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Visual Impact Provision Snowdonia

Marine Habitats Regulations Assessment: Stage 1 Screening and Stage 2 Information to Inform Appropriate Assessment

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Intertek Energy & Water Consultancy Services
Exchange House, Station Road, Liphook, Hampshire GU30 7DW, United Kingdom

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Visual Impact Provision Snowdonia

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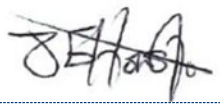
Author/s

Jill Hobbs

Project Manager	Authoriser
	
Jill Hobbs	Eric Houston

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Rev 4	28/02/2020	Post consultation	JH	EH	EH

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GLOSSARY

AA
Appropriate Assessment

AOD
Above Ordnance Datum

AONB
Areas of Outstanding Natural Beauty

Birds Directive
EC Council Directive 2009/147/EC on the conservation of wild birds

CCW
Countryside Council for Wales

CHSR
Conservation of Habitats and Species Regulations 2017

DWG
Drawing

Defra
Department for Environment, Food and Rural Affairs

EC
European Commission

EPB
Earth Pressure Balance

EPZ
Equipotential Zone

European Site
Collective term for Special Areas of Conservation, Special Protection Areas and Ramsar Sites

Habitats Directive
EC Council Directive 92/43/EC on the conservation of natural habitats and of wild fauna and flora

HAT
Highest Astronomical Tide

HRA
Habitats Regulations Assessment

IROPI
Imperative Reasons of Overriding Public Interest

kV
Kilo Volts

Marine Environment Area
Area within the Project Area as agreed with Natural Resources Wales bounded by the mean high-water springs at the landward extent.

MarLin
Marine Life Information Network

MarSEA
Marine Evidence-Based Sensitivity Assessments

MHWN
Mean High Water Neap

MHWS
Mean High Water Springs

MLW
Mean Low Water

NERC
National Environment and Rural Communities Act

NRW
Natural Resources Wales

NTL
Normal Tidal Limit

NVC
National Vegetation Classification

ODN
Ordnance Datum Newlyn

OHL
Overhead line

Pile caps
A thick concrete mat that rests on piles that have been driven into the ground to provide a suitable stable foundation.

Project Area
The Project Area is equivalent to the 'Area of Search for Temporary and Permanent Works'

Proposed Marine Works
All Proposed Project activities which occur below mean high water springs

Proposed Project
VIP Snowdonia Project - section of the OHL 4ZC within and adjacent to Snowdonia National Park which is to be relocated underground.

SAC
Special Area of Conservation

SEC
Sealing End Compound

SSSI
Site of Special Scientific Interest

SuDS
Sustainable Drainage System

TBM
Tunnel Boring Machine

VIP
Visual Impact Provision

VIP Subsection
3km section of the OHL 4ZC within and adjacent to Snowdonia National Park

1. INTRODUCTION

1.1 Project Background

The Visual Impact Provision (VIP) Snowdonia Project is a stakeholder driven project to mitigate the visual impact of existing electricity infrastructure in nationally protected landscapes in Great Britain. For National Grid, which is the transmission owner in England and Wales, this means considering the effects of existing infrastructure on the visual amenity and landscapes of National Parks and Areas of Outstanding Natural Beauty (AONBs).

Following the results of a landscape and visual impact assessment in 2014, covering all 571km of overhead line (OHL) within the scope of the VIP Project, those sections of OHL which had the greatest visual impact on the surrounding landscape were identified. In September 2015, a Stakeholder Advisory Group (consisting of stakeholders with national remits for England and Wales) decided that four sections of OHL should be prioritised for detailed assessment: Dorset (OHL 4YA), New Forest (OHL 4YB), Peak District (east) (OHL 4ZO) and Snowdonia (OHL 4ZC).

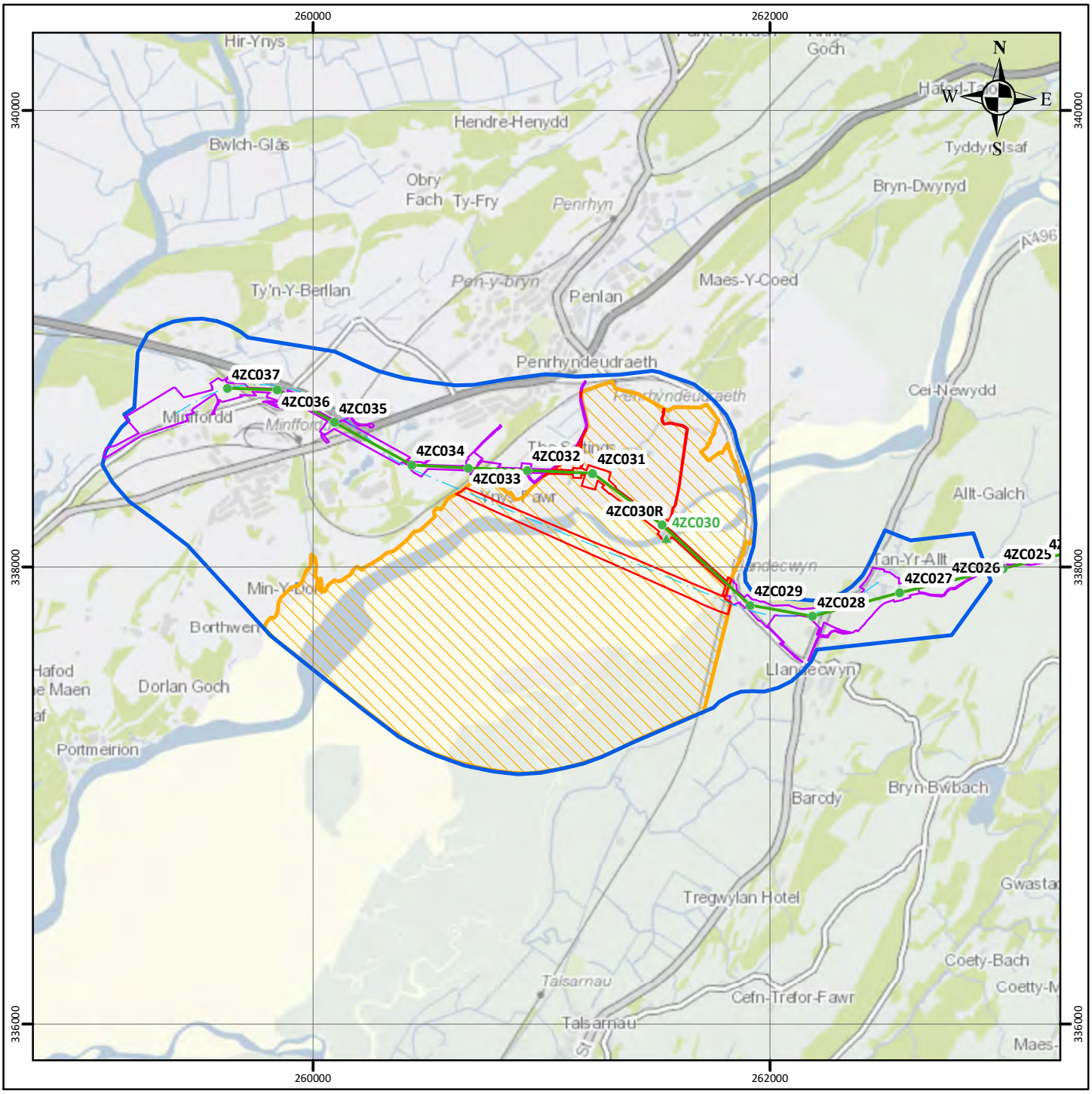
The aim of the VIP Snowdonia Project (hereafter referred to as the Proposed Project) is to relocate a section of the OHL 4ZC underground (hereafter referred to as the VIP subsection) within, and adjacent to, Snowdonia National Park.

The VIP subsection is approximately 3km in length and runs from National Grid's existing Garth Sealing End Compound (SEC) near Minffordd (to the east of Porthmadog) across the Dwyryd Estuary where it enters the western edge of the Snowdonia National Park. It then continues past the small settlement of Cilfor. The Proposed Project will include the construction of a new underground cable connection (constructed within a tunnel); a new SEC and associated terminal pylon; reconfiguration of the existing Garth SEC; two new tunnel head houses and associated accesses; and removal of the existing VIP subsection (pylons and conductors). Construction compounds, laydown areas, temporary access tracks and watercourse crossings will be required to facilitate construction activities. Figure 1-1 (Drawing [DWG] P2048-LOC-001) illustrates the full extent of the Proposed Project.

This Habitats Regulations Assessment (HRA) relates specifically to the Proposed Marine Works which form part of the construction phase of the Proposed Project. The Proposed Marine Works include all project activities which occur within the marine environment. The marine environment is defined as the area below mean high water springs (MHWS). The boundary of the Marine Environment Area within the wider Project Area has been agreed in consultation with Natural Resources Wales (NRW) and is shown in Figure 1-1 (DWG P2048-LOC-001). The location of the Proposed Marine Works is illustrated in Figure 1-2 (DWG P2048-LOC-002) and includes the following:

- Boring a cable tunnel under the Dwyryd Estuary;
- Laying the cables within the tunnel;
- Removal and dismantling of two pylons and their foundations (4ZC030R and 4ZC031) and the associated temporary access tracks to these locations; and
- Removal of the foundations of the previously dismantled pylon 4ZC030.

The removal of the foundations within the marine environment has been included within the Proposed Marine Works at the request of NRW in order to provide benefits to the estuary. The approach to undertaking this work has been discussed with NRW and the proposals outlined in this document align with NRW's conservation objectives for the site by helping to restore the estuary to a more natural status.



Legend

- Pylon
- 4ZC030 Foundation
- Overhead Line
- Proposed Tunnel Alignment
- Proposed Marine Works
- Terrestrial Site Boundary
- Area of Search for Permanent and Temporary Works
- Marine Environment Area

NOTE: Not to be used for Navigation

VISUAL IMPACT PROVISION (VIP) SNOWDONIA PROJECT

The Proposed Project

Drawing No: P2048-LOC-001	B
Date	28 February 2020
Coordinate System	British National Grid
Projection	Transverse Mercator
Datum	OSGB 1936
Data Source	OSOD; ESRI; NG
File Reference	J:\P2048\Mxd\01_LOC\ P2048-LOC-001.mxd
Created By	Chris Dawe
Reviewed By	Chris Carroll
Approved By	Jillian Hobbs

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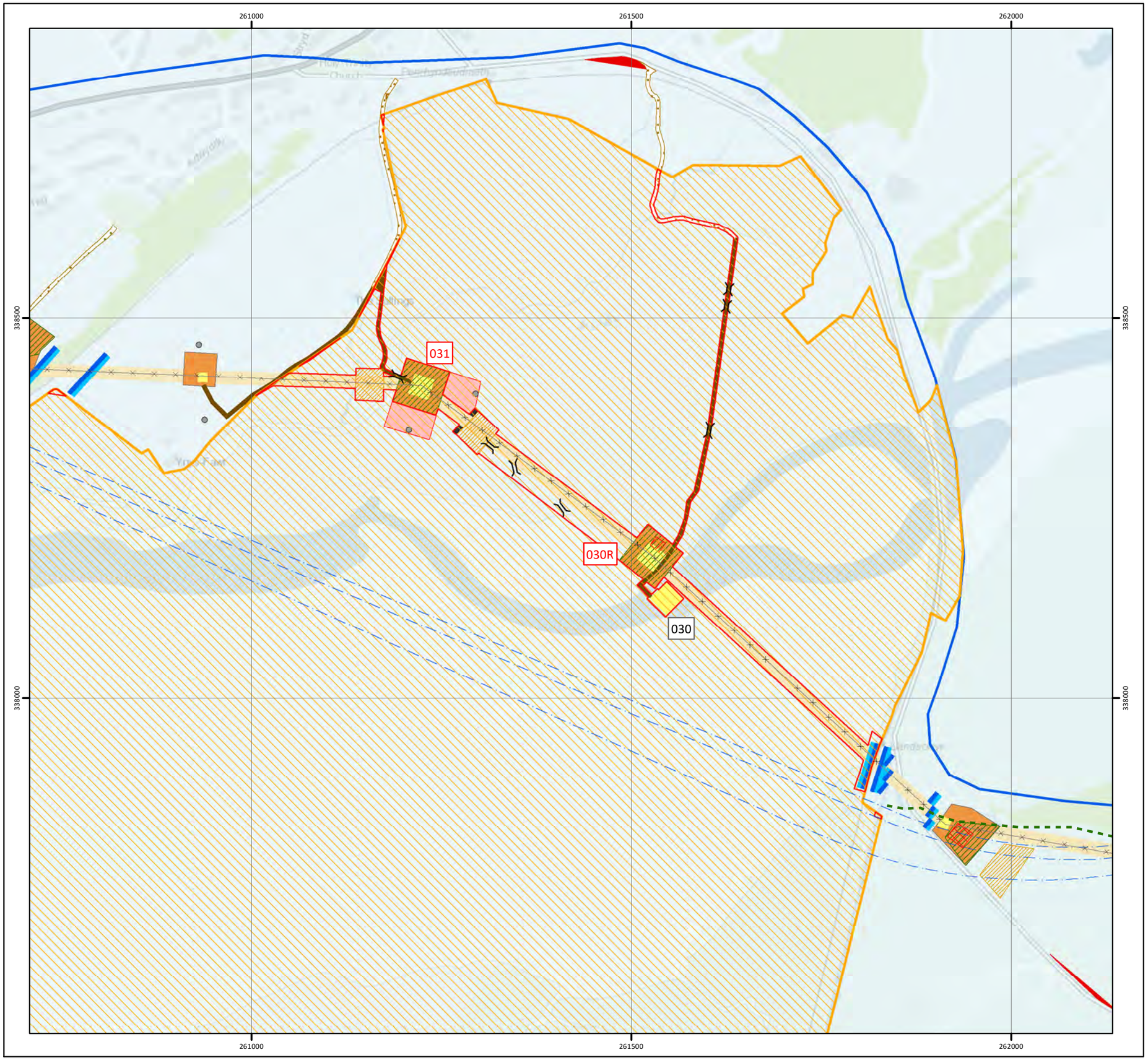


VISUAL IMPACT PROVISION (VIP) SNOWDONIA PROJECT

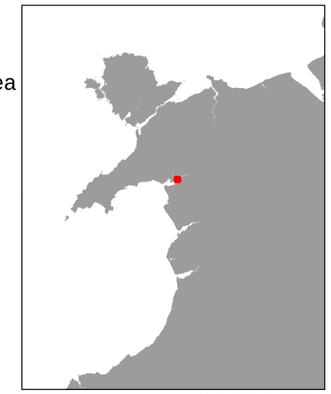
The Proposed Marine Works

Drawing No: P2048-LOC-002 | **C**

Legend

- Indicative Discharge Route
- Overhead Line
- Proposed Bridge Location
- Proposed Tunnel Alignment
- Proposed Marine Works
- Marine Environment Area
- Area of Search for Permanent and Temporary Works
- Indicative Area for Scaffold
- Indicative Scaffold Stay Area
- Indicative Crane Pad For OHL Removal
- Puller/Tensioner Platform Trackway
- Pylon Dismantling Area Trackway
- Foundation Removal Area
- Existing Access Route To Be Used &/Or Improved
- Temporary Access Route - Trackway
- Indicative Land Affected By OHL Tower Removal
- Proposed Working Area During OHL Conductor Removal
- Visibility Splays
- Light Access
- Light Access Area
- Backstay Position

N W E S



NOTE: Not to be used for Navigation

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Projection	Transverse Mercator
Datum	OSGB 1936
Data Source	ESRI; OSOD; NG
File Reference	J:\P2048\Mxd\01_LOC\ P2048-LOC-002.mxd
Created By	Chris Dawe
Reviewed By	Emma Langley
Approved By	Jillian Hobbs

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0 0.1 0.2 0.3 km

1.2 Purpose and Scope of this Report

Regulation 63(1) of The Conservation of Habitats and Species Regulations 2017 (CHSR) requires that any plan or project which has the potential to adversely affect a European site, no matter how far away from that site, be subject to the Habitats Regulations Assessment (HRA) process in order to determine whether Appropriate Assessment (AA) is required.

The Proposed Marine Works are located within the Pen Llyn a 'r Sarnau / Lleyn Peninsula and the Sarnau Special Area of Conservation (SAC) European site. As the project is not directly connected with or necessary to the management of the European site it is necessary for the Proposed Marine Works to be subject to the HRA process (described in Section 2).

The Proposed Marine Works are also located within Morfa Harlech Site of Special Scientific Interest (SSSI). SSSIs are sites which are nationally important areas of land and water (above mean low water) for their biological, geological or physiographical features in Great Britain. They are protected by law under the Wildlife and Countryside Act 1981 (as amended) and it is an offence for any person to intentionally or recklessly damage the protected natural features of a SSSI.

To undertake works within a SSSI which may have an adverse effect on the designating features of the site, a developer must seek advice and approval in the form of a SSSI assent under Section 28H of the Wildlife and Countryside Act 1981 (as amended). The developer must demonstrate that they have given due consideration to the effects of the proposed activities on the features of special interest and that the conservation objectives of the site will not be hindered by the project. There is no formal method for undertaking this assessment, therefore an assessment of the implications of the Proposed Marine Works on the features of the Morfa Harlech SSSI has also been included within this report.

1.3 Consultation

Consultation and stakeholder input have been integral to the design and development of the Proposed Project; identification of existing environmental constraints and sensitivities; and identification of the likely environmental effects.

NRW has been consulted throughout project design. National Grid opened discussions with NRW marine licensing in May 2016 to introduce the Proposed Project and initiate consenting for marine licensing elements of the project. Consultation (which is ongoing) has been undertaken to understand the key concerns relating to survey works across the estuary; the construction of the tunnel under the estuary; the existing pylon structures in the marine environment; and NRWs long term objectives for the European site the Proposed Marine Works are located within. These concerns and objectives have been taken into consideration in the design of the Proposed Marine Works. Outcomes of key consultation with NRW is summarised below:

- In 2017, a Marine Licence (ref RML1725) was granted by NRW for ground investigation works across the Dwyryd Estuary to inform the tunnel alignment design. An HRA was undertaken to support the licence application which identified that the estuary is important for overwintering birds which could be visually disturbed by the survey works. It was agreed with NRW that no works (either survey related, or with respect to the future project) would take place from 01 November through to 31 March without written approval from NRW.
- Due to technically challenging conditions on the estuary in the winter and for safety reasons National Grid has committed to undertaking all works on the estuary between 01 April and 31 October which will have the added benefit of avoiding the overwintering bird season. This seasonal restriction has therefore been included in the project design as a design consideration.
- Consultation with NRW marine licensing (18 January 2019) confirmed that a marine licence will be required under Section 66 of the Marine and Coastal Access Act (MCAA) 2009 for all works seaward of MHWS. This includes removal of pylons; temporary deposits and removal of said deposits i.e.

access tracks, a ramp and bridges for vehicle access and culverts); construction of the tunnel under the seabed; and deposits within the tunnel (i.e. the cable).

Whilst there is an exemption for bored tunnels under Section 31 of the Marine Licensing (Exempted Activity) (Wales) Order 2011, a condition of this exemption is that the works do not cause an impact to the environment. If any impact was caused by the works, then the exemption would not apply, risking the works being undertaken without consent. For this reason, NRW has recommended that a Marine Licence should be sought for the tunnel construction regardless of the method proposed.

NRW's main concern relating to tunnel construction is the potential for impacts on marine fauna from underwater noise and vibration. Following consultation with NRW, National Grid commissioned an underwater noise and vibration assessment to ensure all concerns were addressed.

The 2018 site condition assessment for the Pen Llŷn a`r Sarnau / Lleyn Peninsula and the Sarnau SAC (NRW 2018b) concludes that the Dwyryd pylons are directly impacting the condition of the estuary and Atlantic salt meadows feature of the site leading to the unfavourable condition assessment. The conservation objectives for the site are to 'restore' the features. Considering this objective, NRW has requested that all the pylon structures in the marine environment are removed to restore the estuary to its natural status. National Grid is committed to removing as much of the structures as is feasible, practicable and safe to do so. However, full removal of the existing pylon foundations will not be possible, and this has been acknowledged by NRW. NRW has requested that the worst case (minimum depth of removal) scenario for each marine pylon, which National Grid believe can be realistically achieved, be assessed by the HRA process. NRW also requested that full removal of the pylon foundations and cofferdam at 4ZC030R, (the best-case scenario) is also assessed. NRW has requested that National Grid demonstrate their commitment to attempting to remove more than the minimum worst case where possible, by allowing enough time in the programme and utilising the appropriate plant on site to facilitate this. National Grid has committed to doing so and this is the basis upon which the contract to undertake this work will be placed.

National Grid has also followed NRW's advice to use the same route over the saltmarsh for the access track to 4ZC030R that was in used in 2013 (when the replacement pylon was installed at 4ZC030R) to reduce any potential impacts on the saltmarsh.

On 06 December 2019, a pre-application consultation on the draft of the VIP Snowdonia Project was officially submitted to the local planning authority and all documents were made available on a website for public view. Following this consultation. As a result of consultation and further site visits access to the saltmarsh was amended to be sited 8m further east. Alterations to the access tracks have been updated in Figure 1-2 from those consulted upon which include widening the existing track for approximately 40m at this location to act as a turning point for vehicles onto the saltmarsh.

2. HABITATS REGULATIONS ASSESSMENT

2.1 Legislative Context

The Conservation of Habitats and Species Regulations 2017 (CHSR) transpose the requirements of Articles 6(3) and 6(4) of EC Council Directive 92/43/EC on the conservation of natural habitats and of wild fauna and flora (Habitats Directive) into UK statute.

The Habitats Directive and EC Council Directive 2009/147/EC on the conservation of wild birds (Birds Directive) require European Union member states to work together within the same legislative framework to protect Europe's most valuable species and habitats, irrespective of political or administrative boundaries. At the heart of these Directives is the creation of a network of Europe's most valuable species and habitat sites known as Natura 2000.

The aim of the Natura 2000 network is to ensure the long-term survival of European threatened species and habitats. The network comprises SACs designated under the Habitats Directive, and Special Protection Areas (SPAs) designated under the Birds Directive.

UK Government policy (ODPM Circular 06/2005) states that sites designated under the Convention on Wetlands (Ramsar, Iran 1971) known as the "Ramsar Convention" are also included under the definition Natura 2000. The vast majority of Ramsar sites are also classified as SPAs.

Collectively, SPAs, SACs and Ramsar sites are referred to as European sites under UK Regulations. Sites which are in the process of designation (e.g. Sites of Community Importance (SCI), candidate or possible SACs, proposed SPAs) are included in the definition as if fully protected.

A key protection mechanism under these directives is to consider the possible nature conservation implications of any plan or project on the European site network before any decision is made to allow that plan or project to proceed. Each plan considered for approval, must take into consideration the possible effects it may have alone or in combination with other plans and projects when going through the process referred to in the UK as the HRA process.

2.1.1 Article 6(3) of the Habitats Directive

Article 6(3) of the Habitats Directive requires that any plan or project not directly connected with or necessary to the management of the site but likely to have a significant effect thereon, either individually or in combination with other plans or projects, shall be subject to AA by the competent authority (those with decision making powers) of its implications for the site in view of the site's conservation objectives'.

The competent authority can only agree to the plan or project if, based on the findings of the Appropriate Assessment, it has ascertained that it will not have an adverse effect on the integrity of the site concerned. It is important to note that the onus is on demonstrating the absence (rather than the presence) of negative effects.

Depending on the type and severity of the effects identified, it may be possible to adjust the plan/project or introduce certain mitigation measures to avoid or pre-empt, remove or reduce effects to a non-significant level so that the plan/project may be approved (European Commission 2018).

2.1.2 Article 6(4) of the Habitats Directive

Article 6(4) of the Habitats Directive provides a derogation which would allow a plan/project to be approved in limited circumstances even though it would or may have an adverse effect on a European site. Article 6(4) applies to sites protected under both the Habitats and Birds Directives.

Under article 6(4) a plan / project can only proceed provided three sequential tests are met:

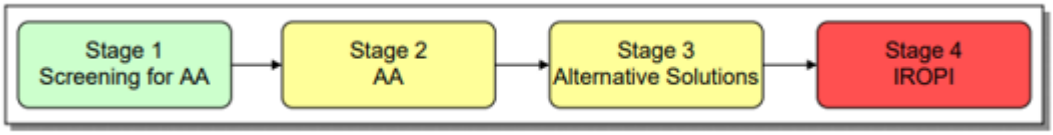
1. There must be no feasible alternative solutions to the plan or project which are less damaging to the affected European site(s);
2. There must be "imperative reasons of overriding public interest" (IROPI) for the plan or project to proceed; and
3. All necessary compensatory measures must be secured to ensure that the overall coherence of the network of European sites is protected.

These tests must be interpreted strictly and can only be formally considered once an AA in line with Article 6(3) of the Directive has been undertaken (Defra 2012).

2.1.3 The HRA process

The European Commission's methodological guidance (EC 2002) outlines a four-stage approach to the AA process, which helps determine likely significant effects and where appropriate, assess adverse effects on the integrity of a European site. The outcome at each successive stage determines whether a further stage in the process is required. The four stages are shown in Figure 2-1 and described below. Collectively they make up what is referred to in the UK as the HRA process.

Figure 2-1 Stages of HRA process



Whilst the obligation to undertake HRA is derived from Articles 6(3) and 6(4) of the Habitats Directive, it is Regulation 63(1) of the Conservation of Habitats and Species Regulations 2017 that sets out procedural requirements in the UK. It requires that the applicant provide such information as the competent authority may reasonably require for the purposes of assessment or to enable them to determine whether an AA is required.

There is no statutory method for undertaking the HRA process, but Welsh Government (2017) guidance outlines the steps to be taken by the applicant at each Stage.

2.1.3.2 Stage 1 - Screening for AA

Screening is the process that addresses and records the reasoning and conclusions in relation to the first two tests of Regulation 63 of The Conservation of Habitats and Species Regulations 2017:

- Whether a plan or project is directly connected to or necessary for the management of the site, and
- Whether a plan or project, alone or in combination with other plans and projects, is likely to have significant effects on a European site in view of its conservation objectives.

Where significant effects are likely, uncertain or unknown at screening stage, then the process must proceed to Stage 2 (AA). Screening should be undertaken without the inclusion of mitigation, unless potential impacts clearly can be avoided through the modification or redesign of the plan or project, in which case the screening process is repeated on the altered plan. The greatest level of evidence and justification will be needed in circumstances when the process ends at screening stage on grounds of no effect.

2.1.3.3 Stage 2 - Appropriate Assessment

If Stage 1 concludes that an AA is required, then the AA must be undertaken by the Competent Authority licensing the plan or project.

To inform the AA the developer must provide data and information on the project and on the European site. An analysis of potential effects on the site must be completed and presented as 'Information to Inform Appropriate Assessment'. This is a more detailed ecological assessment of the proposed activities and looks to answer two key questions:

- What are the likely effects of the proposed activity?
- How quickly could the Qualifying Feature recover from the effect, if at all?

The duty to undertake AA, having considered the 'Information to Inform AA', and to ensure that the stringent evaluation and decision-making procedure is applied correctly, lies with the competent authority, which for the Proposed Project is the Welsh Ministers. The AA will be a focused and detailed impact assessment of the implications of the plan or project, alone and in combination with other plans and projects, on the integrity of a European site in view of its conservation objectives.

If the assessment concludes that the plan or project will adversely affect the integrity of a European site, then the process must proceed to Stage 3, or the plan or project should be abandoned.

Any mitigation measures necessary to avoid, reduce or offset negative effects should be proposed at this stage.

2.1.3.4 Stage 3 – Alternative solutions

This stage examines any alternative solutions or options that enable the plan or project to proceed without adverse effects on the integrity of a European site. The process must return to Stage 2 as alternatives will require AA in order to proceed. Demonstrating that all reasonable alternatives have been considered and assessed, and that the least damaging option has been selected, is necessary to progress to Stage 4.

2.1.3.5 Stage 4 - Imperative Reasons of Overriding Public Interest (IROPI)/Derogation

Stage 4 is the main derogation process of Article 6(4) which examines whether there are IROPI for allowing a plan or project that will have adverse effects on the integrity of a European site to proceed in cases where it has been established that no less damaging alternative solution exists.

Unlike the Environmental Impact Assessment / Strategic Environmental Assessments, the result of which need to be taken into consideration when deciding to approve the plan or project, the conclusions of the AA are definitive and will determine whether the plan or project can be authorised (European Commission 2018).

3. PROJECT DESCRIPTION

3.1 Site Characteristics and Existing Conditions

The Proposed Marine Works are located within the Marine Environment Area as illustrated in Figure 1-2 (DWG P2048-LOC-002) which contains the Dwyryd Estuary, surrounding mud and sandflats and saltmarsh. The proposed tunnel alignment runs across this area and crosses the Dwyryd Estuary. However, the tunnel will be bored at least 15m below ordnance datum (OD) so will not come into contact with surface features. A description of the site characteristics for each of the marine pylon sites (4ZC030, 4ZC030R and 4ZC031) has been provided in the following sub sections.

3.1.1 4ZC030 (Foundations in estuary)

4ZC030 is the site of redundant pylon foundations which sit beyond the shoreline. The pylon at 4ZC030 was installed in the 1960's and was of similar design to 4ZC031 (see Section 3.1.2) but on a lesser scale. It was taken down in 2013 as the estuary channel had moved, undermining the foundations and causing the structure to become unsafe.

The foundations are still in-situ as shown in Figure 3-1. The pile caps and chimneys of three of the foundations are currently visible in the sea, with the fourth only just visible as it is on its side. There are occasions when the water level is low enough to access the foundations, however tidal action has scoured the sand away from the immediate area around each pile cap leaving a margin of deep water between the exposed sand and the pile cap. Bathymetry data collected in 2017 (Structural Soils 2017) indicates that these scour holes reach up to 2m depth (relative to Ordnance Datum Newlyn, ODN, Figure 4-7).

The foundation to each pylon leg consists of eighteen pre-cast concrete piles driven to an unknown depth. The piles are nominally 600mm in diameter and believed to be approximately 20m long, each made up of short sections of pile pushed down on top of each other i.e. not a continuous 20m pile. The piles are tied together with a pile cap with dimension 7.02m x 4.57m x 1.28m (four independent pile caps). The pile caps each have an extended chimney dimension 0.9m x 0.9m x 1.5m.

Figure 3-1 4ZC030 foundations in the estuary (2019)

3.1.2 4ZC030R (Replacement pylon for 4ZC030)

Pylon 4ZC030R (Figure 3-2) was installed on the saltmarsh in 2013 as an emergency replacement pylon for the original pylon at site 4ZC030. Pylon 4ZC030R has single steel tube pile leg foundations (0.76m diameter) which have been driven to suitable load bearing strata and are approximately 18m deep. The top 2m of the steel tube pile has been cleared out to accept the pylon stubs which are set into the top of the tube with a concrete plug. The tube has then been surrounded with a concrete collar approximately 1.80m x 1.80m x 1.20m, 0.6m below ground level. Two of the concrete collars around the foundation legs are below the surface sediments, whilst two remain above ground level within the cofferdam (see Figure 3-3).

The foundations are surrounded by a 12m deep cofferdam which consists of 69 pairs of steel sheet piles to protect the foundations from tidal action. A plan of the foundation arrangement is shown in Figure 3-4 below.

Currently, in 2020 the cofferdam forms a hard promontory sticking out from the rest of the shoreline and saltmarsh edge, acting as an artificial barrier to erosion (see Figure 3-5).

Figure 3-2 4ZC030R Replacement pylon on the edge of the saltmarsh (2019)

Figure 3-3 a) 4ZC030R pylon's two concrete collars exposed at ground level; b) close up of exposed concrete collar

Figure 3-4 Plan view of 4ZC030R foundations and cofferdam

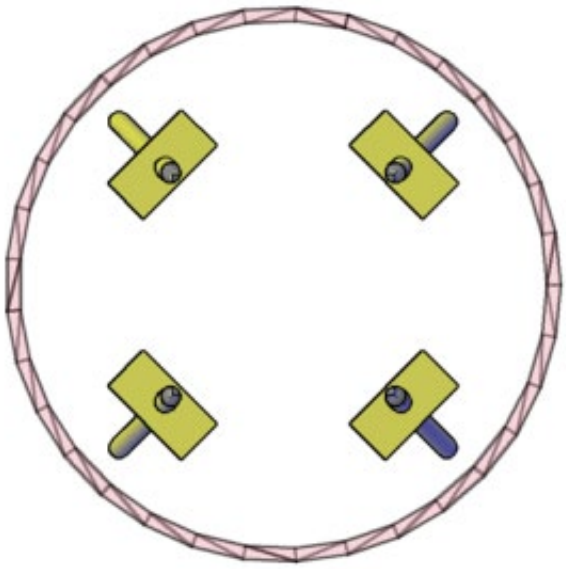


Figure 3-5 4ZC030R Foundations and cofferdam at the edge of the estuary channel (2019)

3.1.3 4ZC031 (Pylon on the saltmarsh)

Pylon 4ZC031 (Figure 3-6) was installed in the 1960's and consists of four foundations each with 18 piled legs beneath a concrete pile cap which in turn is below a concrete chimney and muff. Each pile is made up of short sections of pile pushed down on top of each other i.e. not a continuous pile. This pylon is at a level and location on the saltmarsh where inundation by tides is infrequent.

Figure 3-6 4ZC031 Pylon on saltmarsh (2019)

3.1.4 Access route to 4ZC031

There is an existing stone track leading from the railway line close to Penrhyndeudraeth Station (Figure 3-7) up to a cottage which is located opposite pylon 4ZC031 (Figure 3-8). The existing track extends along the boundary of the Marine Environment Area and is shown as a flood defence on NRW's online flood risk maps (://naturalresources.wales/evidence-and-data/maps/long-term-flood-risk/?lang=en)). Adjacent to this track, on the side of the saltmarsh, is a watercourse which has been classed as a main river by NRW. The access route to pylon 4ZC031 is shown in Figure 1-2 (DWG P2048-LOC-002).

Figure 3-7 Existing stone track from railway line (2019)

Figure 3-8 Existing stone track to cottage opposite 4ZC031 (2019)

3.1.5 Access route to 4ZC030R and 4ZC030

There is an existing stone track to the sewage works which is along the first part of the route to access 4ZC030R and 4ZC030. Beyond this access to 4ZC030R and 4ZC030 is required across the saltmarsh.

The access route to 4ZC030R and 4ZC030 is shown in Figure 1-2 (DWG P2048-LOC-002).

3.2 Proposed Marine Works

3.2.1 Design considerations

The Proposed Marine Works have been designed through an iterative process, in consultation with NRW, that sought to avoid or reduce environmental effects. Constraints which form part of the design of the Proposed Project and which National Grid has committed to for the Proposed Marine Works which are designed to avoid or abate negative environmental effects are presented below in Table 3-1.

Table 3-1 Design considerations

During Construction
National Grid has made a commitment not to undertake the proposed works within the Dwyryd Estuary to remove the overhead line during the period 01 November and 31 March to minimise impacts on overwintering birds.
Existing tracks, where possible, will be used to access the pylons. In addition, where possible, access tracks to pylons will be shared (e.g. at 4ZC30 and 4ZC30R).
The same access track route as used in 2013 for the 4ZC030R pylon replacement will be used.

During Construction
Access trackways will be constructed from temporary trackway instead of stone. This will distribute weight across sensitive habitat better and can be easily removed.
Cranes will not be used at pylon 4CZ031 to reduce the load on the saltmarsh habitat.
Where possible bridges instead of culverts will be used to cross saltmarsh creeks. Bridges are quicker to install and will therefore reduce the amount of time works will be undertaken on the saltmarsh.
Where stone is used it will be contained e.g. by membranes or bags, ensuring direct and specific placement.

3.2.2 Cable tunnel construction

The 4ZC OHL will be replaced with an underground high voltage cable system. In order to construct the cable tunnel, vertical shafts (outside the Marine Environment Area) will need to be constructed at the start and end points of the tunnel either side of the Dwyryd Estuary; one near Garth (western side of the estuary) and one near Cilfor (eastern side of the estuary).

A tunnel with an internal diameter up to 4.4m, will be constructed between the two shafts. Tunnel construction is likely to take 17 months following shaft construction. The tunnelling method will use a tunnel boring machine (TBM) to bore through the ground. The tunnel will then be lined with precast concrete segments behind the TBM. The TBM will be launched from the west (Garth) and received at the shaft at the eastern end of the tunnel (Cilfor). The TBM will be fitted with an effective dust-control system and controlled in a way to minimise noise and vibration. Initially a short section of tunnel (launch chamber (forward shunt) / back shunt) may be constructed using drill and blast or mechanical excavation to enable the TBM to be built below ground and improve the efficiency of the tunnelling process, this will be outside the marine environment.

The type of TBM will be determined and fully specified by the appointed contractor, based upon the geology and hydrogeology to be expected. It is currently anticipated that the contractor will adopt the use of a slurry TBM which works on the principle that the ground to be tunnelled through in front of the cutter head is supported by bentonite slurry. Bentonite is a naturally occurring clay mineral used extensively in the construction industry. The mineral is mixed with water at the surface in large tanks to form a slurry, which is supplied to the TBM by a delivery pipeline. The slurry is contained in the head of the TBM in a pressurised chamber that also contains the cutter head which is used to excavate the ground. The slurry is further utilised to remove excavated material in suspension. The slurry is mixed with the excavated material by the rotating cutter head and is then removed from the tunnel via a return pipeline in a closed piped network. At the surface, the excavated material is removed from the slurry by a treatment plant, which includes settlement tanks, cyclones and filter presses to allow the heavier particles of excavated rock to be separated from the lighter bentonite particles. The slurry is then reconditioned and topped-up as necessary with fresh bentonite before being returned to the TBM head through the supply pipes.

The launch/ drive shaft is used for launching the TBM (on the western side of the tunnel), removing excavated material, supplying materials to the tunnel face and allowing personnel access for construction of the tunnel. The tunnel drive shaft needs to accommodate the plant required to support the tunnel construction such as ventilation ducting, power cables and cooling water pipes. The size of the reception shaft needs to be adequate to allow removal of the TBM on completion of the tunnel.

The tunnel will be constructed at varying depths depending on the final vertical alignment proposed by the contractor, the top of the tunnel will remain below -15m OD for the full tunnel drive. In areas of soft or poor ground, a number of additives may be required to condition the soil to facilitate tunnel construction. Once appointed, the contractor will supply details of all additives to Natural Resources Wales to confirm that they are acceptable for use.

3.2.3 Cable installation

Two High Voltage electrical systems will be installed in the tunnel. One circuit will be operated at 400kV and the other at 132kV. Installation of the High Voltage system within the tunnel will utilise the existing site compound and the shafts created to build the tunnel. The work to install the High Voltage System will largely be completed underground with some activities on the surface at each end to connect to the existing infrastructure.

3.2.4 Conductor and pylon removal

Removal of the existing VIP subsection infrastructure (i.e. removal of the OHL from pylon 4ZC027 to 4ZC037) will take place following installation and commissioning of the new underground cables.

The Conductors between pylons could be simply removed by lowering them to the ground and reeling them onto wooden transport drums, although simple and fast this method offers no protection to anything situated in the span such as roads, buildings, railways, walls, hedges, lower voltage power lines and the ground itself.

An alternative, and the preferred approach to conductor removal is to use continuous tension stringing whereby the conductor is replaced under tension by a light bond which is used to reel the conductor onto drums for removal from site. The light bond will be lowered to the ground and reeled in at the receiving pylon. This method will have minimal impact on anything at ground level.

Pylon dismantling and removal can be carried out using a variety of methods depending on the pylon type, location and access. Potential methods include:

- Crane: Pylons can be dismantled using a large mobile hydraulic crane which is positioned on a crane pad at the pylon location. The crane pad will be approximately 20m x 20m (subject to crane size/site constraints) constructed from imported stone and plastic or metal panelling. It will take approximately three days to dismantle a pylon using a crane (following advanced site preparation i.e. installation of the crane pad and progressing of advanced works on the pylon prior to commencement of works with the crane). The sections of the pylon will be cut/ broken up as they are lowered to the ground using a steelwork breaker/ mechanical shears fitted to an excavator. The cut sections of the pylon are then placed into waste skips (which could be located within the crane pad or on the temporary track way joining the crane platform) and removed from site for reuse or recycling.
- Winch and Derrick: This method requires two small mobile winches (labelled as 'light access' in Figure 1-2) and a derrick (a latticed pole lifting device, see Figure 3-9) to be taken to the site. The derrick will be raised up to the top of the pylon such that approximately one third of the derrick is above the top of the pylon. Four stay wires will be required (for support) at right angles from the top of the derrick down to backstays (concrete blocks on sledges) which are positioned at least one and a half times the maximum height of the derrick away. The pylon will act as a scaffold and will be dismantled from the inside in small sections which will be individually lowered to the ground using the winch and derrick. The winches will be positioned on the saltmarsh and on completion of the works removed, by a telehandler (an all-terrain forklift vehicle). This vehicle will cross a short section of unprotected saltmarsh, once to position the winch and once to remove it.

Figure 3-9 Example of a derrick being used to dismantle a pylon

It is currently anticipated that pylon 4ZC030R will be dismantled with a crane and pylon 4ZC031 with a derrick. The foundation removal method for pylons located within the Marine Environment Area is described below:

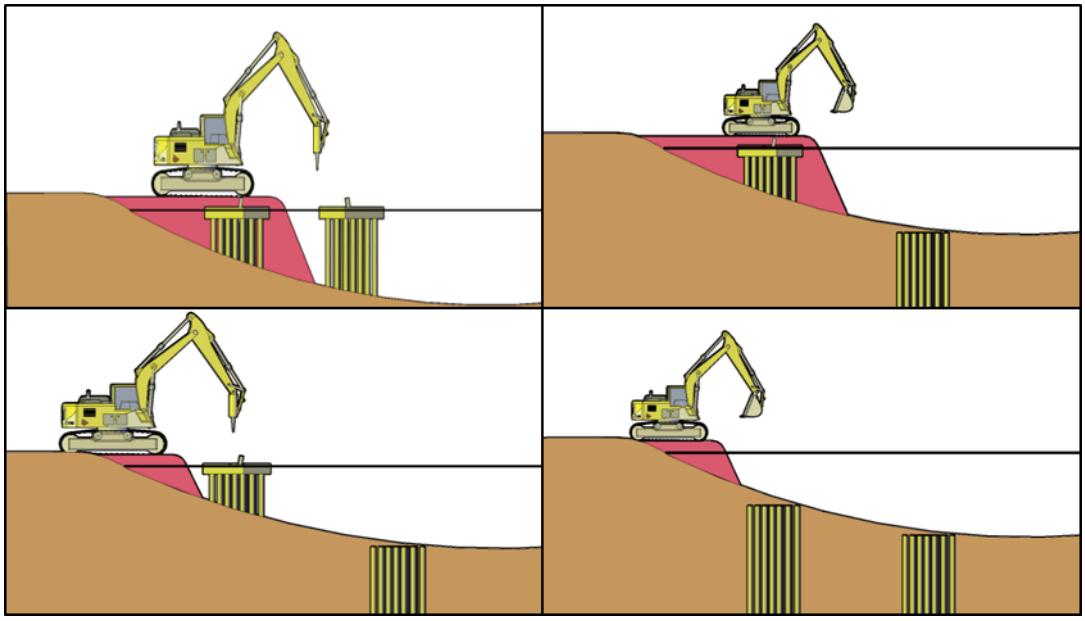
3.2.4.2 4ZC030 (Foundations in estuary)

The method of removing the foundations addresses the pile caps and the pre-cast concrete piles down to below the seabed level. The works will be suspended at high tide and the equipment removed to a place above the anticipated water level.

The pre-cast concrete piles are in sections which are not connected (as they were designed to resist compressive forces), therefore it will not be possible to withdraw the piles from the sand by any method other than to excavate them out as far as is safe and reasonably practicable.

The proposed method of foundation removal involves building a working platform so that an excavator with a hydraulic breaker can be located close to the pylon foundations (Figure 3-10). The working platform will be created by placing boulders in the sea or alternately textile bags filled with granular material. If textile bags are used a capping layer of granular material will be required; laid over the top of the bags. The outer pile caps (the pile caps on the foundations furthest from the shore) will be broken up and removed before reducing the size of the working platform and removing the inner pile caps (on the foundations closest to the shore).

Figure 3-10 Illustration showing working platform to be used for foundation recovery



Although it is expected that the pre-cast concrete piles cannot be totally recovered it is expected that it will be possible to remove sections of pile within the reach of the excavator which is anticipated to be 6-7m below the level of the working platform (the working platform is anticipated to be approximately 1m above low tide level). In terms of assessment, a realistic worst case for foundation removal of 3.75m below ground level (assumed to be the saltmarsh level at 2.5m above ODN) has been adopted. It is anticipated that it will take 21 days to set up and remove the working area and a further seven days for excavation of the foundations.

3.2.4.3 4ZC030R (Replacement pylon for 4ZC030)

National Grid will aim to remove all pylon structures including the foundation piles and cofferdam sheet piles at pylon 4ZC030R.

The foundation collars will be removed by hydraulic breakers. The preferred approach to removing the steel tube piles is to use a Leader Pile Rig which will grip the pile and remove it vertically with a vibrating action (Figure 3-11). It is anticipated that the piles will be removed with the concrete plug intact. The cofferdam ring beam will be removed by using the same Leader Piling Rig which would simultaneously vibrate and lift the metal sheets. The sheets will be cut into manageable sizes and lifted out using a crane. It is anticipated that five days will be required for pylon foundation removal. However, if full removal of the foundations and cofferdam is successful it is anticipated to require seven days (i.e. a further two days to remove the cofferdam) (timescales are weather dependant). As this area is tidal the void in the ground will fill naturally with local material by tidal action.

Figure 3-11 Removal of cofferdam sheet piles using leader pile rig

It is anticipated that full removal of the foundations and cofferdam will be possible. However, this will not be known for certain until the contractors are on site and removal has been attempted. If the piles have fused / bonded they may not come out through vibration and pulling as planned. In this case the foundations will be removed to the maximum depth possible by using an excavator. This will be located on the working area, which will be formed of plastic or aluminium panels. The excavator will remove sediment to allow cutters to be used inside the cofferdam to cut the piles and cofferdam sheet piles.

The sand around the tube piles will be excavated to a depth of around 2m (inside the cofferdam). Even though the foundations are inside the cofferdam, water will continue to enter the excavation even at low tide so continuous pumping will be required. The piles and cofferdam will then be cut at approximately 2m below ground level and removed.

The duration of excavation of the foundations if full removal does not work is estimated to be 17 days in total (three days to attempt full removal and a further 14 days to undertake partial removal). Timescales are weather dependent.

The reinforced concrete will be disposed of and the redundant steelwork removed for recycling.

3.2.4.4 4ZCO31 (Pylon on the saltmarsh)

4ZC031 will be removed using the method outlined below.

- Place temporary trackway across the saltmarsh. Trackway approximately 4.5m wide, constructed of plastic or aluminium panels laid two side by side and a third centrally positioned over the top.
- Excavate soil from around the foundations to depth of 3.75m below ground level and set aside for backfilling.
- Removal of the pile cap and concrete piles to 3.75m below ground level.
- Backfill with soil set aside and a non-cohesive fill imported from local source to maintain the topography.

It is anticipated that once the access to the pylon has been installed (see Section 3.2.3.4), 10 days will be required for pylon removal, and a further four days for excavation of foundation (timescales are weather dependant).

3.2.4.5 Temporary access and laydown

Access Tracks: The removal of pylons (including the foundations) in the Marine Environment Area will require temporary access across saltmarsh habitat. The temporary access will make use of trackway

(or similar); however, upgrades may be required by placing a temporary stone access road/ surface across an existing access track. Pylons 4ZC030, 4ZC030R and 4ZC031 will require temporary access as follows:

- Access to pylons 4ZC030 and 4ZC030R will partly use an existing stone track which leads to a sewage works and partly cross the saltmarsh using a temporary constructed track along the same route used during the installation of pylon 4ZC030R in 2013. The existing stone track may require widening.
- Access to pylon 4ZC031 will partly use a narrow existing stone track which follows the boundary of the SAC (and the Marine Environment Area) and partly use a temporary constructed track across the saltmarsh. To access the saltmarsh from the existing stone track a culverted ramp will be required to cross from the higher ground of the track to the lower ground of the saltmarsh, over a NRW defined 'main river' watercourse. Further details on the ramp are provided below.

In general, preference will be given to using plastic or aluminium road panels to construct temporary roads.

Access to the saltmarsh from the existing track will require the creation of approximately 40m of additional stone track way to make a ramp and turning point for vehicles turning into / out of the saltmarsh. A ramp is required due to the difference in ground level and will need to be culverted due to the presence of a deep channel adjacent to the track (see Figure 3-12). The culverted ramp will be constructed as follows:

Pipes will be laid in the watercourse to carry the water and to prevent fill from blocking the watercourse. At each end of the pipe way, a “headwall” will be built to prevent water flowing outside the pipes, which would scour the fill away. The pipes will be overlaid with geotextile membrane which will prevent fill or silt entering the watercourse. Crushed stone will be placed over the membrane to form the roadway or ramp. All this work will be carried out with a small excavator to lift the pipes and place the crushed stone.

Figure 3-12 Construction of a similar culverted ramp along the existing track in 2013

Two culverts will be built to protect two known watercourses along the access route to pylon 4ZC031. The ramp will sit over one culvert as described above, and track panels will sit over the top of another culvert which will need to be constructed. Due to the dynamic nature of the estuary and saltmarsh, it is possible that by the time the works are planned to take place other culverts may be required for any additional creeks identified along the access routes.

A vehicular bridge approximately 8m x 2.5m will be required to cross a watercourse located in front of the west side of pylon 4ZC031 (see Figure 3-13). Additionally, a further six vehicular bridges approximately 6m x 2.5m will be required to cross creeks on the saltmarsh (three between pylons 4ZC031 and 4ZC030R, and three along the access route to pylons 4ZC030 and 4ZC030R).

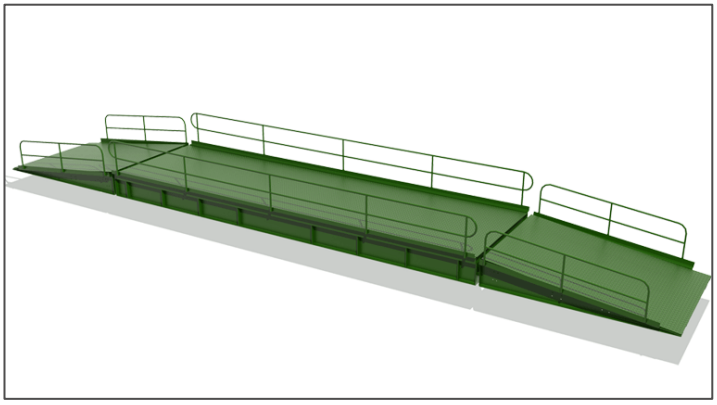
Figure 3-13 Watercourse cutting through the saltmarsh in front of 4ZC031 (2019)

Bridges will be built which can be lifted into place using a crane unit mounted on the delivery lorry. Prior to bridge placement, the bank seat (temporary footings for the bridge) will require some preparation such as laying wooden sleepers or bags of crushed stone to form a temporary level base. The bridge unit, depending on its span, may be delivered as one unit or a series of sections. Figure 3-14 shows an example of a vehicle bridge and Figure 3-15 shows a diagram of the sectioned parts to vehicular bridges.

The bridges will be lifted onto the temporary foundation using the lorry mounted crane and then bolted together.

Figure 3-14 An example of a vehicular bridge

Figure 3-15 Diagram showing three-part sections of vehicular bridge



Where laydown areas are located close to pylons for the removal of conductors, the temporary working area is known as the Equipotential Zone (EPZ) or puller / tensioner platform and it will be constructed from aluminium panels (brown hatched area illustrated in Figure 1.2).

There are two EPZs in the Marine Environment Area, one each side of pylon 4ZC031. The combined footprint of these areas is 3,200m^2**.** The EPZ on the east side of pylon 4ZC031 will also have back stays (black solid area illustrated in Figure 1.2) which are used to brace the pylon tower when the conductors are pulling it in the opposite direction. The back stay will comprise a row of steel sledges installed on the ground each loaded with three kentledge blocks, which weigh approximately 1.4 tonnes each. The footprint of each sledge is approximately 1.2m x 1.8m.

The footprint for light use vehicle access (forklift vehicle) across the saltmarsh will be along a narrow track the width of the vehicle. As the exact route the vehicle takes is unknown, the two footprint areas allow for flexibility. Combined the two areas cover approximately 3820m^2. Pylon dismantling will take place within a temporary working area around the pylon (dark orange solid area and overlapping green hatched area illustrated in Figure 1.2) comprising aluminium or plastic panels. The required footprint is approximately 60m x 60m, with a 32m x 32m gap in the middle.

Excavation of the foundations will take place within the foundation removal areas (yellow solid areas illustrated in Figure 1.2) which are the 32m x 32m gaps in the middle of the working areas for sites 4ZC030R and 4ZC031. Excavation of the foundations at pylon site 4ZC030 will take place from the temporary stone platform approximately 32m x 32m.

3.2.5 Footprint of works

The surface footprint of the Proposed Marine Works is presented in Table 3-2. These are indicative figures which include the surface areas (either on the saltmarsh or in the estuary) affected by the removal of the pylons, conductors and foundations within the Marine Environment Area. There will be no surface footprint from the construction of the tunnel under the estuary and the laying of the cable within the tunnel within the Marine Environment Area.

The area of the existing stone track which crosses the saltmarsh to pylons 4ZC030 and 4ZC030R has been included because it is possible it may require improvement and widening. Since it is likely any additional width which overlaps with the saltmarsh will be less than the existing area of track, this figure is very conservative.

The volumes of excavated material associated with foundation removal works will not be known until the contractor is on site and the maximum depth of excavation has been achieved. However, indicative values have been estimated based on the worst-case depths of excavation and are presented in Table 3-2 below.

Table 3-2 Indicative footprint surface area of Proposed Marine Works

Pylon /site	Description	Working area	Excavation footprint
Pylon working area			
4ZC030	A stone platform will be constructed from the shore approximately 32m x 32m. The excavator will sit on the platform and its arm will be positioned over the exposed foundations which are within scour holes therefore minimal excavation anticipated.	1024 m^2	Not known but minimal
4ZC030R Worst case scenario – partial removal	60m x 60m working area formed using terrafirma plastic panels with 32m x 32m centre gap. At least two layers of panels to be laid due to wet ground conditions. 32m x 32m area disturbed by excavation works. Within this area there will be 4 holes within the cofferdam each approximately 2.25m^2	3,600m^2	1,024m^2
4ZC031	60m x 60m working area formed using terrafirma plastic panels with 32m x 32m centre gap. At least two layers of panels to be laid due to wet ground conditions. 32m x 32m surface area disturbed by excavation works. Within this area there will be 4 holes each approximately 32.5m^2 (6.7m x 4.84m)	3,600m^2	1,024m^2
Sub Total working and excavation areas		**8,224m^2**	**2,048m^2**
Conductor removal laydown areas			
EPZ / Puller/ Tensioner Platform	Two EPZs (Laydown area for the removal of conductors) within the Marine Environment Area, one either side of 4ZC031.	3200m^2	N/A
Back stay	One back stay used to brace the 4ZC031 pylon tower when conductors are pulling it in the opposite direction. Steel sledges will be installed on the ground each loaded with 3 kentledge blocks, which weigh approximately 1.4 tonnes each.	240m^2	N/A
Light Access	Two winches will be positioned on the saltmarsh either side of pylon 4ZC031 by a telehandler (all terrain forklift vehicle)	3820m^2	N/A
Conductor working Area	The conductor working area will receive a light bond which will be lowered to the ground and reeled in at the receiving pylon as described in Section 3.2.3.	9200m^2	N/A
Conductor working area & 3 bridges	Conductor working area and area where 3 bridges will be required	8220m^2	N/A

Pylon /site	Description	Working area	Excavation footprint
Sub Total conductor removal laydown areas		**24,680m²**	**N/A**
Scaffold and Scaffold Stay Areas			
Scaffold & Scaffold Stay	Scaffolding is required in the wider Proposed Project area and parts of the scaffolding and scaffold stay areas partially overlap with the marine environment area. Therefore, although not part of the Proposed Marine Works the footprints of these areas have been included here for completeness.	1210m²	N/A
Sub Total scaffold and scaffold stay areas		**1210m²**	**N/A**
Access routes and watercourse crossings			
4ZC030 & 4ZC030R	Existing stone track (towards sewage works) to be used and / or improved. *Note the footprint value is based on the area of the existing track. Should the track need widening the area inside the SAC is likely to be the length of the existing track but certainly less than the width of the existing track. Therefore, the footprint value is an over-estimate.*	890m²	N/A
	Temporary track – plastic track is between 2m and 2.5m wide. Two panels are laid side by side and a third is laid over the top in the middle. Total width of track approximately 4.5m. 3 temporary vehicular bridges	2160m²	
4ZC031	Existing Stone Access track (to cottage) to be used and / or improved	120m²	
4ZC031	Temporary track - plastic track panels between 2m and 2.5m wide. Two panels are laid side by side and a third is laid over the top in the middle. Total width of track approximately 4.5m.	950m²	
Sub Total area of access tracks		**4120m²**	**N/A**
Total Footprint of works in marine environment		**37,024m²**	**2,048m²**
Total Footprint within the Proposed Marine Works Site Boundary		**38,701m²**	

Table 3-3 Indicative excavation volumes associated with foundation removal

Pylon / Scenario	Pylon structure to remove	Volume of excavated hole/material per foundation leg (Length x width x depth)	Total volume of excavation (4 foundation legs) (+ cofferdam at 4ZC030R)	Quantity of material* to remove from site	Excavated material to be re-used as fill	Quantity of imported fill
4ZC030 Partial removal 3.75m	Concrete pile cap + 18 piles per leg	38.75m³ (7.02m x 4.6m x 1.2m) + 13m³	207m³ (155m³ + 52m³)	207m³	0m³	0m³
	Concrete platform	N/A	N/A	1,800m³ (20m x 20m x 4.5m)	N/A	N/A
4ZC030R Full removal	Concrete pile cap + concrete plugs (concrete plug in each tube pile)	2.25m³ (1.5m x 1.5m x 1.0m) + 1m³	13m³ (9m³ + 4m³)	13m³	0m³	0m³

Pylon / Scenario	Pylon structure to remove	Volume of excavated hole/material per foundation leg (Length x width x depth)	Total volume of excavation (4 foundation legs) (+ cofferdam at 4ZC030R)	Quantity of material* to remove from site	Excavated material to be re-used as fill	Quantity of imported fill
scenario	Metal tube piles & cofferdam sheet piles	N/A	25.2m³ (1.7m³ + 23.5m³)	25.2m³	0m³	0m³
4ZC030R Partial removal 2m scenario	4ZC030R Concrete pile cap + Metal tube piles & cofferdam sheet piles + concrete plugs	N/A	1711m³	38.2m³ (13m³ + 25.2m³)	1,673m³	0m³
4ZC031 Partial removal 3.75m	Chimney & muff	0.49m³ (0.9m x 0.6m x 0.9m)	1.96m³	1.96m³	377m³	110m³
	Pile cap + 18 piles per leg	121.6m³ (6.7m x 4.84m x 3.75m)	486.4m³	107.7m³ 4 x (5.2m x 3.34m x 1.55m)		

* Concrete and / or scrap metal

3.2.6 Project programme

The current indicative programme for the Proposed Project is that, assuming planning consent, on-site works would commence in 2021 and take approximately 5-6 years to complete.

First site access is likely to be taken at the western tunnel drive site near Garth, this is currently expected to take place in early 2021 and is subject to gaining all necessary approvals.

Site establishment near Cilfor is likely to begin later and will be started at a time to allow completion of the shaft prior to the arrival of the TBM. Site establishment at Cilfor will involve building the floating access road (which will permanently remain in situ), a construction compound and any associated groundworks.

The shaft, tunnel head house, and SEC will be constructed at Cilfor. Once the outage is in place, the erection of the new pylon will be completed, as well as the removal of the current 4ZC027 pylon. Once these, and the tunnel are complete and the new conductors and cables energised, the OHL removal will take place. All tunnel, tunnel head house and sealing end compound construction work is expected to be complete by the end of 2025.

Overhead line removal work (including the Proposed Marine Works) is expected to take place in 2026. The Proposed overhead line Marine Works will take place between 01 April and 31 October, with the foundation removal completed and the physical barriers within the estuary removed as far as possible by the end of this period. If the contractor is able to complete the works earlier overhead line removal works may take place in 2025 but would still take place between 01 April and 31 October.

3.3 Pylon Foundations Removal - Scenarios for Assessment

In line with NRWs conservation objectives for the site National Grid is committed to removing as much of the pylon foundations as is safe, feasible and practicable, however, due to the age and configuration

of the pylons, and difficult estuary environment and ground conditions, full removal of all marine pylon foundations will not be possible. NRW has advised that if full removal is not possible then they would like National Grid to assess the realistic worst-case (the greatest depth of removal which is realistically achievable) for each pylon. As National Grid has a high level of confidence in achieving full removal at the replacement pylon 4ZC030R, this has been assessed alongside a worst-case scenario whereby the pylon and cofferdam cannot be removed by vibration and pulling and partial removal by excavation and cutting is required. The different scenarios for marine pylon foundation removal are presented in Table 3-4 and in Figures 3-17 and 3-18.

Table 3-4 Pylon foundation removal scenarios

Pylon Site	Scenario	Method of extraction	Minimum depth of removal
4ZC030	Partial removal Worst case	Construction of temporary platform to access foundations, excavator with hydraulic breaker	3.75m below ground level (-1.25m ODN)
4ZC030R	Scenario 1 Full removal Best case	Collars removed by hydraulic breakers, steel tube piles & cofferdam removed by leader pile rig	Full removal
	Scenario 2 Partial removal Worst case	Excavate sand to 2m, collars removed by hydraulic breakers, steel tube piles and cofferdam cut at 2m depth	2m below ground level (+0.5m ODN)
4ZC031	Partial removal Worst case	Excavate sand around foundations and then mechanically break up pile caps and remove piles to depth excavator arm can reach	3.75m below ground level (-1.25m ODN)

Note: Ground level refers to the saltmarsh level which has been estimated to be 2.5m above ODN

Figure 3-16 Schematic showing the pylon removal scenarios 4ZC030, 4ZC031 worst case, 4ZC030R preferred case

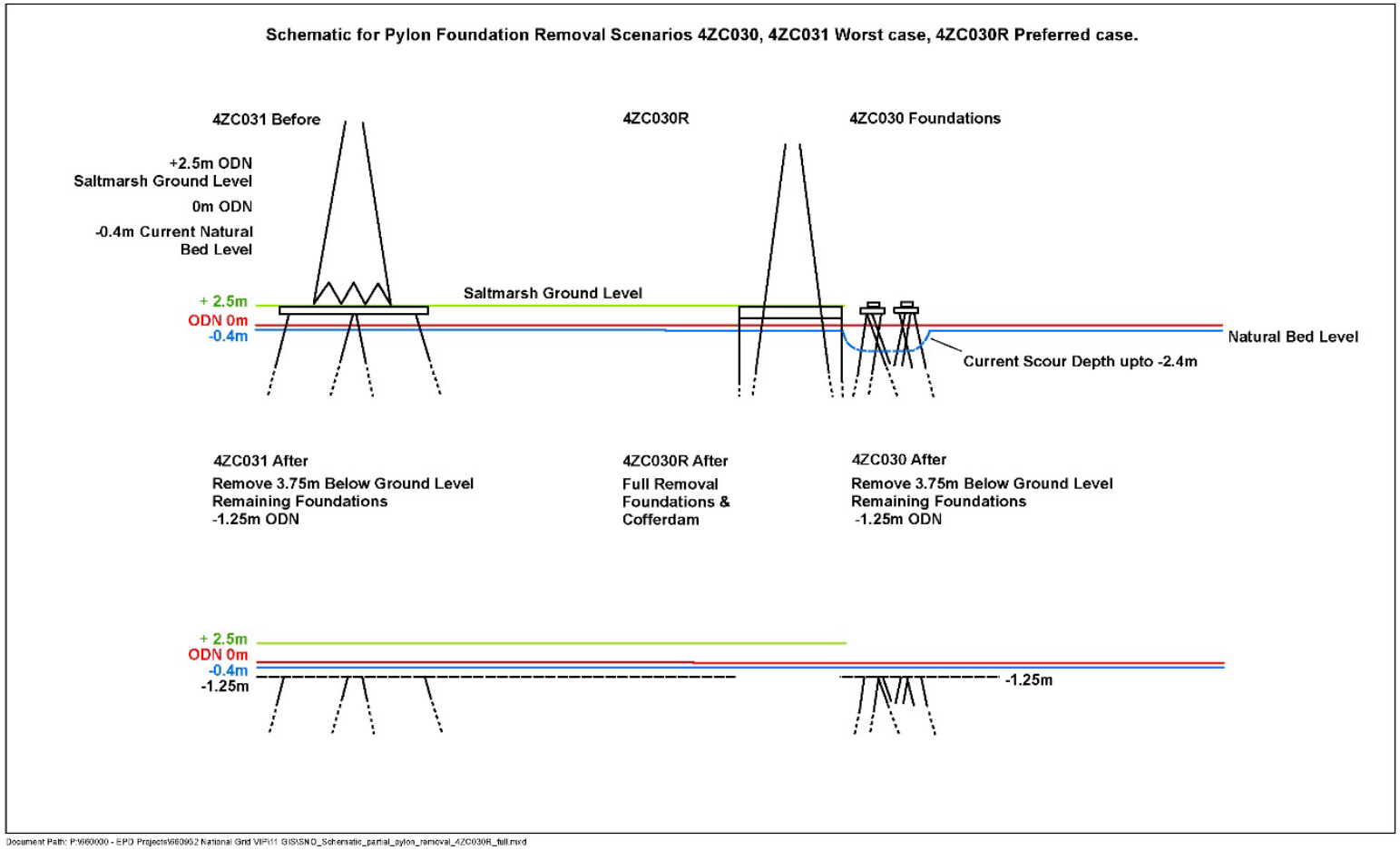
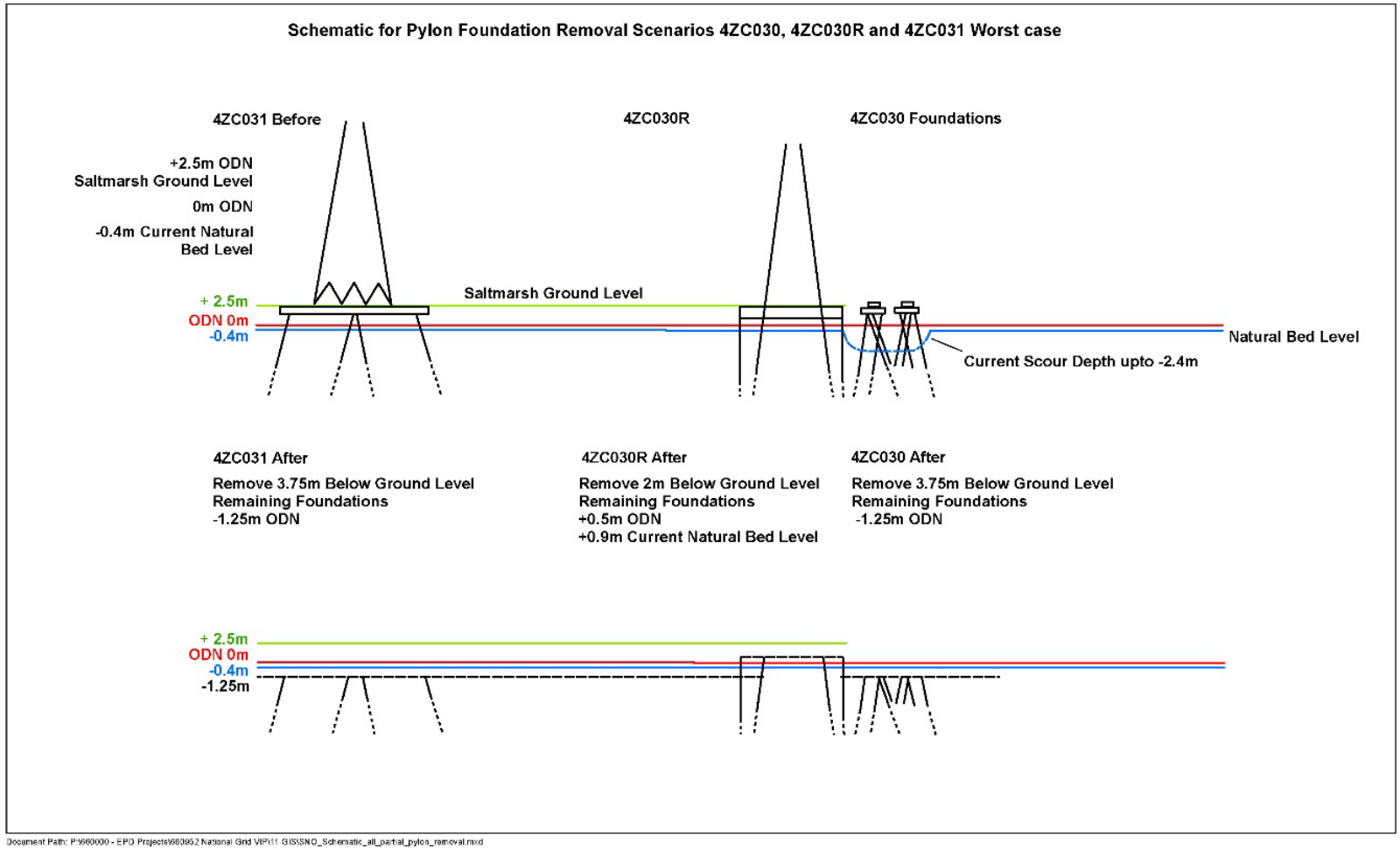


Figure 3-17 Schematic showing the pylon removal scenarios 4ZC030, 4ZC031 worst case, 4ZC030R worst case



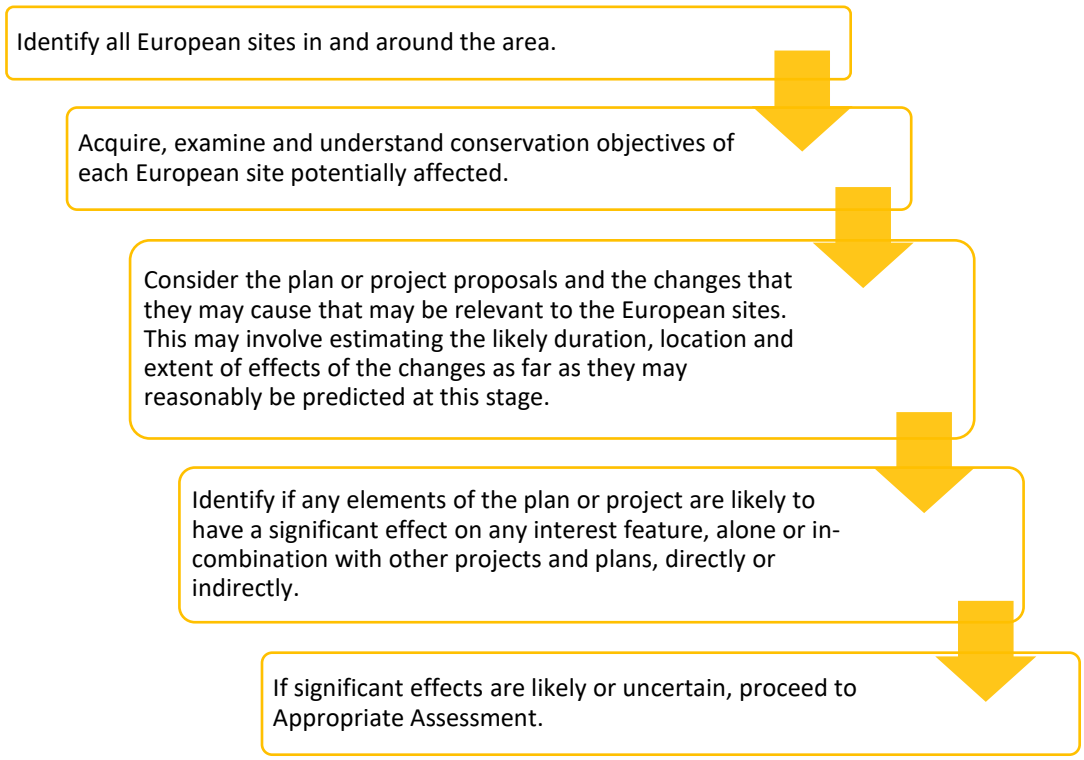
4. STAGE 1 – SCREENING FOR APPROPRIATE ASSESSMENT

4.1 Assessment Approach

4.1.1 Introduction

The assessment approach applied in this AA screening is based on the Welsh Government (2017) guidance, as illustrated in Figure 4-1. It considers all case law relevant to the Habitats Directive summarised in the 2018 European Commission Guidance (EC 2018).

Figure 4-1 HRA Stage 1 Screening Process



Although the guidance shows the process as sequential steps, in practice the steps are undertaken in tandem. Initial screening identifies all sites with marine components or marine features. Features are examined to establish if they could be sensitive to pressures generated by project activities. It is then determined whether there is a pressure-receptor pathway between the project activities (potential pressures) and the features (sensitive receptors). If a pressure-receptor pathway for effect exists, then the conservation objectives for the feature are examined to determine if significant effects are likely or uncertain. Sections 4.1.2 to 4.1.3 describe in detail the method undertaken to reach the Stage 1 Screening conclusions.

4.1.2 Identify relevant European Sites

The HRA process requires that all European sites in and around the proposed project area (The Proposed Marine Works) should be identified in accordance with Welsh Government Guidance. In the absence of a stipulated search area distance, all sites with a marine component, or marine feature have been initially identified within a 15km radius[1]. Information on the designated features of these European sites has been collated and tabulated to facilitate screening.

The potential for a European site to be significantly affected depends on whether receptors which are designating features of a European site:

a. Can come into contact with the Proposed Marine Works; and

b. Are sensitive to the Project activities to the extent that the activity is likely to have an adverse effect on the conservation objectives for the qualifying feature(s).

Identifying relevant European sites for Screening has therefore been achieved by:

- Identifying potential pressures the Proposed Marine Works could have on the environment;
- Identifying receptors which could be sensitive to the pressures and Proposed Marine Works; and
- Identifying pathways for effect (initial screening).

4.1.2.1 Identifying pathways for effect (initial screening)

Initial screening determines whether there is the potential for an interaction between the Proposed Marine Works and the Qualifying Features of a European site i.e. whether there is a pressure-receptor pathway, which could result in a significant effect on the Qualifying Feature. This is done by comparing information such as the zone of influence (i.e. the spatial extent over which effects on the receptors could extend) with information regarding the qualifying feature(s) e.g. species foraging distances, spatial extent of habitats etc. The results have been defined as follows:

- Yes: A pathway between the Proposed Marine Works and the Qualifying Feature can be identified that is likely to result in an effect; or
- No: Either a pathway between the Proposed Marine Works and the Qualifying Feature cannot be established; or a pathway exists but there is no physical overlap of the pressure and the Qualifying Feature.

For all Qualifying Features where it has been determined that there is a pathway for effect (beneficial or adverse), the European site has been taken forward for assessment of likely significant effects (LSE) as described in Section 4.1.3. For all Qualifying Features where it has been determined that there is no pathway, the Qualifying Feature has been screened out from further assessment.

4.1.3 Assess Likely Significant Effects (LSE)

The assessment of LSE either alone or in combination with other plans and projects must be made in light of the sites' conservation objectives.

Implicit in the Habitats Directive is the application of the precautionary principle. This means that the emphasis for assessment should be on objectively demonstrating, with supporting evidence that there will be no significant effects on the European site.

A significant effect is any deleterious effect that has the potential to undermine the conservation objectives of the site. It is only where it is obvious that any potential deleterious effect is negligible that a finding of No LSE can be made.

[1] The distance recommended in Irish Government guidance (Department of Environment, Heritage and Local Government 2009).

Therefore, where it is certain, likely, or uncertain that the Proposed Marine Works will undermine the site's conservation objectives, a conclusion of LSE must be made at Stage 1. The assessment of that risk must be made in the light, amongst other things, of the characteristics and specific environmental conditions of the site concerned.

Where initial screening identifies a pathway for effect, the conservation objectives for the European Site are examined. Information on the sensitivity of the Qualifying Feature(s) and the potential pressures of the Proposed Marine Works is then used to assess whether the potential effect on the conservation objectives of the site is likely to be significant or not. If there is any doubt the assessment should proceed to Stage 2.

The assessment of LSE must consider the Project in-combination with other projects and plans. In-combination effects may arise when the effects of a pressure from the proposed project combines additively with the pressures of other plans or projects resulting in a greater effect than those from the individual projects. Gwynedd Council and Snowdonia National Park Authority have confirmed (2 November 2019) that there are no cumulative developments to be assessed for VIP, Snowdonia. A search of applications on the NRW marine licensing portal for plans and projects within 10km of the Proposed Marine Works was undertaken in November 2019 and again in February 2020, however, no plans and projects within this area were found. Given the Proposed Marine Works are planned for 2026 it is unlikely that information on any projects which could overlap spatially and temporarily with the Proposed Marine Works will be in the public domain yet. Should any future projects have the potential to overlap cumulatively with the Proposed Marine Works, they would need to consider the Snowdonia VIP project in their cumulative effect assessment.

4.2 Identification of Relevant European Sites

4.2.1 Sites within 15km search area

A geographic information system (GIS) was used to map the boundaries of European Sites in relation to the Proposed Marine Works. Four European Sites with either a marine component or marine Qualifying Feature(s) were identified within 15km of the Proposed Marine Works as follows:

- Pen Llyn a 'r Sarnau / Lleyn Peninsula and the Sarnau SAC (Site code: UK0013117)
- Afon Eden - Cors Goch Trawsfynydd SAC (Site code: UK0030075) (note there is also an SSSI associated with this site).
- Afon Gwyrfai a Llyn Cwellyn SAC (Site code: UK0030046)
- Northern Cardigan Bay / Gogledd Bae Ceredigion SPA (Site code: UK9020327)

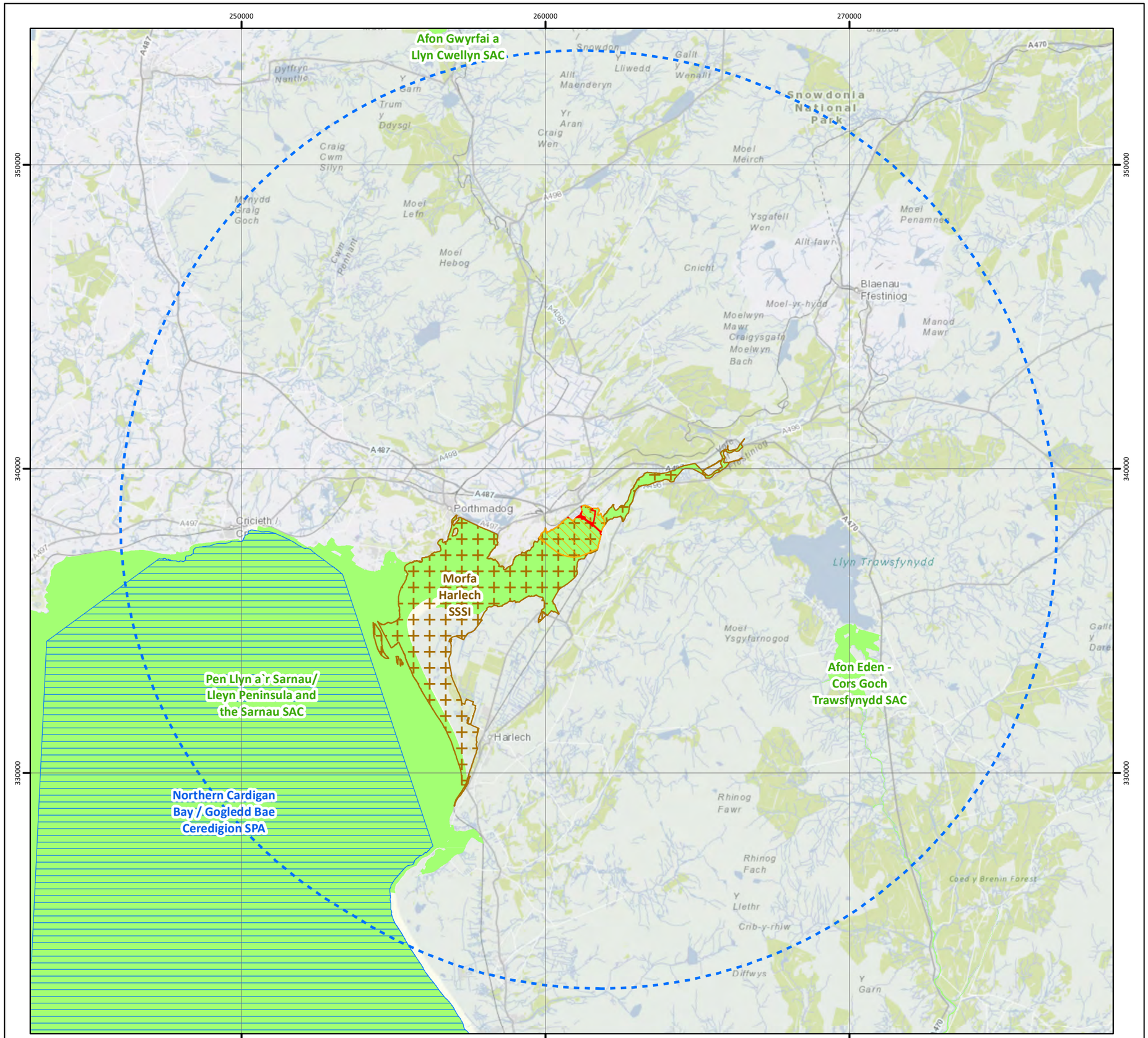
The European Sites in relation to the Proposed Marine Works are illustrated in Figure 4-2 (DWG P2048-PROT-001). Information collated on the Qualifying Features of the sites is presented in Table 4-3.

Additionally, the Proposed Marine Works are located within one SSSI, Morfa Harlech SSSI (site code 0516), which has also been described and mapped in this section because Consent under Section 28E of the Wildlife and Countryside Act 1981 and in accordance with Regulation 24 of the Conservation of Habitats and Species Regulations 2017 will be required.

NATIONAL GRID VIP SNOWDONIA

PROTECTED SITES
Environmental Designations Within 15km of Marine Environment Area

Drawing No: P2048-PROT-001 | **B**



Legend

- Proposed Marine Works
- Marine Environment Area
- 15km Search Buffer

Environmental Designations

- SAC
- SPA
- SSSI

N
W E
S

NOTE: Not to be used for Navigation

Date	27 February 2020
Coordinate System	British National Grid
Projection	Transverse Mercator
Datum	OSGB 1936
Data Source	NRW; JNCC; ESRI; NG
File Reference	J:\P2048\Mxd\02_PROT\ P2048-PROT-001.mxd
Created By	Chris Goode
Reviewed By	Emma Langley
Approved By	Jill Hobbs

nationalgrid intertek

0 1.5 3 4.5 6 km

4.2.2 Identification of potential pressures

The OSPAR Intersessional Correspondence Group on Cumulative Effects (ICG-C) pressure list and descriptions (OSPAR Commission 2011) and the Marine Life Information Network (MarLIN) marine evidence-based sensitivity assessments (MarESA) have been used to describe the potential pressures expected from the Proposed Marine Works. These are listed here and a brief description of each of the identified pressures is provided in Sections 4.2.2.1 to 4.2.2.4.

- Waterflow (tidal current) changes, including sediment transport considerations (Section 4.2.2.1);
- Physical damage (reversible change) - Penetration and/or disturbance of the substrate below the surface of the seabed, including abrasion (Section 4.2.2.2);
- Visual disturbance (Section 4.2.2.3); and
- Underwater noise and vibration changes (Section 4.2.2.4).

4.2.2.1 Waterflow (tidal current) changes, including sediment transport considerations

The Proposed Marine Works have the potential to exert a pressure on waterflow and sediment transport during the temporary installation of the platform from the shore to the foundations at site 4ZC030 in the estuary i.e. could cause temporary scour within the estuary channel.

Additionally, the proposed excavation works at site 4ZC030R have the potential to temporarily increase the supply of silt into the estuary environment which could in turn affect sediment transport locally.

Removal of the pylon structures will reduce the artificial barriers which have given rise to scour holes developing around the foundation legs, and at pylons 4ZCO30R and 4ZC030, and will allow the natural migration of the estuary channel at this location.

4.2.2.2 Physical damage (reversible change) - Penetration and/or disturbance of the substrate below the surface of the seabed, including abrasion.

Excavation works have the potential to adversely affect any habitats within the footprint of the works through disturbance and removal of the substrate.

Additionally, laying temporary access tracks to the marine pylons also has the potential to disturb and damage the habitat along the access route through compaction and disturbance by vehicles and plant.

4.2.2.3 Visual disturbance

During the pylon and foundation removal operations, the presence of vehicles and equipment (e.g. crane, derricks, excavators) have the potential to temporarily disturb marine birds and marine mammals in the vicinity of the Proposed Marine Works. Noise is the primary cause of disturbance although the physical presence of equipment can also cause a disturbance effect due to physical and visual intrusion. Disturbance may result in displacement of marine mammals or birds from an area of use (for feeding, breeding, resting, passage etc.)

4.2.2.4 Underwater noise changes and vibration

The removal of the pylon foundations for pylon 4ZC030 and Pylon 4ZC030R from within the Dwyryd Estuary, or adjacent to it, will involve the use of an excavator and / or hydraulic breaker and for pylon 4ZC030R a leader pile rig with a vibrating action or, if vibration does not work, a steel cutter. These operations have the potential to result in noise and vibration emissions which could have an adverse effect on sensitive receptors; marine mammals or fish.

Additionally, the construction of the cable tunnel beneath the Dwyryd Estuary using a TBM has the potential to emit underwater noise and vibration.

Pressures which have been screened out from assessment within this Stage 1 Screening for AA and the justification for their exclusion are presented in Table 4-1.

Table 4-1 Pressures screened out and the justification for their exclusion

Pressure screened out	Receptor	Justification for exclusion
Changes in suspended solids (water clarity)	Estuary Mudflats and sandflats Fish	During excavations at pylon 4ZC030 there is the potential to temporarily disturb the local seabed. However, most of the disturbed sediments are likely to be sand; the same as the surrounding sandflats. Although sediments will be physically disturbed and suspended, they will be retained in the overall system and will settle out of suspension in the same manner as sediments from the sandflats when they become mobile i.e. disturbed by local current flows. The suspension of sediments within the water column from pylon foundation excavation works may cause small, localised and temporary turbidity before being re-deposited on the estuary bed. A temporary reduction in the feeding capability of fish species relying on sight to locate their prey may occur. As discussed above, although sediment in the channel is likely to be disturbed, it is expected that it will not be noticeable against background levels of disturbance experienced during periods when the estuary sandflats are mobilised.
Changes in water quality	Estuary	The potential exists for disturbed sediments in the marine environment to impact on water quality through releasing retained contaminants or anoxic sediments that impact on levels of dissolved oxygen within the waterbody. In a confined channel this could present a problem for fish as the deoxygenated water may act as a plug in the channel which the fish cannot circumnavigate. However, information derived from site-specific data e.g. Pont Briwet, show that local sediments are clean, have no associated contaminants, have low levels of organics (and therefore have limited potential to be anoxic) (Norwest Holst 2009). In addition, no water quality issues arose during the construction of Pont Briwet, a period of construction works which would have involved greater volumes of disturbed sediment and lasted much longer.
Pollution and other chemical changes - Transition elements and organo-metal contamination	Estuary	The available evidence from site investigations supporting the construction of Pont Briwet (Norwest Holst, 2009) indicate that surface sediments in the near vicinity to the depth of excavations have a very low organic content and are not expected to be anoxic.
Siltation rate changes, including smothering (depth of vertical sediment overburden)	Fish	The re-deposition of suspended sediments has the potential to smother demersal (bottom dwelling) fish species during the excavation works. EC Habitats Directive Annex I fish species are present in the estuary but not in sufficient numbers to be a Qualifying Feature of the Pen Llyn a'r Sarnau/ Lleyn Peninsula and the Sarnau SAC. The impact would depend on the quantities of excavated material released into the estuary. However, any increase in suspended sediments will be minimal and short term, therefore suspended sediments are not predicted to be above background levels.
Physical damage (reversible change) - Penetration and/or disturbance of the substrate below the surface of the seabed, including abrasion.	Benthic species (mudflat and sandflat habitat)	The construction of a temporary platform to access the foundations at pylon 4ZC030 in the estuary channel has the potential to damage / disturb benthic species present directly within the footprint of the platform through smothering, crushing, or abrasion. The excavation of the foundations also has the potential to damage / disturb benthic species present within the footprint of these activities through direct displacement, substratum loss or smothering. Intertidal sandflats are characterised by communities of burrowing invertebrates such as polychaete worms, crustaceans and molluscs. These species have low sensitivity to smothering and National Grid was advised by NRW (C Hawksworth 2017, pers. Comm 27 April) that a benthic survey was not required to inform the Marine Licence application for geotechnical investigations. Given the short term and localised impacts of the Proposed Marine Works, the habitat will recover from temporary disturbance. As such, no significant effects on benthic species are anticipated.

4.2.3 Identification of sensitive receptors

The receptors which could potentially be affected by the Proposed Marine Works and could be the qualifying interest features of European sites are:

- Habitats;
- Fish;
- Birds; and
- Marine mammals (cetacean, pinniped and otter)

4.2.4 Summary of pressures and receptors to be considered by screening

Table 4-2 lists the pressures to be considered by the screening and the receptors that could be potentially affected.

Table 4-2 Summary of potential pressures and sensitive receptors

Pressure	Project Activity	Receptor
Waterflow (tidal current) changes, including sediment transport considerations	Construction of a temporary platform to access the foundations at pylon 4ZC030	Habitat - Estuaries Habitat - Mudflats and sandflats Habitat - Atlantic salt meadow / saltmarsh
	Excavation works including pumping water from within the cofferdam during the partial removal of foundations and cofferdam structures at pylon site 4ZC030R	Habitat - Estuaries Habitat - Mudflats and sandflats
	Full removal / partial removal of foundations and cofferdam at pylon sites 4ZC030R and 4ZC030	Habitat - Estuaries
Physical damage (reversible change) - Penetration and/or disturbance of the substrate below the surface of the seabed, including abrasion.	Excavation of the foundations at pylon site 4ZC031 Excavation of the foundations and cofferdam at pylon site 4ZC030R Temporary access tracks to pylon sites 4ZC030 and 4ZC030R Existing track if widened to pylon site 4ZC031 Temporary watercourse crossings (ramp, bridges and culverts) Laydown areas including backstay and light access	Habitat - Atlantic salt meadow / saltmarsh
	Excavation of the foundations at pylon site 4ZC030	Habitat - Estuaries Habitat - Mudflats and sandflats
Visual disturbance	Physical and visual presence of vehicles and plant and noise during Proposed Marine Works	Birds
Underwater noise changes and vibration	Operations during the excavation of the piles during pylon foundation removal and boring of the tunnel: tunnel boring machine, excavator, hydraulic breaker, pile extraction	Fish, marine mammals

4.2.5 Identification of a pathway for effect (initial screening)

To determine whether a sensitive receptor has the potential to interact with a pressure generated by the Proposed Marine Works it is necessary to understand the nature and existing baseline for the Qualifying Feature. Information on the relevant Qualifying Features of the five sites (Four European sites and one SSSI) screened has been collated and is presented below, organised by receptor (e.g. habitats, fish, birds, marine mammals).

This information has been used to inform the examination of the Qualifying Features of each of the five sites, against potential pressures to determine if there is a pathway for effect (i.e. the initial screening). This initial screening is summarised in Table 4-3 (at the end of the section).

4.2.5.1 Habitats

Pen Llyn a 'r Sarnau / Lleyn Peninsula and the Sarnau SAC and Morfa Harlech SSSI
The Pen Llyn a 'r Sarnau / Lleyn Peninsula and the Sarnau SAC supports multiple marine features that are distributed throughout the site, encompassing areas of sea, coast and estuary. Those present in the Proposed Marine Works area are the Habitats Directive Annex I listed habitats:

- Primary feature: Estuaries;
- Qualifying feature: Mudflats and sandflats not covered by seawater at low tide; and
- Qualifying feature: Atlantic salt meadows (*Glauco-Puccinellietalia maritimae*).

Estuary
The estuary feature of the SAC/SSSI comprises the three main bar-built estuaries situated along the Meirionnydd and Ceredigion coasts; the Glaslyn/Dwyryd estuary, the Mawddach estuary and the Dyfi estuary. The Proposed Marine Works are located within the Dwyryd estuary.

The Dwyryd Estuary is a bar-built estuary that has characteristic sand bars across the mouth. The estuary can also be described as a partially drowned river valley, formed by Holocene glaciation, that has subsequently been largely infilled with marine sands creating expansive drying conditions around low water (Countryside Council for Wales, 2001).

The tidal confluence of the estuary with Tremadog Bay is around 10.2km downstream of the Proposed Marine Works (estimated along the low water thalweg[2]). Ordnance Survey mapping indicates that the normal tidal limit (NTL) is at the A496 bridge near Maentwrog a further 6.3km upstream of the Proposed Marine Works.

The estuary mouth is around 1.4km wide; although at the Proposed Marine Works this narrows to around 0.36km for the main channel and sandflats, or up to 0.91km including the saltmarsh.

Pont Briwet is around 0.38km upstream of the Proposed Marine Works and represents a major narrowing in the channel due to (geological) higher ground either side of the estuary. This natural narrowing favoured the location of the bridge crossing which now includes stone causeways to further constrict the channel width to around 0.11km. The narrowing focuses tidal flows passing under the bridge and develops an over-deepened scour feature which appears to extend furthest on the upstream side of the bridge.

The tidal exchange with Tremadog Bay creates ebb and flood flows which cut a series of braided channels through the sands and over time (decadal to sub-decadal) these channels meander from bank to bank through the main body of the estuary.

In many places the estuary is bordered by extensive areas of saltmarsh. The fronts of these saltmarshes are susceptible to bank erosion when channel meandering cuts in their direction, however, in a few places there are hard structures that limit channel meandering and these areas are commonly devoid of any fronting saltmarsh (e.g. developed land such as the sea wall in front of Porthmadog). When the channel is diverted away from the edge of the saltmarsh there is an opportunity for progradation.

Figure 4-3 provides an overview of the Dwyryd Estuary which includes an overlay of main saltmarsh areas presented on a Google Earth image from low water on 02 June 2016.

[2] A line connecting the lowest points of successive cross-sections along the course of a valley or river.

Figure 4-3 Overview Dwyryd Estuary (satellite image ©2018 Google)

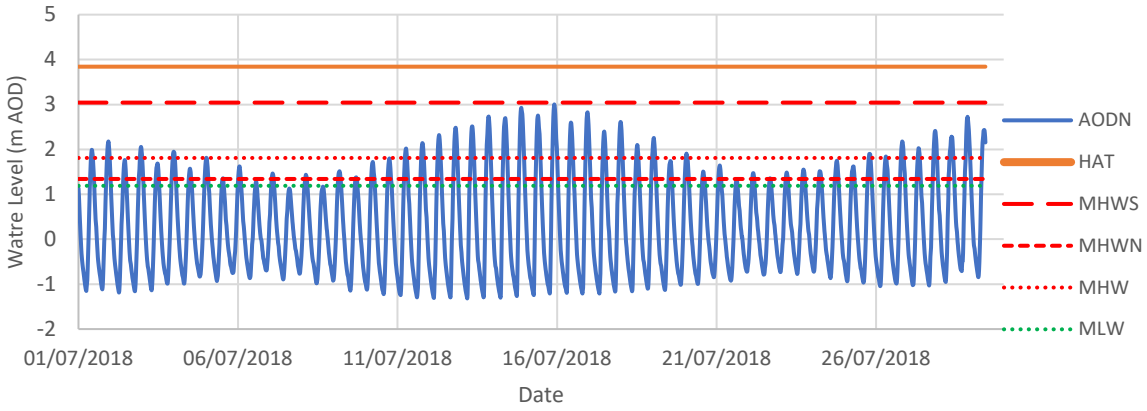
Waterbody

The waterbody within the estuary fluctuates in level (and volume) due to tidal influences from Tremadog Bay. Tides at Criccieth have a mean spring range of around 4.24m and a mean neap range of 1.83m. The narrowing shape and shallowing environment of the estuary act to (further) steepen the flood tide and lengthen the duration of the ebb in an upstream direction until the tidal wave becomes fully dissipated at the tidal limit. This asymmetry in the tide leads to a pulse of relatively stronger (but shorter) flood flows and weaker (but longer) ebb flows.

At low water, the tide retreats to expose large areas of sandflats across the estuary. At this time the remaining flows coming from the Afon Dwyryd provide a source of freshwater draining off the upstream catchment. The volume of freshwater passing through the estuary is relatively small in comparison to the tidal prism (the amount of water exchanged through a section of estuary between high and low water), but these river flows also persist while the tide has retreated to help develop and maintain the low water channel.

Water levels are measured by NRW behind Porthmadog Cob, on the tidal sluices of Afon Glaslyn. Whilst this site is around 7.8km downstream of the Proposed Marine Works, the tidal variations are still considered to provide a good indication of local water levels. Figure 4-4 illustrates a 28-day sequence of water level variation which encapsulates a full lunar cycle of spring-neap-spring tides for July 2018. This period of observations includes close approximations to both mean high water springs (MHWS) (around 16 July 2018) and mean high water neap (MHWN) (around 22 July 2018) tides.

Figure 4-4 Water level observations from Porthmadog



Sandflats and channels

The estuary contains extensive areas of sandflats comprising of material considered to be largely of marine origin that has infilled the estuary.

Borehole samples from several locations in the estuary channel, just downstream of Pont Briwet, indicate that the depth of sands is over 13m below the channel bed with the top layer of material (2 to 3m below channel bed) comprising of 98% sands and 2% silts (Norwest Holst, 2009). The general description of this material is given as 'loose brown grey slightly silty fine to medium sand with a few coarse to gravel sized shell fragments'.

The sediment gradings analysis indicates a D50 of 0.150mm, equivalent to fine sands. In addition, the organic content of the soils was assessed to be <0.1 %. The description of loose material suggests this material is mobile, with the comment about shell content endorsing a marine origin.

A series of braided channels cut through the sandflats due to the action of tidal exchange and river flows. From time to time these channels migrate from bank to bank, a process which can also lead to erosion of the corresponding saltmarsh edge. These channels are most apparent when the tide retreats and exhibit a ‘natural’ depth which is determined by the river flows and the ability of the estuary to erode to this level.

Figure 4-5 shows evidence of past channel migration compiled from old maps covering the period 1889 to 2009. The analysis of channel migration suggested that within a 2km reach of the estuary, centred on Pont Briwet, 92% of the active channel environment (defined by sandflats and channel) has been reworked (Fluvio, 2011).

Figure 4-5 Channel migration over the period 1889 to 2009 (Fluvio, 2011)

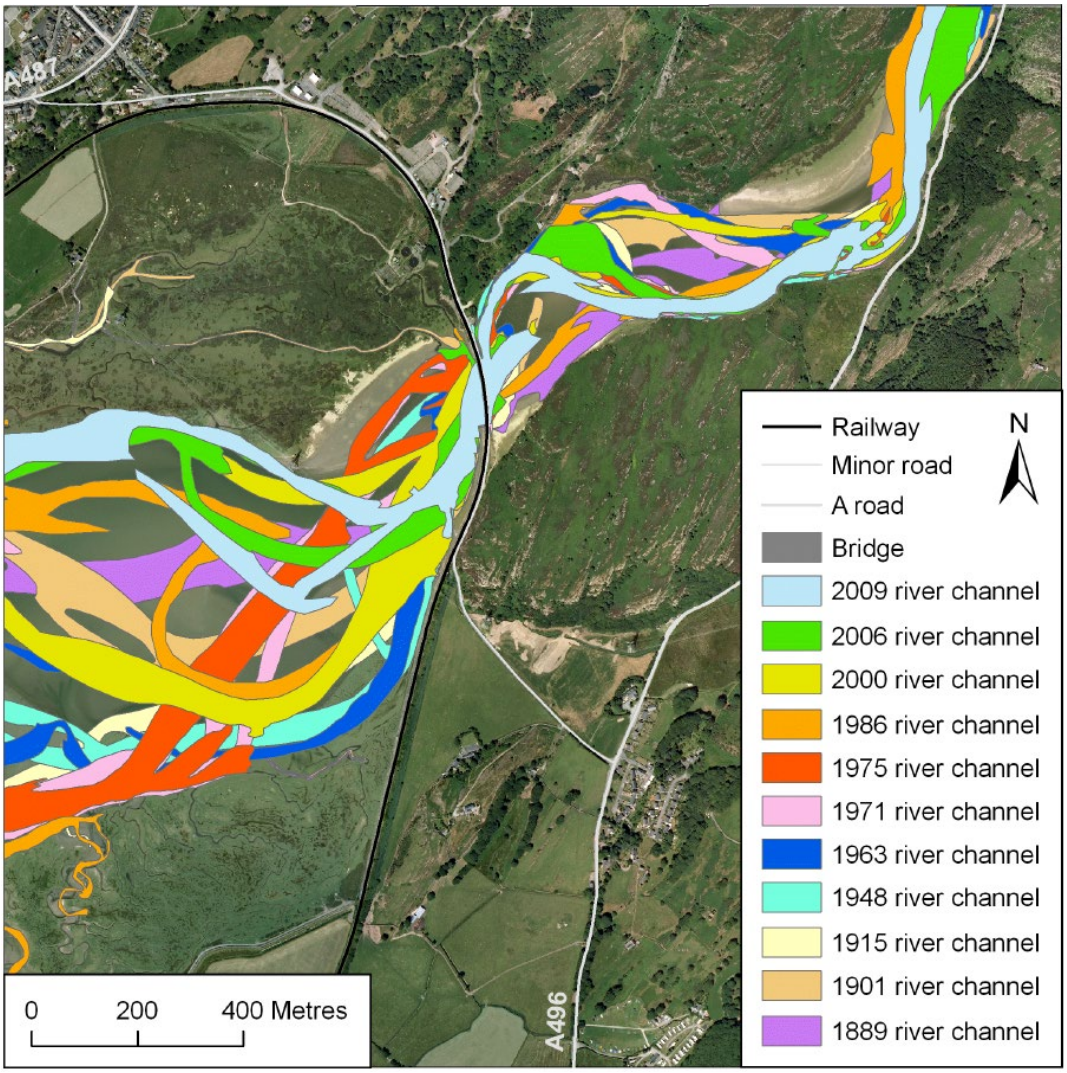
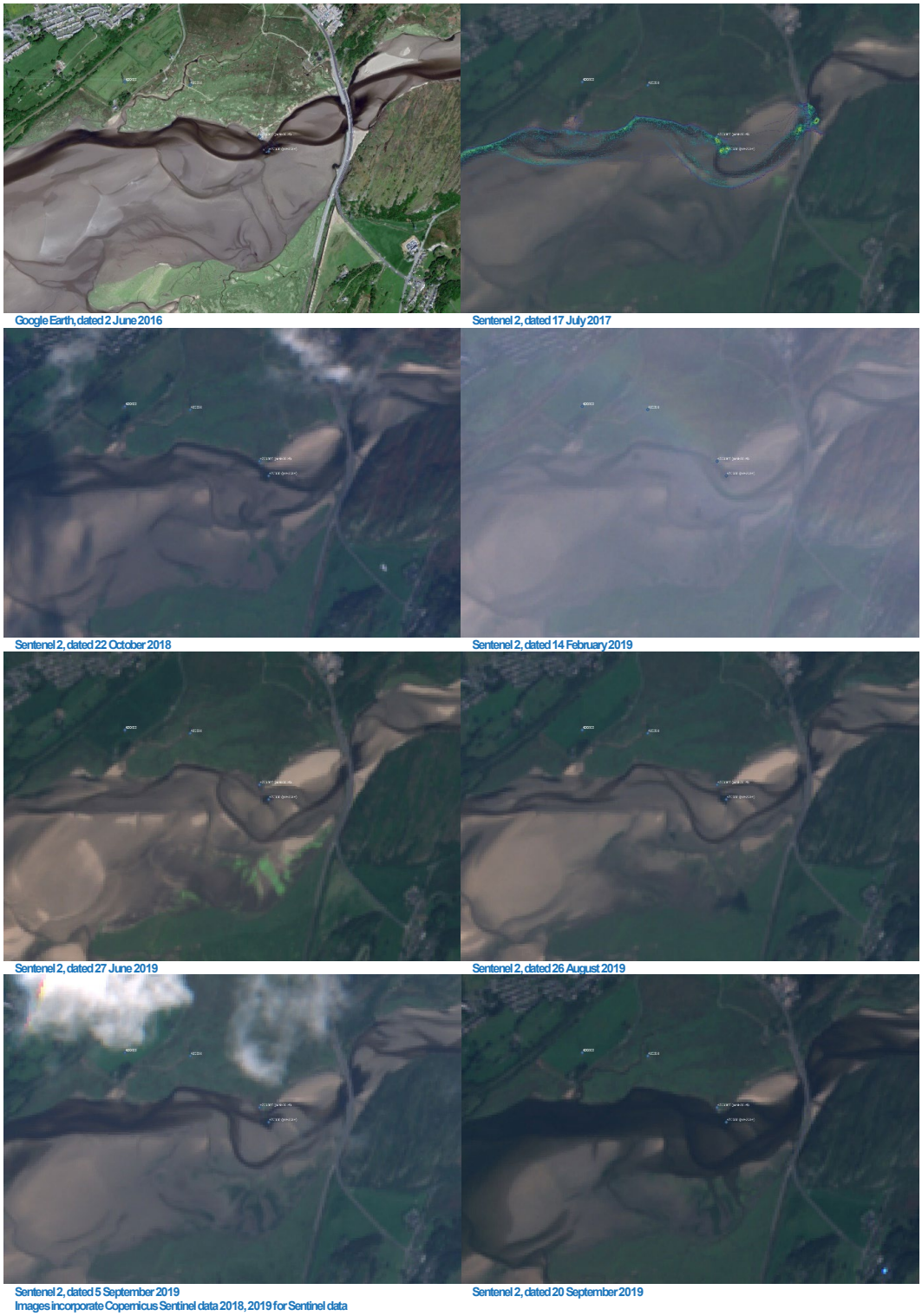


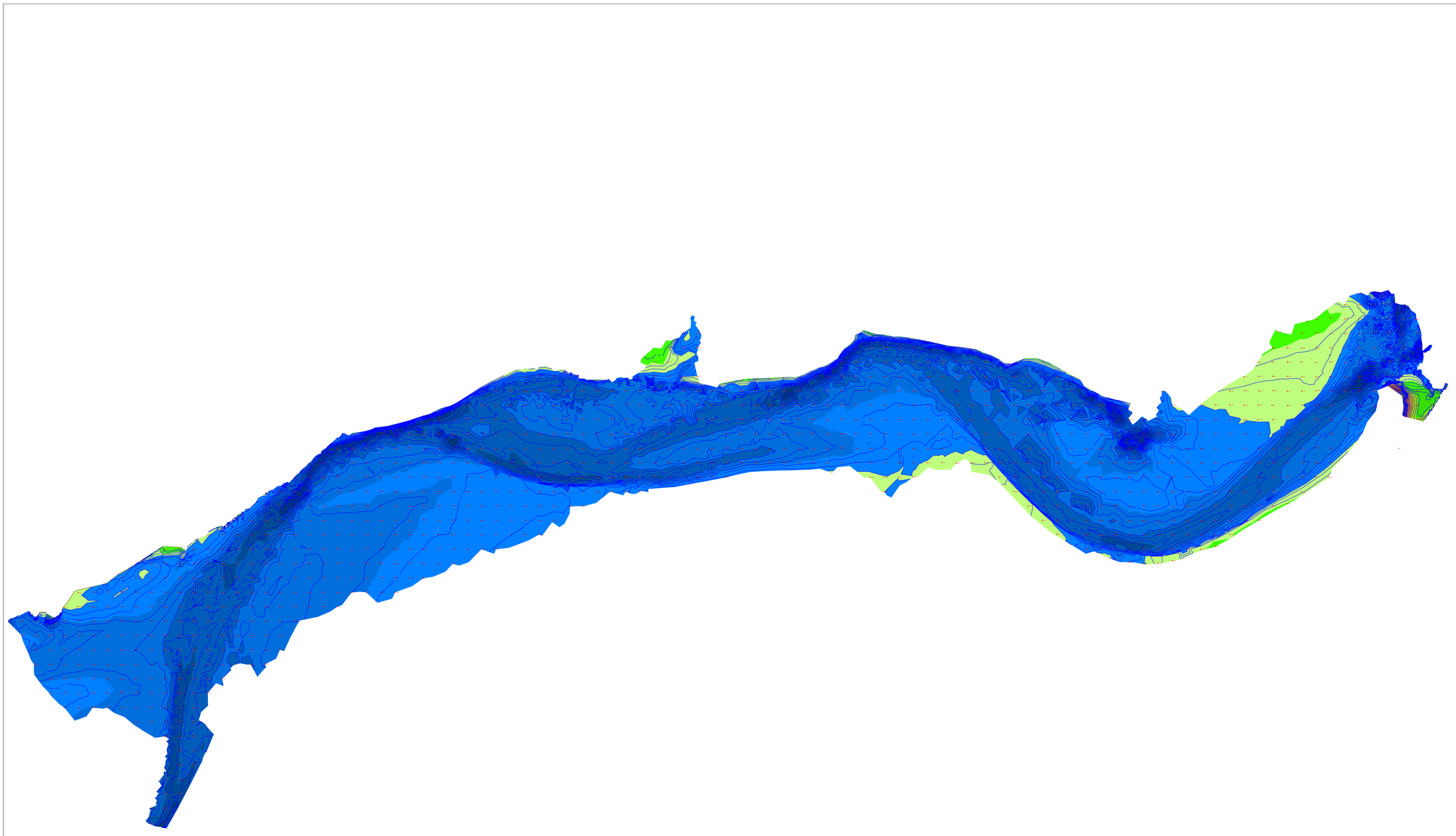
Figure 4-6 provides a view of more recent channel migration based on Google Earth aerial imagery from 2016 and a series of Sentenel-2 satellite images from 2017 to present day. The date of the satellite image from 2017 is selected to be coincident with the National Grid bathymetry survey from July 2017 which is overlain as a series of contours. The timing of the satellite images is not necessarily coincident with periods when the tide has fully retreated (e.g. 20 September 2019) and image quality is also highly susceptible to weather conditions (e.g. cloud cover and daylight), nevertheless the images convey a clear pattern of continual channel migration for the Proposed Marine Works area. At the present time, the low water channel from Pont Briwet initially flows to the south-west then abruptly turns north to encounter the edge of the saltmarsh just to the west of pylon site 4ZC030. Also, of note is the recent development of new saltmarsh on the opposite side of the channel to pylon site 4ZC030 visible as extended greening areas.

Figure 4-6 Channel migration over the period 2016 to 2019



The bathymetry survey commissioned by National Grid (Structural Soils, 2017) (Figure 4-7) provides a means to examine the depth of the low water channel both in proximity to structures around which local scouring is evident (such as at pylon site 4ZC030) and away from structures where the depth is related to the capacity of the low water flows to cut through the sandflats and establish a 'natural' channel cross-section and depth. Close to structures the process of local scouring exceeds the 'natural' channel depth and reaches around 2m below ODN. A similar situation exists where the channel abuts and is held against the saltmarsh and where erosion of the edge of saltmarsh appears to be occurring, at these locations the channel width narrows, and depths can increase to around 1.6m below ODN in some places. When the channel is unbounded and cuts through the sandflats then the 'natural' channel depth in the vicinity of the Proposed Marine Works is much shallower reaching up to 0.4m below ODN, and the channel is generally wider. On some occasions and locations, there may be more than one low water channel, for example a flood dominant channel and an ebb dominant channel, or the relict of former channels.

Composite LIDAR data (Lle Geo-Portal, 2019) provides detailed levels across the saltmarsh and sandflats. The nature of the composite data means this information is an amalgamation of surveys spanning different (unspecified) years. The profile of local sandflats, based on the available LIDAR data, suggests a variable height of between 1.2 and 1.9 m above ODN. The level of MHWN tides is estimated as 1.34m above ODN (based on Porthmadog) suggesting that some areas of the higher standing sandflats remain exposed during neap tides. The corresponding MHWS level is estimated as 3.04m above ODN (based on Porthmadog) indicating that the sandflats are fully submerged during high water periods of spring tides. On this basis, only spring tides can be responsible for sediment mobility and transport across the shallowest areas of the sandflats.



Coordinate System

This survey has been oriented to the Ordnance Survey (OS) National Grid and Datum using GPS observations and the OS Active Network.

Notes

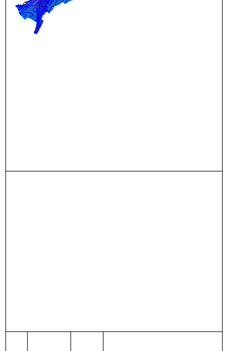
1. Dimensions should not be scaled. All dimensions should be verified on site prior to construction.
2. All dimension and levels are in metres unless otherwise stated.
3. Some detail may have been obscured by parked vehicles, stored materials, overgrown vegetation, and leaf litter.
4. All data shall remain Copyright of Gwalia Surveyors unless formally agreed otherwise.
5. The surveyed boundary features may not be legal boundaries.
6. Gwalia Surveyors cannot accept any responsibility for any damage to computer systems from viruses which may be contained in the data/files supplied.
7. Survey data acquired from 28.07.17 to 30.07.17.
8. Differences were noted between the data acquired from the drone survey (28.08.17) and the bathymetric survey. This is due to the continuous movement of the sand.

Depth

5.4
4.9
4.4
3.9
3.4
2.9
2.4
1.9
1.4
0.9
0.4
-0.1
-0.6

Sheet Layout

N



Rev.	Date	Drawn	Details

Gwalia
SURVEYORS
Unit 1, Link Trade Park,
Penarth Road, Cardiff, CF11 8TQ.
Cardiff: 029 2111 1700 London: 020 3011 1099
W: gwaliasurveyors.co.uk

LAND | UTILITIES | BUILDING | BOUNDARY | BIM

Title:	Bathymetric Survey
Project:	Snowdonia
Client:	WSP
Drawn: DB	Checked: DR
Date: 01.12.2017	Scale: 1:2000 @ A0
Drawing Number: 2592-H-001	Rev.

Sediment transport

Present evidence points to sediment supply to the estuary of mainly marine sands from Tremadog Bay, especially sources in the littoral zone at the mouth of the estuary. These marine sands form the extensive sandflats across the estuary. Silts and muds may also be supplied from the upstream catchment by the river and carried downstream as a suspended sediment load, albeit these concentrations appear very low during typical conditions due to observed good water clarity. The further sources of sediment are from reworking of sandflats and erosion of the saltmarsh edge, although these areas may switch between acting as temporary sources to acting as temporary sinks, depending on conditions acting upon them.

Sediment transport occurs when the movement of the water body through the estuary creates flow conditions that exceed a threshold for sediment mobility allowing the material to be moved either as suspended load or bedload. Such thresholds depend on many factors, but principally the particle size for non-cohesive sediments. Transport ceases when flows drop below the level to hold material in suspension or below the level to overcome friction on the bed (for bedload).

Whilst flood and ebb flows may both act on sediments and carry material upstream and downstream, the asymmetry in magnitude and duration of flows between flood and ebb determines the direction of net transport. Present information suggests the stronger flows on spring flood tides provide the mechanism for upstream transport of sands, whereas the longer duration of the ebb (for both spring and neap tides) is likely to create net downstream transport of silts and muds, when present in suspension. Whilst conditions in the main body of the estuary provide areas for sand deposition, the muds only deposit in areas where flows are weaker and allowing for material to settle out of suspension. These areas include shallower margins of the estuary, across the saltmarsh or within small tidal creeks.

Local scouring is observed around the remaining foundation structures of pylon site 4ZC030 and along the southern perimeter of the cofferdam of pylon 4ZC030R. This scouring appears to be (partly) holding a low water (flood) channel at this location, noting the main ebb channel from Pont Briwet has now moved across the estuary to the south where this abuts with a stable area of sandflat that now appears to exhibit growth of saltmarsh (Figure 4-6).

Saltmarsh

Atlantic salt meadows / saltmarsh is a qualifying feature of the Pen Llyn a ‘r Sarnau / Lleyn Peninsula and the Sarnau SAC and a designating feature of the Morfa Harlech SSSI respectively. There are extensive areas of saltmarsh bordering the estuary. The LIDAR data indicates that the saltmarsh sits relatively high in the tidal frame at heights of between 2.3m to 2.6m above ODN. These levels are only reached by high water periods on spring tides. Based on the water level data from Porthmadog, high water periods of neap tides would be insufficient to inundate the saltmarsh.

During periods of inundation there is an opportunity for saltmarsh levels to "warp up" with any sediments carried in suspension onto these areas also able to settle out. Typically, these will be fine sediments such as silts and muds held in suspension.

Mudflat areas appear to be present (and are mapped as such by NRW) in some of the creeks draining and bordering the saltmarsh. The source of muddy material is likely to be from the upstream catchment, which is mainly rural and partly forested, with inputs heightened during periods of increased rainfall creating a washload.

The site investigation work for Pont Briwet included a trial pit (TP04) on the edge of the saltmarsh (Norwest Holst, 2009). The top layer (above bedrock at this location) to 1.3 m below ground level was described as 'Brown silty fine to coarse sand'.

A photograph of the trial pit (TP04, Figure 4-8) shows the uniform composition of material covered with a relatively thin layer of grass. Whilst other areas of the saltmarsh may have different types of

vegetation the sub-soils are still expected to be similar to TP04. Apart from the surface vegetation, the organic content in trial pits was assessed to be <0.1%.

Figure 4-8 Trial pit at edge of saltmarsh, TP04 (Norwest Holst, 2009)

The saltmarsh comprises the upper, vegetated portions of intertidal mudflats, which usually lie approximately between MHWN tides and MHWS tides and above (JNCC 2016). Atlantic salt meadows develop in the middle and upper reaches of saltmarsh and comprise a variety of community types. The lower saltmarsh within the intertidal area consists of pioneer colonising species such as Salicornia and other annuals colonising mud and sand (Natural Resources Wales 2018a).

Saltmarsh (including salt pastures and salt steppes) of the entire Llyn Peninsula and Sarnau SAC cover approximately 17.52km^2 (1.2% of the entire SAC).

A saltmarsh survey undertaken by RSK (2016a) within the Proposed Marine Works Area, identified communities typical of the west coast of Wales. The main vegetation present is low grade sheep-grazed saltmarsh referable to the National Vegetation Classification (NVC) type SM16c *Festuca rubra* salt-marsh community, *Festuca rubra-Glaux maritima* sub-community and SM18b *Juncus maritimus* salt-marsh community, *Oenanthe lachenalii* sub-community. These habitats both correspond to the Habitats Directive Annex I listed habitat Atlantic salt meadows (*Glauco-Puccinellietalia maritimae*).

Pylon 4ZCO30R is located on the northern edge of the saltmarsh within an area classified as SM18. Vegetation disturbed in 2013-2014 by the emergency pylon replacement works (i.e. installation of pylon 4ZCO30R) was re-surveyed in 2016 and showed positive signs of recovery.

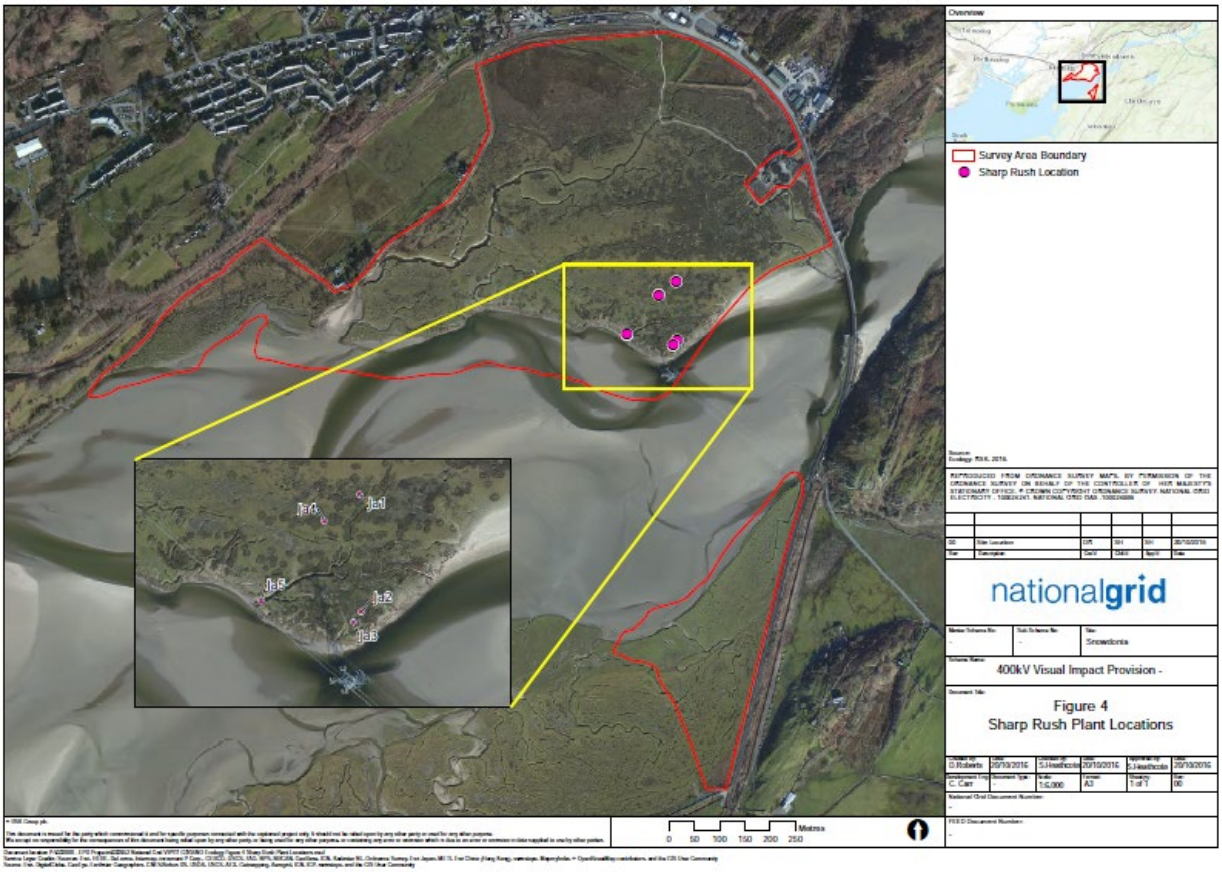
Junctus acutus - sharp rush was identified as the only rare species present in the area. This plant was found in five locations within the saltmarsh survey area (see Figure 4-9), including one location with three plants which were translocated during the 2013-2014 emergency works at pylon 4ZCO30R. One location is already beyond the eroding edge of the saltmarsh and two more are within 10m and at risk of being lost through natural processes.

Eleocharis parvula - dwarf spike rush has been recorded in some of the adjacent salt pans (depressions) on the Atlantic salt meadows / saltmarsh (NRW 2019). However, it was not identified in the 2016 saltmarsh survey (Appendix 16B) (RSK 2016).

Additionally, *Ruppia maritima* – beaked tasselweed which has restricted distribution has also been recorded at this location (NRW 2020a). This species was recorded in the 2016 survey within pools and creeks in the southern part of the saltmarsh survey (outside the Proposed Marine Works) (Appendix 16B) (RSK 2016).

Pylon 4ZCO31 is within an area classified as SM16d. Pylon 4ZCO32 is outside the boundary of the SAC however, access to the pylon for the removal works runs along the boundary of the SAC on an existing stone track.

Figure 4-9 Sharp rush plant location (RSK 2016a)



4.2.5.2 Fish

Pen Llyn a 'r Sarnau / Lleyn Peninsula and the Sarnau SAC

Although no fish species are listed as Qualifying Features of the Pen Llyn a 'r Sarnau / Lleyn Peninsula and the Sarnau SAC, the Afon Dwyryd provides an important habitat for five species of migratory fish: Atlantic salmon (*Salmo salar*), sea lamprey (*Petromyzon marinus*), twaite shad (*Alosa fallax*), sea trout (*Salmo trutta*) and European eel (*Anguilla anguilla*). The estuary acts as an essential migratory route for these species as they make their transitions between fresh and salt water conditions. Atlantic salmon, sea lamprey and twaite shad are Habitats Directive Annex II listed species and the latter two are listed on the Natura 2000 data form, although they are not present in sufficient numbers to represent Qualifying Features of the SAC (NRW 2018a). All the species are listed as Species of Principal Importance in Wales under Section 42 of the National Environment and Rural Communities (NERC) Act 2006. Species action plans have also been produced for salmonids and lampreys as part of the Gwynedd Local Biodiversity Action Plan (Gwynedd Consultancy 2011).

Afon Eden - Cors Goch Trawsfynydd SAC and Afon Gwyrfai a Llyn Cwellyn SAC
Atlantic salmon is a primary reason for the selection of the Afon Gwyrfai a Llyn Cwellyn SAC and a Qualifying Feature of the Afon Eden - Cors Goch Trawsfynydd SAC/SSSI, however, there is no fluvial connectivity between these rivers and the Afon Dwyryd. Therefore, there will be no interaction between this receptor from these sites and the Proposed Marine Works.

4.2.5.3 Birds

Morfa Harlech SSSI
Breeding Birds: The saltmarsh within the Morfa Harlech SSSI at Glan-y-mor is of regional importance for breeding waders, particularly redshank (*Tringa tetanus*) and lapwing (*Vanellus vanellus*). Curlew (*Numenius arquata*), ringed plover (*Charadrius hiaticula*) and oystercatcher (*Haematopus ostralegus*) also regularly breed. Black-headed gulls (*Larus ridibundus*) nest in low numbers at Llyn y Warin, a pool within the dunes. Other breeding marine birds typical of the sand dunes include shelduck (*Tadorna tadorna*). During September to March nationally important numbers of pintail (*Anas acuta*) feed and roost on the extensive areas of mud and saltmarsh in the Dwyryd estuary (CCW, 2001).

Ringed plover, black-headed gull, curlew and lapwing are listed as Species of Principal Importance in Wales under Section 42 of the National Environment and Rural Communities (NERC) Act 2006.

The quality of the saltmarsh within the saltmarsh survey area for breeding birds is considered by RSK (2016a and b) to be of low quality and breeding activities in this area are noted as infrequent or absent.

Wintering birds: Over winter (September to March) the Morfa Harlech SSSI supports nationally important numbers of pintail (*Anas acuta*) which feed and roost on the extensive areas of mud and saltmarsh in the Glaslyn/Dwyryd estuary (CCW, 2001). However, peak numbers of overwintering species are present between November and February. Publicly available bird observation data indicates that numbers of pintail within the Marine Environment Area during October are low (<17 birds) and pintail have not been observed since 2015 during October (BTO 2017; Vanstone et al. 2012).

Northern Cardigan Bay / Gogledd Bae Ceredigion SPA
Wintering birds: Red-throated divers (*Gavia stellata*) start to arrive in UK coastal waters from September, with numbers peaking during the winter and declining in Welsh waters from late February. The site boundary, which is within northern Cardigan Bay, encompasses the marine area where the greatest numbers of red-throated divers have been recorded during aerial surveys. The site is at its closest point 7.9km from the location of the Proposed Marine Works. Although it is possible some individuals from this site could forage as far as the Proposed Marine Works, given the distance, they are unlikely to be present in significant numbers. The SPA site boundary has been selected to encompass the area where they occur in the highest numbers.

4.2.5.4 Marine mammals

Pen Llyn a 'r Sarnau / Lleyn Peninsula and the Sarnau SAC & Morfa Harlech SSSI
The Habitats Directive Annex II listed species common bottlenose dolphin (*Tursiops truncatus*), European otter (*Lutra lutra*) and grey seal (*Halichoerus grypus*) are present in the SAC as a Qualifying Feature, but not a primary reason for site designation (National Resource Wales [NRW] 2018a). Common bottlenose dolphin are present in coastal waters in greatest numbers between May and September and sightings data indicates that common bottlenose dolphin have been recorded throughout Tremadog Bay. However, cetaceans and seals are unlikely to be present on the estuary in the vicinity of the Proposed Marine Works due to the distance from the coast and the very shallow water. Site specific surveys undertaken during summer 2016 have confirmed that no otter are currently resident or noted as present within the area of the Proposed Marine Works (RSK 2016b). Seawatch sightings data and the Marine Mammal Atlas found that grey seal has been recorded near

the mouth of the Dwyryd Estuary in low numbers; however, no sightings of cetacean have been recorded within the Dwyryd Estuary.

Common bottlenose dolphin and European otter are listed as Species of Principal Importance in Wales under Section 42 of the National Environment and Rural Communities (NERC) Act 2006.

Morfa Harlech SSSI
The Dwyryd Estuary provides an important breeding and feeding habitat for European otter. The ditches associated with the embankments and adjacent farmland also provide suitable bankside habitat for the European water vole (*Arvicola amphibius*) (CCW 2001). Site specific surveys undertaken during summer 2016 have confirmed that no otter or water vole are currently resident or noted as present within the area of the Proposed Marine Works (RSK 2016b).

European otter and European water vole are listed as Species of Principal Importance in Wales under Section 42 of the National Environment and Rural Communities (NERC) Act 2006.

Afon Eden - Cors Goch Trawsfynydd SAC/SSSI and Afon Gwyrfai a Llyn Cwellyn SAC: The Afon Eden and Afon Gwyrfai supports the Habitats Directive Annex II listed species European otter (National Assembly for Wales, 2005a and b). However, there is no fluvial connection between these rivers and the Afon Dwyryd and the topography suggests that animals from these European sites are unlikely to be in the area of the Proposed Marine Works.

4.2.5.5 Summary of initial screening

Table 4-3 presents the summary of the initial screening undertaken on the four European Sites and one SSSI.

Table 4-3 Initial screening of relevant European sites

Site name & code	Distance*	Qualifying Interest Features	Potential Pressure	Potential for Pressure-Receptor Pathway	Conclusion
Pen Llyn a'r Sarnau/ Lleyn Peninsula and the Sarnau SAC UK0013117	Within	**Annex I habitats that are a primary reason for selection of this site**: Estuaries	Waterflow changes, including sediment transport considerations	**Yes** – there is potential for a pressure-receptor pathway between this feature and the Proposed Marine Works. Pylon site 4ZC030R removal of foundations and cofferdam and pylon sites 4ZC030 and 4ZC031 removal of foundations.	Screened **IN**
		Annex I habitats that are a primary reason for selection of this site: Sandbanks which are slightly covered by seawater all the time; Coastal Lagoons; Large Shallow inlets and bays; Reefs	No pressure – receptor pathway identified	**No** – the Proposed Marine Works will not interact with these features of the SAC.	Screened **OUT**
		Annex I habitats present as a qualifying feature, but not a primary reason for selection of this site: Mudflats and sandflats not covered by sea water at low tide; Atlantic Salt meadows (*Glauco-Puccinellietalia maritimae*);	Physical damage (reversible change) - Penetration and/or disturbance of the substrate below the surface of the seabed, including abrasion.	**Yes** – there is potential for a pressure-receptor pathway between this feature and the Proposed Marine Works. There is potential for a pathway for effect on the Atlantic salt meadows during removal of the pylon foundations at pylon sites 4ZC031, 4ZC030R and 4ZC030.	Screened **IN**
		Annex I habitats present as a qualifying feature, but not a primary reason for selection of this site: Salicornia and other annuals colonizing mud and sand; Submerged or partially submerged sea caves	No pressure – receptor pathway identified	**No** – the Proposed Marine Works will not interact with these features of the SAC.	Screened **OUT**
		Annex II species present as a qualifying feature, but not a primary reason for site selection: Bottlenose dolphin (*Tursiops truncates*); Otter (*Lutra lutra*); Grey seal (*Halichoerus grypus*)	Underwater noise changes / Visual disturbance	**No** – the Proposed Marine Works will not interact with these features of the SAC.	Screened **OUT**
		Annex II species listed on the Natura 2000 data form but not present in sufficient numbers to be a qualifying feature: sea lamprey (*Petromyzon marinus*), twaite shad (*Alosa fallax*)	Underwater noise changes / Visual disturbance	**No –** a separate noise and vibration assessment on the potential effects of the Proposed Marine Works (ABPMer 2019) and the construction of the cable tunnel under the estuary concluded any effects on fish would be negligible to minor. Assessment is provided in Appendix A.	Screened **OUT**
Northern Cardigan Bay / Gogledd Bae Ceredigion SPA UK9020327	7.9km	**Annex I species** Red-throated diver (*Gavia stellata*) over winter	Visual disturbance	**No** - It is possible that red-throated diver could forage as far as the Proposed Marine Works, however, as the site boundary represents the area most important to the red-throated diver and the Proposed Marine Works will avoid the winter months it is unlikely that they would be present in significant numbers.	Screened **OUT**

Site name & code	Distance*	Qualifying Interest Features	Potential Pressure	Potential for Pressure-Receptor Pathway	Conclusion
Afon Eden - Cors Goch Trawsfynydd SAC UK0030075	8.4km	**Annex I habitats present as a qualifying feature, but not a primary reason for selection of this site**: Active raised bogs	No pressure – receptor pathway identified	**No** – terrestrial feature which will not interact with the Proposed Marine Works.	Screened **OUT**
		Annex II species that are a primary reason for selection of this site: Freshwater pearl mussel, Floating water-plantain	No pressure – receptor pathway identified	**No** – freshwater features which will not interact with the Proposed Marine Works	Screened **OUT**
		Annex II species present as a qualifying feature, but not a primary reason for site selection: Atlantic salmon (*Salmo salar*), Otter (*Lutra lutra*)	Underwater noise / visual disturbance	**No** – these features will not interact with the Proposed Marine Works	Screened **OUT**
Afon Gwyrfai a Llyn Cwellyn SAC UK0030046	14.3km	**Annex I habitats that are a primary reason for selection of this site:** Oligotrophic to mesotrophic standing waters with vegetation of the *Littorelletea uniflorae* and/or of the Isoëto-Nanojuncetea, Water courses of plain to montane levels with the *Ranunculion fluitantis* and *Callitricho-Batrachion* vegetation	No pressure – receptor pathway identified	**No** – terrestrial features which will not interact with the Proposed Marine Works	Screened **OUT**
		Annex II species that are a primary reason for selection of this site: Atlantic salmon (*Salmo salar*)	Underwater noise	**No** – there is no connectivity between the Afon Gwyrfai and the Afon Dwyryd therefore Atlantic Salmon from this SAC won't interact with the Proposed Marine Works.	Screened **OUT**
		Annex II species that are a primary reason for selection of this site: Floating water-plantain	No pressure – receptor pathway identified	**No** - Floating water-plantain is a freshwater feature which will not interact with the Proposed Marine Works.	Screened **OUT**
		Annex II species present as a qualifying feature, but not a primary reason for site selection: Otter (*Lutra lutra*)	Visual disturbance	**No** – there is no connectivity between this feature and the Proposed Marine Works	Screened **OUT**
Morfa Harlech SSSI SSSI_0516	Within	Estuaries	Waterflow changes, including sediment transport considerations	**Yes –** there is potential for a pressure-receptor pathway between this feature and the Proposed Marine Works. Pylon site 4ZC030R removal of foundations and cofferdam and pylon site 4ZC030 removal of foundations	Screened **IN**
		Saltmarsh	Physical damage (reversible change) - Penetration and/or	**Yes –** there is potential for a pressure-receptor pathway between this feature and the Proposed Marine Works.	Screened **IN**

Site name & code	Distance*	Qualifying Interest Features	Potential Pressure	Potential for Pressure-Receptor Pathway	Conclusion
			disturbance of the substrate below the surface of the seabed, including abrasion.	There is potential for a pathway for effect on the saltmarsh habitat during removal of the pylon structures at pylon sites 4ZC031 and 4ZC030R	
		Otter Water vole	Visual disturbance	**No** – Survey results indicated that otter and water voles are not resident or noted as present within the area of the Proposed Marine Works.	Screened **OUT**
		Wintering birds (Pintail)	Visual disturbance	**No –** The Proposed Marine Works will not take place on the estuary during the winter months.	Screened **OUT**
		Breeding birds	Visual disturbance	**No** – Survey results (RSK 2016a) indicated that the quality of the saltmarsh within the Proposed Marine Works area for breeding birds is low quality and breeding activities in this area are noted as infrequent or absent.	Screened **OUT**
		Sand lizard	No pressure – receptor pathway identified	**No** - terrestrial feature which will not interact with the Proposed Marine Works	Screened **OUT**

*The distance from the Proposed Marine Works to the designated site in km

4.3 Assessment of Likely Significant Effect (LSE)

Table 4-3 identified that an interaction between the Proposed Marine Works and Qualifying Features of the **Pen Llyn a`r Sarnau/ Lleyn Peninsula and the Sarnau SAC** is possible, for two identified pressures; waterflow (tidal current) changes and physical damage. This section assesses whether these pressures are likely to result in a significant effect in view of the conservation objectives of this site.

4.3.1 Pen Llyn a 'r Sarnau / Lleyn Peninsula and the Sarnau SAC and Morfa Harlech SSSI

The Qualifying Features of the Pen Llyn a 'r Sarnau / Lleyn Peninsula and the Sarnau SAC and Morfa Harlech SSSI that have been screened in for assessment of LSE are one and the same. They have therefore been considered together in this section.

4.3.1.1 Qualifying Features Screened In

The habitat features which are relevant to this assessment of LSE are:

Pen Llyn a 'r Sarnau / Lleyn Peninsula and the Sarnau SAC

- Estuaries;
- Mudflats and sandflats not covered by seawater at low tide; and
- Atlantic salt meadows.

Morfa Harlech SSSI

- Estuaries
- Saltmarsh

4.3.1.2 Conservation Objectives - Pen Llyn a 'r Sarnau / Lleyn Peninsula and the Sarnau SAC

The Habitats Directive requires that measures taken under it, including the designation and management of SACs, be designed to maintain or restore habitats and species of European Community importance at "favourable conservation status".

To achieve favourable conservation status all the following, subject to natural processes, need to be fulfilled and maintained in the long-term. If these objectives are not met restoration measures will be needed to achieve favourable conservation status.

1. Range

The overall distribution and extent of the habitat features within the site, and each of their main component parts is stable or increasing.

For **estuaries** this includes the stability of sandy sediments in proportion to the muddy sediments.

Restoration and recovery: As part of this objective it should be noted that; for the **estuaries** feature additional land which should form an integral part of the estuarine ecosystem should be restored.

Intertidal mudflats and sandflats: for this feature this requires an overall stability or increase in the amount of the feature, taking into account the areas of long-term stability and localised losses and additions arising from environmental processes.

2. Structure and function

The physical, biological and chemical structure and functions necessary for the long-term maintenance and quality of the habitat are not degraded.

For **Atlantic salt meadows** this includes the morphology of the saltmarsh creeks and pans

Restoration and recovery: As part of this objective it should be noted that; for the **estuaries** feature the structure and functions of the estuaries that have been damaged/degraded by the constraints of artificial structures such as flood banks, are restored.

3. Typical Species

The presence, abundance, condition and diversity of typical species is such that habitat quality is not degraded. Important elements include: species richness, population structure and dynamics, physiological health, reproductive capacity, recruitment, mobility and range.

It should be noted that the conservation objectives for 'Atlantic salt meadows' and 'Mudflats and sandflats not covered by seawater at low tide' are intrinsically linked to the conservation objectives for the Primary Qualifying Feature 'Estuaries'. The range, structure and function of both habitats is dependent on environmental processes in the main body and waterway of the 'Estuaries' i.e. changes in the estuary dynamics can lead to accretion and/or erosion of the features. In addition, the feature description for 'Estuaries' lists Atlantic salt meadows as a 'typical species' the habitat quality (including range) for which should not be degraded.

4.3.1.3 Conservation Objectives – Morfa Harlech SSSI

The Morfa Harlech SSSI Management Statement sets out the vision for the features of interest and outlines any management considered necessary to safeguard the features. The long-term vision for the interest features screened in is that:

- The natural coastal processes that determine the dynamics and proportions of habitats at Morfa Harlech should be allowed to continue.
- Where possible, existing habitats should be maintained, through management of factors within human control.
- The typical and associated nationally rare and scarce plants should not reduce in range within their habitats or lose the ability to reproduce and sustain themselves through factors within human control.

4.3.1.4 Waterflow (tidal current) changes, including sediment transport considerations - Assessment against conservation objectives: Estuaries

Site 4ZC030 – Foundations in the estuary channel

During foundation removal at Site 4ZC030, there will be a short period (estimated to be 28 days) when a temporary work platform will be extended out into the estuary channel to provide access for the excavator to reach the foundations. During this period, the hard structure of the work platform is likely to locally deflect flows, noting that flows in this area are already being impeded by the existing foundations. The existing scour hole around the foundation legs is expected to become temporarily extended upstream and downstream by the work platform and at a comparable scale to the volume and shape of the platform. It is possible that the work platform may encourage the channel to be displaced away from the edge of the Atlantic salt meadows / saltmarsh. However, such channel movement is also considered to be within the envelope of natural variation, as demonstrated in Section 4.2.5.1, and any effects will be temporary.

The removal of the existing structures will reduce the artificial barrier effect which in turn will have a beneficial effect on water flow and sediment transport by allowing the natural migration of the channel and reducing the effects of scour at this location.

The foundations at site 4ZC030 are currently located within the main body of the channel system. Local scouring around the four residual foundations structures has exaggerated local channel depths at this location with scour observed to depths of at least 2.4 m below ODN. The scouring has

effectively locked the estuary channel at this location (and with influences from pylon 4ZC030R) limiting further migration.

Based on the worst-case scenario, 3.75 m removal below local ground level (which is 2.5 m above ODN), then any remaining structures would be at 1.25 m below ODN (-1.25m ODN) or approximately 1.15 m above the presently scoured channel depths (which is at least -2.4m ODN). Some scouring influence may still occur but based on the recent survey data from 2017 (Figure 4-7) the tendency would be for the unbounded natural channel to be at a depth of around 0.4 m below ODN, or shallower. The likelihood is that the natural channel migration process would be able to dominate over any residual influence of structures maintaining local scour and the remaining structures will become buried relatively quickly. Once buried there is unlikely to be any tendency for unburial as natural channel depths would not reach the structures in the future. The removal of foundations and cessation of local scouring would therefore be able to unlock the natural behaviour of channel migration at this location. This is in-line with the conservation objectives to restore the structure and function of the estuary.

Assessment conclusion: No LSE; beneficial effects

Screening Conclusion for SAC: No LSE, AA not required

Screening Conclusion for SSSI: Conservation objectives for the site will not be hindered.

Site 4ZC030R – Replacement pylon on edge of Atlantic salt meadows / saltmarsh

The Proposed Marine Works at this pylon site will be based on the Atlantic salt meadows / saltmarsh. Unlike works at pylon site 4ZC030, there will be no materials placed in the estuary which would act as a temporary artificial barrier to water flow.

During the excavation activity at pylon site 4ZC030R, water will need to be pumped out from the cofferdam. The water may include small amounts of fine sediments (silts representing 2% of the in-situ sediment volume). The anticipated small volumes of pumped water and small volumes of sediment will not lead to the development of any sediment plume, as such it will not result in any adverse effects on sediment transport.

The removal of the existing structures (piles and cofferdam) will reduce the artificial barrier effect which in turn will have a beneficial effect on water flow by allowing the natural migration of the channel. The Proposed Marine Works will result in varying levels of beneficial effects (dependent on the scenario) on sediment transport because the removal of the structures would allow the estuary to function more naturally at this location; and would therefore be in-line with the conservation objectives to restore the estuary.

Full removal (best case)

If full removal is achieved, then it is expected that the low water channel will rapidly occupy the excavated area and any holes from removal of the piles and cofferdam will naturally infill through tidal inundations. The present area of scour observed along the southern margin of the cofferdam is also expected to infill to a depth of around 0.4m below ODN (i.e. re-establish the natural channel depth) from the present scoured depth of around 2.6m below ODN. The full removal will enable the channel to migrate in an unconstrained manner at this location and once the channel has migrated away from this area then the site will become part of the wider sandflat (i.e. the channel migrates naturally to the north) or Atlantic salt meadows / saltmarsh (i.e. the channel migrates naturally to the south). Therefore, full removal will achieve the structure and function conservation objective for the feature at this location by restoring the natural function of the estuary; a beneficial effect.

Partial removal (worst case)

Presently, the southern margin of the pylon site 4ZC030R cofferdam borders the channel and is acting like a hard headland type influence on the southern edge of the Atlantic salt meadows / saltmarsh. There is evidence of local scouring against the cofferdam of up to 2.6 m depth below ODN.

Partial removal of the pylon structures (foundations and cofferdam) to 2m below local ground level equates to the residual structures being at a depth of 0.5m above ODN. At this depth the structures would still protrude above the natural channel depth of 0.4m below ODN by around 0.9m.

Should the channel continue to migrate northwards the remaining structures which protrude above the natural channel depth may still lead to some local scouring and potentially slow down natural channel migration at this location. The amount of scouring is expected to be less severe than what is already observed at pylon site 4ZC030 in the estuary and will be temporary until the channel migrates past this structure, albeit at a slower rate.

Under this scenario, the conservation objective to restore structure and function of the estuary will still be met, as the headland type influence will be significantly reduced. The natural function of the estuary will also be restored as the channel will be able to migrate (albeit at a slower rate) but there may be temporary scouring as the channel migrates past the remaining low protuberances.

Assessment conclusion: No LSE; beneficial effects

Screening Conclusion for SAC: No LSE, AA not required

Screening Conclusion for SSSI: Conservation objectives for the site will not be hindered.

Site 4ZC031 – Pylon on Atlantic salt meadows / saltmarsh

Pylon 4ZC031 is the most landward pylon of the three sites. It is located on existing Atlantic salt meadows / saltmarsh around 130m from the channel and only becomes inundated during high waters on spring tides. Historical records of channel movements in the Dwyryd estuary shown in Figures 4-5 and 4-6, indicate that the estuary channels have never migrated as far as site 4ZC031 over the period 1889 to 2009. This suggests the risk of any structures being involved with channel flows is minimal. On the basis that the worst-case depth of removal is 3.75m below local ground level (local ground level is 2.5m above ODN), then any remaining structures would be at 1.25m below ODN. After removal the excavated material will be backfilled and the net loss of material through removal of concrete will be replaced with locally imported material. Even if the channel were to migrate this far then the remaining structures are sufficiently deep not to interfere with long-term channel migration (equating to low water channel depths of 0.4m below ODN) across this area, should that ever occur; a potential beneficial effect for the structure and function of the estuary feature.

Assessment conclusion: No LSE; beneficial effects

Screening Conclusion for SAC: No LSE, AA not required

Screening Conclusion for SSSI: Conservation objectives for the site will not be hindered.

4.3.1.5 Physical damage (reversible change) - Penetration and/or disturbance of the substrate below the surface of the seabed, including abrasion - Assessment against conservation objectives: Mudflats and sandflats not covered by seawater at low tide

Site 4ZC030 – Foundations in the estuary channel

Excavation works at pylon site 4ZCO30 foundations within the estuary channel, have the potential to disturb and displace sediments within the footprint of the excavation. The partial removal of the

foundations at this site are expected to temporarily leave a slightly larger hole than the existing scour holes due to the removal of the foundation material.

However, since local scouring around the foundation legs is observed to depths of 2.4m below ODN, and the depth of anticipated extraction is 1.25 below ODN then it is expected that minimal excavation to reach this depth will be required. Any holes are unlikely to remain for very long as the dynamic channel migration process quickly overwhelms their former position, infilling any over-deepened locations.

Once the structures have been removed to 1.25m below ODN, local scouring will cease, and the remaining structures are expected to become buried relatively quickly. This will in effect increase the range of the habitat as sediments can reclaim an area previously occupied by an artificial structure. This is in-line with the conservation objective to restore the range of the habitat.

Assessment conclusion: No LSE

Screening Conclusion for SAC: No LSE, AA not required

4.3.1.6 Physical damage (reversible change) - Penetration and/or disturbance of the substrate below the surface of the seabed, including abrasion - Assessment against conservation objectives: Atlantic salt meadows / saltmarsh

Atlantic salt meadows / saltmarsh (including salt pastures and salt steppes) of the entire Lleyn Peninsula and Sarnau SAC cover approximately 17.52km^2 (1.2% of the entire SAC). They cover approximately 4.2km^2 of the Morfa Harlech SSSI (19% of the entire SSSI).

The presence of the pylons on the Atlantic salt meadows / saltmarsh is listed in the 2018 SAC condition assessment (NRW 2018b) as an activity that directly impacts the condition of the feature of the site, leading to the assessment that the Atlantic salt meadows feature is in an unfavourable condition.

Site 4ZC030R - Full removal

For the best-case scenario, full removal of all the pylon structures will cause minimal disturbance to the Atlantic salt meadows / saltmarsh sediments. The removal will be undertaken in two steps; breaking up the concrete pile collars; and removing the piles and cofferdam sheet piles using a pile rig to vibrate and pull the structures from the ground. Minimal excavation works (disturbing minimal sediments at each of the four leg) will be required to complete Step 1 as two of the pile collars are above ground level and the other two appear to be just below the surface. Excavation is not required during Step 2.

Although there will be some disturbance to the Atlantic salt meadows / saltmarsh it will be temporary and localised. As the Atlantic salt meadows / saltmarsh are within the estuary feature they are included within the objective to restore the structure and function of the estuary. Removal of the pylon structures is therefore in-line with the conservation objectives for the SAC and the SSSI

Assessment conclusion: No LSE

Screening Conclusion for SAC: No LSE, AA not required

Screening Conclusion for SSSI: Conservation objectives for the site will not be hindered.

Site 4ZC030R - Partial removal

For the worst-case scenario, it has been assumed that the removal of the piles and cofferdam are unsuccessful due to fusing / bonding of the structures to the surrounding sediments. In this scenario, the pile collars will have been removed; as in the best-case scenario.

The Proposed Marine Works at site 4ZC030R will result in the direct loss of the Atlantic salt meadow Qualifying Interest, due to displacement of substrate within the excavation area (approximately 32m x 32m). Atlantic salt meadows / saltmarsh has a crust of vegetation and soil bound together by roots, but below the surface the substrate is very sandy (RSK 2016a). Should full removal of the foundations and cofferdam not succeed, then sediments around the four foundation legs and the inner side of the cofferdam will be excavated to 2m below ground level to cut and remove the structures at this depth. During this process, water is likely to egress into the cofferdam and the whole area within the excavation area is likely to be disturbed through movements of plant. All the excavated sediment will be set aside for backfill following completion of the removal works. Although there will be a small net loss of material (approximately 38m^3 over a 1024m^2 area) due to the removal of the concrete and metal, backfill of the excavated sediment will initially result in the formation of a mound over the site. This will flatten out as the sediments settle out.

Evidence for the potential of Atlantic salt meadows / saltmarsh regeneration over the affected area is provided by the current baseline in 2019 which shows that since the replacement pylon was installed in 2013 (and saltmarsh habitat within the footprint of the works was lost), Atlantic salt meadows / saltmarsh vegetation has re-generated and covers much of the area again as shown in Figure 3-5. Atlantic salt meadows / saltmarsh habitat will therefore recover within 5 to 10 years, i.e. over the short to medium term, following disturbance. This is in-line with the conservation objectives to maintain the Qualifying Features range in the long term. Additionally, the physical and biological structure and function of the Atlantic salt meadows / saltmarsh will be maintained.

National Grid shoreline monitoring data between 2013 and 2017 for 4ZC030R indicates that the shoreline is retreating on the northern side of the estuary and the Atlantic salt meadows / saltmarsh is eroding. The cofferdam is currently acting as an artificial barrier to this migration and erosion. Following partial removal of the pylon structures, should the estuary channel continue to migrate north, the channel at this location has the potential to migrate over the 4ZC030R site (albeit at a slower rate than with full removal of the structures) resulting in saltmarsh habitat loss through natural processes. Since the loss is by natural processes it is still compatible with the conservation objectives of the site as it represents a return to more natural processes of the estuary feature; again in-line with the conservation objective to restore the structure and function of primary designating feature of the SAC, the estuary.

As discussed in Section 4.2.5.1, the main vegetation present in the vicinity of pylon 4ZC030R is low grade sheep-grazed saltmarsh classified as the NVC type SM18 *Juncus maritimus* salt-marsh community, *Oenanthe lachenalii* sub-community. Following the Proposed Marine Works, regeneration of Atlantic salt meadows / saltmarsh over the short to medium term would not change the type of species found at this location and therefore the conservation objective to maintain the typical species will be met.

Assessment conclusion: No LSE

Screening Conclusion for SAC: No LSE, AA not required

Screening Conclusion for SSSI: Conservation objectives for the site will not be hindered.

Site 4ZC031

Pylon 4ZC031 is set back on the Atlantic salt meadows / saltmarsh approximately 130m from the estuary channel. The proposed works at this site will result in the direct disturbance of the habitat, through temporary substratum loss and displacement of sediment during excavation of the foundations. Based on the worst-case scenario of 3.75m depth removal of the foundations, there will be a net loss of approximately 110m^3 over the four excavation holes from removal of concrete. Excavated sediment will be backfilled into the holes and excavation area. However, there is likely to

be residual holes at each foundation leg approximately 32m^2 in area and 0.85m in depth, resulting from the removal of the concrete and piles. The resulting mud holes represent a loss of Atlantic salt meadows / saltmarsh habitat.

Assessment conclusion: There is potential for a LSE.

Screening Conclusion for SAC: Potential for LSE, AA is required

Screening Conclusion for SSSI: Potential that conservation objectives for the site will be hindered.

Access routes and working areas

Vehicle access routes to the marine pylons and working/pylon dismantling areas have the potential to damage / disturb the Atlantic salt meadows / saltmarsh habitat through abrasion and crushing. Access will be established as follows:

- Access to pylon sites 4ZC030 and 4ZC030R will:
  - Require a working area comprising a temporary stone platform to access 4ZC030 foundations which depending on its location may cause some compaction to Atlantic salt meadows / saltmarsh;
  - Partly use an existing stone track which leads to a sewage works. There will be no impact on the saltmarsh unless the track needs widening, in which case some compaction of any Atlantic salt meadows / saltmarsh habitat present within the footprint of this narrow strip along the length of the existing track could occur; and
  - Partly cross the Atlantic salt meadows / saltmarsh using a temporary constructed track along the same route used during the installation of pylon 4ZC030R in 2013.
  - Cross watercourses via three temporary vehicular bridges
- Access to 4ZC031 and between 4ZC031 and 4ZC030R will:
  - Partly use a narrow existing stone track which follows the boundary of the SAC (and the Marine Environment Area). There will be no impact on the saltmarsh along this stretch;
  - Widen an approximately 40m section of the existing stone track. A temporary culverted ramp will be constructed to cross a watercourse and access the saltmarsh from the stone track;
  - Partly cross the Atlantic salt meadows / saltmarsh using a temporary constructed track;
  - Cross watercourses via one additional temporary culvert and four temporary vehicular bridges; and
  - Access to locate two winches on the Atlantic salt meadows / saltmarsh either side of pylon 4ZC031 using a telehandler (all terrain forklift vehicle).

The temporary stone working platform will be approximately 20m x 20m, the majority of which will be located in the channel or on the mudflats. It is possible a small area may overlap with the Atlantic salt meadows / saltmarsh.

The temporary access tracks across the Atlantic salt meadows / saltmarsh will be made up of plastic or aluminium road panels either of which will help spread any heavy load to the surface of the Atlantic salt meadows / saltmarsh. Any compression of soils is expected to be minimal and limited to these tracks.

Temporary working areas for dismantling pylons 4ZC030R and 4ZC031 will be approximately 60m x 60m with a 32m x 32m gap in the middle and will be constructed of aluminium or plastic panels. Additionally, there will be two temporary EPZs for removal of conductors, one either side of pylon

4ZC031 will be constructed of aluminium panels and have a combined footprint of 3,155m^2. These plastic or aluminium panels will help spread the load of plant within the working areas and reduce any compaction to the Atlantic salt meadows / saltmarsh.

Temporary, localised compaction of the Atlantic salt meadows / saltmarsh will occur as a result of the weight of the backstay, light use vehicle access and construction of the ramp and other watercourse crossings.

- Small depressions (1.8m by 1.2m) could be created where each backstay sledge is used due to the weight of the blocks (4.2 tonnes).
- The ramp to access the saltmarsh from the existing stone track will locally compact a small area of saltmarsh vegetation. Crushed stone which will form the roadway will be placed over a geotextile membrane laid on the saltmarsh and will be removed on completion of the works. Any compression of soils is expected to be minimal.
- At watercourse crossings, the banks will be prepared by laying wooden sleepers or bags of crushed stone to form a temporary level base before positioning the bridge unit. This may leave a depression each side of the watercourse, but this will be a localised temporary effect with recovery to the saltmarsh over the short-term.
- The forklift vehicle will cross a short section of Atlantic salt meadows / saltmarsh grass with no roadway to position the two winches at pylon site 4ZC031. Although a small area of grass will be temporarily compressed, the vehicle will only cross the area once to position the winch and once to remove it. Any damage to the Atlantic salt meadows / saltmarsh is likely to be minimal.

Juncus acutus - sharp rush, a rare species, was identified in the 2016 saltmarsh survey (RSK 2016a) in five locations. NRW screening opinion (Ref: SC1815, 2019) noted that the assemblage species *Eleocharis parvula* - dwarf spike rush has been recorded in some of the adjacent salt pans (depressions) on the Atlantic salt meadows / saltmarsh. Dwarf spike rush was not identified in the 2016 site survey (RSK 2016a). Additionally, *Ruppia maritima* – beaked tasselweed which has restricted distribution has also been recorded at this location (NRW 2020). This species was recorded in the 2016 survey within pools and creeks in the southern part of the saltmarsh survey (outside the Proposed Marine Works) (Appendix 16B) (RSK 2016). All three species would be vulnerable to any infilling/blocking (temporary or long-term) and compression/erosion associated with vehicle movements.

The Proposed Marine Works are scheduled for 2026. There is therefore the potential that dwarf spike rush, sharp rush and beaked tasselweed could be found along the access routes or within the working areas by the time works start. The screening has returned a conclusion of uncertain effects because it cannot be ruled out that the access tracks will not disturb these rare species.

Assessment conclusion: LSE cannot be ruled out.

Screening Conclusion for SAC: LSE cannot be ruled out, AA is required

Screening Conclusion for SSSI: Potential that conservation objectives for the site will be hindered.

4.4 Screening Statement and Conclusions

To determine whether the Proposed Marine Works are likely to have a significant effect on any European sites, either individually or in-combination with other plans or projects, AA screening was carried out.

The AA Screening considered four European Sites with marine components or marine designating features within 15km of the Proposed Marine Works and a SSSI which the Proposed Marine Works are located in.

The initial screening presented in Table 4-3 concluded that there is a pressure-receptor pathway between the Proposed Marine Works and one European Site, **Pen Llyn a'r Sarnau/ Lleyn Peninsula and the Sarnau SAC** (site code UK0013117), and the **Morfa Harlech SSSI** (site code 0516).

The potential pressures which could result in significant effects on these sites were identified as:

- Waterflow (tidal current) changes, including sediment transport considerations; and
- Physical damage (reversible change) - Penetration and/or disturbance of the substrate below the surface of the seabed, including abrasion.

Further analysis of the likely significant effects taking into consideration the SAC and SSSIs conservation objectives concluded:

- Waterflow (tidal current) changes, including sediment transport considerations:
  - No LSE – AA of the SAC is not required
  - The conservation objectives of the SSSI will not be hindered.
- Physical damage (reversible change) - Penetration and/or disturbance of the substrate below the surface of the seabed, including abrasion:
  - LSE cannot be ruled out – AA of the SAC is required.
  - There is the potential that the conservation objectives for the SSSI will be hindered and mitigation should be proposed.

5. STAGE 2 – INFORMATION TO INFORM APPROPRIATE ASSESSMENT

5.1 Introduction

The Stage 1 Screening documented in Section 4 concluded that there is the potential for likely significant adverse effects on the following site and that an AA is required:

- Pen Llyn a`r Sarnau/ Lleyn Peninsula and the Sarnau SAC (site code UK0013117)

In addition, it concluded that there is the potential that the conservation objectives for the Morfa Harlech SSSI (site code 0516) could be hindered by the Proposed Marine Works.

The Qualifying Feature requiring further assessment in both sites is the Atlantic salt meadows / saltmarsh. The habitat has been protected at both a national and European level. The assessment provided in this section therefore considers the conservation objectives and site integrity of the SAC and SSSI.

Gwynedd Council and Snowdonia National Park Authority have confirmed that there are no cumulative developments to be assessed for VIP, Snowdonia. In addition, and as described in Section 4.1.3, a search of applications on the NRW marine licensing portal has not identified any projects or plans which should be considered by the HRA.

AA is a focused and detailed impact assessment of the implications of the plan or project alone and in combination with other plans and projects, on the integrity of a European site in view of its conservation objectives. It is undertaken by the competent authority, which for Marine Licence applications is the Welsh Government, supported by NRW. To inform the AA, the proponent of the plan (i.e. National Grid) must provide 'Information to Inform AA' which provides data and information on the project and an analysis of potential effects on the European site.

Welsh Government (2017) guidance on Stage 2 simply states the developer should "Provide information to the competent authority as reasonably required for the purposes of assessing the implications for N2K [European] sites in light of relevant conservation objectives. Draft a report to inform the competent authority's Appropriate Assessment."

This Section draws on information provided in this document as identified in Table 5-1 and provides further assessment of the significant effects on the Qualifying Interests of the SAC. Where appropriate it proposes mitigation measures which will be taken by National Grid to reduce the significance of effects.

Table 5-1 Cross-reference to other supporting information

Relevant information	Section
Description of Proposed Marine Works	Section 3
Conservation objectives of the European Site	Section 4.3.1.2
Assessment of aspects of the Proposed Marine Works which could negatively affect the conservation objectives of the European Site	Section 4.3.1

5.2 Pen Llyn a'r Sarnau/ Lleyn Peninsula and the Sarnau SAC and Morfa Harlech SSSI

5.2.1 Screening conclusion

5.2.1.1 Qualifying feature – Atlantic salt meadows / saltmarsh

The AA screening identified that the Proposed Marine Works at pylon site 4ZC031 has the potential to result in a LSE on Atlantic salt meadows / saltmarsh from the pressure 'physical damage (reversible change) - penetration and/or disturbance of the substrate below the surface of the seabed, including abrasion.' In addition, it cannot be ruled out that the temporary access tracks and watercourse crossings to pylon 4ZC031 and pylons 4ZC030R and 4ZC030 and working areas, will not affect the protected species dwarf spike rush *Eleocharis parvula.*

The SAC conservation objectives for the Qualifying feature Atlantic salt meadows are:

"To achieve favourable conservation status all the following, subject to natural processes, need to be fulfilled and maintained in the long-term. If these objectives are not met restoration measures will be needed to achieve favourable conservation status.

- *Range – the overall distribution and extent of the habitat features within the site, and each of their main component parts is stable or increasing.*
- *Structure and function – The physical, biological and chemical structure and functions necessary for the long-term maintenance and quality of the habitat are not degraded. For Atlantic salt meadows this includes the morphology of the saltmarsh creeks and pans.*
- *Typical Species – The presence, abundance, condition and diversity of typical species is such that habitat quality is not degraded. Important elements include: species richness, population structure and dynamics, physiological health, recruitment, mobility and range."*

The conservation objectives for Atlantic salt meadows is intrinsically linked to the conservation objectives for the Primary Qualifying Feature Estuaries. The range, structure and function of Atlantic salt meadows is dependent on environmental processes in the main body and waterway of the 'Estuaries' i.e. changes in the estuary dynamics can lead to accretion and/or erosion of the Atlantic salt meadows feature. In addition, the feature description for 'Estuaries' lists Atlantic salt meadows as a 'typical species', the habitat quality (including range) for which should not be degraded. It is therefore appropriate to also consider the key objectives for the Estuary feature which is:

"Restoration and recovery

As part of this objective it should be noted that; for the ***estuaries*** *feature the structure and functions of the estuaries that have been damaged/degraded by the constraints of artificial structures such as flood banks, are restored."*

The long-term vision for the Morfa Harlech SSSI is that:

- The natural coastal processes that determine the dynamics and proportions of habitats at Morfa Harlech should be allowed to continue.
- Where possible, existing habitats should be maintained, through management of factors within human control.
- The typical and associated nationally rare and scarce plants should not reduce in range within their habitats or lose the ability to reproduce and sustain themselves through factors within human control.

5.2.2 Assessment of effects

Site 4ZC031– Partial removal of pylon structures

The driving force behind undertaking the Proposed Marine Works at site 4ZC031 is to remove artificial structures from the Primary Qualifying Feature Estuary. Partial removal of the pylon structures at 4ZC031 will contribute to the achievement of this conservation objective as discussed in Section 4.3.1.4. There will be no LSE on the Estuary feature. However, there will be disturbance of the Atlantic salt meadows / saltmarsh Qualifying Feature; the conservation objective for which is to maintain in the long-term the habitat quality i.e. the range, structure and function and typical species, such that the habitat is not degraded.

The excavation works at site 4ZC031 will involve the excavation of relatively large holes (32m^2 in area) around each foundation leg within a 1024m^2 excavation area which will be subject to ground level disturbance from plant movements throughout the area. Although excavated sediment (approximately 377m^3) will be used to backfill the holes, there will be a significant net loss of material from the removal of concrete (pile caps and piles) (approximately 110m^3). Following backfill of the excavated sediments an indicative calculated depth of the residual holes is 0.85m.

The Proposed Marine Works at this site will result in the direct loss of Atlantic salt meadows / saltmarsh habitat and the creation of mud holes. This would have an adverse effect on the range of the Atlantic salt meadows / saltmarsh but would not necessarily affect the structure and function of the habitat. Some Atlantic salt meadows / saltmarshes have pronounced areas of higher ground with varying densities of water-filled depressions (salt pans) or bare areas of mud (mud basins) which are connected to the creek system and which drain at low tide (Defra 2007). Findings of the saltmarsh survey (RSK 2016a) indicated that throughout the undisturbed grassland there are discrete pools and depressions formed by the natural erosion of the sandy sediment. Once the vegetation crust of the Atlantic salt meadows / saltmarsh is broken, the sandy sediment is easily eroded, and the pools can be undercut around the edges leading to gradual expansion. This process can be reversed when vegetation can establish and stabilise sediment (RSK 2016a). The depth of the depression appears to be a key factor as illustrated in Figure 5-1; although hydrology is likely to be key to determining if these pools become permanent features or re-vegetate (RSK 2016a). NRW has advised that completely backfilling the excavation may not be necessary, as the creation of a shallow pan could potentially provide a suitable area for *Eleochoris parvula*. (NRW 2020a).

Figure 5-1 Examples of depressions within the Marine Environmental Area (RSK 2016a)

Plate 6. A deep depression with no vegetation.

Plate 7. A shallow depression with some growth of *Glaux maritima* (Sea-milkwort) and some surface algae.

It is possible the excavation holes would fill in with sediment over the long term and Atlantic salt meadows / saltmarsh would regenerate. This would maintain the range of the habitat in the long-term however, it is uncertain whether this would occur and there remains the potential that the depressions would represent a loss of habitat, which would have a significant effect on meeting the conservation objective for the Qualifying Feature. For this reason, mitigation measures will be implemented to restore the habitat in the short-term; ensuring that there is no loss of range.

Access tracks

Juncus acutus - sharp rush has been identified at five locations within the Marine Environment Area; including one location with three plants which were translocated during the 2013-2014 emergency works at 4ZCO30R. One location is already beyond the eroding edge of the Atlantic salt meadows / saltmarsh and two more are within 10m and at risk of being lost through natural processes (RSK 2016a).

Eleocharis parvula - dwarf spike rush has been recorded in some of the adjacent salt pans (depressions) on the Atlantic salt meadows / saltmarsh. However, it was not identified in the 2016 saltmarsh survey (RSK 2016a).

Ruppia maritima – beaked tasselweed has also been recorded at this location (NRW 2020a). This species was recorded in the 2016 survey within pools and creeks in the southern part of the saltmarsh survey (outside the Proposed Marine Works) (Appendix 16B) (RSK 2016).

A survey of the Atlantic salt meadows / saltmarsh has not been undertaken in recent years and it is therefore possible that sharp rush, dwarf spike rush and beaked tasselweed are now present in other areas of the Marine Environment Area. In addition, the Proposed Marine Works will not be carried out until 2026, sufficient time for plants to become established.

As it is uncertain whether sharp rush, dwarf spike rush or beaked tasselweed will be present along the planned temporary access tracks and within working areas, mitigation measures will be implemented to ensure that effects on rare plant species are avoided.

5.2.3 Mitigation measures

The following mitigation measures will be implemented by National Grid to avoid or reduce significant effects:

1. Prior to commencing excavation works at Site 4ZC031 the top layer of saltmarsh will be temporarily translocated and maintained. Locally sourced sediment (source to be agreed with NRW) will be used to backfill the depressions. NRW has advised that completely backfilling the excavation may not be necessary, as the creation of a shallow pan could potentially provide a suitable area for *Eleochoris parvula*. NRW has recommended leaving a depth of approximately 30cm, avoiding a regular shape if possible. The translocated Atlantic salt meadows / saltmarsh turf will be replaced to restore the habitat.
2. Within 1-year prior to the Proposed Marine Works the access routes and work areas will be surveyed to confirm the locations of rare species such as sharp rush and dwarf spike rush. Any plants identified as at risk from the access tracks and work areas will be relocated (within the SAC to an area not disturbed by the Proposed Marine Works), or an exclusion area established around them. An Ecological Clerk of Works will be appointed to ensure works do not disturb rare plants.

5.2.4 Conclusion

It is possible that the Qualifying Interest 'Atlantic Salt meadows' / Saltmarsh could be disturbed by the Proposed Marine Works. The partial removal of pylon 4ZC031, the use of temporary access tracks and working areas has the potential to reduce the range of the Qualifying Feature. To avoid significant effects, National Grid will commit to restoring the habitat at site 4ZC031 and establishing ahead of the Proposed Marine Works the location of rare species so that they can be avoided or relocated (within the SAC). In addition, the partial removal of the pylon 4ZC031 is in-line with the conservation objective to restore the natural structure and function of the estuary Primary Qualifying Feature. In light of this, it is concluded that the Proposed Marine Works will not have an adverse effect on the integrity of the Pen Llyn a'r Sarnau/ Lleyn Peninsula and the Sarnau SAC either alone or in combination with other plans or projects. In addition, it will not hinder the conservation objectives of the Morfa Harlech SSSI.

Conclusion for SAC – No adverse effect on integrity of the site, either alone or in combination with other plans or projects.

Conclusion for SSSI – No adverse effect on integrity of the site, either alone or in combination with other plans or projects. Conservation objectives will not be hindered.

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APPENDIX A

VIP Snowdonia Project: Underwater Noise Assessment (ABPMer 2019)

1 Introduction

ABPmer has been commissioned by National Grid to undertake a qualitative desk-based assessment of the potential effects of underwater noise and vibration generated during the construction of the Visual Impact Provision (VIP) Snowdonia Project (here on referred to as the Proposed Project) on sensitive marine fauna. The Proposed Project will involve constructing a cable tunnel under the Dwyryd Estuary and removing existing pylons within and adjacent to this estuary.

The Estuary forms part of the Pen Llyn a'r Sarnau / Lleyn Peninsula and the Sarnau Special Area of Conservation (SAC) and Morfa Harlech Site of Special Scientific Interest (SSSI). Pen Llyn a'r Sarnau / Lleyn Peninsula and the Sarnau SAC is designated for a number of coastal and marine habitat features, as well as bottlenose dolphin, otter and grey seal which are present as qualifying features but not a primary reason for site selection. As noted in the scoping report/opinion, marine mammals will not be affected by the Proposed Project and therefore have been scoped out of the assessment. It should also be noted that National Grid have made a commitment not to undertake the proposed works within the Dwyryd Estuary, specifically the removal of the overhead line, during the winter bird season; winter birds have therefore been scoped out of this assessment. The focus of this assessment is therefore the potential noise and vibration effects of the Proposed Project on fish species within the Dwyryd Estuary.

The key construction activities associated with the Proposed Project that have the potential to result in underwater noise and vibration and have been considered as part of this assessment are as follows:

- The construction of the tunnel shafts located more than 600 m either side of the estuary which may involve the use of drill and blast construction techniques and/or mechanical excavation (it is anticipated that the shafts will have up to a 15 m internal diameter on the western side near Garth, and a 12.5 m internal diameter on the eastern side near Cilfor). There will be one deep shaft, and the other much shallower; the actual depth will be determined during the detailed design stage by the design and build contractor. If the deep shaft is located on the west (Garth) the shaft depths will be:
    - Garth 71 m; and
    - Cilfor 39.5 m.

  If the deep shaft is located on the east (Cilfor) the shaft depths will be:
    - Garth 32 m; and
    - Cilfor 73.5 m.
- The tunnel would be constructed at varying depths depending on the final vertical alignment proposed by the contractor, the top of the tunnel will remain below -15 m Above Ordnance Datum (AOD) over its full length. In areas of soft or poor ground, a number of additives may be required to condition the soil to facilitate tunnel construction;
- The removal of existing pylon foundation comprising pre-cast concrete piles will involve building a working platform and then using an excavator with a hydraulic breaker. The removal of foundation collars will also involve hydraulic breaker; and
- The removal of the existing pylon foundation comprising steel tubular piles and steel sheet pile cofferdam will involve using a leader pile rig which will grip the pile and remove it vertically with a vibrating action or, if this is not possible, by an excavator.

2 Sources of Noise and Vibration

Estimated underwater sound source levels of the key construction activities associated with the Proposed Project have been identified from available published and unpublished studies and are included in Table 1 below. These source levels have been extrapolated from underwater field measurements of activities taking place directly in the water column, with the exception of the tunnel boring machine (TBM), where the predicted source level is based on underwater measurements of tunnelling taking place in close proximity to the seabed.

Table 1 Predicted underwater source levels of construction activities

Activity	Source level	Reference
Drilling (rotary)	161 to 165 dB re 1µPa Root Mean Squared (RMS)	Barham (2017)
Drilling (percussive)	185 dB re 1µPa (RMS)	Barham (2017)
Blasting (20kg charge)	259 dB re 1 µPa (peak)	Ward (2015)
Tunnel boring machine (TBM) whilst being used in rock	178 dB re 1 µPa (peak)	Stephenson (2018)
Excavation (backhoe dredging)	154 to 179 dB re 1µPa m (RMS)	Jones and Marten (2016)
Hydraulic (rock) breaker	210 dB re 1µPa (peak)	Barham (2017)
Vibro piling*	197 dB re 1µPa (peak)	Illingworth & Rodkin (2007)
* A measurement of vibro piling has been used to estimate the source level of the extraction of piles using a leader pile rig with a vibrating action as it is considered a reasonable proxy.		

3 Noise and Vibration Effects

3.1 Impact assessment methodology

Although the Proposed Project has been screened as a non-EIA development, to facilitate the impact assessment process, a standard analysis methodology has been applied. This framework has been developed from a range of sources, including the Marine Works (EIA) Regulations 2007 (as amended), the new EIA Directive (2014/52/EU), statutory guidance, consultations and ABPmer's previous (extensive) EIA project experience. This methodology follows the principles of the Charted Institute of Ecology and Environmental Management's (CIEEM) latest guidelines for ecological impact assessment in the UK and Ireland which combines advice for terrestrial, freshwater and coastal environments (CIEEM, 2018)..

The first stage of the assessment identifies the potential environmental changes resulting from the Proposed Project and the features of interest (receptors) that are likely to be affected (which are together referred to as the impact pathway).

The second stage involves understanding the nature of the environmental changes to provide a benchmark against which the changes and levels of exposure can be compared. The scale of the impacts via the impact pathways depends upon a range of factors, including the following:

- Magnitude (local/strategic):
  - Spatial extent (small/large scale);
  - Duration (temporary/short/intermediate/long-term);
  - Frequency (routine/intermittent/occasional/rare);
- Reversibility;
- Probability of occurrence;
- Confidence, or certainty, in the impact prediction;
- The margins by which set values are exceeded (e.g. water quality standards);
- The importance of the receptor (e.g. designated habitats and protected species);
- The sensitivity of the receptor (resistance/adaptability/recoverability);
- The baseline conditions of the system; and
- Existing long-term trends and natural variability.

The likelihood of a feature being vulnerable to an impact pathway is then evaluated as a basis for assessing the level of the impact and its significance.

The key significance levels for either **beneficial** or **adverse** impacts are described as follows:

1. **Negligible**: Insignificant change not having a discernible effect;
2. **Minor**: Effects tending to be discernible but tolerable;
3. **Moderate**: Where these changes are adverse they may require mitigation; and
4. **Major**: Effects are highest in magnitude and reflect the high vulnerability and importance of a receptor (e.g. to nature conservation). Where these changes are adverse they will require mitigation.

3.2 Drill and blast

The tunnel shafts may be constructed using a drill and blast technique. There are two specific types of drilling: rotary drilling and percussive drilling. Rotary drilling consists of a rotating head forced into the ground. As a worst case, measurements of a Wirth B5 rotary drilling rig taken from a marine

development in Strangford Lough, Northern Ireland were used to estimate the typical source level presented in Table 1 (this is considered to be worst case as the illustrative measurements used are for a development within the marine environment; the proposed shaft construction will be at distance of more than 600 m either side of the estuary). Percussive drilling is different from rotary drilling as it adds a rapid hammer action to the rotating head. Measurements taken from a percussive drilling operation at the European Marine Energy Centre at Orkney were used to estimate the typical source level presented in Table 1. The illustrative levels of underwater noise generated by both types of drilling (which are considered to be worst case) are comparable to the levels generated by small to moderately sized ships (UKMMAS, 2010; Thomsen *et al*., 2011).

Very little published data is available that allows for an estimation of peak levels underwater of detonations from confined explosions. A study by Nedwell and Thandavamoorthy (1992) involved measurements in the marine environment from detonations in boreholes. These indicated that the peak pressure could be as low as 6% of that generated in equivalent, open water conditions. For a 20kg charge, the peak pressure in open water is 259 dB re 1 µPa. The peak pressure underwater from confined explosions is expected to be significantly less (it should be noted that this is considered to be worst case as the proposed shaft construction will be outside of the water column and at a distance of more than 600 m either side of the estuary).

The drill and blast activities that may be required at the tunnel shafts are taking place outside of the water environment, more than 600 m from the edge of the estuary. The force generated by the drill and blast techniques will be exerted on the ground at that location. Sound may travel as both compressional waves, in a similar manner to the sound in the water, or as a seismic wave, where the displacement travels as Rayleigh waves (Brekhovskikh, 1960). The waves can travel outwards through the seabed or be reflection from deeper sediments. As these waves propagate, sound will also "leak" upwards contributing to the airborne sound wave. The noise from drill and blast activities will therefore be considerably reduced as a result of absorption of the sound by the ground and by the air, the interaction with the ground surface (reflection and scattering) and the interaction with and transmission through the ground. Given the distance of the tunnel shafts from the estuary, the drill and blast activities are unlikely to be measurable in the water environment and the potential effects on marine fauna in the Dwyryd Estuary are considered to be **negligible**.

3.3 Tunnel Boring Machine

A TBM will be used to construct the cable tunnel under the Dwyryd Estuary. Measurements of the use of TBMs at 10 m depth in different substrates indicate a maximum peak sound pressure level of approximately 178 dB re 1 µPa in the water column immediately adjacent to the seabed in the vicinity of the TBM whilst being used in rock (Table 1). This level of noise is comparable to the source levels of small shipping vessels (UKMMAS, 2010; Thomsen *et al*., 2011).

The TBM for the Proposed Project will be located at varying depths depending on the final vertical alignment proposed by the contractor, although the top of the tunnel is proposed to remain below -15 m Above Ordnance Datum (AOD) (around 35 m below the estuary). The underlying geology of the Dwyryd Estuary is primarily an approximately 5 to 10 m layer of tidal flat deposits (fine to medium sand) over a 5 to 10 m layer of cohesive superficial deposits (soft clay and silt) over a 6 to 35 m layer of flacial/flaciofluvial deposits over the underlying Ffestiniog Flags Formation (mudstone/siltstone). The propagation of noise from the TBM will be attenuated by at least one or two orders of magnitude due to the absorption of the sound by the seabed, as well as by reflection and scattering processes and the interaction with and transmission through the seabed, particularly at the boundaries of different sediment layers. The underwater sound pressure levels that reach the seabed are therefore unlikely to result in any disturbance to fish in the estuary for the duration of construction activities. Overall, given the distance of the TBM from the estuary, and the complex underlying geology, the tunnelling activities

are unlikely to be noticeable in the water environment and the potential effects on marine fauna in the Dwyryd Estuary are considered to be **negligible**.

3.4 Excavator

The construction of the tunnel shafts may involve using a mechanical excavator. The removal of the pylon foundations for Pylon 4ZC030R and Pylon 4ZC030 from within the Dwyryd Estuary may also involve the use of an excavator in shallow water. Measurements of underwater noise from backhoe dredging operations indicate that the highest levels of underwater noise occur when the excavator is in contact with the seabed (Jones and Marten, 2016). Backhoe dredgers have been shown to create source noise levels in the range of 154 to 179 dB re 1µPa m (Table 1). These levels are comparable to the levels generated by small vessels (UKMMAS, 2010; Thomsen *et al*., 2011).

Should a mechanical excavator be used for the construction of the tunnel shafts this will take place completely outside of the water environment. There will be no direct coupling between the excavation activities for the tunnel shafts and the water environment. The noise from excavation activities will therefore be considerably reduced as a result of absorption of the sound by the seabed and by the air, the interaction with the ground surface (reflection and scattering) and the interaction with and transmission through the seabed. Given that any excavation activities that may be involved during the construction of the tunnel shafts would generate relatively low levels of sound and would take place outside the water environment, they are unlikely to be measurable in the water environment and the potential effects on marine fauna in the Dwyryd Estuary are considered to be **negligible.**

Even though the foundations of Pylon 4ZC030R are inside a cofferdam, water will continue to enter the excavation area even at low tide so continuous pumping will be required during the excavation works. A working platform will be created at Pylon 4ZC030 which will allow excavation activities to take place during different tidal periods. Low frequency sounds, such as those from dredging activities, do not propagate well in shallow water due to the wave-guide effect (i.e. where the wavelength is of a similar magnitude to the water depth) (NPL, 2014). This effect means that there will be a lower cut-off frequency at a particular depth, below which sound waves will not propagate well. Any sound at frequencies below the cut off will not be able to propagate far because the grazing angle[1] of the sound wave exceeds the critical angle[2] and it loses energy very quickly through multiple reflections between the surface and bottom with limited horizontal propagation (NPL, 2014). Given that any excavation activities required at Pylon 4ZC030R or Pylon 4ZC030 would generate relatively low levels of sound and would be located in very shallow water, these activities are likely to be discernible only in very close proximity to the foundation i.e. within several metres. Furthermore, the published thresholds of injury in fish (Popper *et al*., 2014) would not be exceeded even at the source of the excavation noise. Overall, the potential effects on marine fauna in the Dwyryd Estuary are considered to be **negligible**.

3.5 Hydraulic breaker

The removal of the pylon foundations for Pylon 4ZC030R and Pylon 4ZC030 from the estuary may require a hydraulic breaker. Hydraulic (rock) breaking involves a drill-bit-like hammer rapidly striking and breaking up the substrate. Underwater sounds due to the breaking of hard material, such as concrete, by mechanical action can be considerably stronger than those of routine dredging activities (Thomsen *et al*., 2011). The estimated source level from hydraulic breaking is 210 dB re 1µPa (peak)

[1] When dealing with a beam that is nearly parallel to a surface, it is sometimes more useful to refer to the angle between the beam and the surface, rather than that between the beam and the surface normal, in other words 90° minus the angle of incidence.

[2] The critical angle is the angle of incidence above which the total internal reflection occurs.

(Table 1) which is higher than levels generated by commercial shipping (UKMMAS, 2010; Thomsen *et al.*, 2011).

The foundation collars at Pylon 4ZC030R will be removed by hydraulic breaker. This will take place outside the water environment, and therefore the potential effects on marine fauna in Dwyryd Estuary would be **negligible**.

In contrast, a working platform will be created at Pylon 4ZC030 which will enable the hydraulic breaking activities to be carried out at different states of the tide. Low frequency sounds, including those from construction activities, do not propagate well in shallow water due to the wave-guide effect (see Section 3.4).

Any hydraulic breaking activities required at Pylon 4ZC030 would generate localised high levels of underwater sound but these are anticipated to be attenuated very rapidly given the very shallow water at this location. Furthermore, the breaking up of the foundation will last around seven days. The working times are yet to be agreed. However, there will be down time periods of inactivity. There will, therefore, be significant periods each day when marine fauna is not exposed to elevated levels of underwater sound.

Based on the estimated source level of hydraulic breaking (Table 1), instantaneous published thresholds of injury in fish with swim bladder (i.e. Atlantic salmon, European eel, sea trout and twaite shad) would be exceeded within 2 m from the source of hydraulic breaking (Popper *et al.*, 2014). However, it is considered very unlikely that any fish would be located so close to the works as they will have dispersed with the visual disturbance caused by movements of plant and vehicles on the shore and therefore mitigation is not considered necessary. Published thresholds of injury in fish with no swim bladder (i.e. sea lamprey) in fish would not be exceeded even at the source of the hydraulic breaking activities (Popper *et al.*, 2014). Potential behavioural effects on fish (e.g. avoidance reaction) are likely to be very localised given the shallow water nature at the location of Pylon 4ZC030. Overall, the potential effects on marine fauna in the Dwyryd Estuary are considered to be **negligible to minor.**

3.6 Pile extraction

The removal of the steel tubular piles and sheet pile cofferdam at Pylon 4ZC030R will involve using a leader pile rig with a vibrating action. An underwater measurement for a leader pile rig involved in extraction of piles has not been identified in the literature. The vibro extraction of sheet piles uses the same tool as for driving sheet piles and the noise is generated in the sheet piles through the coupling to the piling hammer. Therefore, a measurement of vibro piling sheet piles has been used to estimate the source level of the extraction of piles as it is considered a reasonable proxy. The estimated source level from this activity is 197 dB re 1µPa (peak) (Table 1).

Even though the foundations of Pylon 4ZC030R are inside a cofferdam, water will continue to enter the excavation area even at low tide so continuous pumping will be required during the excavation works. Any piling extraction activities required at Pylon 4ZC030R would therefore take place in shallow water and therefore would be considerably reduced due to the wave-guide effect (see Section 3.4). These pile extraction activities will last approximately seven days and daily working hours represent 48 % of the time over a period of a week. There will also be down time periods of inactivity, during for example pile positioning and set up. There will therefore be periods each day when marine fauna are not exposed to elevated levels of underwater sound. Furthermore, the published thresholds of injury in fish (Popper *et al.*, 2014) would not be exceeded even at the source of the piling extraction. Overall, therefore, the potential effects on marine fauna in the Dwyryd Estuary are considered to be **negligible**.

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