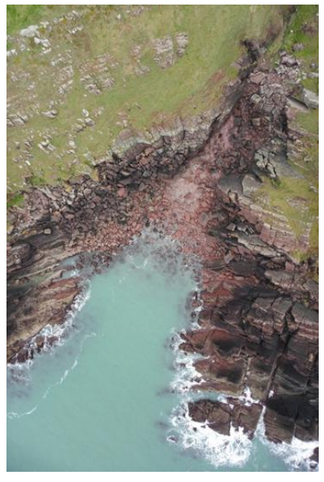
mWave Marine Energy Device and Onshore Infrastructure

HABITATS REGULATION ASSESSMENT



June 2019

No Significant Effect Report

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1.1 Introduction

1.1.1.1 This No Significant Effect Report (NSER) presents the findings from the Habitat Regulations Assessment (HRA) for the Wave Energy Converter and associated offshore and onshore infrastructure (mWave Project) which is to be located in Pembrokeshire, West Wales. The location of the Project and nearby Natura 2000 sites are shown on Figure 1.1. This NSER has been prepared with regard to the requirements of the Conservation (Natural Habitats &c.) Regulations 2010 (as amended), known as and referred to in this report as 'the Habitats Regulations'. This report comprises the Stage 1 (Screening) of the process as outlined in Section 1.3.

1.1.1.2 This report accompanies the applications for a Marine Licence (ML) from Natural Resources Wales Permitting Services (NRW-PS) for the offshore works to Mean High Water Spring and Town and County Planning Permission from Pembrokeshire Coast National Park Authority (PCNPA) for the onshore works to Mean Low Water (MLW). The Habitats Directive require the competent authority *'to make an appropriate assessment of the implications for that site in view of that site's conservation objectives'* before authorising a project likely to have a significant effect on a European site'. Whilst the project falls within two consenting processes, in this instance the competent authority for the mWave Project is NRW-PS, and they will consult with PCNPA during the process.

1.1.1.3 Guidance of the HRA assessment process is provided on NRW-PS website[1]. Here it is stated that the first test to be applied is whether the proposed project is likely to have a significant impact on the relevant European Site. If NRW-PS conclude that the work is likely to have a significant impact, they will carry out an Appropriate Assessment of the works to assess whether they will have an adverse impact on the integrity of the European Site. The website goes on to state that unless the conclusion is that there will be no adverse impact, the applicant will have to consider measures to mitigate any adverse effects. If appropriate and adequate mitigation measures are not possible, the project may only be consented if there is no alternative approach, that there are reasons of overriding public interest for it to proceed, and after a suitable compensation package has been agreed. Where an Appropriate Assessment is required under the Habitats Directive, the applicant must provide sufficient information to inform that assessment (further information is provided in Section 1.3.2).

1.1.1.4 The following document has been prepared to provide sufficient information to enable NRW-PS to undertake the process outlined above. The document has been prepared taking into account the Nationally Significant Infrastructure Project guidance on the HRA process which can be found in Planning Inspectorate Advice Note 10 (November 2017) (Section 1.3.2).

[1] https://naturalresources.wales/permits-and-permissions/marine-licensing/marine-licence-habitats-regulations-assessment/?lang=en

1.2 Background to the Project

1.2.1.1 Pembrokeshire Coastal Forum (PCF) and Marine Energy Wales (MEW) are developing a Marine Energy Testing Area (META) in West Wales which comprises eight marine test sites. Five of these test sites, where limited activities will be undertaken, are directly adjacent to Pembroke Port Infrastructure. The remaining three sites (Phase 2 sites) are within Milford Haven Waterway (Sites 6 and 7) and off East Pickard Bay (Site 8). These sites will be for the testing of a range of instrumentation as well as small and large scale marine energy devices over a fifteen year period. An Environmental Statement to assess the potential effects of the META project is required for these three sites due to their size and duration of use, along with their siting within a sensitive area. MEW, with support from RPS Energy Ltd, have prepared an Environmental Statement and Report to Inform Appropriate Assessment in support of the consents for the META project.

1.2.1.2 Originally, Bombora intended that the licensing and consenting of the mWave project would be undertaken within the consenting and licensing of the META project, with mWave being deployed within META Site 8 (East Pickard Bay) once consents for the META project as whole were in place and conditions discharged. However, due to the nature of the META project, which will facilitate testing of a variety of device types and sizes, and the timescales of Bombora's project and after detailed consultation with NRW-PS and MEW it was agreed that the most appropriate route would be for Bombora to submit separate applications for consent for the mWave project outside of the framework of the META project consenting in anticipation of a shorter determination period for the mWave project.

1.3 Habitats Regulation Assessment

1.3.1 Introduction

1.3.1.1 The Habitats Directive affords protection to European habitats and species designated under the Habitats Directive (Special Areas of Conservation (SACs)) and the Birds Directive (Special Protection Areas (SPAs)), collectively referred to as Natura 2000 or European sites. Under Article 6(3) of the Habitats Directive (EC Directive 92/43/EEC on the conservation of natural habitats and of wild flora and fauna). Competent Authorities have a duty to conduct HRA screening to assess whether any plan or project, which is not directly connected with or necessary to the management of a European site is likely to have a significant effect on such a site. This assessment is, either individually or in-combination with other plans and projects. Plans or projects adjacent, but not within a European site boundary will also undergo such a HRA screening.

1.3.1.2 Where potential impacts on a qualifying interest are identified through the screening process, further evaluation is undertaken to determine whether or not the Project (alone or in-combination with other Projects) will or will not have LSEs on the site taking into account appropriate mitigation. This will result in a conclusion of Likely Significant Effect (LSE) or no LSE. Where it is obvious that there is no connectivity or impact pathway between the Project and a designated site, it should be concluded that there is no LSE. No LSE should also be concluded for trivial effects (minor effects on qualifying interests that will not have a significant effect on a site) despite there being connectivity providing there is sufficient evidence to support this conclusion.

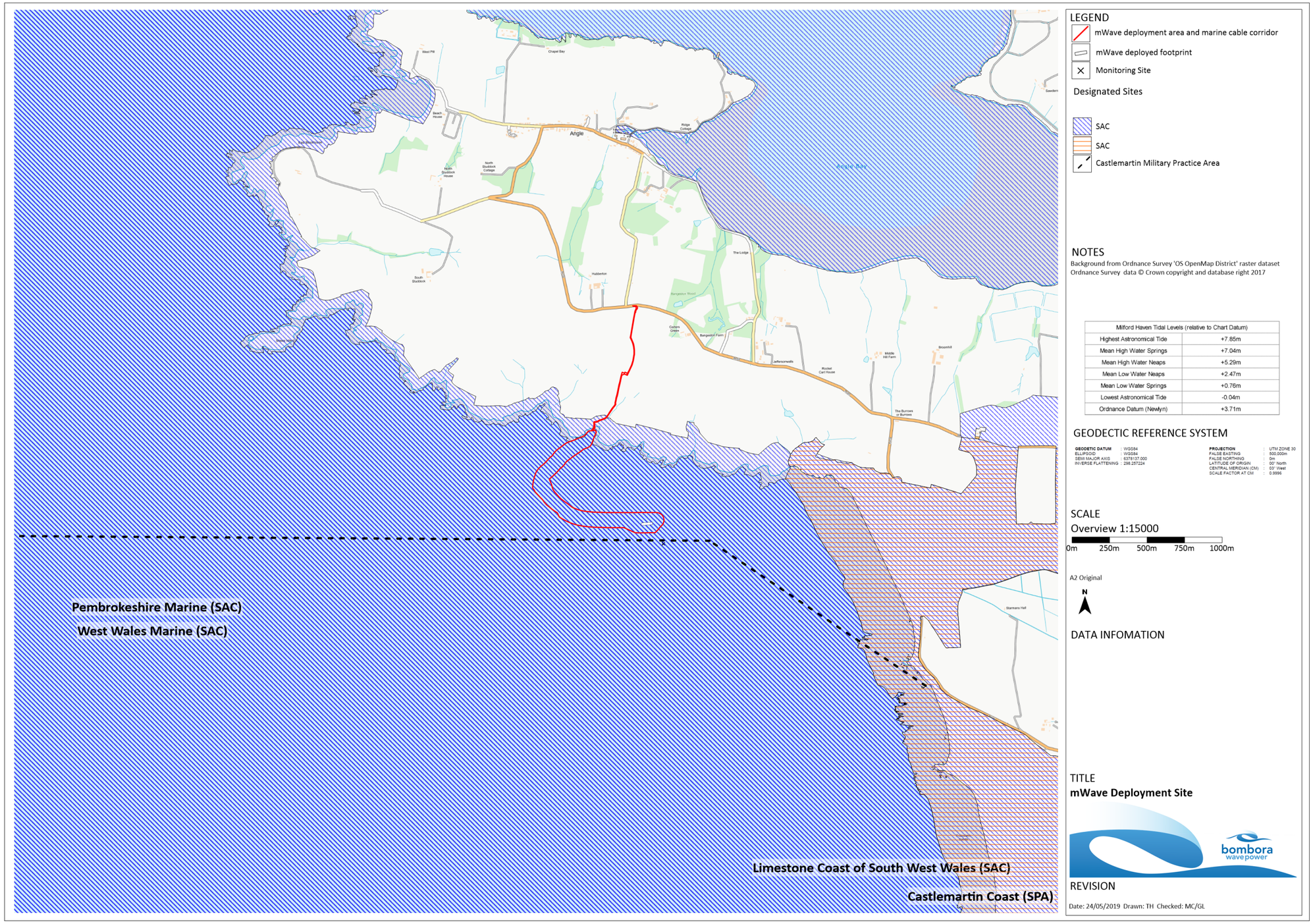


Figure 1.1 mWave Project and nearby designated sites

1.3.1.3 Where a project or plan may have a likely significant effect (LSE), or the effect is uncertain, the project shall be subject to an Appropriate Assessment of its implications for the European site in view of the site's conservation objectives, to determine whether the plan or project will have an adverse effect on the integrity of the European site. The Habitats Directive applies the precautionary principle to these sites and projects can only be permitted when it is ascertained that there will be no adverse effect on the integrity of the site(s) in question. Where adverse effects are identified a project may only be permitted in the absence of alternative solutions if there is an Imperative Reason of Overriding Public Interest (IROPI) for the project to go head.

1.3.1.4 The Habitats Directive is transposed in England and Wales by the Conservation of Habitats and Species Regulations 2017 which covers onshore areas and territorial waters (out to 12 nautical miles). In accordance with these Regulations, the effects of a project on the integrity of a European site are assessed and evaluated as part of the HRA process.

1.3.2 Habitats Regulation Assessment Stages

1.3.2.1 Although mWave is not a Nationally Significant Infrastructure Project, guidance on the HRA process can be found in Planning Inspectorate Advice Note 10 (November 2017). Here the guidance identifies that the HRA is a multi-stage process which helps determine Likely Significant Effects and (where appropriate) assesses adverse effects on the integrity of a European site. It goes on to clarify that the European guidance describes a four stage process to HRA, which can be summarised in a flow diagram. This flow diagram is provided below for ease of reference.

1.3.2.2 In consideration of the guidance provided above, and the fact that the Project is not directly connected with, or necessary for the management of a European site for nature conservation, the process identified in Figure 1.2 has been followed. Here the purpose will be to identify whether there is potential for the Project to have a LSE on any Natura site. As identified above, where there is no connectivity or impact pathway between the Project and a designated site or where the effect on qualifying interests is trivial such that it will not have a significant effect on a site, despite there being connectivity, providing that there is sufficient evidence to support a conclusion, a conclusion of no LSE will be made. For those sites where it cannot be concluded that there will be no LSE, an Appropriate Assessment is required.

1.3.2.3 The guidance goes on to state that there should be a continuous evaluation of the assessment findings against thresholds of LSE. If at any time during the process it is determined 'no significant effect (alone or in combination)' and no reasonable scientific doubt remains, then the assessment can be concluded. The Applicant should then provide the results of their assessment with the application in the form of a No Significant Effects Report (NSER).

1.3.2.4 Further information on the Screening of the mWave project is provided in Section 3.0.

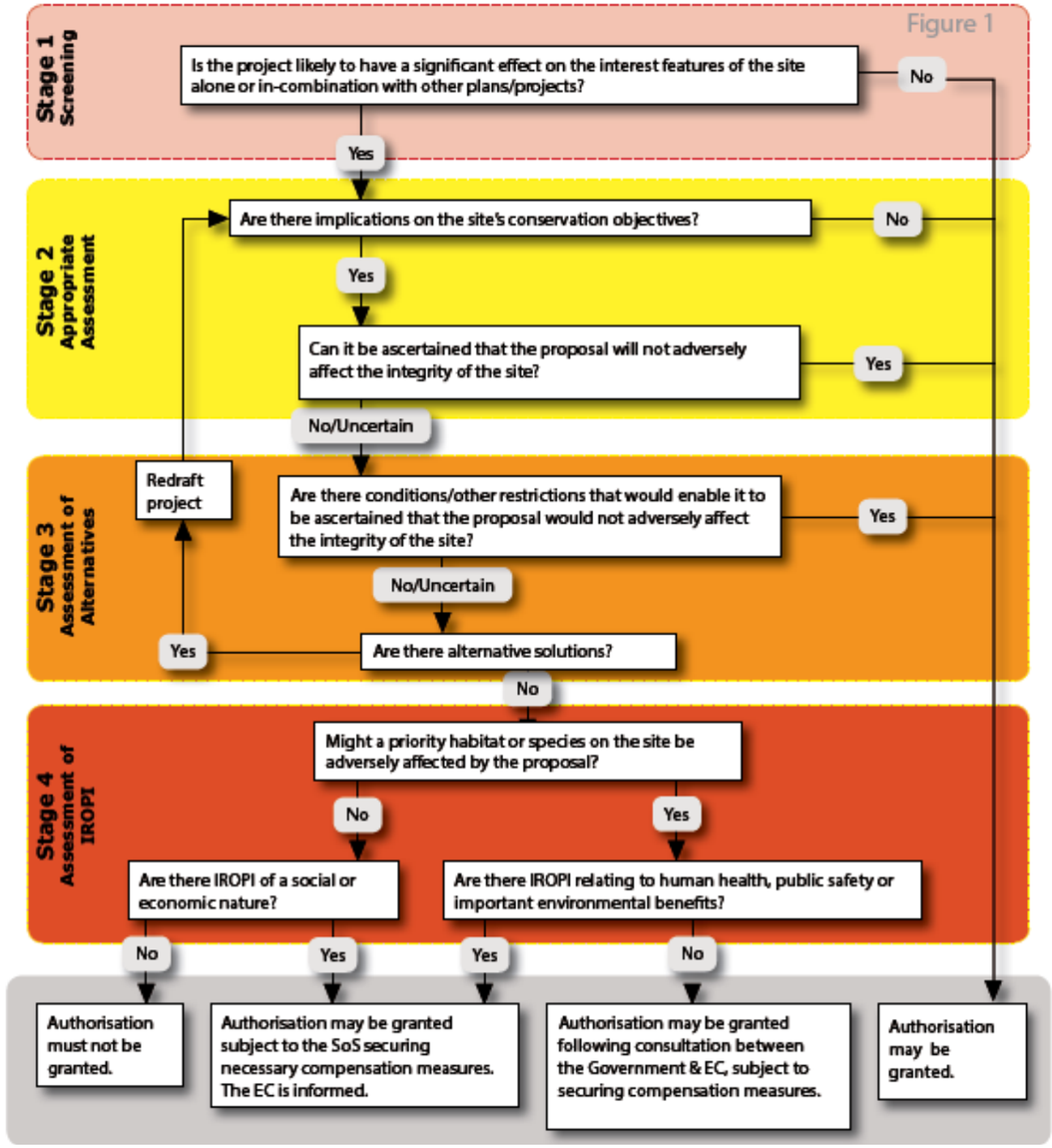


Figure 1.2 HRA flow diagram from 2017 Planning Inspectorate Guidance

2. Overview of mWave Project

2.1 Background to the Project

2.1.1.1 The mWave project comprises the installation, operation and decommissioning of a Wave Energy Converter (WEC) and associated onshore elements. The testing of mWave will be for 6 - 12 months, with decommissioning thereafter. The consent period is for up to 18 months, to allow for weather windows during the installation and decommissioning of the project. The offshore elements include mWave, a full scale WEC, a marine communication cable, an Acoustic Doppler Current Profiler (ADCP) monitoring device, Subsea Umbilical Termination Unit (SUTU) and navigation markers, if required. The onshore elements comprise the communication cable, termination box, onshore anchor points for the cable and a control station.

2.1.1.2 The following sections initially provide an overview of the local area, and then a brief overview of the Project starting with the offshore element, its installation, operation and decommissioning, followed by the onshore element, its installation, operation and decommissioning.

2.2 Existing Site and Surrounding Area

2.2.1.1 The marine element of the project will be located in the inshore waters of Pembrokeshire, south of the Angle Peninsula off East Pickard Bay. The site is some 2.5km south-east of Sheep Island, the southern extent of the Milford Haven Waterway, some 1.2km west of Freshwater West beach and is positioned offshore at approximately 750m below Mean High Water Spring (MHWS). The proposed deployment site off the Angle peninsula is exposed to a good wave resource benefiting from a significant fetch from the prevailing wind direction which is ideal for testing mWave.

2.2.1.2 The marine cable will make landfall at a rocky gully called East Pickard Bay before running in land to the control station. The control station site is situated on agricultural land which was formerly the south eastern extent of RAF Angle Airfield. It is approximately 500m from the B4320, 275m from the coastal footpath and 1.5km from the western extent of Freshwater West Beach. The nearest residential property is approximately 470m to the northeast. There is an existing gated access off the B4320 to a farm track which initially runs down between two fenced field boundaries to the site. The topography and existing vegetation provides some screening from all directions.

2.2.1.3 Part of the mWave Project lies within the Pembrokeshire Marine SAC and West Wales Marine SAC. The project is also near to Castlemartin Coast Special Protection Area (SPA) and the Limestone Coast of South West Wales SAC. The location of the project and relevant designations in the local area are shown in Figure 1.1.

2.3 Offshore element of Project

2.3.1 Overview of mWave and marine communication cable

2.3.1.1 The mWave is a full scale WEC prototype that sits on the seabed with four membrane covered air filled cells. The gravity base foundation means that there will be no requirement for moorings. As a wave passes overhead the device uses the change in water pressure to displace air in the membrane covered cells, the membranes inflate and deflate to move air within the device (Figure 2.1). At any instant, those cells with a higher pressure supply air to a high-pressure duct which then flows through the enclosed turbine and returns to low pressure cells. The turbine is enclosed to exclude water getting into the enclosed air system Through the air being pushed through the turbine by change in water pressure, electricity can be generated by the turbine. Note, during offshore testing of mWave electricity will not be exported.

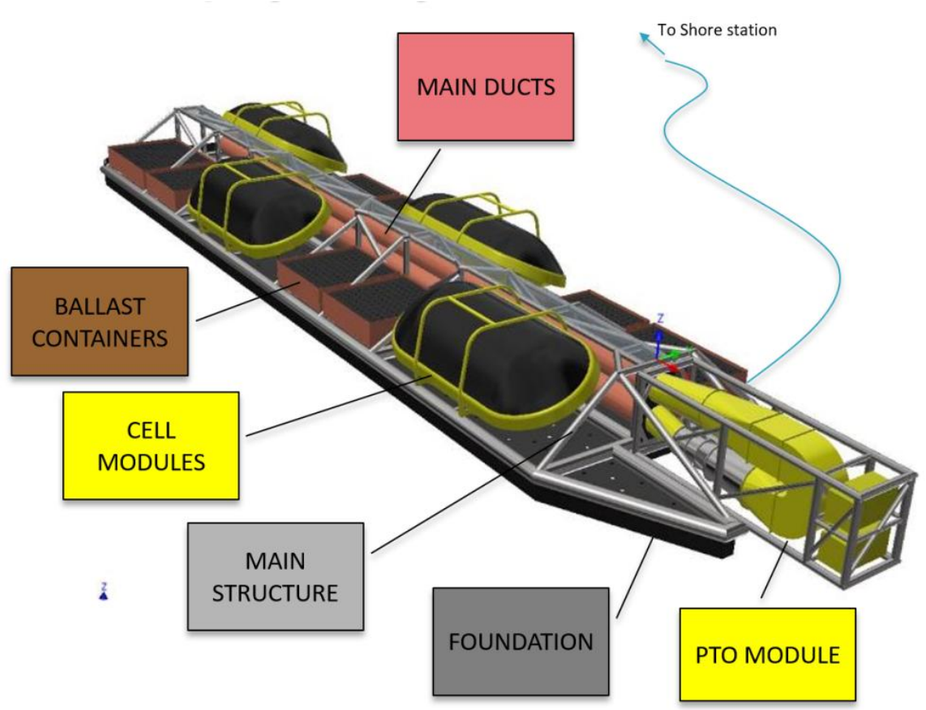


Figure 2.1 Key components of mWave

2.3.1.2 The mWave device has been designed with gravity foundations, so that installation will be relatively simple with no need for piles or anchoring points. The foundation of mWave comprises a keyed skirt that presses into the sand (Figure 2.2). The device is placed on the seabed and the penetration of the skirt into the sand up to 1m keeps the device in place throughout its deployment. The device contains ballast trays in the areas not occupied by cells and chain will be placed in the trays to add further weight to the device. Bathymetric survey of the seabed (Titan 2018) has confirmed that the area is relatively flat featureless sand. As such there will be no need for ground preparation work and the installation process will have minimal impact on the seabed.

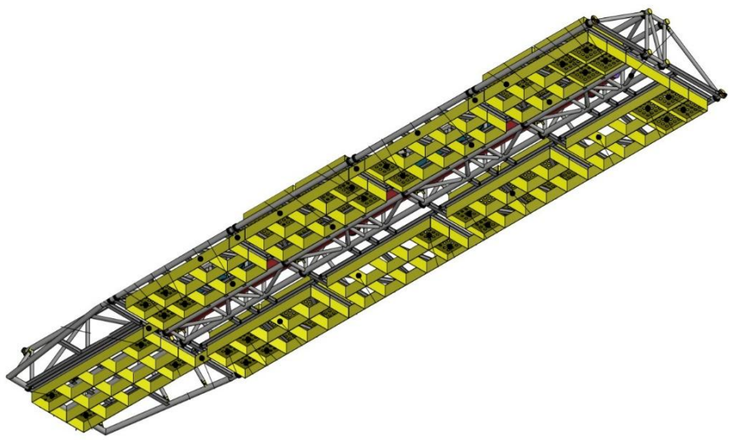


Figure 2.2 mWave gravity foundation

2.3.1.3 The physical size of the mWave structure is approximately 75m long (including the Power Take Off module (PTO)), 7m high and 15m wide at the base and approximately 17m wide across the widest section. The location for mWave will be 11m below Chart datum, which will provide a water clearance above the device of between 4.2m - 10.5m between MLWS and MHWS. An allowance for scour protection has been included in the project design and this along with an ADCP to monitor currents in the area, the SUTU connector and cable, gives a footprint of <1900m^2. Surface navigational markers, if required by navigational statutory stakeholders (MHPA, Trinity House, Maritime and Coast Guard (MCA)), will be used to identify the position of the mWave device on the seabed.

2.3.1.4 A communication cable will be connected to the PTO unit. The cable will be 150mm dimension and 1.4km long running to the landfall at East Pickard Bay (area of 210m^2), with a further 50m in the intertidal area and 350m onshore. As with the WEC the cable will be laid on the surface, across the sandy and then rocky substrate. Four rock bags will be used at intervals to hold the cable in on the sandy substrate place thereby minimising impacts. Details of the onshore cable route is given in section 2.4.

2.3.2 Overview of installation

2.3.2.1 Installation of mWave is relatively simple. Six moorings will be pre-installed on site a day or so in advance of installation with a span of up to 200m by 200m. Using the buoyancy of the air filled cells, mWave will be floated on the surface and towed by two vessels (50m with 6m draught), from the Port in the Waterway to the deployment site. Sufficient air will then be released from the cells for the device to be slowly lowered to the seabed on a winch. One end will be lowered and touch the seabed before the other end is lowered. Once on the seabed, ballast in the form of chain will be used to maintain the device position within trays on the seabed. After the initial mooring installation, will take up to three vessels 3 days to deploy mWave. A 200m advisory safety distance would be maintained during mWave deployment.

2.3.2.2 The cable will be laid on the surface of the seabed. It will take one vessel up to 3 days to lay the cable, and position rock bags. The cable laying vessel will be moored off East Pickard Bay. A winch cable will be attached from the onshore winch point and the cable floated ashore. Once secured the floats will be cut so that the cable rests on the seabed and the cable laying vessel will move offshore to lay the remainder of the cable.

2.3.3 Overview of Operation and Maintenance

2.3.3.1 As discussed above the WEC, mWave, will sit on the seabed, and it will comprise multiple seafloor-mounted, air-filled cells covered by flexible rubber membranes. Wave peaks and troughs above the mWave result in differential pressure across the membrane causing the membrane to inflate and deflate. At any instant, those cells with a higher pressure supply air to a high-pressure duct in the pneumatic circuit, via a set of non-return cell outlet valves. This high-pressure air flows through the enclosed turbine and returns to low pressure cells, via a low-pressure manifold and non-return inlet valves. The turbine is enclosed so that water does not get into the enclosed air system. Through the air being pushed through the turbine by change in water pressure, electricity can be generated by the turbine. As such whilst mWave is a WEC it is not of the conventional type, using the movement of air instead of movement of the device itself to generate electricity. The mWave project will be the first deployment of the full scale device and as such noise data is not available. Noise data is available for other WEC, but there are a number of factors which mean that the operating noise from mWave is likely to be lower than conventional WEC devices. Further information on operational noise can be found in Chapter 6: Underwater Noise.

2.3.3.2 The WEC will be tested over a 6-12month period, with normal operation requiring no offshore intervention. During the testing period offshore O&M activities will be undertaken approximately once per month which will comprise routine inspection and scheduled maintenance. A specialist barge or module intervention tool (MIT) will be towed to site using a working class Multicat. A RIB will also be on site to handle lines and act as a guard boat. Once the MIT device is in place, a cell or PTO can be lifted out of the main structure (Figure 2.9) and a replacement cell or PTO lowered in place. During this operation the main mWave structure remains on the seabed so there is no disturbance to the seabed. In total it is predicted that there will be 76 vessel trips during a 12 month period, comprising 3 vessels visiting once a month for a 2 days. A 200m advisory safety distance would be maintained during major O&M activity. There will be no O&M requirements for the cable. Data from the ADCP will be transmitted onshore via the communication cable.

2.3.3.3 Whilst a sandy site is required for the gravity foundations, scour may occur around the edges of mWave through localised tidal currents, in particular during storm events. Further assessment of scour is provided in Chapter 5: Coastal Processes and, whilst scour protection is not anticipated to be required, an allowance for the installation of rock has been included in the assessments undertaken for the project. A video camera will be positioned on the device and it will monitor the scour during operation. Time and date stamped photos will be taken of a gauge painted onto the device to allow assessment of change in sediment depth during operation. If monitoring indicates that scour protection is needed rock will be brought to site contained in bags which can be removed at the end of the deployment period, unless leaving in situ is deemed to be lower impact. Each rock bag would contain up to five tonnes of rock, with a diameter of up to 2m. Rock bags would be deployed around the device,

this amount of scour protection would equate to 100 rock bags which is equivalent to 500 tonnes. It is estimated to take up to 10 vessel trips over a five day period to deploy this volume of rock.

2.3.4 Overview of Decommissioning

2.3.4.1 Decommissioning of the offshore mWave device and marine cable will be undertaken after the short term deployment of up to 18 months. The decommissioning of the marine device, navigational marker (if required) and temporary communication cable will be the reverse of the installation, it is proposed that the Marine Licence includes this phase of the Project.

2.3.4.2 Similarly, the removal of the onshore cable and temporary onshore control station will also be the reverse of the installation process.

2.4 Onshore element of Project

2.4.1.1 As discussed above the temporary onshore elements of the project comprise the control station and the cable which will provide communication, air and auxiliary power to support testing.

2.4.1.2 The cable will be 150mm diameter and there will be approximately 50m in the intertidal section and approximately 350m from Mean High Water Springs (MHWS) to the control station. From the landfall at East Pickard Bay a small section of lower intertidal area would be crossed before the cable is taken up the vertical western side of the gully to the cliff top. The cable will be within a plastic conduit that is fixed to the rock surface using clamps. A termination box and an anchor point (to take the strain of any cable movement from the tides) will be located at the top of the cliff. The cable would then be laid on the ground (for about 350m) along field boundaries to the control station. The control station, which will be located on agricultural land, comprises three shipping containers, each 20-23ft by 8ft by 8ft, a 1m Wifi antenna (15cm^2), a chemical toilet and bunded fuel tank. Parking for three cars will be provided (Figure 2.3).

Figure 2.3 Location and provisional layout of temporary control station with site access

2.4.2 Overview of installation

2.4.2.1 As discussed above the cable will be attached to the onshore winch system and brought onshore. The end of the cable then be pulled out of the gully to the termination box and anchor point, using two hand propelled winches and two temporary anchor points. The attachment of the clamps to the rock, which will take the conduit, will be undertaken using hand held tools only. In order to lay the cable between the termination box and the control station, a roll of cable will be brought to site on a trailer using a 4WD vehicle. The vehicle will position itself within agricultural fields as close to the gully as possible. One end of the cable will then be pulled off the drum down to the termination box. Once secured, the 4WD vehicle will work its way back up the agricultural fields to the control station allowing the cable to be laid along the required field boundaries. The cable will also need to cross the Wales Coast Path, which will be achieved close to an existing gate on the path (in consultation with PCNPA).

2.4.2.2 At the control station site, limited ground preparation works using a wheeled digger and delivery of 2 lorries of stone, will be required prior to installation of the control station. Delivery and installation of control station units will require three trips by a lorry with HIAB which would occur over 2-3 days, depending on availability. The chemical toilet and bunded fuel store will also be delivered to site.

2.4.2.3 It is anticipated that it will take approximately 6 days for pre-cable pull works which includes installing the clamps/conduit and anchor points using up to four personnel with hand-held tools. It will take approximately three days to set up and pull the cable onshore across the intertidal area and connect to the termination box. Preparation and installation of the control station will take place over roughly a 2 week interval.

2.4.3 Overview of Operation and Maintenance

2.4.3.1 During operation, it is anticipated that a generator and a compressor will be located at the control station. The generator will be used to drive the compressor and it will operate approximately 3hrs in every 6hr period, with timing linked to the tidal height. The generator and compressor will be secured in sound proof enclosures, where needed.

2.4.3.2 The mWave is designed to run autonomously with minimum human intervention so site visits will be kept to a minimum. Staff visits will be typically up to two vehicles once per week during the daytime, although initially visits will be more frequent, eg staff visits every working day for two months. A lorry will be required to deliver fuel for the operation of the generator and compressor approximately at fortnightly intervals. All staff and delivery vehicles will use the farm track and will park by the control station, away from the main road. There will be no external lighting at the control station and there is no maintenance required for the cable.

2.4.4 Overview of Decommissioning

2.4.4.1 Subsequent to completion of the project, the control station and cable will be removed. It is anticipated that decommissioning of the site will be similar to installation. An HGV with mounted crane would be used to remove the control station units. The cable from the termination box to the control station would be pulled landward and taken off site by road. The cable from the termination box out to sea would be pulled offshore by a cable vessels and taken off site.

2.4.5 Embedded Mitigation

2.4.5.1 As part of the project design process, a number of designed-in measures have been proposed to reduce the potential for impacts on a range of receptors. Key ones are identified below and a full list can be found in Chapter 2: Project Description.

Table 2.1 Embedded Mitigation

Measures adopted as part of the mWave project	Justification
Deployment site located on flat sand substrate and cable route along area of low diversity.	Minimises potential impact on sensitive habitats such as Annex I reef.
Flat sandy seabed. No requirement for seabed preparation in advance of deployment.	Minimises disturbance during installation, potential for increased suspended sediments and noise.
Gravity foundation, simple installation, requires no moorings.	Minimises potential for collision, disturbance from noise and suspended sediments.
Cable laid on surface and not trenched offshore and onshore.	Minimises disturbance during installation and potential for suspended sediments and disturbance to ecology onshore.
Deployment of mWave on seabed with limited vessel activity during installation and operation.	Minimises potential for collision and pollution incidents.
No external moving parts which may cause impact to marine life (only the membranes at the top of the device inflating and deflating to move air within the device)	Minimises potential for collision and impact on marine ecology.
Due to design (no moorings which create noise or cavitation noise due to mWave operating in air at subsonic speeds) noise levels are anticipated to be lower than conventional WEC.	WEC design will minimise potential for noise. In addition, gravity foundation with no need for mooring lines reduces noise.
Site selection process for onshore control station and cable route.	Onshore cable route and control station site selected to minimise potential impact on ecological features including protected species.
EMP - Environmental Management Plan. The Environmental Management Plan (EMP) will cover both the offshore and onshore elements of the project.	The marine section of EMP will include planning for accidental spills, including measures to reduce the risk of an incident. In addition to this it will include an Invasive Non Native Species (INNS) assessment using NRW-PS Biosecurity Risk Assessment. The onshore element will present the procedures agreed with PCNPA with regard to works in proximity to the coastal path.
EMMP - Environmental Monitoring and Mitigation Plan. The EMMP will cover both the offshore and onshore elements of the project.	Linked closely to the EMP, this document will provide details of any requirements identified within this chapter to minimise potential effects on ecology prior to installation, as well as any recommended monitoring.

3. Proposed mWave approach to HRA

3.1 Consultation

3.1.1.1 As discussed in Section 1.2 Background to the Project, the licensing and consenting of the mWave project was originally intended to be undertaken within the consenting and licensing of the Marine Energy Wales META project with mWave being deployed at the eastern end of META Site 8 (East Pickard Bay). Whilst the mWave device is short term and of limited extent compared to the META project, the HRA Screening information for the META Site 8 and has been used as a baseline in the following document to ensure consistency of information across the two projects which are likely to be in the consenting process at the same time. In addition consultation was undertaken on META Site 8 project, which also included the mWave communication cable route and the mWave device. A summary of the key issues raised during consultation specific to HRA process at Site 8 and the mWave project, is provided in Table 3.1, along with feedback with respect to the mWave project.

3.2 Stage 1 Screening

3.2.1.1 In order to undertake stage 1 screening for the project a list of Natura sites which have the potential to be directly or indirectly affected by the Project have been identified taking into consideration consultation responses. The sites have been identified using a source-pathway-receptor approach to help identify susceptibility to *Likely Significant Effects*. For each Natura site the distance from the mWave project is provided and the relevant qualifying features are identified. For marine ornithological receptors within SPAs, only those species which are within potential foraging range based on Thaxter *et al.* (2012) have been identified.

3.2.1.2 Subsequent to identifying all of the Sites and features, a project specific review of receptors has been provided (section 5). The review has been based on the information provided in the Environmental Statement (Bombora, 2019) in support of the marine licence and onshore planning application. The results of the assessment will be used to determine if there is likely to be a significant effect as undertaken in Section 6. Where no LSE is determined, a conclusion of no LSE will be made and no further assessment of the feature will be undertaken.

3.2.1.3 In addition to this, further evaluation has also been undertaken to determine whether or not the Project in-combination with other Projects will or will not have LSEs on the site. Due to the scale of the mWave project (both spatially and temporally) the projects identified for in-combination effects will be those assessed within the Environmental Statement.

3.2.1.4 For those features, where it is not possible to conclude no LSE due to lack of detailed information or uncertainty, Appropriate Assessment will be undertaken as per Stage 2 in Figure 1.2.

3.3 Cumulative Effects Assessment for the Project and other Projects and Plans

3.3.1.1 The Cumulative Impact Assessment (CIA) takes into account the impact associated with the mWave project (as identified above) together with other projects and plans. Due to the nature and scale of the mWave project the projects and plans selected as relevant to the CIA are those identified as part of the EIA process and reported in the Environmental Statement in Chapter 4: Environmental Assessment Methodology.

3.3.1.2 In undertaking the CIA for the mWave project, it is important to bear in mind that other projects and plans under consideration will have differing potential for proceeding to an operational stage and hence a differing potential to ultimately contribute to a cumulative impact alongside the mWave project. For example, relevant projects and plans that are already under construction are likely to contribute to cumulative impact (providing effect or spatial pathways exist), whereas projects and plans not yet approved or not yet submitted are unlikely to contribute to such an impact, due to the short duration of the mWave project (18 months). The Projects which have been included in the CIA are presented in Appendix A, Table A and are shown in Figure A.

Table 3.1: Summary of consultation with NRW on the HRA Screening and EIA Scoping Reports prepared for META Project, and relevant to mWave.

Receptor	Consultee and type/method of consultation	Date	Issue raised	How/where dealt with in the NSER
Benthic ecology	Pre-application advice	10 January 2019	The East Pickard Bay site (META Site 8) boundary should be revised to avoid the designated reef feature and instead focus the area on sand substrate only. Drop-down camera surveys are proposed for the cable route which we consider will be sufficient for micro siting of the cable lay.	On the basis of NRW's advice, the boundary of the META Site 8 has been revised to avoid the designated reef feature. mWave is located on sandy substrate at the south eastern end of META Site 8. Site survey has confirmed this habitat at the mWave deployment location. Drop-down camera survey has been undertaken of the communication cable route for mWave. Information from this survey has been used to inform the assessment of the effects of the project - see below.
Benthic ecology	NRW a. Response to META HRA Screening Report.	28 Feb 2019.	The potential for temporary habitat disturbance to Annex I 'Reef' feature during META installation and retrieval activities should also include disturbance arising from marine cable installation and removal at East Pickard Bay.	The consideration of potential effect from the installation and removal of the cable has been presented in section 5.2.1. The assessment was supported by site-specific survey. The results of the DDV survey (Aquatic Survey and Monitoring Ltd 2019) confirmed that the habitats and communities across the bedrock reef at East Pickard Bay were relatively low in diversity compared to many other areas around Pembrokeshire, due to the effects of scour and siltation. No species or features of notable marine nature conservation importance were found and none of the habitats and species seen are considered especially vulnerable or sensitive to the expected physical effects of the cable deployment, presence or retrieval
Diadromous fish	NRWa. Response to META HRA Screening Report.	28 Feb 2019.	In the META EIA scoping report it was noted that the impacts to be scoped into the EIA for fish include: Temporary habitat disturbance, Temporary increases in suspended sediment, Sediment deposition. We consider that if these potential impact pathways are to be scoped into the EIA then they should also not be screened out of the HRA. Long term habitat loss should not be screened out.	Consideration of fish is provided in Section 5.3.10.
			Typical species of the estuary habitat feature of Pembrokeshire Marine SAC should also be considered. This includes Atlantic herring which are known to spawn within the Milford Haven Waterway. In particular, there is a known spawning ground at Burton Point within close proximity to the Warrior Way test area. David Clarke of SEACAMS can provide more information on the location of these areas.	mWave is remote from the Waterway and as such there will be no LSE from the project on species associated with the estuary habitat feature of Pembrokeshire Marine SAC. No further consideration is proposed.
Marine mammals and otters	NRWa. Response to META HRA Screening Report.	28 Feb 2019.	We recommend that the relevant marine mammal management unit (MU) is used as the spatial scale for screening. If potential impact pathways are identified for a marine mammal Annex II feature, then all sites with that feature within the relevant MU for that species should be screened in for assessment.	It is considered that as that the regional marine mammal study area outlined in Chapter 9: Marine Mammals of the Environmental Statement, which uses a 100 km zone for inclusion/consideration of SACs, is conservative with respect to the potential effects arising from mWave as standalone and in combination. See section 5.3.9 for consideration of marine mammals.
			The META site is within the Celtic and Irish Seas MU for harbour porpoise. All of the SACs with harbour porpoise as a feature should therefore be considered in the assessment. We recommend that North Anglesey Marine SAC is considered in the same way as the other harbour porpoise SACs. The impact pathways, and conclusions of LSE would be the same for this site as with the other sites.	
			For the harbour porpoise features of the West Wales Marine SAC and Bristol Channel Approaches SAC we consider that it is not appropriate to rule out a potential LSE from underwater noise associated with tidal turbine operation and from pile drilling.	There will be no turbine operation or pile drilling associated with the mWave project and as such underwater noise during operation and as such there will be no LSE from the project on harbour porpoise. See Section 5.3.9 for further information.
			For the Cardigan Bay SAC and Pen Llyn a'r Sarnau SAC, we agree with the conclusion of no LSE on the bottlenose dolphin features of both SACs.	Noted
			For the grey seal feature of the Pembrokeshire Marine SAC, we consider that it is not appropriate to rule out a potential LSE from operational noise from tidal turbines operation and from pile drilling.	There will be no turbine operation or pile drilling associated with the mWave project and as such underwater noise during operation and as such there will be no LSE from the project on Grey Seal. See Section 5.3.8 for further information.
			For the grey seal feature of the Cardigan Bay SAC and Pen Llyn a'r Sarnau SAC, we disagree with the conclusions of no LSE from 'Disturbance from installation noise' and 'Disturbance from underwater noise resulting from device operation'.	
			Changes to hydrodynamics resulting in potential impairment of foraging opportunities for marine mammals should be included.	Effects associated with changes to the hydrodynamic regime have been considered within this NSER. See Section 5.3.9 for further information.
	NRW –PS/ MMO. Response to META EIA Scoping Report.	28 March 2019.	Consideration must be given to all marine mammal SACs within the relevant management unit. While most sites have been included in the assessment, for completeness the assessment should also list North Anglesey Marine SAC. Potential impacts should be considered on harbour porpoise from all 3 SACs within the management unit.	It is considered that as the regional marine mammal study area outlined in Chapter 9: Marine Mammals of the Environmental Statement, which uses a 100 km zone for inclusion/consideration of SACs, is conservative with respect to the potential effects arising from mWave as standalone or in combination. See section 5.3.9 for consideration of marine mammals.
Marine ornithology	NRWa. Response to META HRA Screening Report.	28 Feb 2019.	We consider that the correct ornithological sites and features have been screened into the assessment and agree with the methodology used.	Noted.
			Impacts of lighting on devices should also be considered	mWave will sit on the seabed with a minimum of 4.2m of water cover at MLWS, which is good clearance for the type of vessels which are present in the waters off East Pickard Bay. As such the need for navigational marking will be discussed and agreed with MCA and TH. It is anticipated if any navigational marking is required, with or without lighting, this will be minimal and there will be no LSE from its presence. In terms of the onshore control station, no external night time lighting is proposed. No further consideration is proposed.
	NRW -PS/MMO. Response to META EIA Scoping Report.	28 March 2019.	The list of species and designated sites to assess should be updated to include all sites for which the foraging range of their designated feature intersects the proposed site boundaries. This includes Carmarthen Bay / Bae Caerfyrddin SPA (designated for wintering common scoter), Northern Cardigan Bay / Gogledd Bae Ceredigion SPA (designated for wintering red-throated diver).	A screening of species has been included in Table 4.1 using the potential foraging range based on Thaxter *et al.* (2012). Further information is provided in Section 5.3.11.

4. Receptors associated with Natura 2000 sites

4.1.1.1 Section 2 above (Overview of mWave Project) sets out the source of potential impacts associated with the mWave project. For instance, the installation, operation and decommissioning of the device itself will entail boat traffic, disturbance of the marine and benthic environment as well as the potential for pollution, should an incident occur. Deployment of the communication cable as well as installation of the control station will entail physical impact to marine, intertidal and terrestrial environments as well as disturbance caused by presence of individuals and site plant.

4.1.1.2 The significance of particular impacts will depend on a variety of factors. For instance, underwater noise generated by the enclosed mWave turbine may have the potential to cause hearing damage or disturbance to marine mammals. However, the likelihood of damage occurring will depend on factors such as noise levels generated, sensitivity of potential receptors, as well as the frequency and proximity that receptors get to the potential injury zone.

4.1.1.3 In order to facilitate the source-pathway-receptor approach, receptors associated with nearby Natura 2000 sites are identified and characterised to help identify susceptibility to *Likely Significant Effects*. The following Natura sites occur in proximity to the project.

Table 4.1 Receptors associated with Natura 2000 sites.

Designated Site	Distance to terrestrial ecology study area (km)	Relevant Qualifying Interest Feature
Special Areas of Conservation		
Pembrokeshire Marine/ Sir Benfro Forol SAC	0	The third largest UK marine SAC, covering an area of 138,069 ha and supporting eight Annex I habitats and seven Annex II species. Annex 1 habitats forming the primary reason for site selection include: • Estuaries; • Large shallow inlets and bays; and • Reefs. Annex 1 habitats forming qualifying features include: Sandbanks which are slightly covered by seawater all the time; Mudflats and sandflats not covered by seawater at low tide; Coastal lagoons (Priority feature); Atlantic salt meadows (*Glauco-Puccinellietalia maritimae*); and Submerged or partially submerged sea caves. Annex II species forming the primary reason for site selection include: • Grey seal (*Halichoerus grypus*); and • Shore dock (*Rumex rupestris*). Annex II species forming qualifying features include: Sea lamprey (*Petromyzon marinus*); River lamprey (*Lampetra fluviatilis*); Allis shad (*Alosa alosa*); Twaite shad (*Alosa fallax*); and Otter (*Lutra lutra*).
West Wales Marine/Gorllewin Cymru Forol SAC	0	Harbour porpoise *Phocoena phocoena*
Limestone Coast of South West Wales / Arfordir Calchfaen de Orllewin Cymru SAC	1.1	The site is comprised of carboniferous limestone sea-cliffs in exposed and sheltered elevations. The SAC stretches from Castlemartin in Pembrokeshire to the Bishopston Valley on Gower. Annex I habitats forming the primary reason for site selection include: • Vegetated sea cliffs of the Atlantic and Baltic coasts; and • Fixed coastal dunes with herbaceous vegetation (grey dunes); Annex I habitats forming qualifying features include: European dry heaths; Semi-natural dry grasslands and scrubland facies on calcareous substrates (Festuco-Brometalia) (*important orchid sites); Caves not open to the public; and Submerged or partially submerged sea caves. Annex II species forming the primary reason for site selection include: • Greater horseshoe bat (*Rhinolophus ferrumequinum*); and • Early gentian (*Gentianella anglica*). Annex II species forming qualifying features include: Petalwort (*Petalophyllum ralfsii*).
Cleddau Rivers / Afonydd Cleddau SAC	17	A site consisting of two large river catchments noted for: Watercourses of plain to montane levels with the *Ranunculion fluitantis* and *Callitricho-Batrachion* vegetation; Active raised bogs; and Alluvial forests with *Alnus glutinosa* and *Fraxinus excelsior*. Annex II species forming the primary reason for site selection include: Brook lamprey (*Lampetra planeri*); River lamprey (*Lampetra fluviatilis*); Bullhead (*Cottus gobio*); and Otter (*Lutra lutra*). Annex II species forming qualifying features include: Sea lamprey (*Petromyzon marinus*).
Pembrokeshire Bat Sites and Bosherston Lakes / Safleoedd Ystlum Sir Benfro a Llynnoedd Bosherston SAC	8.95	The site is focussed on habitats and species associated with eight sites centred around the National Trust owned Stackpole Estate. In particular, the site encompasses the shallow marl lake system of Bosherston Lakes (created by damming and drowning three valleys in the Carboniferous Limestone during the late 18th and mid-19th Century) as well as important bat roosts. Annex I habitats forming the primary reason for site selection include: • Hard oligo-mesotrophic waters with benthic vegetation of Chara spp. Annex II species forming the primary reason for site selection include: • Greater horseshoe bat (*Rhinolophus ferrumequinum*). Annex II species forming qualifying features include: Lesser horseshoe bat (*Rhinolophus hipposideros*); and Otter (*Lutra lutra*).
Special Protection Areas		Species which are within potential foraging range based on Thaxter *et al.* (2012)
Castlemartin Coast	1.1	Carboniferous limestone rocky coastline of geological and biological interest. The site supports exposed cliff communities, species-rich maritime grasslands, maritime heath and scrub. In particular the coastline is known for its breeding and over-wintering population of Chough (P*yrrhocorax pyrrhocorax)*, an Annex I species of European importance.
Skomer, Skokholm and the seas off Pembrokeshire/ Sgomer, Sgogwm a Moroedd Penfro SPA	8	Atlantic puffin *Fratercula arctica,* European storm petrel *Hydrobates pelagicus,* Lesser blac backed gull *Larus fuscus,* Manx shearwater *Puffinus puffinus,* Razorbill *Alca torda*, Comm guillemot *Uria aalge,* Black-legged kittiwake *Rissa tridactyla*
Grassholm SPA	23	Gannet *Morus bassanus*
Aberdaron Coast and Bardsey Island/Glannau Aberdaron ac Ynys Enlli SPA	121	Manx shearwater *Puffinus puffinus*
Saltee Islands SPA	113	Fulmar *Fulmarus glacialis*
Irish Sea Front SPA	216	Manx shearwater *Puffinus puffinus*
Lambay Island SPA	210	Fulmar *Fulmarus glacialis*

Figure 1.1, previously, and Figures 4.1 to 4.3 provide an overview of the various designated sites in relation to the mWave project.

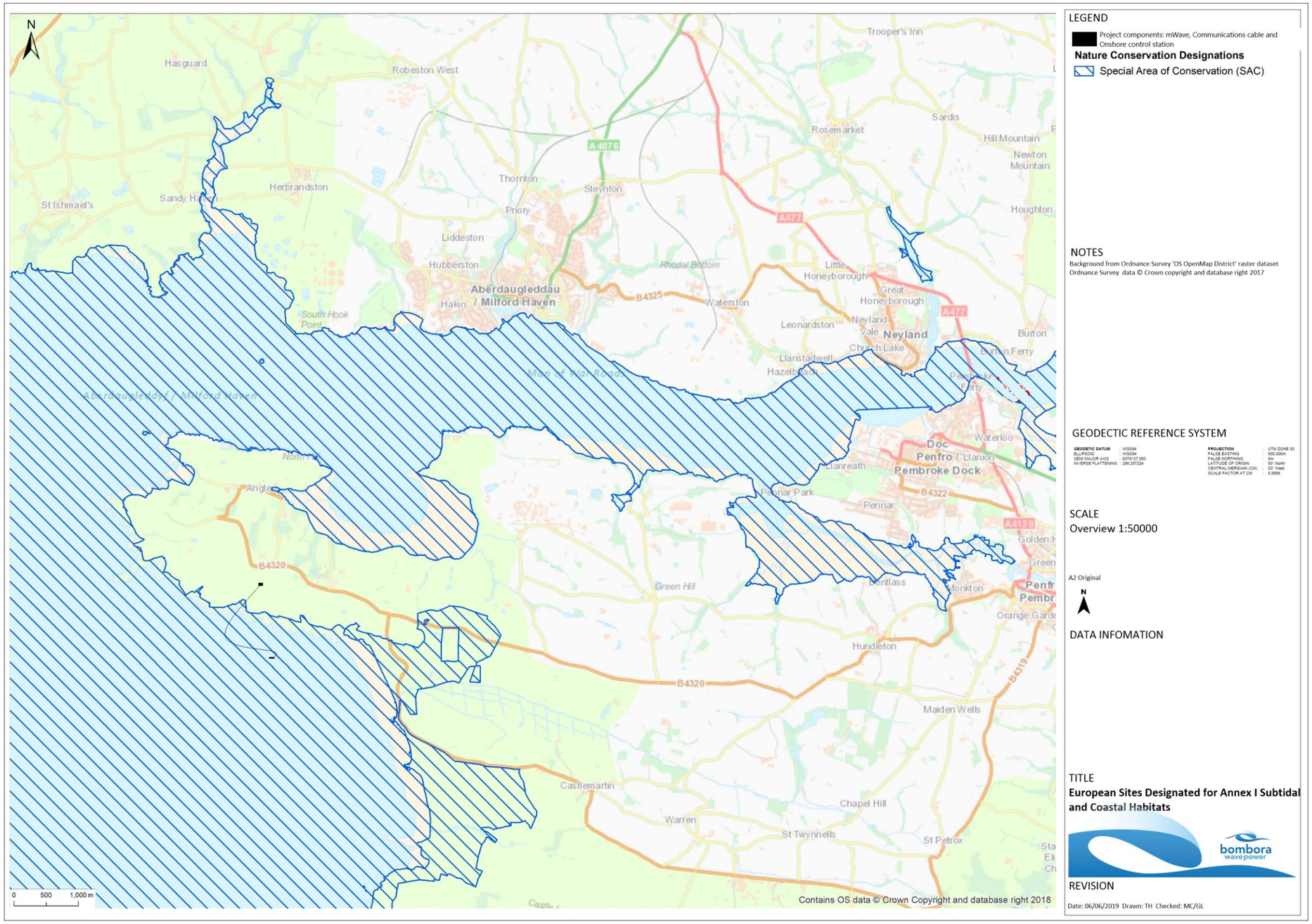


Figure 4.1 European sites designated for Annex I Subtidal and coastal habitats

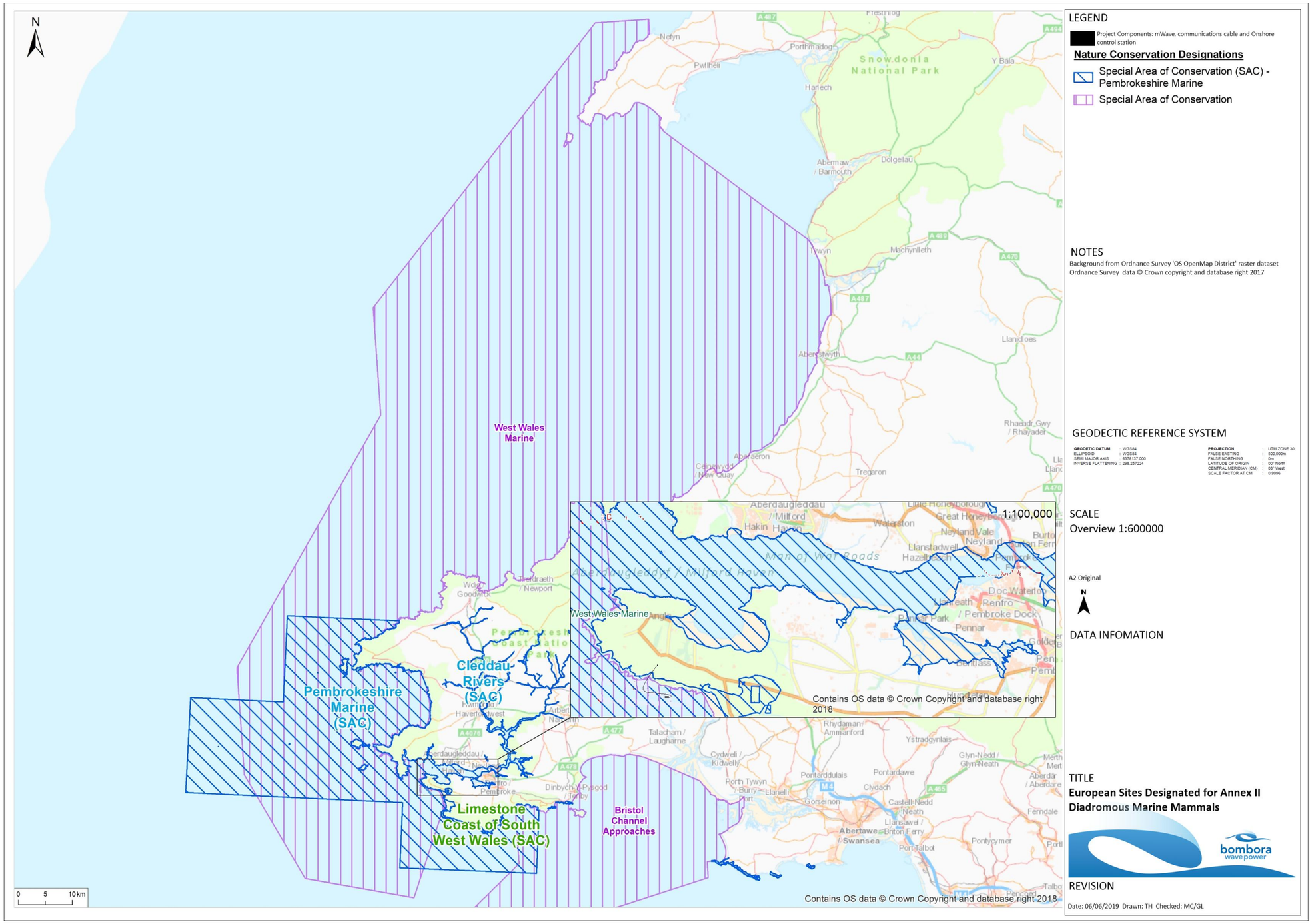


Figure 4.2 Designated sites for Marine Mammals

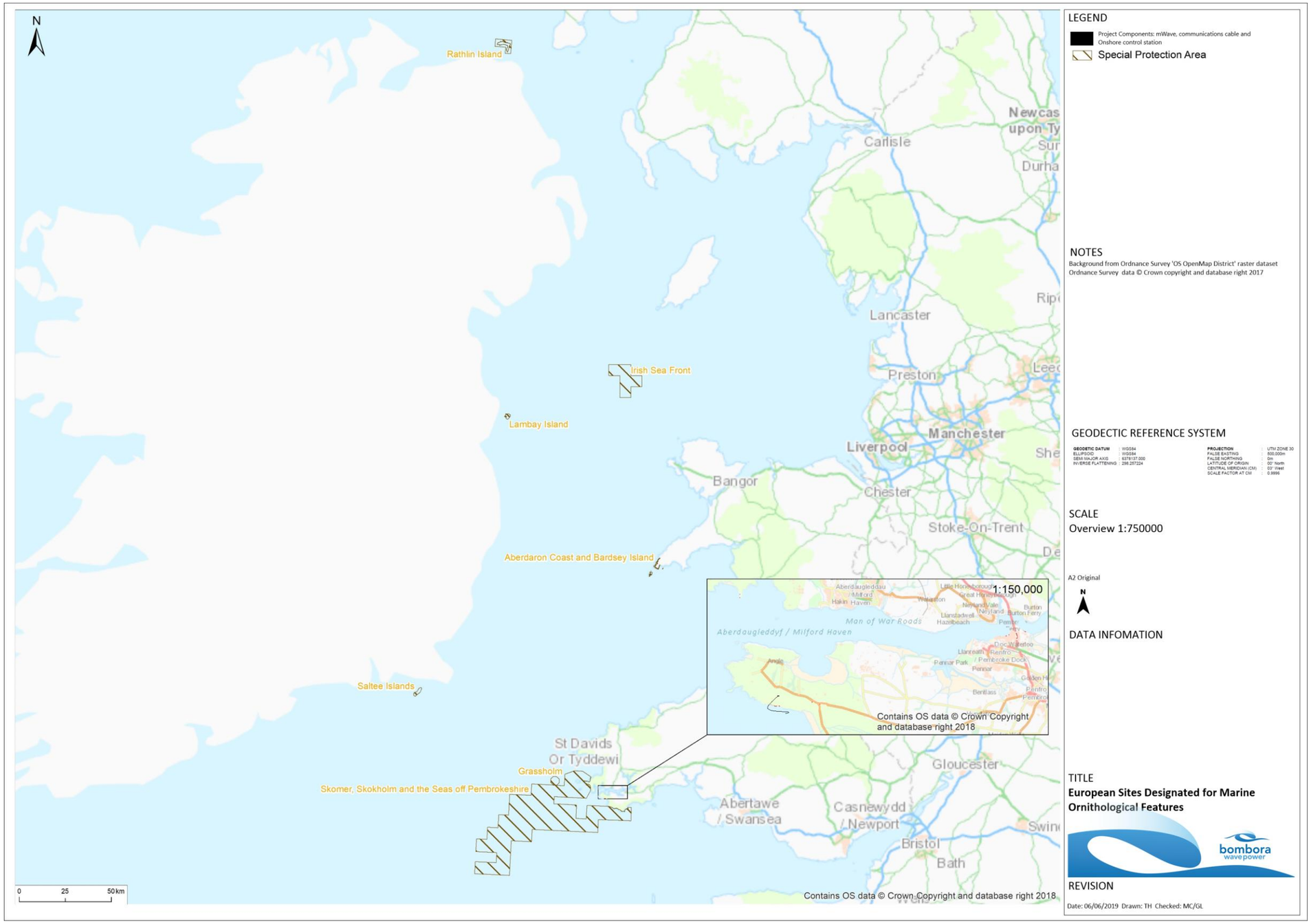


Figure 4.3 Designated sites for Ornithological Features

5. Review of receptors associated with Natura 2000 sites

5.1 Overview of Natura 2000 habitats

5.1.1.1 The mWave device will be located off the south Angle Peninsula as shown in Figure 1.1. It is located distant from the following Annex I habitats forming the primary reason for site selection and the following qualifying features, and as such there is no receptor-impact pathway:

- Estuaries;
- Large shallow inlets and bays;
- Sandbanks which are slightly covered by seawater all the time;
- Mudflats and sandflats not covered by seawater at low tide;
- Coastal lagoons (Priority feature); Atlantic salt meadows (*Glauco-Puccinellietalia maritimae)*; and Submerged or partially submerged sea caves.

5.2 Habitats

5.2.1 Annex I subtidal and intertidal reef

5.2.1.1 As identified in Table 3.1 during consultation on the META Project advice was provided by NRWa as to the boundary of Site 8, East Pickard Bay, in relation to Annex I reef habitat. As a result of this consultation the boundary of Site 8 was modified, with a portion of the northern edge being removed, such that it did not affect possible Annex I Reef Habitat. Figure 4.4 illustrates the modified Site 8 boundary and the extent of possible Annex I reef. Bathymetric survey (Titan 2018) confirmed that the mWave device will be positioned on an expanse of circalittoral coarse sediments remote from Annex I reef habitat, as shown on Figure 4.4. The bathymetric survey covered an area of approximately 2km in an east west direction which included a significant proportion of the META Site 8 area. In addition to this a preliminary review of the SEACAMS multibeam backscatter data for undertaken for the META Site 8 project, (as presented in Appendix 7.1: Multibeam Backscatter Data of Chapter 7 Benthic Subtidal and Intertidal Ecology) indicates predominantly soft sandy sediments are likely to be present across the entire META Site 8 area.

5.2.1.2 In terms of Annex I reef the JNCC website confirms that in terms of selection criteria *'They are generally subtidal but may extend as an unbroken transition into the intertidal zone, where they are exposed to the air at low tide. Intertidal areas are only included within this Annex I type where they are connected to subtidal reefs.'*[2] Whilst the cable will pass across a band of rocky habitat of low biodiversity (see Chapter 7: Benthic Subtidal and Intertidal Ecology, Section 7.7.3), which transitions into intertidal rocky habitat, it is possible that this habitat does not constitute Annex I intertidal reef habitat as it is not continuous with wider offshore reef habitat which is most likely to be located to the west or further offshore of the META site boundary.

5.2.1.3 In order to ensure that the cable route did not impact on sensitive habitats, a Drop Down Video (DDV) camera survey was undertaken for the mWave Project (Aquatic Survey and Monitoring, 2019). The results of the DDV survey confirmed that the habitats and communities across the bedrock reef at East Pickard Bay (the cable landfall) were relatively low in diversity compared to many other areas around Pembrokeshire, due to the effects of scour and siltation. No species or features of notable marine nature conservation importance were found and none of the habitats and species seen are considered especially vulnerable or sensitive to the expected physical effects of the cable deployment, presence or retrieval.

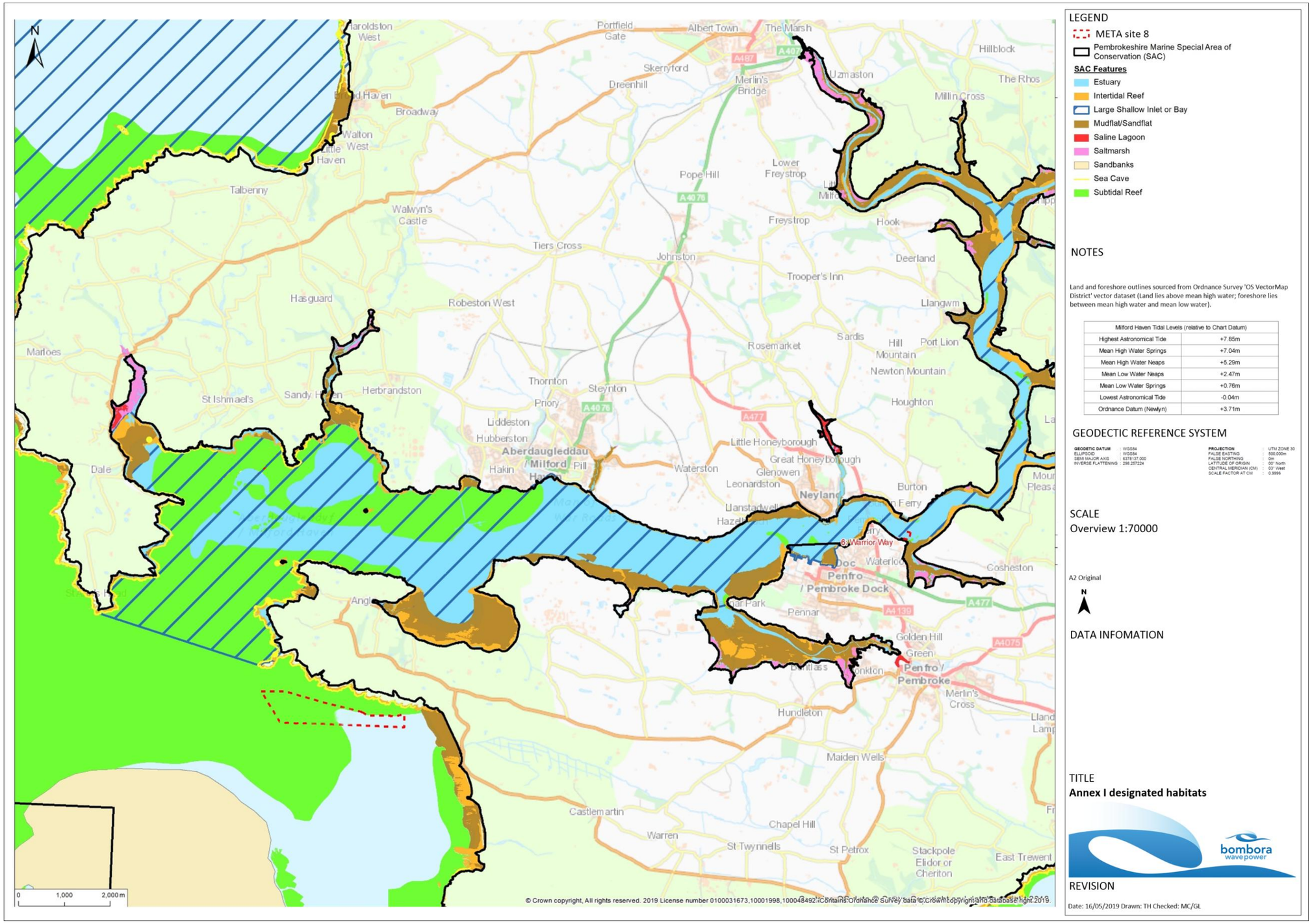
5.2.1.4 Notwithstanding this Chapter 7 Benthic Subtidal and Intertidal Ecology considered the potential effects of the project on possible Annex I reef. Due to the installation method, small footprint and temporary nature of deployment, the potential for a LSE on Annex I reef either directly by the marine cable or indirectly from mWaves deployment, is not considered likely for the installation or decommissioning phase.

5.2.1.5 Indirect effects were also considered for INNS and accidental pollution. A number of factors limit the potential for the project to have a LSE. The vessels employed in installation activities are expected to be local to the UK and generally transit from the Waterway, thereby limiting the potential for the introduction of new marine INNS to the area via this pathway. During the installation phase, there will be up to 3 vessels (including guard boat) required for the installation of mWave over 3 days, 14 trips vessel trips over 5 days for chain ballast, and one vessel for cable laying over a maximum of 3 days. As mWave will be towed around the coast from Milford Haven Waterway, the sea conditions for installation will have to be good, with good visibility.

5.2.1.6 Overall, with the limited number of vessels involved in installation phase, the use of a guard boat and the slow moving nature of the activity, the potential of an accidental pollution event occurring and the introduction of INNS is considered to be unlikely. In addition to this, as identified in Table 2.1 a Biosecurity Risk Assessment following NRW-PS guidance will also be prepared for the project, which will further reduce the likelihood of a marine INNS being taken from the Ports within the Waterway to East Pickard Bay. During operation and maintenance, again vessels are expected to be local to the UK and generally transit from the Waterway to the area and only a small number will be involved in activities at any one time, during good sea conditions. As such the potential for a LSE on Annex I reef is not considered likely for all phases of the mWave Project.

5.2.1.7 Considering the very small physical scale of the mWave Project and the very low likelihood of any impact occurring, there is considered to be no mechanism by which this Project could act cumulatively with other Projects to impact on Annex I reef habitat.

[2] http://jncc.defra.gov.uk/protectedsites/sacselection/habitat.asp?FeatureIntCode=H1170



LEGEND

- META site 8
- Pembrokeshire Marine Special Area of Conservation (SAC)

SAC Features

- Estuary
- Intertidal Reef
- Large Shallow Inlet or Bay
- Mudflat/Sandflat
- Saline Lagoon
- Saltmarsh
- Sandbanks
- Sea Cave
- Subtidal Reef

NOTES

Land and foreshore outlines sourced from Ordnance Survey 'OS VectorMap District' vector dataset (Land lies above mean high water; foreshore lies between mean high water and mean low water).

Milford Haven Tidal Levels (relative to Chart Datum)	
Highest Astronomical Tide	+7.85m
Mean High Water Springs	+7.04m
Mean High Water Neaps	+5.29m
Mean Low Water Neaps	+2.47m
Mean Low Water Springs	+0.76m
Lowest Astronomical Tide	-0.04m
Ordnance Datum (Newlyn)	+3.71m

GEODECTIC REFERENCE SYSTEM

GEODETIC DATUM	: WGS84	PROJECTION	: UTM ZONE 30
ELLIPSOID	: WGS84	FALSE EASTING	: 500.000m
SEMI MAJOR AXIS	: 6378137.000	FALSE NORTHING	: 0m
INVERSE FLATTENING	: 298.257224	LATITUDE OF ORIGIN	: 00° North
		CENTRAL MERIDIAN (CM)	: 03° West
		SCALE FACTOR AT CM	: 0.9996

SCALE
Overview 1:70000

A2 Original

DATA INFOMATION

TITLE
Annex I designated habitats

REVISION
Date: 16/05/2019 Drawn: TH Checked: MC/GL

Figure 4.4 Annex I habitats and possible Annex I reef in relation to META Site 8 (mWave being deployed in the eastern end)

5.3 Species

5.3.1.1 Mobile species associated with these Natura 2000 sites include (some have been grouped for ease of review):

- Otter (*Lutra lutra*);
- Chough (P*yrrhocorax pyrrhocorax);*
- Bats including Greater horseshoe bat (*Rhinolophus ferrumequinum*) and Lesser horseshoe bat (*Rhinolophus hipposideros);*
- Shore dock (*Rumex rupestris*), Petalwort (*Petalophyllum ralfsii*) and Early gentian (*Gentianella anglica*);
- Marine mammals including Grey Seal (*Halichoerus grypus)* and Harbour porpoise (*Phocoena phocoena*);
- Diadromous fish including Sea lamprey (*Petromyzon marinus*), River lamprey (*Lampetra fluviatilis*) and Brook lamprey (*Lampetra planeri*); Allis shad (*Alosa alosa*) and Twaite shad (*Alosa fallax*); and Bullhead (*Cottus gobio*).
- Marine ornithology including - Marine Atlantic puffin *Fratercula arctica,* European storm petrel *Hydrobates pelagicus,* Lesser black-backed gull *Larus fuscus,* Manx shearwater *Puffinus puffinus,* Razorbill *Alca torda*, Common guillemot *Uria aalge,* Black-legged kittiwake *Rissa tridactyla;* Fulmar *Fulmarus glacialis* and Gannet *Morus bassanus.*

5.3.2 Otter

5.3.2.1 Otter occupy a home range within which they feed, rest and breed. The size of this range depends on habitat quality and particularly food supply. Radio-tracking of otters has taken place in various UK locations (Green et al (1994) and Durbin (1998)) although data is based on a limited numbers of animals. Kruuk (2006) suggests male home ranges average 32km (but may be as long as 80km) and female ranges average 20km.

5.3.2.2 The Otter Survey of Wales Project (Strachan, 2015) provides a valuable insight into the status of this protected mammal. It is believed that hunting, poor water quality and the introduction of persistent organochlorine pesticides (as well as endocrine disrupting chemical such as polychlorinated biphenyls (Chanin, 2003)) from the late 1950s led to a drastic decline in the otter population to such an extent that by the mid1970s UK otters only survived in Scotland, parts of Wales and south-west England. In order to investigate the otter population in Wales, the country was divided into 15 hydrometric areas with over a thousand separate survey sites. The Angle Peninsula falls within the Cleddau hydrometric survey area. From a low point in 1977-78 where only 41% of survey sites were positive for otter, it is now believed that the Cleddau region is one of a number of regions now nearing carrying capacity (97% positive returns from 67 survey sites in 2009-10).

5.3.2.3 In terms of the availability of habitat for otters at East Pickard Bay, the coastline and watercourses feeding into it provided opportunities for hunting. Additionally, temporary shelter is provided beneath rocks of the upper shoreline and more substantial cover is likely to be available in scrub and woodland habitat inland. However, no field sign suggesting the presence of otters was found during site visits.

5.3.2.4 The requirement for up to 3 vessels during the installation phase of mWave will result in a small increase in underwater noise, a risk of collision or propeller strike, possible increases in suspended solid concentration during cable-laying or mWave gravity foundation deployment, as well as accidental pollution incidents.

5.3.2.5 The installation of mWave is expected to take up to 3 days and cable-laying also up to 3 days. Installation will be restricted to daylight hours with the largest vessels being up to 50m in length with a draught of 6m. Pre-installed moorings will be used and a seabed footprint of the mWave and communication cable will be up to 210m^2. In terms of underwater sound pressure, a theoretical worst case source level at 1 m of 179 dB re 1 µPa (rms) / 229 SEL (24h) dB re 1 µPa^{2}s is possible (for cable laying vessels used for the mWave installation vessels (using measurements of McCauley (1998)).

5.3.2.6 The impact of exposure to anthropogenic sound on marine mammals, particularly cetaceans has been well documented, and effects may include physical damage, disorientation and impact on navigation; communication masking; and reduced ability to locate prey. It is now recognised that some of the more ubiquitous noise sources, such as ships, can either individually or cumulatively mask communication signals of, and pose a threat to marine mammals (Chen *et al.,* 2017). However, the effects of underwater noise on otters is not well understood, and no hearing data is available. Since the acuity of otters is significantly less that than for marine mammals, the masking of biologically relevant sounds is not expected to occur (Ghoul and Reichmuth, 2012).

5.3.2.7 Otters produce a range of vocalisations in different social contexts, however vocalisations have never been observed beneath the water's surface (Ghoul and Reichmuth, 2012), thus communication masking is unlikely to occur. Studies on sea otters show an audible range of 0.125 kHz and 32 kHz, which are relatively comparable to terrestrial mustelids (Ghoul and Reichmuth, 2012). Peak underwater hearing sensitivity lies in the range 7 kHz to 16 kHz while overall sensitivity levels are somewhat reduced compared with pinniped species such as seals.

5.3.2.8 Otters within range of increased vessel noise are likely to leave the water (Ghoul and Reichmuth, 2012). However, since the hearing acuity of otters is significantly less than for many marine mammal species, it is unlikely that disturbance ranges for otter will extend as far underwater as predicted for other marine mammals.

5.3.2.9 Otters primarily utilise a narrow strip of water along the shore for foraging, and rarely venture more than 2km from the shoreline (Kruuk, 2006). An observational survey of 500 dives off the coast of Shetland revealed that coastal otters dive for food within 80m of the shore 62% of the time, within 50m 84% of the time, and within 20m 98% of the time (Kruuk and Moorhouse, 1991). Otters prefer to dive in shallow waters of 0–3m and rocky intertidal areas where benthic prey are more abundant; it has been theorised this is also a method of conserving body heat, reducing thermoregulatory costs and reducing travel time (Kruuk and Moorhouse, 1991; Nolet *et al.,* 1993). The deployment site for mWave is over 415m from MLWS and has a depth of 11m below chart datum. As such the potential for disturbance to otter foraging areas is unlikely.

5.3.2.10 Whilst vessel strike has been identified in sea otters (Ballachey and Bodkin, 2015), there are no available reports of vessel strike in European otter, which is less due to their preference for inshore waters. Vessels travelling at 7m/s or faster are those most likely to cause death or serious injury to marine mammals, basking sharks or otters (Wilson *et al.,* 2007). Vessels involved in the installation phase are likely to be travelling considerably slower than this, in particular the vessels which will tow mWave to site and those involved with cable laying activities.

5.3.2.11 In terms of suspended solids, Freshwater West Bay is a relatively high energy environment characterised by deposits of coarse sand away from the boulders and cobbles of the shoreline. Otters possess sensitive muzzles with sensory whiskers used to detect prey items either through direct contact or due to receiving vibrations in the water column (Denhardt *et al*., 2001). The suspended solid load associated with any disturbance of the sediments in proximity to East Pickard Bay is unlikely to compare to the normal higher loads found in local estuaries and rivers which successfully support otters.

5.3.2.12 Other potential hazards include entrapment and accidental pollution. Buoy ropes are unlikely to pose a threat to small and manoeuvrable animals such as otters. Potential pollutants are largely restricted to fuel oil within the few vessels used during installation. Given that a period of stable weather and sea conditions will be chosen for installation, an accidental collision which might cause a vessel to leak fuel oil is not considered likely.

5.3.2.13 In addition to the marine environment, inland of East Pickard Bay a minor watercourse and scrub habitat provide additional foraging habitat and potential resting sites or holts. Conroy and Kruuk (1995) found coastal holts were often within 100m of the shoreline but other researchers have found holts as far as 500m away (Moorhouse, 1988). Although unpublished observations by Kruuk suggest otters do not avoid resting sites close to human activity or noise, such sites tend to be in locations were the risk of direct physical disturbance is low (Chanin, 2003).

5.3.2.14 Site visits in March and April 2019 failed to find any field sign suggesting the presence of otters inland of East Pickard Bay. However, given the short duration of cable deployment activities and avoidance of habitat potentially providing cover, the risk of disturbing otters is considered unlikely.

5.3.2.15 Considering that otters are largely a nocturnal animal (Strachan, 2015), less sensitive to anthropogenic noise than marine mammals such as cetaceans and that they tend to forage close to the shoreline, suggests limitations to any receptor-impact pathway.

5.3.2.16 Additionally, the short and controlled timespan required for installation of the mWave device suggests a negligible risk of adverse impact to individual otters. Given that otters are thought to be at carrying capacity in the Cleddau region, the impact of the mWave project on individual otters or an impact to the favourable conservation status at even a local level would appear to be negligible.

5.3.2.1 Considering the very small physical scale of the onshore and offshore works associated with the mWave Project and the very low likelihood of any impact occurring, there is considered to be no mechanism by which this Project could act cumulatively with other Projects to impact on Otter.

5.3.3 Chough

5.3.3.1 The (red-billed) chough (*Pyrrhocorax pyrrhocorax*) is one of the smallest members of the UK crow family (Mullarney et al, 1999).

5.3.3.2 Chough favour low intensity livestock farming practices close to suitable nesting sites on rock faces, or in caves and old buildings. They prefer short grassland swards of 5cm or less and soft soils where they can probe for invertebrates. Prey items include beetles, beetle larvae, leatherjackets, ants, spiders, sand hoppers, and earthworms. In the winter, cereal grains may be taken, especially before birds go to roost. Dung invertebrates are an important food source and stubble fields can provide a source of cereals during the autumn and winter (RSPB, 2019).

5.3.3.3 The coastline of Pembrokeshire provides the habitat characteristics required by chough and as such, parts of the county have been recognised and protected through site designation. In Wales, the chough population has increased in recent years and it is green-listed by the RSPB as a bird of least conservation concern (Eaton et al, 2015). The annual assessment of Pembrokeshire chough in 2018 provided confirmatory evidence of breeding in 67 pairs (Haycock, 2018). The survey found no evidence of breeding at East Pickard Bay.

5.3.3.4 A site visit on the 19 March 2019 revealed a flock of 16 chough feeding in the coastal grassland around East Pickard Bay and these appeared largely unperturbed by occasional coastal path walkers as well as several surveyors and occasional drone flights going on at the time. A review of data by Jackson (2018) for the Wylfa Newydd project on Anglesey cited a personal communication with Adrienne Stratford of the RSPB stating that "*Chough are considered to be generally resilient to disturbance as long as the disturbing factors are regular and present prior to breeding attempts, or occur later in the breeding period after the initial setting up of breeding territories*".

5.3.3.5 Studies by Whitehead et al (2005) which focussed on 15 differing habitat types and 14 chough pairs at 4 breeding sites found preferential use of grassland swards of less than 2cm and strong use of bare earth associated with paths and cloddiau (earth banks). This behaviour was thought to relate to ease of walking on vegetation as well as access to invertebrate prey within the soil. In addition, chough foraging during the breeding season was concentrated within 600m of the nest site. Johnstone et al (2011) reported a concentration of foraging activity within 300m of the nest and that habitat quality within this zone appeared to directly influence breeding success.

5.3.3.6 The installation phase of mWave will involve cable deployment within habitat used by chough. In particular, the drilling of bolt holes in order to secure the conduit to take the armoured cable to rocks, or installing rock anchors, is a noise chough are unlikely to be accustomed to. The drilling work in the intertidal area and at the top of the cliff is expected to take up to 3 days and will be undertaken using hand tools.

5.3.3.7 Potential impacts relating to the installation phase of the mWave project largely involve disturbance due to construction activity at East Pickard Bay (the infrastructure including rollers involved with attaching the armoured cable to the shore as well as the cable pull to the control station and personnel involved with this work). In addition, the cable itself (150mm diameter by 200m length) will smother approximately 30m^2 of coastal grassland vegetation potentially used by chough.

5.3.3.8 The potential impact of displacing chough from habitat in the vicinity of the cable needs to be considered. Coastal grassland and semi-improved neutral grassland within 100m of the cable route equates to approximately 30500m^2. A temporary and reversible loss of 30m^2 equates to approximately 0.0009% of available habitat within 100m of the cable route. This is a fraction of the available habitat associated with the coastal slopes to the east and west of East Pickard Bay.

5.3.3.9 Installation of the cable infrastructure and cable pull is expected to take 9 days in total. The noisiest part of this work is likely to be drilling of holes for attachment of clamps/anchors which will be over 3 days, and intermittent in nature. The displacement of chough from habitat in proximity to the cable route for a maximum time period of 9 days (not continuous) when alternative habitat is available to the east and west is not considered likely to be significant at even a local level.

5.3.3.10 Considering the very small physical scale of the onshore works associated with the mWave Project and the very low likelihood of any impact occurring, there is considered to be no mechanism by which this Project could act cumulatively with other Projects to impact on Chough.

5.3.4 Greater and lesser horseshoe bats

5.3.4.1 Greater horseshoe bats are a large but manoeuvrable species largely associated with landscapes supporting woodland and pasture with well-structured hedgerows and treelines. Prey items vary throughout the year but mainly consist of chafers, dung beetles and moths although seasonally, Hymenoptera, crane-flies, caddis flies and spiders will be taken (Dietz et al, 2009).

5.3.4.2 Lesser horseshoes are generally found in lowland areas of un-intensive agriculture with well-connected hedgerows and treelines. Lesser horseshoes are smaller bats than greater horseshoes and as such, prey items tend to be smaller. Prey items include crane-flies, Hymenoptera, lace-wings and small moths as well as mosquitos, small beetles, aphids and spiders (Dietz et al, 2009).

5.3.4.3 Habitat loss and as well as persistent agrichemicals including timber treatments (such as Lindane and DDT) in roosts and cattle worming treatments (such as Ivermectin) are believed to have led to a population decline in greater horseshoe bats since the 1950s (Dietz et al, 2009; Jones, 1990). Remaining populations are concentrated in areas with favourable roost sites and habitats.

5.3.4.4 During the summer months, greater horseshoe bats use warm roof spaces entered through open flyways are used whilst in winter, cellars and caves with stable temperatures and humid conditions are utilised. Dietz et al (2009) note that in Britain and Central Europe foraging usually occurs within 5km of a roost (2.1km on average). Winter roosts are often only a few kilometres from summer roosts although in England they have been recorded from distances of up to 30km. In Pembrokeshire, larger sea caves not fully immersed at high tide can provide temporary roosts or even winter hibernation sites (CCW, 2008).

5.3.4.5 Lesser horseshoe summer day roosts are often found in stone buildings with slate roofs accessed directly through unobstructed openings, whilst caves, mines and cellars are used during the winter (Schofield, 2008).

5.3.4.6 The ability of bats to access foraging areas from roost sites is also important and light spill can have a negative impact leading to spatial avoidance and ultimately habitat fragmentation. Research by Jones and Morton (1992) found that despite the presence of street lit areas within their home range, lit areas were never used by *Rhinolophus ferrumequinum*. Recent guidance by Stone (2018) categorised the horseshoe bat species as particularly susceptible to the impact of lighting. The negative effects of artificial light on lesser horseshoe use of the landscape has also been well-documented (Stone, 2014).

5.3.4.7 Clearly the wooded valleys, extensive areas of unimproved grassland as well as availability of roost sites including sea caves influences the presence of greater horseshoe bats in southern Pembrokeshire. The National Trust property at Stackpole supports the largest known colony of greater horseshoe bats in Wales and outlying roosts such as Orielton lies less than 10km from the study area.

5.3.4.8 In terms of sensitivity, greater horseshoe bats of Pembrokeshire are of International importance. Greater horseshoe bats have been recorded on the Angle Peninsula and are likely to use habitat within the study area. However, neither buildings or sea caves with potential for roosting bats occur in close proximity to the study area. The only potential impact pathway involves impact on foraging resources or disruption of commuting routes.

5.3.4.9 The control station infrastructure is centred around self-contained shipping containers in a small compound (approximately 28m x 20m) located within an area of rank improved grassland. The area will not be lit at night nor will its installation involve the removal of linear features including vegetation that may form a focus for commuting bats. Cable installation will involve directly laying a 150mm reinforced cable on top of existing rock and vegetation between the high intertidal and the control station. Approximately 200m of this will be within unimproved coastal grassland and low scrub vegetation. This equates to approximately 30m^2 which is roughly equivalent to the poached area of a typical field entrance. The remaining length of cable will be located at the base of a boundary fence at the edge of an improved grassland whilst the control station compound (560m^2) will also impact an area of improved grassland. The potential reduction of foraging resources brought about by these impacts is considered to be negligible when consideration is given to availability of habitat locally as well as the temporary and reversible nature of the impact.

5.3.4.10 In common with the assessment of potential impacts on greater horseshoe bats and given the absence of available of roost sites within the study area, potential impacts have to focus on disturbance of commuting routes or reduction in foraging resources. For the reasons set out in the consideration of potential impacts on greater horseshoe bats, no significant adverse effects are considered likely with lesser horseshoe bats.

5.3.4.11 Taking into considering the very small physical scale of the onshore works associated with the mWave Project and the very low likelihood of any impact occurring, there is considered to be no mechanism by which this Project could act cumulatively with other Projects to impact on greater or lesser horseshoe bats.

5.3.5 Shore dock

5.3.5.1 King (2006) describes shore dock as being "*…quite catholic in its habitat requirements, in that it can occur wherever three critical features are present, namely within a few metres of high water, with fresh-water available all year round, and a lack of competition from other perennial species, notably Phragmites australis in damp areas and Rubus fruticosus in drier places*".

5.3.5.2 Shore dock (*Rumex rupestris*) is listed as a feature of the Pembrokeshire Marine SAC. The closest known plants to East Pickard Bay grow at Marloes Sands some distance (10km+) from the study area (J Woodman 2019, pers.comm.).

5.3.5.3 A sheltered bench above the rock strewn interface between the high intertidal and terrestrial environment at East Pickard Bay offers potential for shore dock. However, a search of this location during site visits in March and April 2019 failed to find any plants of this species. Shore dock is not considered to a form a constraint to the project.

5.3.5.4 Considering the lack of shore dock within the proposed onshore works area, there is considered to be no mechanism by which this Project could act cumulatively with other Projects to impact on shore dock.

5.3.6 Petalwort

5.3.6.1 Petalwort is a leafy liverwort of open, damp calcareous dune slacks (JNCC, 2019). The nearest dune slack to the project is at Broomhill Burrows SSSI. No impact pathway has been identified with any likelihood of affecting this habitat either alone or in combination.

5.3.7 Early gentian

5.3.7.1 This species is a diminutive annual or biennial of base-rich grasslands. *Gentianella anglica* is now considered a sub-species of Autumn gentian (*Gentianella amarella*) (Stace, 2019) although the Habitat Directive still recognise it as a separate taxon.

5.3.7.2 It typically grows in short calcareous grassland turf on south-facing slopes grazed by rabbits or livestock. In the south of England, it is associated with chalk escarpments (JNCC, 2019) whilst in Pembrokeshire it is found on limestone.

5.3.7.3 No impact pathway has been identified with any likelihood of affecting this habitat either alone or in combination..

5.3.8 Grey seal

5.3.8.1 Globally, there are three hotspots of grey seal abundance; one in eastern Canada and north-east USA; a second smaller population in the Baltic Sea; and the third along the coast of the UK (38% of the World's grey seals breed in the UK) (SCOS, 2017). Grey seals can live for 20- 30 years, with females tending to live longer than males (SCOS, 2015). Sexual maturity is reached at approximately ten years in males, and five years in females (SCOS, 2015) and gestation occurs over 10 to 11 months.

5.3.8.2 While grey seals are known to travel up to 2,100 km on foraging trips, most foraging trips remain within 145 km from haul-out sites (SCOS, 2015). Seals are highly mobile and feed mainly at the benthos in shelf seas (Thompson, 2012; Chen *et al.,* 2016). Telemetry studies of animals tagged on Welsh haul-out sites indicate that grey seals may make foraging trips to very localised areas, with animals from a particular locality tending to remain in that region (Strong *et al.,* 2006).

5.3.8.3 Grey seals are widely distributed in Welsh waters. Breeding colonies in northwest Pembrokeshire, particularly on Ramsey Island, extending southwards to Skomer Island and northwards to southern Ceredigion (Baines and Evans, 2009). Small concentrations occur around the Lleyn Peninsula and the coast of Anglesey. These breeding colonies act as haul-out sites in the non-breeding season. Approximately 5,000 grey seals use habitats on the Welsh coast, which is the most important breeding colony for grey seal in the southern UK. Approximately 5% of UK grey seal pups are born on the coasts of SW Wales and SW England each year (SCOS, 2017). Grey seals are a feature of the Skomer Marine Conservation Zone (MCZ) and seal pupping sites are found at both Skomer Island and Marloes peninsula sites (Lock *et al.,* 2017). The Marloes peninsula contributes, on average, 41% of the total pup production in the Skomer MCZ.

5.3.8.4 In 2015, 465 pups were born in North Pembrokeshire and 379 pups born on Skomer and adjacent mainland sites in 2015 (SCOS, 2017). In 2017, 383 pups were born within the Skomer Marine Conservation Zone (the highest number of seal births within the whole of the MCZ since records began) with 225 pups born on Skomer Island (the second highest total ever recorded) and 158 born on Marloes Peninsula (Büche and Stubbings, 2018), Pupping occurs between July and November, and in 2017 the highest number of pups were born in September (n = 146) and October (n = 57). Büche and Stubbings (2018) identified *Castle Bay*, *North Haven* and *Matthew's Wick* (all on east Skomer Island) as the most important haul-out sites within the MCZ, with average daily numbers of seals recorded as 44, 33 and 24 seals respectively. The Garland Stone does not appear to play a major role as a haul-out sire during the autumn, however seals use it all year. Weather conditions are most likely the most significant determining factor on number of seals hauled-out per site day to day (Büche and Stubbings, 2018).

5.3.8.5 The Grey Seal Breeding Census Skomer Island 2017 (Büche and Stubbings, 2018) identified two seals hauled-out on North Haven beach, with tags which identified them as having originated 105 km away. Two seals which originated from the Skomer MCZ were identified in Cornwall, 147 km and 131 km away.

5.3.8.6 The Angle Peninsula falls within the South and West England and Wales MU which extends from the bottom of south west Scotland, the length of the coast of Wales and south west England to east of the Isle of Wight. The estimated grey seal summer population size for this MU is 6,000 (IAMMWG, 2013).

5.3.8.7 In terms of project impacts, potential exists for increased underwater noise, vessel strike, accidental pollution, increased suspended sediment loads and changes in the abundance or distribution of prey species.

5.3.8.8 Grey seals have an estimated functional hearing range between 50 Hz and 86 kHz. A conservative estimate that exposure to underwater noise that has the potential to result in the onset of injury (by vessel movement) up to 7m from the sounds source (Environmental Statement, Chapter 9: Marine Mammals).

5.3.8.1 Baseline vessel activity in the area is low with larger vessels heading to and from the Waterway passing some 2km to the west. Whilst the largest vessel used for the installation of mWave is 50m length with 6m draught, the zone of potential impact is small. Vessels involved in the installation of mWave and the communication cable will be present within the local study area for a matter of days therefore potential impacts will be of a short-term duration.

5.3.8.2 Given that the number of grey seal are relatively low locally, particularly as the nearest haul out sites are located more than 10km away, limited numbers of animals would be expected to forage in the vicinity of the mWave device or even moderately close to it. Similarly, the risk of vessel strike would also be expected to be low for the same reasons.

5.3.8.3 In addition, to low risk of accidental pollution because installation would be undertaken during calm conditions, the small footprint of the mWave device is not considered likely to create significant suspended sediment loading or impact potential prey species. For these reasons a LSE on grey seal is not considered likely.

5.3.8.4 In terms of operational noise as, mWave is a full scale WEC prototype that sits on the seabed with four membrane covered air filled cells. The gravity base foundation means that there will be no requirement for moorings. Wave peaks and troughs above the mWave result in differential pressure across the membrane causing the membrane to inflate and deflate. At any instant, those cells with a higher pressure supply air to a high-pressure duct in the pneumatic circuit, via a set of non-return cell outlet valves. This high-pressure air flows through the enclosed turbine and returns to low pressure cells, via a low-pressure manifold and non-return inlet valves. The turbine is enclosed so that no water gets into the enclosed air system. Through the air being pushed through the turbine by change in water pressure, electricity can be generated by the turbine. Whilst mWave is a WEC, it is not of the conventional type, using the movement of air instead of movement of the device itself to generate electricity. The mWave project will be the first deployment of the full scale device and as such noise data is not available to assess its potential effect. As data is not available for the device a data review of operational noise was undertaken.

5.3.8.5 A conservative estimate of the potential effect of the underwater noise from the operation of the WEC was undertaken using data from a surface positioned WEC (Pelamis P2) and turbine project (OpenHydro). Whilst mWave is a WEC there are a number of factors which means that the operating noise from mWave is likely to lower than both Pelmaris P2 and OpenHydro, including:

- The Pelamis report (Lepper 2011) suggests a significant contribution of noise from moorings (rattling, clanking, banging) – mWave has no equivalent systems.
- The OpenHydro device has hydrofoils which means there is a possibility of cavitation. Cavitation is a significant noise source. The rotational speed and deployment depth of the OpenHydro device limits the likelihood of cavitation occurring. The mWave turbine operates in air at subsonic speeds meaning there is no equivalent noise source for the mWave.

5.3.8.6 In pinnipeds in water (grey seal VER), the conservative assessment estimates that animals may be exposed to underwater noise that has the potential to result in the onset of injury (tidal turbine operation) up to 23m from the sound source (Pelamis P2 WEC). However, it is more likely that pinnipeds may be exposed to underwater noise up to 2m (OpenHydro tidal turbine) from the sound source, as a conservative estimate. For these reasons a LSE on grey seal is not considered likely.

5.3.8.7 Taking into considering the very small physical scale of the offshore works associated with the mWave Project and the very low likelihood of any impact occurring, there is considered to be no mechanism by which this Project could act cumulatively with other Projects to impact on grey seal.

5.3.9 Harbour porpoise

5.3.9.1 The harbour porpoise has a widespread distribution throughout the north Atlantic, occurring in temperate waters, largely found over the North Atlantic continental shelf. The species is the most numerous marine mammal in north-western European shelf waters (Reid *at al.* 2006).

5.3.9.2 Harbour porpoise normally live for approximately 12 years, although they have been recorded to reach a maximum age of 24. Harbour porpoise reach sexual maturity at between three and four years of age; reproduction is highly seasonal, with mating occurring between June and August and a corresponding peak in birth rates in June to July around the British Isles, following a 10 to 11-month gestation period (Lockyer, 1995).

5.3.9.3 Often associated with near-shore headlands and strong tidal currents, porpoise are commonly observed within shallow bays, estuaries and narrow tidal channels (Pierpoint, 2008). They are however known to exhibit strong vessel avoidance. Harbour porpoise exhibit diet flexibility, feeding on a varied diet of fish, cephalopods and crustaceans, thought to help this species to avoid being adversely affected by local anthropogenic over-exploitation of any one fish species.

5.3.9.4 The harbour porpoise is the most common and widespread species of cetacean in Welsh waters (Baines and Evans, 2012) with hot spots identified off the Pembrokeshire coast; the Lleyn Peninsula (to a lesser extent); in southern Cardigan Bay; and in the Bristol Channel off the south coast of Wales (around the Gower Peninsula and in Newport Bay) (Baines and Evans, 2012).

5.3.9.5 Along the Pembrokeshire coast, the harbour porpoise is the most commonly encountered cetacean (Reid et al., 2003a, Baines and Evans, 2012) and the species is present throughout the year (Pierpoint, 2001). The whole of the West Wales Marine SAC has been identified as an important summer area for harbour porpoise, and a smaller section to the south of the site, around Cardigan Bay, has also been identified as winter habitat for this species. Survey data has identified the West Wales Marine SAC as an area with persistently higher density of porpoises in relation to other areas (IAMMWG, 2015). Survey data from 2006–2011, supporting the designation of the West Wales Marine SAC, identifies the regional study area as hosting a discrete and persistent area of relatively high harbour porpoise density in comparison to the wider marine area, with concentrations of animals identified off Strumble Head, Pembrokeshire Islands, and in the vicinity of Cemaes Head and the Teifi Estuary at Cardigan (Heinänen and Skov, 2015; Pierpoint, 2001).

5.3.9.6 Harbour porpoise in most of the eastern North Atlantic are generally considered to behave as a 'continuous' biological population that extends from the French coasts of the Bay of Biscay, northwards to the arctic waters of Norway and Iceland (IAMMWG, 2015). The IAMMWG, for practical management purposes however, has identified three Management Units (MUs) as appropriate for harbour porpoise: North Sea (NS), West Scotland (WS) and Celtic and Irish Seas (CIS).

5.3.9.7 The total harbour porpoise abundance for the CIS MU was estimated as 104,695 animals (95% Confidence Interval 25,611 to 87,092) (IAMMWG, 2015). The MU abundance estimate has been used as the reference population to put any potential impacts into context.

5.3.9.8 In terms of project impacts, potential exists for increased underwater noise, vessel strike, accidental pollution, increased suspended sediment loads and changes in the abundance or distribution of prey species.

5.3.9.9 Marine mammals, particularly cetaceans, are capable of generating and detecting sound (Au et al., 1974; Bailey et al., 2010) and are dependent on sound for many aspects of their lives, i.e. prey-identification; predator avoidance; communication and navigation. Increases in anthropogenic noise may consequently pose a risk within the marine environment (Parsons et al., 2008; Bailey et al., 2010).

5.3.9.10 The impact of exposure to anthropogenic sound on marine mammals, particularly cetaceans has been well documented, and effects may include physical damage, disorientation and impact on navigation; communication masking; and reduced ability to locate prey.

5.3.9.11 The hearing and vocalisation ranges of harbour porpoises are high with an estimated functional hearing range of 275 Hz-160 kHz. For High Frequency (HF) cetaceans, a conservative assessment estimates that animals may be exposed to underwater noise that has the potential to result in the onset of injury up to 46m from the sound source (if the sound pressure levels of a dynamic positioning rig are used as a proxy for the mWave installation vessels (using measurements of McCauley (1998) i.e. a theoretical worst case source level at 1 m of 179 dB re 1 µPa (rms) / 229 SEL (24h) dB re 1 μPa^2s is possible (for cable laying vessels used for the mWave installation vessels). However, this assumes that animals would remain within these ranges continuously for 24 hours, and as such it is highly likely that animals would be disturbed, resulting in them moving away from the noise impact.

5.3.9.12 Harbour porpoise are particularly sensitive to high frequency noise and are more likely to avoid vessels (Heinanen and Skov, 2015). Given the small footprint of mWave device and limited movement of vessels required to install and maintain it, the potential for a LSE related to noise or vessel strike is considered to be highly unlikely.

5.3.9.13 Similarly, the potential for increased sediment loading of the water column in a relatively high energy environment or a significant change to potential prey species by the footprint of a device 75m long by 15m wide and 7m high, at a LSE level is unlikely. Accidental pollution is also unlikely in that calm conditions would be chosen for installation reducing the risk of vessel collisions.

5.3.9.1 During operation In High Frequency (HF) cetaceans (harbour porpoise VER), a conservative assessment estimates that animals may be exposed to underwater noise that has the potential to result in the onset of injury up to 18m from the sound source (Pelamis P2 WEC). It is more likely that high frequency cetaceans may be exposed to underwater noise up to 2m (OpenHydro tidal turbine) from the sound source, as a conservative estimate. For these reasons, and taking into consideration the conservative nature of the assessment, a LSE on grey seal is not considered likely.

5.3.9.2 Taking into considering the very small physical scale of the offshore works associated with the mWave Project and the very low likelihood of any impact occurring, there is considered to be no mechanism by which this Project could act cumulatively with other Projects to impact on harbour porpoise.

5.3.10 Diadromous Fish

5.3.10.1 Of the fish species associated with nearby Natura 2000 site, two species: brook lamprey and bullhead are not found in the marine environment and therefore no impact pathway exists for the mWave project to create a LSE.

5.3.10.2 Migratory species including Sea lamprey, River lamprey, Allis shad and Twaite shad have the potential to move through the study area.

5.3.10.3 All the species identified migrate to the waters of the Waterway, using different mechanisms for wider and local navigation such as solar cues, currents and olfactory trails (Binder 2011).

5.3.10.4 mWave is a WEC which will be deployed off East Pickard Bay on the open coastal waters south of Angle Peninsula and some 3.5km to the south east of the mouth of the Waterway. The device sits on the seabed and it will generate energy through the displacement of air from membrane covered cells which are present on the top of the device. The displaced air is passed through an enclosed generator before being re-circulated through the device. By its very nature the mechanisms within the device has to be contained to prevent air escaping, and as such there are no areas which contain moving parts which will impact on fish. As such if a migrating fish were to follow the coastline to the Waterway the physical presence of the mWave device would not hinder or impact on their passage.

5.3.10.5 Bathymetric survey confirmed that the deployment site for mWave is flat even sand (Titan 2018). The installation of mWave requires no site preparation, no installation of foundation and no piling. The device is simply towed to site on the surface by two vessels (and accompanied by a guard boat) and then gently lowered to the seabed through reduction in buoyancy. Once on the seabed the gravity foundation will settle into the sand up to a depth of 1m. Ballast in the form of chain will be added to trays. The marine cable from mWave to the coast will be laid on the seabed, with no trenching or burial, using one vessel. As such increased suspended sediments as a result of installation works will be minimal and short term (Chapter 5: Coastal Processes).

5.3.10.6 An assessment of underwater noise during installation activities was undertaken within Chapter 6: Underwater Noise. The review of noise data confirmed that as there is no piling or site levelling works, the most significant noise would originate from the range of vessels on site, with cable laying activities being most persistent. Any ballast installation would require a short time on site before the vessel returns to port to repeat the process. The worst case potential distance for disturbance for fish during installation is 21m as a result of the vessel used for cable laying. Cable laying activity will be of short duration, undertaken on up to 3 days, with the installation of mWave taking up to 3 days, and placement of ballast 5 days. Based on this information it is concluded that the short term deployment of mWave will not impact on the movement of migratory fish to and from the Waterway. See table 8.13 for further information on underwater noise.

5.3.10.7 Fish and shellfish receptors are vulnerable to a number of impacts during construction including temporary habitat loss and increased SSC during installation works. Likewise during operation

5.3.10.1 Marine mammals exploit a suite of different prey items and can travel great distances to forage. It is likely that any effects on fish and shellfish will occur over a similar, or lesser, extent and duration as those for marine mammals. For example, avoidance behaviour of fish during the installation phase will lead to displacement over potentially smaller ranges than those given for most marine mammals. In addition, as prey moves out of the areas of potential impact, so marine mammals are likely to follow in order to exploit these resources.

5.3.10.2 The fish and shellfish communities found within the East Pickard Bay area were characteristic of the fish and shellfish assemblages in the wider area. Whilst the mWave project will have a localised impacts such as increased SSC, or loss of habitat, due to the highly mobile nature of marine mammals, it is likely that these animals will be able to exploit similar resources elsewhere.

5.3.10.3 In addition to this, whilst noise data is not available for the operation of mWave, data is available for other marine energy devices such as Pelamis P2 (a semi submerged surface WEC) and OpenHydro (tidal turbine). Both of these devices are considered to be worst case in comparison to mWave with respect to noise. For instance, noise surveys for Pelamis P2 indicated a significant noise component associated with mooring lines and its movement on the surface, neither of which is relevant to mWave. Significant noise can also be generated from turbines in particular through cavitation. The mWave turbine operates in air at subsonic speeds meaning there is no equivalent noise source. During operation worst case disturbance distance identified was between 6m - 78m. Even taking into consideration the worst case exclusion area based on Pelamis data, due to the coastal location of mWave, with it being positioned approximately 415m from MLWS at 11m below CD (Chapter 2: Project Description), it will not inhibit fish movement along the coast.

5.3.10.4 To conclude, due to the short term low impact installation method and the benign operational nature of the device, it is considered that mWave will not have a LSE on migratory fish.

5.3.10.5 Taking into considering the very small physical scale of the offshore works associated with the mWave Project and the very low likelihood of any impact occurring, there is considered to be no mechanism by which this Project could act cumulatively with other Projects to impact on protected diadromous fish species

5.3.11 Marine ornithology

5.3.11.1 A range of bird species have been identified as being within the foraging distance of the mWave project. These included Marine Atlantic puffin *Fratercula arctica,* European storm petrel *Hydrobates pelagicus,* Lesser black-backed gull *Larus fuscus,* Manx shearwater *Puffinus puffinus,* Razorbill *Alca torda*, Common guillemot *Uria aalge,* Black-legged kittiwake *Rissa tridactyla;* Fulmar *Fulmarus glacialis* and Gannet *Morus bassanus.* Desktop data review indicated that while these species may be in greater numbers within their respective SACs, the number of birds recorded within the area off East Pickard Bay are low with counts in the range of 0.08 to 1 bird per 3km^2.

5.3.11.2 In terms of receptor path impact routes from the mWave project, these were reviewed in detail within the Environmental Statement Chapter 10: Marine Ornithology. Areas identified were temporary displacement/disturbance and accidental pollution during all phases of the project and collision with the development during operation.

5.3.11.3 In terms of collision with the device, the device is placed on the seabed with a minimum of 4.2m water coverage at all states of the tide. The device functions through the movement of air within a closed system with no external parts. As such if a diving bird did come within the vicinity of the device there are no areas which may cause impact to the bird. With regard to displacement/disturbance, the presence of shipping moving through an area or undertaking activities will have the potential to temporarily displace birds from the local area. However, there will only be a limited number of vessels associated with each phase of the project and these will be on site for only a few days at a time. The number of species identified above recorded in the area are very low and as such no LSE is likely to occur.

5.3.11.4 In terms of accidental pollution, as all offshore works will be undertaken in good sea conditions, and there will be limited number of vessel movements over a limited number of days. In terms of mWave, it will use EU/Internationally approved marine environment suitable anti-foulants or lubricants, as such no significant increase in marine pollution events is envisaged resulting in no LSE.

5.3.11.1 Taking into considering the very small physical scale of the offshore works associated with the mWave Project and the very low likelihood of any impact occurring, there is considered to be no mechanism by which this Project could act cumulatively with other Projects to impact on protected marine ornithological species.

6. Habitats Regulation Assessment

6.1 Screening of Designated Sites

6.1.1.1 As discussed above a preliminary screening of Natura 2000 sites within a 10km radius of the proposed development has been undertaken (with SPA species identified based on the foraging distance of the species, section 4.1). For each designated site, the approximate distance to the development is given. Subsequent to this comments are provided on the key features of the designation and if there is potential for these to be affected by the proposals. Finally, the need for further assessment is identified.

Table 6.1 Screening of Natura 2000 Sites

Designated Site Name/Designation	Proximity (km)	Qualifying features	Impact pathways	mWave	CIA
Pembrokeshire Marine / Sir Benfro Forol SAC	0 (Within)	The third largest UK marine SAC, covering an area of 138,069 ha and supporting eight Annex I habitats and seven Annex II species.		**LSE**	**LSE**
		Annex 1 habitats forming the primary reason for site selection include:			
		Estuaries;	The Annex I habitat listed is absent.	No	No
		Large shallow inlets and bays; and	The Annex I habitat listed is absent.	No	No
		Reefs.	For reasons set out more clearly in Section 5.2.1 no LSE were identified. The potential impact of habitat loss, potential introduction of INNS and accidental pollution brought about by the project is considered to be at a trivial level and therefore, no LSE identified. For reasons set out more clearly in Section 5.2.1, there is considered to be no mechanism by which this Project could act cumulatively with other Projects to impact on Annex I reef habitat.	No	No
		Annex 1 habitats forming qualifying features include:			
		Sandbanks which are slightly covered by seawater all the time;	The Annex I habitat listed is absent.	No	No
		Mudflats and sandflats not covered by seawater at low tide;	The Annex I habitat listed is absent.	No	No
		Coastal lagoons (Priority feature);	The Annex I habitat listed is absent.	No	No
		Atlantic salt meadows (*Glauco-Puccinellietalia maritimae*); and	The Annex I habitat listed is absent.	No	No
		Submerged or partially submerged sea caves.	The Annex I habitat listed is absent	No	No
		Annex II species forming the primary reason for site selection include:			
		Grey seal (*Halichoerus grypus*); and	For reasons set out more clearly in Section 5.3.8 no LSE were identified. The potential impact of disturbance and habitat loss brought about by the project is considered to be at a trivial level and therefore, no LSE identified. For reasons set out more clearly in Section 5.3.8, there is considered to be no mechanism by which this Project could act cumulatively with other Projects to impact on grey seal.	No	No
		Shore dock (Rumex rupestris).	Existing records and site survey indicate this species is not present within the study area (nearest population 10km away) – No impact pathway.(see section 5.3.5). No mechanism by which this Project could act cumulatively with other Projects.	No	No
		Annex II species forming qualifying features include:		No	No
		Sea lamprey (*Petromyzon marinus*);	No significant impact pathway identified.	No	No
		River lamprey (*Lampetra fluviatilis*);	No significant impact pathway identified.	No	No
		Allis shad (*Alosa alosa*);	No significant impact pathway identified.	No	No
		Twaite shad (*Alosa fallax*); and	No significant impact pathway identified.	No	No
		Otter (*Lutra lutra*).	For reasons set out more clearly in Section 5.3.2 no LSE were identified. The potential impact of disturbance and habitat loss brought about by the project is considered to be at a trivial level and therefore, no LSE identified. For reasons set out more clearly in Section 5.3.2, there is considered to be no mechanism by which this Project could act cumulatively with other Projects to impact on Otter.	No	No
West Wales Marine/ Gorllewin Cymru Forol SAC	0 (Within)	A UK marine SAC covering 737,614 ha designated for its population of the Annex II species, harbour porpoise (*Phocoena phocoena*).			
		Harbour porpoise	High frequency noise generated by the mWave device has potential to cause hearing damage in marine mammals including porpoise. However, worst case assessment concludes that in order for harm to occur, an animal would have to spend a prolonged period within the potential injury zone in close proximity to the device (estimated at 2m). Only a small area of habitat will be affected by the project. This is considered unlikely and for reasons set out in Section 5.3.9, no LSE identified. For reasons set out more clearly in Section 5.3.9, there is considered to be no mechanism by which this Project could act cumulatively with other Projects to impact	No	

Designated Site Name/Designation	Proximity (km)	Qualifying features	Impact pathways	mWave	CIA
			on harbour porpoise.		
Limestone Coast of South West Wales / Arfordir Calchfaen De Orllewin Cymru SAC	1.2	The site is comprised of carboniferous limestone sea-cliffs in exposed and sheltered elevations. The SAC stretches from Castlemartin in Pembrokeshire to the Bishopston Valley on Gower. Annex I habitats forming the primary reason for site selection include:			
		Vegetated sea cliffs of the Atlantic and Baltic coasts; and	Limestone geology is absent from the site. Although vegetated sea cliffs will be impacted by works the scale at which this occurs is considered trivial. No LSE identified.	No	No
		Fixed coastal dunes with herbaceous vegetation (grey dunes).	Fixed dune habitat is absent from the site. No impact pathway identified.	No	No
		Annex I habitats forming qualifying features include:			
		European dry heaths;	No impact pathway identified.	No	No
		Semi-natural dry grasslands and scrubland facies on calcareous substrates (Festuco-Brometalia) (*important orchid sites);	No impact pathway identified.	No	No
		Caves not open to the public;	No impact pathway identified.	No	No
		and Submerged or partially submerged sea caves.	No impact pathway identified.	No	No
		Annex II species forming the primary reason for site selection include:			
		Greater horseshoe bat (*Rhinolophus ferrumequinum*); and	No buildings or sea caves with potential for roosting are located in immediate proximity to the site. Potential foraging habitat or commuting routes are unaffected. The control station will be unlit. No impact pathways identified, (see Section 5.3.4). No mechanism by which this Project could act cumulatively with other Projects.	No	No
		Early gentian (Gentianella anglica).	This plant is not present in habitat associated with the site. No direct or indirect impact pathways identified, (see Section 5.3.7). No mechanism by which this Project could act cumulatively with other Projects.	No	No
		Annex II species forming qualifying features include: Petalwort (*Petalophyllum ralfsii*).	This species is not present in habitat associated with the site. No direct or indirect impact pathways identified, (see Section 5.3.6). No mechanism by which this Project could act cumulatively with other Projects.	No	No
Pembrokeshire Bat Sites and Bosherton Lakes / Safleoedd Ystlum Sir Benfro a Llynnoedd Bosherton SAC	9	The site is focussed on habitats and species associated with eight sites centred around the National Trust owned Stackpole Estate. In particular, the site encompasses the shallow marl lake system of Bosherston Lakes (created by damming and drowning three valleys in the Carboniferous Limestone during the late 18th and mid-19th Century) as well as important bat roosts. The closest constituent site associated with the SAC is *Orielton Stable Block and Cellars*.Annex I habitats forming the primary reason for site selection include:			
		Hard oligo-mesotrophic waters with benthic vegetation of Chara spp.	The Annex I habitat listed is absent and distant from the study area. No impact pathway identified. No mechanism by which this Project could act cumulatively with other Projects.	No	No
		Annex II species forming the primary reason for site selection include: Greater horseshoe bat (*Rhinolophus ferrumequinum*).	No buildings or sea caves with potential for roosting are located in immediate proximity to the site. Potential foraging habitat or commuting routes are unaffected. The control station will be unlit. No impact pathways identified, (see Section 5.3.4). No mechanism by which this Project could act cumulatively with other Projects.	No	No
		Annex II species forming qualifying features include:			
		Lesser horseshoe bat (*Rhinolophus hipposideros*); and	No buildings or sea caves with potential for roosting are located in immediate proximity to the site. Potential foraging habitat or commuting routes are unaffected. The control station will be unlit. No impact pathways identified, (see Section 5.3.4). No mechanism by which this Project could act cumulatively with other Projects.	No	No
		Otter (*Lutra lutra*).	For reasons set out more clearly in Section 5.3.2, the potential impact of disturbance and habitat loss brought about by the project is considered to be at a trivial level and therefore, no LSE identified. For reasons set out more clearly in Section 5.3.2, there is considered to be no mechanism by which this Project could act cumulatively with other Projects to impact on Otter.	No	No
Castlemartin Coast SPA	1.1	Carboniferous limestone rocky coastline of geological and biological interest			
		The site supports exposed cliff communities, species-rich maritime grasslands, maritime heath and scrub. In particular the coastline is known for its breeding and over-wintering population of Chough (P*yrrhocorax pyrrhocorax)*, an Annex I species of European importance.	No impact pathway identified.	No	No
		Chough	Existing information and site survey have indicated the absence of nesting chough from East Pickard Bay. The potential impact of disturbance and habitat loss brought about by the project is considered to be at a trivial	No	No

Designated Site Name/Designation	Proximity (km)	Qualifying features	Impact pathways	mWave	CIA
			level and therefore, no LSE identified. Section 5.3.3 above provides further detail. For reasons set out more clearly in Section 5.3.3, there is considered to be no mechanism by which this Project could act cumulatively with other Projects to impact on chough.		
Cleddau Rivers / Afonydd Cleddau SAC	17	A site consisting of two large river catchments noted for:**Annex I habitats forming qualifying features include:**			
		Watercourses of plain to montane levels with the *Ranunculion fluitantis* and *Callitricho-Batrachion* vegetation; Active raised bogs; and Alluvial forests with *Alnus glutinosa* and *Fraxinus excelsior*.	The Annex I habitats listed are absent and distant from the study area. No impact pathway identified. Annex II species listed are absent or distant from the study area. No LSE identified. No mechanism by which this Project could act cumulatively with other Projects.	No	No
		Annex II species forming the primary reason for site selection include: Brook lamprey (*Lampetra planeri*); River lamprey (*Lampetra fluviatilis*); Bullhead (*Cottus gobio*); and Otter (*Lutra lutra*). Annex II species forming qualifying features include: Sea lamprey (*Petromyzon marinus*).	For reasons set out more clearly in Section 5.3.10, the potential impacts of disturbance or collision brought about by the project is considered to be at a trivial level and therefore, no LSE. For reasons set out more clearly in Section 5.3.10, there is considered to be no mechanism by which this Project could act cumulatively with other Projects to impact on migratory fish.	No	No
Skomer, Skokholm and the seas off Pembrokeshire/ Sgomer, Sgogwm a Moroedd Penfro SPA	8	Site designated for the protection of (note only species within foraging distance identified (see section 4.1).:			
		European storm petrel *Hydrobates pelagicus;* Red-billed chough *Pyrrhocorax pyrrhocoraxl* Short-eared owl *Asio flammeu.* *Regularly occurring species (breeding) including:* Lesser black-backed gull *Larus fuscus,,* Atlantic puffin *Fratercula arctica,*Manx shearwater *Puffinus puffinu;* Seabird assemblage	For reasons set out more clearly in Section 5.3.11, the potential impacts of disturbance, accidental pollution or collision brought about by the project is considered to be at a trivial level and therefore, no LSE. For reasons set out more clearly in Section 5.3.11, there is considered to be no mechanism by which this Project could act cumulatively with other Projects to impact on protected marine ornithological receptors.	No	No
Grassholm SPA	23	Site designated for the protection of (note only species within foraging distance identified (see section 4.1).:			
		Gannet *Morus bassanus*	For reasons set out more clearly in Section 5.3.11, the potential impacts of disturbance, accidental pollution or collision brought about by the project is considered to be at a trivial level and therefore, no LSE.	No	No
Aberdaron Coast and Bardsey Island/ Glannau Aberdaron ac Ynys Enlli SPA	121	Site designated for the protection of (note only species within foraging distance identified (see section 4.1).:			
		Manx shearwater *Puffinus puffinus*	For reasons set out more clearly in Section 5.3.11, the potential impacts of disturbance, accidental pollution or collision brought about by the project is considered to be at a trivial level and therefore, no LSE. For reasons set out more clearly in Section 5.3.11, there is considered to be no mechanism by which this Project could act cumulatively with other Projects to impact on Manx shearwater.	No	No
Saltee Islands SPA	113	Site designated for the protection of (note only species within foraging distance identified (see section 4.1).			
		Fulmar *Fulmarus glacialis*	For reasons set out more clearly in Section 5.3.11, the potential impacts of disturbance, accidental pollution or collision brought about by the project is considered to be at a trivial level and therefore, no LSE. For reasons set out more clearly in Section 5.3.11, there is considered to be no mechanism by which this Project could act cumulatively with other Projects to impact on Fulmar.	No	No
Irish Sea Front SPA	216	Site designated for the protection of (note only species within foraging distance identified (see section 4.1).:			
		Manx shearwater *Puffinus puffinus*	For reasons set out more clearly in Section 5.3.11, the potential impacts of disturbance, accidental pollution or collision brought about by the project is considered to be at a trivial level and therefore, no LSE. For reasons set out more clearly in Section 5.3.11, there is considered to be no mechanism by which this Project could act cumulatively with other Projects to impact on Manx shearwater.	No	No
Lambay Island SPA	210	Site designated for the protection of (note only species within foraging distance identified (see section 4.1).:			
		Fulmar *Fulmarus glacialis*	For reasons set out more clearly in Section 5.3.11, the potential impacts of disturbance, accidental pollution or collision brought about by the project is considered to be at a trivial level and therefore, no LSE. For reasons set out more clearly in Section 5.3.11, there is considered to be no mechanism by which this Project could act cumulatively with other Projects to impact on Fulmar.	No	No

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Appendix A Cumulative Effects Assessment for the Project and other Projects and Plans

Project phase	Developer - Reference	Approx. distance to mWave (km)	Spatial/ temporal overlap with the mWave project	Details	Date of Construction	Further Assessment required?	Notes taken from assessment
Dredging sites							
Installation/ Operation and Maintenance	Neyland Yacht Haven ltd. - DML1743	11.5	No spatial overlap. Potential for temporal overlap.	Dredge and disposal from Neyland Marina - annual volume 5500 m^3.	13/12/2017-12/12/2020	No	mWave project is very localised in extent and due to the scale and nature of the project no LSE has been identified on habitats and species of SACs or SPAs (Section 6.0). Considering the very small physical scale of the Project and the very low likelihood of any impact occurring, there is considered to be no mechanism by which this Project could act cumulatively with other Projects.
Installation/ Operation and Maintenance	Milford Haven Port Authority - DML1646	4.5	No spatial overlap Potential for temporal overlap.	Maintenance dredging throughout the Milford Haven. Annual volume 362500 m^3.	09/03/2017-08/03/2022	No	mWave project is very localised in extent and due to the scale and nature of the project no LSE has been identified on habitats and species of SACs or SPAs (Section 6.0). Considering the very small physical scale of the Project and the very low likelihood of any impact occurring, there is considered to be no mechanism by which this Project could act cumulatively with other Projects.
Dredge disposal sites							
Installation/ Operation and Maintenance	Neyland dredge disposal site - LU190	11.5	No spatial overlap. Potential for temporal overlap	Location: South of Neyland within the central channel of the Milford Haven, 0.22 nm diameter x 5 m depth Status: Open	Not applicable	No	mWave project is very localised in extent and due to the scale and nature of the project no LSE has been identified on habitats and species of SACs or SPAs (Section 6.0). Considering the very small physical scale of the Project and the very low likelihood of any impact occurring, there is considered to be no mechanism by which this Project could act cumulatively with other Projects.
Installation/ Operation and Maintenance	Milford Haven dredge disposal site - LU170	5	No spatial overlap. No temporal overlap as site is closed.	Location: South of St Ann's Head at the mouth of the Milford Haven estuary, unknown diameter x 30 m depth. Status: Closed	Not applicable	No	Site closed. No further assessment.
Installation/ Operation and Maintenance	St Ann's Head dredge disposal site - LU180	5	No spatial overlap. No temporal overlap as site is closed	Location: Within the Milford Haven dredge disposal site, unknown diameter x 30 m depth. Status: Closed	Not applicable	No	Site closed. No further assessment.
Installation/ Operation and Maintenance	Milford Haven Two dredge disposal site - LU169	16	No spatial overlap No temporal overlap.	Location: To the south of Milford Haven dredge disposal grounds, unknown diameter x 50 m depth. Status: Open		No	mWave project is very localised in extent and due to the scale and nature of the project no LSE has been identified on habitats and species of SACs or SPAs (Section 6.0). Considering the very small physical scale of the Project and the very low likelihood of any impact occurring, there is considered to be no mechanism by which this Project could act cumulatively with other Projects
Installation/ Operation and Maintenance	Milford Haven Three dredge disposal site - LU169	37	No spatial overlap No temporal overlap.	Location: To the west of Milford Haven dredge disposal grounds, 1 nm diameter x unknown depth. Status: Open		No	mWave project is very localised in extent and due to the scale and nature of the project no LSE has been identified on habitats and species of SACs or SPAs (Section 6.0). Considering the very small physical scale of the Project and the very low likelihood of any impact occurring, there is considered to be no mechanism by which this Project could act cumulatively with other Projects
Research							
Installation	Greenlink Interconnector Ltd. - RML1827	0	Potential spatial overlap Temporal overlap	Ground investigations		Yes	mWave project is very localised in extent and due to the scale and nature of the project no LSE has been identified on habitats and species of SACs or SPAs (Section 6.0). Considering the very small physical scale of the Project and the very low likelihood of any impact occurring, there is considered to be no mechanism by which this Project could act cumulatively with other Projects
Installation	University College of Swansea - DEML1861	7	Location is assumed to be by the Pembroke Power station. No spatial overlap. Temporal overlap.	Pembroke Power bubble barrier experiment Investigation into the effectiveness of bubble curtains in sediment management	07-2018 - no end date given Band 2 licence issued 12/12/2018 - three-year study	No	mWave project is very localised in extent and due to the scale and nature of the project no LSE has been identified on habitats and species of SACs or SPAs (Section 6.0). Considering the very small physical scale of the Project and the very low likelihood of any impact occurring, there is considered to be no mechanism by which this Project could act cumulatively with other Projects.

Project phase	Developer - Reference	Approx. distance to mWave (km)	Spatial/ temporal overlap with the mWave project	Details	Date of Construction	Further Assessment required?	Notes taken from assessment
Installation	University College of Swansea - DEML1845	1.5	Potential spatial overlap Temporal overlap	Deposition and subsequent removal of marker buoys with environmental monitoring and mid-water settlement plates.	30/08/2018-29/08/2019	No	No cumulative effects as there will be no temporal overlap of the projects.
Installation/ Operation and Maintenance	Neyland Yacht Haven Ltd - CML1658	11.5	No spatial overlap. No temporal overlap.	Pile replacement in Neyland Marina.	21/11/2016-20/11/2019	No	No cumulative effects as there will be no temporal overlap of the projects.
Installation/ Operation and Maintenance	Mixed use developments - Local Planning Authority Reference: 14/0158/PA	10	No spatial overlap. Temporal overlap remains unknown.	Undetermined planning application. Demolition of several existing buildings and the mixed-use redevelopment of Milford Waterfront comprising up to 26,266 m^2 of commercial, hotel, leisure, retail and fishery related floorspace. Up to 190 residential properties, up to 70 additional marina berths, replacement boat yards, landscaping, public realm enhancements, access and ancillary works. A decision on this application is yet to be made by the local planning authority.	EIA screening decision was returned on the 30/04/2018 - no further information has been provided	No	mWave project is very localised in extent and due to the scale and nature of the project no LSE has been identified on habitats and species of SACs or SPAs (Section 6.0). Considering the very small physical scale of the Project and the very low likelihood of any impact occurring, there is considered to be no mechanism by which this Project could act cumulatively with other Projects
Installation/ Operation and Maintenance/ Decommissioning	Greenlink Interconnector Ltd. - Government reference: qA1296053	0	Spatial overlap at edge of deployment area. Temporal overlap	The Project is a 500MW subsea electricity interconnector linking the power markets in Ireland and Great Britain and is planned for commissioning in 2023. As an EU Project of Common Interest, it is one of Europe's most important energy infrastructure projects. The interconnector is planned to make Landfall at Fresh Water West beach	07/2018 - ongoing	Yes	mWave project is very localised in extent and due to the scale and nature of the project no LSE has been identified on habitats and species of SACs or SPAs (Section 6.0). Considering the very small physical scale of the Project and the very low likelihood of any impact occurring, there is considered to be no mechanism by which this Project could act cumulatively with other Projects
Installation/ Operation and Maintenance	EGNEDOL Wales Ltd	N/A	Potential temporal overlap	EGNEDOL propose to create an environmentally sustainable centre of excellence in Milford Haven, at the Waterston and Blackbridge sites. The proposal includes providing business units and refurbishing a jetty to serve as a primary supply link to the EGNEDOL electricity generation plan, and for export of products. The land-based green energy scheme may generate up to 350 MW.	Not available	No	mWave project is very localised in extent and due to the scale and nature of the project no LSE has been identified on habitats and species of SACs or SPAs (Section 6.0). Considering the very small physical scale of the Project and the very low likelihood of any impact occurring, there is considered to be no mechanism by which this Project could act cumulatively with other Projects
Ministry of Defence sites							
	Ministry of Defence	0.1	Temporal overlap	The Castlemartin Range is located immediately south of the entrance to the Waterway and extends for up to 12 NM from the coast between Little Furznip (at the southern extent of Freshwater West) and St Govan's Head (Milford Haven Port Authority 2019). The southern boundary of the East Pickard Bay (Site 8) site is located adjacent to the northern boundary of the Castlemartin Military	Not applicable	Yes	mWave project is very localised in extent and due to the scale and nature of the project no LSE has been identified on habitats and species of SACs or SPAs (Section 6.0). Considering the very small physical scale of the Project and the very low likelihood of any impact occurring, there is considered to be no mechanism by which this Project could act cumulatively with other Projects

Project phase	Developer - Reference	Approx. distance to mWave (km)	Spatial/ temporal overlap with the mWave project	Details	Date of Construction	Further Assessment required?	Notes taken from assessment
				Practice Area D113A. The range at Castlemartin supports the training of military personnel (Army) in the firing of a range of munitions at land based targets.			
Aquaculture projects							
Installation/ Operation and Maintenance	Tethys Oysters	3	Temporal overlap	The oyster farm is located on the eastern side of Angle Bay, whereby oysters are grown in baskets on metal supports. The farm will be serviced from the shore by foot	Oct 2017 – Oct 2020 (possible renewal of licence)	No	mWave project is very localised in extent and due to the scale and nature of the project no LSE has been identified on habitats and species of SACs or SPAs (Section 6.0). Considering the very small physical scale of the Project and the very low likelihood of any impact occurring, there is considered to be no mechanism by which this Project could act cumulatively with other Projects
Installation/ Operation and Maintenance	Pembrokeshire Scallops	6.5	Temporal overlap	The scallop farm is located within Castlebeach Bay, whereby a system of weighted ropes will be deployed for growing scallops and mix species of native algae. The farm will be serviced by vessels and divers	Jan 2019 – Q4 2020 (possible renewal of licence)	no	mWave project is very localised in extent and due to the scale and nature of the project no LSE has been identified on habitats and species of SACs or SPAs (Section 6.0). Considering the very small physical scale of the Project and the very low likelihood of any impact occurring, there is considered to be no mechanism by which this Project could act cumulatively with other Projects
Pembroke Dock Marine Projects							
Installation/ Operation and Maintenance	Milford Haven Port Authority - SC1810: Pembroke Dock Infrastructure	10	No spatial overlap. Potential for temporal overlap	Pembroke Dock redevelopment. Scoping Report submitted. The intention of the Project is to create a flexible and efficient port-related office, industrial, warehousing and distribution, and ancillary operations infrastructure. This will involve the redevelopment of its existing space to incorporate increased deep-water access, internal and external heavy fabrication areas, construction of MEECE and Education/Skills Facility and the construction of a heavy lift facility.	Q3 2019 – Q3 2023	No	mWave project is very localised in extent and due to the scale and nature of the project no LSE has been identified on habitats and species of SACs or SPAs (Section 6.0). Considering the very small physical scale of the Project and the very low likelihood of any impact occurring, there is considered to be no mechanism by which this Project could act cumulatively with other Projects.
Installation/ Operation and Maintenance	META Project, Site 8	0	Spatial overlap Temporal overlap will occur throughout the duration of the mWave project	The META project will allow the deployment and testing of marine renewable devices in the waters off East Pickard Bay. META Site 8 will be consented for up to two devices. An assessment of the maximum META project design has been undertaken in the ES supporting the consents.	In consenting	Yes	mWave project is very localised in extent and due to the scale and nature of the project no LSE has been identified on habitats and species of SACs or SPAs (Section 6.0).The META project concluded no significant effects on relevant Natura 2000 receptors. Considering the very small physical scale of the Project and the very low likelihood of any impact occurring, there is considered to be no mechanism by which this Project could act cumulatively with other Projects.
Installation/ Operation and Maintenance/Decommissioning	Marine Energy Wales - DEML1875	9.4	No spatial overlap Potential for temporal overlap	Marine Energy Test Area - Phase 1 Band 2 application submitted. The Project aims to create pre-consented test areas within the Pembroke Dock area. The test areas will have licensable activities to suit testing of initial stage marine renewable devices. These include testing of non-operating components and subassemblies. No full-scale testing is to be support within the test areas	21/04/2019-21/04/2029	No	mWave project is very localised in extent and due to the scale and nature of the project no LSE has been identified on habitats and species of SACs or SPAs (Section 6.0). Considering the very small physical scale of the Project and the very low likelihood of any impact occurring, there is considered to be no mechanism by which this Project could act cumulatively with other Projects.
Installation/ Operation and Maintenance/Decommissioning	Wave Hub Ltd. - SC1082	20	No spatial overlap No temporal overlap	Demonstration zone Scoping Report submitted The Project entails the development of	2024	No	mWave project is very localised in extent and due to the scale and nature of the project no LSE has been identified on habitats and species of SACs or SPAs (Section 6.0). Considering the very small physical scale of the Project

Project phase	Developer - Reference	Approx. distance to mWave (km)	Spatial/ temporal overlap with the mWave project	Details	Date of Construction	Further Assessment required?	Notes taken from assessment
				90 km2 of seabed with water depths of approximately 50 metres and a wave resource of approximately 19 kW/m; to support the demonstration of wave arrays with a generating capacity of up to 30MW for each project. Consent for this Project could be achieved in 2022, infrastructure could be built by 2024 and the first technology could be installed in 2025.			and the very low likelihood of any impact occurring, there is considered to be no mechanism by which this Project could act cumulatively with other Projects.

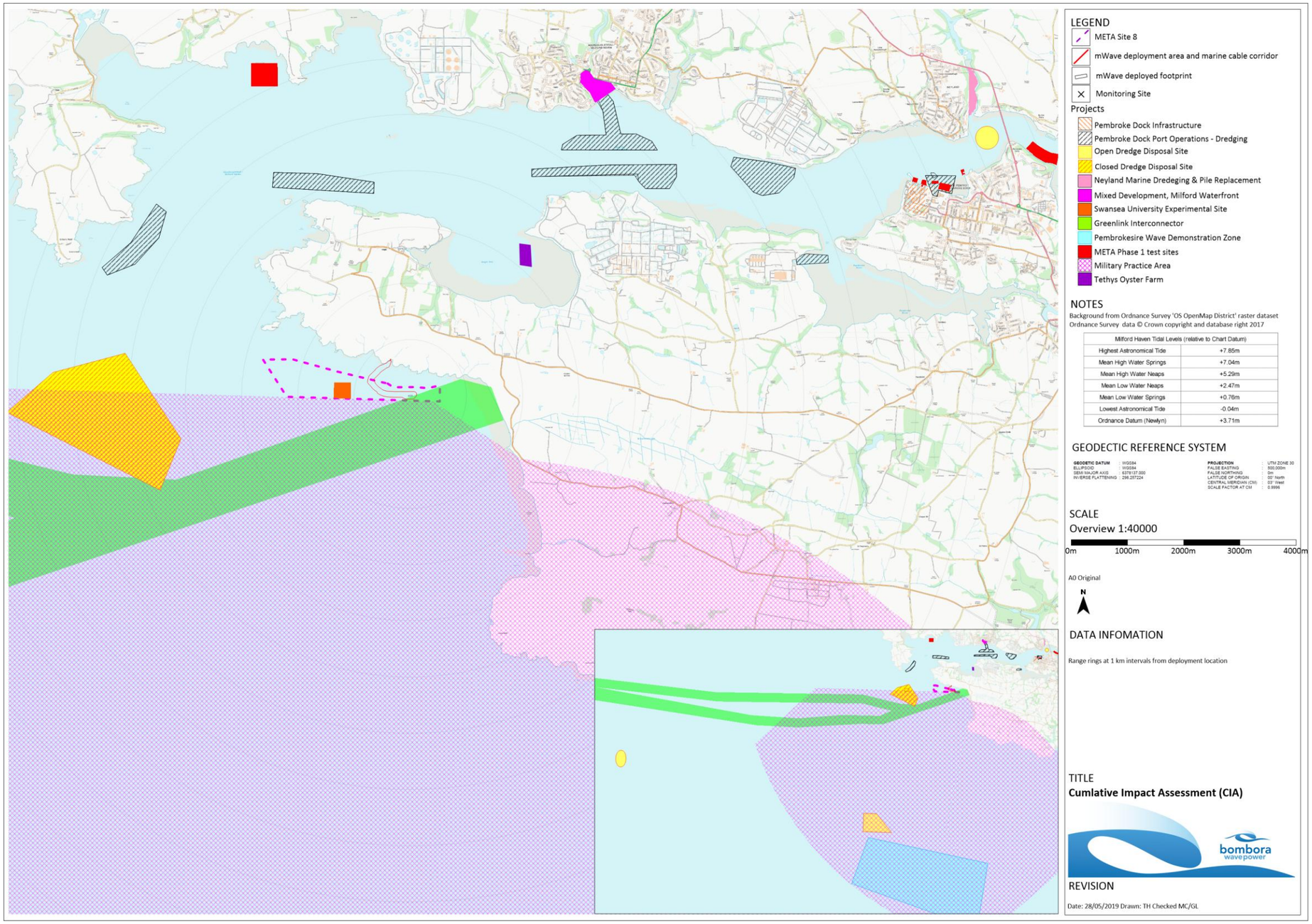

Figure A Location of projects considered as part of the cumulative effects assessment