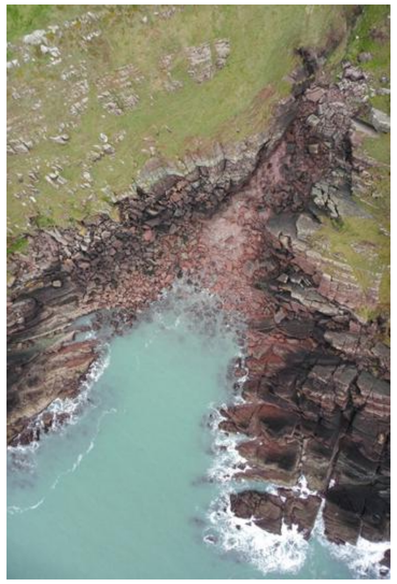
mWave Marine Energy Device and Onshore Infrastructure

ENVIRONMENTAL STATEMENT



June 2019

CHAPTER 2: Project Description

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Glossary

Term	Definition
Above Ordnance Datum	Height of land above Mean Sea Level Newlyn.
Acoustic Doppler Current Profiler	An acoustic doppler current profiler (ADCP) is a hydroacoustic current meter similar to sonar, used to measure waves and water current velocities over a range of depth.
Below Chart Datum	Depth of land below Mean Sea Level Newlyn.
Decommissioning phase	The period over which retrieval and removal of mWave infrastructure will occur.
Draught	The vertical distance between the waterline and the bottom of the hull of a marine vessel.
Dynamic Positioning	Use of a vessel's thrusters and propellers to maintain position
Environmental Impact Assessment (EIA)	A statutory process by which certain planned projects must be assessed before a formal decision to proceed can be made. It involves the collection and consideration of environmental information, which fulfils the assessment requirements of the EIA Directive and EIA Regulations, including the publication of an Environmental Statement.
Environmental Management Plan	Document that sets out the environmental framework within which the project will be delivered including covering consents and legislative requirements. The plan will include sub-plans where these are required e.g. Marine Pollution Contingency Plan.
Environmental Mitigation and Monitoring Plan	A document detailing the mitigation and monitoring proposed to be undertaken.
Impact	Change that is caused by an action; for example, land clearing (action) during construction which results in habitat loss (impact).
META Project	The META project, located in Pembrokeshire, consists of eight test sites where marine energy testing activities will be permitted. The licensing and consenting of the mWave project was originally intended to be undertaken within the consenting and licensing of the META project, with mWave being deployed within META Site 8.
MHWS	The height of mean high water springs is the average throughout the year (when the average maximum declination of the moon is 23.5°) of two successive high waters during those periods of 24 hours when the range of the tide is at its greatest.
MLWS	The height of the mean low water springs is the average height obtained by the two successive low waters during the same period as mean high water springs.
Operation and maintenance phase	The period over which operational and maintenance activities to support mWave marine energy testing.
Pembroke Dock Marine (PDM)	Project aiming to develop a world class centre for marine energy development, fabrication, testing and deployment. Part of the wider Swansea Bay City Deal.
Receptor	A component of the natural or man-made environment that is affected by an impact, including people.
Chain ballast	Weight required in the form of chain which will be placed in the ballast trays of the device. as part of waves seabed attachment method.
Seabed clearance	Clearance of areas of seabed for some devices to allow safe attachment to/placement on the seabed.
Subsea Umbilical Termination Unit	Underwater connection box approx 1.5m². mWave umbilical from device, communication cable coming from East Pickard Bay landfall and ADCP will connect into unit.
Swansea Bay City Deal	A project aiming to drive the Welsh economy forwards, increasing productivity, supporting jobs and increasing investment in the Swansea Bay City Region.
The Waterway	The Milford Haven Waterway

Acronyms

Acronym	Description
ADCP	Acoustic Doppler Current Profiler
AOD	Above Ordnance Datum
bcd	below chart datum
DEFRA	Department for Environment, Food and Rural Affairs
DP	Dynamic Positioning
EIA	Environmental Impact Assessment
EMMP	Environmental Mitigation and Monitoring Plan
EMP	Environmental Management Plan
HSE	Health and Safety Executive
INNS	Invasive Non-Native Species
MCA	Maritime and Coastguard Agency
META	Marine Energy Test Areas
MEW	Marine Energy Wales
MHPA	Milford Haven Port Authority
MHWS	Mean High Water Springs
ML	Marine Licence
MLWS	Mean Low Water Springs
MOD	Ministry of Defence
NPS	National Policy Statement
NRWa	Natural Resources Wales advisory
NRW-PS	Natural Resources Wales – Permitting Services
PDM	Pembroke Dock Marine
SAC	Special Area of Conservation
SPA	Special Protection Area
SSSI	Site of Special Scientific Interest
SUTU	Subsea Umbilical Termination Unit

Acronym	Description
WEC	Wave Energy Converter
UXO	Unexploded Ordnance

Units

Unit	Description
Ha	Hectare
km	Kilometre
m	Metre
mm	Millimetre
month	Calendar month
m^2	Metres squared
MW	Megawatt (electrical power)
m/s	Metres per second
NM	Nautical Mile

2. PROJECT DESCRIPTION

2.1 Introduction

2.1.1.1 This chapter provides a description of the offshore and onshore elements of the mWave project for which a marine licence and planning permission is being sought. The project description forms the basis for the environmental assessment provided in this Environmental Statement.

2.1.1.2 The effects of the project which have been assessed throughout the Environmental Statement is based on the most up to date design information. Where elements may vary, for instance exact number of operation and maintenance vessel trips, the assessment encompasses the maximum scenario.

2.1.1.3 The option assessment stage (Chapter 3: Needs and Alternatives) in combination with a number of measures which have been included as part of the project design, would reduce or avoid adverse environmental effects arising. For instance, the communication cable will be laid on the seabed and on land, and not buried thereby reducing impacts both offshore and onshore. In addition, in agreement with NRWa, the positioning of the Wave Energy Converter (WEC) on sand away from Annex I reef. Details of measures are provided in this chapter (section 2.6.2), and those that are relevant to each topic are set out in each topic chapter. This chapter, together with the subsequent topic chapters, provide the information required to identify and assess the likely significant effects of the project in accordance with Regulation 18 and Schedule 4 of the EIA Regulations.

2.2 Purpose of this chapter

2.2.1.1 The primary purpose of the Environmental Statement is to support the marine licence application for the mWave project, including the WEC, marine communications cable up to MHWS, Acoustic Doppler Current Profiler (ADCP), Subsea Umbilical Termination Unit (SUTU) and navigational markers (if needed) and the planning application for the onshore section of the cable (from MLW), the termination box, anchor point and onshore control station.

2.2.1.2 This chapter provides a description of the various elements of the mWave project, both offshore and onshore components. The chapter goes on to provide details of the approach to installation, operation and maintenance and decommissioning works in the marine and terrestrial environment. Information is provided on vehicle/vessel numbers as well as details on noise levels as a result of the onshore element of the project, both installation and operation. Information on the potential noise as a result of offshore installation and operation are provided in Chapter 6: Underwater Noise, and this information is subsequently used in the assessments on fish (Chapter 8) and marine mammals (Chapter 9).

2.3 Policy context

2.3.1.1 As identified in Chapter 1 Introduction it was originally intended that the licensing and consenting of the mWave project would be undertaken within the consenting and licensing of the META Project Site 8 (East Pickard Bay), with the mWave being located within the eastern part of META Site 8 (approximately 2.2km from the western boundary and 0.5km from the eastern boundary). 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, it was agreed with NRW-PS and MEW 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. Whilst the META project is to be consented for a range of different marine devices over a 15 year period, and a maximum and most likely Project Design Envelope has been identified for assessment to encompass a range of different devices, this application is for a single device of known characteristics for a short duration (up to 18 months).

2.3.1.1 The project design envelope for the mWave project is set out in this chapter based on the guidance provided in Schedule, Regulation 12(2) of The Marine Works (Environmental Impact Assessment) (Amendment) Regulations 2017. The project description will cover the three main components, namely the offshore mWave device, the communication cable route and the onshore control station. For ease of reference the offshore works are discussed first followed by the onshore works.

2.3.1.2 Guidance on what the Project Description chapter should contain can be found in the Overarching National Policy Statement for Energy (EN-1) states that *'the Environmental Statement should set out, to the best of the applicant's knowledge, what the maximum extent of the proposed development may be in terms of site and plant specifications, and assess, on that basis, the effects which the project could have to ensure that the impacts of the project as it may be constructed have been properly assessed'*

2.4 Consultation

2.4.1.1 Whilst limited specific consultation has been undertaken for mWave as a standalone project, consultation was undertaken as part of the wider META project. A summary of the key issues raised during consultation specific to use of Site 8 or the mWave project is outlined in Table 2.1 below, together with how these issues have been considered in the production of this Environmental Statement chapter.

2.4.1.2 Table 2.1 below summarises the issues raised relevant to the project description which have been identified during consultation activities undertaken to date. Table 2.1 also indicates either how these issues have been addressed within this Environmental Statement or how the Applicant has had regard to them. Note that consultation specific to each environmental subject area is presented within the relevant topic chapter.

Table 2.1: Summary of key consultation issues raised during consultation activities undertaken for the META project which is relevant to mWave Project Description

Date	Consultee and type of response	Issues raised	Response to issue raised and/or where considered in this chapter
Dec 2017	Element Power – direct engagement	Potential overlap with Element Power Greenlink Interconnector.	Clarified that the Greenlink cable route would not have any direct impacts on the proposed site at East Pickard Bay.
May 2018	MOD – Rural Steering Group	Concept presented and proposed locations identified. One site located adjacent MOD firing range. Requested to be kept informed	Clarified that no direct impact to range (mWave will be 100m north of the northern boundary of the range).
	NRWa Scoping Opinion	We consider that the location of the East Pickard Bay test area should be amended. This is because it currently covers a large area that includes both circalittoral rock and mobile sand. In order to minimise the direct impact on designated (SAC) reef feature, which includes all circalittoral rock in the area, it would be beneficial to move the East Pickard Bay site to the South slightly to cover only areas of mobile sand substrate. This should be easily identified in the multibeam bathymetry as the boundary between rock and sand will be clear. The subtidal sand substrate in Freshwater West bay is not part of the subtidal sandbank SAC feature. Section 2.4.3: The proposed area currently overlaps with Pembrokeshire Marine SAC reef feature as well as mobile sand habitat which does not form part of an Annex I feature of the SAC. We advise that, in order to minimise the risk of impact to this SAC feature, the test area is revised and moved slightly to the south to focus the area on sand substrate only. The bathymetric survey already completed should be sufficient to establish the difference between the reef and sand habitats which can then be used to inform a revised area. If these changes are made then we do not consider that further surveys would be required within this area, because: • Mobile sand is resilient to the habitat disturbance and temporary loss of habitat. There would likely be a quick recovery of the habitats affected. • The habitat is not part of a SAC feature.	Bathymetric survey was undertaken of the mWave deployment location and the surrounding area (Titan 2018). The results of the survey confirmed that mWave will be positioned on an expanse of circalittoral coarse sediments remote from Annex I reef habitat. Dropdown video camera survey has been undertaken along the cable route which has confirmed that the cable passes across sandy sediments before reaching the rock coastline. The species present 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.
	NRWa Scoping Opinion	We consider that Construction impacts should also be included – debris, pollutants etc. Construction methods need to ensure that pollutants and debris on the seafloor are minimised.	As described in section 2.5.2, the deployment of mWave requires minimal works, with no seabed preparation and the device simply being towed to site and lowered onto the seabed, with chain ballast added to trays on the WEC. As such the potential for debris and pollution will be minimised. Notwithstanding this, a marine pollution control plan (MPCP) forms part of the Environmental Management Plan (EMP) see section 2.6.3.
	NRWa Scoping Opinion	Given the proposed time scale for deployments the potential impacts to coastal processes are likely to be short term and recoverable. However, the suggested refinement of the PDE above will help to resolve potential issues around multiple deployments over a wide area.	The mWave project is the deployment of a single WEC for up to18months. As identified by NRWa and confirmed in Chapter 5, Coastal Processes the potential impacts to coastal processes are short term and recoverable.
	NRWa Scoping Opinion	The description of the project as a whole is clear but there is some detail lacking on the scale of the devices to be deployed and the type of devices likely to be deployed.	mWave is standalone deployment and details of the device are provided in this chapter.
	NRW Scoping Opinion	In order to determine the most suitable location within the wider test area we recommend that multi-beam bathymetric surveys are conducted for each test area. This will allow identification of the broader habitats and help target areas where drop down video can be used to ground truth this information. The chosen area should present low sensitivities to the various impacts from the project as well as high resilience to habitat disturbance and temporary loss.	Bathymetric multi-beam survey data has been collected for the mWave deployment site and surrounding area (Titan 2018). This data has been used to ensure appropriate positioning of the device on sandy substrate. In addition to this dropdown video camera survey has been undertaken along the cable route which has confirmed that the cable passes across sandy sediments before reaching the rock coastline. The species present 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.

2.5 Project Description

2.5.1 Project Overview

2.5.1.1 The mWave Project entails the testing of a full-scale wave energy prototype device which is to be deployed off East Pickard Bay on the south side of the Angle Peninsula. mWave will not be grid-connected, although a temporary communications cable and onshore control station will be required to enable testing. 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.

2.5.1.2 A Marine Licence is being sought from Natural Resources Wales-Permitting Services (NRW-PS) for the offshore works, whilst planning permission is being sought from Pembrokeshire Coast National Par Authority (PCNPA) for the onshore works, both for a period of 18 months. The red line boundary for the marine licence and planning application is shown on Figures 1.1a and 1.1b respectively (Chapter 1: Introduction). The red line boundary for the marine licence includes the location of the full scale Wave Energy Converter (WEC), mWave, and any agreed navigational markers, a Subsea Umbilical Termination Unit (SUTU) which connects mWave to an Acoustic Doppler Current Profiler (ADCP) for monitoring currents and the marine communication cable up to Mean High Water Springs (MHWS). The red line boundary for the onshore planning application includes the communication cable from Mean Low Water (MLW) to a termination box and anchor points close to the coast, and then onwards to the control station and the site access from the control station to the B4320.

2.5.1.1 Figure 1.1a shows the red line boundary for the marine licence and includes detail on the following:

- infrastructure deployment area; the area within which the communications cable and SUTU will be deployed for the full operational period,
- mWave deployment area; the area within which the mWave device will be deployed for the full operational period,
- ADCP and ADCP communication cable deployment area; the area within which the ADCP and ADCP communication cable will be deployed for the full operational period.
- temporary mooring area; the area within which temporary moorings could be deployed for installation or maintenance.

2.5.1.2 The mWave deployment area consists of an area 2.6 ha of sandy substrate, allowing mWave to be microsited following a pre-deployment bathymetry survey and possible UXO survey. The boundary includes a width of 100m for communications cable micrositing.

2.5.1.3 The red line boundary for the planning consent includes a cable corridor of 5m from MLW and provision for the siting of the control station within an area of 0.24 ha. The site access and site entrance is 0.18 ha, the width of the track and entrance onto the public highway.

2.5.2 Details of mWave device

Marine Access

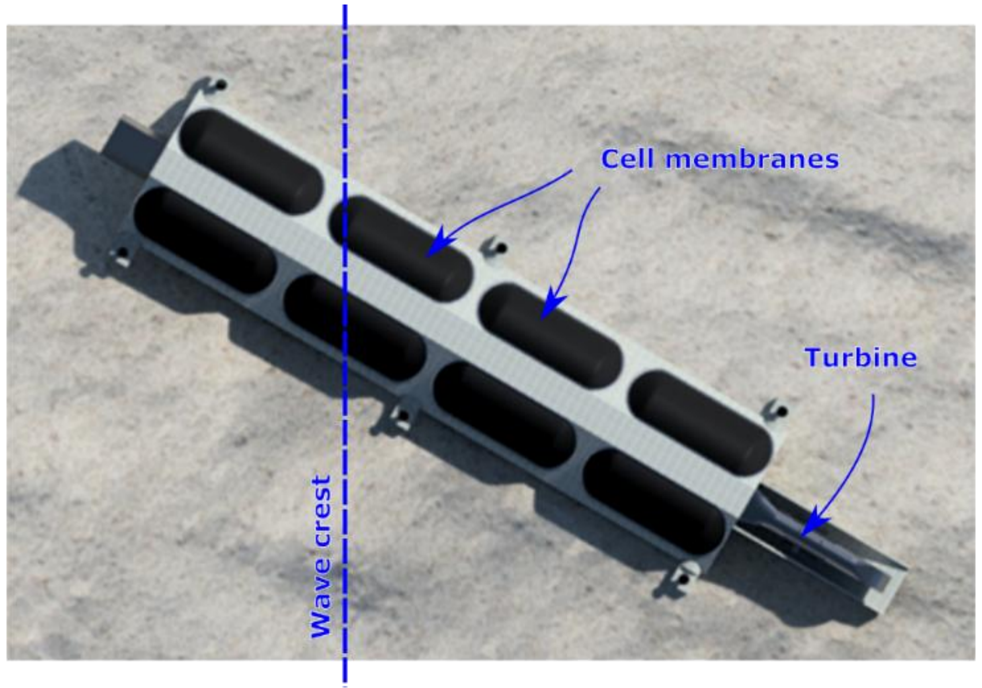
2.5.2.1 Access to the deployment site off East Pickard Bay will be from the Port of Pembroke / Milford Haven. Vessels installing and decommissioning the mWave project will have a maximum length of 50m, and a maximum draught of 6m. Vessels involved in the project will not require the use Dynamic Positioning for maintaining position during installation.

mWave Design and How it Works

2.5.2.2 The mWave is a submerged pressure-differential absorber with flexible membranes as the working interface. As such the mWave device will sit on the seabed, and it will comprise multiple seafloor-mounted, air-filled cells covered by flexible rubber membranes. 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.

2.5.2.3 The full scale prototype for deployment off East Pickard Bay will have four membrane covered cells. These membrane covered cells convert wave pressure into internal cell air pressure. Wave peaks and troughs above the WEC cause differential pressure between cells. 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 totally enclosed so that no water gets into the enclosed pressurised 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.

2.5.2.4 Figure 2.1 below provide an illustration of the mWave device and Figure 2.2 illustrates the main components of mWave.



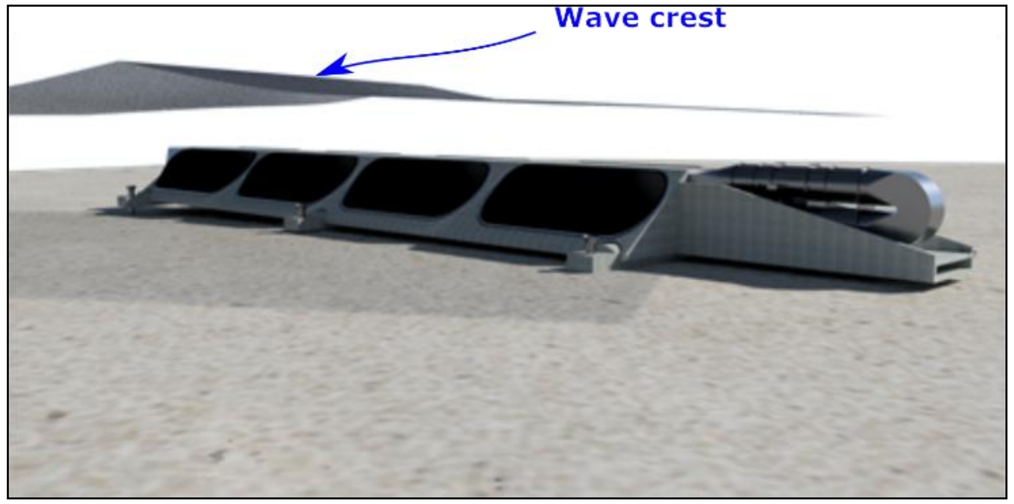


Figure 2.1: Artistic impression of the commercial full-scale *mWave* prototype, in (a) plan view and (b) elevation view, with waves approaching from the right.

2.5.2.5 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 membranes.

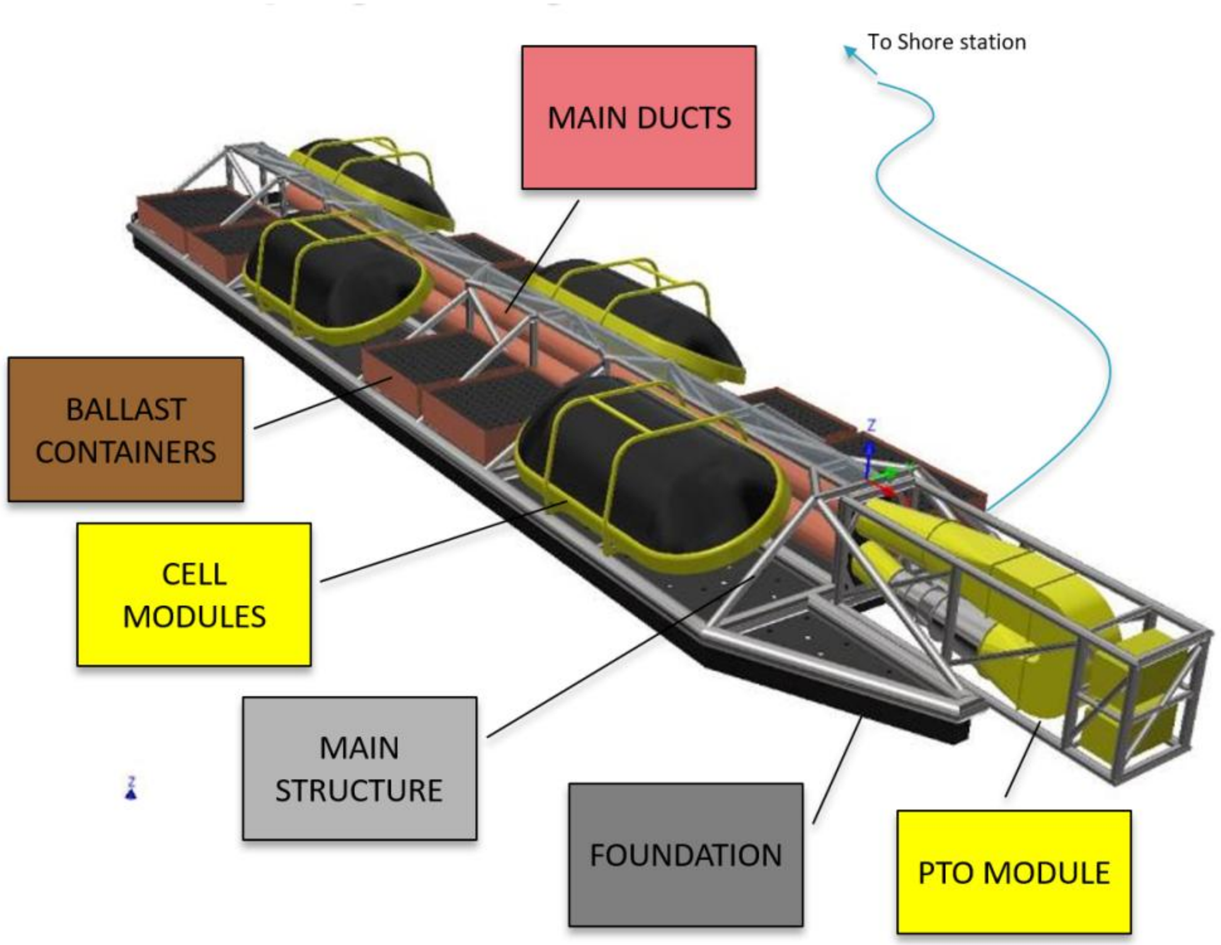


Figure 2.2: CAD image of the mWave device to be installed off East Pickard Bay.

mWave Foundation

2.5.2.6 The mWave device has been designed with gravity foundations, so that installation will be relatively simple with no need for piles or anchoring points. As such it will have minimal impact on the seabed. The foundation of mWave comprises a keyed skirt that presses into the sand (Figure 2.3). 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 (Figure 2.2) and chain will be placed in the trays to add further weight to the device. Once the deployment period is complete, the chain ballast can be removed and the device can simply be lifted off the seabed. The sand will fall out of the skirt back onto the seabed.

Figure 2.3: Underside of the mWave showing the skirted foundation

mWave Deployment Site Characteristics

2.5.2.7 As discussed previously the mWave sits on the sea-bed fully submerged with no infrastructure above the sea surface. The preferred depth of submergence of the device in most long-fetch wave climates will be in the range of 8-15m (from mean low water level to mWave base). The precise submergence required depends on the wave resource in the area, with deeper depths being appropriate for sites with larger wave resource. The location for mWave will be 11m below Chart datum (as shown on Figure 2.4), which will provide a water clearance above the device of between 4.2m - 10.5m between MLWS and MHWS. The deployment area for mWave off East Pickard Bay is shown on Figure 1b, Chapter 1: Introduction.

2.5.2.8 With the design of mWave's gravity foundation, the optimum position for the mWave device is on a sandy substrate. In this way the sand can be used to stabilise the device during testing. Bathymetry data for the site (Titan 2018) has confirmed that the seabed substrate is suitable, in that there is depth of 2m of sand on the seabed. The data also confirms that there will not be any requirement for geotechnical clearance (no rocks present) and that the device will be located on an area of relatively flat sandy seabed (no sand ripples present). The ADCP, which will monitor waves and currents in the area, will be positioned to the southeast of mWave (Figure 2.4).

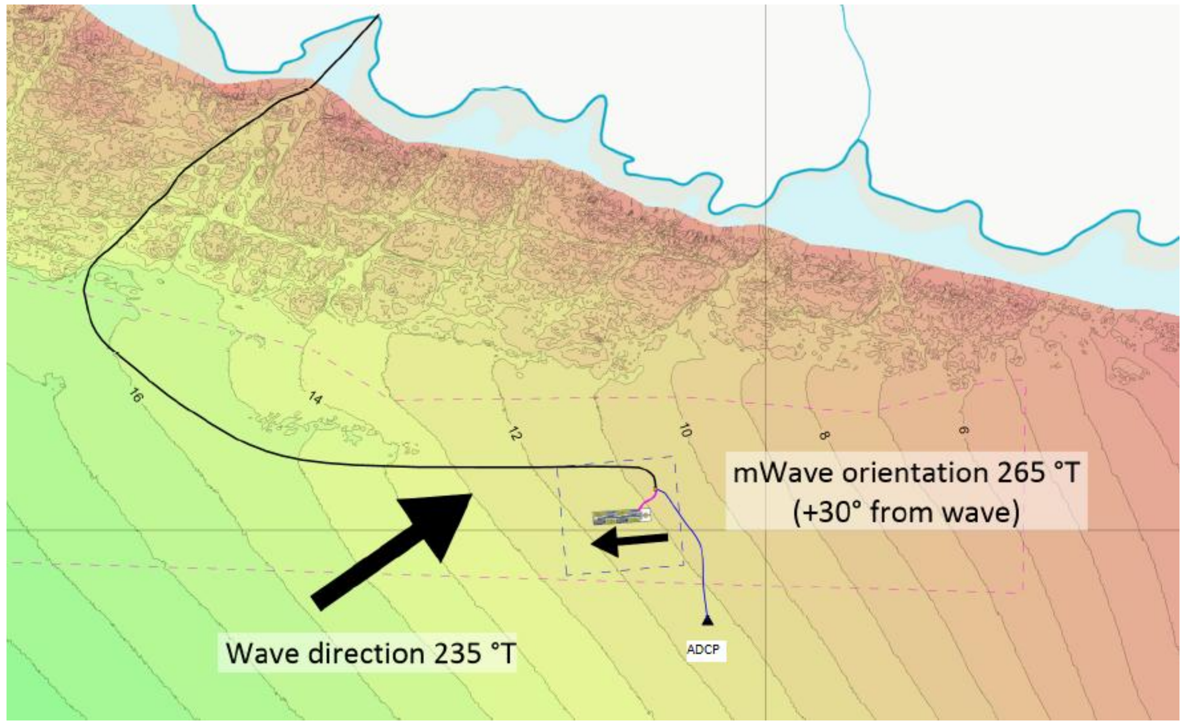


Figure 2.4 Bathymetric data for mWave deployment site and cable route (Titan 2018)

mWave Manufacturing and Installation

2.5.2.9 An outline installation programme is provided in Figure 2.5 overleaf. It is anticipated that key components of the mWave device will be manufactured locally. The mWave device will be assembled into one structure at Pembroke Dock. A slipway at Pembroke Dock will be used to lower the device into the water, where it will be towed down the Milford Haven Waterway around the headland to East Pickard Bay. Prior to towing to site some wet testing will be undertaken off Pembroke Dock at the META Phase 1 site.

2.5.2.10 Six moorings will be pre-installed on site in advance of installation. The moorings will span an area of approximately 200m by 200m. Whilst the mooring spread will be of the order 40,000m^2, the actual area affected will be much less (each mooring comprising an 4m x 4m anchor and 65m of 4.4cm chain) for mWave. The proposed temporary spread is to be deployed a couple of days prior to the installation and removed once the installation is complete .

2.5.2.11 For transport to site, buoyancy of the mWave device will be maintained with the use of air in the cells of the device (Figure 2.6). The mWave device will be towed to site using two multicat vessels (50m in length with a draught of up to 6m), one at each end. At the installation location, the two installation vessels will be secured using a pre-installed mooring system. A guard boat will be present during the installation process to ensure safety and monitor a 200m advisory clearance area.

2.5.2.12 When the mWave device is over the deployment site, sufficient air will be released from the cells for the device to sink slowly to the seabed using controlled buoyancy. One end will be lowered and touch the seabed before the other end is released (Figure 2.7). Once the mWave device is on the seabed ballast in the form of chain will be used to maintain the device position on the seabed. The chain will be brought to the site and placed in the ballast containers as shown on Figure 2.2.

2.5.2.13 The offshore works for the installation of mWave will take up to 3 days during an appropriate weather window, with the temporary vessel moorings being installed in advance The delivery of chain ballast will require up to 14 vessel visits (26m by 2.5m draught), over five days, The timing of marine works will be dependent on securing required consents and licences, and the discharge of associated consent conditions, as well as an appropriate weather window.

ACTIVITY	DURATION	2020										2021					
		MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN
Site preparation and control station installation	2 weeks																
Onshore cable installation from junction box to control station	5 days																
Offshore cable installation to onshore junction box	3 days																
mWave device installation at East Pickard Bay	2 days																
mWave device operation (6-12 months)	6-12 months																
mWave device decommisisoning weather window (to avoid winter decommissioning)	< 5 months																
mWave device decommissioning	2 days																
Offshore cable decommissioning to onshore juntion box	3 days																
Onshore cable decommissioning from junction box to control station	5 days																
Control station decommissioning	2 weeks																

Figure 2.5 Provisional mWave Project Programme

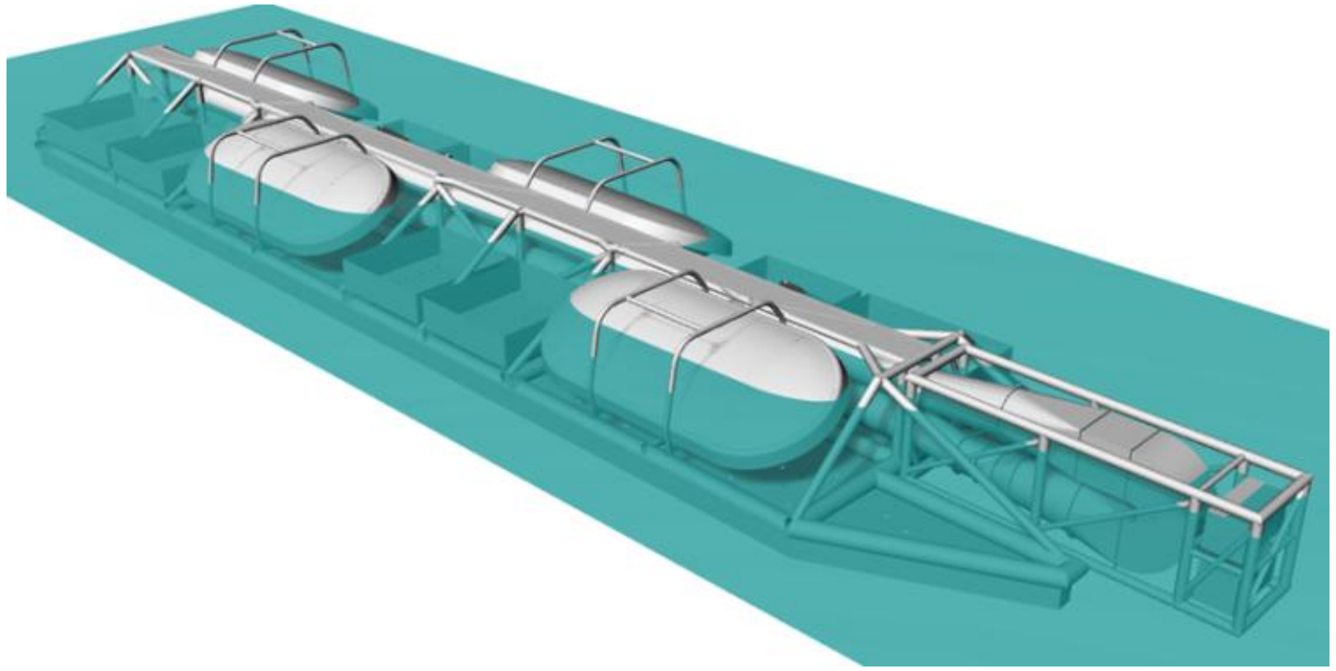


Figure 2.6 Illustrating mWave partially inflated and during transport to site

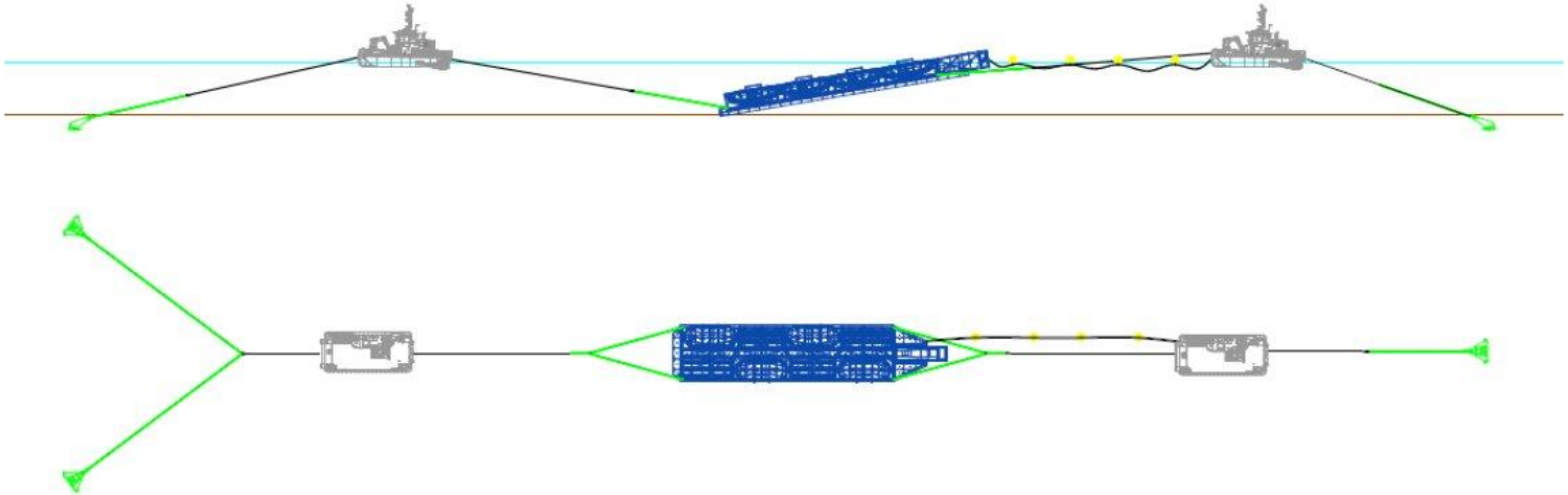


Figure 2.7 Illustrating mWave installation process

2.5.2.14 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 project. A video camera will be positioned on the device and it will monitor the scour during the deployment. Time and date stamped photos will be taken of a gauge painted onto the device to allow assessment of change in sediment depth during the deployment. 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.

mWave Markings and Lighting

2.5.2.15 As identified above there would be between 4.2m and 10.5m water clearance above mWave at MLWS to MHWS. Consultation would be undertaken with Trinity House Lighthouse Services and Maritime and Coast Guard (MCA concerning the requirement for surface navigational markers for the mWave device. If needed the navigational markers/buoys will be coloured as required by navigational statutory stakeholders (Trinity House and MCA).

2.5.2.16 As mWave will be positioned on the seabed there will be minimal lighting associated with offshore testing of mWave. Any lighting will be associated with navigational marking (buoys) if required. Lighting of navigational marker buoys will be discussed and agreed with Trinity House and MCA.

Energy Generation and Energy Demand

2.5.2.17 The mWave device will generate energy when waves pass overhead and will operate at 0.95MW. mWave will not be grid connected, and the electricity generated will either be used by the device (battery charging, powering of instrumentation etc) or it will be converted into thermal energy and dissipated in the sea water (see section 2.5.5, Residue and Emissions). As such a S.36 consent, as required under Electricity Act 1989, will not be required for mWave.

2.5.2.18 In order to gather data from the mWave device during testing a temporary communication cable and temporary onshore control station will be required. The communication cable will provide air for the device, data communications and auxiliary power for periods when the electrical battery storage on the device is too low.

Sustainability

2.5.2.19 Development of marine energy inherently promotes environmental sustainability by utilising renewable natural resources to generate electricity as opposed to non-renewable sources. The testing of the mWave for future development and use is therefore an inherently environmentally sustainable project.

2.5.2.20 In addition, whilst the mWave project is short term, it incorporates the following sustainability measures:

- Use of antifoulants or lubricants that are EU/Internationally approved for use in marine environments;
- Reduce, re-use and recycle in relation to any waste material produced; and
- Support from local supply chain where possible and appropriate, to minimise the carbon footprint of mWave infrastructure production and support requirements.

mWave Vulnerability to Accidents and Disasters

2.5.2.21 During all offshore project activity, the works on site will have to be undertaken in good sea conditions with good visibility. Vessels when on site will be slow moving or moored, due to the nature of work being undertaken. These factors will minimise the risk of potential incidents.

2.5.2.22 Conventional wave energy converters have focused on extracting power from the ocean's surface. These converters must be engineered to survive the harshest ocean storms, increasing design complexity and capital costs. Bombora's mWave harnesses the vast potential of wave energy in the form of pressure on the sea floor where more than 80% of wave energy is accessible at 10 meters below the surface. This greatly reduces the risks associated with surviving extreme storms and enables a simpler and more cost-effective design.

2.5.2.23 In addition to this, the mWave design will also minimise the potential for maritime accidents and disasters by being placed on the seabed with good clearance for vessels which are likely to be in the area, thereby reducing potential interaction with other users and shipping and navigation (see Chapters 12: Shipping and Navigation, and 15: Other Users). The short term deployment minimises the number of vessel transits required for deployment, retrieval, operation and maintenance, so that the potential for near-misses or collisions with other vessels are minimised (see Chapter 12: Shipping and Navigation). Consultation with MCA and Trinity House will confirm the requirements for navigational marker buoys. A Notice to Mariners will be used to identify the position of mWave to other users of the area.

Operation and Maintenance of mWave

2.5.2.24 The actual offshore testing of mWave will be about 6-12 months. During that period the WEC will operate without any need for routine maintenance, with the information on the device performance being transmitted onshore via the communication cable. Notwithstanding this an allowance has been made for routine maintenance and trialling of procedures.

2.5.2.25 Offshore O&M activities will be undertaken approximately once per month which will comprise routine inspection and scheduled maintenance.

2.5.2.26 As discussed above the mWave comprises a main structure, power take off unit (PTO) and 4 cells with membranes. During offshore testing the removal and replacement of the cells and PTO will be undertaken on occasion using a specialist barge or module intervention tool (MIT).

2.5.2.27 The MIT will be towed to site using a working class Multicat for the maintenance operation and it will be secured above the mWave device using a 4 point mooring system spanning an area of approximately 200m by 200m. The MIT and Multicat will be approximately 50m long with a draught of 6m. 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 2.8) 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. Should visual inspection of the device be necessary, it will be undertaken using drop down video camera and diver inspection, where appropriate,

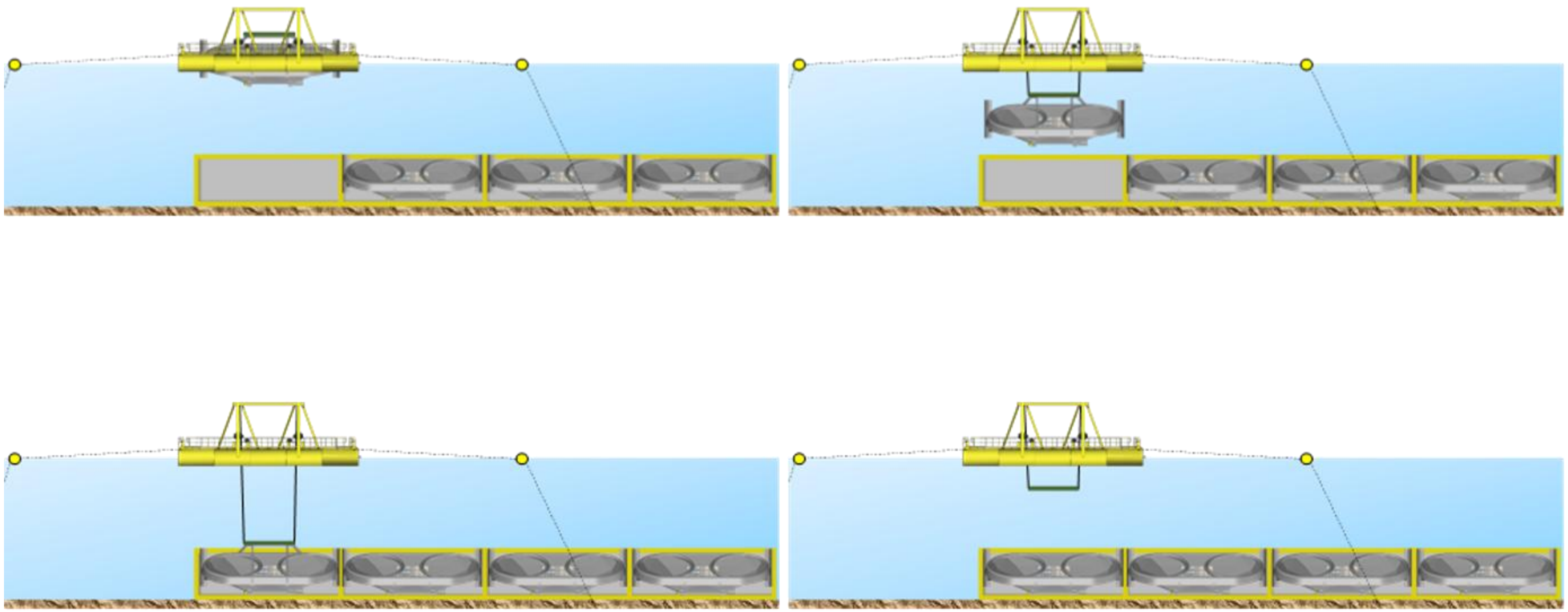


Figure 2.8 Operations and maintenance of mWave using MIT

mWave Offshore Decommissioning

2.5.2.28 Decommissioning of the offshore mWave device and marine cable will commence after the testing period. An allowance for weather has been included in the project with a maximum deployment of 18 months. As the Project is short term, and the decommissioning of the offshore element will be the reverse of the installation, it is proposed that the Marine Licence includes this phase of the Project. Initially the ballast chain in the trays that will be removed and then the device membranes will be inflated sufficiently for it to be gently lifted out of the sand and brought to the surface. The device will then be towed back to Pembroke Dock where it will be dissembled and recycled where possible.

2.5.2.29 Similarly the removal of the onshore cable and temporary onshore control station will also be the reverse of the installation process. Further details of installation are provided in Section 2.5.3 and 2.5.4.

2.5.2.30 Table 2.2 below provide a summary of the key parameters of the mWave element of the project which have formed the basis for the assessment of effects within the technical chapters 5 - 17.

Table 2.2: mWave testing, installation and decommissioning activity summary

Project detail	Maximum scenario
Advanced works	Deployment of six temporary moorings. No seabed clearance or levelling required.
Position in water column	mWave device sits on the seabed, using gravity foundations.
Largest Dimensions	75m (L) x 17m (W) x 7m (H)
Height of water above device	4.2m MLWS 7.35m mid tide 10.5m MHWS
Seabed footprint mWave	1032 m^2
Area of other elements	Cable 210m^2 ADCP/SUTU and cable 24m^2
Maximum area offshore (including possible scour protection during operation)	<1900 m^2
Number of days for installation/decommissioning - some operations will overlap. mWave Ballast chain	 3 days 5 days
No. of vessels for deployment and retrieval - mWave Ballast chain	3 vessels on site (2 multicats, (50m by 6m draught), 1 RIB) 14 vessel visits
Lubricants and antifoulants	Any antifoulants (only around sensors) or lubricants used will be EU/Internationally approved for use in marine environments.
Mooring/Attachment method for mWave	Gravity base foundation - no anchoring system required.
Mooring spread for installation/ decommissioning	200 m x 200 m (40,000 m^2)

2.5.2.31 Table 2.3 presents the operation and maintenance activity characteristics at East Pickard Bay.

Table 2.3: mWave O&M characteristics

Project detail	Maximum scenario
Duration of testing activity	approx 6-12 months
Number of O&M visits per month of deployment	one visit per month each of 2 days
Maximum total number of moored O&M in a 12-month period	24
Scour protection if required (with possible 2m width scour protection around edge of device)	10 vessels over 5 days
Maximum No. of vessels utilised in O&M at any one time (including guard boat)	3 (tow vessel plus MIT (50m by 6m draught) and RIB)
Total number of O&M visits (mooring may be required on occasion)	76 vessel visits in a 12-month period.

2.5.2.32 Once deployed mWave will remain offshore of East Pickard Bay throughout its consented period and operation will not be restricted to daylight hours. However installation, deployment and retrieval, and maintenance activities on mWave will be undertaken during daylight hours.

2.5.3 Details of Communication Cable Route

2.5.3.1 A marine communication cable linked to an onshore control station is required to support the offshore testing of the mWave device. The cable, which will be run directly to the onshore control station from the offshore mWave device via the SUTU will be approximately 1.8km in total length making landfall at East Pickard Bay (Figure 2.9). The cable and control station will be in situ for up to 18 months. The cable and control station will be removed following testing of the mWave device.

2.5.3.2 The marine cable will connect to the Subsea Umbilical Termination Unit (SUTU) which will then be connected to the Power Take Off module of the device (Figure 2.2). Approximately 1.4km of cable be required from the device to MLWS, approximately 50m of cable will be required in the intertidal area (between MLWS and MHWS) and a further 350m of cable will be required from MHWS to the control station. In order to minimise any effects from the installation of the temporary cable in the marine and terrestrial environment, where possible, the cable will be laid on the surface of the ground.

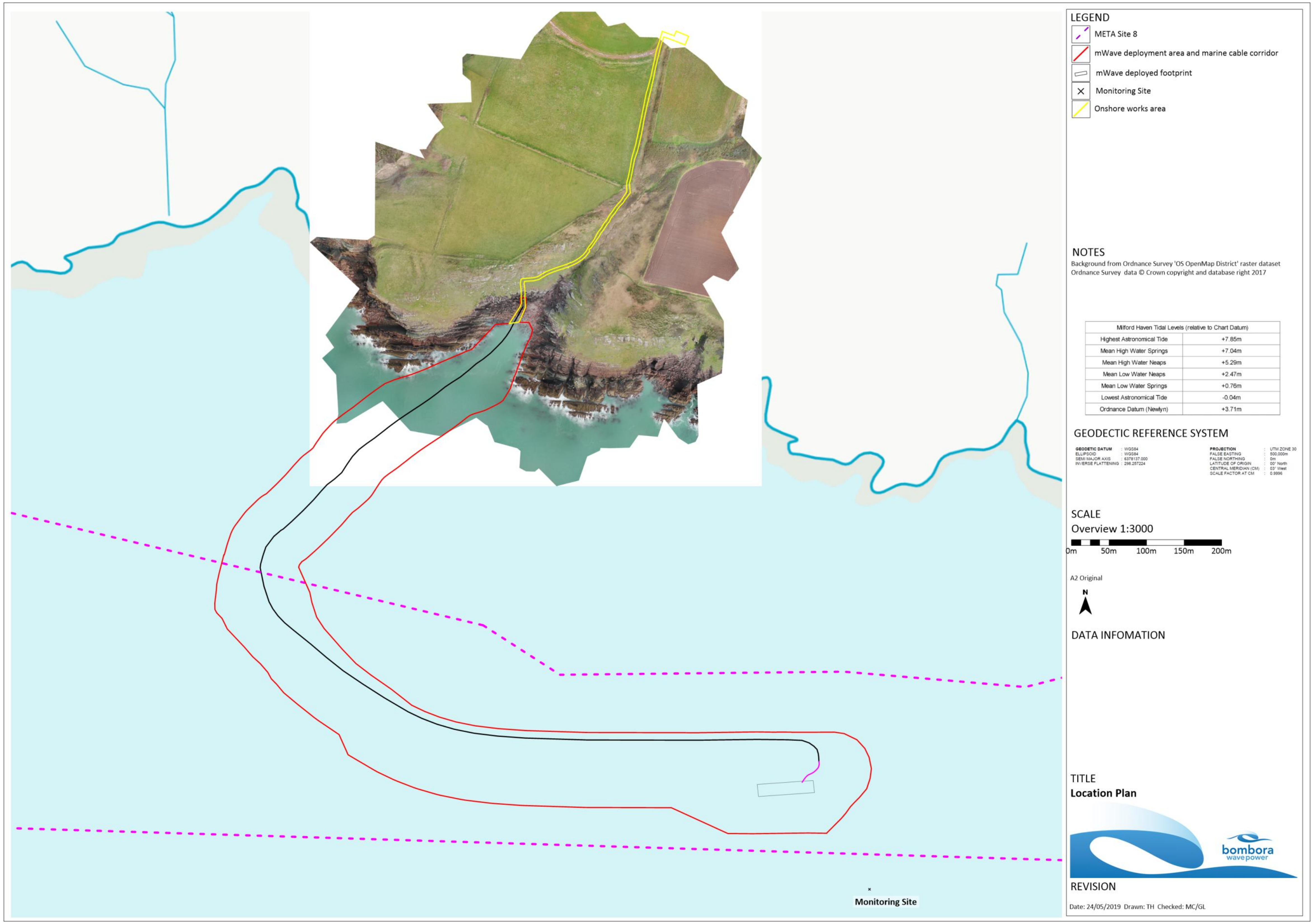


Figure 2.9 Overview of offshore and onshore cable route corridor

Offshore cable route

2.5.3.3 From the mWave device the cable will be laid across the sandy seabed and then to shore via a natural channel in the near shore rock seabed (Figure 2.4) at East Pickard Bay. Four rock bags (approximately 2m diameter) will be placed at approximately 200m intervals to keep the cable in place across the offshore sandy section of the cable route. Positioning the cable in the natural channels in the near shore environment will maintain its position. Drop down camera survey of the rocky near shore section of the cable route was undertaken in March 2019 (Aquatic Survey 2019). The survey has confirmed that no species or features of notable marine nature conservation importance were present. In addition, none of the habitats and species seen were considered especially vulnerable or sensitive to the expected physical effects of the cable deployment, presence or retrieval. Assessment of the effects of the cable on the marine environment are presented in Chapter 7 Benthic Subtidal and Intertidal Ecology.

Onshore cable route

2.5.3.4 As discussed above the cable will make landfall at East Pickard Bay, a narrow rocky gully. The cable would be laid across the surface of a small section of lower intertidal area and then up the vertical western side of the gully to the cliff top (Figure 2.10). The cable will be fed through a plastic conduit that is fixed to the rock surface using stainless steel clamps which have been bolted into the rock face.

Figure 2.10 Cable route looking up and down gully

2.5.3.5 The clamps will be attached to the rock via two 20mm stainless steel bolts which will be resin fixed. There will be 12-15 plates attached to the rock, i.e. one approximately every 5m or less. The attachment of the clamps to the rock will be undertaken using hand held tools only.

2.5.3.6 A termination box (approximately 100cm x 60cm x 60cm) and an anchor point would be required at the top of the intertidal section. This is where the cable laid from offshore will end, with the remainder of the cable being laid from the control station. A location between existing rock features would be identified for the termination box and it would be hidden using rock or turf.

2.5.3.7 The cable will also need to be anchored to take the strain of tidal movement. The anchor point, which will be located near the termination box, is likely to comprise two ~32mm thickness steel hollow bars installed and fully grouted into up to two 76mm diameter holes. The exact details of the anchor point will be determined during anchor design. A base plate (100mm) with clam shell clamps will be located on top of the anchor bolts to secure the cable to the anchor. Rocks or turf will be used for screening of the anchor attachment point, where necessary. The anchor would be installed around 28 days in advance of the cable pull.

2.5.3.8 Figure 2.11a & b shows a projecting rock located approximately 100m from the coastal footpath. This area could be used as an anchor point for the cable and termination box.

Figure 2.11a and b showing projecting rock and potential termination box location

2.5.3.9 From the anchor and termination box, for approximately 100m, the cable would be laid on the grass surface, secured with soil nails along the toe of the rock exposure before crossing to an existing fence to the coastal footpath. The fence line runs along the top of the west side of East Pickard Bay gully to the recently installed wooden gate on the coastal path (Figure 2.12). At the gate, the cable would be buried using hand tools, across the coastal path (in previously disturbed ground) for a small distance (approx 1m).

Figure 2.12 Recently installed footpath gate and cable crossing point.

2.5.3.10 After crossing the coastal path the cable would then be laid beside the stone wall which runs up the remainder of the gully to agricultural land. It would then be laid along field boundaries to the control station (Figure 2.9).

2.5.3.11 For the onshore cable route the final details of works in the coastal area will be discussed and agreed with PCNPA. In addition to this, the timing of the works in the vicinity of the coastal path and maintaining access along the path will also be discussed and agreed with PCNPA.

Cable installation offshore

2.5.3.12 The subtidal section of the communication cable will be laid using a single vessels of up to 50m length and 6m draught. The cable vessel will anchor off East Pickard Bay. A winch cable will be brought from onshore and attached to the communication cable on the vessel. The cable will have floats attached and it will be gently pulled onshore using a land-based winch system (Figure 2.13). When secured onshore, the floats will be cut so that the cable rests on the seabed.

2.5.3.13 The cable laying vessel will then head offshore laying the remainder of the cable through the rocky channels and then across the sand to mWave. On the areas of sand three rock bags will be positioned at around 200m intervals to maintain the cable in position. A further fourth rock bag will be installed near the shore end of the cable approximately 100m from the rocky shore. The rock bags will be brought to site on the cable laying vessel.

2.5.3.14 Cable laying offshore and across the intertidal area to the termination box will be undertaken in one day, but an allowance for 3 days of activities has been included in the programme. Offshore works would only be undertaken during an appropriate weather window.

Cable installation onshore

2.5.3.15 As discussed previously the cable will be pulled onshore from the offshore cable laying vessel using a manual winch system with two anchor points. The anchors for the cable lift will be installed into a rock outcrop immediately north west of the point where the cable will come up over the crest of the gully. These anchors will be 20mm stainless steel rock dowels installed and grouted into a 51mm diameter hole. The anchors will be installed approximately 28 days in advance of the cable pull. In addition to this, the termination box and permanent anchor will be installed in advance of the cable pull. The cable lift will be carried out using two manual winches which will be located within agricultural fields to the north of East Pickard Bay (Figure 2.13). The equipment would be brought to site in 4WD vehicles and setup the day before the cable pull.

2.5.3.16 A temporary diversion of the coastal footpath will be set up in advance of the cable pull. The coastal path diversion would be requested for a period of 3 weeks in order to accommodate a suitable weather window for the cable pull, but the diversion will only be used when the pull was actually occurring. Figure 2.13 shows the cable winch points and the proposed route of the coastal path diversion.

2.5.3.17 As discussed above, a wire cable link will be made between the marine cable on the offshore vessel and the cable pull location. The cable will then be winched onshore using manual winches. The cable will be fed up through the preinstalled conduit attached to the rock face and then connected to the termination box.

2.5.3.18 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 near the winch points (Figure 2.13). One end of the cable will then be pulled off the drum down along the wall in the gully and then across the path 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. If required by the landowner, a stock proof fence would be installed along the edge of the agricultural fields where the cable is laid.

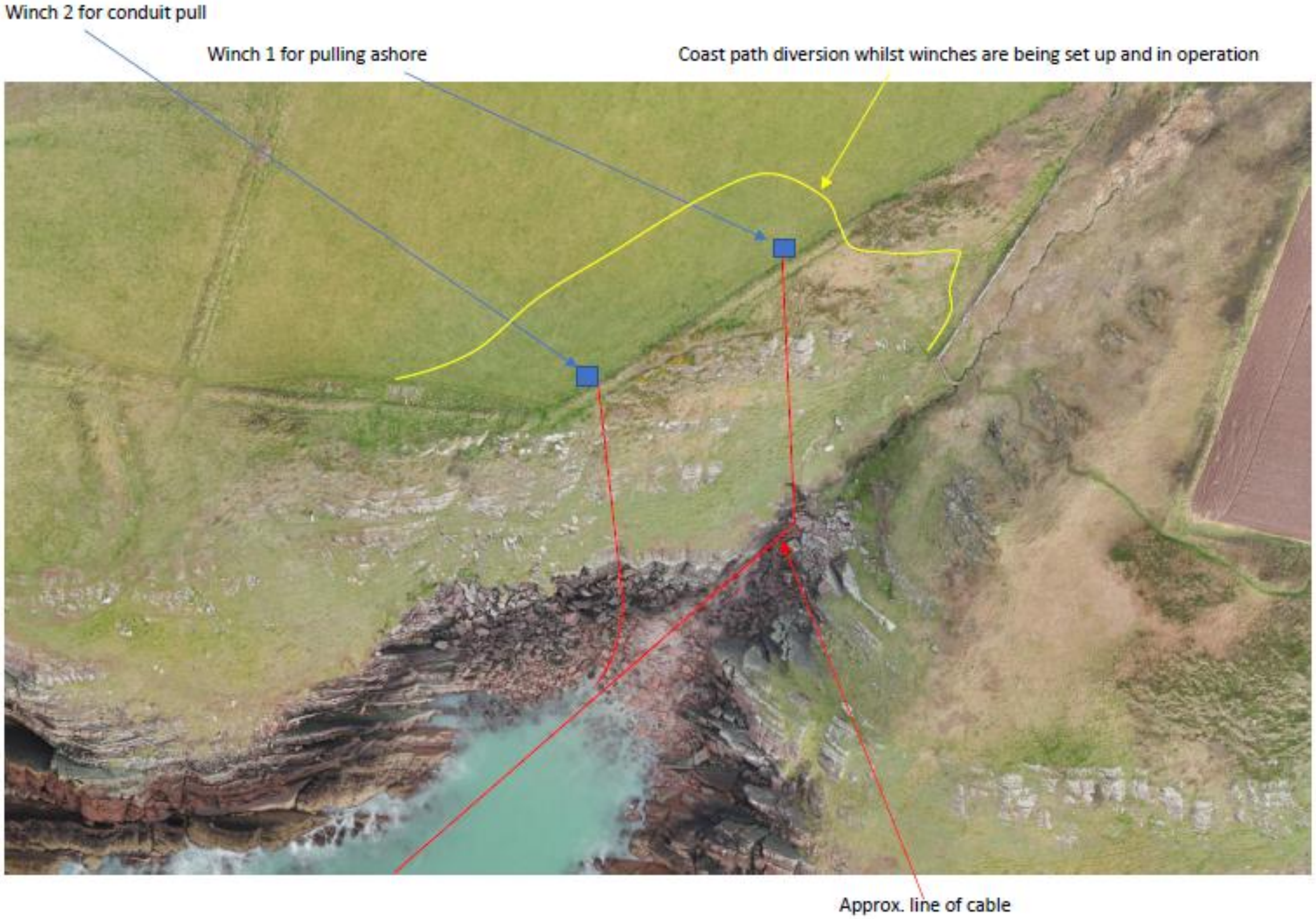


Figure 2.13 Provisional location of cable pull points and temporary coastal path diversion

2.5.3.19 It is anticipated that it will take approximately six days in total for the pre-installation works which includes the rock clamps/conduit in the gully, the termination box and temporary and permanent anchor points. The rock clamps will be installed by four personnel with hand-held tools and the termination box will also be positioned using hand held tools. The rock anchors will be installed in a single day using a pneumatic rock drill powered by a compressor which will be towed into the fields above the site. It will take about two days to lay the cable from the control station to the termination box. As identified above it will take approximately three days to pull the cable onshore to the termination point, with the winch point being set up in advance. Up to seven personnel will be needed for the actual cable pull and operation of the winches. The elements of the cable laying activities will overlap and overall the cable installation activity will take about 9 days. Note the final pull will depend on appropriate weather window.

2.5.3.20 The cable corridor from mWave up to MHWS is assessed within Chapter 7 Benthic Subtidal and Intertidal Ecology. The cable route from MHWS to the onshore control station is assessed within Chapter 17 Terrestrial Ecology.

2.5.3.21 Table 2.4 below details the proposed cable installation methodology.

Table 2.4: Marine and intertidal cable installation summary.

Cabling installation PDE	
Marine Cabling (below MLWS)	
Installation methodology	Laid on seabed in areas of sandy seabed with approx. four rock bags to maintain in position. Laid in natural rock channel to East Pickard Bay landfall.
Cable specification	150 mm diameter reinforced cable.
Length of cabling	1.400 km
Duration of installation	Up to 3 days, subject to sea conditions. Cable laying starts at East Pickard Bay. Once cable onshore, boat will work back towards mWave.
Vessels	Maximum length of 50m, and a maximum draught of 6 m.
Number of vessels	One cable laying vessel, anchored for cable pull onshore.
Cabling between MLWS and termination box above MHWS	
Installation methodology	The cable will be brought up the vertical gully side using two manual winch points positioned within the agricultural fields to the north and two temporary anchor points above the gully. The cable from the offshore cable installation vessel will be brought onshore through the intertidal area and fed through a conduit. The conduit will be pre-installed, attached to a semi-vertical rock face with rock clamps, using hand held tools only. No plant will be present within the intertidal area. A termination box and anchor point will be required. These will be screened by natural features where possible, or buried using hand tools. Cable installation to the termination box will require up to four personnel to be present within the intertidal area at any one time.
Cable specification	150 mm diameter reinforced cable.
Length of cabling	0.05 km
Duration of installation works	9 days in total - 3 days for offshore cable laying and pull from offshore vessel to termination box (as above). 6 days pre-installation works for rock clamps/conduit, termination box and anchor points. The activities will overlap. A temporary diversion of the footpath will be in place and used when needed.
Plant requirements	4WD vehicles and trailer in agricultural fields to north to pull cable using self-propelled hand operated winches. Pneumatic rock drill and compressor for anchor installation. Hand tools only will be used within the intertidal area.
Cabling between Termination Box and Control Station	
Installation methodology	A roll of cable will be brought to site on a trailer using a 4WD vehicle. The vehicle will position itself within agricultural fields to the north. One end of the cable pulled off drum down to the termination box. Once secured, the 4WD vehicle will work its way back up the agricultural fields to the control station. The cable will be laid on the ground secured by soil nails, where appropriate, following features such as fence lines and stone walls where available. The cable will be buried under the coastal footpath by an existing gate and a temporary diversion will be in place.
Cable specification	150 mm diameter reinforced cable.
Length of cabling	0.35km
Cable trench width	N/A
Cable trench depth	N/A
Duration of installation works	The cable laying from the termination box to the control station will take about 2 days overlapping with other cable laying activity.
Plant requirements	4WD vehicle/tractor with trailer. Hand tools only will be used within the coastal area.
Number of plant	4WD vehicles and trailer in agricultural fields to north.

Operation and maintenance of the communication cable

2.5.3.22 No operation or maintenance of the intertidal or marine sections of the cable is planned. Inspections to ensure routine operation may be carried out. These will be undertaken by foot onshore, and by RIB or similar small vessel within the marine environment, if required.

Indicative timing of installation of the marine cable

2.5.3.23 It would be proposed to commence the cable installation programme as soon as consents are in place and any conditions have been discharged. As identified above the duration of works is short (less than 10 days). Whilst a suitable weather would need to be identified for the offshore works, elements of the onshore works need to be undertaken in advance. The timing of the cable attachment works within the coastal area will be discussed and agreed with NRW advisory and PCNPA with respect to ecological constraints, if necessary. Diversion of the coastal footpath will be discussed and agreed with PCNPA.

2.5.4 Temporary Control Station

2.5.4.1 The temporary control station will house power and electrical facilities to support auxiliary power, air supply and communications equipment for operation, monitoring of the testing of the marine device. It will be positioned within agricultural land at the south eastern extent of the WWII RAF Angle Airfield, to the south of the B4320. Whilst there are some remnants from the airfield within some fields, the control station site is rough grassland (Figure 2.14a) and shows little evidence of its former use (see Chapter 16 Geology Hydrology and Land Quality). The location of the site has been chosen to minimise potential effects on the environment and on existing agricultural land use. The control station site has good road access from the wider surrounding area and an existing gated farm track provides access off the main road to the site (Figure 2.14a). The control station site is adjacent to a field boundary (Figure 2.14b), with screening being provided through natural topography and hedgerows.

Figure 2.14a showing control station site and 2.14b access track from main road

2.5.4.2 The temporary control station will comprise three shipping containers, two approximately 20ft by 8ft by 8ft, and a third 23ft by 8ft by 8ft, with a single Wifi antenna positioned on top. The antenna will be approximately 15cm x 15cm at the top of a 1m high mast. A chemical toilet and a bunded fuel tank will also be required.. An indicative site layout is provided in Figure 2.15.

2.5.4.3 Prior to the installation of the control station there will be minimal works. The ground will be levelled with a digger with surface scrape, soil being retained on site. A layer of stone will be placed on the ground before the control station units are delivered to site and lifted into place.

Transport Access Routes for Onshore Works

2.5.4.4 The shipping containers will be transported to site via the existing road network on a vehicle with a high mounted crane lift. It is proposed that vehicles for the installation will use the A477 and A4075 to Pembroke and then the B4319, Clay Lane and the B4320 to site. Delivery lorries will not use the A4319 and Main Street through the centre of Pembroke. Local access for the installation of the temporary control station and onshore cabling will be via the existing farm track across private land which is accessed through an existing farm gate off the B4320.

2.5.4.5 Local access for the temporary onshore control station and installation machinery for cabling will be via the existing farm track across private land which is accessed through an existing farm gate off the B4320. Installation of the temporary control station will aim to be 08:00 to 19:00 hours Monday to Friday.

Operation of Control Station

2.5.4.6 During operation, it is anticipated that there will be one generator and one compressor located at the control station. The generator will be a low speed/low noise 1500 rpm generator. It will be used to drive the compressor and it will operate approximately 2-3hrs in every 6hr period. The operation is linked to the tides, with increased air pressure being required when the water depth is higher. The generator will also be used to power the instrumentation in the control station during staff visits. The proposed generator is housed in a weather-proof silenced canopy, and it produces only 65dB at 7 metres. The compressor will produce slightly more noise at 98dB and as such it be secured in sound proof enclosure. Further information on noise during operation is provided under 'Residues and emissions'.

2.5.4.7 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 up to 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.

Figure 2.15 Location and provisional layout of temporary control station with site access

Decommissioning of Control Station

2.5.4.8 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. HGVs 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.

2.5.4.9 A summary of installation, operation and decommissioning of the control station is provided below.

Table 2.5: Control station installation, operation and decommissioning summary

Control Centre Installation	
Activity	**Number of vehicles and anticipated duration**
Site preparation	Wheeled digger to undertake minimal ground preparation works and delivery of stone (2 lorries) over 1 week.
Shipping containers	Delivery and installation of containers will required three trips by a lorry with HIAB which would occur over 2-3 days, depending on availability.
Bunded oil tank/Chemical toilet	2 vehicles single trip
Installation Staff	3 vehicles per day over 2 weeks
Control Centre Operation	
Staff	2 vehicles once per day for first 2 months and then 2 vehicles once per week
HGV	Fuel delivery 1 HGV once every fortnight Servicing toilet facility weekly initially and then monthly.
Noise emissions	Generator 2-3hrs in every 6 hours (65dB at 7 metres). Compressor 98dB (2-3 hours in every 6 hours).
Control Centre Decommissioning	
Shipping containers	Removal of containers and other kit will require similar vehicles as for installation.

Waste

2.5.4.10 The installation and operation and maintenance of mWave will not give rise to the production of any hazardous waste. As part of Bombora's standard procedures, any waste that is produced during any stage of the project will follow the general good practice principles as set out in the Waste Hierarchy of Prevention, Re-use, Recycle, Other recovery, Disposal (Defra, 2011).

Use of Natural Resources

2.5.4.11 The testing of mWave will utilise and effect natural resources found within the marine and terrestrial environment. The potential impact of installation, operation and decommissioning of the mWave project have been assessed in chapters 5 – 17.

2.5.5 Residues and Emissions

2.5.5.1 There will be no radiation from the onshore or offshore elements of the mWave at any stage of its development. Emissions which will be generated from the Project include noise during installation, and noise and heat during operation. Underwater noise during installation and operation is discussed Chapter 6, with the information from the chapter being used in Chapter 8 Fish and Chapter 9 Marine Mammals. Onshore noise during installation and operation and subsequently, heat emissions during operation are discussed within the following sections.

Onshore noise

2.5.5.2 As identified in the previous sections there are a number of activities associated with the installation and operation of the onshore works which will generate noise. In terms of installation, whilst all of the activities are of short duration the overall installation period will be about 10 -14 days for the cable and control station. During operation there will be a requirement for compressor and generator to operate intermittently during the offshore operation of mWave. The offshore operational period is anticipated to be approximately 6 - 12 months. A preliminary assessment of the noise effects of the project has therefore been undertaken. The details are presented in Appendix 2.1 and a summary is provided below.

2.5.5.3 Baseline noise data was collected from two locations over a 48hour period. The nearest residential receptor (A), is some 470m to the north east of the control station site and the Wales Coast Path (B) is 275m to the south of the control station but adjacent to the cable route (Figure 2.16).

Figure 2.16 Showing baseline noise survey location (A)s and sensitive receptor in the south.

2.5.5.4 The results of the background noise survey are summarised below and, as expected, they confirmed low ambient and background noise levels in the area. However, the data collected for the area also noted high L_{max} values, in particular at the coastal path where levels between 75 and 90dB(A) were recorded, most notably in the morning. At the nearest residential receptor L_{max} above 65dB(A) were recorded, again mostly in the morning.

Table 2.6: Baseline noise data

Position	Period	Ambient Sound Level $L_{Aeq,15min}$ (dB)	Background Sound Level $L_{A90,15mins}$ (dB)
A	Daytime (0700-1900hrs)	42	37
	Evening (1900-2300hrs)	38	34
	Night-time (2300-0700hrs)	39	35
B	Daytime (0700-1900hrs)	38	30
	Evening (1900-2300hrs)	28	26
	Night-time (2300-0700hrs)	30	19

2.5.5.5 The 'noisiest activities at the control station site during installation and operation have been assessed using NoiseMap Five computer modelling software. The installation of rock clamps and anchors using a pneumatic rock drill has been assessed at the coast. As the measured ambient sound levels are below the Cat A threshold of 65dB(A) daytime, a 65dB $L_{Aeq,0700-1900hrs}$ daytime construction noise limit has been considered for the installation phase. For operational noise, a worst case assessment has been undertaken with the noise levels being considered against the existing night time background (L_{A90}) at the nearest residential receptor (34 $L_{Ar,Tr}$ (dB)).

2.5.5.6 The result of the noise mapping confirms that predicted noise levels from short-term installation works for the control station a noise level of 30dB $L_{Aeq,1hr}$ is predicted at Carters Green, which is well within the BS5228 daytime construction noise limit of 65dB$L_{Aeq,1hr}$ at the nearest residential receptor. During installation of rock clamps or anchors at the coast, a noise level of 43dB $L_{Aeq,1hr}$ is predicted at Carters Green, whilst noise levels of around 55dB-65dBL_{Aeq} are indicated on the Pembrokeshire Coast Path. All works would be during daytime.

2.5.5.7 During operation there will be a generator and compressor, the latter being noisier and as such it will be acoustically screened. Noise map predictions indicate a noise level of 28dB $L_{Aeq,15mins}$ at Carters Green during operation. This noise level is below the night time threshold identified previously.

2.5.5.8 To conclude whilst there will be a short term increase in noise during installation works, the levels at the nearest residential receptor will be well below the Cat A threshold of 65dB(A) daytime noise limits. At the coastal path there may be levels around the Cat A threshold of 65dB(A) intermittently during rock drilling. These works will be of short duration and any users of the footpath will be passing through.

2.5.5.9 During operation, with acoustic screening of the compressor, the noise level at the nearest residential receptor will be below the background level recorded during baseline survey.

Heat emissions

2.5.5.10 As identified in section 2.5.2 'Energy Generation and Energy Demand', mWave will not be grid connected, and the electricity generated will either be used by the device (battery charging, powering of instrumentation etc) or it will be converted into thermal energy and dissipated in the sea water. An assessment of the minimum, moderate and maximum operating case for the potential heating from the mWave device has been undertaken based on site specific data. The minimum, moderate case and maximum operating case corresponded to significant wave heights of 0.5m, 2.5m and 4.5m.

2.5.5.11 Data collected during an oceanographic survey (Titan 2019) recorded a minimum current velocity of 0.02 m/s at the mWave site at 'slack water'. This means that there will always be some water movement around the device. When there are no waves there is no generation and therefore no heating. For minimum operating case (wave of 0.5m) even though there is a lower generation from the device, there is less movement of water around the device and therefore a lower volume of water to heat, leading to a greater heating effect. With higher wave heights (4.5m) there is greater generation, but more movement (volume) of water and therefore the heating effect is less.

2.5.5.12 As such the maximum heating effect of the water was calculated to be during low wave heights and minimum generation case. The heat output of the device during these low wave conditions is 8000W. The lowest current would be experienced at around slack water or when there is the lowest water velocity, which is estimated to be a period of 30 minutes.

2.5.5.13 Taking into account the movement of water from the waves as a vertical oscillation as well as the current as a horizontal motion, the volume of water heated during the 30 minute period of slack would be $10m^3$. The temperature increase over the $10m^3$ volume of water would be 0.3^oC. The heating effect for the moderate and maximum cases was lower at 0.2^oC. The lowest sea temperature in Pembrokeshire in the winter is around 7.6^oC rising up to $17.2\,^oC$[1] in the summer. Taking this into account, the localised increase in water would be in the range of 1.9% - 2.6%.

2.5.5.14 Putting the volume of water being heated by mWave in context, assuming static water, the volume of water directly over the mWave device at any one time at MLWS would be $5{,}367m^3$ and at MHWS $13{,}374m^3$. As such the volume of water heated would be between 0.07-0.19% of the water passing over mWave device at a particular time. It is therefore concluded that the worst case potential for heat generation in the water, through dissipation of heat from the mWave device would be minimal and localised.

2.5.5.15 As the mWave project is not likely to give rise to notable heat emissions in the surrounding environment during its operational and maintenance phases, this aspect has not been considered further in this Environmental Statement.

2.6 Mitigation Measures Adopted as Part of the Project

2.6.1 Overview

2.6.1.1 In order to avoid or reduce the environmental effects, a number of measures have been designed into the project. In addition to this, to accompany the Environmental Statement, Bombora will provide the following two outline plans:

1) Environmental Management Plan (EMP), which will include a Marine Pollution Contingency Plan and an Invasive Non-Native Species Risk Assessment.

2) Environmental Monitoring and Mitigation Plan (EMMP);

2.6.2 Designed in Measures

2.6.2.1 As discussed above a number of measures have been incorporated into the design of the mWave Project to reduce the potential effects during its installation and short term deployment. Details of these can be found within each topic chapter of the Environmental Statement and the key ones are briefly outlined below:

2.6.2.2 Onshore control station and cable route option selection process used to minimise potential impact of the project on a range of environmental receptors (Chapter 3, Needs and Alternatives, section 3.3.5)

- Minimal requirement for offshore vessels during all phases of project which will minimise disturbance (physical disturbance and noise) to marine ecology, marine birds and to other users and will reduce the potential for pollution incidents.
- All offshore works undertaken in good sea conditions, with good visibility thereby reducing potential for interaction with other users and the potential for pollution incidents.
- mWave placed on seabed, with good clearance for vessels which are likely to be in the area, with good water coverage, minimises the potential for interaction with the device and pollution incidents.
- The offshore deployment location selected is on sandy substrate away from sensitive habitats, such as Annex I Reef (Chapter 7: Benthic Subtidal and Intertidal Ecology, section 7.7.3).
- Drop-down video survey confirmed that for the cable landfall the habitats and communities across the bedrock reef at East Pickard Bay were relatively low in diversity (Chapter 7: Benthic Subtidal and Intertidal Ecology, section 7.7.3).
- Flat sandy seabed and no requirement for seabed preparation in advance of deployment (Section 2.5.2).
- Gravity foundation, simple installation, requires no permanent moorings thereby minimising potential impacts on marine ecological receptors (Section 2.5.2).
- No external moving parts which may cause impact to marine life (only movement of air-filled membrane covered cells) (Section 2.5.2).
- Deployment of mWave on seabed with limited vessel activity during operation, minimises visual effects during operation (Chapter 14 Seascape Landscape Assessment).
- Due to design (using membrane covered air filled cells) noise levels during operation are anticipated to be lower than conventional WEC (see Chapter 6, Underwater Noise).
- Cable laid on surface and not trenched either offshore or onshore (Section 2.5.3) thereby minimising impacts on marine ecology (reduced suspended sediment, reduced loss of habitat, reduced noise), terrestrial ecology, archaeology (marine and terrestrial).
- Cable route near coast avoids Geologically sensitive features.
- Minimal requirement for onshore vehicles during all phases of project minimises potential effect on ecological receptors and noise disturbance to nearby residents.
- Lorries delivering onshore control station units will avoid Pembroke Main Street thereby minimising impact on the town centre during installation and decommissioning phases.

[1] https://www.seatemperature.org/europe/united-kingdom/wales/

- Control site on agricultural land with natural screening reducing visual impacts to the surrounding area (Section 2.5.4).
- Control site distant from residential receptors (470m), coastal path (275m) and beaches (1.3km) minimising the potential for disturbance during the various stages of the project.
- Existing gates and access track available to control station site minimises potential effect on ecological receptors (Section 2.5.4).
- Minimal site preparation works at control station minimises potential effect on ecological receptors and residential receptors (Section 2.5.4).
- All soil material contained on site, thereby minimising risks in terms of previous site use (RAF WWII Airfield).
- Control station delivered to site as units reduces installation time and minimises potential effect on ecological receptors (Section 2.5.4).
- Compressor and generator acoustically screened and operating about 50% of time minimises potential effects in terms of operational noise on residential receptors (Section 2.5.4).
- No night-time external lighting of control station minimises potential effect on ecological receptors such as bats (Section 2.5.4).

2.6.3 Environmental Management Plan (EMP)

2.6.3.1 The Environmental Management Plan (EMP) (Appendix 2.2) will cover both the offshore and onshore elements of the project. The information contained within the EMP will form the basis for discussion with the appropriate regulatory authorities during the consenting/planning process. The plan will be updated and submitted for approval by the regulatory authorities during the consenting process.

2.6.3.2 The onshore and offshore installation works will be undertaken in accordance with the EMP. It will set out the key management measures that Bombora and their contractors will adopt and implement during all stages of the mWave Project.

2.6.3.3 The marine section of EMP will include planning for accidental spills, including measures to reduce the risk of an incident. In addition to this the EMP will include an INNS assessment using NRW-PS Biosecurity Risk Assessment Template which will reduce the risk of spreading marine invasive non-native species (INNS) (see Chapter 7, Benthic Subtidal and Intertidal Ecology). In terms of the onshore works, the EMP plan will present the procedures agreed with PCNPA with regard to works in proximity to the coastal path. This would include details of the cable pull onshore, the method and timing of the cable being laid in the coastal path, and measures to ensure safe passage of walkers in the area. Any requirements identified within Chapter 17 Terrestrial Ecology, to minimise potential effects on identified species, will also be provided.

2.6.3.4 Depending on specific marine licence and planning conditions, the plan will include:

- Communication and reporting procedures;
- Roles and Responsibilities;
- Training and competence;
- Monitoring and auditing procedures;
- Procedures agreed with PCNPA with regard to work in the vicinity of the coastal path;
- Invasive non-native species - an assessment for INNS following NRW-PS Marine Biosecurity Risk Assessment Plan template;
- Marine Pollution Contingency Plan which clearly sets out response procedures in the unlikely event of a spill, including the communications and reporting procedures in the event of an incident.

2.6.4 Environmental Mitigation and Monitoring Plan (EMMP)

2.6.4.1 The Environmental Monitoring and Mitigation Plan (EMMP) (Appendix 2.3) is linked closely to the EMP and it will provide details of any requirements identified within the various assessment chapters to minimise potential effects on receptors during the lifetime of the project, such as details of any advanced checks which may be required in advance of installation works.

2.6.4.2 This plan will outline the monitoring which is proposed for the mWave project, including the post-deployment monitoring that will be undertaken during the operation of the device. As identified previously, this document will also detail any mitigation measures that will be undertaken to minimise potential impacts to environmental receptors, or which will be implemented as good construction practice to further reduce insignificant impacts as identified in the Environmental Statement.

2.6.5 Onshore Archaeology

2.6.5.1 As identified in Section 2.6.2 there are a number of measures which have been embedded in the design to minimise the potential effect of the project on the surrounding environment. One key measure is the decision to lay the communication cable on the surface of the ground, negating the need for trenching. For health and safety reasons, the cable will, however, be buried across the coastal path. A route across the recently installed gate has been chosen to minimise disturbance of previously undisturbed land.

2.6.5.2 At the control station there will be minimal site preparation (surface scrape and stone placement) in an agricultural field, before containers are delivered to site. As a result of the non intrusive installation methods, the potential to affect unknown archaeological resource is mitigated. Whilst no impact is anticipated on archaeological resource a desk based assessment has been prepared and will be submitted with the onshore planning application. Consideration of the potential effect of the control station and cable on West Pickard Camp Hill Fort is presented in Chapter 14 Seascape Landscape Assessment.

2.7 References

Aquatic Survey and Monitoring Ltd. (2019). Drop-down video survey of East Pickard Bay, Freshwater West, March 2019 A report for Bombora WavePower Ltd

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