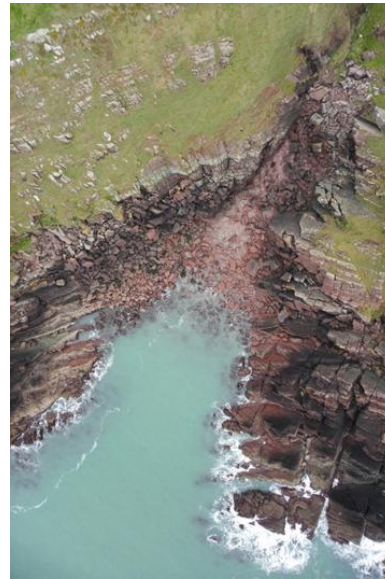




mWave Marine Energy Device and Onshore Infrastructure

ENVIRONMENTAL STATEMENT



June 2019

CHAPTER 16: Geology, Hydrology and Land Quality

Table of Contents

Glossary	ii
Acronyms	ii
Units	ii
16. ONSHORE GEOLOGY, HYDROLOGY AND LAND QUALITY	1
16.1 Introduction	1
16.2 Purpose of this chapter	1
16.3 Study area and putting the site in context	1
16.3.2 Sites of Special Scientific Interest	4
16.3.3 Regionally Important Geological Sites	4
16.4 Policy context	6
16.4.1 National Policy Statements	6
16.4.2 Other relevant policies	6
16.5 Consultation	6
16.6 Baseline Methodology	8
16.6.1 Desktop study	8
16.6.2 Site specific surveys	8
16.7 Details of Cable Route	8
16.7.2 Details of Communication Cable Route	8
16.7.3 Embedded Mitigation	10
16.7.4 Impacts scoped out of the assessment	10
16.8 Baseline environment and consideration of cable route	10
16.8.2 General Setting	10
16.8.3 Tuff units within the Old Red Sandstone	11
16.8.4 Consideration of cable route	14
16.9 Conclusion and summary	14
16.10 References	14

Table of Tables

Table 16.1: Summary of geological designations.	4
Table 16.2: Summary of NPS EN-1 policy framework provisions relevant to onshore geology.....	6
Table 16.3: Summary of key issues raised during consultation activities relevant to onshore geology, hydrology and land quality.	7
Table 16.4: Summary of information reviewed during desk study.....	8
Table 16.5 Cable installation summary.....	9

Table of Figures

Figure 16.1 Geological study area - topography and extent (online OS).....	1
Figure 16.2a Aerial showing lines of old runways with direction of control station.....	2
Figure 16.2b Location of control station in relation to runways.....	2
Figure 16.2c Control station site.....	3
Figure 16.3 Study area - water features and cable route.....	3

Figure 16.4 Statutory (GCR) and non-statutory (RIGS) geological sites within the Angle Peninsula Coast SSSI	5
Figure 16.5 Proposed Cable route.....	8
Figure 16.6a Cable route looking up and down gully.....	9
Figure 16.7a and b showing projecting rocks and potential junction box location.....	9
Figure 16.8 Old Red Sandstone exposures in cliffs at East Pickard Bay on the south coast of the Angle Peninsula.....	10
Figure 16.9 View from kayak showing the gully at the back of East Pickard Bay and the lower part of a valley extending back up to the coastal plateau.....	11
Figure 16.10 Age and stratigraphy of the Old Red Sandstone in South Pembrokeshire.....	11
Figure 16.11 Significance of the Townsend Tuff (TT) as a lithostratigraphic marker within the Old Red Sandstone of Wales.....	12
Figure 16.12 Western cliff section at East Pickard Bay, showing the Old Red Sandstone sequence that includes exposures of the Townsend Tuff and Pickard bay Tuff (boxed area as shown in more detail below) and cable route.....	12
Figure 16.13 Townsend Tuff (TT) and Pickard Bay Tuff (PBT) exposures in western cliff section at East Pickard Bay.....	12
Figure 16.14 Detail of Pickard Bay Tuff exposure in the western cliff section at East Pickard Bay (inset: log from Williams, et al. 1981)	12
Figure 16.15 Townsend Tuff (TT) exposures in eastern cliff section at East Pickard Bay.....	13
Figure 16.16 Townsend Tuff (TT) exposures in eastern cliff section at East Pickard Bay.....	13
Figure 16.17 Detail of Townsend Tuff exposure in the cliff section east of the fault gully in East Pickard Bay.....	13
Figure 16.18 Old Red Sandstone outcrops and locations where the Townsend Tuff and associated tuff beds are exposed.....	15
Figure 16.19 East Pickard Bay - overview of cable route in relation to geological interests.....	16

Glossary

Term	Definition
European site	Special Area of Conservation (SAC) or candidate SAC, a Special Protection Area (SPA) or potential SPA, a site listed as a Site of Community importance (SCI) or a Ramsar site.
META Project	The META project, located in Pembrokeshire, consists of eight test sites where a range of marine energy testing activities will be permitted over a 15 year period. 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.
Intertidal	An area of a seashore that is covered at high tide and uncovered at low tide.

Acronyms

Acronym	Description
GCR	Geological Conservation Review
META	Marine Energy Testing Area
MEW	Marine Energy Wales
NRWa	Natural Resources Wales Advisory
NRW-PS	Natural Resources Wales Permitting Services
NSIP	Nationally Significant Infrastructure Project
NPS	National Policy Statement
OD	Ordnance Datum
ORS	Old Red Sandstone
PCNPA	Pembrokeshire Coast National Park Authority
RIGS	Regionally Important Geological Site
SSSI	Site of Special Scientific Interest

Units

Unit	Description
ha	Hectare
km	Kilometre
m	Metres
m ²	Metre squared

16. ONSHORE GEOLOGY, HYDROLOGY AND LAND QUALITY

16.1 Introduction

- 16.1.1.1 This chapter of the Environmental Statement presents the results of the Environmental Impact Assessment (EIA) for the potential impacts of the mWave project on onshore geology, hydrology and land quality. Specifically, this chapter considers the potential impact of the communication cable which will make landfall at East Pickard Bay, and the onshore control station which is located approximately from 400m from the coast.
- 16.1.1.2 The assessment of effects from the mWave device and communications cable on the marine environment is addressed in Chapter 6: Coastal Processes.

16.2 Purpose of this chapter

- 16.2.1.1 The primary purpose of the Environmental Statement is to support the marine licence application for the mWave project, including the full scale WEC, marine communications cable up to MHWS, Acoustic Doppler Current Profiler (ADCP), Subsea Umbilical Termination Unit (SUTU) and navigational markers (if needed). The Environmental Statement will also support the planning application for the onshore section of the communication cable (from MLW), the termination box, cable anchor point and onshore control station.
- 16.2.1.2 The onshore works will have the potential to effect hydrology and land quality. However, as discussed in Chapter 2: Project Description, the proposed onshore works are minimal in extent and in nature, with the cable being laid on the surface of the ground and the control station units being brought onto site and lifted into position. As such significant impacts are not anticipated. Notwithstanding this an overview of hydrology and land quality has been provided. In terms of geological interests, the potential effects of the communicable cable will be limited to direct impacts in the immediate vicinity of the cable at East Pickard Bay. The assessment contained herein therefore does not follow the standard methodology utilised in the assessment within other chapters of this Environmental Statement.
- 16.2.1.3 This Environmental Statement chapter:
- Provides an overview of the study area in terms of geology, hydrology and land quality and considers the onshore works in this respect;
 - Gives an explanation of the framework in which geological conservation at the site has been considered;
 - Provides an overview of consultation relevant to geology, hydrology and land quality and provides responses to matters raised;
 - Provides an overview of the communication cables during installation, operation and decommissioning.
 - Describes the detailed geology and geomorphology of East Pickard Bay, based on site survey and desk-based review, and

- Finally assesses the potential effects of the cable on onshore geological features.

16.3 Study area and putting the site in context

- 16.3.1.1 The proposed marine communication cable will make landfall at East Pickard Bay on the south coast of the Angle Peninsula, before running inland across agricultural fields to the onshore control station. In terms of geological sensitivity, the latter part of the cable route will not affect any geological features. The study area for the cable route is shown in Figure 16.1, extending from MLWS to the top of the coastal slopes at approximately 45mOD.
- 16.3.1.2 The Wales Coast Path provides views over East Pickard Bay, but there is no formal access to it. Nevertheless, for well over 50 years, public access to the area seaward has never been challenged, and this de-facto right of access has also been utilised by those who have carried out geological research at East Pickard Bay. The assessment of effects of the cable route on geology will be focussed on this area.



Figure 16.1 Geological study area - topography and extent (online OS)

Land quality

- 16.3.1.3 In terms of land quality, 'green field' sites are previously undeveloped either for commercial development or exploitation, whereas a brown field site has been previously developed. When developing a brown field site, consideration must be given to the potential for contamination from its previous use. The PCNPA website¹ provides further guidance on the matter where it confirms that the words 'Contaminated Land' now have a specific legal definition, under Section 78A (2) of Part 2A Environmental Protection Act 1990 (EPA). Here 'Contaminated Land' is defined as; *"Land which appears to the Local Authority to be in such a condition, by reason of substances in, on, or under the land, that significant harm is being caused, or there is a significant possibility of such harm being caused; or significant pollution of controlled waters is being caused, or there is a significant possibility of such pollution being caused."* The website goes on to state that whilst Pembrokeshire does have areas of land affected by contamination, no sites within Pembrokeshire have been formally determined yet as Contaminated Land in accordance with the new definition.
- 16.3.1.4 As identified in Chapter 2, the control station will be positioned within agricultural land at the south eastern extent of the old WWII RAF Angle Airfield, to the south of the B4320. Although the site is currently used for agriculture, as it had a previous use it could be classified as a brown field site. Figure 16.2a shows the lines of the runways and Figure 16.2b shows the location of the control station site in relation to the runways. Whilst along some edges of the fields within the airfield there is hardstanding, which are remnants of its previous use as an airfield, the control station site is rough grassland and shows little evidence of its former use (Figure 16.2c). Notwithstanding this, the consideration of the potential for contamination from the former land use has been incorporated into the project to ensure that there will be minimal risk from contamination.
- 16.3.1.5 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 (Chapter 2 Project Description). The onshore cable will be laid on the surface and will not be buried (other than crossing the coastal path). With the proposed cable installation method, the minimal ground works at the control station site and any material being retained on site, there should be minimal risk in terms of contaminated land.

¹ <https://www.pembrokeshire.gov.uk/contaminated-land>



Figure 16.2a Aerial showing lines of old runways with direction of control station

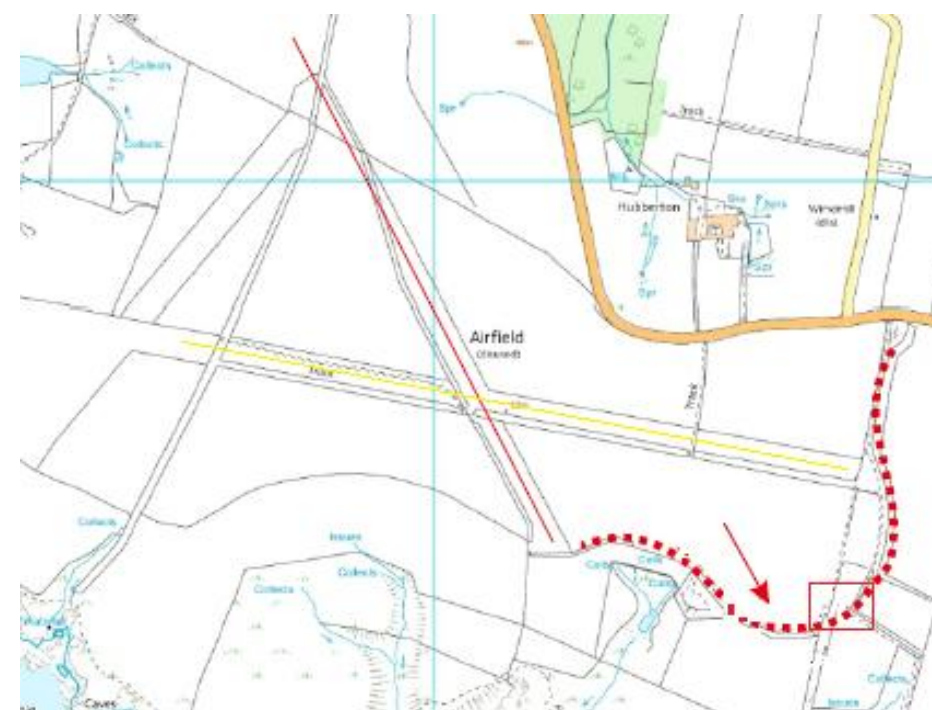


Figure 16.2b Location of control station in relation to runways



Figure 16.2c Control Station site.

Hydrology

- 16.3.1.6 With respect to water features in the area, there is a small stream which forms from two springs approximately 100m to the south east (>5m downhill) of the control station site. The stream then follows the valley down into the narrow gully of East Pickard Bay and onto the intertidal area (Figure 16.3). Looking at the data available from Cycle 2 River and Water bodies², the groundwater within the Angle Peninsula is identified as good both qualitatively and chemically.

² <https://nrm.maps.arcgis.com/apps/webappviewer/index.html?id=2176397a06d64731af8b21fd69a143f6>



Figure 16.3 Study area - water features and cable route³

- 16.3.1.7 As identified above the control station site and the cable route is distant from any water course. The control station site will require minimal groundwork/levelling with a layer of stone being placed on site before the units are brought to site and lifted into position. The cable will be brought out of East Pickard Bay gully in the lower tidal section thereby avoiding being laid near the stream. Staff involved in the works in the intertidal area will be kept to a minimum thereby reducing trampling adjacent to the watercourse. The cable will be laid on the surface of the ground, secured by soil nails, where appropriate, crossing the coastal path by a gate remote from the stream. With standard good construction practice on site, this method of installation in itself will mitigate the potential for significant impact on any water feature.

³ <http://lle.gov.wales/map#m=-5.08896,51.67028,16&b=europa>

16.3.1.8 During operation, there will be a requirement for fuel to be stored on site for the operation of compressors during offshore operation of mWave, which will last about 6-12 months. The fuel will be delivered to site by lorry approximately once every two - three weeks, and it will be stored in a bunded fuel tank. As discussed above, the control station units will be placed on a layer of stone and any rain water will soak through the stone into the ground beneath. Decommissioning of the site will be roughly the opposite of installation with the control station and onshore cable being removed from site by lorries.

16.3.1.9 To conclude, at the control station, as there will be minimal intrusive ground works, with all material being retained on site, the risk in terms of land contamination is minimal. With regard to water quality, due to the proposed installation method (cable being laid on the surface, distant from water features) and with good construction practice no significant impact is anticipated on any water features (surface or groundwater). As such no further assessment of land quality or water quality is proposed, and the remainder of this chapter will focus on the potential effects of the cable on geological interests.

16.3.2 Sites of Special Scientific Interest

16.3.2.1 East Pickard Bay lies within Angle Peninsula Coast Site of Special Scientific Interest (SSSI). The most significant geological features within the SSSI, as identified by the Geological Conservation Review (GCR), are legally protected through SSSI legislation (Wildlife and Countryside Act, 1981) and responsibility for ensuring their conservation lies with Natural Resources Wales (NRW). All GCR sites are of at least UK-wide significance to geological science and many are of international significance. The boundary of the SSSI and GCR sites is shown in Figure 16.4.

16.3.2.2 East Pickard Bay does not lie within either of the two GCR sites associated within the SSSI (these are at West Angle Bay).

16.3.3 Regionally Important Geological Sites

16.3.3.1 Other sites of lesser importance are highlighted as a Regionally Important Geological Sites (RIGS). These are notified to the relevant planning authority (in this case Pembrokeshire Coast National Park Authority) for consideration when planning applications are received, although RIGS have no statutory protection.

16.3.3.2 East Pickard Bay (RIGS no.453) is a significant site for scientific study (summarised in Williams, *et al.* 1982), not least because it includes relatively easily accessible and clean exposures of two of the thickest tuff units (originally layers of volcanic ash) within the lower part (Milford Haven sub-Group) of the 'Old Red Sandstone' (ORS). The sedimentary sequence in which the tuffs occur is also of related interest.

16.3.3.3 A summary of the geological designations is provided below.

Table 16.1: Summary of geological designations.

Geological Conservation Review (GCR) sites				
GCR no.	Name	GCR Block	Associated SSSI	Consultee/s
1458	West Angle Bay	Quaternary of Wales	Angle Peninsula Coast	NRW PCNPA
1733	West Angle Bay (North)	Non-Marine Devonian		
Regionally Important Geological Sites (RIGS)				
453	East Pickard Bay	Old Red Sandstone	Angle Peninsula Coast	PCNPA
1633	Freshwater West (North)	Old Red Sandstone	Broomhills Burrows	PCNPA

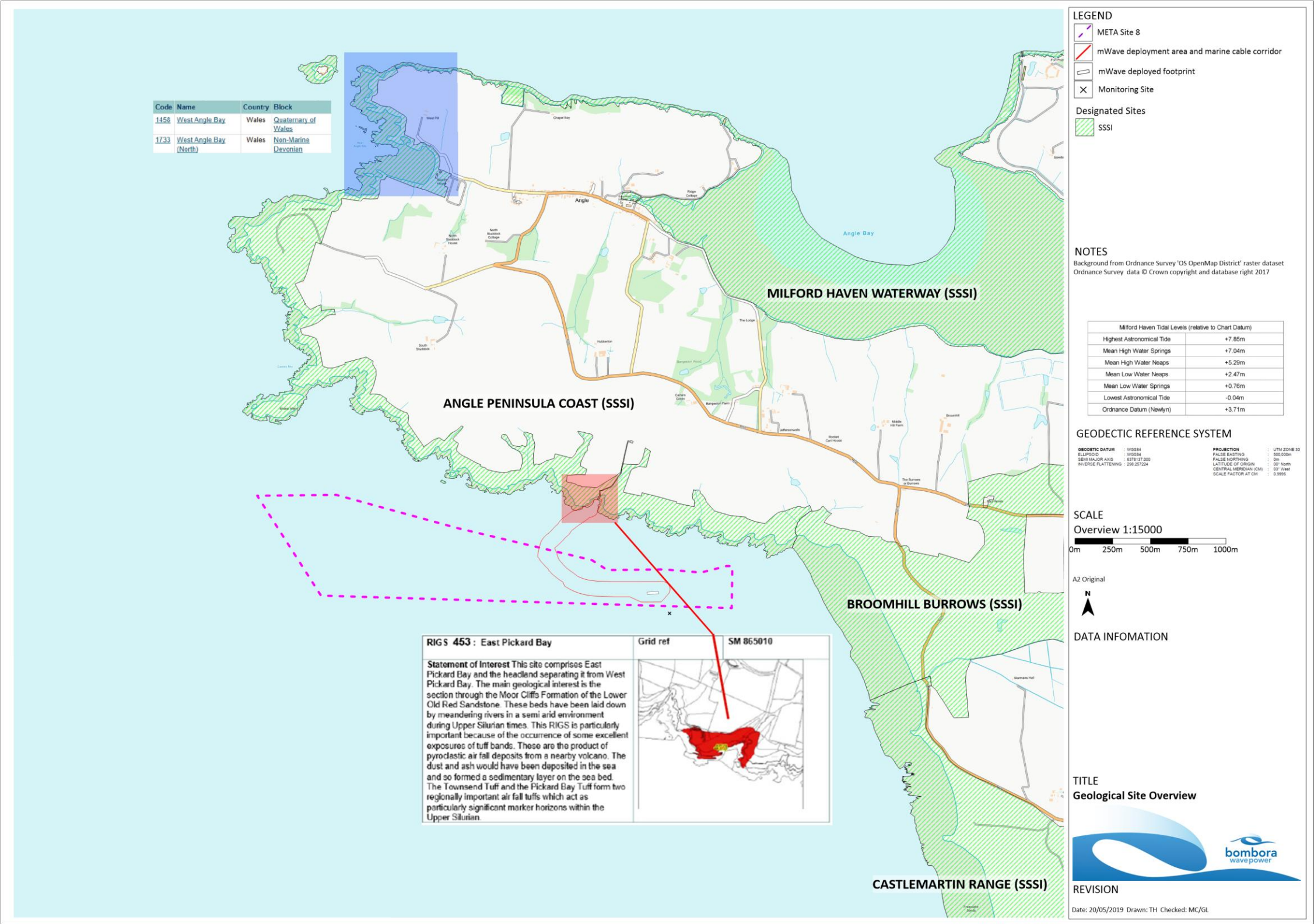


Figure 16.4 Statutory (GCR) and non-statutory (RIGS) geological sites within the Angle Peninsula Coast SSSI

16.4 Policy context

16.4.1 National Policy Statements

- 16.4.1.1 While it is recognised that the mWave project does not constitute a Nationally Significant Infrastructure Project (NSIP), the National Policy Statements (NPS) available to support NSIPs are considered to provide useful context to the production of onshore geology environmental assessment.
- 16.4.1.2 Planning policy on renewable energy infrastructure, specifically in relation to benthic subtidal and intertidal ecology, is contained in the Overarching National Policy Statement (NPS) for Energy (EN-1; DECC, 2011a) and the NPS for Renewable Energy Infrastructure (EN-3, DECC, 2011b).
- 16.4.1.3 NPS EN-1 include guidance on what matters are to be considered in the assessment. These are summarised in Table 16.2.

Table 16.2: Summary of NPS EN-1 policy framework provisions relevant to onshore geology.

Summary of NPS EN-01 provisions	How and where considered in the Environmental Statement
Biodiversity (Section 5.3) (*relevant text to geodiversity has been underlined)	
Where the development is subject to EIA the applicant should ensure that the Environmental Statement clearly sets out any effects on <u>internationally, nationally and locally designated sites of ecological or geological conservation</u> importance, on protected species and on habitats and other species identified as being of principal importance for the conservation of biodiversity (paragraph 5.3.3 in NPS EN-1).	Effects on onshore geological features of conservation importance are considered in section 16.8. Information on geological interests and the effects of the project is presented in section 16.8. An evaluation of these receptors in the context of their conservation importance considered Section 16.3.2.
The applicant should show how the project has taken advantage of <u>opportunities to conserve and enhance biodiversity and geological conservation interests</u> (paragraph 5.3.4 in NPS EN-1).	Measures adopted as part of the onshore works, minimal construction method to conserve geological interests are outlined in section 16.7.2.
Development should aim <u>to avoid significant harm to biodiversity and geological conservation interests</u> , including through mitigation and consideration of reasonable alternatives; where significant harm cannot be avoided, then appropriate compensation measures should be sought (paragraph 5.3.7 in NPS EN-1).	Measures designed to avoid significant harm to geological conservation interests are outlined in Section 16.7.2. No significant effects, in EIA terms, are predicted on geological conservation interests as a result of the mWave project (section 16.8).
The most important sites for biodiversity are those identified through international conventions and European Directives (paragraph 5.3.9 in NPS EN-1).	Effects on geological conservation interests, including those listed as features of designated sites, are considered in section 16.8.
Development proposals provide many <u>opportunities for building-in beneficial biodiversity or geological features as part of good design</u> . When considering proposals, the Infrastructure Planning Commission (IPC) now Planning Inspectorate (PINS) should maximise such opportunities in and around developments, using requirements or planning obligations where appropriate (paragraph 5.3.15 in NPS EN-1).	Designed-in measures to be adopted as part of the onshore works for the mWave project are presented in section 16.7.3.
The applicant should include appropriate mitigation measures as an integral part of the proposed development..	Mitigation measures proposed for the onshore works for the onshore works are presented in Section 16.7.3.

16.4.2 Other relevant policies

- 16.4.2.1 The Pembrokeshire Coast National Park Local Development Plan, adopted September 2010, Proposals Map identifies the coastal area of East Pickard Bay as within the Pembrokeshire Coast National Park planning jurisdiction (Policy 1). Elements of the Project (including the onshore infrastructure) are located within areas designated as Nature Conservation Designations (SAC and/or SSSI) and Heritage Coast. Key policies with specific relevance to geological interests in the PCNPA are as follows (Appendix 3.1 provides wider policy information):
- Policy 8 Special Qualities (Strategic Policy) states that 'The special qualities of the Pembrokeshire Coast National Park will be protected and enhanced. The priorities will be to ensure that:
 - f) Development which would damage or destroy Geological Conservation Review sites or any other important geological resource is not permitted....
 - Policy 10 'Local Site of Nature Conservation or Geological Interest' states that development that would be liable to significantly harm the nature conservation value of a Local Nature Reserve or other site of local nature conservation interest, or the main features of interest within a Regionally Important Geodiversity Site, will only be permitted if the importance of the development outweighs the local value of the site and mitigation, minimisation or off setting has been investigated.

16.5 Consultation

- 16.5.1.1 The mWave project was originally intended to be the first deployment within META Site 8 (East Pickard Bay) and as such, consultation on META Site 8 also included the mWave project and communication cable route. As an early part of the consultation process, a scoping document was prepared by RPS and submitted to PCNPA. The scoping document had four possible locations for siting the temporary control station and cable route search areas between the mWave device and the temporary control station options, some of which crossed streams or a road (see Chapter 3 Needs and Alternative). An EIA scoping opinion was provided by PCNPA on the four onshore site options presented in the RPS scoping document, one of which is the East Pickard Bay site.
- 16.5.1.2 In addition to this a site visit was undertaken by a geological specialist to evaluate the landfall location and assess an early cable route option at East Pickard Bay. Notes from the site visit were issued to NRWa and feedback was provided.
- 16.5.1.3 A summary of the key issues raised during consultation specific to geology, water quality and land issues is outlined below, taking into consideration the final choice of onshore control station and cable route. An overview of how these issues have been considered in the production of this Environmental Statement chapter is provided in Table 16.2.

Table 16.3: Summary of key issues raised during consultation activities relevant to onshore geology, hydrology and land quality.

Date	Consultee and type of response	Issues raised	Response to issue raised and/or where considered in this chapter
10 January 2019	NRW advisory – discretionary advice service	Area designated as a Regionally Important Geological Site (RIGS). NRW provided with a geological constraints report undertaken by Sid Howells of Geological and Educational Services Ltd following a site visit in early December 2018 for initial cable route option. NRWa have subsequently reviewed the field note and are happy with the conclusion that the geological interest of the RIGS site will not be affected by the proposed development.	Subsequent to a site visit in December 2018, and after discussion with cable specialists, an optimised cable route option has been identified which is a more direct route out of the gully. As with the first route, the same method of installation will be used. A further site visit has been undertaken by the Geologist for the revised cable route, and the findings are reported herein.
10 January 2019	NRW advisory – discretionary advice service.	Temporary control station and cabling could have potential land contamination and controlled waters impact, therefore the following information to support the application. At landfall site Preliminary Risk Assessment (desk study) to outline potential contaminated land issues to assess risk to controlled water from the site. Furthermore the proposed location of the terrestrial elements may fall within Freshwater West (north) Geological Conservation Review Site.	The control station will be located on agricultural land which formed the eastern edge of the old RAF Angle airfield. The site is rough grassland adjacent to a farm track. There will be minimal site preparation works and all material will be retained on site. The control station components will be brought to site and lifted into place. The cable will be laid on the surface of the ground along its route, other than for a small section across the coastal footpath. Here it will be buried near to the coastal path gate. A termination box and cable anchors will also need to be located near the coast. The area near to the coastal path where the cable will be buried is green field and no contamination is predicted. At the control station, whilst it was previously an airfield, as there will be minimal intrusive ground works, the risk of land contamination is minimal. No further assessment is proposed. Details on installation of the control station and cable can be found in Chapter 2: Project Description. There is a small stream which forms from two springs approximately 100m to the south east of the control station site and runs approximately 400m down the gully to East Pickard Bay intertidal area. The cable route will leave the gully in the lower intertidal area via a cliff face and as such, the stream is avoided. The cable will be laid on the surface and not trenched/ buried other than to cross the coastal footpath at the footpath gate a point approximately 12m from the stream. The termination box and anchor points will be located on the headland also distant from the stream. Due to the proposed installation method and with good construction practice implemented through the EMP, no significant impact is anticipated on any water features and as such no further assessment is proposed. Details on installation of the control station and cable can be found in Chapter 2, Project Description. Designated areas which may be directly affected by the cable route and control station are identified in Figure 16.4. The Freshwater West (North) GCR will not be affected by the cable landfall at East Pickard Bay.
19 January 2019	Pembrokeshire County Council (PCC)	Geosciences - The final chosen site of the temporary control station and its associated cabling route could have potential contaminated and controlled waters impact and therefore we will require the following information to support the application. Preliminary Risk Assessment (desk study) to outline potential contaminated land issues to assess risk to controlled water from the site. Water Feature survey with a buffer of 300m either side of cabling. Based on the results of the survey the applicant must assess the likely impacts from the development on the surface and groundwater.	The control station will be located on agricultural land which formed part of the old RAF Angle airfield. There will be minimal site preparation works and all material will be retained on site. The cable will be laid on the surface of the ground along its route, other than for a small section across the coastal footpath. Here it will be buried using hand tools. A termination box and anchor points will also need to be located near the coast. The coastal area is green field and no contamination is predicted. At the control station, whilst it was previously an airfield, as there will be minimal intrusive ground works, the risk of land contamination is minimal. No further assessment is proposed. Details on installation of the control station and cable can be found in Chapter 2: Project Description. There is a small stream which forms from two springs approximately 100m to the south east of the control station site and runs approximately 400m down the gully to East Pickard Bay intertidal area. The cable route will leave the gully in the lower intertidal area via a cliff face and as such, the stream is avoided. The cable will be laid on the surface and not trenched/ buried other than to cross the coastal footpath at the footpath gate approximately 12m away from the stream. The termination box and anchor points will be located on the headland approximately 70m from the stream. Due to the proposed installation method and with good construction practice implemented through the EMP, no significant impact is anticipated on any water features and as such no further assessment is proposed. Details on installation of the control station and cable can be found in Chapter 2: Project Description.

16.6 Baseline Methodology

16.6.1 Desktop study

- 16.6.1.1 Desktop study and site-specific survey work has been used to inform the baseline environment.
- 16.6.1.2 The mWave communication cable route is located on the south coast of the Angle peninsula, to the south east of Milford Haven Waterway. Data and knowledge on the onshore geology is readily available and has been reviewed during the desktop study. These are summarised in Table 16.4 below.

Table 16.4: Summary of information reviewed during desk study.

Title	Source	Year	Author
East Pickard Bay RIGS: boundary map	www.pembrokeshirecoast.org.uk/files/files/.../RIGS_SPG_FinalOct11Eng.pdf	2019	PCNPA
East Pickard Bay RIGS: description and conservation guidelines	NRWa	2019	NRWa
Geological Conservation Review: site selection	http://jncc.defra.gov.uk/page-2947	2019	JNCC
Geological Conservation Review: database	http://jncc.defra.gov.uk/page-2949		JNCC
East Pickard Bay: published geological descriptions	Allen, J R L and Williams, B P J. 1981.. Allen, J R L and Williams, B P J. 1982. Williams, B.P. J. et al, 1982 Basset, M.G. (Ed.).		
East Pickard Bay: geological map (1:50,000)	https://www.bgs.ac.uk/	2019	British Geological Society
East Pickard Bay: topographic maps	https://osmaps.ordnancesurvey.co.uk/	2019	Ordnance survey
East Pickard Bay: air photos	https://www.google.co.uk/intl/en_uk/earth/	2019	GoogleEarth

16.6.2 Site specific surveys

- 16.6.2.1 An initial site visit was undertaken at the cable landfall site at East Pickard Bay on 5 December 2018 by the geological specialist (Sid Howells, GES Ltd). The site visit was to evaluate the geological features in the area with respect to cable route options and an initial option was evaluated. Field notes were prepared and provided to NRWa, who were unable to attend the site visit, but feedback was provided (Table 16.2). Information on the alternative cable routes considered is provided in Chapter 3 Needs and Alternatives.

- 16.6.2.2 A subsequent site visit was carried out 17 April 2019 to evaluate the final cable route option. The visit comprised a comprehensive assessment and photographic recording of geological features of the study area (Figure 16.1) to inform the assessment of potential effects from the installation of the temporary communication cable.

16.7 Details of Cable Route

- 16.7.1.1 As identified above the key geological interest relevant to this assessment is within the coastal slope and cliffs area, in particular in the immediate vicinity of the landfall at East Pickard Bay. A detailed description of the onshore cable route and installation methods to the control station can be found in Chapter 2: Project Description. A summary of the cable route at East Pickard Bay is provided below for ease of reference.

16.7.2 Details of Communication Cable Route

- 16.7.2.1 In order to minimise any effects from the installation of the temporary cable on the marine and terrestrial environment, where possible, the cable will be laid on the surface of the ground. From the mWave device the cable will be laid on the seabed across the sandy seabed and then to shore via a natural channel in the near shore rock seabed. The route of the cable from the landfall point to the control station is show in Figure 16.5.

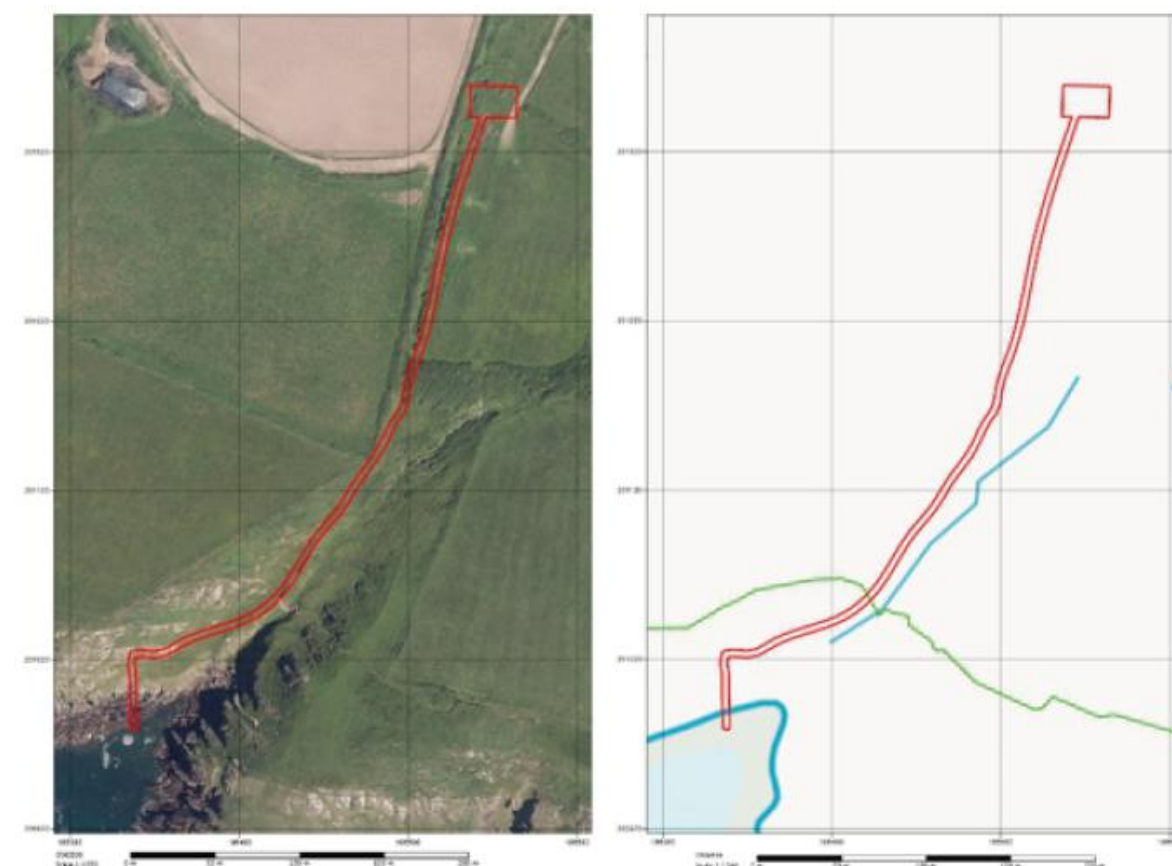


Figure 16.5 Proposed Cable route

- 16.7.2.2 The cable will be winched onshore using a manual winch system, with the main pull point being located in agricultural fields to the north and two anchor points near the coast (Chapter 2 Project Description, 2.5.3). Between MLWS to the termination box, which will be above MHWS, the cable will 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 16.6). Along this section the cable will be within a plastic conduit that is fixed to the rock surface using clamps. The clamps will be attached to the rock face via two bolts and there will be approximately 12-15 plates attached to the rock, i.e. one approximately every 5m. The attachment of the clamps to the rock will be undertaken using handheld tools only.



Figure 16.6 Cable route looking up and down gully

- 16.7.2.3 A termination box (approximately 100cm x 60cm x 60cm) will be required at the top of the intertidal section. A location between existing rock features will be identified and the termination box will be hidden using rock or turf or buried using hand tools. 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 a 76mm diameter hole. The exact number and thickness of hollow bars will be determined during anchor design. The cable will be clamped to the anchor. Rocks or turf will be used for screening, where necessary.
- 16.7.2.4 Figure 16.7a & 16.7b shows the projecting rocks located approximately 70m from the coastal footpath. This could be used as an anchor point for the cable, with an area adjacent suitable for positioning the termination box.



Figure 16.7a and b showing projecting rocks and potential junction box location

- 16.7.2.5 From the projecting rocks the cable will be laid on the grass surface, secured with soil nails along the toe of the exposures on the coastal slope before crossing to an existing fence line 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. At the gate, the cable will be buried using hand tools, across the coastal path for a small distance (approx 1m). A summary of the intertidal cable section is provided below.

Table 16.5: Cable installation summary

Cabling installation	
Installation methodology	The cable will be winched ashore using a manual winch system and two anchor points. The cable will then be brought up the vertical gully on the west side of East Pickard Bay within a conduit. The conduit will be fixed to the semi-vertical rock face with clamps and rock bolts, using hand-held tools only. From the top of the cliff the cable will be laid on the grass surface, secured with soil nails along the toe of the exposure before crossing to an existing fence-line 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. At the gate, the cable will be buried using hand tools, across the coastal path for a small distance (1m). A termination box and anchoring 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.

Cabling installation	
Length of cabling	0.05 km
Cable trench width	N/A
Cable trench depth	N/A
Duration of installation works	3 days
Plant requirements	Hand tools only will be used within the intertidal area.
Number of plant	None

Operation and maintenance of the communication cable

- 16.7.2.6 No operation or maintenance of the onshore sections of the cable is planned. Inspections to ensure routine operation may be carried out. These will be undertaken by foot within the intertidal area.

Decommissioning of cable

- 16.7.2.7 The cable will be removed at the end of the project. It is anticipated that decommissioning of the cable will be similar to installation. 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 vessel and taken off site.

16.7.3 Embedded Mitigation

- 16.7.3.1 Detailed below are mitigation measures which are embedded in the Project. A full list can be found in Chapter 2: Project Description, Section 2.6.2.
- Cable laid on surface and not trenched onshore thereby minimising impacts terrestrial ecology, archaeology, water features.
 - 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.
 - Existing gates and access track available to control station site minimises potential effect on receptors..
 - Minimal site preparation works at control station minimises potential effect on receptors.
 - 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 receptors.
 - Implementation of Environmental Management Plan.

16.7.4 Impacts scoped out of the assessment

- 16.7.4.1 Whilst the communication cable will be laid on the surface of the ground and will not be buried, apart from a small section, there will be a requirement to attach the cable to the rock face to ensure that it is secure as it is taken up the cliff. Whilst the installation of the communication cable, and associated anchors, has the potential to affect features of geological interest, the operation and decommissioning will have no impact. These have been scoped out of the following assessment.

16.8 Baseline environment and consideration of cable route

- 16.8.1.1 This section characterises the existing environment in terms of the geology in the vicinity of East Pickard Bay and along the proposed cable route. It then goes on to identify the potential impact from the communication cable. Specifically, with the objective of determining whether or not it would destroy, damage, obscure or prevent access to any component of the geological features of the East Pickard Bay RIGS.

16.8.2 General Setting

- 16.8.2.1 East Pickard Bay (SM 864 009) is located on the southern coastline (Figure 16.8) of the Angle Peninsula, approximately 2km west-north-west of the northern limit of the long sandy beach at Freshwater West.
- 16.8.2.2 The bay has developed from erosion (marine, fluvial and fluvio-glacial) along the plane of a strike-slip fault which cuts obliquely (SW-NE) through northwards-dipping sedimentary rock layers forming part of the sequence known loosely as the 'Old Red Sandstone' (ORS).
- 16.8.2.3 Below a small footbridge (at c.30mOD) on the Wales Coast Path, a small stream drops to the bay through the fault gulley (Figure 16.9). In the intertidal area of the bay the bedrock is mostly obscured by boulders, but clean and accessible exposure can be found near high water and in the cliff faces.
- 16.8.2.4 Above these exposures there is a vegetated (grass or scrub) coastal slope with some protruding bedrock, although this is generally heavily weathered and/or covered by lichens. The fault is obscured by rockfall debris and vegetated soil, but its existence is evidenced by displacement of the Townsend Tuff (see 16.18).

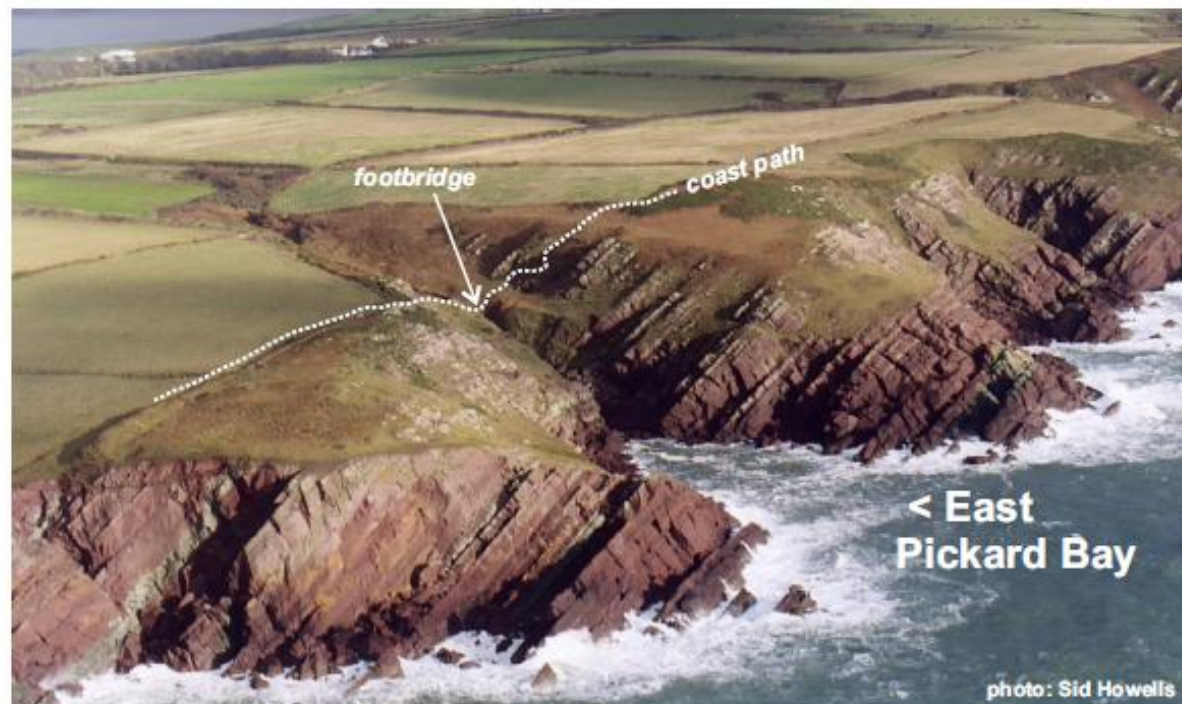


Figure 16.8 Old Red Sandstone exposures in cliffs at East Pickard Bay on the south coast of the Angle Peninsula



Figure 16.9 View from kayak showing the gully at the back of East Pickard Bay and the lower part of a valley extending back up to the coastal plateau.

16.8.3 Tuff units within the Old Red Sandstone

- 16.8.3.1 The Townsend Tuff, c. 3.4m thick at this site, is a distinctive unit and important lithostratigraphic-chronostratigraphic marker within the lower part (Milford Haven sub-Group) of the Old Red at East Pickard Bay (Figures 16.10 & 16.11) At East Pickard Bay, the Townsend Tuff is exposed on the western headland (Figures 16.12- 16.15) and on the eastern side of the fault gully (Figure 16.17 and 16.18).
- 16.8.3.2 East Pickard Bay is the type locality for a second prominent tuff unit, the Pickard Bay Tuff (Figure 16.16), approximately 1.7m thick and 17m above the Townsend Tuff (as measured perpendicular to bedding planes in the ORS sequence), which is also exposed in the western cliff section (Figure 16.13).
- 16.8.3.3 To the east of the fault the Pickard Bay Tuff is obscured (Figure 16.17) but its approximate sub-surface position can be determined through measurement from the Townsend Tuff.
- 16.8.3.4 Beds below, between, and above these two prominent tuff layers would be included in any sedimentary log (a standard scientific method of recording) of the ORS sequence at this location. To date, only logs of the tuffs have been published (Williams et al, 1982). Five thinner tuff beds (no more than a few centimetres thick) are also present, as recorded by Allen & Williams, 1982.
- 16.8.3.5 Although this is the type locality for the Pickard Bay Tuff, it has not been designated as a Geological Conservation Site. This is because both the Pickard Bay Tuff and the Townsend Tuff are also exposed within several GCR sites in South Pembrokeshire as shown in Figure 16.13, which also shows their coverage within RIGS.
- 16.8.3.6 This duplication across GCR sites and RIGS is necessary to allow study of lateral variations between ORS sequences (Allen & Williams, 1982), consisting mainly of mudstones and siltstones (often showing development of calcrete paleosols), together with interbedded sandstones.
- 16.8.3.7 Sediments were deposited in a complex fluvial environment (braided river channels and floodplains). Distant volcanic eruptions added fine-grained ash, and these are extremely useful for correlation and dating.

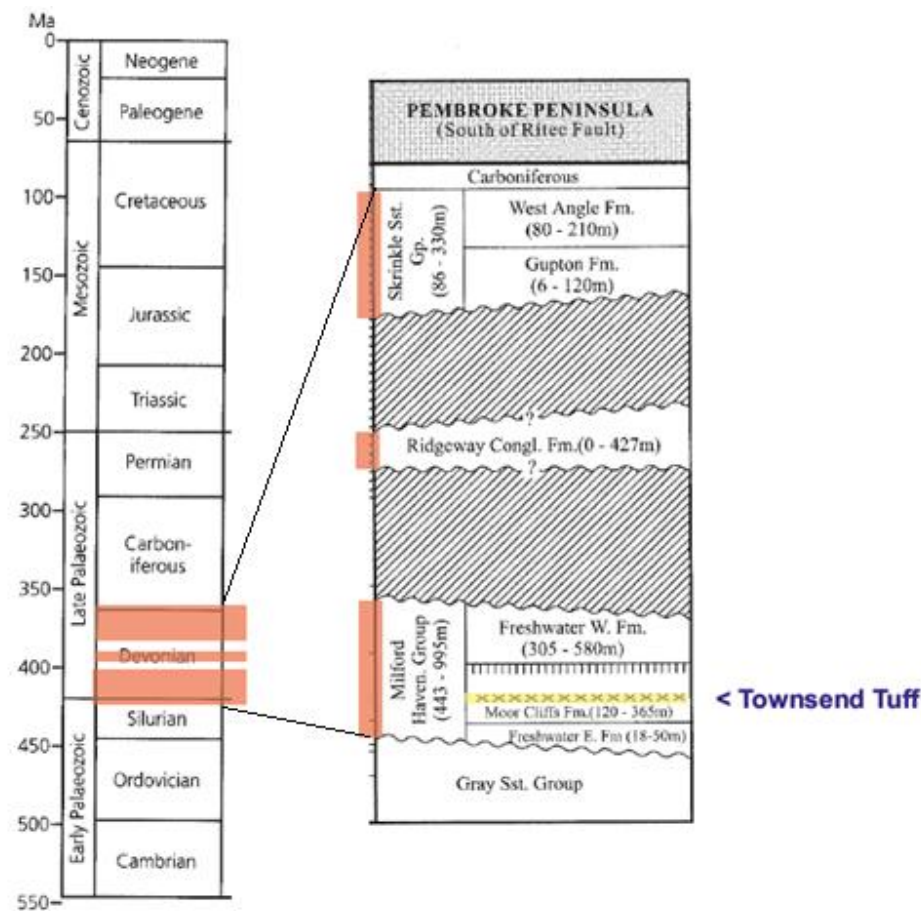


Figure 16.10 Age and stratigraphy of the Old Red Sandstone in South Pembrokeshire

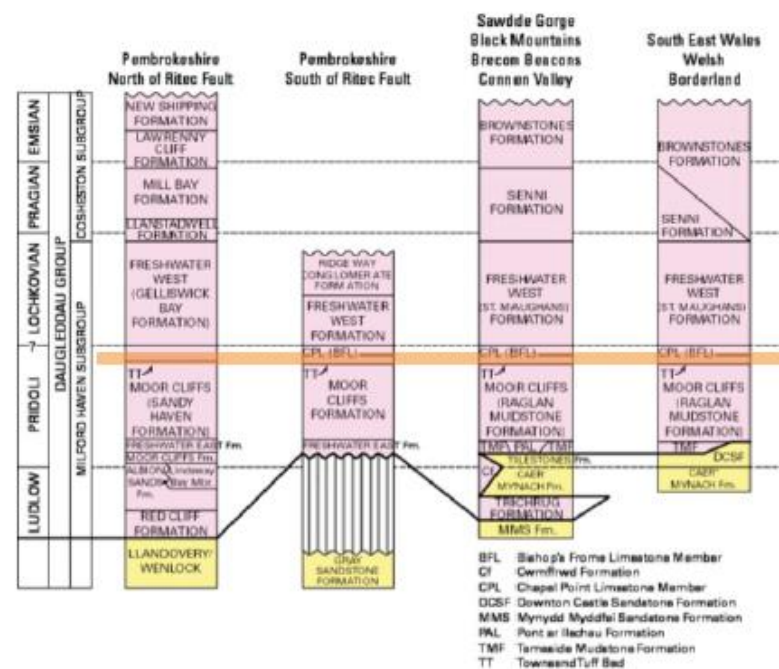


Figure 16.11 Significance of the Townsend Tuff (TT) as a lithostratigraphic marker within the Old Red Sandstone of Wales



Figure 16.12 Western cliff section at East Pickard Bay, showing the Old Red Sandstone sequence that includes exposures of the Townsend Tuff and Pickard bay Tuff (boxed area as shown in more detail below) and cable route



Figure 16.13 Townsend Tuff (TT) and Pickard Bay Tuff (PBT) exposures in western cliff section at East Pickard Bay



Figure 16.14 Detail of Pickard Bay Tuff exposure in the western cliff section at East Pickard Bay (inset: log from Williams, et al. 1981)



Figure 16.16 Townsend Tuff (TT) exposures in eastern cliff section at East Pickard Bay



Figure 16.15 Townsend Tuff (TT) exposures in eastern cliff section at East Pickard Bay



Figure 16.17 Detail of Townsend Tuff exposure in the cliff section east of the fault gully in East Pickard Bay

16.8.4 Consideration of cable route

- 16.8.4.1 As discussed above and as shown in Figure 16.19, the cable route passes well clear of (50m away from) the key locations for scientific study of the Old Red Sandstone sequence that includes the Townsend Tuff and Pickard Bay Tuff.
- 16.8.4.2 On the evidence presented in Figure 16.19 it is clear that the installation, operation and decommissioning phases of the proposed cable would not have any adverse effects on the geological features of the East Pickard Bay RIGS.
- 16.8.4.3 No transboundary or inter-related effects are anticipated. There are no projects within the area which could have the potential to have a cumulative impact on the features of geological interests at East Pickard Bay.

16.9 Conclusion and summary

- 16.9.1.1 Installation activities associated with the mWave project onshore works, which comprise a communication cable, with associated termination box and cable anchors and control station, have the potential to have impacts on geology, land quality and water quality. However, proposed installation methods and cable route choice will minimise any effects. The cable will be laid on the surface and not buried. At the coast it will be secured to a rock face to take it out of the gully to the termination box and anchor before heading inland, secured with soil nails on grassed areas. At the control station site there will be minimal ground works (levelling) and no soil will be taken off site. The control station units will then be brought to site.
- 16.9.1.2 In terms of land quality, the control station will be located on agricultural land which forms the eastern edge of the old RAF Angle airfield and as such is classified as brown field (previously developed). The area for the control station is at the edge of a rough grassland field, adjacent to an access track. There will be minimal site preparation works and all material will be retained on site. The coastal area, where the cable will be laid, is green field and no contamination is predicted. With the minimal intrusive ground works, the risk of land contamination is minimal.
- 16.9.1.3 There is a small stream which forms from two springs approximately 100m to the south east of the control station site and runs approximately 400m down the gully to East Pickard Bay intertidal area. The cable route will leave the gully in the lower intertidal area via a cliff face and the stream is avoided. The cable will be laid on the surface and not trenched/ buried other than to cross the coastal footpath at the footpath gate approximately 12m from the stream. The termination box and anchor point will be located on the headland approximately 70m from the stream. Due to the proposed installation method and with good construction practice, no significant impact is anticipated on any water features.

- 16.9.1.4 Geological interests are present at the cable landfall at East Picard Bay namely the Old Red Sandstone sequence that includes the Townsend Tuff and Pickard Bay Tuff. Site survey has confirmed that the cable route passes well clear of (50m away from) the key locations for scientific study and there will be no impact on geological features of interest.

16.10 References

- Allen, J R L and Williams, B P J. 1981. Sedimentology and stratigraphy of the Townsend Tuff Bed (Lower Old Red Sandstone) in South Wales and the Welsh Borders. Quarterly Journal of the Geological Society, Vol.138, 15-29.
- Allen, J R L and Williams, B P J. 1982. The architecture of an alluvial suite: rocks between the Townsend Tuff and Pickard Bay Tuff Beds (early Devonian), southwest Wales. Phil. Trans. Royal Soc. Edinburgh, Vol. 297, 51-89.
- Williams, B.P. J. et al, 1982. Old Red Sandstone facies of the Pembroke Peninsula, south of the Ritec Fault. pp 151-174 in Basset, M.G. (Ed.) Geological Excursions in Dyfed, South-West Wales. National Museum of Wales

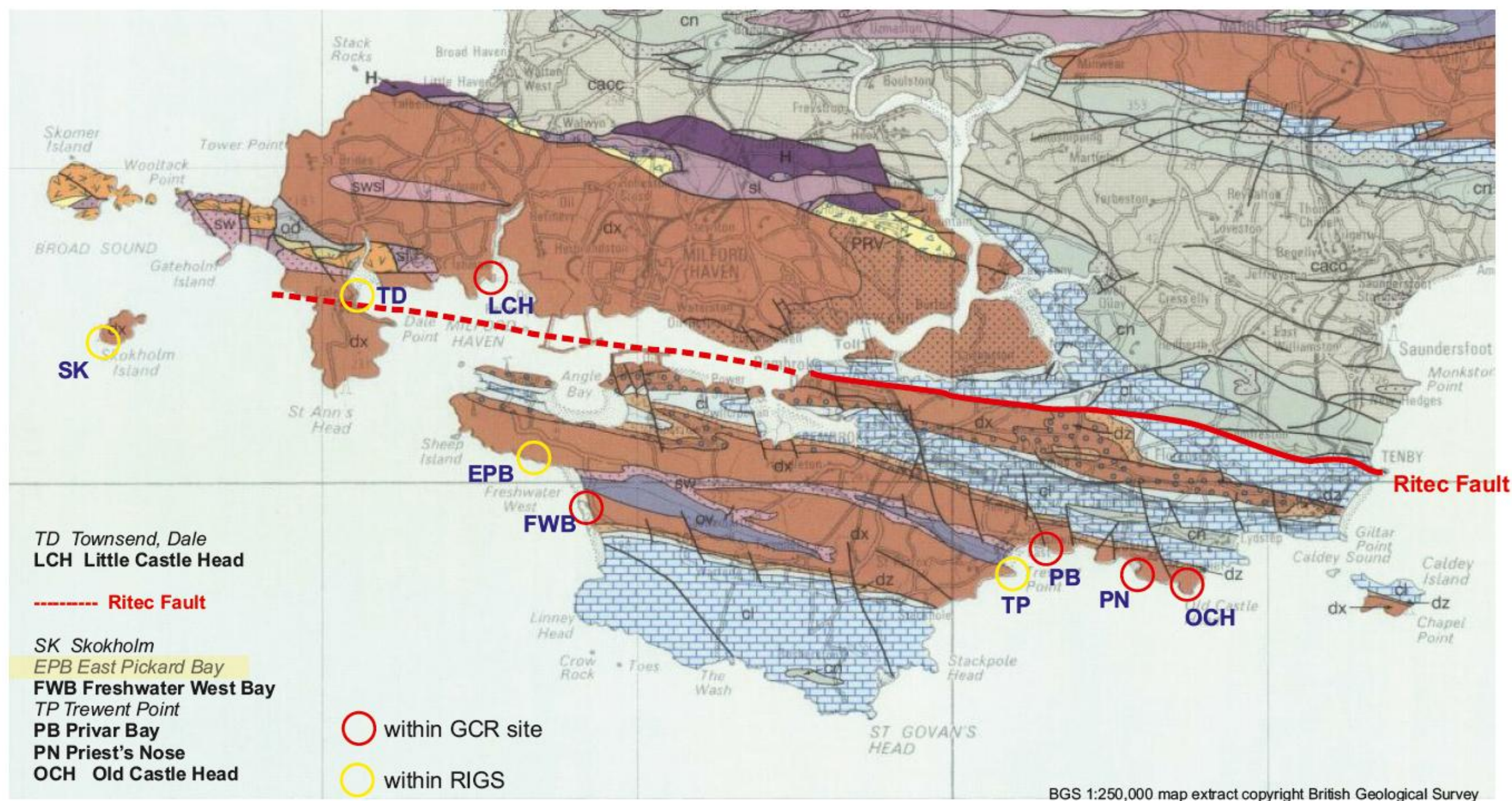


Figure 16.18 Old Red Sandstone outcrops and locations where the Townsend Tuff and associated tuff beds are exposed

The Townsend Tuff (and associated tuff beds, including Pickard Bay Tuff) is used in stratigraphic correlation within the lowest part of Old Red Sandstone (ORS) sedimentary sequences in West Wales and elsewhere (eg. Brecon Beacons, Clee Hills). These tuff beds are also useful in comparing lateral variability of ORS sequences that include the tuffs.

The Ritec Fault was active at the time the ORS sequences were deposited, so exposures to the north and south of the fault need to be considered separately.

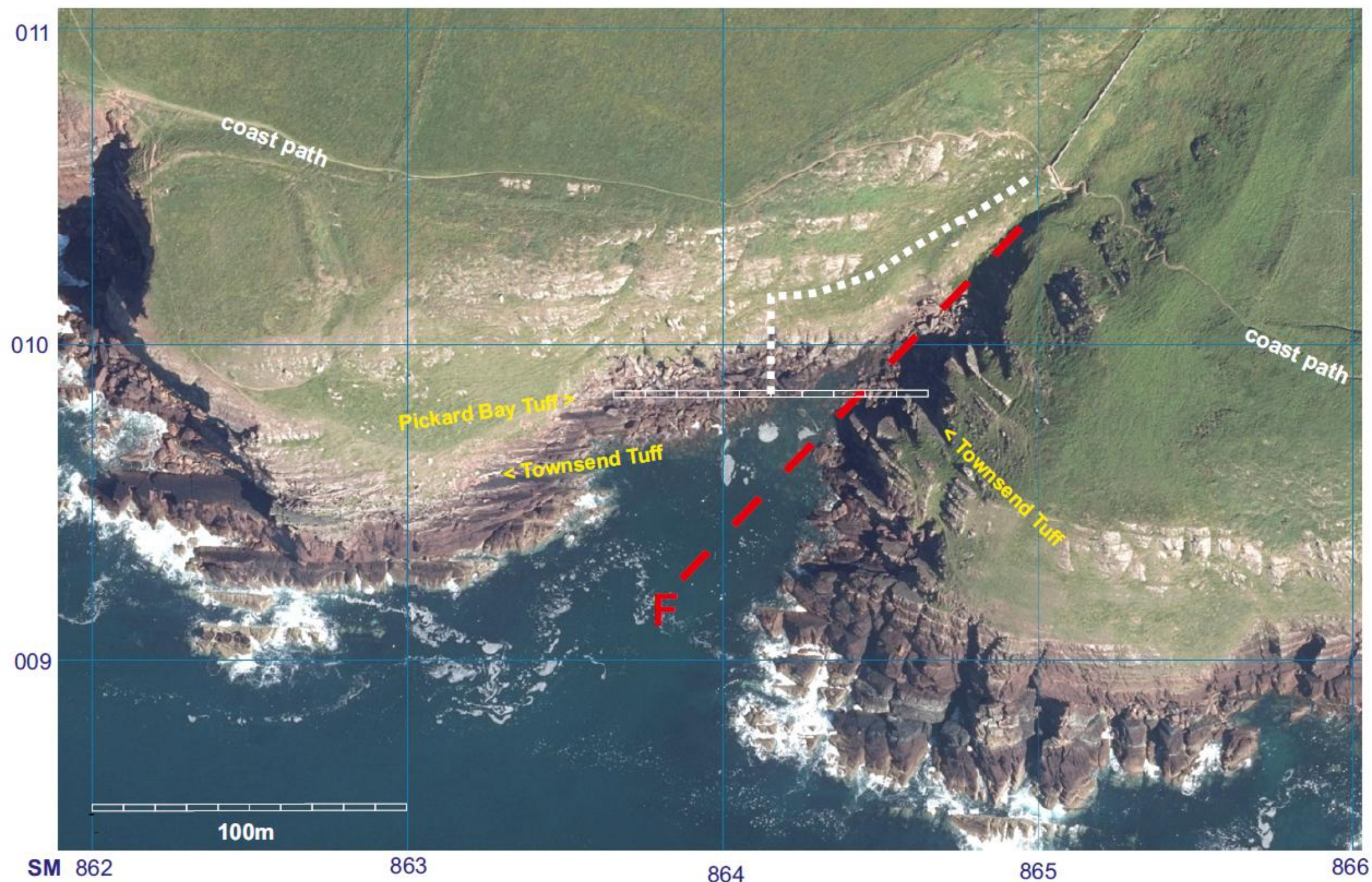


Figure 16.19 East Pickard Bay - overview of cable route in relation to geological interests.

As can be seen, this route clearly does not impinge upon areas where the Old Red Sandstone sequence and associated tuff units (including the Townsend Tuff and Pickard Bay Tuff) would be studied ie. the western headland of the bay and the cliff section east of the fault (F),