number: 6.4.6).

10.3.351 In terms of visual stimuli, potential effects are essentially limited to the vessel movements associated with the Project and spillage from artificial lighting. Vessel movements are predicted to be very infrequent (one per month) and so will not represent any discernible change to existing background levels.

10.3.352 During operation of the MOLF, a 0.1 Lux contour extends no more than 125m across the water. This is predominantly from the MOLF cranes and would only occur at three specific locations. Typically the 0.1 Lux extends no more than 100m across the water when the cranes are not in use (figure 10-11).

10.3.353 No effects due to changes in visual and acoustic stimuli are predicted on the SPA Arctic tern population during the operational phase of the Project.

B Land-take, including seabed or intertidal land

Construction

B1 Change and/or loss of habitat [Marine Licence]

10.3.354 Potential effects on the SPA Arctic tern population during the construction period could arise from land take within the Porth-y-pistyll area and as a result of the deposit of dredged material at the Disposal Site. These could have indirect effects on foraging terns via impacts on fish prey populations.

10.3.355 As described in the section on Sandwich terns, construction activities within Porth-y-pistyll would involve the construction of the MOLF, cofferdams and the breakwater. This would cause a loss of seabed habitat within an area of only 0.35km^2, which represents an insignificant proportion of the foraging area available to Arctic terns, even when considering those from the Cemlyn Bay colony only. The tern tracking surveys demonstrate the limited extent to which this area is used for foraging with none of the total 442 foraging attempts recorded within the area (figure 10-19).

10.3.356 For the disposal of dredged material, the modelling of all sediment fractions (coarse sand, medium sand, fine sand and fines fractions) for the whole period of disposal (disposal of up to 242,000m^3 over 35 days) predicts that in the upper 10% of the water column (where the highest concentrations occur), the suspended sediment concentration increase above typical background concentration would occur in a zone of approximately 1km around the disposal location. Suspended sediment concentrations fall below the typical background concentration within 48 hours and, therefore, the effect on water quality associated with disposal would be of a short duration following the completion of disposal. The modelling predicts that the sediment plume disperses to background suspended sediment concentrations after approximately 3 hours.

10.3.357 The Disposal Site is approximately 10km, 20km and 25km from the Skerries, Cemlyn Bay and Ynys Feurig colonies, respectively. As such, only the Skerries colony is well within the mean maximum foraging range of 24.2km for Arctic tern [RD330]. Habitat-association models predict that Arctic terns from each of these three colonies make little, if any, use of the waters around the Disposal Site (but with birds from the Skerries being the most likely to use this area) (figures 6-12 to 6-14, [RD362]). However, analyses of the RSPB/BTO Arctic tern GPS tracking data from the Skerries demonstrate that the northern edge of the Disposal Site lies within the predicted 50% utilisation distribution of these birds (figure 6-35), and ESAS surveys have recorded Arctic terns in the vicinity of the Disposal Site (figure 6-36). Overall, the area that is predicted to be affected by disposal is small relative to the area available to foraging Arctic terns from the Skerries and lies outside their main foraging areas, and in an area with moderate levels of use. Furthermore, as detailed in the section on Sandwich tern, the effects of increased suspended sediment concentrations at the Disposal Site are predicted to be relatively short-term.

10.3.358 Hence, land-take during construction is not predicted to have an adverse effect on the integrity of the Morwenoliaid Ynys Môn/Anglesey Terns SPA Arctic tern population.

Operation

B2 Change and/or loss of habitat [Marine Licence]

10.3.359 The marine structures would be retained during the operational phase and would essentially represent a permanent loss of seabed habitat. However, as detailed above, the extent of this habitat loss is insignificant relative to the foraging area available to Arctic terns from the SPA colonies.

10.3.360 As such, land-take is not predicted to have impacts on the SPA Arctic tern population during the operational phase.

C Changes in marine water quality [Marine Licence; Construction water discharge EP]

10.3.361 Changes in marine water quality potentially could affect the availability of the fish prey of Arctic terns leading to impacts on the SPA population. As for Sandwich terns, such effects could arise during construction as a result of suspended sediment input to the marine environment from fluvial sources and increases in suspended sediment concentration and contaminant re-mobilisation during dredging and disposal, or during operation via discharge from the cooling water system.

Construction

10.3.362 As outlined above for Sandwich tern, the input of suspended sediment to the marine environment from fluvial sources, dewatering and sewage and increases in suspended sediment concentration and contaminant re-mobilisation during dredging and disposal are predicted to occur on small spatial scales relative to the areas used by, and available to, foraging terns. The maximum spatial effect is predicted to be during capital dredging, where a maximum area of approximately 25ha is predicted to experience an increase in suspended sediment concentration of greater than 6.1mg/L (equal to the low end of observed ambient concentrations). The suspended sediment concentration increase above typical background concentration during disposal of dredged material would occur in a zone of approximately 1km around the disposal location.

10.3.363 The areas over which these effects would extend do not coincide with areas of importance to foraging Arctic terns, whilst they would also be temporary and of relatively short duration (over 35 days). Therefore, changes in water quality as a result of construction activities are not predicted to lead to adverse effects on the SPA Arctic tern population.

Operation

10.3.364 Discharge from the cooling water system during operation would have thermal effects on the adjacent marine area, whilst there may also be effects of TRO from the residual biocide (used for the treatment of biofouling on the

submerged structures, especially the cooling water system). These effects have the potential to lead to impacts on the SPA Arctic tern population via indirect effects on their fish prey.

10.3.365 Details of the potential for thermal effects and for effects from TRO on the fish prey species of Sandwich tern, along with the basis for defining ZOIs for both of these potential effects have been outlined above for Sandwich terns. During the breeding season, Arctic terns tend to depend on a similar range of prey types to those of Sandwich terns, with sandeels and clupeids being important. A particularly consistent finding is that of a high proportion of sandeels in the diet of Arctic tern chicks at colonies in Britain and Ireland [RD85]. Long term monitoring of the prey items fed to Arctic tern chicks at the Skerries (from 1989 to 2017) and Ynyns Feurig (from 1992 to 2016) shows that the relative importance of these two prey groups varies annually but, on average, the chick diet at the Skerries was composed of 74% sandeels and 20% clupeids, whilst at Yns Feurig it was composed of 69% sandeels and 20% clupeids [RD285]. These broad similarities in diet between Arctic terns and Sandwich terns within the SPA suggest that it is reasonable to apply the same thermal and TRO ZOIs to Arctic terns as used for Sandwich terns (figure 10-7).

10.3.366 A number of studies have investigated foraging range, behaviour and prey taken by different tern species nesting

10.3.367 In terms of the extent of overlap with the predicted foraging ranges of Arctic terns from the different colonies within the SPA, the thermal ZOI and TRO ZOI represent approximately 0.12% and 0.15%, respectively, of the total modelled range for each colony (figures 6-12 to 6-14, [RD362]). However, neither of these ZOIs overlapped with the zones predicted to account for 95% of the usage by birds from either Ynys Feurig or the Skerries (although the zone of 95% usage by Skerries birds lies close to both ZOIs). The thermal ZOI and TRO ZOI account for approximately 3% and 4%, respectively, of the 95% usage zone for the Cemlyn Bay Arctic terns (figures 6-12 to 6-14).

10.3.368 Data from the different tracking studies estimate that approximately 13–26% of Arctic tern foraging attempts occur within the thermal ZOI, depending on whether estimates are based on complete tracks only or on all tracks (and as calculated by combining the data from the different surveys) (table 10-19, figure 10-19). These estimates would appear to suggest that this ZOI may be of particular importance to foraging Arctic terns. However, closer inspection of the data show that the foraging records within the thermal ZOI are largely attributable to a single track (from the four Arctic tern tracks recorded in this ZOI, out of a total sample of 24). This single track accounted for 54 of the total 59 foraging records in the thermal ZOI, with all of these 54 records concentrated at the eastern edge of the ZOI (figure 10-19, table 10-19). Therefore, little confidence can be placed on this estimate of foraging use by Arctic terns, given that it derives largely from a single bout of unusually concentrated feeding activity.

Table 10-19The percentage of Arctic tern foraging locations and tracks occurring within the thermal ZOI (sample sizes (n) upon which the percentage estimates are based are given)

Survey	Foraging locations (%)		Tracks (%)	
	Complete tracks[1]	All tracks	Complete tracks[1]	All tracks
2016 Jacobs	31.82% (n=176)	22.75% (n=255)	22.22% (n=9)	17.65% (n=17)
2017 Jacobs	2.38% (n=42)	2.32% (n=43)	33.33% (n=3)	25.00% (n=4)
2009 JNCC	0.00% (n=2)	0.00% (n=144)	0.00% (n=1)	0.00% (n=2)
2009 ECON	- (n=0)	- (n=0)	- (n=0)	0.00% (n=1)

[1] Complete tracks are those where birds were followed from, and back to, the colony

10.3.369 The high percentage of foraging attempts recorded within the thermal ZOI may not be representative. The overall trend in the tracking data is for most Arctic tern activity and foraging to occur to the northwest of this ZOI (figure 6-34). This, together with the fact that the thermal ZOI accounts for just 3% of the area of greatest predicted use by the Cemlyn Bay Arctic terns (as defined by the 95% usage zone – figure 6-14), suggests there is little basis for considering the thermal effects from the cooling water discharge to be of any more importance to the SPA Arctic tern population than to either the Sandwich tern or common tern populations.

10.3.370 This is particularly so, given that the potential for detrimental effects within this ZOI arises from a reduction in foraging efficiency (as opposed to an entire loss of the ZOI as potential foraging habitat). However, it is possible that such reductions in foraging efficiency could have greater effects on Arctic terns than on the other two tern species as a result of differences in foraging behaviour and prey selection. Arctic terns (as the smallest of the three species) generally take smaller prey, which may include higher proportions of fish larvae and juvenile fish that can be available closer to the surface [RD279]. A dependence on prey near to the surface could lead to greater impacts from the thermal discharge because fish may select feeding areas deeper within the water column where temperature increases are less marked (so leading to a reduction in prey availability).

10.3.371 Although some studies have reported very small prey being taken by Arctic terns (e.g. median prey lengths of 1.6cm [RD279]), such findings are not ubiquitous, and other studies report larger average prey sizes and show considerable overlap with the prey sizes taken by common terns and, sometimes, Sandwich terns [RD32; RD216]. Data and information on the foraging behaviour and diet of the tern species within the Morwenoliaid Ynys Môn/Anglesey Terns SPA are limited, but suggest broad overlap between the different species in some aspects. Most notably, sandeels and clupeids comprise the key foods for the chicks of both Arctic tern and Sandwich tern ([RD256], [RD285]), whilst Arctic terns and common terns show a tendency

for activity and foraging to be concentrated towards the north of Cemlyn Bay (as determined from the tracking data – figure 6-33 and 6-34).

10.3.372 Approximately 2% of Arctic tern foraging attempts were recorded within the TRO ZOI, again as calculated by combining the data from the different tracking surveys (table 10-20, figure 10-19). As for the other offshore ZOIs, the estimated use of the TRO ZOI by Arctic terns is associated largely with the Cemlyn Bay colony and not with the overall SPA population.

Table 10-20The percentage of Arctic tern foraging locations and tracks occurring within the TRO ZOI (sample sizes (n) upon which the percentage estimates are based are given)

Survey	Foraging locations (%)		Tracks (%)	
	Complete tracks[1]	All tracks	Complete tracks[1]	All tracks
2016 Jacobs	0.00% (n=176)	1.18% (n=255)	44.44% (n=9)	47.06% (n=17)
2017 Jacobs	4.76% (n=42)	6.98% (n=43)	66.67% (n=3)	75.00% (n=4)
2009 JNCC	100% (n=2)	1.39% (n=144)	100% (n=1)	100% (n=2)
2009 ECON	- (n=0)	- (n=0)	- (n=0)	0.00% (n=1)

[1] Complete tracks are those where birds were followed from, and back to, the colony

10.3.373 In relation to Arctic tern, additional consideration is given to the potential for TRO to affect fish larvae in surface waters, given that Arctic terns have been shown to preferentially select small fish (including fish larvae) which may be abundant close to the water surface [RD279], although such findings are not ubiquitous.

10.3.374 Acute toxic effects (mortality) of TRO primarily would be experienced by organisms entrained through the cooling water system (see above). Once discharged, TRO still has the potential to affect ecological receptors, although the extent and scale of effects are less easy to predict than for entrainment, and would likely be sub-lethal. An exception to this is the potential for mortality for some species of ichthyoplankton (fish larvae). Specifically larvae of herring and Dover sole may be vulnerable to mortality from predicted residual TRO concentrations predicted in the surface layer of water within a distance of about 900m from the outfall (Application Reference Number: 6.4.13). This differs from the TRO ZOI and, apart from surface waters, the majority of the water column in this zone would have much lower TRO concentrations, decreasing to zero at the sea bed. Therefore, effects on herring and Dover sole fish larvae would be predicted only at the surface.

10.3.375 As described above, the available studies of tern foraging behaviour and diet indicate that Arctic terns tend to take smaller prey than common and Sandwich terns. These studies suggest that a high proportion of items fed to Arctic tern chicks can be in size classes 0-4cm (which would include larval fish) and 4-8cm ([RD279], [RD256]; [RD216]. However, there is considerable

variability in prey sizes taken and often considerable overlap between the three tern species in this respect [RD32]. The diet of adult terns tends to be more varied than the prey fed to chicks [RD32], and common and Sandwich as well as Arctic terns are likely to feed opportunistically on smaller prey items such as fish larvae and invertebrates.

10.3.376 Although two species of the ichthyoplankton community in the vicinity of the cooling water outfall (i.e. in surface waters within 900m) may suffer mortality, the predicted effects of TRO on fish populations are negligible (Application Reference Number: 6.4.13). As detailed above, fish larvae may comprise a greater proportion of the diet of Arctic tern than of either common or Sandwich tern, but Arctic tern will also take much larger prey items, and are not limited to small prey. Furthermore, the potential foraging range of Arctic terns at Cemlyn Bay is much larger than the distance over which TRO effects on fish larvae may occur (figures 6-14 and 6.34).

10.3.377 Based on the above considerations, changes in marine water quality as a result of discharge from the cooling water system during operation are not predicted to result in adverse effects on the integrity of the Morwenoliaid Ynys Môn/Anglesey Terns SPA Arctic tern population. The estimated use of the thermal and TRO ZOIs by Arctic terns is associated largely with the Cemlyn Bay colony as opposed to the overall SPA population, although a small proportion of the foraging by the much larger Skerries population is also likely to occur within these ZOIs (figure 6-13). As such, findings from the tracking surveys will overestimate the extent to which these ZOIs are used by foraging Arctic terns from the SPA population. Considering the potential for impacts to the Arctic terns at Cemlyn Bay (and, hence, the consequences in terms of maintaining range and distribution), data from the small sample of tracked birds suggest that most foraging activity by Arctic terns occurs to the north-west of these ZOIs. There were few foraging attempts recorded in the TRO ZOI, and although a high percentage of foraging attempts occurred within the thermal ZOI, this was attributable to an unusually high concentration of foraging attempts from a single track (figure 10-19).

10.3.378 Potential effects within the thermal ZOI are limited to a reduction in the prey resource only, whilst the effects of TRO on fish populations are considered to be negligible. Although Arctic terns may show a greater tendency than the other two tern species to rely on prey that are close to the surface (which may become unavailable within the thermal ZOI) and to rely on ichthyoplankton as prey (some of which can suffer direct mortality from the effects of TRO), such effects are unlikely to be important. This is because Arctic terns are able to exploit a wide range of prey sizes and types, and within the SPA population, sandeels and clupeids comprise the key foods for chicks. Furthermore, an extensive foraging area is available to the Cemlyn Bay Arctic terns, within which the thermal and TRO ZOIs form a very small proportion (figure 6-14).

D Changes in surface and groundwater hydrology [Construction water discharge EP]

10.3.379 Effects from changes in surface and groundwater hydrology were screened into the assessment for the Morwenoliaid Ynys Môn/Anglesey Terns SPA on the basis of the potential for effects on the nesting habitat at the Cemlyn Bay lagoon on which approximately 1% proportion of the SPA Arctic tern population are dependent.

10.3.380 The potential effects of changes in surface and groundwater hydrology during both the construction and operation periods on the habitats at the Cemlyn Bay lagoon have been considered in chapter 7, with the conclusion being drawn that no adverse effects on these habitats would arise. Given the nature of the changes predicted, there is no potential for an adverse effect on the SPA Arctic tern population.

E Changes in air quality [Marine Licence; Operational combustion activity EP]

10.3.381 Effects from changes in air quality were screened into the assessment for the Morwenoliaid Ynys Môn/Anglesey Terns SPA on the basis of the potential for effects on the nesting habitat at the Cemlyn Bay lagoon on which approximately 1% of the SPA Arctic tern population are dependent.

10.3.382 The potential effects of changes in air quality during both the construction and operation periods on the habitats at the Cemlyn Bay lagoon have been considered in chapter 7, with the conclusion that no adverse effects on these habitats would arise. However, terns are not dependant on this qualifying feature; changes in air quality and potential effects on vegetation are considered for terns in the context of vegetation on the islands used by breeding terns. Changes in air quality are not predicted to affect the vegetation on which Arctic terns are dependent for the provision of nesting habitat on the islands. As such, changes in air quality are not predicted to affect either the use of the islands by terns or their breeding success, and it follows that changes in air quality would not result in adverse effects on the SPA Arctic tern population.

F Alteration of coastal processes and hydrodynamics [Marine Licence]

Construction and operation

10.3.383 Any changes as a result of coastal processes and hydrodynamics (e.g. scour, smothering, changes to currents and waves) have the potential to cause indirect impacts on the SPA Arctic tern population via effects on prey species.

10.3.384 Any coastal squeeze could only occur at locations where new structures are constructed and therefore is limited to the marine area of the Wylfa Newydd Development Area as a maximum. As described above in relation to land-take, this area represents an insignificant proportion of the foraging area available to Arctic terns from the Cemlyn Bay colony (and

more so for the whole SPA population), whilst none of the total 442 Arctic tern foraging attempts recorded were within this area (figure 10-19).

10.3.385 The maximum predicted effect area for deposition of sediment on the seabed is shown in figure 7-9. The coastal process assessment (Application Reference Number: 6.4.12) concludes that there is no potential for an alteration in intertidal or subtidal habitats across this area and, consequently, no significant effect on the prey species for Arctic terns, so that no adverse effects on the SPA population are predicted.

G Physical interaction between species and Project infrastructure

Construction

10.3.386 No pathways were identified for construction-related effects on the SPA Arctic tern population from physical interaction between species and Project infrastructure. Therefore, no effects on the SPA Arctic tern population are predicted from physical interactions between species and Project infrastructure during the construction period.

Operation

G1 Entrapment of prey [Operational water discharge EP]

10.3.387 As outlined above in the Sandwich tern section, fish (and invertebrate) populations which are prey for terns would suffer mortality from impingement and entrainment within the cooling water intake. Such mortality potentially could have population-level consequences and, therefore, could lead to indirect effects on the SPA Arctic tern population.

10.3.388 As for Sandwich tern, clupeids and sandeels are key prey groups for Arctic tern during the breeding season [RD85], and the levels of mortality predicted to affect these prey groups as a result of impingement and entrainment are detailed in the Sandwich tern section above. Context to the potential scale of the losses of available prey from impingement and entrainment to the SPA Sandwich tern population was provided by considering the dietary equivalence for Sandwich terns, using a bioenergetics approach. This approach was also applied in relation to the SPA Arctic tern population, but with different assumptions in relation to the proportions of prey items in the diet. As detailed above, long-term monitoring of the prey items brought to chicks at Ynys Feurig and the Skerries demonstrates the key importance of these two groups [RD285]. Compared with Sandwich and common terns, Arctic terns (as the smallest of the three species) tend to take smaller prey, but there is considerable overlap in the size of prey items taken by all three species (with typical and maximum weights of fish fed to chicks being 2 and 12g for Arctic terns, 2.5 and 16g for common tern, and 6 and 30g for Sandwich tern [RD32].

10.3.389 For Arctic tern, clupeids were assumed to comprise 9% and 11% of the chick and adult diets, respectively, with sandeels assumed to comprise 86% and 85% of the chick and adult diets, respectively (which differs slightly from

the average of 69%-74% for sandeels and 20% for clupeids as estimated by the dietary studies at Ynsy Feurig and the Skerries). With each Arctic tern adult assumed to be present on the breeding grounds for 122 days and each chick for 40 days, and with daily energy requirements assumed to be 347kJ d^{-1} for adults and 302kJ d^{-1} for chicks, the per capita energy requirements of adults and chicks over the breeding season were estimated as 42,334kJ and 12,701kJ, respectively. This was estimated to equate to the consumption of:

- 15,304 (or 9,474g of) sandeels and 811 (or 1,186g of) clupeids by each adult bird during the breeding season.
- 4,645 (or 2,876g of) sandeels and 199 (or 291g of) clupeids by each chick during the breeding season.

10.3.390 Predictions on the impingement rates suggest that a total of 1.9kg of sandeel and clupeids will be impinged during the breeding season, as estimated without accounting for any of the mitigation measures that would be incorporated. This represents approximately 20% of the biomass of sandeels and clupeids estimated to be consumed by an adult Arctic tern during the breeding season. With reference to the SPA population size at designation, the impingement rates represent 0.007% of the sandeel and clupeid biomass consumed during the breeding season by a population of 1,290 pairs ([RD328], [RD236]), whilst they represent 0.002% of that consumed by the current SPA Arctic tern population (based on the most recent five-year mean population size of 4,206 breeding pairs – see table 6-6).

10.3.391 Based on the values of the predicted entrainment rates as converted to EAVs, the number of sandeels and clupeids entrained during the breeding season is equivalent to the numbers consumed by approximately 55 adult Arctic terns (Application Reference Numbe: 6.4.13). This represents approximately 2% of the sandeel and clupeid biomass consumed during the breeding season by the adult Arctic terns in the SPA population at designation (1,290 pairs, as above), and approximately 1% of the biomass consumed during the breeding season on the basis of the most recent five-year mean SPA population estimate (i.e. 4,206 breeding pairs). Considering the Cemlyn Bay colony in isolation, the estimated losses to entrainment would represent 183% of biomass consumed by the adult population at the time of designation (i.e. 15 breeding pairs) and 67% of the biomass consumed by the current adult population (i.e. 41 breeding pairs).

10.3.392 As in the analogous calculations for Sandwich terns above, the combined estimates for impingement and entrainment (without accounting for proposed mitigation measures) are equivalent in each case to those calculated for entrainment alone (to the nearest 1%). This is because the predicted biomass of fish prey subject to entrainment (converted to EAV) is greater than for impingement by two to three orders of magnitude. In years of moderate to high breeding success, estimated impingement and entrainment of fish prey would represent a substantially smaller percentage than 1% of the current Arctic tern SPA population size (or 67% of the current Cemlyn Bay population size) due to the additional consumption by the chicks. Furthermore, given that clupeids and sandeels are likely to form the

bulk of the diet of all three tern species currently breeding in the Morwenoliaid Ynys Môn/Anglesey Terns SPA, then the predicted number of sandeels and clupeids entrained during the breeding season would represent a substantially smaller percentage (less than 0.5%) of the biomass consumed by the adult birds from the three SPA tern populations combined. When considering the Cemlyn Bay colony alone, the estimated losses to impingement and entrainment would represent less than 1% of the biomass consumed by all three tern populations at this colony.

10.3.393 The dietary equivalence values estimated above provide a means by which the scale of the potential losses from impingement and entrainment can be assessed relative to the quantities consumed by the SPA Arctic tern population. However, they cannot be interpreted as a direct loss of the prey that would be available to the SPA population because it cannot be assumed that all of the potential prey items lost to impingement and entrainment would otherwise become available as prey. This is clearly demonstrated by considering the dietary equivalence values in the context of the total number of adult terns from all three SPA populations combined.

10.3.394 The effect of these potential losses to the prey resource of Arctic terns also needs to be considered in relation to the conservation objectives of the SPA. In relation to the objective that the population size should be stable or increasing (relative to the population size at designation), the Arctic tern SPA population size has increased substantially since designation and the current prey resource supports a population that is approximately three times that at designation. Therefore, the scale of reduction in the prey resource which would be required to cause the population to decline to below the size at designation is many times greater than that predicted on the basis of the dietary equivalence calculations (even when it is assumed that all prey items lost to impingement and entrainment would otherwise be available as prey).

10.3.395 For the conservation objective concerned with the maintenance of range and distribution, consideration needs to be given to the Cemlyn Bay colony and whether there is a disproportionate risk of potential impacts to the Arctic terns at this colony. Such a scenario is highly unlikely because fish are highly mobile species and any effects are likely to manifest across a much wider area than the immediate vicinity of the cooling water intake. However, if effects on fish populations were localised, effects on the Arctic tern population at Cemlyn Bay remain unlikely. This is because the tracking surveys demonstrate that most foraging by the Cemlyn Bay Arctic terns occurs to the north of the colony, with few tracks following relatively inshore routes east that pass close to the cooling water intake (figure 6-34). Therefore, the waters in the vicinity of the cooling water intake do not appear to be particularly important as a foraging area for Arctic tern.

10.3.396 As for Sandwich tern, it is also worth noting that the increase in the Arctic tern SPA population size has coincided with the period when entrainment of fish was occurring from the water intake cooling system of the Existing Power Station, which operated from 1971 to 2015. Over this same period, the numbers of breeding pairs of Arctic terns at Cemlyn Bay has declined overall (from an estimated 100 pairs in 1972), although there have

been large fluctuations in numbers over this period (Application Reference Number: 6.4.89 [RD164]).

10.3.397 Finally, the dietary equivalence calculations treat the predicted impingement and entrainment estimates as representing 100% mortality, whereas only a proportion of the potential prey that are impinged or entrained would die as a result of this process

10.3.398 On the basis of the above dietary equivalence calculations and the associated considerations, it is concluded that the entrapment of prey in the cooling water intake would not have adverse effects on the SPA Arctic tern population.

H Potential for intra-Project effects

10.3.399 Effects from the Project may not operate in isolation but instead may combine to cause adverse effects on the Morwenoliaid Ynys Môn/Anglesey Terns SPA Arctic tern population. The potential for this is considered below.

10.3.400 Arctic terns are distributed across all three colonies within the SPA, with only 1% of the SPA population estimated to currently breed at the Cemlyn Bay colony (chapter 6). Effects from the Project are most likely to affect Arctic terns from the Cemlyn Bay colony (with considerably less potential for effects on the other colonies). As such, the potential for effects in the case of Arctic terns is concerned more with the conservation objective to maintain range and distribution within the SPA, than with the conservation objectives related to maintaining numbers and breeding success.

Construction

10.3.401 As for Sandwich tern, a range of pathways exist for potential effects to Arctic terns during construction (as outlined above). In relation to disturbance, it is concluded above that the combined effects from noise, vibration and visual disturbance at the colony will have no adverse effects on the SPA population, whilst the main potential effects from visual disturbance within the offshore environment are essentially incorporated within the assessment for noise disturbance (because the offshore visual ZOI is encompassed within the offshore noise ZOI).

10.3.402 With the proposed mitigation in place, it is considered that any effect of noise and visual disturbance at the Cemlyn Bay colony will be minimal, with little likelihood of any detectable effects on breeding success. Similarly, population-level effects resulting from the predicted disturbance in the offshore environment are highly unlikely (whether considering the SPA population overall, or the Cemlyn Bay colony specifically). The potential loss of foraging habitat to Arctic terns is small, with only 2% (from an albeit small sample of tracked birds) of foraging attempts located within the offshore noise ZOI, and with this ZOI accounting for approximately 3% of the area with greatest predicted use by the Cemlyn Bay Arctic terns (as defined by the zone of 95% usage within the modelled range – figure 6-14). Furthermore, the broad trend in the tracking data is for most foraging to occur to the north of the offshore ZOI, whilst the additional energetic costs of

having to circumvent the offshore noise ZOI would be less than for Sandwich terns.

10.3.403 Other potential effects from construction activities are considered unlikely and would give rise to, at most, minor effects (as detailed above). Given this, it is concluded that the intra-Project effects during construction would not have adverse effects on the integrity of the Morwenoliaid Ynys Môn/Anglesey Terns SPA Arctic tern population.

Operation

10.3.404 During operation there is little potential for effects to the SPA Arctic tern population from disturbance, whilst the permanent loss of foraging habitat extends over an area of approximately 0.01% of the modelled foraging range of the Cemlyn Bay Arctic terns (and approximately 0.5% of the zone of 95% usage within this predicted range). The main potential effects during operation relate to potential reductions in prey availability. This could arise from discharges from the CWS (causing increases in sea temperature and TRO levels) and losses of potential prey as a result of impingement and entrainment. The TRO ZOI held few records of Arctic tern foraging attempts (approximately 2%), and although 13% to 26% of foraging attempts were recorded with the thermal ZOI this was attributable to an unusually high concentration of foraging attempts on a single track (figure 10-19). The broad trend from the small sample of Arctic tern tracks was for most foraging to occur to the north-west of thermal and TRO ZOIs. Furthermore, the thermal ZOI and TRO ZOI each comprised less than 0.15% of the modelled foraging range of the Cemlyn Bay Arctic terns, and only 3% to 4% of the area with greatest predicted use by these birds (as defined by the zone of 95% usage within the modelled range – figure 6-14).

10.3.405 Within the thermal ZOI the effects on prey are limited to a likely reduction in availability, whilst there may be detrimental effects to a small proportion of the ichthyoplankton within the TRO ZOI (although the overall effects on fish populations are considered to be negligible). These effects could lead to greater effects on Arctic terns than on the other two tern species because Arctic terns may select small fish as prey (including ichthyoplankton) from closer to the water surface (where prey availability may be most reduced within the thermal ZOI). However, Arctic terns frequently exploit a wider range of prey sizes, including size groups that may overlap with those of common and Sandwich terns (e.g. [RD32]). Therefore, such effects on potential prey within the thermal ZOI and TRO ZOI are unlikely to have more than a small effect on the overall prey resource available to the Cemlyn Bay Arctic terns.

10.3.406 Mortality of fish from impingement and entrainment will have greatest effects on the egg and larval life-stages. As r-selected species, fish reproductive rates are high, as are the levels of natural mortality, particularly amongst the egg and larval life-stages. Estimation of the losses of potential prey as a result of impingement and entrainment (calculated without accounting for the mitigation measures which will be put in place) suggests that these will represent small proportion of the prey resource available to

the SPA Arctic tern population. In relation to the Cemlyn Bay colony specifically, these losses represent approximately 67% of the prey biomass estimated to be consumed by the adult Arctic terns at this colony, but less than 1% of the biomass consumed by the adults of all three species at this colony (which is likely to be a more relevant value, given the similarity in the main prey types of the different species, at least in terms of the items fed to chicks). Furthermore, the tracking studies demonstrate that most foraging occurs to the north of the colony, with few tracks following relatively inshore routes that pass close to the cooling water intake (suggesting little potential for impacts in the event that effects on the fish populations are localised).

10.3.407 Considering these potential effects together suggests that depletion of the Arctic tern prey resource as a result of their cumulative action is unlikely. Given this, it is concluded that the intra-Project effects during operation would not have adverse effects on the integrity of the Morwenoliaid Ynys Môn/Anglesey Terns SPA Arctic tern population.

Arctic tern (Sterna paradisaea) (in-combination)

10.3.408 Projects identified with the potential to contribute to in-combination effects on the Morwenoliaid Ynys Môn/Anglesey Terns SPA Arctic tern population are as for Sandwich tern (table 10-2).

10.3.409 The potential for in-combination effects is identified for the same combination of effects and projects as for Sandwich terns, with the same conclusions reached regarding in-combination effects (see table 10-12). In relation to the Rhyd-y-groes Re-power project and the potential for effects on visual and acoustic stimuli and physical interaction between species and project infrastructure, the conclusions of the Environmental Statement in relation to the SPA Arctic tern population were as for Sandwich tern.

10.3.410 Therefore, no adverse effects from the Project in-combination with the other projects considered in table 10-8 are predicted in relation to the Morwenoliaid Ynys Môn/Anglesey Terns SPA Arctic tern population.

Roseate tern (Sterna dougallii) (alone and in-combination)

10.3.411 Although a qualifying feature of the Morwenoliaid Ynys Môn/Anglesey Terns SPA, Roseate terns no longer breed regularly within the SPA, with no records on the Seabird Monitoring Programme database of breeding by this species within the SPA since at least 2011 (JNCC 2017u).

10.3.412 Therefore, no adverse effects are predicted on the SPA Roseate tern population as a result of the Project activities (alone or in-combination) during the construction or operational phases of the Project.

Decommissioning

10.3.413 For the decommissioning phase, the Stage 1 Screening exercise concluded that LSE cannot be excluded for changes in marine water quality and visual and acoustic stimuli for all European Designated Sites.

10.3.414 The potential for adverse effects to the integrity of the Morwenoliaid Ynys Môn/Anglesey Terns SPA in relation to both of these effects has been considered above for the construction and operational phases. For both phases it has been concluded that there will be no adverse effects to the SPA, either from the Project alone or from the Project in-combination with other projects and plans.

10.3.415 Hence, for the decommissioning phase it can be assumed that with equivalent risk management and measures in place the assessment undertaken for the construction and operation phases of the Project in relation to these two impacts will apply equally to the decommissioning phase. Therefore, it is concluded that there would be no adverse effects on the integrity of the Morwenoliaid Ynys Môn/Anglesey Terns SPA.

Conclusion for the site

10.3.416 It is concluded that, with the adoption of the proposed mitigation measures (including those embedded into the design), the Project would not have adverse effects on the integrity of the Morwenoliaid Ynys Môn/Anglesey Terns SPA.

10.3.417 Specifically with reference to the conservation objectives for the SPA, it is predicted that the Project would not:

- adversely affect the number of breeding terns within the SPA;
- affect the number of chicks that would successfully fledge within the SPA or beyond;
- constrain or hinder the range and distribution of terns within the SPA or beyond;
- adversely affect the extent of supporting habitats used by terns; or
- adversely affect the quality of supporting habitats for tern species.

10.3.418 The conclusion reached for the Morwenoliaid Ynys Môn/Anglesey Terns SPA qualifying features is summarised in table 10-21 (× = no adverse effect on integrity).

Table 10-21 Conclusion for the Morwenoliaid Ynys Môn/Anglesey Terns SPA qualifying features

Site Features	Changes in visual and acoustic stimuli	Land-take (including seabed or inter-tidal)	Changes in marine water quality	Changes in surface and ground-water hydrology	Change in air quality	Alteration of coastal processes and hydro-dynamics	Physical interaction between species and Project infra-structure
Sandwich tern (*Sterna sandvicensis*)	×	×	×	×	×	×	×
Common tern (*Sterna hirundo*)	×	×	×	×	×	×	×

Site Features	Changes in visual and acoustic stimuli	Land-take (including seabed or inter-tidal)	Changes in marine water quality	Changes in surface and ground-water hydrology	Change in air quality	Alteration of coastal processes and hydro-dynamics	Physical interaction between species and Project infra-structure
Arctic tern (*Sterna paradisaea*)	×	×	×	×	×	×	×
Roseate tern (*Sterna dougallii*)	×	×	×	×	×	×	×

10.4 Assessment of potential effects for other SPAs, pSPAs and Ramsar (bird feature) sites screened in on the basis of breeding seabird populations

Introduction

10.4.1 This section presents the assessment for all other SPAs (i.e. excluding Morwenoliaid Ynys Môn/Anglesey Terns SPA), pSPAs and Ramsar (bird feature) sites that are screened into Stage 2 of this Shadow HRA on the basis of breeding seabird qualifying features. For each European Designated Site, the conservation objectives are set out followed by a summary of the findings of the Stage 1 Screening exercise for the construction and operational phases.

10.4.2 For the decommissioning phase, the Stage 1 Screening exercise concluded that LSE cannot be excluded for changes in marine water quality and visual and acoustic stimuli for all European Designated Sites. As for the assessment of the Morwenoliaid Ynys Môn/Anglesey Terns SPA, it is assumed that, with equivalent risk management and measures in place, the assessment undertaken for the construction and operational phases of the Project in relation to these two effects applies equally to the decommissioning phase.

Ynys Seiriol/Puffin Island SPA

Conservation objectives

10.4.3 The conservation objectives for the cormorant population of the Ynys Seiriol/Puffin Island SPA as presented in section 4.1 of the SPA Core Management Plan [RD57] are as follows:

- The number of breeding cormorants are stable or increasing.
- The abundance and distribution of prey species are sufficient to support this number of breeding pairs and for successful breeding.

- The management and control of activities or operations likely to adversely affect the cormorants is appropriate for maintaining the feature in favourable condition and is secure in the long term.

Cormorant (*Phalacrocorax carbo*)

10.4.4 The Stage 1 Screening assessment concluded that there is potential for LSE on this qualifying interest feature of this SPA for the following screening categories during the construction and operational phases:

- Changes in visual and acoustic stimuli.
- Land take, including seabed or intertidal land.
- Changes in marine water quality.
- Alteration of coastal processes and hydrodynamics.
- Physical interaction between species and Project infrastructure.

10.4.5 The conservation status of cormorant (*Phalacrocorax carbo*) is 'Favourable: unclassified'.

Glannau Aberdaron and Ynys Enlli/Aberdaron Coast and Bardsey Island SPA

Conservation objectives

10.4.6 The conservation objectives for Glannau Aberdaron and Ynys Enlli/Aberdaron Coast and Bardsey Island SPA are extracted from section 4.1 (chough) and section 4.2 (Manx shearwater) of the SPA Core Management Plan [RD50]). These are:

Red-billed chough (Pyrrhocorax pyrrhocorax)

- The breeding population of chough is at least 14 pairs, or 5% of the GB population.
- The wintering population of chough is at least 28 individuals, or 5% of the GB population.
- Sufficient suitable habitat is present to support the populations.
- Breeding population is stable or increasing.
- Productivity is stable.
- Non-breeding flocks are stable or increasing (summer and winter).
- Breeding and non-breeding birds use Ynys Enlli for feeding throughout the year.
- Chough feeding habitats are themselves in a favourable conservation status and that the specified and operational limits and grazing prescriptions for these habitats incorporate chough feeding requirements (i.e. sward height and bare ground).
- Disturbance of breeding and feeding chough is minimal.

- The factors affecting the feature are under control.

Manx shearwater (Puffinus puffinus)

- Breeding population of Manx shearwater (confined to Ynys Enlli) is stable or increasing.
- Reproductive rates remain stable.
- Deaths from the lighthouse attractions, fencing and other infrastructure are minimal.
- No ground predators are introduced.
- Nesting birds are not disturbed by restoration works on boundary walls or recreational activities.
- All factors affecting the achievement of these conditions are under control.

Manx shearwater

10.4.7 The Stage 1 Screening assessment concluded that there is potential for LSE on this qualifying interest feature of this SPA for the following screening categories during the construction and operational phases:

- Changes in visual and acoustic stimuli.
- Land take, including seabed or intertidal land.
- Changes in marine water quality.
- Alteration of coastal processes and hydrodynamics.
- Physical interaction between species and Project infrastructure.

10.4.8 The conservation status of Manx shearwater (*Puffinus puffinus*) is 'Favourable: maintained'.

Red-billed chough

10.4.9 The Stage 1 Screening assessment concluded that there is potential for LSE on this qualifying interest feature of this SPA for the following screening categories during the construction and operational phases:

- Changes in visual and acoustic stimuli.
- Land take, including seabed or intertidal land.
- Change in air quality.

10.4.10 The conservation status of red-billed chough (*Pyrrhocorax pyrrhocorax*) is 'Favourable: maintained'.

Sgomer, Gogwm a moroedd Benfro/Skomer, Skokholm and the seas off Pembrokeshire SPA

Conservation objectives

10.4.11 As the conservation objectives are currently in draft for the Sgomer, Gogwm a moroedd Benfro/Skomer, Skokholm and the seas off Pembrokeshire SPA due to the seas off Pembrokeshire being an extension to the original SPA, the existing conservation objectives relating to the qualifying features screened into the Shadow HRA are presented below. The existing conservation objectives for Skomer and Skokholm SPA as presented in sections 4.1 – 4.7 of the SPA Core Management Plan [RD51] are as follows:

Manx shearwater (Puffinus puffinus)

- During the breeding season the population of Manx shearwater will be at least 150,000 pairs within the SPA (this represents around half of the current breeding population).
- Breeding success will be at least 0.5 chicks per egg laid.
- The factors affecting the feature are under control.

Seabird assemblage of international importance

- Each of the component species of the seabird assemblage will be in favourable condition for the assemblage as a whole to achieve favourable condition.
- During the breeding season the SPA will regularly support at least 67,000 individual seabirds of the following species, most of which also qualify independently as SPA features:
  - Razorbill *Alca torda;*
  - Guillemot *Uria aalge;*
  - Kittiwake *Rissa tridactyla;*
  - Puffin *Fratercula arctica;*
  - Lesser black-backed gull *Larus fuscus;*
  - Manx shearwater *Puffinus puffinus; and*
  - Storm petrel *Hydrobates pelagicus.*

Manx shearwater

10.4.12 The Stage 1 Screening assessment concluded that there is potential for LSE on this qualifying interest feature of this SPA for the following screening categories during the construction and operational phases:

- Changes in visual and acoustic stimuli.
- Land take, including seabed or intertidal land.
- Changes in marine water quality.

- Alteration of coastal processes and hydrodynamics.
- Physical interaction between species and Project infrastructure.

10.4.13 The conservation status of Manx shearwater (*Puffinus puffinus*) is 'Favourable: maintained'.

Grassholm SPA

Conservation objectives

10.4.14 The existing conservation objectives for Grassholm SPA as presented in section 4.1 of the SPA Core Management Plan [RD52] are as follows:

- The population will not fall below 30,000 pairs in three consecutive years.
- It will not drop by more than 25% of the previous year's figures in any one year.
- There will be no decline in this population significantly greater than any decline in the North Atlantic population as a whole.

Gannet

10.4.15 The Stage 1 Screening assessment concluded that there is potential for LSE on this qualifying interest feature of this SPA for the following screening categories during the construction and operational phases:

- Changes in visual and acoustic stimuli.
- Land take, including seabed or intertidal land.
- Changes in marine water quality.
- Alteration of coastal processes and hydrodynamics.
- Physical interaction between species and Project infrastructure.

10.4.16 The conservation status of gannet (*Morus bassanus*) is 'Favourable: maintained'.

Ribble and Alt Estuaries SPA and Ramsar site

Conservation objectives

10.4.17 The Ribble and Alt Estuaries SPA conservation objective was published by Natural England in June 2014 [RD230] as follows:

- To ensure that the integrity of the site is maintained or restored as appropriate, and ensure that the site contributes to achieving the aims of the Wild Birds Directive, by maintaining or restoring:
  - the extent and distribution of the habitats of the qualifying features;
  - the structure and function of the habitats of the qualifying features;
  - the supporting processes on which the habitats of the qualifying features rely;

- the population of each of the qualifying features; and
- the distribution of the qualifying features within the site.

Lesser black-backed gull (*Larus fuscus*)

10.4.18 The Stage 1 Screening assessment concluded that there is potential for LSE on this qualifying interest feature of this SPA for the following screening categories during the construction and operational phases:

- Changes in visual and acoustic stimuli.
- Land take, including seabed or intertidal land.
- Changes in marine water quality.
- Alteration of coastal processes and hydrodynamics.
- Physical interaction between species and Project infrastructure.

10.4.19 The conservation status of the qualifying feature could not be ascertained from the management plan/statutory nature conservation body management advice for the European Designated Site.

Morecambe Bay SPA and Ramsar site

Conservation objectives

10.4.20 The Morecambe Bay SPA conservation objective was published by Natural England in January 2016 [RD233] and is the same as that for the Ribble and Alt Estuaries SPA.

Seabird assemblage of international importance (lesser black-backed gull)

10.4.21 The Stage 1 Screening assessment concluded that there is potential for LSE on this qualifying interest feature of this SPA for the screening categories set out above for the Ribble and Alt Estuaries SPA during the construction and operational phases.

10.4.22 The conservation status of the qualifying feature could not be ascertained from the management plan/statutory nature conservation body management advice for the European Designated Site.

Morecambe Bay and Duddon Estuary SPA

Conservation objectives

10.4.23 The conservation objectives are currently the same as for the Morecambe Bay SPA.

Lesser black-backed gull (*Larus fuscus*) and the seabird assemblage of international importance

10.4.24 The Stage 1 Screening assessment concluded that there is potential for LSE on these qualifying interest features of this SPA for the following screening

categories set out above for the Morecambe Bay SPA (and Ribble and Alt Estuaries SPA) during the construction and operational phases.

10.4.25 The conservation status of these qualifying features could not be ascertained from the management plan/statutory nature conservation body management advice for the European Designated Site.

Bowland Fells SPA

Conservation objectives

10.4.26 The conservation objective for the Bowland Fells SPA was published by Natural England in June 2014 [RD231] and is the same as that for the Ribble and Alt Estuaries SPA:

Lesser black-backed gull (*Larus fuscus*)

10.4.27 The Stage 1 Screening assessment concluded that there is potential for LSE on this qualifying interest feature of this SPA for the screening categories set out above for the Ribble and Alt Estuaries SPA during the construction and operational phases.

10.4.28 The conservation status of the qualifying feature could not be ascertained from the management plan/statutory nature conservation body management advice for the European Designated Site.

Lambay Island SPA

Conservation objectives

10.4.29 The Lambay Island SPA conservation objective was published by the Department of Arts, Heritage, Regional, Rural and Gaeltacht Affairs in 2016 [RD225] and is as follows:

- To maintain or restore the favourable conservation condition of the bird species listed as Special Conservation Interests for this SPA.

10.4.30 The favourable conservation status of the species is achieved when:

- population dynamics data on the species concerned indicate that it is maintaining itself on a long-term basis as a viable component of its natural habitats;
- the natural range of the species is neither being reduced nor is likely to be reduced for the foreseeable future; and,
- there is, and will probably continue to be, a sufficiently large habitat to maintain its populations on a long-term basis.

Fulmar, lesser black-backed gull, guillemot and puffin

10.4.31 The Stage 1 Screening assessment concluded that there is potential for LSE on these qualifying interest features of this SPA for the following screening categories during the construction and operational phases:

- Changes in visual and acoustic stimuli.
- Land take, including seabed or intertidal land.
- Changes in marine water quality.
- Alteration of coastal processes and hydrodynamics.
- Physical interaction between species and Project infrastructure.

10.4.32 The conservation status of these qualifying features could not be ascertained from the management plan/statutory nature conservation body management advice for the European Designated Site.

Ireland's Eye SPA

Conservation objectives

10.4.33 The Ireland's Eye SPA conservation objective was published by the Department of Arts, Heritage, Regional, Rural and Gaeltacht Affairs in August 2016 [RD226] and is the same as the conservation objective for the Lambay Island SPA.

Guillemot

10.4.34 The Stage 1 Screening assessment concluded that there is potential for LSE on this qualifying interest feature of this SPA for the screening categories set out above for Lambay Island SPA during the construction and operational phases.

10.4.35 The conservation status of the qualifying feature could not be ascertained from the management plan/statutory nature conservation body management advice for the European Designated Site.

East Coast (Northern Ireland) Marine pSPA

Conservation objectives

10.4.36 The draft conservation objectives for this pSPA [RD66] are to maintain each feature in favourable condition. For each feature, the following objectives are set:

- To maintain or enhance the population of the qualifying species.
- To maintain or enhance the range of habitats utilised by the qualifying species.
- To ensure that the integrity of the site is maintained.
- To ensure there is no significant disturbance of the species and,
- To ensure that the following are maintained in the long term:
  - population of the species as a viable component of the site;
  - distribution of the species within site;
  - distribution and extent of habitats supporting the species; and,

- structure, function and supporting processes of habitats supporting the species.

Manx shearwater

10.4.37 The Stage 1 Screening assessment concluded that there is potential for LSE on this qualifying interest feature of this SPA for the screening categories set out above for Lambay Island SPA during the construction and operational phases.

10.4.38 The conservation status of the qualifying feature could not be ascertained from the management plan/statutory nature conservation body management advice for the European Designated Site.

Copeland Islands SPA

Conservation objectives

10.4.39 The conservation objectives for Copeland Islands SPA were published by the Department of Agriculture, Environment and Rural Affairs in November 2015 [RD67] and are as follows:

- To maintain or enhance the population of the qualifying species.
- Fledging success sufficient to maintain or enhance population.
- To maintain or enhance the range of habitats utilised by the qualifying species.
- To ensure that the integrity of the site is maintained.
- To ensure there is no significant disturbance of the species.
- To ensure that the following are maintained in the long term:
  - population of the species as a viable component of the site;
  - distribution of the species within site;
  - distribution and extent of habitats supporting the species; and,
  - structure, function and supporting processes of habitats supporting the species.

Manx shearwater

10.4.40 The Stage 1 Screening assessment concluded that there is potential for LSE on this qualifying interest feature of this SPA for the screening categories set out above for Lambay Island SPA during the construction and operational phases.

10.4.41 The conservation status of the qualifying feature could not be ascertained from the management plan/statutory nature conservation body management advice for the European Designated Site.

Saltee Islands SPA

Conservation objectives

10.4.42 The Saltee Islands SPA conservation objective was published by the Department of Arts, Heritage, Regional, Rural and Gaeltacht Affairs in August 2016 [RD220] and is as follows:

- To maintain the favourable conservation condition of fulmar, gannet, cormorant, shag, lesser black-backed gull, herring gull, kittiwake, guillemot, razorbill and puffin in the Saltee Islands SPA.

10.4.43 Of these species, the Stage 1 Screening assessment concluded that LSE only has the potential to arise on fulmar and gannet (due to the potential connectivity for these species with the ZOIs).

Fulmar and gannet

10.4.44 The Stage 1 Screening assessment concluded that there is potential for LSE on this qualifying interest feature of this SPA for the screening categories set out above for Lambay Island SPA during the construction and operational phases.

10.4.45 The conservation status of the qualifying feature could not be ascertained from the management plan/statutory nature conservation body management advice for the European Designated Site.

Rathlin Island SPA

Conservation objectives

10.4.46 The conservation objectives for this SPA [RD68] are to maintain each feature in favourable condition. For each feature, the following feature objectives are set:

- Fledging success sufficient to maintain or enhance population.
- To maintain or enhance the range of habitats utilised by the qualifying species.
- To ensure that the integrity of the site is maintained.
- To ensure there is no significant disturbance of the species.
- To ensure that the following are maintained in the long term:
  - population of the species as a viable component of the site;
  - distribution of the species within site;
  - distribution and extent of habitats supporting the species; and,
  - structure, function and supporting processes of habitats supporting the species.

Seabird assemblage of international importance (including fulmar)

10.4.47 The Stage 1 Screening assessment concluded that there is potential for LSE on this qualifying interest feature of this SPA for the screening categories set out above for Lambay Island SPA during the construction and operational phases.

10.4.48 The conservation status of the seabird assemblage of international importance (including fulmar) is 'Favourable: unclassified'.

Horn Head to Fanad Head SPA

Conservation objectives

10.4.49 The conservation objective for the Horn Head to Fanad Head SPA was published by the Department of Arts, Heritage, Regional, Rural and Gaeltacht Affairs in August 2016 [RD227], as follows:

- To maintain or restore the favourable conservation condition of the bird species listed as Special Conservation Interests for this SPA.

10.4.50 The favourable conservation status of the species is achieved when:

- population dynamics data on the species concerned indicate that it is maintaining itself on a long-term basis as a viable component of its natural habitats;
- the natural range of the species is neither being reduced nor is likely to be reduced for the foreseeable future; and,
- there is, and will probably continue to be, a sufficiently large habitat to maintain its populations on a long-term basis.

Fulmar

10.4.51 The Stage 1 Screening assessment concluded that there is potential for LSE on this qualifying interest feature of this SPA for the screening categories set out above for Lambay Island SPA during the construction and operational phases.

10.4.52 The conservation status of the qualifying feature could not be ascertained from the management plan/statutory nature conservation body management advice for the European Designated Site.

West Donegal Coast SPA

Conservation objectives

10.4.53 The West Donegal Coast SPA conservation objective, and conditions for achieving favourable conservation status, were published by the Department of Arts, Heritage, Regional, Rural and Gaeltacht Affairs in August 2016 [RD228] and are the same as that for the Horn Head to Fanad Head SPA.

Fulmar

10.4.54 The Stage 1 Screening assessment concluded that there is potential for LSE on this qualifying interest feature of this SPA for the screening categories set out above for Lambay Island SPA during the construction and operational phases.

10.4.55 The conservation status of the qualifying feature could not be ascertained from the management plan/statutory nature conservation body management advice for the European Designated Site.

Tory Island SPA

Conservation objectives

10.4.56 The conservation objective for the Tory Island SPA, and conditions for achieving favourable conservation status, were published by the Department of Arts, Heritage, Regional, Rural and Gaeltacht Affairs in August 2016 [RD229] and are the same as that for the Horn Head to Fanad Head SPA.

Fulmar

10.4.57 The Stage 1 Screening assessment concluded that there is potential for LSE on this qualifying interest feature of this SPA for the screening categories set out above for Lambay Island SPA during the construction and operational phases.

10.4.58 The conservation status of the qualifying feature could not be ascertained from the management plan/statutory nature conservation body management advice for the European Designated Site.

Ailsa Craig SPA

Conservation objectives

10.4.59 The conservation objectives for Ailsa Craig SPA were published by Scottish Natural Heritage in 2006 [RD296] and are as follows:

- To avoid deterioration of the habitats of the qualifying species (listed below) or significant disturbance to the qualifying species, thus ensuring that the integrity of the site is maintained.
- To ensure for the qualifying species that the following are maintained in the long term:
  - population of the species as a viable component of the site;
  - distribution of the species within site;
  - distribution and extent of habitats supporting the species;
  - structure, function and supporting processes of habitats supporting the species; and,
  - no significant disturbance of the species.

Gannet

10.4.60 The Stage 1 Screening assessment concluded that there is potential for LSE on this qualifying interest feature of this SPA for the following screening categories during the construction and operational phases:

- Changes in visual and acoustic stimuli.
- Land take, including seabed or intertidal land.
- Changes in marine water quality.
- Alteration of coastal processes and hydrodynamics.
- Physical interaction between species and Project infrastructure.

10.4.61 The conservation status of gannet (*Morus bassanus*) is 'Favourable: maintained'.

Appropriate Assessment for other SPAs, pSPAs and Ramsar (bird feature) sites screened in on the basis of breeding seabird populations

10.4.62 The assessment for all other SPAs, pSPAs and Ramsar sites for which LSE was determined on the basis of breeding seabird populations (i.e. those listed above) relies on the apportionment exercise described in chapter 6 for each of these European Designated Sites. The apportionment exercise accounts for the occurrence of birds on the area of interest from all breeding colonies of the species that are within foraging range. This was undertaken to estimate the number of birds within the Block 1 survey area population that were expected to derive from the colonies of each European Designated Site (the Block 1 survey area encompassing the 5km Wylfa Newydd Development Area ZOI used for scoping – see chapter 4). Similarly, the apportionment exercise was used to provide a qualitative indication of the importance of the Disposal Site for the relevant SPA (or Ramsar site) population. The methodology for the apportionment calculation is described in chapter 6.

10.4.63 For all European Designated Sites, the apportionment exercise concludes that the population within the Block 1 survey area represents a fraction of 1% of the respective population of each European Designated Site. Similarly, the Disposal Site was also determined to be of little importance to any of the populations from these European Designated Sites, with the exception of Glannau Aberdaron and Ynys Enlli/Aberdaron Coast and Bardsey Island SPA.

10.4.64 For the Glannau Aberdaron and Ynys Enlli/Aberdaron Coast and Bardsey Island SPA, the potential for a functional link was identified for the qualifying species Manx shearwater (for the Aberdaron Coast and Bardsey Island SPA see section 10.6 for an assessment in relation to the chough qualifying feature). Boat-based surveys recorded a peak ‘raw’ count of 586 individuals of this species in the vicinity of the Disposal Site in June 2017 (figure 6-37b). This ‘raw’ count is derived from a part of the Disposal Site ZOI only and has not been corrected for distance detection effects [RD26]. On the basis of this

uncorrected count and apportionment calculations for the Disposal Site ZOI (chapter 6) a precautionary assumption has been made that the Disposal Site may be used by significant numbers of Manx shearwater from the Glannau Aberdaron and Ynys Enlli/Aberdaron Coast and Bardsey Island SPA. An assessment for this SPA and qualifying interest is included below.

10.4.65 For all other European Designated sites considered in this section, if it is assumed that all birds that are attributed to European Designated Sites were lost from the population as a result of the effects of the Project (a highly improbable scenario), on the basis of the apportionment exercise alone, adverse effects on integrity of other SPAs, pSPAs and Ramsar sites can be excluded (for the Project alone) (for the Aberdaron Coast and Bardsey Island SPA see section 10.6 for justification of this conclusion in relation to the chough qualifying feature). It should be noted that the apportionment exercise is a worst case assessment because it assumes that all birds observed within the entire Block 1 population occurred within a precautionary 5km ZOI (whereas only a proportion of these do in reality).

10.4.66 Given the very small percentage of European Designated Site populations that potentially could be affected, there is no realistic pathway for significant in-combination effects with other plans or project, even if it is assumed that all birds that are attributed to European Designated Sites were lost from the population as a result of the effects of the Project. Consequently, adverse effects on integrity can be excluded for all other SPAs (i.e. excluding Morwenoliaid Ynys Môn/Anglesey Terns SPA), pSPAs and Ramsar (bird feature) sites that are screened into Stage 2 of this Shadow HRA on the basis of breeding seabird qualifying features in-combination with other plans and projects.

Appropriate Assessment for Glannau Aberdaron and Ynys Enlli/Aberdaron Coast and Bardsey Island SPA

Manx Shearwater (alone)

10.4.67 The citation population for the Glannau Aberdaron and Ynys Enlli/Aberdaron Coast and Bardsey Island SPA breeding Manx shearwater population is 6,930 breeding pairs [RD166]. The Seabird 2000 census estimate is 16,183 breeding pairs for the SPA population (from 2001 – [RD164] and the most recently available estimate for the SPA (from 2015) is 21,000 breeding pairs (NRW, pers. comm.).

10.4.68 The Disposal Site covers the northern half of the Holyhead Deep (IS040) disposal site which was operational between 1983 and April 2017, when it was closed following the award of a Marine Licence to Minesto Limited to install tidal kites within the southern half of the Holyhead Deep disposal site.

10.4.69 The peak count of Manx shearwater at the Disposal Site was recorded in June 2017 (figure 6-37b), so coincides with the likely occurrence of breeding birds [RD113]. During the June 2017 count, the species was distributed throughout the boat based survey area. Lower counts, but with birds also distributed widely throughout the survey area, were also recorded in May

and July 2017, and August 2016. Surveys in September 2016, March 2017 and April 2017 recorded fewer, more dispersed, records (figure 6-37a, 6-37b),

10.4.70 The foraging range of breeding Manx shearwater is estimated to be in excess of 330km from breeding colonies [RD330]. A recent study has followed the movements of tagged adult Manx shearwaters nesting on Skomer Island in Wales, with birds recorded making short (1-3 days), medium (4-7) and long (8-11 days) foraging trips during the chick rearing period. Tags recorded diving behaviour, revealing that adults are capable of diving to a mean maximum depth of 31m and as far as 55m, and that dives took place only during daylight hours suggesting that birds were tracking prey visually [RD307]. (Adults return to colonies to feed nestlings at night). The distribution of foraging behaviour indicated that this was concentrated in areas close to the breeding colony and also in central areas of the Irish and Celtic seas. The majority of foraging dives were within 100km of a sea front [RD306].

A Changes in visual and acoustic stimuli [Marine Licence]

10.4.71 Activities at the Disposal Site would be restricted to the movements of vessels carrying dredged material and the release of dredged material into the water column. The seasonal timing of these vessel movements is unknown.

10.4.72 Vessel movements and the release of dredged material at the Disposal Site would not cause changes to visual and acoustic stimuli at the SPA breeding colony of Manx shearwater (confined to Ynys Enlli/Bardsey Island), which is approximately 60km from the Disposal Site.

10.4.73 SPA birds passing through or foraging at the Disposal Site could be disturbed by the presence or movement of vessels releasing sediment. In an assessment of the sensitivity of seabirds to offshore wind developments, the vulnerability of Manx shearwater to disturbance and displacement by offshore wind farm structures, ship and helicopter traffic was scored as 1 (on a scale of 1 to 5, where 1 equated to hardly any escape behaviour and a very short flight distance when approached, as well as to flexibility in habitat use) ([RD117], [RD115]). This suggests that Manx shearwaters passing through or foraging within the Disposal Site would be subject to little or no disturbance from the presence of vessels. Given the very extensive area over which this species may forage from breeding colonies, any disturbance to foraging birds would also be negligible, as birds would readily switch to alternative foraging areas.

10.4.74 As such, no adverse effects are predicted on the SPA Manx shearwater population as a result of disturbance and displacement from visual and acoustic stimuli.

B Land take, including seabed or intertidal land [Marine Licence]

10.4.75 Direct loss of subtidal habitats would occur from the disposal of dredged material at the Disposal Site, as summarised below.

10.4.76 As part of the embedded mitigation, it is assumed that rock material would be deposited within a micro-sited area of the Disposal Site with rocky substrata. Rock would be deposited over a period of approximately 16 months following commencement of dredging in the outer harbour. Assuming that a volume of rock equal to 368,000m^3 (this being a worst case volume) is disposed at the micro-sited area would result in raising the seabed by approximately 1m (less than 1.5% of the baseline depth).

10.4.77 The loss of resource is considered to be negligible in terms of the extensive rocky habitat adjacent to the Disposal Site. In the short-term a similar community to that existing will develop on the disposed rocky material.

10.4.78 Modelling predicts that sediment disposal would cover an area of 180ha to a depth of 1cm or more. It is assumed this would be over an existing area of coarse sediments. Recovery of the existing benthic communities would occur in the short to medium term (five to 10 years).

10.4.79 Loss of habitat would result in some displacement of fish, including potential prey species of Manx shearwater. However, with recovery, habitat loss would be short to medium term (five to 10 years) and any displacement of fish would be minimal and short term, with no noticeable effect on populations in the area.

10.4.80 No adverse indirect effects are predicted for Manx shearwater foraging at the Disposal Site, via loss of habitat for prey species and depletion of prey resource.

C Changes in marine water quality [Marine Licence]

10.4.81 For the purposes of modelling sediment plumes it has been assumed that there would be two disposal events per day over a period of 35 days. This is a worst case scenario and it is likely that dredging release would happen less frequently and over a longer period of time. Disposal of sediment would result in an increase in suspended sediment concentrations (SSC) at and beyond the point of disposal. Sediment dispersion would be subject to the hydrodynamic processes of the Disposal Site.

10.4.82 The maximum volume of soft sediment that would be disposed is 242,000m^3 with sediment disposal operations estimated to take 35 days to complete.

10.4.83 Plume dispersion modelling has been carried out using a range of model scenarios (Application Reference Number: 6.4.94). The model outputs predict the fate of the disposed material in terms of increases to SSCs beyond background levels and also sediment deposition rates.

10.4.84 A number of conservative assumptions have been made including the following:

- The volume of sediment disposed of would be 242,000m^3.
- Modelling of disposal events every 12 hours, continuously for 35 days (this is the worst case scenario – assuming no break in operations).
- There are no waves during the 35 day disposal period. The model predicted that the addition of waves would result in a more rapid

dispersion of dredged material; therefore, a more conservative scenario was to model without waves (Application Reference Number: 6.4.94).

10.4.85 Modelling outputs indicated that increases in SSCs beyond typical background concentrations are highly transitory. Following a single disposal event all sediment would have dispersed to such a degree that SSCs would be within typical background concentrations within 3 hours. Furthermore, at 48 hours after the final disposal event it is considered that the SSCs generated by the sediment plume would not be discernible from the background environment.

10.4.86 An assessment of the effect on marine water quality from the potential mobilisation of sediment-bound contaminants concluded that the maximum dissolved concentration for each contaminant resulting from dredging and excavation is several orders of magnitude below the available EQS, suggesting that the potential for dredging activity within the Wylfa Newydd Development Area to affect water quality from contaminants in sediments is minimal.

10.4.87 Increases in the turbidity of water following the release of sediment could affect the foraging behaviour of Manx Shearwater if increased turbidity of water interfered with visual pursuit of prey. Given the very short term increases in turbidity predicted from the modelling of sediment release, and extensive area over which this species may forage from breeding colonies, impacts on foraging birds are not predicted to occur. Any increases in turbidity at the disposal site would be localised and short-term, and individuals of this wide-ranging species would readily be able to switch to alternative foraging areas.

10.4.88 As such, no adverse effects are predicted on the integrity of the Glannau Aberdaron and Ynys Enlli/Aberdaron Coast and Bardsey Island SPA as a result of changes in marine water quality.

D Alteration of coastal processes and hydrodynamics [Marine Licence]

10.4.89 The depositing of material on the seabed has the potential to affect hydrodynamics. Consideration was given to the potential changes that the dredge material (sediment and rock) could elicit on these processes. However, it was concluded, based on the worst case assumptions in terms of dredged material to be disposed, that there would be no noticeable effect on hydrodynamics or coastal processes. Thus there is no potential for adverse indirect effects on Manx shearwater at the Disposal Site, and hence no adverse effects are predicted on the integrity of the Glannau Aberdaron and Ynys Enlli/Aberdaron Coast and Bardsey Island SPA.

E Physical interaction with Project infrastructure [Marine Licence]

10.4.90 There would be no permanent Project infrastructure at the Disposal Site. Vessels carrying sediment for disposal would be present during disposal events. No physical interaction is predicted between vessels and Manx shearwater (a species considered to have low sensitivity to disturbance and

displacement by boat traffic - see above), and therefore no adverse effect is predicted on Manx shearwater using the Disposal Site. Therefore, no adverse effects are predicted on the integrity of the Glannau Aberdaron and Ynys Enlli/Aberdaron Coast and Bardsey Island SPA.

Manx shearwater (*Puffinus puffinus*) (in-combination)

10.4.91 Two developments were identified with the potential for in combination effects in relation to Manx shearwater using the Disposal Site. These were the Deep Green Holyhead Deep tidal energy development and the West Anglesey Demonstration Zone/Morlais Tidal Demonstration Array. A description of each development and assessment of the potential for in combination effects is provided in table 10-22.

10.4.92 Based on the conclusions described in table 10-22, no adverse effects from the Project in-combination with these other projects are predicted in relation to the Glannau Aberdaron and Ynys Enlli /Aberdaron Coast and Bardsey Island Coast SPA Manx shearwater population.

10.5 Assessment of potential effects for SPAs and Ramsar sites screened in on the basis of passage seabird populations

Introduction

10.5.1 This section presents the assessment for the two SPAs and Ramsar sites that are screened into Stage 2 of this Shadow HRA on the basis of passage seabird qualifying features. For each of these sites, the conservation objectives are set out followed by a summary of the findings of the Stage 1 Screening exercise for the construction and operational phases.

10.5.2 For the decommissioning phase, the Stage 1 screening exercise concluded that LSE cannot be excluded for changes in marine water quality and visual and acoustic stimuli for all European Designated Sites. As for the assessment of the Morwenoliaid Ynys Môn/Anglesey Terns SPA, it is assumed that, with equivalent risk management and measures in place, the assessment undertaken for the construction and operational phases of the Project in relation to these two effects applies equally to the decommissioning phase.

Table 10-22 Assessment of potential in-combination effects on the Glannau Aberdaron and Ynys Enlli/Aberdaron Coast and Bardsey Island SPA Manx Shearwater population

Project	Visual and acoustic stimuli	Assessment of potential in-combination effects on the SPA Sandwich tern population
Holyhead Deep 10MW Tidal kite installation (or 'Minesto project')	This proposed tidal turbine development is sited in the Holyhead Deep. Planning consent has not yet been granted. The potential effects have been identified based on the HRA for this project.	This proposed tidal energy development is a 9km^2 area sited in the Holyhead Deep. The application site lies within the foraging range of Manx shearwater breeding at the SPA. The HRA for the Holyhead Deep project [RD213] identifies no effects of disturbance on seabird populations. Furthermore, it concludes no LSE in relation to the Glannau Aberdaron and Ynys Enlli/Aberdaron Coast and Bardsey Island SPA. Therefore, it is considered that there is no effect on noise and acoustic stimuli that could influence the SPA Manx shearwater population, and no adverse in-combination effect is predicted.
West Anglesey Demonstration Zone	This proposed marine energy development, involving a tidal array, is sited off the Holyhead coast. It has not yet submitted applications for marine and land planning.	The WADZ covers an area of 37km^2 and is within foraging range of Manx shearwater breeding at the SPA. On the basis that: (i) The assessment for the Project Disposal Site predicts minimal or no effects of changes in visual and acoustic stimuli on Manx shearwater, and no adverse impacts in relation to the conservation objectives for the SPA; (ii) Manx Shearwater is considered to be of low sensitivity to disturbance from vessels and other anthropogenic activities ([RD117]; [RD114]; [RD115]) and has an extensive foraging range (in excess of 330km from breeding colonies [RD330]); and (iii) The WADZ is not consented and will be subject to EIA and HRA which will include an assessment of disturbance to seabirds from visual and acoustic stimuli; consent will be dependent on a finding of no adverse effect on European sites and qualifying species; No in combination effect associated with visual and acoustic stimuli is predicted.

Project	Potential effect on land-take (including seabed or intertidal)	Assessment of potential in-combination effect
Holyhead Deep 10MW Tidal kite installation (or 'Minesto project')	This proposed tidal turbine development is sited in the Holyhead Deep. Planning consent has not yet been granted. The potential effects of this project have been identified based on the HRA for this project.	This proposed development is within a 9km^2 area sited in the Holyhead Deep; it lies within the foraging range of Manx shearwater breeding at the SPA. The HRA for the Holyhead Deep project identifies no effects of habitat loss and change on seabird populations. Furthermore, it concludes no LSE in relation to the Glannau Aberdaron and Ynys Enlli/Aberdaron Coast and Bardsey Island SPA. Therefore, it is considered that there is no effect on land-take and habitat change that could influence the SPA Manx Shearwater population and no adverse in-combination effect is predicted.
West Anglesey Demonstration Zone	This proposed marine energy development, involving a tidal array, is sited off the Holyhead coast. It has not yet submitted applications for marine and land planning.	The WADZ covers an area of 37km^2 and is within foraging range of Manx shearwater breeding at the SPA. On the basis that: (i) The assessment for the Project Disposal Site predicts minimal or no impacts on Manx shearwater and no adverse impacts in relation to the conservation objectives for the SPA; and (ii) Manx Shearwater is a species with an extensive foraging range (in excess of 330km from breeding colonies, Thaxter et al. 2012) and considered to be of low vulnerability to tidal devices (Furness et al. 2012); (iii) The WADZ is not consented and will be subject to EIA and HRA which will include an assessment of effects on land-take; consent will be dependent on a finding of no adverse effect on European sites and qualifying species; No in combination effect associated with land-take is predicted.
Project	**Potential effect on marine water quality**	**Assessment of potential in-combination effect**
Holyhead Deep 10MW Tidal kite installation	This proposed tidal turbine development is sited in the Holyhead Deep. Planning consent has not yet been granted. The potential effects of this project have been	This proposed development is within a 9km^2 area sited in the Holyhead Deep; it lies within the foraging range of Manx shearwater breeding at the SPA. The HRA for the Holyhead Deep project identifies no effects of changes in marine water

	identified based on the HRA for this project.	quality on seabird populations. Furthermore, it concludes no LSE in relation to the Glannau Aberdaron and Ynys Enlli/Aberdaron Coast and Bardsey Island SPA. Therefore, it is considered that there is no effect on marine water quality that could influence the SPA Manx Shearwater population, and no adverse in-combination effect is predicted.
West Anglesey Demonstration Zone	This proposed marine energy development, involving a tidal array, is sited off the Holyhead coast. It has not yet submitted applications for marine and planning consent.	The WADZ covers an area of 37km^2 and is within foraging range of Manx shearwater breeding at the SPA. On the basis that: (i) The assessment for the Project Disposal Site predicts minimal or no effect of changes in marine water quality on Manx shearwater and no adverse impacts in relation to the conservation objectives for the SPA; and (iii) The WADZ is not consented and will be subject to EIA and HRA which will include an assessment of impacts on marine water quality (including mitigation measures if required); consent will be dependent on a finding of no adverse effect on European sites and qualifying species; No in combination effect on marine water quality is predicted.
Project	**Potential effect on coastal processes and hydrodynamics**	**Assessment of potential in-combination effect**
Holyhead Deep 10MW Tidal kite installation	This proposed tidal turbine development is sited in the Holyhead Deep. Planning consent has not yet been granted. The potential effects of this project have been identified based on the HRA for this project.	The HRA for the Holyhead Deep project identifies no effects of changes to coastal processes and hydro-dynamics on seabird populations. Furthermore, it concludes no LSE in relation to the Glannau Aberdaron and Ynys Enlli/Aberdaron Coast and Bardsey Island SPA. Therefore, it is considered that there is no effect on coastal processes that could influence the SPA Manx shearwater population, and no adverse in-combination effect is predicted.
West Anglesey Demonstration Zone	This proposed marine energy development, involving a tidal array, is sited off the Holyhead coast. It has not yet submitted applications for marine and planning consent.	The WADZ covers an area of 37km^2 and is within foraging range of Manx shearwater breeding at the SPA. On the basis that: (i) The assessment for the Project Disposal Site predicts no impacts of alteration of coastal processes and hydrodynamics on Manx shearwater, and no adverse impacts in relation to the conservation objectives for the SPA; and

		(iii) The WADZ is not consented and will be subject to EIA and HRA which will include consideration of effect on coastal processes and hydrodynamics; consent will be dependent on a finding of no adverse effect on European sites and qualifying species; No in combination effect on coastal processes and hydrodynamics is predicted.
Project	**Potential effect on physical interaction between species and project infra-structure**	**Assessment of potential in-combination effect**
Holyhead Deep 10MW Tidal kite installation	This proposed tidal turbine development is sited in the Holyhead Deep. Planning consent has not yet been granted. The potential effects of this project have been identified based on the HRA for this project.	The HRA for the Holyhead Deep project identifies no effects of physical interactions between species and project infra-structure on Manx shearwater populations. Furthermore, it concludes no LSE in relation to the Glannau Aberdaron and Ynys Enlli/Aberdaron Coast and Bardsey Island SPA. Therefore, it is considered that there is no effect on physical interaction between species and project infra-structure that could influence the SPA Manx shearwater population, and no adverse in-combination effect is predicted.
West Anglesey Demonstration Zone	This proposed marine energy development, involving a tidal array, is sited off the Holyhead coast. It has not yet submitted applications for marine and planning consent.	The WADZ covers an area of 37km^2 and is within foraging range of Manx shearwater breeding at the SPA. On the basis that: (i) The assessment for the Project Disposal Site predicts no impacts on Manx shearwater from physical interaction with project infrastructure and no adverse impacts in relation to the conservation objectives for the SPA; and (ii) Manx Shearwater is considered to be of low vulnerability to tidal devices (Furness et al. 2012); (iv) The WADZ is not consented and will be subject to EIA and HRA which will include consideration of effect on coastal processes and hydrodynamics; consent will be dependent on a finding of no adverse effect on European sites and qualifying species; No in combination effect due to physical interaction between species and project infra-structure is predicted.

Aber Afen Dyfrdwy/Dee Estuary SPA and Ramsar site

Conservation objectives

10.5.3 The Aber Afen Dyfrdwy/Dee Estuary SPA conservation objective was published by Natural England in January 2016 [RD234] as follows:

- Ensure that the integrity of the site is maintained or restored as appropriate, and ensure that the site contributes to achieving the aims of the Wild Birds Directive, by maintaining or restoring:
  - the extent and distribution of the habitats of the qualifying features;
  - the structure and function of the habitats of the qualifying features;
  - the supporting processes on which the habitats of the qualifying features rely;
  - the population of each of the qualifying features; and
  - the distribution of the qualifying features within the site.

Sandwich tern (*Sterna sandvicensis*)

10.5.4 The Stage 1 screening assessment concluded that there is potential for LSE on this qualifying interest feature of this SPA for the following screening categories during the construction and operational phases:

- Changes in visual and acoustic stimuli
- Land take, including seabed or intertidal land
- Changes in marine water quality
- Alteration of coastal processes and hydrodynamics
- Physical interaction between species and Project infrastructure

10.5.5 The conservation status of the qualifying feature could not be ascertained from the management plan/statutory nature conservation body management advice for the European Designated Site.

Mersey Narrows and North Wirral Foreshore SPA and Ramsar site

Conservation objectives

10.5.6 The conservation objectives for the Mersey Narrows and North Wirral Foreshore SPA was published by Natural England in June 2014 [RD232] as follows:

10.5.7 To ensure that the integrity of the site is maintained or restored as appropriate, and ensure that the site contributes to achieving the aims of the Wild Birds Directive, by maintaining or restoring:

- the extent and distribution of the habitats of the qualifying features;
- the structure and function of the habitats of the qualifying features;

- the supporting processes on which the habitats of the qualifying features rely;
- the population of each of the qualifying features; and
- the distribution of the qualifying features within the site.

Common tern (*Sterna hirundo*)

10.5.8 The Stage 1 screening assessment concluded that there is potential for LSE on this qualifying interest feature of this SPA for the following screening categories during the construction and operational phases:

- Changes in visual and acoustic stimuli
- Land take, including seabed or intertidal land
- Changes in marine water quality
- Alteration of coastal processes and hydrodynamics
- Physical interaction between species and Project infrastructure

10.5.9 The conservation status of the qualifying feature could not be ascertained from the management plan/statutory nature conservation body management advice for the European Designated Site.

Appropriate Assessment for SPAs and Ramsar sites screened in for passage seabird populations

10.5.10 The assessment for the above two SPAs and Ramsar sites which have been screened in on the basis of passage seabird populations (specifically Sandwich tern and common tern) is based on the lack of evidence of any major passage movements of these species from the surveys undertaken for the Project (see chapter 6 and Application Reference Number: 6.4.89).

10.5.11 Based on the above, adverse effects on integrity of these SPAs and Ramsar sites can be excluded (for the Project alone). Furthermore, the lack of evidence of any sizeable concentrations of passage birds suggests there is no realistic pathway for significant in-combination effects with other plans or projects. Consequently, adverse effects on integrity can be excluded for these two SPAs and Ramsar sites in-combination with other plans and projects.

10.6 Assessment of potential effects for SPAs screened in on the basis of chough populations

Introduction

10.6.1 This section presents the assessment for the three SPAs that are screened into Stage 2 of the Shadow HRA on the basis of chough populations. For two of these SPAs, the conservation objectives are first stated followed by a summary of the findings of the Stage 1 screening exercise for the construction and operational phases. Details of the conservation objectives and summary findings of the Stage 1 screening exercise for the construction

and operational phases for the third SPA with chough as a qualifying feature (i.e. Glannau Aberdaron and Ynys Enlli/Aberdaron Coast and Bardsey Island SPA) are given in section 10.4 above because this SPA is also screened in for Manx shearwater.

10.6.2 For the decommissioning phase, the Stage 1 screening exercise concluded that LSE cannot be excluded for marine water quality and changes in visual and acoustic stimuli for all European Designated Sites. As for the assessment of the Morwenoliaid Ynys Môn/Anglesey Terns SPA, it is assumed that, with equivalent risk management and measures in place, the assessment undertaken for the construction and operational phases of the Project in relation to these two effects applies equally to the decommissioning phase.

Glannau Ynys Gybi/Holy Island Coast SPA

Conservation objectives

10.6.3 The conservation objectives for Glannau Ynys Gybi / Holy Island Coast SPA are presented in Section 4.6 of the SPA Core Management Plan [RD47] and are as follows:

- The breeding population of Chough within the SPA is at least 18 pairs, of which at least 12 should be within the Glannau Ynys Gybi / Tre Wilmot SSSI and at least 6 should be within the Glannau Rhoscolyn SSSI.
- The non-breeding population of Chough is at least 18 individuals or 2.5 % of the GB wintering population.
- Sufficient suitable habitat (including Atlantic sea cliffs, maritime grassland, maritime heath, wet heath and dry heath) is present and in appropriate condition to support the breeding populations.
- All factors affecting the achievement of these conditions are under control.

Red-billed chough (*Pyrrhocorax pyrrhocorax*)

10.6.4 The Stage 1 Screening assessment concluded that there is potential for LSE on this qualifying interest feature of this SPA for the following screening categories during the construction and operational phases:

- Changes in visual and acoustic stimuli.
- Land take, including seabed or intertidal land.
- Change in air quality.

10.6.5 The conservation status of red billed chough (*Pyrrhocorax pyrrhocorax*) is 'Unfavourable: declining'.

Mynydd Cilan, Trwyn y Wylfa ac Ynysoedd Sant Tudwal/Mynydd Cilan, Trwyn y Wylfa and the St. Tudwal Islands SPA

Conservation objectives

10.6.6 The conservation objectives for this SPA are detailed below, taken from section 4.1 of the Mynydd Cilan, Trwyn y Wylfa ac Ynysoedd Sant Tudwal/Mynydd Cilan, Trwyn y Wylfa and the St. Tudwal Islands SPA Core Management Plan [RD53]:

- The breeding population of chough is at least 9 pairs.
- The non-breeding population of chough is at least 18 individuals.
- Sufficient suitable habitat is present to support the populations.
- The factors affecting the feature are under control.

Red-billed chough (*Pyrrhocorax pyrrhocorax*)

10.6.7 The Stage 1 Screening assessment concluded that there is potential for LSE on this qualifying interest feature of this SPA for the following screening categories during the construction and operational phases:

- Changes in visual and acoustic stimuli.
- Land take, including seabed or intertidal land.
- Change in air quality.

10.6.8 The conservation status of red-billed chough (*Pyrrhocorax pyrrhocorax*) is 'Favourable: maintained'.

Appropriate Assessment for SPAs screened in for chough populations

Chough (*Pyrrhocorax pyrrhocorax*) (alone)

10.6.9 The three SPAs for which breeding and non-breeding chough are qualifying features have been screened into the Stage 2 of this Shadow HRA on the basis of possible connectivity with the Wylfa Newydd Development Area (and associated ZOIs) (chapter 6). The assessment for these SPAs uses the information detailed in Application Reference Number: 6.4.47 and is based on consideration of:

- The findings from the extensive programme of breeding, winter transect and vantage point surveys on the Wylfa Newydd Development Area, which demonstrate regular use of the site by four to six birds only.
- The distances between the Wylfa Newydd Development Area and the SPAs, which are 13.1km, 63.3km and 65.1km respectively for the Glannau Ynys GybiHoly Island Coast SPA, Glannau Aberdaron and Ynys Enlli/Aberdaron Coast and Bardsey Island SPA and the Mynydd Cilan, Trwyn y Wylfa ac Ynysoedd Sant Tudwal/Mynyyd Cilan, Trwyn y

Wylfa and St. Tudwal Islands SPA (table 4.2 and figure 4.4). Although one or more SPAs are within the natal and winter dispersal distance of chough, they are sufficient to mean that substantive areas of suitable habitat occur closer to each of the SPA populations than the Wylfa Newydd Development Area.

- Limited evidence that birds recorded within the chough SPAs have also been recorded within the Wylfa Newydd Development Area. Sightings of colour-ringed choughs fledging from nests in the Wylfa Head area between 2007 and 2015 have indicated that 2 of 30 marked birds have been re-sighted within the Glannau Ynys Gybi/Holy Island Coast SPA. Thus it is possible that birds fledged at Wylfa Head could subsequently breed within this SPA. In addition a colour-ringed bird fledged from a nest within the Glannau Ynys Gybi/Holy Island Coast SPA was recorded during the Wylfa Newydd Development Area winter chough surveys in 2017(Application Reference Number: 6.4.47). This indicates that the Wylfa Newydd Development Area lies within the winter foraging range and/or dispersal range of fledged birds from the SPA population.

10.6.10 The potential for connectivity or functional linkage (as defined by the following sub-sections) between the Wylfa Newydd Development Area study area and the three chough SPAs screened for Appropriate Assessment is considered further below.

Potential for breeding chough from SPA populations to forage in the Wylfa Newydd Development Area

10.6.11 This section considers the possibility that during the breeding season, adult chough breeding within the SPAs screened into Stage 2 might travel to Wylfa Head to forage. If the Wylfa Newydd Development Area is an important foraging area for breeding chough from one or more SPAs then there is the potential for the proposed development to adversely affect the SPA breeding populations.

10.6.12 Studies of the foraging behaviour of chough during the breeding season show that most foraging activity is within 300-600m of the nest ([RD145], [RD359]).

10.6.13 The three chough SPAs screened in for the Appropriate Assessment are all well beyond the likely breeding season foraging distance of chough nesting in the Wylfa Newydd Development Area (at distances of 13.1km, 63.3km and 65.1km - see above). Therefore, it is highly unlikely that chough breeding within the SPAs would forage over the Wylfa Newydd Development Area during the breeding season, and there is effectively no functional linkage with any SPA where chough is a qualifying feature.

Potential for chough from SPA populations to forage in the Wylfa Newydd Development Area outside the breeding season

10.6.14 During the non-breeding season, choughs congregate at traditional roost sites and range or forage from these locations through the winter months.

Roosts may support up to 80 birds or more. Individual birds tend to remain at the same communal roost site during the non-breeding season. Studies in Wales have demonstrated that non-breeding chough can forage up to 25km from roost sites, but that 95% of all observations of flocks of chough which contained colour-ringed individuals were within 6km of the roost ([RD339], [RD61]).

10.6.15 Baseline data for the Wylfa Newydd Development Area for the period November 2009 to June 2017 indicate that typically about four (and a peak of six) birds were recorded during non-breeding season surveys. The area does not support a non-breeding season roost for chough. The nearest roost is about 5.5km to the west at Church Bay/Carmel Head (Application Reference Number: 6.4.47). Sightings of colour-ringed birds using the Wylfa Newydd Development Area in the non-breeding season (based on dedicated searches for colour-ring birds in 2017) provided confirmed identification of one bird (a, probable female, chough fledged from the Glannau Ynys Gybi/Holy Island Coast SPA in 2015) and the likely identification of a second bird (a 13 year old female originally from Church Bay).

10.6.16 The data on chough from surveys and the desk study suggest that the Wylfa Newydd Development Area is not used by large numbers of birds during the non-breeding-season. It is situated at the edge of the likely regular foraging range of chough using the nearest winter roost at Church Bay/Carmel Head. Limited data on colour-ringed birds indicate that chough using the Wylfa Newydd Development Area include birds from the wider regional population and the Glannau Ynys Gybi/Holy Island Coast SPA. Thus, there is a functional link to the latter SPA. Once settled on a breeding territory choughs tend to be relatively sedentary [RD209] and it is considered very unlikely that birds from breeding populations in the Glannau Aberdaron and Ynys Enlli/Aberdaron Coast and Bardsey Island SPA and Mynydd Cilan, Trwyn y Wylfa ac Ynysoedd Sant Tudwal/Mynyyd Cilan, Trwyn y Wylfa and St. Tudwal Islands SPA would travel as far as the Wylfa Newydd Development Area in winter.

10.6.17 Given that the Wylfa Newydd Development Area is at the limit of the regular foraging distance of chough from the nearest winter roost, and that small numbers of birds only were recorded using the Wylfa Newydd Development Area during winter surveys, it is considered that the contribution of the study area to the winter foraging range of chough is not significant in terms of the conservation objectives of the Glannau Ynys Gybi/Holy Island Coast SPA. It is considered that there is no significant functional link to the Glannau Aberdaron and Ynys Enlli/Aberdaron Coast and Bardsey Island SPA or the Mynydd Cilan, Trwyn y Wylfa ac Ynysoedd Sant Tudwal/Mynyyd Cilan, Trwyn y Wylfa and St. Tudwal Islands SPA.

Potential for recruitment of chough from Wylfa Head into SPA breeding populations

10.6.18 Young birds fledged from nests at Wylfa Head could potentially be recruited into SPA breeding populations. A study of natal dispersal distances (i.e. between natal nests and subsequent breeding areas) of chough in North

Wales [RD61] indicated a mean of 23.2km and maximum of 75km for females (n=61) and a mean of 10.1km and maximum of 45km for males (n=54). The pattern of natal dispersal of male and female chough in North Wales is shown in figure 3.3 of Application Reference Number: 6.4.47 (from [RD61]). This figure shows that for both sexes the number of birds settling decreases with distance from the natal site, thus the further away a given potential breeding area is from a nesting area, the less likely that fledglings will disperse to breed in that area; it also shows that females tend to disperse further than males. Overall 44% of all juveniles (51 of a total of 115) dispersed >15 km from their natal nest site to breed; male natal dispersal showed a steep decline from a peak at 0-5km, whereas for females, over 64% dispersed more than 15km with most settling 15-20km from the natal nest [RD61].

10.6.19 Given the distances between Glannau Aberdaron and Ynys Enlli/Aberdaron Coast and Bardsey Island SPA, and Mynydd Cilan, Trwyn y Wylfa ac Ynysoedd Sant Tudwal/Mynyyd Cilan, Trwyn y Wylfa and St. Tudwal Islands SPA, from the Wylfa Newydd Development Area (respectively 63.3 km and 65.1 km) it is very unlikely that male chough fledglings from Wylfa Head would disperse to breed within these SPAs. These two SPAs are within the natal dispersal distance of female chough, but given the pattern of decrease in numbers settling with increasing distance, the probability of females fledged from Wylfa Head entering the SPA breeding populations is considered to be very low. Thus, there is not considered to be a significant functional link between the Wylfa Newydd Development Area breeding population and these SPA breeding populations.

10.6.20 Given the distance of 13.1km from the Wylfa Newydd Development Area, Glannau Ynys Gybi/Holy Island Coast SPA is within the dispersal distances of male and female chough fledglings from Wylfa Head. There is a possibility that fledglings from the Wylfa Newydd Development Area might settle to breed within the SPA. This is backed up by evidence from sightings of colour-ringed fledglings from Wylfa Head within the SPA (see above and Application Reference Number: 6.4.47). Thus, a functional link between the Wylfa Newydd Development Area population and the SPA population is likely and there is a potential for adverse impacts on the Wylfa Head population to affect the SPA population.

10.6.21 The likelihood of an adverse effect depends on a number of factors:

- The status of the SPA population, whether it is increasing, stable or declining;
- Whether the SPA population is a ‘source’ or ‘sink’ population, i.e. whether it produces more potential recruits to the breeding population than can be accommodated within the SPA and birds disperse to breeding populations in surrounding areas, or whether the SPA population is dependent on the recruitment of breeding birds from areas outside the SPA; and

- If the SPA population is dependent on recruitment of birds fledged in surrounding areas, the relative contribution of the Wylfa Head population compared with other breeding chough populations which might contribute recruits to the SPA.

10.6.22 The conservation status of the chough population of the Glannau Ynys Gybi/Holy Island Coast SPA is 'Unfavourable: declining' (see above, and table 3.1 in Application Reference Number: 6.4.47). Thus, there is the potential for the SPA breeding population to be supported by recruits from surrounding areas. The recorded patterns of natal dispersal for chough in North Wales indicate that recruits might come from breeding areas up to 75km from the SPA (the maximum recorded natal dispersal distance for female fledglings [RD61]. The estimated breeding population of chough within this distance of the SPA is 96 pairs (Application Reference Number: 6.4.47). Assuming that all of these are within the potential area from which SPA recruits could be derived, indicates that the Wylfa Head population of 1-2 pairs (table 3.4, Application Reference Number: 6.4.47) is a small proportion of the population within the potential 'recruitment catchment' of the SPA. Given the maximum natal dispersal distance of 75km for female fledglings and the large number of alternative chough breeding pairs which could potentially supply recruits to the breeding population of the Glannau Ynys Gybi/Holy Island Coast SPA, the contribution of dispersing juvenile chough from the Wylfa Head area is not considered to be significant in terms of the SPA conservation objectives.

Conclusion

10.6.23 In relation to the chough SPAs screened in for Appropriate Assessment, three possible sources of connectivity, or functional links with the Wylfa Newydd Development Area have been identified: that breeding adults from the SPAs might forage within the Wylfa Newydd Development Area during the breeding season, that the Wylfa Newydd Development Area might be used for foraging outside the breeding season by choughs from SPA populations, and that maintenance of the population of the Glannau Ynys Gybi/Holy Island Coast SPA might be dependent on chough recruitment from within the Wylfa Newydd Development Area.

10.6.24 Consideration of the baseline survey data and available information and data from a desk study has identified no significant functional link between the Wylfa Newydd Development Area and any SPA for which chough is a qualifying feature. There is, therefore, no likelihood of an adverse effect arising with regard to the conservation objectives for chough as qualifying features of the SPAs.

Chough (*Pyrrhocorax pyrrhocorax*) (in-combination)

10.6.25 The appropriate assessment for the Glannau Ynys Gybi/Holy Island Coast SPA alone identified no significant functional links with the Project, but it was possible that choughs fledged from Wylfa Head nests could be recruited to the SPA population, and that choughs from the SPA population might make occasional use of the Wylfa Newydd Development Area during the non–

breeding season. Thus, consideration was given to the potential for in-combination effects of other plans and projects on the Glannau Ynys Gybi/Holy Island Coast SPA.

10.6.26 Seven projects were considered in the in-combination assessment, which is presented in table 10-23. As described in chapter 5, there is no potential for LSIE with any of the plans scoped into the assessment.

10.6.27 Based on the conclusions described in table 10-23, no adverse effects from the Project in-combination with these other projects are predicted in relation to the Glannau Ynys Gybi/Holy Island Coast SPA chough population.

10.6.28 For the Project alone, there is considered to be effectively no functional link between the WDNA and the Glannau Aberdaron and Ynys Enlli/Aberdaron Coast and Bardsey Island SPA and the Mynydd Cilan, Trwyn y Wylfa ac Ynysoedd Sant Tudwal/Mynydd Cilan, Trwyn y Wylfa and the St. Tudwal Islands SPA, and no realistic pathway for in-combination effects with these SPAs.

Table 10-23 Assessment of potential in-combination effects on the Glannau Ynys Gybi/Holy Island Coast SPA chough population

Project	Visual and acoustic stimuli	Assessment of potential in-combination effects on the SPA Chough population
Wylfa Decommissioning	The project's ES identifies that potential disturbance to bird populations, including chough, could result from visual and acoustic stimuli associated with the decommissioning works.	The Existing Power Station ceased operation on 30 December 2015 and is currently in a defueling phase. Other decommissioning activities will not begin in earnest until all fuel is removed from site, and are understood to continue until 2025. Some information on these activities is available from an Environmental Statement (Magnox 2013, updates the original ES from 2008). The decommissioning plans are being updated and further details will be provided as Environmental Masterplan documents. In relation to noise disturbance, at the time of the 2008 ES for the Wylfa Decommissioning project it was not possible to produce an accurate assessment of the cumulative noise impacts from these decommissioning works and from the construction works that would be associated with the Project, due to the lack of detailed information available at that time. However, it is intended that a noise impact assessment for the Wylfa Decommissioning, including consideration of the cumulative impacts, would be presented as part of a Section 61 Consent Application. The Section 61 Consent Application would allow for the appointed contractors to prepare definitive method statements that would allow more accurate prediction of noise impacts, and the resulting agreement would be a formal agreement between the developer / contractor and the Isle of Anglesey County Council where noise levels, hours of work and any mitigation are agreed upon. Mitigation measures will include restriction of clearance of habitat, demolition of buildings used by chough and some of the major works associated with the Wylfa Decommissioning to periods outside the bird breeding season, provision of nest boxes for chough to provide alternative sites in areas that will not be disturbed by the decommissioning works, and measures to minimise loss and degradation of coastal habitats. The in-combination assessment is based on the following parameters and assumptions: (i) Mitigation will be in place to ensure that potential noise and visual disturbance from the Wylfa Decommissioning will not add significantly to levels predicted from the Project alone. (ii) The Decommissioning site is approximately 15km from the SPA and at this distance disturbance from decommissioning activities will not directly affect chough within the SPA,

		during the breeding or non-breeding periods; (iii) Disturbance from decommissioning activities will not affect chough from SPA populations if they disperse to Wylfa Head outside the breeding season. (iv) Disturbance from decommissioning activities will not affect the breeding population at Wylfa Head, which is within the 'recruitment catchment' for the SPA population and a potential source of recruits for the SPA population. On this basis it is considered that there would be no adverse in-combination effect of disturbance from visual and acoustic stimuli on the SPA chough population.
Anglesey Eco Park	No Environmental Statement or HRA is currently available for the Anglesey Eco Park to inform the in-combination assessment. The potential effects of this project have been identified based on the outline planning permission.	The development comprises a proposed Biomass Plant and Eco Park at the former Anglesey Aluminium site in Holyhead. It is situated about 13km from the Project and 4km from the SPA. Given the current status of the Anglesey Eco Park, an assumption has been made that its construction and operation can be managed and mitigated in such a way that there is no effect on noise and acoustic stimuli that could influence the SPA Sandwich tern population, and no adverse in-combination effect is predicted
Holyhead Waterfront Redevelopment	No Environmental Statement or HRA has been found to inform the in-combination assessment. The potential effects have been identified based on the project website (www.holyheadwaterfront.co.uk/).	Planning permission granted in 2012. An Environmental Statement is believed to have accompanied the Planning Application. At the time of writing the Environmental Statement was not available online. Subsequently awaiting the outcome of a 'village green' application which may prevent the development from proceeding. A Town or Village Green Public Inquiry was held in October 2016. The development is situated about 15km from the Project and 250m from the SPA. It is assumed that a requirement of the planning permission is that construction and operation can be managed and mitigated in such a way that there is no effect on noise and acoustic stimuli that could influence the SPA chough population, and no adverse in-combination effect is predicted.
North Wales Connection Project	There is no Environmental Statement or HRA available to inform the in-combination assessment. The potential	A proposed new electricity transmission line running southeast from the Project to the Pentir substation. At the nearest points, the development is about 1km from the Project and 15km from the SPA. The preferred corridor for the new overhead line runs alongside and close to

	effects of this project have been identified based on the scoping report (National Grid, 2016).	an existing overhead line. The scoping assessment for the North Wales Connection considers that the likelihood of a significant effect from disturbance/displacement on chough is unlikely. The development will be subject to EIA and HRA which will include a detailed assessment of disturbance to chough from visual and acoustic stimuli; consent will be dependent on a finding of no adverse effect on European sites and qualifying species (alone and in combination). On this basis no in combination effect due to visual and acoustic stimuli is predicted.
Rhyd-y-groes Wind Farm re-power	This project involves the replacement of the existing 24 wind turbine generators (WTGs) at this site by 11 more modern WTGs. The potential effects of this project have been identified based on the Environmental Statement.	The development is about 1.5km from the Project and 15.5km from the SPA. Planning consent was granted in 2016. The timing of decommissioning of the existing wind farm and construction of the new wind farm could coincide with the construction phase for the Project. The Environmental Statement for the project reports that chough were not recorded within the study area during 2 years of baseline field surveys, and habitats within the study area were of negligible value as foraging habitats relative to other locations nearer the coast; this species was scoped out of the ecological impact assessment for the proposed development (TPG Wind, 2015). On this basis no in combination effect due to visual and acoustic stimuli is predicted for the SPA chough population.
Almwch LNG (Liquid Natural Gas)	Although the existing planning consent for the Alnwch LNG (Liquid Natural Gas) was renewed in 2013, the future plans and timescales of this project are unclear and, at the time of writing, no Environmental Statement is available online.	Under the proposals tankers will import liquid gas to a mooring 3km from the Amlwch coast, off the north coast of Anglesey. The LNG will then be transferred by undersea pipeline from the mooring platform to the site where it is converted back to natural gas and sent into the UK gas network. The development is about 10km from the Project and 23km from the SPA. The 19 hectare site near Amlwch on the north coast of Anglesey is on a former industrial site and will make use of some existing industrial buildings. The proposals also include measures to protect and enhance the natural habitats of local wildlife as well as landscaping improvements It is assumed that a requirement of the planning permission is that construction and operation can be managed and mitigated in such a way that there is no effect on noise and acoustic stimuli that could influence the SPA chough population, and no adverse in-combination effect is predicted.
Visitor and Media Reception Centre	When the Wylfa Newydd Project is operational, Horizon intends to apply for	The proposed development is 0km from the Project and about 15km from the SPA. Construction works would not be ongoing at the same time as the construction of the

(Horizon)	planning permission for a Visitor and Media Reception Centre. There is no potential for a temporal link, but there is potential for a spatial link with the Wylfa Newydd Project. Given that this is a future planning application, there are currently no details or environmental assessments available for the Visitor and Media Reception Centre.	Project. An assumption has been made that the construction and operation can be managed and mitigated in such a way that there is no effect of disturbance from noise and acoustic stimuli, that could influence the SPA chough population, and no adverse in-combination effect is predicted.
Project	**Potential effect of land-take**	**Assessment of potential in-combination effect**
Wylfa Decommissioning	The project's ES identifies that potential effects on chough, could occur from disturbance, loss and/or degradation of coastal habitats associated with the decommissioning works	Mitigation measures during decommissioning will include provision of nest boxes for chough to provide alternative sites to any that are lost as a result of the decommissioning works, and measures to minimise loss and degradation of coastal habitats. The in-combination assessment is based on the following parameters and assumptions: (i) The Decommissioning site is approximately 15km from the SPA there will be loss or deterioration of SPA habitats; (ii) Alternative nesting sites for chough will be provided at Wylfa Head to ensure no loss of breeding sites within the SPA 'recruitment catchment' as a result of decommissioning; and (iv) Mitigation will be place to minimise loss and degradation of habitats suitable for chough at Wylfa Head as a result of decommissioning, so there would be no loss or deterioration of habitats for chough from SPA populations if they disperse to Wylfa Head outside the breeding season. On this basis it is considered that there would be no adverse in-combination effect on the SPA Chough population with the Wylfa Decommissioning.
Anglesey Eco Park	No Environmental Statement or HRA is currently available for the Anglesey Eco Park to inform the in-combination assessment. The potential effects of this	The Anglesey Eco Park is situated about 13km from the Project and 4km from the SPA. There will be no loss of habitat within the SPA. Development will take place on a former industrial site and there will be no loss of habitat suitable for chough which might be used by the chough SPA populations outside the breeding season. No adverse in-combination effect

	project have been identified based on the outline planning permission.	on the SPA population is predicted.
North Wales Connection Project	There is no Environmental Statement or HRA available to inform the in-combination assessment. The potential effects of this project have been identified based on the scoping report (National Grid, 2016).	A proposed new electricity transmission line running southeast from the Project to the Pentir substation. At the nearest points, the development is about 1km from the Project and 15km from the SPA. The preferred corridor for the new overhead line runs alongside and close to an existing overhead line. The scoping assessment for the North Wales Connection considers that the likelihood of a significant effect from reduction of foraging habitat for chough is unlikely. The development will be subject to EIA and HRA which will include a detailed assessment of land take; consent will be dependent on a finding of no adverse effect on European sites and qualifying species (alone and in combination). On this basis no in combination effect due to land take is predicted
Rhyd-y-groes Wind Farm re-power	This project involves the replacement of the existing 24 wind turbine generators (WTGs) at this site by 11 more modern WTGs. The potential effects of this project have been identified based on the Environmental Statement.	The development is about 1.5km from the Project and 15.5km from the SPA. Planning consent was granted in 2016. Planning consent was granted in 2016. The timing of decommissioning of the existing wind farm and construction of the new wind farm could coincide with the construction phase for the Project. The Environmental Statement for the project reports that chough were not recorded within the study area during 2 years of baseline field surveys, and habitats within the study area were of negligible value as foraging habitats relative to other locations nearer the coast; this species was scoped out of the ecological impact assessment for the proposed development (TPG Wind, 2015). On this basis no in combination effect due to land take is predicted for the SPA chough population.
Almwch LNG (Liquid Natural Gas)	Although the existing planning consent for the Alnwch LNG (Liquid Natural Gas) was renewed in 2013, the future plans and timescales of this project are unclear and, at the time of writing, no Environmental Statement is available online.	The development is about 10km from the Project and 23km from the SPA. The 19 hectare site near Amlwch on the north coast of Anglesey is on a former industrial site and will make use of some existing industrial buildings. The proposals also include measures to protect and enhance the natural habitats of local wildlife as well as landscaping improvements. (LNG World News 2016). On this basis it is assumed that there would be no loss of habitat suitable for chough and no potential for in combination effects on the SPA population.

Visitor and Media Reception Centre (Horizon)	When the Wylfa Newydd Project is operational, Horizon intends to apply for planning permission for a Visitor and Media Reception Centre. There is no potential for a temporal link, but there is potential for a spatial link with the Wylfa Newydd Project. Given that this is a future planning application, there are currently no details or environmental assessments available for the Visitor and Media Reception Centre.	The proposed development is 0km from the Project and about 15km from the SPA. Construction works would not be ongoing at the same time as the construction of the Project. An assumption has been made that the construction and operation can be managed and mitigated in such a way that there is no effect of loss and/or degradation of coastal habitats that could influence the SPA chough population, and no adverse in-combination effect is predicted.
Project	**Potential effect on physical interaction between species and project infra-structure**	**Assessment of potential in-combination effect**
North Wales Connection Project	There is no Environmental Statement or HRA available to inform the in-combination assessment. The potential effects of this project have been identified based on the scoping report (National Grid, 2016).	A proposed new electricity transmission line running southeast from the Project to the Pentir substation. At the nearest points, the development is about 1km from the Project and 15km from the SPA. The preferred corridor for the new overhead line runs alongside and close to an existing overhead line. The scoping assessment for the North Wales Connection identifies a moderate likelihood of a significant effect on chough from collision with overhead transmission lines. The development will be subject to EIA and HRA which will include a detailed assessment of land take; consent will be dependent on a finding of no adverse effect on European sites and qualifying species (alone and in combination). Physical interaction in terms of collision with project infrastructure is not considered to be a risk for chough in relation to the Project. On this basis no in combination effect due to physical interaction with the project infrastructure is predicted for the SPA chough population.
Rhyd-y-groes Wind Farm re-power	This project involves the replacement of the existing 24 wind turbine generators (WTGs) at this site by 11 more modern	The development is about 1.5km from the Project and 15.5km from the SPA. Planning consent was granted in 2016. Planning consent was granted in 2016. The timing of decommissioning of the existing wind farm and construction of the new wind farm could

	WTGs. The potential effects of this project have been identified based on the Environmental Statement.	coincide with the construction phase for the Project. The Environmental Statement for the project reports that chough were not recorded within the study area during 2 years of baseline field surveys, and habitats within the study area were of negligible value as foraging habitats relative to other locations nearer the coast; this species was scoped out of the ecological impact assessment for the proposed development (TPG Wind, 2015). On this basis no in combination effect due to physical interaction with the project infrastructure is predicted for the SPA chough population.

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11 Conclusions

11.1 Stage 1 Screening

11.1.1 For the construction and operation phases of the Project, the Stage 1 Screening assessment concluded that a LSE could not be discounted for European Designated Sites in Wales, England, Scotland, Ireland and Northern Ireland. This included:

- 22 SACs and cSACs (with 11 in Wales (wholly), three cross-border sites (Wales and England) and four sites each in Ireland and Northern Ireland).
- 23 SPAs and pSPAs (with seven in Wales, one cross-border site (Wales and England), five sites in England, seven in Ireland, two in Northern Ireland and one site in Scotland).
- Five Ramsar sites (with one in Wales, one cross-border site (Wales and England) and three sites in England).

11.1.2 For decommissioning the Stage 1 Screening assessment concluded that, due to the likely scale of marine works on this phase, LSE could not be excluded for marine water quality and changes in visual and acoustic stimuli.

11.1.3 The Stage 2 Appropriate Assessment, therefore, considered the effects of the Project, alone and in-combination with other plans and projects, for each of these European Designated Sites and their interest features with respect to the screening categories (land take, changes in air quality, etc.) that had the potential to affect each site (including marine water quality and changes in visual and acoustic stimuli for decommissioning).

11.2 Embedded and additional mitigation

11.2.1 In reaching conclusions regarding the effects of the Project on the integrity of European Designated Sites, proposed mitigation has been taken into account.

11.2.2 Table 11-1 summarises the mitigation that has been considered in this Shadow HRA, including embedded mitigation (i.e. measures that are incorporated into the design of the Project in order to minimise or avoid a negative effect). Table 11-1 also sets out the proposed timing of the additional mitigation measures (i.e. construction or operational phase) and how all mitigation is to be secured.

11.2.3 The conclusions of this Shadow HRA for habitats, marine mammals, migratory fish and birds are presented in sections 11.4 to 11.7 below.

11.3 Resilience measures

11.3.1 In addition to the proposed mitigation, Horizon has held discussions with the North Wales Wildlife Trust, the National Trust and the RSPB regarding various resilience measures that would be beneficial to the management of Cemlyn lagoon. These include:

- The provision of annual funding during the construction phase to maintain or enhance the productivity and breeding success of the tern colony through predator control measures, increasing the length of seasonal staffing to encompass March and the August Bank Holidays, access management and the investigation of measures to secure breeding habitat.
- The development of an incident response plan, and agreed triggers, to address any adverse effects of increased sediment loads discharging to the lagoon from storm events, nutrient release and heavy metals/contaminants.
- Discussions with the landowner, tenant and NRW regarding the introduction of a weir/sluice at the mouth of the lagoon, with a facility to stop lock the inflow and regulate storm water flows, to manage water levels.

11.3.2 These measures are not required as mitigation arising from predicted Projects effects and as such are not identified as mitigation measures in the Shadow HRA assessment. On this basis the measures do not represent a material consideration for decision making purposes. Horizon would, however, identify and facilitate initiatives to implement the identified measures on a voluntary basis..

Table 11-1 Schedule of mitigation measures, timing and securing permissions relevant to the HRA

Effect	Mitigation	Project phase in which the mitigation would apply	Relevant document [and securing permission]
Changes in terrestrial water quality (and marine) water quality			
Increase in suspended sediment and potential change in chemical content of drainage discharge	Appropriate drainage would be installed prior to Main Construction. This would include settlement ponds, appropriate treatment to manage flows and meet agreed water quality thresholds (Environmental Quality Standards). For the Nant Cemlyn (which drains to the Cemlyn Lagoon) specific measures to manage the discharge of sediment would be implemented during the construction of Mound E. Flow would be diverted into the Afon Cafnan until vegetation establishes and risk of sediment discharge (as agreed with NRW) would be low. • No polyelectrolyte dosing would be employed for discharge E1. • From the point of commencement of earthworks on the west of Mound E onwards, no water would be discharged into Nant Cemlyn via discharge E1 until vegetation has re-established and risk of sediment run off is agreed with NRW to be low. • After establishment of vegetation, if there are any additional bulk earthworks on the west of Mound E resulting in a risk of sediment discharge, no water would be discharged into Nant Cemlyn via discharge E1 until re-establishment has been again been agreed in writing with NRW. • During the above period(s) all water to be diverted and discharged into the Afon Cafnan via discharge E2.	Construction	Main Power Station Site sub-CoCP [DCO, drainage design] [Construction discharge EP]

Effect	Mitigation	Project phase in which the mitigation would apply	Relevant document [and securing permission]
Changes in marine water quality			
Foul water discharge	Foul water discharge would be to existing Dŵr Cymru Welsh Water sewage treatment works and to on-site package treatment plants. Foul water would not be discharged to the surface water environment.	Construction	Main Power Station Site sub-CoCP Marine Works sub-CoCP [DCO; Marine Licence; Construction discharge EP]
Operational discharge from the Cooling Water System	The cooling water outfall will be designed to: • increase the momentum of discharge • propel the thermal plume • promote mixing and dispersal of associated biocide products to the north of Wylfa Head where offshore currents will aid decay and dispersion • reduce the risk of recirculation (reducing the effect on prey).	Embedded	Design Principles – DAS [Operational water discharge EP]
	The biocide dosing regime will be designed to reduce biofouling risk, normally between April and December, when sea temperatures are above 10°C. Typically biocide dosing would be applied to all areas of the CWS except around screens to prevent harm to fish impinged on screens. In line with best practice, continuous dosing will be applied during a higher fouling risk period. Sodium hypochlorite or appropriate alternatives would be used for this purpose.	Embedded Operation	Wylfa Newydd CoOP [Operational water discharge EP]
Change in air quality			
Dust emissions from concrete batching plant	The design of the concrete-batching plant will include embedded mitigation measures to prevent or reduce emissions of dust as part of the design. These will include enclosing the various parts of the plant, silos and cement powder delivery systems and fitting them with suitable dust mitigation systems.	Embedded	Design Principles – DAS [DCO]

Effect	Mitigation	Project phase in which the mitigation would apply	Relevant document [and securing permission]
Construction dust (earthworks and material handling)	The key method for controlling dust emissions is through good process, site design and good housekeeping. The dust control measures implemented would be based on the following hierarchy: • adopt activities that do not give rise to dust releases; • good process design to reduce dust emissions (such as reducing drop heights/where possible covering stockpiles, reduction of vehicle speed); • abatement systems or control measures in place (water bowsers); and • daily vigilance and mitigation. Good practice measures to control dust during construction are derived from the guidance on the assessment of dust from demolition and construction (Institute of Air Quality Management).	Construction	Wylfa Newydd CoCP [DCO]
Construction plant, machinery and marine vessels emissions	• The drivers of all vehicles would switch off their engines when stationary – there would be no idling vehicles. • Mains electricity or battery-powered equipment would be used where practicable to avoid the use of petrol or diesel generators. • Construction plant and machinery would be maintained in accordance with the manufacturers' instructions to reduce the risk of elevated emissions due to poor engine/emissions, maintain abatement performance, and ensure that any malfunctions are swiftly repaired.	Construction	Wylfa Newydd CoCP [DCO]
	A comprehensive air quality monitoring and reporting scheme will be developed in discussion with the IACC and NRW, including agreement of thresholds and additional achievement criteria to ensure compliance with the appropriate environmental standards. Since the Project is in development it would continue to be developed with the regulator and finalised for approval prior to the start of construction. Where necessary additional modelling and assessment would be undertaken to support the development of the Project	Construction	Main Power Station Site sub-CoCP [DCO]

Effect	Mitigation	Project phase in which the mitigation would apply	Relevant document [and securing permission]
	as it matures. In order to achieve the appropriate environmental standards the Project would include a range of measures to achieve that outcome, for example: • A fleet mix that would include newer NRMM complying with the EU Stage IV NRMM emissions standards (i.e. plant generally manufactured after 2014), which emit 80% less NOx than Stage IIIB plant. • Active and on-going management of the plant and machinery operating in close proximity to the key exceedance areas where an impact is predicted. • Use of continuous NOx and NO_2 monitoring to track compliance against the AQOs, critical levels and mitigation objectives, including appropriate feedback mechanisms to ensure the emissions management scheme can be adapted to respond to measured exceedances or elevated concentrations. The continuous monitoring would be supplemented with passive NO2 diffusion tube monitoring at a greater number of locations to track the changes in annual mean NO_2 concentrations. Regular reports would be made to the IACC and NRW and an on-line web access system to the monitoring system and monitoring data set up		
Combustion plant emissions (deposition of nitrogen and acidic compounds)	All combustion plant (including the standby generator) would operate on ultra-low sulphur diesel, which has a sulphur content of 10 parts per million or less (i.e. 0.001% sulphur content), where this does not compromise safety and operational requirements. This would reduce emissions of sulphur dioxide from the generator exhaust by a factor of 100 compared to standard gas oil with a sulphur content of 0.1%.	Embedded	Wylfa Newydd CoOP [Operational combustion activity EP]
	The standby generators and boilers would always be operated in line with the selected equipment manufacturer's operating procedures, and in many cases these would be superseded by Horizon's operating procedures as a nuclear operating facility. Horizon would undertake appropriate routine maintenance and testing of all proposed combustion plant to optimise combustion	Good Practice Construction Operation	Wylfa Newydd CoOP [Operational combustion activity EP]

Effect	Mitigation	Project phase in which the mitigation would apply	Relevant document [and securing permission]
	parameters and avoid abnormal or elevated emissions.		
	For routine testing during normal operations only one standby generator would ever be tested at any one time. In addition, no routine tests on other standby generators would be undertaken within the same day to eliminate the potential for any combined short-term effects. Additional tests would need be undertaken in line with commissioning and operating procedures, which may include same day testing during commissioning and other infrequent occurrences (e.g. in unlikely event of a generator breakdown or failures to start).	Operation	Wylfa Newydd CoOP [Operational combustion activity EP]
Changes in visual and acoustic stimuli			
Underwater noise	Dredging, rock breaking, rock cutting and drilling undertaken in the marine environment would follow best practice guidance for minimising the risk of injury to marine mammals [from piling noise] detailed by the Joint Nature Conservation Committee. This guidance includes the requirements listed below. • Establishment of a mitigation zone around the construction site. • Only commence construction operations during the hours of daylight and good visibility (observers should be able to monitor the full extent of the mitigation zone). • Visual monitoring by Marine Mammal Observer(s) (MMOs). • Passive Acoustic Monitoring (PAM). • Pre–construction activity search for marine mammals. • Delay if marine mammals detected within the mitigation zone. • Soft-start of construction activity for a period of not less than 20 minutes. • Pre–construction activity search and soft-start procedure should be repeated before construction activity recommences, if construction	Construction	Marine Works sub-CoCP [Marine Licence; DCO]

Effect	Mitigation	Project phase in which the mitigation would apply	Relevant document [and securing permission]
	activity operations pause for a period of greater than 10 minutes. • Clear communication between the MMOs/PAM operators and the construction activity operators. Reports detailing the construction activity and marine mammal mitigation, the 'MMO and PAM reports', would be sent to the relevant conservation agency after the end of the construction activity.		
Disturbance to breeding terns from construction noise - monitoring	During construction works noise levels would be measured at the tern colony either through direct monitoring on the island or calculations based on monitoring adjacent locations. Where monitored noise levels are found to be above the committed noise levels (below), the following actions would be undertaken immediately: • review works in the area likely to be causing the breach and consider any necessary mitigation actions (including if necessary, temporary suspension of works); • confirm that monitored levels are not being impacted by other noise or vibration sources; • determine whether the exceedance is due to a particular activity or item of equipment, and if so, identify if the equipment can be substituted for an alternative piece of equipment; • implement other feasible and reasonable measures (which may include modifying time of works, using an alternate construction methodology, or a combination of these); and • continue monitoring (including additional monitoring, if required) to verify that the control measures have reduced the noise levels to acceptable level at the relevant receptors. These commitments would apply from 15th April to 15th August (unless otherwise stated; 15th April date to be guided by information from the NWWT	Construction	Main Power Station Site sub-CoCP [DCO] Marine works sub-CoCP [Marine Licence]

Effect	Mitigation	Project phase in which the mitigation would apply	Relevant document [and securing permission]
	on when the first terns/black-headed gulls typically arrive to set up a colony).		
Disturbance to breeding terns from construction noise - main earthworks (anticipated to be for the first two years, but to be kept under review to account for changes to the construction programme)	Horizon will commit that: • Blasting on the site would only be undertaken when, taking into account wind factors, noise shielding and other mitigation, the predicted blast noise at the colony would be less than 60 dB or daily ambient noise at the colony (whichever is higher). • Day-time construction noise at the colony would not exceed 59 dB $L_{Aeq, 1\text{-}hour}$ [Reason: based on modelled noise level of 58.6 dB $L_{Aeq, 1\text{-}hour}$]. • Night-time (7pm to 7am) maximum construction noise at the colony would not exceed 43 dB $L_{Aeq, 1\text{-}hour}$ [Reason: based on modelled noise level of 42.8 dB $L_{Aeq, 1\text{-}hour}$].	Construction	Main Power Station Site sub-CoCP [DCO] Marine works sub-CoCP [Marine Licence]
Disturbance to breeding terns from construction noise - additional noise controls during subsequent seasons (anticipated to be year 3 onwards)	Day-time modelling of construction activities predicts level of 43.7 dB $L_{Aeq, 1\text{-}hour}$ Night-time (7pm to 7am) modelling of construction activities predicts level of 42.4 dB $L_{Aeq, 1\text{-}hour.}$ Therefore no specific general construction noise commitments are proposed. However, Horizon will commit to the following for subsequent nesting season establishment periods (as defined below): • Blasting would only be undertaken when blast noise calculations (including weather conditions) predict noise levels at the colony of less than 54 dB $L_{AF,max}$. [Reason: main blasting would be complete and only minor or unforeseen blasting requirements would remain.]	Construction	Main Power Station Site sub-CoCP [DCO] Marine works sub-CoCP [Marine Licence]
Disturbance to breeding terns from construction noise – additional noise controls during the establishment period	During main earthworks, in order to allow for the sensitivity of terns arriving and establishing their nesting colony, additional construction constraints (below) would be applied during the 'establishment period'. The 'establishment period' is to be defined as follows: • The tern nesting site would be monitored from 1st April each year (historically only very few terns arrive before early April each year). • The establishment period would be four weeks, to be taken as starting	Construction	Main Power Station Site sub-CoCP [DCO] Marine works sub-CoCP [Marine Licence]

Effect	Mitigation	Project phase in which the mitigation would apply	Relevant document [and securing permission]
	on 15th April unless significant nest establishment is observed ahead of this date, in which case it would begin earlier. • The activities that constitute the establishment of nesting territories by any tern species that is a qualifying feature of the Morwenoliaid Ynys Môn/Anglesey Terns SPA are aerial display flights over the nesting islands and/or performing courtship behaviour on the ground by scrape making. In addition to these activities taking place, the frequency of occurrence of such activity is important in defining the establishment period, and Horizon would agree the basis for determining the start of the establishment period (including observed activity and frequency of occurrence) with NRW. • Trained observers (who would be professional, independent ornithologists with detailed knowledge of terns) would monitor black-headed gull to determine if their nesting behaviour appears to be affected by construction noise. If there is a lack or low numbers (based on black-headed gull status and trends) of recorded black-headed gull nesting attempts at the Cemlyn colony, the mitigation defined below would be initiated at an earlier point in time (i.e. prior to 15th April). The constraint period would be as the 'establishment period' and apply for no more than four weeks but would end earlier if [>c.50%] of the Sandwich terns expected to be present in the colony are considered to have begun egg-laying and be sitting on nests [quantum to be agreed with NRW]. During the establishment period for the first two years of construction, Horizon will commit to: • Blasting on the site would only be undertaken when, taking in account wind factors, noise shielding and other mitigation, the predicted blast noise at the colony would be less than 55 dB $L_{AF,max}$ or the daily ambient noise at the colony (whichever is higher) [Reason: this allows		

Effect	Mitigation	Project phase in which the mitigation would apply	Relevant document [and securing permission]
	some blasting in favourable wind conditions (i.e. when the wind direction is such that the tern colony is not downwind of the construction works), any further constraint in blast size is likely to prevent any meaningful work on the site] • Day-time construction noise at the colony would not exceed 55 dB $L_{Aeq, 1\text{-hour}}$ [Reason: during this period, Horizon will commit to only undertaking works on on the far side Mound E that are not visible from the colony and minimising reworking of dumped material in this area. Noise modelling of this working pattern predicts 57.5 dB $L_{Aeq, 1\text{-hour}}$. In order to achieve 55 dB $L_{Aeq, 1\text{-hour}}$, works would avoid the most adverse (light downwind) wind conditions for noise transfer to the colony] • Night-time (7pm to 7am) construction noise at the colony would not exceed 43 dB $L_{Aeq, 1\text{-hour}}$ [Reason: based on modelled noise level of 42.8 dB $L_{Aeq, 1\text{-hour}}$]		
Disturbance to breeding terns from construction noise – reactive monitoring	• Throughout the nesting periods during the construction phase, if the colony exhibits fly-up disturbance reactions [to be quantified] as a direct result of attributable noise events or shows a measurable increase in the incidence of disturbance events above those recorded during baseline observation works (undertaken over the 2017 and 2018 breeding seasons), then alternative methods of working or additional constraints would be applied (including the option of temporary suspension of works following the protocol defined here). [From the 2017/2018 observational surveys, Horizon will have an agreed baseline incidence of [circa 1.6] fly ups per hour. If the independent observers record more than three fly ups per hour for which there is no obvious non-Horizon cause, Horizon would cease the most obvious disturbing activity; if the observers record more than two fly-ups in the next hour Horizon would stop the next most disturbing activity. The following days works would be planned based on this experience of the reaction of terns to the disturbing activity. Ceased	Construction	Main Power Station Site sub-CoCP [DCO] Marine works sub-CoCP [Marine Licence]

Effect	Mitigation	Project phase in which the mitigation would apply	Relevant document [and securing permission]
	activities would start again seven days later, under observation.] • In order to attribute noise events responsible for an observed disturbance reaction of the type defined in the footnote below to the construction works, Horizon would establish a real time feedback mechanism between the observers and a nominated, dedicated site manager. The site manager would have full knowledge of all construction activities being undertaken and the authority to instigate the measures necessary on site to prevent recurrence of the disturbing activity. This feedback mechanism would also allow for consideration of other potentially disturbing factors not related to the construction works (e.g. aircraft noise) and, if such third party disturbance is deemed to be responsible in its entirety for the observed disturbance, no action would be taken.		
Disturbance at the breeding tern colony from visual stimuli	Between April 15th and May 15th there would be no works undertaken within 500m of the nesting islands and the areas on the shingle ridge that are known to be used occasionally by nesting terns. This period encompasses the main pre-laying and nest establishment period for all three tern species at Cemlyn Bay. Thereafter, there would be no bulk earthworks undertaken within 500m of any known active tern nests within the Morwenoliaid Ynys Môn/Anglesey Terns SPA.	Construction	Power Station Main Site Sub-CoCP [DCO]
Physical interaction between species and Project infrastructure			
Entrapment of fish (prey species) within the cooling water system	The Cooling Water System would be designed to limit the entrapment of marine organisms, including through the following measures: • A maximum intake velocity of 0.3m/s in front of the intake opening at lowest astronomical tide. • Screening in the form of coarse raked bars located in front of fine mesh drum screens (for the main cooling water intake) and band screens (for the service water intake). The proposed fine mesh screen size is 5mm.	Embedded	Design Principles – DAS [Marine Licence; DCO; Operational water discharge EP]

Effect	Mitigation	Project phase in which the mitigation would apply	Relevant document [and securing permission]
	• An Acoustic Fish Deterrent (AFD) in front of the cooling water intake, designed in line with the Best Available Techniques. The sound field would be located in the most appropriate location within the intake entrance; it will be specified to allow redundancy in the system and supported by modelling to demonstrate a uniform sound field. It will also be designed to avoid effects on marine mammals. • An effective Fish Recovery and Return system, discharge point located below Lowest Astronomical Tide (LAT), designed in line with the Best Available Technique that would remove fish impinged on all screens and return them to sea.		
Visitor pressure (trampling)	• A Workforce Management Strategy would be implemented to keep workers on site and control their interactions with the people and environment around them. • The Workforce Management Strategy will be agreed with NRW prior to the inception of the construction phase and reviewed as necessary during the works.	Construction	Workforce Management Strategy [DCO]
Introduction of INNS			
Introduction of INNS	Horizon will prepare one (or more) Biosecurity Risk Assessment(s) and Method Statement(s) to cover all activities. Each Biosecurity Risk Assessment will consider in general: • measures that would be undertaken to control and eradicate INNS within the area of works; and, • measures or actions that aim to prevent INNS being introduced to the site for the duration of the construction phase. For the management of existing known presence of INNS, Biosecurity Risk Assessments and Method Statements will detail: • how areas with the presence of INNS would be demarcated; • how any contaminated materials would be appropriately managed	Construction	Wylfa Newydd CoCP [DCO, terrestrial] [Marine Licence, marine]

Effect	Mitigation	Project phase in which the mitigation would apply	Relevant document [and securing permission]
	throughout the works, including where appropriate eradication from the site; • appropriate disposal; and, • how any transfer or spread would be prevented. In terms of the prevention of new introduction to the site through terrestrial and marine pathways, Biosecurity Risk Assessments and Method Statements will detail: • risk pathways and risk activities for the transfer and spread of non-native species; • risk assessment for the transfer and spread of individual non-native species of known concern; • methods to manage risk of transfer including any actions to be undertaken prior to reaching site; and • contingency planning and corrective actions. Horizon would implement a monitoring programme for non-native species. This would include observational surveys on structures that may provide suitable substrate for non-native species. Surveys would record presence/abundance of non-native species with reporting in agreement with NRW. Monitoring survey requirements for specific sites would be set out in the sub-CoCPs where relevant. Where new presence of INNS is discovered, Biosecurity Risk Assessments and Method Statements would be reviewed and amended where necessary. Wherever appropriate, workers would be given an activity specific tool-box talk from an Environmental Clerk of Works. For the marine environment, an initial pre-construction survey would be undertaken and regular surveys would begin once construction of the breakwaters and MOLF is completed. The frequency and extent of monitoring would reduce over time, particularly once the MOLF is no longer operational.		

Effect	Mitigation	Project phase in which the mitigation would apply	Relevant document [and securing permission]
	The ongoing requirement for monitoring would be regularly reviewed and agreed with NRW.		

11.4 Stage 2 AA: habitats and species (terrestrial, freshwater and coastal) of SACs and Ramsar sites

Bae Cemlyn/Cemlyn Bay SAC

11.4.1 It is concluded that no adverse effects on the integrity of the coastal lagoon qualifying feature of the Bae Cemlyn/Cemlyn Bay SAC would arise in the context of changes to air quality, coastal processes, terrestrial and marine water quality due to the construction, operation and decommissioning phases of the Project, either alone or in-combination with other plans and projects.

11.4.2 The mitigation measures proposed would reduce the potential effects of the Project on water quality in the Cemlyn lagoon. In particular, the diversion of the discharge from the drainage system from discharge E1 (i.e Nant Cemlyn) to discharge E2 (Afon Cafnan) until the risk of suspended sediment release is low would significantly reduce effects on the lagoon.

11.4.3 With regard to the perennial vegetation of stony banks qualifying feature, the extent of vegetation and/or the typical component species have the potential to be altered due to increased nitrogen and acid deposition from construction plant, machinery and vessel emissions. However, no adverse effect on integrity of this qualifying feature is predicted.

11.4.4 Furthermore, an adverse effect is not predicted on supporting habitats (Esgair Cemlyn) as a result of the Project (i.e. due to changes in coastal processes, deposition of fine sediment during capital dredging or from discharge from the drainage system or sewage inputs).

Other SACs/Ramsar site

11.4.5 This Shadow HRA concludes that no adverse effects on site integrity would arise for the Glannau Ynys Gybi/Holy Island Coast SAC, Llyn Dinam SAC, Corsydd Môn/Anglesey Fens SAC and Corsydd Môn a Llyn/Anglesey and Llyn Fens Ramsar site due to air emissions. The basis for this conclusion is that the flora and fauna species composition, habitat condition, habitat distribution and cover, population viability of component species and presence of invasive species (which are all criteria embodied within the conservation objectives for each European Designated Site) would not be adversely affected by the predicted effects of the Project on air quality.

11.4.6 No adverse effect on site integrity is also concluded for the Corsydd Môn/Anglesey Fens SAC and Corsydd Môn a Llyn/Anglesey and Llyn Fens Ramsar site due to changes in terrestrial water quality and surface and groundwater hydrology. In the post-construction phase, the creation of new fen habitat and the improvement of existing fen habitat is expected to contribute positively towards achieving the conservation objectives for these European Designated Sites.

11.5 Stage 2 AA: marine mammals

Harbour porpoise

11.5.1 The assessment of the Gogledd Môn Forol/North Anglesey Marine cSAC for harbour porpoise is based on the population of the Celtic and Irish Seas Management Unit (CIS MU). Based on the proportion of the CIS MU population potentially affected, this Shadow HRA concludes that there will be no adverse effect on integrity of the Gogledd Môn Forol/North Anglesey Marine cSAC.

11.5.2 The following European Designated Sites have harbour porpoise as a qualifying feature and are also located within the CIS MU:

- Gorllewin Cymru Forol/West Wales Marine cSAC.
- Dynesfeydd Môr Hafren/Bristol Channel Approaches cSAC.
- North Channel cSAC.
- Rockabill to Dalkey Island SAC (Ireland).

11.5.3 The only pathway for a potential effect is on the population of the CIS MU (i.e. the individuals associated with the SACs/cSACs). On this basis, therefore, the effects on the SAC/cSACs listed above would be the same as or smaller than the results for the CIS MU for the Gogledd Môn Forol/North Anglesey Marine cSAC. Hence, an adverse effect on integrity, alone or in-combination with other plans and projects, of these European Designated Sites is not predicted.

Bottlenose dolphin

11.5.4 Bottlenose dolphin is a qualifying interest feature of two European Designated Sites screened into the assessment (Pen Llyn a'r Sarnau/Llŷn Peninsula and the Sarnau SAC and Bae Ceredigion/Cardigan Bay SAC).

11.5.5 Based on the proportion of the CIS MU population potentially affected, this Shadow HRA concludes that there would be no adverse effect on integrity, alone or in-combination with other plans and projects, for these European Designated Sites.

Grey seal

11.5.6 In addition to Pen Llyn a'r Sarna /Llŷn Peninsula and the Sarnau SAC, the Shadow HRA assessed the following European Designated Sites with grey seal as a qualifying feature:

- Bae Ceredigion/Cardigan Bay SAC.
- Sir Benfro Forol/Pembrokeshire Marine SAC.
- The Maidens SAC (Northern Island).
- Lambay Island SAC (Ireland).
- Saltee Islands SAC (Ireland).

11.5.7 The assessment for these European Designated Sites was based on the South and West England and Wales MU.

11.5.8 Based on the proportion of the South and West England and Wales MU population potentially affected, this Shadow HRA concludes that there would be no adverse effect on integrity, alone or in-combination with other plans and projects, for these European Designated Sites.

Harbour seal

11.5.9 Harbour seal is a qualifying feature of the following European Designated Sites with respect to:

- Murlough SAC (Northern Ireland).
- Strangford Lough SAC (Northern Ireland).
- Lambay Island SAC (Ireland).
- Slaney River Valley SAC (Ireland).

11.5.10 The assessment for these European Designated Sites was based on the population of the West England and Wales MU.

11.5.11 Based on the proportion of the West England and Wales MU population potentially affected, this Shadow HRA concludes that there would be no adverse effect on integrity, alone or in-combination with other plans and projects, for these European Designated Sites.

11.6 Atlantic salmon and freshwater pearl mussel

11.6.1 This Shadow HRA concludes that the predicted effects of the Project on underwater noise, coastal processes and water quality during its construction and operational phases are not significant in the context of the migration pathways for juvenile and adult Atlantic salmon and sea trout. In addition, no significant entrapment in the cooling water system is predicted.

11.6.2 For the decommissioning phase, there is the potential for an effect on marine water quality and changes in visual and acoustic stimuli. However, on the basis that the effect of the works would be within that associated with the construction phase, no adverse effect during decommissioning is predicted

11.6.3 On this basis, no adverse effect on integrity, alone or in-combination with other plans and projects, on the following European Designated Sites at any stage of the Project is predicted.

- Afon Gwyrfai a Llŷn Cwellyn SAC.
- Afon Eden – Cors Goch Trawsfynydd SAC (both the Atlantic salmon and freshwater pearl mussel *Margaritifera margaritifera* qualifying features).
- Afon Dyfrdwy a Llŷn Tegid / River Dee and Bala Lake SAC.
- Afon Teifi / River Teifi SAC.

11.7 Stage 2 AA: birds

Morwenoliaid Ynys Môn/Anglesey Terns SPA

11.7.1 The most significant potential effects on the tern populations of the SPA, particularly the Sandwich tern population that breeds on the islands within Cemlyn lagoon, are from noise and visual disturbance during construction and potential effects on tern prey resources due to changes in marine water quality during construction (suspended sediments from capital dredging, dewatering and sewage discharge) and operation (discharge of cooling water), as well as entrapment of prey species within the circulating water system.

11.7.2 With the implementation of the proposed mitigation related to construction and blasting noise and visual disturbance (table 11-1), this Shadow HRA concludes that no adverse effect on integrity of the Morwenoliaid Ynys Môn/Anglesey Terns SPA would occur at any stage of the Project either alone or in-combination with other plans and projects.

Other SPAs, pSPAs and Ramsar sites (with bird qualifying features)

11.7.3 For all other European Designated Sites (except the Glannau Aberdaron and Ynys Enlli/Aberdaron Coast Bardsey Island SPA), this Shadow HRA concludes that the population within the survey area represents a fraction of 1% of the respective population of each European Designated Site. On the basis, adverse effects on integrity of other SPAs, pSPAs and Ramsar sites can be excluded (alone and in-combination).

11.7.4 For the Glannau Aberdaron and Ynys Enlli/Aberdaron Coast Bardsey Island SPA, the potential for connectivity was identified for the qualifying species Manx shearwater. Based on raw counts from boat surveys, a precautionary assumption was been made that the Disposal Site may be used by significant numbers of breeding Manx Shearwater from this SPA. However, the Shadow HRA concludes that adverse effects on the integrity of this SPA could be excluded (alone and in-combination) because of the lack of effect on the population from the different potential effects.

11.7.5 For three SPAs for which breeding and non-breeding chough are qualifying features, LSE was also determined on the basis of possible connectivity with the Wylfa Newydd Development Area, namely:

- Glannau Ynys Gybi/Holy Island Coast SPA.
- Glannau Aberdaron and Ynys Enlli/Aberdaron Coast Bardsey Island SPA.
- Mynydd Cilan, Trwyn y Wylfa ac Ynysoedd Sant Tudwal/Mynydd Cilan, Trwyn y Wylfa and the St. Tudwal Islands SPA.

11.7.6 This Shadow HRA concludes that there is evidence of a functional link with the Wylfa Newydd Development Area, but adverse effects on the integrity of these SPAs can be excluded for all stages of the Project because a

functional link could only be established for the Glannau Ynys Gybi/Holy Island Coast SPA, and in this case the level of functionality is insignificant.

11.8 Conclusion of the Shadow HRA

11.8.1 The overall conclusion drawn from the above for the purposes of the Shadow HRA is that adverse effects on the integrity of European Designated Sites or their qualifying features would not arise due to the effects of the Project in its construction, operation or decommissioning phases, either alone or in-combination with other plans and projects.

11.8.2 The proposed mitigation measures should be secured through the DCO, Marine Licence and Environmental Permits.

11.8.3 In the context of the HRA process, given the findings of the shadow AA, this assessment can be concluded at the end of Stage 2 and, hence, Stages 3 and 4 do not need to be considered.

12 References

ID	Reference
[RD1]	Aarestrup, K., Økland, F., Hansen, M.M., Righton, D., Gargan, P., Castonguay, M., Bernatchez, L., Howey, P., Sparholt, H., Pedersen, M.I. and McKinley, R.S. 2009. Oceanic spawning migration of the European eel (*Anguilla anguilla*). *Science*. 325(5948), pp.1660-1660.
[RD2]	Alabaster, J.S. 1990. The temperature requirements of adult Atlantic salmon (*Salmo salar L*.) during their upstream migration in the River Dee. *Journal of Fish Biology.* 37, pp. 659-661.
[RD3]	Alabaster, J. S., Gough, P. J. and Brooker, W. J. 1991. The environmental requirements of Atlantic salmon, *Salmo salar L*., during their passage through the Thames Estuary, 1982–1989. *Journal of Fish Biology.* 38, pp. 741-762.
[RD4]	Andersen, S. M., Teilmann, J., Dietz, R., Schmidt, N. M. and Miller, L. A. 2012. Behavioural responses of harbour seals to human-induced disturbances. *Aquatic Conservation: Marine and Freshwater Ecosystem* 22(1), pp. 113-121.
[RD5]	Arlettaz, R., Patthey, P., Baltic, M., Leu, T., Schaub, M, Palme, R. and Jenni-Eiermann, S. 2007. Spreading free-riding snow sports represent a novel serious threat for wildlife. *Proceedings of the Royal Society*. 274, pp. 1219-1224
[RD6]	Arnold, H. and Mayer, S.J. 1995. The ecology of bottlenose dolphins in Cardigan Bay, Wales, UK. *Abstracts of the Eleventh Biennial Conference on the Biology of Marine Mammals*. Orlando, Florida.
[RD7]	Arveson, P.T. and Vendittis, D.J., 2000. Radiated noise characteristics of a modern cargo ship. *The Journal of the Acoustical Society of America.* 107(1), pp.118-129.
[RD8]	Baines, M.E. and Evans, P.G.H. 2012. *Atlas of the Marine Mammals of Wales*. CCW Monitoring Report No. 68. 2nd edition. 139pp.
[RD9]	Bamber, R. N., Evans N. J. and Whittall, A. M. 2000. *Survey of Potential Coastal Saline lagoons and Pools in Wales, December 1998*. Natural History Museum Consultancy Report No. ECM 646/99; 67pp. CCW Contract Science Report No. 377.
[RD10]	Bamber, R. N., Evans, N. J., Sanderson, W. G. and Whittall, A. 2001. *Coastal saline lagoons and pools in Wales: review and proposals*. Bangor, CCW Contract Science Report No 464: 69pp.
[RD11]	Bandomir-Krischak, B. 1996. Preliminary results on reproduction of harbour porpoises in German coastal waters. *European Research on Cetaceans*. 9, pp.212-214.
[RD12]	Barlow, J. 2015. Inferring trackline detection probabilities, g(0), for cetaceans from apparent densities in different survey conditions. *Marine Mammal Science*. 31(3), pp.923-943.

ID	Reference
[RD13]	Barnthouse, L.W., 2013. Impacts of entrainment and impingement on fish populations: a review of the scientific evidence. *Environmental science and policy*. 31, pp.149-156.
[RD14]	Bash, J., Berman, C., and Bolton, S. 2001. *Effects of turbidity and suspended solids on salmonids*. Center for Streamside Studies, University of Washington, Seattle, WA.
[RD15]	Beale C.M. & Monaghan, P. 2004. Human disturbance: people as predation-free predators? *Journal of Applied Ecology.* 41, pp.335-343.
[RD16]	Bellanca M.A. and Bailey D.S. 1977. *Effects of chlorinated effluents on aquatic ecosystem in the lower James river*. J. WPCF : 639-645.
[RD17]	Berg, L. 1982. The effect of exposure to short-term pulses of suspended sediment on the behaviour of juvenile salmonids, in G.F. Hartman *et al*. [eds.] *Proceedings of the Carnation Creek workshop: a ten-year review*. Department of Fisheries and Oceans, Pacific Biological Station, Nanaimo, Canada. pp.177-192.
[RD18]	Berrow, S.D. and Rogan, E. 1995. Stomach contents of harbour porpoises and dolphins in Irish waters. *European Research on Cetaceans.* 9, pp.179-181.
[RD19]	Berry, W., Rubinstein, N., Melzian, B. and Hill, B. 2003. *The biological effects of suspended and bedded sediment (SABS) in aquatic systems: a review*. US Environment Protection Agency, National Health and Environmental Health Effects Laboratory, Rhode Island, Internal Report, 58pp.
[RD20]	Bexton, S., Thompson, D., Brownlow, A., Barley, J., Milne, R. and Bidewell, C. 2012. Unusual mortality of pinnipeds in the United Kingdom associated with helical (corkscrew) injuries of anthropogenic origin. *Aquatic Mammals*. 38(3), p.229.
[RD21]	Bjørge, A. and Tolley, K.A. 2002. Harbour Porpoise. *Encyclopedia of Marine Mammals*. Perrin, W. F., Würsig, B. and Thewissen, J. G. M. (eds.), San Diego, Academic Press: 549-551.
[RD22]	Börjesson, P. and Read, A.J. 2003. Variation in timing of conception between populations of the harbour porpoise. *Journal of Mammalogy.* 84(3), pp.948-955.
[RD23]	Börjesson, P., Berggren, P. and Ganning, B. 2003. Diet of harbor porpoises in the Kattegat and Skagerrak seas: accounting for individual variation and sample size. *Marine Mammal Science*. 19(1), pp.38-058.
[RD24]	British Energy Estuarine and Marine Studies (BEEMS). 2011. *Thermal standards for cooling water from new build nuclear power stations*. EDF BEEMS.
[RD25]	Brown, AL. 1990. Measuring the effect of aircraft noise on seabirds. *Environment International*. 16, pp.587-592.

ID	Reference
[RD26]	Buckland, S.T., Anderson, D., Burnham, K., Laake, J., Borchers, D. and Thomas, L. 2001. *Introduction to distance sampling: estimating abundance of biological populations*. Oxford University Press, Oxford.
[RD27]	Burger, J. 1984. Colony stability in least terns. *The Condor*, 86, pp.61-67.
[RD28]	Burger, J. 1998. Effects of motorboats and personal watercraft on flight behaviour over a colony of common terns. *The Condor*. 100, pp.528-534.
[RD29]	Burger, J. 2003. Personal watercraft and boats: Coastal conflicts with common terns. *Lake and Reservoir Management*, 19, pp.26-34.
[RD30]	Burton, N.H.K. 2000. Winter site-fidelity and survival of redshank Tringa totanus at Cardiff, south Wales. *Bird Study*, 47, pp.102-112.
[RD31]	Burton. N.H.K. and Armitage, M.J.S. 2005. Differences in the diurnal and nocturnal use of intertidal feeding grounds by redshank Tringa totanus. *Bird Study*, 52, pp.120-128.
[RD32]	Cabot, D, Nisbet, I. 2013. Terns. Collins New Naturalist Library, 123. HarperCollins, UK.
[RD33]	Calladine, J.R., Park, K.J., Thompson, K. and Wernham, C.V. 2006. *Review of urban gulls and their management in Scotland*. A report to the Scottish Executive.
[RD34]	Camphuysen, K., Fox, T., Leopold, M. and Petersen, K. 2004. Towards standardised seabirds at sea census techniques in connection with environmental impact assessments for offshore wind farms in the UK. *A Comparison of Ship and Aerial Sampling Methods for Marine Birds, and their Applicability to Offshore Wind Farm Assessments*. Koninklijk Nederlands Instituut voor Onderzoek der Zee Report commissioned for COWRIE.
[RD35]	Canadian Council of Ministers of the Environment (CCME) 2001. *Canadian sediment quality guidelines for the protection of aquatic life*. CCME EPC-98E.
[RD36]	Carney, K.M. and Sydeman, W.J. 1999 A review of human disturbance effects on nesting colonial waterbirds. *Waterbirds*. 22, pp.68-79.
[RD37]	Central Dredging Association (CEDA) 2011. *Underwater sound in relation to dredging*. Central Dredging Association position paper, prepared by the CEDA Working Group on Underwater Sound under the remit of the CEDA Environment Commission. [Online]. [Accessed: 28/01/13]. Available from: www. dredging.org/documents/ ceda/html_page/2011-11_ceda.
[RD38]	Centre for Ecology and Hydrology. 2016. *UK Air Pollution Information System*. [Online]. [Accessed: August 2016]. Available from: http://www.apis.ac.uk/.
[RD39	Chapman, C. and Tyldesley, D. 2016. *Functional linkage: How areas that are functionally linked to European sites have been considered when they may be affected by plans and projects – a review of authoritative decisions*. Natural England Commissioned Reports, number 207.

ID	Reference
[RD40]	Cheney, B., Thompson, P.M., Ingram, S.N., Hammond, P.S., Stevick, P.T., Durban, J.W., Culloch, R.M., Elwen, S.H., Mandleberg, L., Janik, V.M., Quick, N.J., Islas-Villanueva, V., Robinson, K.P., Costa, M., Eisfel, S.M., Walters, A., Phillips, C., Weir, C.R., Evans, P.G.H., Anderwald, P., Reid, R.J., Reid, J.B. and Wilson, B. 2013. Integrating multiple data sources to assess the distribution and abundance of bottlenose dolphins (*Tursiops truncatus*) in Scottish waters. *Mammal Review*. 43(1), pp.71-88.
[RD41]	Clarke, R.T., Liley, D., Sharp, J.M. and Green, R.E. 2013. Building development and roads: Implications for the distribution of stone curlews across the Brecks. *PLoS ONE*. 8, pp.1–17.
[RD42]	Corkeron, P.J., Bryden, M.M. and Hedstrom, K.E. 1990. Feeding by bottlenose dolphins in association with trawling operations in Moreton Bay, Australia. *The bottlenose dolphin*, pp.329-336.
[RD43]	Countryside Council for Wales (CCW). 2008. *Core Management Plan including conservation objectives for Ynys Feurig, Cemlyn Bay and The Skerries SPA; Cemlyn Bay SAC; Ynys Feurig SSSI; The Skerries SSSI; Cemlyn Bay SSSI*. March 2008. [Online]. [Accessed: 22/05/2017]. Available from: https://www.naturalresources.wales/media/671214/Cemlyn%20WES32%20plan%20English.pdf
[RD44]	Countryside Council for Wales (CCW). 2008. *Core Management Plan including conservation objectives for Afon Gwyrfai a Llyn Cwellyn SAC*. April 2008. [Online]. [Accessed: 25/05/2017] Available from: https://www.naturalresources.wales/media/670697/Afon%20Gwyrfai%20a%20Llyn%20Cwellyn%20Management%20%20Plan%20_English_.pdf
[RD45]	Countryside Council for Wales (CCW). 2008. *Core Management Plan including conservation objectives for Afon Eden – Cors Goch Trawsfynydd SAC*. February 2008. [Online]. [Accessed: 25/05/2017]. Available from: https://www.naturalresources.wales/media/670687/Afon%20Eden%20WES32%20plan%20English.pdf
[RD46]	Countryside Council for Wales (CCW). 2008. Core Management Plan including conservation objectives for Afon Dyfrdwy a llyn Tegid / River Dee and Bala Lake SAC. April 2008. [Online]. [Accessed: 25/05/2017]. Available from: https://www.naturalresources.wales/media/673374/River_Dee___Bala_Lake_32_Plan.pdf.
[RD47]	Countryside Council for Wales (CCW). 2008. *Core Management Plan including Conservation Objectives for Glannau Ynys Gybi SAC and Glannau Ynys Gybi SPA*. [Online]. [Accessed: 16/05/2017]. Available from: https://www.naturalresources.wales/media/672152/Glannau%20Ynys%20Gybi%20WES%20Plan%20English.pdf.

ID	Reference
[RD48]	Countryside Council for Wales (CCW). 2008. *Core Management Plan including conservation objectives for Llyn Dinam Special Area for Conservation and Llynnau Y Fali Site of Special Scientific Interest*. March 2008. [Online]. [Accessed: 22/05/2017]. Available from: https://www.naturalresources.wales/media/672701/Llyn%20Dinam%20SAC%20plan%2015%20April%202008%20%20_English_.pdf.
[RD49]	Countryside Council for Wales (CCW). 2008. *Core Management Plan including conservation objectives for Corsydd Môn/ Anglesey Fens SAC and Corsydd Môn a Llyn/ Anglesey and Llyn Fens Ramsar site (Anglesey sites only)*. April 2008. [Online]. [Accessed: 22/05/2017]. Available from: https://naturalresources.wales/media/675002/corsydd-mon-sac-english.pdf.
[RD50]	Countryside Council for Wales (CCW). 2008. *Core Management Plan including Conservation Objectives for Glannau Aberdaron and Ynys Enlli /Aberdaron Coast and Bardsey Island SPA (including part of Clogwyni Pen Llŷn/Lleyn Seacliffs SAC and Pen Llŷn A'r Sarnau SAC). (These sites are underpinned by Glannau Aberdaron SSSI, Ynys Enlli Sssi, and Ynysoedd Y Gwylanod SSSI)*. [Online]. [Accessed: 17/05/2017] Available from: https://www.naturalresources.wales/media/672092/Glannau%20Aberdaron%20Plan%20English.pdf.
[RD51]	Countryside Council for Wales (CCW). 2008. *Core Management Plan including Conservation Objectives for Skomer and Skokholm SPA*. [Online]. [Accessed: 18/05/2017] Available from: http://naturalresources.wales/media/674164/Skomer%5B1%5D.Skokholm%20management%20plan%2007.pdf.
[RD52]	Countryside Council for Wales (CCW). 2008. *Core Management Plan including Conservation Objectives for Grassholm SPA*. [Online]. [Accessed: 18/05/2017] Available from: https://www.naturalresources.wales/media/674134/Grassholm%20SPA%20Management%20Plan%2021%5b1%5d.4.08%20(English).pdf.
[RD53]	Countryside Council for Wales (CCW). 2008. *Core Management Plan including Conservation Objectives for Mynydd Cilan, Trwyn y Wylfa ac Ynysoedd Sant Tudwal SPA (including part of Clogwyni Pen Llŷn/Lleyn Seacliffs SAC and Pen Llŷn A'r Sarnau SAC). (All sites are underpinned by Porth Ceiriad, Porth Neigwl Ac Ynysoedd Sant Tudwal SSSI)*. [Online]. [Accessed: 17/05/2017] Available from: https://www.naturalresources.wales/media/673012/Mynydd%20Cilan%20SAC%20Plan%20English.pdf.
[RD54]	Countryside Council for Wales (CCW). 2009. *Pembrokeshire Marine European Marine Site*: *Advice provided by the Countryside Council for Wales in fulfilment of Regulation 33 of the Conservation (Natural Habitats, andC.) Regulations 1994*. February 2009. [Online]. [Accessed: 22/05/2017]. Available from: http://www.ukmpas.org/pdf/Sitebasedreports/Pembrokeshire_Marine_Reg_33_Advice_Feb_2009.doc.pdf.

ID	Reference
[RD55]	Countryside Council for Wales (CCW). 2009. *Cardigan Bay European Marine Site: Advice Provided by The Countryside Council for Wales in Fulfilment of Regulation 33 of The Conservation (Natural Habitats, andC.) Regulations 1994*. [Online] [Accessed: 29/01/18]. Available from: https://www.naturalresources.wales/media/673505/Cardigan%20Bay%20R33%20Feb%202009.pdf
[RD56]	Countryside Council for Wales (CCW). 2009. *Pen Llŷn a'r Sarnau /Lleyn Peninsula and the Sarnau European Marine Site: Advice Provided by The Countryside Council for Wales in Fulfilment of Regulation 33 of The Conservation (Natural Habitats, andC.) Regulations 1994*.
[RD57]	Countryside Council for Wales (CCW). 2009. *Y Fenai a Bae Conwy / Menai Strait and Conwy Bay European Marine Site comprising: Y Fenai a Bae Conwy / Menai Strait and Conwy Bay Special Area of Conservation, Traeth Lafan Special Protection Area, and Ynys Seiriol / Puffin Island Special Protection Area: Advice provided by the Countryside Council for Wales in fulfilment of Regulation 33 of the Conservation (Natural Habitats, andc.) Regulations 1994. February 2009*.[Online] [Accessed: 22/05/17] Available from: https://www.naturalresources.wales/media/673892/Y%20Fenai%20a%20Bay%20Conwy%20R33%20Advice%20Feb%202009%20English.pdf
[RD58]	Countryside Council for Wales (CCW). 2011. *Core Management Plan including conservation objectives for Afon Teifi / River Teifi SAC (Special Area of Conservation)*. April 2011. [Online] [Accessed: 25/05/17] Available from: https://www.naturalresources.wales/media/670702/Afon%20Teifi%20%20River%20Teifi%20Management%20Plan.pdf
[RD59]	Cramp, S. 1985. *Handbook of the Birds of Europe, the Middle East and North Africa*. Oxford University Press, New York.
[RD60]	Cronin, M., Kavanagh, A. and Rogan, E. 2008. *The foraging ecology of the harbour seal (Phoca vitulina vitulina) in southwest Ireland*.
[RD61]	Cross, A.V. and Stratford, A. 2015. Juvenile survival, pre-breeding dispersal and natal fidelity of red-billed choughs on the Llŷn Peninsula, Gwynedd. *Welsh Birds*. 15, pp.26-49.
[RD62]	Cunningham, L., Baxter, J.M., Boyd., I.L., Duck, C.D., Lonergan, M., Moss, S.E. and McConnell, B. 2009. Harbour seal movements and haul-out patterns: implications for monitoring and management. *Aquatic Conservation: Marine and Freshwater Ecosystems*. 19, pp.398-407.
[RD63]	Cutts, N. Hemmingway, K. & Spencer, J. Waterbird Disturbance Mitigation Toolkit Informing Estuarine Planning and Construction Projects (Version 3.2, March 2013). University of Hull. [Online]. [Accessed: 29/01/18]. Available from: http://www.tide-project.eu/
[RD64]	Cutts, N., Phelps, A. and Burdon, D. 2009. *Construction and waterfowl: defining sensitivity, response, impacts and guidance*. Report to Humber INCA.

ID	Reference
[RD65]	Danie, D.S., Trial, J.G. and Stanley, J.G. 1984. *Species profiles: life histories and environmental requirements of coastal fish and invertebrates (North Atlantic). Atlantic salmon* (No. FWS/OBS-82/11.22). Maine Univ., Orono (USA). Maine Cooperative Fishery Research Unit, 1984.
[RD66]	Department of Agriculture, Environment and Rural Affairs (DAERA) 2015. *East Coast Marine Special Protection Area (SPA) UK9020320 Conservation Objectives*. Department of Agriculture, Environment and Rural Affairs. [Online]. [Accessed: 29/01/18]. Available at URL: https://www.daera-ni.gov.uk/sites/default/files/consultations/doe/east-coast-%28northern-ireland%29-marine-proposed-special-protection-area-conservation-objectives.pdf
[RD67]	Department of Agriculture, Environment and Rural Affairs (DAERA) 2015. *Copeland Islands Special Protection Area (SPA) UK9020291 Conservation Objectives*. Department of Agriculture, Environment and Rural Affairs. [Online]. [Accessed: 18/05/17]. Available from: https://www.daera-ni.gov.uk/sites/default/files/publications/doe/copeland-islands-SPA-conservation-objectives-2015.pdf
[RD68]	Department of Agriculture, Environment and Rural Affairs (DAERA) 2015. *Rathlin Island Special Protection Area (SPA) UK9020011 Conservation Objectives*. Department of Agriculture, Environment and Rural Affairs. [Online]. [Accessed: 29/01/18]. Available from: https://www.daera-ni.gov.uk/sites/default/files/publications/doe/rathlin-spa-conservation-objectives-2015.pdf
[RD69]	Department of Agriculture, Environment and Rural Affairs (DAERA) 2017. *The Maidens SAC UK0030384 Conservation Objectives*. Department of Agriculture, Environment and Rural Affairs. [Online]. [Accessed: 29/01/18]. Available from: https://www.daera-ni.gov.uk/sites/default/files/publications/daera/The%20Maidens%20SAC%20Conservation%20Objectives%202017.PDF
[RD70]	Department of Agriculture, Environment and Rural Affairs (DAERA) 2017. *Murlough SAC UK 0016612 Conservation Objectives*. Department of Agriculture, Environment and Rural Affairs. [Online]. [Accessed: 22/05/17]. Available from: https://www.daera-ni.gov.uk/sites/default/files/publications/doe/Murlough%20SAC%20Conservation%20Objectives%202017.PDF.
[RD71]	Department of Agriculture, Environment and Rural Affairs (DAERA) 2017. *Strangford Lough SAC UK UK0016618 Conservation Objectives*. Department of Agriculture, Environment and Rural Affairs. [Online]. [Accessed: 29/01/18]. Available from: https://www.daera-ni.gov.uk/sites/default/files/publications/doe/Strangford%20Lough%20SAC%20Conservation%20Objectives%202017.PDF.

ID	Reference
[RD72]	Department of Agriculture, Environment and Rural Affairs (DAERA) 2017. *Citation document for Copeland Islands SPA*. [Online]. [Accessed: 29/01/18]. Available from: https://www.daera-ni.gov.uk/sites/default/files/publications/doe/Copeland%20Island%20SPA%20Citation%20documents%20and%20map.pdf
[RD73]	Department of Agriculture, Environment and Rural Affairs (DAERA) and Joint Nature Conservation Committee (JNCC) 2017. *SAC Selection Assessment: North Channel*. January, 2017. Joint Nature Conservation Committee, UK. [Online]. [Accessed: 29/01/18]. Available from: http://jncc.defra.gov.uk/page-7242
[RD74]	Department of Commerce. 2008. Small Takes of Marine Mammals Incidental to Specified Activities; Port of Anchorage Marine Terminal Redevelopment Project. Anchorage, Alaska. National Marine Fisheries Service (NMFS), National Oceanic and Atmospheric Administration (NOAA), Commerce. Administrator: RIN 0648-XG36.
[RD75]	Department of Communities and Local Government (DCLG) 2006. *Environmental Impact Assessment: A Guide to Good Procedures*. Consultation paper, June 2006, Department for Communities and Local Government: London.
[RD76]	Department of Energy and Climate Change (DECC) 2010. Habitats Regulations Assessment: Site Report for Wylfa. *EN-6: Revised Draft National Policy Statement for Nuclear Power Generation*. Department of Energy and Climate Change.
[RD77]	Department of Energy and Climate Change (DECC) 2011. *EN-6: National Policy Statement for Nuclear Power Generation*. Department of Energy and Climate Change.
[RD78]	Department of Energy and Climate Change (DECC). 2014. *Record of the Habitats Regulations Assessment undertaken under Regulation 61 of the Conservation of Habitats and Species Regulations 2010 (as amended) for an application under the Planning Act 2008 (as amended): Burbo Bank Extension* (September 2014).
[RD79]	Department of Energy and Climate Change (DECC) 2016. *UK Offshore Energy Strategic Environmental Assessment*. OWESEA3 March 2016: Appendix 1a.7 – Marine and Other Mammals.
[RD80]	Department of the Environment Northern Ireland (DOENI) and Joint Nature Conservation Committee (JNCC) 2016. *Harbour Porpoise (Phocoena phocoena) possible Special Area of Conservation: North Channel Draft Conservation Objectives and Advice on Activities*. January, 2016. Department of the Environment Northern Ireland and Joint Nature Conservation Committee, UK. [Online]. [Accessed: 22/05/17]. Available from: http://jncc.defra.gov.uk/pdf/NorthChannelConservationObjectivesAndAdviceOnActivities.pdf.
[RD81]	Dierschke, V., Furness, R.W. and Garthe, S. 2016. Seabirds and offshore wind farms in European waters: Avoidance and attraction. *Biological Conservation*. 202, pp.59-68.

ID	Reference
[RD82]	Dietz, R., Teilmann, J., Henrisksen, O.D. and Laidre. K. 2003. Movements of seals from Rodsand sanctuary monitored by satellite telemetry. *Relative importance of the Nysted Offshore Wind Farm to seals*. NERI, Denmark. Report No. 429: p.44.
[RD83]	Dŵr Cymru Welsh Water. 2013. *Habitats Regulations Assessment of Revised Draft Water Resources Management Plan 2013: Assessment of Preferred Options.* Report by AMEC Environment and Infrastructure UK Limited, December 2013.
[RD84]	Ecology Consulting. 2012. *Teeside Offshore Wind Farm: Ornithological monitoring of construction piling works*. Report to Teeside Offshore Wind Ltd.
[RD85]	Eglington, S.M. and Perrow, M.R. 2014. *Literature review of tern (Sterna and Sternula spp.) foraging ecology*. Report to JNCC.
[RD86]	English Nature. 2001. *Habitats Regulations Guidance Note (HRGN) 4. Alone or in combination under The Conservation (Natural Habitats andC) Regulations 1994*. English Nature 2001.
[RD87]	Environment Agency 2009. *Habitats assessment for radioactive substances*. Better regulation science programme, Science report: SC060083/SR1 Environment Agency.
[RD88]	Environment Agency 2010. *Regulatory Guidance Series, No RSR 2: The regulation of radioactive substance activities on nuclear licensed sites*. Environment Agency.
[RD89]	Environment Agency. 2011. G*eneric design assessment: UK EPRTM nuclear power plant design AREVA NP SAS and Electricité de France SA*. [Online]. [Accessed 25/06/2017]. Available from https://www.gov.uk/government/publications/generic-design-assessment-uk-epr-nuclear-power-plant-design-by-areva-np-sas-and-electricite-de-france-sa-consultation-documents
[RD90]	Environment Agency. 2016. *Air Emissions Risk Assessment for your Environmental Permit*. [Online]. [Accessed: 29/01/18]. Available from: https://www.gov.uk/guidance/air-emissions-risk-assessment-for-your-environmental-permit
[RD91]	Environmental Protection UK and Institute of Air Quality Management (EPUK and IAQM). 2017. *Land Use Planning and Development Control: Planning For Air Quality*, v1.2 January 2017.
[RD92]	Epworth, B. and Haycock, N. 2006. *Cemlyn Lagoon: Review of the Water Level Management Plan*. Report to the National Trust by Haycock Associates. Pershore, Worcestershire, 42pp.
[RD93]	Erwin, RM 1989. Responses to human intruders by birds nesting in colonies: Experimental results and management guidelines. *Colonial Waterbirds.* 12, pp.104-108.
[RD94]	European Commission 2000. *Assessment of plans and projects significantly affecting Natura 2000 sites – Methodological guidance on the provisions of Article 6(3) and (4) of the Habitats Directive 92/43/EEC*. EC 2000.
[RD95]	European Commission. 2007. *European Union Risk Assessment Report Sodium Hypochlorite.* Italy: European Commission.

ID	Reference
[RD96]	Evans, P.G.H. 1980. Cetaceans in British Waters. *Mammal Review.* 10(1), pp.1-52.
[RD97]	Evans, P.G.H., Anderwald, P. and Baines, M.E. 2003. *UK Cetacean Status Review*. Report to English Nature and the Countryside Council for Wales.
[RD98]	Evans, P.G.H., Baines, M.E., and Anderwald, P. 2011. Risk Assessment of Potential Conflicts between Shipping and Cetaceans in the ASCOBANS Region. ASCOBANS AC18/Doc. 6-04 (S). 32pp.
[RD99]	Evans, P.G.H., Carson, Q., Fisher, P., Jordan, W., Limer, R. and Rees, I., 1993. A study of the reactions of harbour porpoises to various boats in the coastal waters of southeast Shetland. *European Research on Cetaceans*. 8, pp.60-64.
[RD100]	Evans, P.G.H., James, K. and Lohrengel, K. 2015a. *Cetaceans in north Wales*. Sea Watch Foundation Report. 35 pp.
[RD101]	Evans, P.G.H., Pierce, G.J., Veneruso, G., Weir, C.R., Gibas, D., Anderwald, P. and Begoña Santos, M. 2015b. *Analysis of long-term effort-related land-based observations to identify whether coastal areas of harbour porpoise and bottlenose dolphin have persistent high occurrence and abundance*. JNCC report No. 543, JNCC, Peterborough.
[RD102]	Everaert, J. and Stienen, E.W.M. 2007. Impact of wind turbines on birds in Zeebrugge (Belgium). *Biodiversity and Conservation*. 16, pp.3345-3359.
[RD103]	Feingold, D. and Evans, P.G.H. 2013. *Bottlenose Dolphin and Harbour Porpoise Monitoring in Cardigan Bay and Pen Llŷn a'r Sarnau Special Areas of Conservation*. Interim report, February 2013. CCW and Sea Watch Foundation.
[RD104]	Feingold, D. and Evans, P.G.H. 2014. *Connectivity of Bottlenose Dolphin in Welsh Waters: North Wales Photo-Monitoring Report*. Sea Watch Foundation. 16 pp.
[RD105]	Feingold, D. and Evans, P.G.H. 2014. *Bottlenose Dolphin and Harbour Porpoise Monitoring in the Cardigan Bay and Pen Llŷn a'r Sarnau Special Area of Conservation 2011 – 2013*. NRW Evidence Report Series, Report No: 4, 120 pp. Natural Resources Wales, Bangor Sea Watch Foundation. Report Number. 95. 124 pp.
[RD106]	FGS. 2017. Wylfa Newydd Nuclear Power AFD Preliminary Acoustic Modelling Further Modelling Report. Fish Guidance Systems Ltd report to Jacobs UK Ltd, Document Reference – 1342PMS0203. 22pp.
[RD107]	Fijn, R.C., de Jong, J., Courtens, W., Verstraete, H., Stienen, E.W.M. and Poot, M.J.M., 2017. GPS-tracking and colony observations reveal variation in offshore habitat use and foraging ecology of breeding Sandwich Terns. *Journal of Sea Research*. 127, pp.203-211.

ID	Reference
[RD108]	Finneran, J.J. and Jenkins, A.K. 2012. *Criteria and thresholds for U.S. Navy acoustic and explosive effects analysis*. SSC Pacific Technical Report, April 2012.
[RD109]	Fontaine, M.C., Baird, S.J.E., Piry, S., Ray, N., Ferreira, M., Jauniaux, T., Llavona, A., Ozturk, B., Ozturk, A.A., Ridoux, V., Rogan, E., Sequeira, M., Siebert, U., Vikingsson, G.A., Bouquegneau, J.M. and Michaux, J.R. 2007. Rise of oceanographic barriers in continuous populations of a cetacean: the genetic structure of harbour porpoises in Old World waters. *BMC BIOLOGY*, 5. [Online]. [Accessed: 29/01/18]. Available from: http://www.biomedcentral.com/1741-7007/5/30 .
[RD110]	Fontaine, M.C., Roland, K., Calves, I., Austerlitz, F., Palstra, F.P., Tolley, K.A., Ryan, S., Ferreira, M., Jauniaux, T., Llavona, A., Öztürk, B., Öztürk, A.A., Ridoux, V., Rogan, E., Sequeira, M., Siebert, U., Vikingsson, G.A., Borrell, A., Michaux, J.R. and Aguilar, A. 2014. Postglacial climate changes and rise of three ecotypes of harbour porpoises, *Phocoena phocoena*, in western Palearctic waters. *Molecular Ecology*. 23(13): pp.3306–3321.
[RD111]	Fontaine, M.C., Thatcher, O., Ray, N., Piry, S., Brownlow, A., Davison, N.J., Jepson, P., Deaville, R. and Goodman, S.J. 2017. Mixing of porpoise ecotypes in southwestern UK waters revealed by genetic profiling. *Royal Society open science*. 4(3), p.160992.
[RD112]	Frederiksen, M., Børg, M., Daunt, F., Phillips, R.A., Barrett, R.T., Bogdanova, M.I., Boulinier, T., Chardine, J.W., Chastel, O., Chivers, L.S., Christensen-Dalsgaard, S., Clément-Chastel, C., Colhoun, K., Freeman, R., Gaston, A.J., González-Solís, J., Goutte, A., Grémillet, D., Guilford, T., Jensen, G.H., Krasnov, Y., Lorentsen, S-H., Mallory, M.L., Newell, M., Olsen, B., Shaw, D., Steen, H., Strøm, H., Systad, G.H., Thórarinsson, T.L. and Anker_Nilssen, T. 2012. Multicolony tracking reveals the winter distribution of a pelagic seabird on an ocean basin scale. *Diversity and Distributions*. 18, pp.530-542.
[RD113]	Furness, R.W. 2015. *Non-breeding season populations of seabirds in UK waters: Population sizes for Biologically Defined Minimum Population Scales (BDMPS)*. Natural England Commissioned Reports, no. 164.
[RD114]	Furness, R. W., Wade, H. M., Robbins, A. M. C. and Masden, E. A. 2012. Assessing the sensitivity of seabird populations to adverse effects from tidal stream turbines and wave energy devices. *Journal of Marine Science.* 69, pp.1466–1479.
[RD115]	Furness, RW, Wade, HM and Masden, EA. 2013. Assessing vulnerability of marine bird populations to offshore wind farms. *Journal of Environmental Management*. 119, pp.56-66.
[RD116]	Garrett, H.M. 2016. Freshwater pearl mussel larval encystment of host fish species in the Afon Eden – Cors Goch Trawsfynydd SAC. NRW Evidence Report 164. 31pp. NRW. Bangor.
[RD117]	Garthe, S and Hüppop, O. 2004. Scaling possible adverse effects of marine wind farms on seabirds: Developing and applying a vulnerability index. *Journal of Applied Ecology*. 41, pp.724-734.

ID	Reference
[RD118]	Gaskin, D.E. 1992. Status of the harbour porpoise, *Phocoena phocoena*, in Canada. *Canadian Field-Naturalist.* 106(1), pp.36-54.
[RD119]	Gordon, J., Thompson, D., Leaper, R., Gillespie, D., Pierpoint, C., Calderan, S., Macaulay, J., Gordon, T. and Simpson, N. 2011. *Phase 2 – Studies of marine mammals in Welsh high tidal energy waters v5*. Report Number: JER3688R110408JG. 130 pp + Appendices.
[RD120]	Grant, M.C. and Pearce-Higgins, J.W., 2012. Spatial variation and habitat relationships in moorland bird assemblages: a British perspective. Birds and Habitat*. Cambridge University Press, Cambridge*. pp.207-236.
[RD121]	Green, J., Green, R. and Jefferies, D. J. 1984. A radio-tracking survey of otters *Lutra lutra* on a Perthshire river system. *Lutra*. 27, pp.85-145.
[RD122]	Grellier, K. and Wilson, B. 2003. Bottlenose dolphins using the Sound of Barra, Scotland. *Aquatic Mammals*. 29(3), pp.378-382.
[RD123]	Grellier, K., Hammond, P.S., Wilson, B., Sanders-Reed, C.A. and Thompson, P.M. 2003. Use of photo-identification data to quantify mother-calf association patterns in bottlenose dolphins. *Canadian Journal of Zoology.* 81, pp.1421-1427.
[RD124]	Hammond, P.S. and Grellier, K. 2006. *Grey seal diet composition and prey consumption in the North Sea*. Final report to Department for Environment Food and Rural Affairs on project MF0319.
[RD125]	Hammond, P.S., Lacey, C., Gilles, A., Viquerat, S., Boerjesson, P., Herr, H., Macleod, K., Ridoux, V., Santos, M., Scheidat, M. and Teilmann, J. 2017. *Estimates of cetacean abundance in European Atlantic waters in summer 2016 from the SCANS-III aerial and shipboard surveys*. Wageningen Marine Research.
[RD126]	Hammond P.S., Macleod K., Berggren P., Borchers D.L., Burt L., Cañadas A., Desportes G., Donovan G.P., Gilles A., Gillespie D., Gordon J., Hiby L., Kuklik I., Leaper R., Lehnert K, Leopold M., Lovell P., Øien N., Paxton C.G.M., Ridoux V., Rogano E., Samarraa F., Scheidatg M., Sequeirap M., Siebertg U., Skovq H., Swifta R., Tasker M.L., Teilmann J., Canneyt O.V. and Vázquez J.A. 2013. Cetacean abundance and distribution in European Atlantic shelf waters to inform conservation and management. *Biological Conservation.* 164, pp.107-122.
[RD127]	Hammond, P.S., Northridge, S.P., Thompson, D., Gordon J.C.D., Hall, A.I., Aarts, G. and Matthiopoulos, J. 2005. *Background information on marine mammals for Strategic Environmental Assessment 6*. Sea Mammal Research Unit.
[RD128]	Hammond, P.S., Northridge, S.P., Thompson, D., Gordon, J.C.D., Hall, A.J., Murphy, S.N. and Embling, C.B. 2008. *Background information on marine mammals for Strategic Environmental Assessment 8*. Report to DECC. Sea Mammal Research Unit, St. Andrews, Scotland, UK, 52 pp.

ID	Reference
[RD129]	Harwood, A.J.P., Perrow, M.R., Berridge, R.J., Tomlinson, M.L. and Skeate E.R. 2017. Unforeseen responses of a breeding seabird to the construction of an offshore wind farm. In Köppel, J (ed) *Wind Energy and Wildlife Interactions: Presentations from the CWW2015 Conference*. pp 19-41. Springer International Publishing.
[RD130]	Heinänen, S. and Skov, H. 2015. *The identification of discrete and persistent areas of relatively high harbour porpoise density in the wider UK marine area*, JNCC Report No.544 JNCC, Peterborough.
[RD131]	Hernández-Milián, G. 2014. *Trophic role of small cetaceans and seals in Irish waters*. Doctoral dissertation, University College Cork, Ireland. 405 pp.
[RD132]	Hernández-Milian, G., Begoña Santos, M., Reid, D. and Rogan, E. (2015) Insights into the diet of Atlantic white-sided dolphins (*Lagenorhynchus acutus*) in the Northeast Atlantic. *Marine Mammal Science*, 32(2), pp.735-742.
[RD133]	Hoover-Miller, A., Bishop, A., Prewitt, J., Conlon, S., Jezierski, C. and Armato, P. 2013. Efficacy of voluntary mitigation in reducing harbour seal disturbance. *The Journal of Wildlife Management*. 77, pp. 689-700.
[RD134]	Hunt, G.L. and Furness, R.W. 1996. *Seabird/fish interactions with particular reference to seabirds in the North Sea*. ICES Cooperative Research Report. No. 216. 93 pp.
[RD135]	Ingram, S.N. and Rogan, E. 2002. Identifying critical areas and habitat preferences of bottlenose dolphins Tursiops truncatus. *Marine Ecology Progress Series.* 244, pp.247-255.
[RD136]	Institute of Air Quality Management (IAQM). 2014. *Guidance on the assessment of dust from demolition and construction*. Institute of Air Quality Management, Version 1.1, June 2016.
[RD137]	Inter-Agency Marine Mammal Working Group (IAMMWG) 2013. *Management units for marine mammals in UK waters* (June 2013).
[RD138]	Inter-Agency Marine Mammal Working Group (IAMMWG) 2015. *Management Units for cetaceans in UK waters (January 2015)*. JNCC Report No. 547, JNCC Peterborough.
[RD139]	International Council for the Exploration of the Sea (ICES) 2014. *Report of The Working Group on Marine Mammal Ecology* (WGMME).
[RD140]	International Maritime Organization (IMO) 2008. *Harmful Aquatic Organisms In Ballast Water*. Application for Final Approval of the RWO Ballast Water Management System (CleanBallast). [Online]. [Accessed: 29/01/18]. Available from: http://www.bsh.de/de/Meeresdaten/Umweltschutz/Ballastwasser/RWO/Antrag_RWO_FA_MEPC_59.pdf

ID	Reference
[RD141]	Jennings, G 2012. *The ecology of an urban colony of common terns Sterna hirundo in Leith Docks, Scotland*. PhD thesis, University of Glasgow.
[RD142]	Jobling, M. 1981. Temperature tolerance and the final preferendum- rapid methods for the assessment of optimum growth temperatures. *Journal of Fish Biology.* 19, pp.439 – 455.
[RD143]	Johnson, W.P., Schmidt, P.M. and Taylor, D.P. 2014. Foraging flight distances of wintering ducks and geese: A review*. Avian Conservation and Ecology*, 9.
[RD144]	Johnston, D.W., Westgate, A.J. and Read, A.J. 2005. Effects of fine-scale oceanographic features on the distribution and movements of harbour porpoises *Phocoena phocoena* in the Bay of Fundy. *Marine Ecology Progress series*. 295, pp.279-293.
[RD145]	Johnstone,I., Mucklow, C., Cross, T., Lock, L & Carter, I. The return of the Red-billed Chough to Cornwall: the first ten years and prospects for the future. British Birds. 104, pp.416–431.
[RD146]	Joint Nature Conservation Committee (JNCC) 2013. *Individual Species Reports – 3rd UK Habitats Directive Reporting 2013*. [Online]. [Accessed: 29/01/18]. Available from: http://jncc.defra.gov.uk/page-6391 .
[RD147]	Joint Nature Conservation Committee (JNCC). 2015. *JNCC Citation for Bae Cemlyn/ Cemlyn Bay*. [Online]. [Accessed: 29/01/18]. Available from: http://jncc.defra.gov.uk/ProtectedSites/SACselection/n2kforms/UK0030114.pdf
[RD148]	Joint Nature Conservation Committee (JNCC) 2016. *Joint SNCB interim displacement advice note*. JNCC, Peterborough
[RD149]	JNCC (2016). Irish Sea Front potential SPA: draft departmental brief (version 5). February 2016.
[RD150]	Joint Nature Conservation Committee (JNCC) 2017. *Habitat account - Marine, coastal and halophytic habitats: 1230 Vegetated sea cliffs of the Atlantic and Baltic coasts*. JNCC website. [Online]. [Accessed: 13/06/17]. Available from: http://jncc.defra.gov.uk/ProtectedSites/SACselection/habitat.asp?FeatureIntCode=h1230.
[RD151]	Joint Nature Conservation Committee (JNCC) 2017. *Habitat account - Temperate heath and scrub: 4030 European dry heaths*. JNCC website. [Online]. [Accessed: 01/06/17]. Available from: http://jncc.defra.gov.uk/protectedsites/sacselection/habitat.asp?FeatureIntCode=H4030.
[RD152]	Joint Nature Conservation Committee (JNCC) 2017. *Habitat account - Temperate heath and scrub: 1230 4010 Northern Atlantic wet heaths with Erica tetralix*. JNCC website. [Online]. [Accessed: 13/06/17]. Available at URL: http://jncc.defra.gov.uk/ProtectedSites/SACselection/habitat.asp?FeatureIntCode=H4010.

ID	Reference
[RD153]	Joint Nature Conservation Committee (JNCC) 2017. *Habitat account - Freshwater habitats: 3150 Natural eutrophic lakes with Magnopotamion or Hydrocharition-type vegetation*. JNCC website. [Online]. [Accessed: 13/06/17]. Available from: http://jncc.defra.gov.uk/protectedsites/sacselection/habitat.asp?FeatureIntCode=H3150.
[RD154]	Joint Nature Conservation Committee (JNCC) 2017. *Habitat account - Natural and semi-natural grassland formations: 6410 Molinia meadows on calcareous, peaty or clayey-silt-laden soils (Molinion caeruleae)*. JNCC website. [Online]. [Accessed: 14/06/17]. Available from: http://jncc.defra.gov.uk/protectedsites/sacselection/habitat.asp?FeatureIntCode=H6410
[RD155]	Joint Nature Conservation Committee (JNCC) 2017. *Habitat account - Raised bogs and mires and fens: 7210 Calcareous fens with Cladium mariscus and species of the Caricion davallianae*. JNCC website. [Online]. [Accessed: 14/06/17]. Available from: http://jncc.defra.gov.uk/protectedsites/sacselection/habitat.asp?FeatureIntCode=H7210.
[RD156]	Joint Nature Conservation Committee (JNCC) 2017. *Habitat account - Raised bogs and mires and fens: 7230 Alkaline fens*. JNCC website. [Online]. [Accessed: 14/06/17]. Available from: http://jncc.defra.gov.uk/protectedsites/sacselection/habitat.asp?FeatureIntCode=H7230.
[RD157]	Joint Nature Conservation Committee (JNCC) 2017. *Habitat account - Freshwater habitats: 3140 Hard oligo-mesotrophic waters with benthic vegetation of Chara spp*. JNCC website. [Online]. [Accessed: 14/06/17]. Available from: http://jncc.defra.gov.uk/ProtectedSites/SACselection/habitat.asp?FeatureIntCode=H3140.
[RD158]	Joint Nature Conservation Committee (JNCC) 2017. *Invertebrate species: arthropods: 1044 Southern damselfly Coenagrion mercuriale*. JNCC website. [Online]. [Accessed: 14/06/17]. Available from: http://jncc.defra.gov.uk/ProtectedSites/SACselection/species.asp?FeatureIntCode=S1044.
[RD159]	Joint Nature Conservation Committee (JNCC) 2017. *Invertebrate species: arthropods: 1065 Marsh fritillary butterfly Euphydryas (Eurodryas, Hypodryas) aurinia*. JNCC website. [Online]. [Accessed: 14/06/17]. Available from: http://jncc.defra.gov.uk/protectedsites/sacselection/species.asp?FeatureIntCode=s1065.
[RD160]	Joint Nature Conservation Committee (JNCC) 2017. *Invertebrate species: molluscs: 1013 Geyer`s whorl snail Vertigo geyeri*. JNCC website. [Online]. [Accessed: 14/06/17]. Available from: http://jncc.defra.gov.uk/ProtectedSites/SACselection/species.asp?FeatureIntCode=S1013.

ID	Reference
[RD161]	Joint Nature Conservation Committee (JNCC) 2017. *SAC Selection Assessment: Bristol Channel Approaches / Dynesfeydd Môr Hafren*. January 2017. Joint Nature Conservation Committee, UK. [Online]. [Accessed: 29/01/18]. Available from: http://jncc.defra.gov.uk/page-7241
[RD162]	Joint Nature Conservation Committee (JNCC) 2017. JNCC website - harbour porpoise. [Online]. [Accessed: 29/01/18]. Available from: http://jncc.defra.gov.uk/ProtectedSites/SACselection/species.asp?FeatureIntCode=S1351.
[RD163]	Joint Nature Conservation Committee (JNCC) 2017. JNCC website - bottlenose dolphin. [Online]. [Accessed: 29/01/18]. Available from: http://jncc.defra.gov.uk/ProtectedSites/SACselection/species.asp?FeatureIntCode=S1349
[RD164]	Joint Nature Conservation Committee (JNCC) 2017. *Seabird Monitoring Programme Database.* [Online]. [Accessed: 29/01/18]. Available from: http://jncc.defra.gov.uk/smp/
[RD165]	Joint Nature Conservation Committee (JNCC) 2017. *SPA description (information as published 2001) Ynys Seiriol / Puffin Island*. [Online]. [Accessed: 29/01/18]. Available from: http://jncc.defra.gov.uk/page-2083-theme=default
[RD166]	Joint Nature Conservation Committee (JNCC) 2017. *SPA description (information as published 2001) Glannau Aberdaron and Ynys Enlli / Aberdaron Coast and Bardsey Island*. [Online]. [Accessed: 29/01/18]. Available from: http://jncc.defra.gov.uk/default.aspx?page=2058
[RD167]	Joint Nature Conservation Committee (JNCC) 2017. *SPA description (information as published 2001) Skokholm and Skomer*. [Online]. [Accessed: 29/01/18]. Available from: http://jncc.defra.gov.uk/default.aspx?page=2061
[RD168]	Joint Nature Conservation Committee (JNCC) 2017. *SPA description (information as published 2001) Grassholm*. [Online]. [Accessed: 29/01/18]. Available from: http://jncc.defra.gov.uk/default.aspx?page=2060
[RD169]	Joint Nature Conservation Committee (JNCC) 2017. *SPA description (information as published 2001) Ribble and Alt Estuaries*. [Online]. [Accessed: 29/01/18]. Available from: http://jncc.defra.gov.uk/page-1984
[RD170]	Joint Nature Conservation Committee (JNCC) 2017. *SPA description (information as published 2001) Bowland Fells*. [Online]. [Accessed: 29/01/18]. Available from: http://jncc.defra.gov.uk/page-1987
[RD171]	Joint Nature Conservation Committee (JNCC) 2017 *SPA description (information as published 2001) Ailsa Craig*. [Online]. [Accessed: 29/01/18]. Available from: http://jncc.defra.gov.uk/default.aspx?page=1949

ID	Reference
[RD172]	Joint Nature Conservation Committee (JNCC) and Natural Resources Wales (NRW) 2016. *Harbour Porpoise (Phocoena phocoena) possible Special Area of Conservation: North Anglesey Marine/ Gogledd Môn Forol Draft Conservation Objectives and Advice on Activities*. January, 2016. Natural Resources Wales and Joint Nature Conservation Committee, UK. [Online]. [Accessed: 22/05/17]. Available from: http://jncc.defra.gov.uk/pdf/NorthAngleseyMarineConservationObjectivesAndAdviceOnActivities.pdf.
[RD173]	Joint Nature Conservation Committee (JNCC) and Natural Resources Wales (NRW) 2016. *Harbour Porpoise (Phocoena phocoena) possible Special Area of Conservation: West Wales Marine / Gorllewin Cymru Forol Draft Conservation Objectives and Advice on Activities*. January, 2016. Natural Resources Wales and Joint Nature Conservation Committee, UK. [Online]. [Accessed: 29/01/18]. Available from: http://jncc.defra.gov.uk/pdf/WestWalesMarineConservationObjectivesAndAdviceOnActivities.pdf
[RD174]	Joint Nature Conservation Committee (JNCC) and Natural Resources Wales (NRW) 2017. *SAC Selection Assessment: North Anglesey Marine / Gogledd Môn Forol*. January, 2017. Joint Nature Conservation Committee, UK. [Online]. [Accessed: 29/01/18]. Available from: http://jncc.defra.gov.uk/page-7244
[RD175]	Joint Nature Conservation Committee (JNCC) and Natural Resources Wales (NRW) 2017. *SAC Selection Assessment Document: West Wales Marine / Gorllewin Cymru Forol*. January, 2017. Natural Resources Wales and Joint Nature Conservation Committee, UK. [Online]. [Accessed: 29/01/18]. Available from: http://jncc.defra.gov.uk/page-7343
[RD176]	Jones, D. and Marten, K. 2016. Dredging sound levels, numerical modelling and EIA. *Maritime Solutions for a Changing World*, p.21.
[RD177]	Jones, E., McConnell, B., Sparling, C. and Matthiopoulos, J. 2013. *Grey and harbour seal density maps.* Marine Mammal Scientific Support Research programme MMSS/001/11. Report to Scottish Government. 35 pp.
[RD178]	Jones, E.L., Morris, C. D., Smout, S. and McConnell, B. J. 2016. *Population scaling in 5 km x 5 km grey and harbour seal usage maps*. Commissioned by Marine Scotland under contract MMSS/002/15.
[RD179]	Jones, G. 1994. A Review of the Welsh Region Microtagging Programme 19-84 – 1993*. Environment Agency: Newcastle.*
[RD180]	Kastelein, R.A., Hardemann, J.and Boer, H. 1997. Food consumption and body weight of harbour porpoises (*Phocoena phocoena*). In *The biology of the harbour porpoise*, Read, A.J., Wiepkema, P.R., Nachtigall P.E. 1997pp. 217–234. ed. Woerden, The Netherlands: De Spil Publishers.

ID	Reference
[RD181]	Kastelein, R.A., Bunskoek, P., Hagedoorn, M., Au, W.L.W. & de Haan, D. 2002a. Audiogram of a harbor porpoise (*Phocoena phocoena*) measured with narrow-band frequency-modulated signals. *JASA*. 112(1), pp.334-344.
[RD182]	Kastelein, R.A., Vaughan, N., Walton, S., and Wiepkema, P R. 2002b. Food intake and body measurements of Atlantic bottlenose dolphins (*Tursiops truncatus*) in captivity. *Marine Environmental Research*. 53(2), pp.199-215.
[RD183]	Keiper, C.A., Ainley, D.G., Allen, S.G. and Harvey, J.T. 2005. Marine mammal occurrence and ocean climate off central California, 1986 to 1994 and 1997 to 1999. *Marine Ecology Progress Series*. 289, pp.285-306.
[RD184]	Kiely, O., Lidgard, D., McKibben, M., Connolly, N. and Baines, M. 2000. *Grey seal: Status and monitoring in the Irish and Celtic Seas.* Maritime INTERREG Series. Coastal Resources Centre, National University of Ireland, Cork. Wildlife Trust, Haverfordwest, Wales. Report No. 3. 77 pp.
[RD185]	Laist, D.W., Knowlton, A.R., Mead, J.G., Collet, A.S. and Podesta, M. 2001. Collisions between ships and great whales. *Marine Mammal Science*. 17(1), pp.35-75.
[RD186]	Langford, T.E.L. 1990. Ecological Effects of Thermal Discharges (Pollution Monitoring Series). *Elsevier, Essex.*
[RD187]	Langston, R.H.W. 2010. *Offshore wind farms and birds: Round 3 zones, extensions to Round 1 and Round 2 sites and Scottish territorial waters.* RSPB Research Report, no. 39. RSPB, Sandy, Beds.
[RD188]	Learmonth, J.A., Murphy, S., Luque, P.L., Reid, R.J., Patterson, I.A.P., Brownlow, A., Ross, H.M., Barley, J.P., Begona Santos, M. and Pierce, G.J. 2014. Life history of harbor porpoises (*Phocoena phocoena*) in Scottish (UK) waters. *Marine Mammal Science*. 30(4), pp.1427-1455.
[RD189]	Lewis, E.J. and Evans, P.G.H. 1993. Comparative ecology of bottlenose dolphins (*Tursiops truncatus*) in Cardigan Bay and the Moray Firth, pp. 57-62. In: European Research on Cetaceans - 7. Proc. *7th Ann. Conf. ECS*, Inverness, ed P.G.H. Evans. European Cetacean Society, Cambridge, England. 306pp.
[RD190]	Liret, C. 2001. *Domaine vital, utilisation de l'espace et des ressources : les grands dauphins, Tursiops truncatus, de l'île de Sein.* Thèse de doctorat de l'Université de Bretagne Occidentale, Brest. 155 p.
[RD191]	Liret, C., Creton, P., Evans, P. G. H., Heimlich-Boran, J. R. and Ridoux, V. 1998. *English and French coastal Tursiops from Cornwall to the Bay of Biscay, 1996*. Photo-identification Catalogue. Project sponsored by Ministere de l'Environnement, France and Sea Watch Foundation, UK.

ID	Reference
[RD192]	Livezey, K.B., Fernández-Juricic, E. and Blumstein, D.T. 2016. Database of bird flight initiation distances to assist in estimating effects from human disturbance and delineating buffer areas. *Journal of Fish and Wildlife Management*. 7, pp.181-191.
[RD193]	Lockyer, C. 1995. Aspects of the morphology, body fat condition and biology of the harbour porpoise, Phocoena phocoena, in British waters. *Reports - International Whaling Commission Special Issues*. 16, pp.199-210.
[RD194]	Lockyer, C., Desportes, G., Hansen, K., Labberté, S. and Siebert, U. 2003. Monitoring growth and energy utilisation of the harbour porpoise (Phocoena phocoena) in human care. *NAMMCO Scientific Publications*. 5, pp.107-120.
[RD195]	Lowry, L.F., Frost, K.J., Hoep, J.M. and Delong, R.A. 2001. Movements of satellite tagged subadult and adult harbour seals in Prince William Sound, Alaska. *Marine Mammal Science*. 17(4), pp.835-861.
[RD196]	Lucke, K., Lepper, P.A. and Blanchet, M. 2009. Temporary shift in masked hearing thresholds in a harbour porpoise (*Phocoena phocoena*) after exposure to seismic airgun stimuli. *Journal of the Acoustical Society of America.* 125(6), pp.4060 – 4070.
[RD197]	Macleod, K., Simmonds, M.P. and Murray, E. 2003. Summer distribution and relative abundance of cetacean populations off north-west Scotland. *Journal of the Marine Biological Association of the UK*, 83(05), pp.1187-1192.
[RD198]	Magnox Ltd 2013. *Wylfa Nuclear Power Station Environmental Statement 2013*. Update in Support of the Application to Decommission Wylfa Nuclear Power Station as Required by Statutory Instrument 1999 No. 2892: Nuclear Reactors (Environmental Impact Assessment for Decommissioning) Regulations 1999 (as amended).
[RD199]	Maitland, P.S. 2003. *Ecology of the River, Brook and Sea Lamprey. Conserving Natura 2000, Rivers Ecology Series* No. 5. English Nature: Peterborough.
[RD200]	Malme, C.I., Miles, P.R., Miller, G.S., Richardson, W.J. and Roseneau, D.G. 1989. *Analysis and ranking of the acoustic disturbance potential of petroleum-industry activities and other sources of noise in the environment of marine mammals in Alaska.* Final report (No. PB-90-188673/XAB; REPT--6945). Bolt, Beranek and Newman, Inc., Cambridge, MA (USA).
[RD201]	Mandleberg, L. 2006. *Bottlenose dolphins of the Hebrides, a summary report from five years of research (2001-2005).* Report to Biodiversity Action Grants Scheme. Hebridean Whale and Dolphin Trust, Tobermory, 19 pp.

ID	Reference
[RD202]	Marine Management Organisation (MMO) 2014. *Mapping UK Shipping Density and Routes from AIS.* A report produced for the Marine Management Organisation, pp 35. MMO Project No: 1066.
[RD203]	Marubini, F., Gimona, A., Evans, P., Wright, P., and Pierce, G. 2009. Habitat preferences and interannual variability in occurrence of the harbour porpoise *Phocoena phocoena* off northwest Scotland. *Marine Ecology Progress Series*. 381, pp.297–310.
[RD204]	Masden, E.A., Haydon, D.T., Fox, A.D. and Furness, R.W. 2010. Barriers to movement: Modelling energetic costs of avoiding marine wind farms amongst breeding birds. *Marine Pollution Bulletin*. 60, pp.1085-1091.
[RD205]	Matthiopoulos J, McConnell B.J, Duck C and Fedak M.A. 2004. Using satellite telemetry and aerial counts to estimate space use by grey seals around the British Isles. *Journal of Applied Ecology*. 41(3), pp.476-491.
[RD206]	McConnell, B.J., Chambers, C., Nicholas, K.S. and Fedak, M.A. 1992. Satellite tracking of grey seals (*Halichoerus grypus*). *Journal of Zoology*. 226(2), pp.271-282.
[RD207]	McConnell, B.J., Fedak, M.A., Lovell, P. and Hammond, P.S. 1999. Movements and foraging of grey seals in the North Sea. *Journal of Applied Ecology.* 36, pp.573-590.
[RD208]	McGinnis, S.M., Whittow, G.C., Ohata, C.A. and Huber, H. 1972. Body heat dissipation and conservation in two species of dolphins. *Comp. Biochem. Physiol*. 43A, pp.417–423.
[RD209]	McKay, C.R. 1996. Conservation and ecology of the red-billed chough *Pyrrhocorax pyrrhocorax*. PhD thesis. University of Glasgow, UK, 220pp.
[RD210]	McLeod, E.M., Guay, P.J., Taysom, A.J., Robinson, R.W. and Weston, M.A. 2013. Buses, cars, bicycles and walkers: The influence of the type of human transport on the flight responses of waterbirds. *PLoS ONE*, 8.
[RD211]	Medeiros, R., Ramos, J.A., Paiva, V.H., Almeida, A., Pedro, P. and Antunes, S. 2007. Signage reduces the impact of human disturbance on little tern nesting success in Portugal. *Biological Conservation*. 135, pp.99-106.
[RD212]	Minesto. 2016. *Deep Green Holyhead Deep Project Phase 1 (0.5. MW) Environmental Statement.* L-100194-S00-EIAS-001. 580 pp.
[RD213]	Minesto 2016. *Deep Green Holyhead Deep Project Phase 1 (0.5. MW) Offshore Habitats Regulations Assessment (HRA) Report*. L-100194-S14-REPT-001.
[RD214]	Minesto 2017. *DG Holyhead Deep Array Project - Scoping Report. Q4 2016 - additional work scopes*. L-100194-S21-REPT-002.
[RD215]	Mitchell, P.I., Newton, S.F., Ratcliffe, N. and Dunn, T.E. 2004. *Seabird Populations of Britain and Ireland. Results of the Seabird 2000 Census (1998-2002)*. T. and A.D. Poyser, London.

ID	Reference
[RD216]	Monaghan, P., Uttley, J.D., Burns, M.D., Thaine, C. and Blackwood, J. 1989. The relationship between food supply, reproductive effort and breeding success in Arctic terns Sterna paradisaea. *Journal of Animal Ecology.* 58, pp.261-274.
[RD217]	Morlais 2015. *Morlais Tidal Demonstration Array Scoping Report*. April 2015. Royal HaskoningDHV PB2735/R/304464/Edin.
[RD218]	Murphy, S., Barber, J.L., Learmonth, J.A., Read, F.L., Deaville, R., Perkins, M.W., Brownlow, A., Davison, N., Penrose, R., Pierce, G.J. and Law, R.J., 2015. Reproductive failure in UK harbour porpoises Phocoena phocoena: legacy of pollutant exposure?. *PLoS One*. *10*(7), p.e0131085.
[RD219]	National Grid. 2016. *North Wales Connection Project: Preliminary Environmental Information Report*. National Grid.
[RD220]	National Parks and Wildlife Service (NPWS) 2011. *Conservation Objectives: Saltee Islands SAC 000707 and Saltee Islands SPA 004002*. Version 1.0. National Parks and Wildlife Service, Department of Arts, Heritage and the Gaeltacht. [Online]. [Accessed: 18/05/17] Available from: https://www.npws.ie/sites/default/files/protected-sites/conservation_objectives/CO004002.pdf.
[RD221]	National Parks and Wildlife Service (NPWS) 2011. *Conservation Objectives: Slaney River Valley SAC 000781*. Version 1.0. National Parks and Wildlife Service, Department of Arts, Heritage and the Gaeltacht. [Online]. [Accessed: 22/05/17] Available from: https://www.npws.ie/sites/default/files/protected-sites/conservation_objectives/CO000781.pdf.
[RD222]	National Parks and Wildlife Service (NPWS) 2011. *Lambay Island SPA Site Synopsis*. [Online]. [Accessed: 18/05/17] Available from: https://www.npws.ie/sites/default/files/protected-sites/synopsis/SY004069.pdf.
[RD223]	National Parks and Wildlife Service (NPWS) 2012. *Saltee Islands SPA Site Synopsis*. [Online]. [Accessed: 18/05/17] Available from: https://www.npws.ie/sites/default/files/protected-sites/synopsis/SY004002.pdf.
[RD224]	National Parks and Wildlife Service (NPWS) 2013. *Conservation Objectives: Rockabill to Dalkey Island SAC 003000*. Version 1. National Parks and Wildlife Service, Department of Arts, Heritage and the Gaeltacht.
[RD225]	National Parks and Wildlife Service (NPWS) 2013. *Conservation Objectives: Lambay Island SAC 000204*. Version 1. National Parks and Wildlife Service, Department of Arts, Heritage and the Gaeltacht. [Online]. [Accessed: 22/05/17] Available from: https://www.npws.ie/sites/default/files/protected-sites/conservation_objectives/CO000204.pdf.

ID	Reference
[RD226]	National Parks and Wildlife Service (NPWS) 2014. *Ireland's Eye SAC Site Synopsis*. [Online]. [Accessed: 18/05/17] Available from: https://www.npws.ie/sites/default/files/protected-sites/synopsis/SY002193.pdf.
[RD227]	National Parks and Wildlife Service (NPWS) 2014. *Citation document for Horn Head to Fanad Head SPA*. [Online]. [Accessed: 29/01/18] Available from: https://www.npws.ie/protected-sites/spa/004194
[RD228]	National Parks and Wildlife Service (NPWS) 2015. *Citation document for West Donegal Coast SPA*. [Online]. [Accessed: 29/01/18] Available from: https://www.npws.ie/sites/default/files/protected-sites/synopsis/SY004150.pdf
[RD229]	National Parks and Wildlife Service (NPWS) 2015. *Citation document for Tory Island SPA*. [Online]. [Accessed: 29/01/18] Available from: https://www.npws.ie/sites/default/files/protected-sites/synopsis/SY004073.pdf
[RD230]	Natural England 2014a. *European Site Conservation Objectives for Ribble and Alt Estuaries Special Protection Area Site Code: UK9005103*. 30 June 2014. [Online]. [Accessed: 18/05/17] Available from: http://publications.naturalengland.org.uk/publication/4868920422957056.
[RD231]	Natural England 2014b. *European Site Conservation Objectives for Bowland Fells Special Protection Area Site Code: UK9005151*. 30 June 2014. [Online]. [Accessed: 18/05/17] Available from: http://publications.naturalengland.org.uk/publication/5922368258048000
[RD232]	Natural England 2014c. *European Site Conservation Objectives for Mersey Narrows and North Wirral Foreshore Special Protection Area Site Code: UK9020287*. 30 June 2014. [Online]. [Accessed: 18/05/17] Available from: http://publications.naturalengland.org.uk/publication/6521906232557568
[RD233]	Natural England 2016a. *European Site Conservation Objectives for Morecambe Bay Special Protection Area and potential Special Protection Area Site Code: UK9005081*. 29 January 2016. [Online]. [Accessed: 12/05/17]. Available from: http://publications.naturalengland.org.uk/file/5173020531359744
[RD234]	Natural England 2016b. *European Site Conservation Objectives for The Dee Estuary Special Protection Area Site Code: UK*9013011. 5 February 2016. [Online]. [Accessed: 18/05/17]. Available from: http://publications.naturalengland.org.uk/publication/6557770283220992

ID	Reference
[RD235]	Natural England, Joint Nature Conservation Committee (JNCC) and Natural Resources Wales (NRW) 2016. *Harbour Porpoise (Phocoena phocoena) possible Special Area of Conservation: Bristol Channel Approaches / Dynesfeydd Môr Hafren Draft Conservation Objectives and Advice on Activities. January, 2016. Natural Resources Wales and Joint Nature Conservation Committee, UK.* [Online]. [Accessed: 22/05/17] Available from: http://jncc.defra.gov.uk/pdf/BristolChannelApproachesConservationObjectivesAndAdviceOnActivities.pdf
[RD236]	Natural Resources Wales (NRW). 2015. *Anglesey Terns / Morwenoliaid Ynys Môn possible Special Protection Area: Draft conservation objectives.* December 2015. [Online]. [Accessed: 12/05/17] Available from: https://naturalresources.wales/media/675726/anglesey-terns-pspa-draft-conservation-objectives-final.pdf
[RD237]	Natural Resources Wales (NRW). 2017. *Pen Llŷn a'r Sarnau / Lleyn Peninsula and the Sarnau Special Area of Conservation: Advice provided by Natural Resources Wales in fulfilment of Regulation 35 of the Conservation of Habitats and Species Regulations 2010 (as amended)*. [Online]. [Accessed: 29/01/18]. Available from: https://naturalresources.wales/media/682010/pen-llyn-ar-sarnau-reg-35-report.pdf
[RD238]	Nedwell, J.R., Edwards, B., Turnpenny, A.W.H. and Gordon, J. 2004. Fish and marine mammal audiograms: A summary of available information. Subacoustech, 534R0214.
[RD239]	Nedwell, J.R., Turnpenny, A.W.H., Lovell, J.M. and Edwards, B. 2006. An investigation into the effects of underwater piling noise on salmonids. *J Acoust Soc Am*. November 2006.
[RD240]	New, L.F., Moretti, D.J., Hooker, S.K., Costa, D.P. and Simmons, S.E., 2013. Using energetic models to investigate the survival and reproduction of beaked whales (family Ziphiidae). *PloS* ONE, 8(7), p.e68725.
[RD241]	Newcombe, C.P. and MacDonald, D.D. 1991. Effects of suspended sediments on aquatic ecosystems. *North American Journal of Fisheries Management.* 11, pp.72-82.
[RD242]	Nikitik, C. 2007. Benthic Invertebrate Communities in Cemlyn lagoon, Anglesey, North Wales. *Environment Agency Wales SE Area Environmental Appraisal Team Ref. No. EASE/TM/07/200*, 17pp.
[RD243]	Nisbet, I.C.T. 2000 Disturbance, habituation, and management of waterbird colonies. *Waterbirds*. 23, pp.312-332.
[RD244]	Nisbet, I.C.T and Welton, M.J. 1984. Seasonal variations in breeding success of common terns: consequences of predation. *Condor*. 16, pp.53-60.

ID	Reference
[RD245]	Norrman, E.B., Duque, S.D. and Evans, P.G.H. 2015. *Bottlenose Dolphins in Wales: Systematic Mark-Recapture Surveys in Welsh Waters.* Sea Watch Foundation. Report for Natural Resources Wales. 84 pp.
[RD246]	Northridge, S.P., Tasker, M.L., Webb, A. and Williams, J.M. 1995. Distribution and relative abundance of harbour porpoises (*Phocoena phocoena* L.), white-beaked dolphins (*Lagenorhynchus albirostris* Gray), and minke whales (*Balaenoptera acutorostrata Lacepède*) around the British Isles. *ICES Journal of Marine Science: Journal du Conseil*. 52(1), pp.55-66.Egllinton
[RD247]	North Wales Wildlife Trust (NWWT). 2011. *Summary report for Cemlyn lagoon*. NWWT.
[RD248]	North Wales Wildlife Trust (NWWT). 2017. *Summary report for Cemlyn lagoon.* NWWT.
[RD249]	O'Brien, J. and Berrow, S.D. 2006. Seaweed ingestion by a bottlenose dolphin. *Irish Naturalists' Journal.* 28(8), pp.338–9.
[RD250]	O'Cadhla, O., Keena, T., Strong, D., Duck, C. and Hiby, L. 2013. *Monitoring and breeding population of grey seals in Ireland 2009 – 2012.* Irish Wildlife Manuals No. 74. National Parks and Wildlife Services, Department of Arts, Heritage and the Gaeltacht, Dublin, Ireland.
[RD251]	Ojowski, U, Eidtmann, C, Furness, RW and Garthe, S. 2001. Diet and nest attendance of incubating and chick-rearing northern fulmars (Fulmarus glacialis) in Shetland. *Marine Biology*. 139, pp.1193-1200.
[RD252]	Oudejans, M.G., Visser, F., Englund, A., Rogan, E. and Ingram, S.N. 2015. Evidence for distinct coastal and offshore communities of bottlenose dolphins in the North East Atlantic. *PloS ONE*, 10(4), p.e0122668.
[RD253]	Parvin, S.J., Nedwell, J.R. and Harland, E. 2007. *Lethal and physical injury of marine mammals, and requirements for Passive Acoustic Monitoring.* Subacoustech report no. 565R0212 prepared for the RK Government Department for Business, Enterprise and Regulatory Reform.
[RD254]	Pearson, T.H. 1968. The feeding biology of sea-bird species breeding on the Farne Islands, Northumberland. *The Journal of Animal Ecology*, pp.521 - 552.
[RD255]	Pendlebury, C., Zisman, S., Walls, R., Sweeney, J., McCloughlin, E., Robinson, C., Turner, C. and Loughrey, J. 2011. Literature review to assess bird species connectivity to Special Protection Areas. *Scottish Natural Heritage Commissioned Report No. 390.*

ID	Reference
[RD256]	Perrow, M.R., Gilroy, J.J., Skeate, E.R. and Mackenzie, A. 2010. *Quantifying the relative use of coastal waters by breeding terns: towards effective tools for planning and assessing the ornithological impact of offshore wind farms.* ECON Ecological Consultancy Ltd. Report to COWRIE Ltd.
[RD257]	Perrow, M., Harwood, A., Berridge, M. and Skeate, E. 2017. The foraging ecology of Sandwich terns in north Norfolk. *British Birds*. 112, pp.257-277.
[RD258]	Perrow, M.R., Skeate, E.R. and Gilroy, J.J. 2011. Visual tracking from a rigid-hulled inflatable boat to determine foraging movements of breeding terns. *Journal of Field Ornithology.* 82, pp.68-79.
[RD259]	Pesante, G., Evans, P.G.H., Anderwald, P., Powell, D. and McMath, M. 2008a. Connectivity of Bottlenose Dolphin in Wales: North Wales Photo-Monitoring Interim Report 2008. *Marine Monitoring Report* No. 62. 42 pp.
[RD260]	Pesante, G., Evans, P.G.H., Baines, M.E. and McMath, M. 2008b. *Abundance and Life History Parameters of Bottlenose Dolphin in Cardigan Bay: Monitoring 2005-2007.* CCW Marine Monitoring Report *No. 61. 7581 pp.*
[RD261]	Pierce, G.J., Santos, M.B., and Cerviño, S. 2007. Assessing sources of variation underlying estimates of cetacean diet composition, a simulation study on analysis of harbour porpoise diet in Scottish (UK) waters. *Journal of the Marine Biological Association of the United Kingdom*, 87(1), pp.213-221.
[RD262]	Pierpoint, C. 2001. Harbour porpoise distribution in the coastal waters of SW Wales. *Report to the International Fund for Animal Welfare.*
[RD263]	Pierpoint, C. 2008. Harbour porpoise (*Phocoena phocoena*) foraging strategy at a high energy near-shore site in south-west Wales UK. *Journal of the Marine Biological Association of the United Kingdom.* 88, pp.1167−1173.
[RD264]	Pirotta, E., Laesser, B.E., Hardaker, A., Riddoch, N., Marcoux, M. and Lusseau, D. 2013. Dredging displaces bottlenose dolphins from an urbanised foraging patch. *Marine Pollution Bulletin*. 74(1), pp.396-402.
[RD265]	Planning Inspectorate (PINS) 2016. *Advice Note Ten: Habitat Regulations Assessment relevant to Nationally Significant Infrastructure Projects*. January 2016 Version 7.
[RD266]	Polacheck, T. and Thorpe, L. 1990. The swimming direction of harbor porpoises in relationship to a survey vessel. *Report of the International Whaling Commission*. 40, pp.463-470.
[RD267]	Popper, A.N. 2005. *A Review of Hearing by Sturgeon and Lamprey*. Report to the U.S. Army Corps of Engineers.

ID	Reference
[RD268]	Popper, A.N., Hawkins, A.D., Fay, R.R., Mann, D.A., Bartol, A., Carlson, T.J., Coombs, S., Ellison, W.T., Gentry, R.L., Halvorsen, M.B., Lokkeborg, S., Rogers, P.H., Southall, B.L., Zeddies, D.G. and Tavolga, W.N. 2014. *Sound Exposure Guidelines for Fishes and Sea Turtles*: A Technical Report prepared by ANSI – Accredited Standards Committee S3/SC1 and registered with ANSI. Springer Briefs in Oceanography, ASA S3/SC1.4TR-2024.
[RD269]	Pye, K. and Blott, S.J. 2010. *Cemlyn Bay and Adjoining Areas, Anglesey: Geomorphological Assessment.* External Investigation Report No. EX1208.
[RD270]	Pye, K. and Blott, S.J. 2016. *Cemlyn, Anglesey: Further Geomorphological Assessment*. Report to the National Trust. KPAL Report EX20671, 10 March 2016.
[RD271]	Raum-Suryan, K.L. and Harvey, J.T. 1998. Distribution and abundance of and habitat use by harbor porpoise, *Phocoena phocoena*, off the northern San Juan Islands, Washington. *Fishery Bulletin.* 96(4), pp.808-822.
[RD272]	Read, A.J. 1990. Reproductive seasonality in harbour porpoises, Phocoena phocoena, from the Bay of Fundy. *Canadian Journal of Zoology.* 68(2), pp.284-288.
[RD273]	Read, A.J. and Westgate, A.J. 1997. Monitoring the movements of harbour porpoise (Phocoena phocoena) with satellite telemetry. *Marine Biology.* 130, pp.315-322.
[RD274]	Redding, J.M., C.B. Schreck, and Everest, F.H. 1987. Physiological effects on coho salmon and steelhead of exposure to suspended solids. *Transactions of the American Fisheries Society.* 116, pp.737-744.
[RD275]	Reid, J.B, Evans, P.G.H. and Northridge, S.P. 2003. *Atlas of cetacean Distribution in North west European waters*. JNCC, Peterborough.
[RD276]	Richardson, W.J., Greene, C.R., Malme, C.I. and Thompson, D.H. 1995. *Marine mammals and noise*. Academic Press Inc., San Diego, 1995.
[RD277]	Ridgway, S.H. and Joyce, P.L., 1975. Studies on seal brain by radiotelemetry. *Rapports et Proces-Verbaux des Reunions*. 169, pp.81-91.
[RD278]	Roberts, D.A. 2012. Causes and ecological effects of resuspended contaminated sediments (RCS) in marine environments. *Environment International*. 40, pp.230-243.
[RD279]	Robertson, G. S., Bolton, M., Grecian, W. J., Wilson, L. J., Davies, W., and Monaghan, P. 2014. Resource partitioning in three congeneric sympatrically breeding seabirds: Foraging areas and prey utilization. *The Auk.* 131, pp.434-446.

ID	Reference
[RD280]	Robinson, K.P., O'Brien, J.M., Cheney, B., Costa, M, Eisfeld, S.M., Haberlin, D., Mandleberg, L., O'Donovan, M., Oudejans, M.G., Ryan, C. Stevick, P.T., Thompson, P.M. and Whooley, P. 2012. Discrete or not so discrete: long distance movements by coastal bottlenose dolphins in the UK and Irish waters. *The Journal of Cetacean Research and Management* 12, pp.365–371.
[RD281]	Roche, K., Harris, R., Warrington, S. and Copp, G.H. 1995. Home range and diet of re-introduced European otters Lutra lutra (L.) in Hertfordshire rivers. *Aquat. Conserv*. 5, pp.87–96.
[RD282]	Rodgers, J.A. and Schwikert, S.T. 2002. Buffer-zone distances to protect foraging and loafing waterbirds from disturbances by personal watercraft and outboard-powered boats. *Conservation Biology*. 16, pp.216-224.
[RD283]	Rodgers, J.A. and Smith, H.T. 1995. Set-back distances to protect nesting bird colonies from human disturbance in Florida. *Conservation Biology*. 9, pp.89-99.
[RD284]	Rogan, E. and Berrow, S.D. 1996. A review of harbour porpoises Phocoena phocoena, in Irish waters*. Report to International Whaling Commission.* 46, pp.595-606.
[RD285]	RSPB. 2017. Anglesey Tern Diet Report. Unpublished RSPB report. Sandy, Beds., 5pp.
[RD286]	Ruddock, M. and Whitfield, D.P. 2007. A review of disturbance distances in selected bird species. *Report to Scottish Natural Heritage*. p.181.
[RD287]	Russell, D.J.F. and McConnell, B.J. 2014. Seal at-sea distribution, movements and behaviour. *Report to DECC. URN, D*, 14
[RD288]	Russell, D.J.F., McConnell, B.J., Thompson, D., Duck, C.D., Morris, C., Harwood, J. and Matthiopoulos, J. 2013. Uncovering the links between foraging and breeding regions in a highly mobile mammal. *Journal of Applied Ecology*, Vol 50, no. 2, pp. 499-509.
[RD289]	Santos M.B. and Pierce, G.J. 2003. The diet of harbour porpoise (*Phoceona phoceona*) in the North east Atlantic. *Oceanography and Marine Biology: an Annual Review 2003*. 41, pp.355–390.
[RD290]	Santos, M.B. Pierce, G.J., López, A., Martinez-Cedeira, J.A, Fernandez, M.T., Ieno, E., Mente, E., Porteiro, C., Carrera, P and Meixide, M. 2011. *Variability in the diet of common dolphins (Delphinus delphis) in Galician waters 1991-2003 and relationship with prey abundance.* ICES CM/2004 Q:09.
[RD291]	Santos, M.B., Pierce, G.J., Learmonth, J.A., Reid, R.J., Ross, H.M., Patterson, I.A.P., Reid, D.G. and Beare, D. 2004. Variability in the diet of harbor porpoises (*Phocoena phocoena*) in Scottish waters 1992–2003. *Marine Mammal Science*. 20(1), pp.1-27.

ID	Reference
[RD292]	Santos, M.B., Pierce, G.J., Reid, R.J., Patterson, I.A.P., Ross, H.M. and Mente, E. 2001. Stomach contents of bottlenose dolphins (*Tursiops truncatus*) in Scottish waters. *Journal of the Marine Biological Association of the United Kingdom.* 81, pp.873-878.
[RD293]	Schippers, P., Snep, R., Schotman, A., Jochem, R., Stienen, E. and Slim, P. 2009. Seabird metapopulations: searching for alternative breeding hbitats. *Popul Ecol* 51: 459-470.
[RD294]	Scholander, P. F. and Schevill, W. E. 1955. Counter-current vascular heat exchange in the fins of whales. *J. Appl. Physiol*. 8, pp.279–282
[RD295]	Schwemmer, P., Gupner, F., Adler, S., Klingbeil, K. and Garthe, S. 2016. Modelling small-scale foraging habitat use in breeding Eurasian oystercatchers (Haematopus ostralegus) in relation to prey distribution and environmental predictors. *Ecological Modelling*. 320, pp.322-333.
[RD296]	Scottish National Heritage (SNH) 2006. *Conservation Objectives for Ailsa Craig Special Protection Area*. [Online]. [Accessed: 18/05/17]. Available from: http://gateway.snh.gov.uk/sitelink/siteinfo.jsp?pa_code=8463#caseworks
[RD297]	Scottish National Heritage (SNH) 2012. Guidance on use of flight initiation distances for developments / onshore wind farms. *SNH.*
[RD298]	Scottish National Heritage (SNH) 2014. Interim guidance on apportioning impacts from marine renewable developments to breeding seabird populations in Special Protection Areas. *SNH.*
[RD299]	Scottish National Heritage (SNH) 2016. Guidance on use of flight initiation distances for developments / onshore wind farms. *SNH.*
[RD300]	Sea Mammal Research Unit (SMRU) 2014. Testing the hypothetical link between shipping and unexplained seal deaths: Final report. *Sea Mammal Research Unit, University of St Andrews, Report to Scottish Government*, no. USD, 2.
[RD301]	Searle, K., Mobbs, D., Butler, A., Bogdanova, M., Freeman, S., Wanless, S. and Daunt, F. 2014. Population consequences of displacement from proposed offshore wind energy developments for seabirds breeding at Scottish SPAs (CR/2012/03). *Final report to Marine Scotland Science.*
[RD302]	Servizi, J.A. and Martens, D.W. 1992. Sublethal responses of coho salmon (Oncorhynchus kisutch) to suspended sediments. *Canadian Journal of Fisheries and Aquatic Science.* 49, pp.1389-1395.
[RD303]	Sharples R.J., Matthiopoulos, J. and Hammond, P.S. 2008. Distribution and movements of harbour seals around the coast of Britain: Outer Hebrides, Shetland, Orkney, the Moray Firth, St Andrews Bay, The Wash and the Thames. *Report to DTI July 2008*.

ID	Reference
[RD304]	Sharples, R.J., Moss, S.E., Patterson, T.A. and Hammond, P.S. 2012. Spatial Variation in Foraging Behaviour of a Marine Top Predator (*Phoca vitulina*) Determined by a Large-Scale Satellite Tagging Program. *PLoS ONE* 7(5): e37216.
[RD305]	Shearer, W. 1992. The Atlantic Salmon. *Halstead Press.*
[RD306]	Shoji, A., Aris-Brosou, S., Fayet, A., Padget, O., Perrins, C. and Guilford, T. 2015. Dual foraging and pair coordination during chick provisioning by Manx shearwaters: empirical evidence supported by a simple model*. The Journal of Experimental Biology*. 218, pp.2116-2123.
[RD307]	Shoji, A., Dean, B., Kirk, H., Freeman, R., Perrins, C. M. and Guilford, T. 2016, The diving behaviour of the Manx Shearwater Puffinus puffinus. *Ibis*. 158, pp.598–606.
[RD308]	Shucksmith, R., Jones, N.H., Stoyle, G.W., Davies, A. and Dicks, E.F. 2009. Abundance and distribution of the harbour porpoise (*Phocoena phocoena*) on the north coast of Anglesey, Wales, UK. *Journal of the Marine Biological Association of the United Kingdom*, 89, pp.1051–1058.
[RD309]	Smith, L.A., Link, J.S., Cadrin, S.X. and Palka, D.L. 2015. Consumption by marine mammals on the Northeast U.S. continental shelf. *Ecological Applications*. 25(2), pp.373 – 389
[RD310]	Smolker, R.A., Richards, A.F., Connor, R.C. and Pepper, J.W. 1992. Sex differences in patterns of association among Indian Ocean bottlenose dolphins. *Behaviour.* 123, pp.38-69.
[RD311]	Sneddon, P.E. and Randall, R.E. 1993. Coastal vegetated shingle structures of Great Britain, 61 pp.
[RD312]	Sonntag, R.P., Benke, H., Hiby, A.R., Lick, R. and Adelung, D. 1999. Identification of the first harbour porpoise (*Phocoena phocoena*) calving ground in the North Sea. *Journal of Sea Research* 41, pp.225-232.
[RD313]	Sørensen, T.B. and Kinze, C.C. 1994. Reproduction and reproductive seasonality in Danish harbour porpoises, *Phocoena phocoena*. *Ophelia.* 39(3), pp.159-176.
[RD314]	Southall, B.L., Bowles, A.E., Ellison, W.T., Finneran, J.J., Gentry, L., Greene, C.R., Kastak, D., Ketten, D., Miller, J.H., Nachtigall, P.E., Richardson, W.J., Thomas, J.A. and Tyack, P.L. 2007. Marine mammal noise exposure criteria: Initial scientific recommendations. *Aquatic Mammals*, Vol. 33, No. 4, pp.411-521.
[RD315]	Special Committee on Seals (SCOS) 2014. *SCOS Report*. Scientific Advice on Matters Related to the Management of Seal Populations: 2014.
[RD316]	Special Committee on Seals (SCOS) 2015. *SCOS Report*. Scientific Advice on Matters Related to the Management of Seal Populations: 2015.

ID	Reference
[RD317]	Special Committee on Seals (SCOS) 2016. *SCOS Report*. Scientific Advice on Matters Related to the Management of Seal Populations: 2016. [Online] [Accessed: 29/01/18]. Available from: http://www.smru.st-andrews.ac.uk/files/2017/04/SCOS-2016.pdf
[RD318]	Spencer, J.F. 1990. The impingement of fish, invertebrates and weed on CWS screens of Wylfa Power Station, September 19085 – September 1987. *Central Electricity Generating Board, Report No. ESTD/L/0076/R89*, 27pp.
[RD319]	Statutory Nature Conservation Bodies (SNCBs) 2015. *Interim advice on risk of seal corkscrew injuries* (February 2015).
[RD320]	Stienen, E.W.M. 2006. Living with gulls. Trading off food and predation in the Sandwich Tern *Sterna sandvicensis*. *PhD thesis, University of Groningen, The Netherlands*. 192 pp.
[RD321]	Stienen, E.W.M., Brenninkmeijer, A. and Geschiere, C.E. 2001. Living with gulls: the consequences for Sandwich terns of breeding in association with black-headed gulls. *Waterbirds.* 24, pp.68-82.
[RD322]	Stone, C.J., Webb, A., Barton, C., Ratcliffe, N., Reed, T.C., Tasker, M.L., Camphuysen, C.J. and Pienkowski, M.W. 1995. An atlas of seabird distribution in north-west European waters. *Joint Nature Conservation Committee*, Peterborough, UK.
[RD323]	Strasser, E.H. and Heath, J.A. 2013. Reproductive failure of a human-tolerant species, the American kestrel, is associated with stress and human disturbance. *Journal of Applied Ecology*. 50, pp.912-919.
[RD324]	Stringell, T.B., Bamber, R.N., Burton, M., Lindenbaum, C., Skates, L.R. and Sanderson, W.G. 2013. A tool for protected area management: multivariate control charts 'cope' with rare variable communities. *Ecology and Evolution*. John Wiley and Sons.
[RD325]	Stringell, T., Millar, C., Sanderson, W., Westcott, S., McMath, A. 2014. When aerial surveys won't do: Grey seal pup production in cryptic habitats of Wales. *Journal of the Marine Biological Association of the United Kingdom*, 94(6), pp.1155–-1159.
[RD326]	Strong, P.G. 1996. The West Wales grey seal diet study. *Countryside Council for Wales.*
[RD327]	Strong, P. and Morris, S.R., 2010. Grey seal (*Halichoerus grypus*) disturbance, ecotourism and the Pembrokeshire marine code around Ramsey Island. *Journal of Ecotourism*. 9(2), pp.117-132.
[RD328]	Stroud, D.A., Chambers, D., Cook, S., Buxton, N., Fraser, B., Clement, P., Lewis, P., McLean, I., Baker, H. and Whitehead, S. (eds). 2001. The UK SPA network: its scope and content. *JNCC, Peterborough*.

ID	Reference
[RD329]	Teilmann, J., Dietz, R., Larsen, F., Desportes, G., Geertsen, B.M., Andersen, L.W., Aastrup, P.J., Hansen, J.R. and Buholzer, L. 2004. Satellitsporing af marsvin i danske og tilstødende farvande. Danmarks Miljøundersøgelser. *Faglig rapport fra DMU* 484: 86 s. (elektronisk).
[RD330]	Thaxter, C.B., Lascelles, B., Sugar, K., Cook, A.S.C.P., Roos, S., Bolton, M., Langston, R.H.W. and Burton, N.H.K. 2012. Seabird foraging ranges as a preliminary tool for identifying candidate Marine Protection Areas. *Biological Conservation*. 156, pp.53-61.
[RD331]	Theobald, P.D., Robinson, S.P., Lepper, P.A., Hayman, G., Humphrey, V.F., Wang, L.S. and Mumford, S. 2011. The measurement of underwater noise radiated by dredging vessels during aggregate extraction operations.
[RD332]	Thompson, P. M. and Miller, D. 1990. Summer foraging activity movements of radio-tagged common seals (*Phoca vitulina* L.) in the Moray Firth, Scotland. J. *Appl. Ecol*. 27: 492±501.
[RD333]	Thompson, D., Bexton, S., Brownlow, A., Wood, D., Patterson, T., Pye, K., Lonergan, M. and Milne, R. 2010. Report on recent seal mortalities in UK waters caused by extensive lacerations. *Sea Mammal Research Unit, Scottish Oceans Institute, University of St Andrews, Scotland.*
[RD334]	Thompson, P.M., McConnell, B.J., Tollit, D.J., Mackay, A., Hunter, C. and Racey, P.A. 1996. Comparative distribution, movements and diet of harbour and grey seals from the Moray Firth, N.E. Scotland. *Journal of Applied Ecology*. 33, pp.1572-1584.
[RD335]	Thompson, D., Onoufriou, J., Brownlow, A. and Bishop, A. 2015. Preliminary report on predation by adult grey seals on grey seal pups as a possible explanation for corkscrew injury patterns seen in the unexplained seal deaths. *Sea Mammal Research Unit report to Scottish Government*, 15pp.
[RD336]	Thomsen, F., Borsani, F., Clarke, D., de Jong, C., de Wit, P., Goethals, F., Holtkamp, M., San Martin, E., Spadaro, P., van Raalte, G. and Victor, G.Y.V. 2016. WODA Technical Guidance on Underwater Sound from Dredging. In *The Effects of Noise on Aquatic Life II* (pp. 1161-1166). Springer, New York, NY
[RD337]	Thomsen, F., Lüdemann, K., Kafemann, R. and Piper, W. 2006. *Effects of offshore wind farm noise on marine mammals and fish*. Biola, Hamburg, Germany on behalf of COWRIE Ltd, 62.
[RD338]	Thomsen, F., McCully, S., Wood, D., Pace, F. and White, P. 2009. *A generic investigation into noise profiles of marine dredging in relation to the acoustic sensitivity of the marine fauna in UK waters with particular emphasis on aggregate dredging: PHASE 1 Scoping and review of key issues*. Contract No. MEPF/08 P, 21.

ID	Reference
[RD339]	Thorpe, R.I. and Young, A.J. 2009. *Chough Special Protection Areas in Wales: A Report to the Countryside Council to Wales 2009.* Unpublished report produced by the RSPB: Bedfordshire.
[RD340]	Todd, V.L., Todd, I.B., Gardiner, J.C., Morrin, E.C., MacPherson, N.A., DiMarzio, N.A. and Thomsen, F. 2014. A review of impacts of marine dredging activities on marine mammals. *ICES Journal of Marine Science*, 72(2), pp.328-340.
[RD341]	Tolley, K.A. and Rosel, P.E. 2006. Population structure and historical demography of eastern North Atlantic harbour porpoises inferred through mtDNA sequences. *Marine Ecology Progress Series*, 327, pp.297-308.
[RD342]	Tollit, D.J., Black, A.D., Thompson, P.M., Mackay, A., Corpe, H.M., Wilson, B., Parijs, S.M., Grellier, K. and Parlane, S. 1998. Variations in harbour seal *Phoca vitulina* diet and dive-depths in relation to foraging habitat. *Journal of Zoology*. 244(2), pp.209-222.
[RD343]	Turnpenny, A.W.H. 1988. Fish impingement at estuarine power stations and its significance to commercial fishing. *Journal of Fish Biology*, 33(sA), pp.103-110.
[RD344]	Turnpenny, A.W.H. and Taylor, C.J.L. 2000. An assessment of the effect of Sizewell power stations on fish populations. *Hydroecologie Appliquee*. 12, pp.87-134.
[RD345]	Tynan, C.T., Ainley, D.G., Barth, J.A., Cowles, T.J., Pierce, S.D. and Spear, L.B. 2005. Cetacean distributions relative to ocean processes in the northern California Current System. *Deep Sea Research Part Ii: Topical studies in Oceanography*. 52(1), pp.145-167.
[RD346]	UK Technical Advisory Group (UK TAG) 2007. Proposed EQS for Water Framework Directive Annex VIII substances: ammonia (un-ionised). *Science Report: SNIFFER Report: WFD52(ii).* Report no. SC040038/SR2.
[RD347]	Van Renterghem, T., Botteldooren, D. and Dekoninck, L. 2014. Airborne sound propagation over sea during offshore wind farm piling. *Journal of Acoustical Society of America*. 135, pp.599-609.
[RD348]	Veneruso, G. and Evans, P.G.H. 2012a. *Connectivity of Bottlenose Dolphins in Welsh Waters: North Wales Photo-Monitoring Interim Report*. Report to Countryside Council for Wales. Sea Watch Foundation. 17pp.
[RD349]	Veneruso, G. and Evans, P.G.H. 2012b. *Bottlenose Dolphin and Harbour Porpoise Monitoring in Cardigan Bay and Pen Llyn a"r Sarnau Special Areas of Conservation*. CCW Monitoring Report No. 95. 66pp.
[RD350]	Vos, J.G., Bossart, G., Fournier, M. and O'Shea, T. eds. 2003. *Toxicology of marine mammals*. CRC Press.

ID	Reference
[RD351]	Wakefield, E.D. Bodey, T.W., Bearhop, S., Blackburn, J., Colhoun, K., Davies, R., Dwyer, R.G., Green, J., Gremillet, D., Jackson, A.L., Jessopp, M.J., Kane, A., Langston, R.H.W., Lescroel, A., Murray, S., Le Nuz, M., Patrick, S., Peron, C., Soanes, L., Wanless, S., Votier, S. and Hamer, K.C. 2013. Space partitioning without territoriality in gannets. *Science*. 341, pp.68-70.
[RD352]	Wanless, S., Harris, M.P. and Greenstreet, S.P.R. 1998. Summer sandeel consumption by seabirds breeding in the Firth of Forth, south-east Scotland. *ICES Journal of Marine Science: Journal du Conseil*. 55(6), pp.1141 - 1151.
[RD353]	Water Quality Technical Advisory Group (WQTAG) (2006) WQTAG160 (version 4). *Guidance on assessing the impact of thermal discharges on European Marine Sites*. January 2006.
[RD354]	Welsh Assembly Government. 2009. *Technical Advice Note 5: Nature Conservation and Planning*. September, 2009.
[RD355]	Wernham, C., Toms, M., Marchant, J., Clark, J., Siriwardena, G and Baillie, S. 2002. *The Migration Atlas: Movements of the Birds of Britain and Ireland*. T and AD Poyser, London.
[RD356]	Westcott, S. 2002. *The distribution of grey seals (Halichoerus grypus) and census of pup production in North Wales 2001*. CCW Contract Science Report. No. 499. 157 pp.
[RD357]	Westcott, S.M. and Stringell, T.B. 2003. *Grey seal pup production for North Wales, 2002*. CCW Marine Monitoring Report No. 5. 55 pp
[RD358]	Westcott, S.M. and Stringell, T.B. 2004. *Grey seal distribution and abundance in North Wales, 2002-2003*. CCW Marine Monitoring Report No. 13. 80 pp.
[RD359]	Whitehead, S., Johnstone, I. and Wilson, J. 2005. Choughs *Pyrrhocorax pyrrhocorax* breeding in Wales select foraging habitat at different spatial scales. *Bird Study*. 52, pp.193-203.
[RD360]	Williams, A.D., Williams, R., Heimlich-Boran, J.R., Evans, P.G.H., Tregenza, N.J.C., Ridoux, V., Liret, C. and Savage, S. 1996. A preliminary report to an investigation into bottlenose dolphins (Tursiops truncatus) of the English Channel: A collaborative approach. *European Research on Cetaceans.* 10, pp.217-220.
[RD361]	Wilson, B., Reid, R.J., Grellier, K., Thompson, P.M. and Hammond, P.S. 2004. Considering the temporal when managing the spatial: a population range expansion impacts protected areas based management for bottlenose dolphins. *Animal Conservation* 7, pp.331–338.
[RD362]	Wilson, L.J., Black, J., Brewer, M.J., Potts, J.M., Kueper, A., Win, I., Kober, K., Bingham, C., Mavor, R. and Webb, A. 2014. Quantifying usage of the marine environment by terns Sterna sp. around their breeding colony SPAs. *JNCC Report no. 500.*

ID	Reference
[RD363]	Wilson, B., Thompson, P.M., Hammond, P.S. 1997. Habitat use by bottlenose dolphins: seasonal distribution and stratified movement patterns in the Moray Firth Scotland. *The Journal of Applied Ecology* 34, pp.1365–1374.
[RD364]	Wilson, B., Batty, R. S., Daunt, F. and Carter, C. 2007. *Collision risks between marine renewable energy devices and mammals, fish and diving birds*. Report to the Scottish Executive. Scottish Association for Marine Science, Oban, Scotland, PA37 1QA.
[RD365]	Wilson, L.J., Black, J., Brewer, M.J., Potts, J.M., Kuepfer, A., Win, I., Kober, K., Bingham, C., Mavor, R. and Webb, A. 2015. Quantifying usage of the marine environment by terns Sterna sp. around their breeding colony SPAs. *JNCC Report No. 500.*
[RD366]	Wilson, S. 2014. *The impact of human disturbance at seal haul-outs. A literature review for the Seal Conservation Society*. http://www.pinnipeds.org/attachments/article/199/Disturbance%20for%20SCS%20-%20text.pdf.
[RD367]	Wisniewska, D.M., Johnson, M., Teilmann, J., Rojano-Doñate, L., Shearer, J., Sveegaard, S., Miller, L.A., Siebert, U. and Madsen, P.T. 2016. Ultra-high foraging rates of harbor porpoises make them vulnerable to anthropogenic disturbance. *Current Biology*. 26(11), pp.1441-1446.
[RD368]	Wither, A., Bamber, R., Colclough, S., Dyer, K., Elliott, M., Holmes, P., Jenner, H., Taylor, C. and Turnpenny, A. 2012. Setting new thermal standards for transitional and coastal (TraC) waters. *Marine Pollution Bulletin*. 64, pp. 1564 - 1579.
[RD369]	Wood, C.J. 1998. Movement of bottlenose dolphins around the south-west coast of Britain. *Journal of Zoology.* 246, pp.155–163.
[RD370]	WRc, 1996. *A review of polyelectrolytes to identify priorities for EQS development*. R&D Technical report P21, Foundation for Water Research, Marlow, Environment Agency, Bristol
[RD371]	Wright, M.D., Goodman, P. and Cameron, T.C. 2010. Exploring behavioural responses of shorebirds to impulsive noise. *Wildfowl*. 60, pp.150-167.
[RD372]	Wűrm, S. and Hűppop., O .1998. Reaktion der Herzschlagrate von Flussseeschwalben (Sterna hirundo) auf das Angebot akustischer Reize. Seev6gel, Zeitschrift VereinJordsand 19 (Sonderheft 1): 92-95. [cited from Nisbet, 2000).