GREENLINK
MARINE ENVIRONMENTAL IMPACT ASSESSMENT REPORT- IRELAND

APPENDIX L

Welsh and Irish Landfall Final Selection Report

P1975_R4500_RevF1
July 2019

Greenlink Interconnector
- connecting the power markets in Ireland and Great Britain

Greenlink
INTERCONNECTOR

CONTENTS

1. INTRODUCTION

Intertek Energy & Water Consultancy Services (Intertek) has been appointed by Greenlink Interconnector Limited (Greenlink) to provide a range of marine consultancy and engineering services related to the Greenlink Interconnector.

Greenlink proposes to develop an electricity interconnector, which will allow transfer of power between the high voltage grid systems of the UK and the Republic of Ireland. The power would be able to flow in either direction at different times, depending on the supply and demand in each country. Greenlink will connect to the UK National Grid system at Pembroke substation in Pembrokeshire, Wales and to the Irish network at Great Island substation in County Wexford, Ireland.

Greenlink will use high voltage direct current (HVDC) technology to link the two power systems. As both national electrical systems use high voltage alternating current (HVAC) supply, convertor stations will be located near each substation to convert the HVAC electrical supply to HVDC.

Greenlink emerged as a separate interconnector project from the Greenwire renewable energy input project, proposed by Element Power. It was awarded an interconnector licence in GB by Ofgem on 10 February 2015. Element Power had previously commissioned a study to identify suitable DC cable landfall locations in Pembroke, Wales for Greenwire. This, as well as a new study specifically commissioned for Greenlink, have been used to identify suitable landfall locations in Pembroke, Wales and County Wexford, Ireland. The studies are:

- JP Kenny (2012) Greenwire Part 2a: South Wales Landfall Options Report (*224729-00_Part 2a - South_Wales_Landfalls_Technical_Note_R2.pdf)*
- Intertek (2016) Greenlink Interconnector Project Landfall Selection Report (*P1975_RN3926_Rev4.pdf)*

These documents conclude that of the options investigated, two landfalls are most feasible on the Welsh coast and four landfalls are most feasible on the Irish coast. Copies of these reports, containing the detailed methodology and assessment for the landfall locations, can be found in Appendix A and B of this report.

This report summarises the studies and details the subsequent consultation with stakeholders that has led to the selection of the final landfall options in Wales and Ireland.

- Wales: **Freshwater West**
- Ireland: **Boyce's Bay** and **Baginbun Beach**

2. WELSH LANDFALL

2.1 Introduction

JP Kenny (2012) undertook a desktop study for the Greenwire project that identified eight potentially suitable landfall locations in Pembrokeshire, Wales. These were Broad Haven, Freshwater West, Tenby South Beach, Dale, Whitesands, Abereiddy LF, Aber Mawr 1 & 2 and Strumble Head.

Table 2-1 summarises the landfall assessments detailed in the desktop study. The two preferred options, as identified in the report were:

- **Broad Haven;** and
- **Freshwater West.**

Table 2-1 Summary of landfall selection

Landfall	JP Kenny conclusions	Intertek comment
Freshwater West (preferred)	Advantages: ▪ It has the shortest onshore route of all options under consideration; ▪ Technically straightforward; ▪ The nearshore route avoids the firing range; ▪ Sandy foreshore with favourable nearshore beach profile; ▪ Reasonable onshore access. Disadvantages: ▪ Proximity to firing range; ▪ Proximity to Milford Haven harbour entrance; ▪ Shore crossing and working area likely to be through dunes to public carpark and subsequently be likely be subject to environmental restrictions; ▪ Evidence of land movement in the slope behind dunes leading up to the public access road; ▪ Potential for rock to be encountered in the nearshore (slate and conglomerate exposed on the beach at low tide at far Northern end of beach), areas of rock identified on admiralty chart.	Intertek agrees that this is a good choice for the Greenlink Interconnector to landfall. The greatest advantage of using this location as the preferred landfall option is that is it shortest route to the connection point with no technical challenges. It is also south of the haven and therefore avoids a harbour crossing. The offshore route does not avoid the firing range but consultation with the MoD has resulted in permission to route within the Castlemartin military area thus eliminating this as a routing constraint and potential disadvantage. Using HDD will also eliminate the disadvantages posed by the environmental restrictions behind the beach. The major disadvantage of using this landfall is the potential risk the firing range will have in the operation and maintenance phase of the cables life; however, this isn't thought to be significant as the cable lies on the northern edge of Castlemartin firing range.
Broad Haven (preferred)	Advantages: ▪ The nearshore route can avoid the firing ranges; ▪ Sandy foreshore (with some exposed rocks at northern end); ▪ Nearshore geology on the admiralty chart is mostly sand, muds and gravels; ▪ Favourable beach profile; ▪ Onshore routing is constructible. Disadvantages: ▪ It necessitates a technically challenging but feasible crossing of Milford Haven (~3km); ▪ Broad Haven is a high value recreational amenity area and it is probable that the permit construction window will exclude the summer months; ▪ Desire to avoid laying the cable along the seafront and through the town where possible; ▪ Admiralty chart indicates some areas of rock in the nearshore; ▪ Crossing under seawall is required if routing at the northern end of Broad Haven (not a major concern); ▪ Storm water culvert at the northern end of the beach may impact on northern shore crossing route options.	Intertek also agrees that Broad Haven is a good choice for the Greenlink Interconnector to landfall. The beach profile is very favourable from a construction perspective. At the time of the desktop study, the major attraction of this landfall selection was that it avoids the Castlemartin firing range entirely. Subsequent discussions with the MoD has meant that the firing range is no longer a constraint, and therefore avoidance of the area no longer outweighs the disadvantage that the technically challenging crossing of Milford Haven poses to reach the connection point from this landfall.

Landfall	JP Kenny conclusions	Intertek comment
Broad Haven South (Not selected)	Broad Haven South is within the Castlemartin Firing range and as such should not be considered further unless other more favourable options are excluded. Points of note for Broad Haven South: ▪ Steep walking path access to down to the beach from the carpark (stairs, ~100m, up to 30deg slope); ▪ Landfall construction will likely require an HDD into carpark to avoid open cut on the steep slope; ▪ Tourist information boards identify several bird species local to the area including guillemot, razorbill and the area is also a nesting zone for Chough (Britain's rarest crow); ▪ Rocks offshore (visible, castle rock), and also small breaking waves to the west of castle rock; ▪ Sandy beach; ▪ High tourist amenity and visual landscape value; ▪ Significantly longer offshore route than Freshwater West.	Although Castlemartin firing range is no longer considered a constraint, an offshore route to this landfall would require traversing more of the active area. In addition, the offshore route would be approximately 10 km longer than one routing to Freshwater West. Only HDD would be feasible at this location.

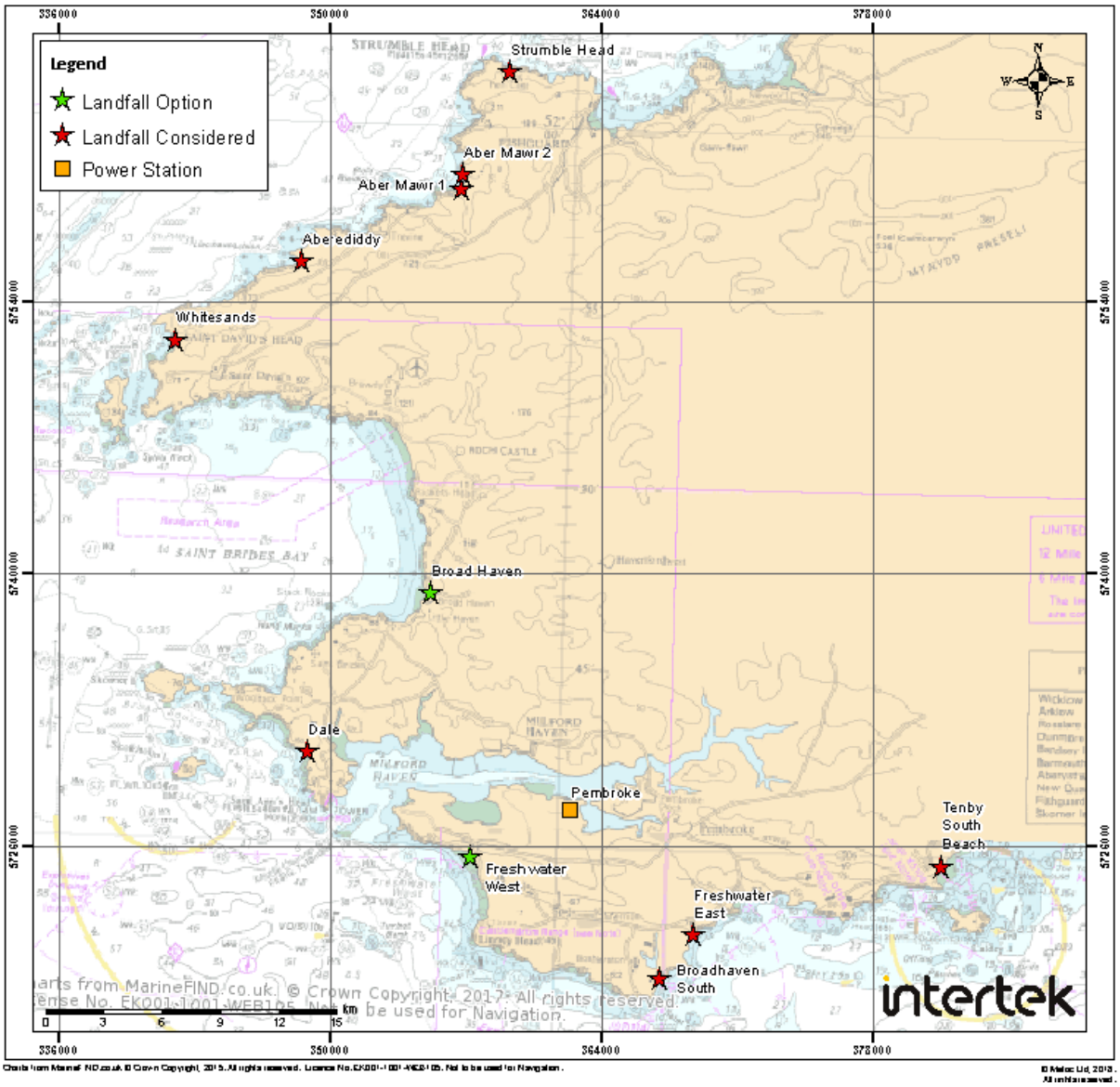
Freshwater East
(Not selected)
	Freshwater East is within the Castlemartin Firing range and as such should not be considered further unless other more favourable options are excluded.
	Points of consideration for Freshwater East:
	▪ Gently sloping beach with gravel/pebbles/cobbles overlying sand;
	▪ Admiralty chart indicates gravels and sands in the nearshore;
	▪ The main access to the beach is from a car-park located approximately 20m to 50m from the beach at close to it's southern extent:
	  ▪ One walking path passes through small dunes (1-3m high) onto beach;
	  ▪ Another concreted footpath provides access alongside a small stream to the beach;
	▪ Difficult onshore route to the southwest:
	  ▪ Tight narrow roads, small stream with one-way narrow bridge (4 to 5m long bridge at the beach access location);
	  ▪ A two-lane road runs from the public access, at the southern end of the beach, towards the north. As soon as it exits the beach the road rises steeply and then run along the top of the slope approximately 300m behind the beach and estimated at over 30m high. Residential properties are located at the top of this steep bank along the length of the beach. There are also some walking access tracks down the slope to the beach and farm access which may be able to be improved for onshore cable construction up the slope;
	▪ There are mooring buoys for small watercraft at the southern extent of the beach and buoys marking the boat speed zones;
	▪ Significantly longer offshore route than Freshwater West.
		Castlemartin firing range is no longer considered a constraint. However, the main factor to discount this landfall location is that the offshore route length would be approximately 15 to 20 km further than Freshwater West, and whereas the route to Freshwater West traverses the edge of the Firing Range a more direct path through the active area would be required to reach this landfall.

Landfall	JP Kenny conclusions	Intertek comment
Tenby South Beach (Not selected)	A landfall at Tenby South Beach can be routed to narrowly avoid the Castlemartin Firing range. However, it is the longest offshore route, is a popular tourist area and has a long onshore route. Points of consideration: ▪ Sandy beach, admiralty chart indicates sand and shells in the nearshore area; ▪ Golf course runs behind most of the beach except at the southeastern end; ▪ Any landfall would likely be located at the SE end of beach, near new apartment blocks to avoid the golf course; ▪ There are other cables making landfall at the SE end of beach for which proximity agreements would need to be negotiated; ▪ Offshore, the cable would be routed between Caldey Island and Woolhouse rocks.	Castlemartin firing range is no longer considered a constraint but the added offshore cable route length (30km) and the additional asset proximity agreements has discounted this landfall location. The offshore cable route would also have to be engineered between Caldey island and Wales mainland which would represent a permanent risk to the cable during installation and the operation and maintenance phase with regards to anchor strike. An additional navigational risk assessment, specific to this location may be necessary.
Dale (Not selected)	The option to the west of Dale town is a difficult landfall, due to geology, topography and access issues, and therefore is not preferable.	Intertek agrees with the assessment.
Whitesands (Not selected)	Whitesands appears technically feasible from a landfall construction viewpoint. Observations regarding the Whitesands landfall are noted below: ▪ Sandy beach with rock outcrops at northern extent, although rock noted in the nearshore on the admiralty chart; ▪ Exit from a beach landfall could be through to the public car-park (approximately 40m x 120m); ▪ From the car-park a narrow single lane road climbs up in a moderately steeply manner (no parking available on the road); ▪ Adjacent to the access road at the top of the slope leading down to the beach is the St David's City Golf Course (entrance approximately 700m from the beach). The golf course extends to within 100m of the beach, on the southern side of the access road and south of the public car-park; ▪ The beach has a high recreational amenity value and is a prominent surfing location; ▪ The onshore route ~25km longer than that to Broad Haven but correspondingly the offshore route is shorter; ▪ Most of the onshore main access road is suitable except for narrow congested sections through St David's and Solva town. It may be possible for alternative onshore routes to be proposed. However, the feasibility of the onshore route and the potential for public opposition due to the high recreational amenity value would need to be further investigated if this option is to be considered further.	Due to the length & challenges of the onshore route and the potential for public opposition Intertek did not consider this landfall further.

Landfall	JP Kenny conclusions	Intertek comment
Abereiddy LF (Not selected)	Abereiddy is a small beach located to the northeast of Whitesands and the town of St David's. The landfall comprises the following features: ▪ Exposed bedrock to the west of the beach; ▪ To the east the foreshore comprises pebbles overlying sand; ▪ A small (<2m) high concrete seawall is the sea defence for the public carpark which runs along the beachfront (~30m x 120m long); ▪ Admiralty chart indicates shells and pebbles are present in the nearshore. The water depth increases quickly to ~25m at the end of the inlet approximately 400m offshore; ▪ Beach is used for access to the nearby "blue lagoon", a disused slate quarry which has been infilled with seawater through a breach in the outer wall. This lagoon is a popular location for tourism activities that include coasteering; ▪ Road access is generally suitable except for the final access to the beach which is approximately 4 to 5m wide. Much longer onshore route than Broad Haven.	The landfall study carried out by JP Kenny is inconclusive as to why this landfall was not selected. From an offshore perspective this landfall is a similar length to Freshwater West and poses minimal routing restrictions offshore. However, the approach to the beach consists of 2km of rock and potential reef (within the Pembrokeshire Marine Special Area of Conservation) and installation would be technically challenging e.g. extended HDD, rock cutting through potentially protected feature. In addition, as this area is a popular location for tourism, this option was discounted.
Aber Mawr 1 & 2 (Not selected)	Aber Mawr 1 and 2 are gravel/pebble beaches located north of Abereiddy. Both beaches are similar in terms of geology. Access is difficult with no public road to the beaches. The Pembrokeshire coastal path network passes right across both beaches. The admiralty chart identifies the nearshore geology as gravels and pebbles. Access to both beaches is difficult: ▪ The public road is only one lane wide for the last 500-800m; ▪ For Aber Mawr 1, construction access would be very challenging as behind the beach is a wetland/marsh area extending for approximately 500m; ▪ For Aber Mawr 2, construction access could be built alongside the coastal walking path whichleads at a moderate slope down the cliff, southwest towards the beach. This may require some adjacent landowner permissions.	Access to both beaches would be extremely difficult, therefore these landfalls were not selected.
Strumble Head (Not selected)	Strumblehead was not accessed during the site visit as there was no public access available to the beach. It is the most northerly landfall that was identified as part of the desk top review. The location identified is a small inlet at the end of small valley to beach. The aerial view indicates a sandy foreshore but with rocks offshore. The beach is located approximately 500m from the public road and therefore landowner agreement would be required for construction and cable routing.	The lack of access at the landfall site excluded it from further consideration as a landfall option.

*Reference: JP Kenny (2012) Greenwire Part 2a: South Wales Landfall Options Report

Figure 2-1 Map of Preferred Welsh Landfall Locations



2.2 Broad Haven

This landfall north of Milford Haven comprises of a flat sandy foreshore with minimal offshore routing restrictions.

The onshore route would be to the east, just north of Broad Haven Town. The route would then turn south towards Milford Haven; where a crossing across the estuary would be required to run from Venn Farm on the northern side of the Haven to a location on the southern side.

While crossing the estuary is technically challenging, options may include horizontal directional drilling (HDD) or tunnelling to be near the power station. The total length of the proposed crossing is approximately 3km.

2.3 Freshwater West

Landfall options to the south of Milford Haven are all severely restricted due to the presence of Castlemartin and Manorbier firing ranges; actively used for military practice. The nearshore route can

be positioned just outside the Castlemartin firing range by positioning at the northern end of the beach.

The shore crossing at Freshwater West would extend through sand dunes approximately 3m high at the northern extent. The sand dunes are environmentally sensitive areas and installation through this area would require environmental permitting. The landfall construction method may be restricted to an HDD option to avoid disturbance to the dunes.

Due to the proximity to both the firing range and Milford Haven harbour mouth it is possible that substantial cable burial depth would be required to provide sufficient protection to the cable.

One of the most attractive characteristics of this landfall location is that it has the shortest onshore route to the converter substation and tie in point.

2.4 Landfall Selection – Freshwater West

Of the two options, initially Freshwater West was less preferential because offshore constraints meant that sections of the marine cable route enter the Castlemartin firing range Sea Danger Area. Routing within the vicinity of the range was thought to be not feasible or at the very least problematic. However, consultation with the MoD in late 2013 and early 2014 (see Appendix C, minutes 14/01/2014) with respect to Freshwater West being a potentially landfall, indicated that routeing within the Castlemartin firing would be permitted. Further discussions with the MoD throughout 2016 and 2017 (see Appendix C, minutes 4 May 2017), determined that the co-location of a submarine cable and the military firing range was possible, from the MoD perspective. Subsequent, detailed discussions with the MoD have culminated in a letter agreeing protocols for access to the Sea Danger Area (10 July 2017, Appendix C).

Elements of the Broad Haven landfall such as onshore cost, route length, and the technically difficult challenges associated with engineering a crossing of Milford haven e.g. HDD or tunnelling under, have led to Freshwater West being given higher preference than Broad Haven. Overall Freshwater West is likely to be less challenging, and once the MoD confirmed that routeing through the Castlemartin Firing Range will be possible, this led to its selection as the preferred landfall.

Preferred Welsh Landfall Selection:

- **Freshwater West,** Pembrokeshire, Wales

3. IRISH LANDFALL

3.1 Introduction

Intertek was appointed by Element Power Ireland in 2015 to undertake a landfall assessment for the Greenlink Interconnector for the landfall in Ireland. A desk-based study identified ten possible sites, of which eight were visited and assessed in 2015. These were; Rathmoylan Cove, Boyce's Bay, Sandeel Bay, Carnivan Bay, Baginbun Beach, Dollar Bay, Booley Bay, Newtown Beach, Bannow beach and Cullenstown Beach. After site visits four preferred options were identified in report P1975_RN3926_Rev4 (Appendix B), namely:

- Baginbun Beach;
- Booley Bay;
- Boyce's Bay; and
- Sandeel Bay.

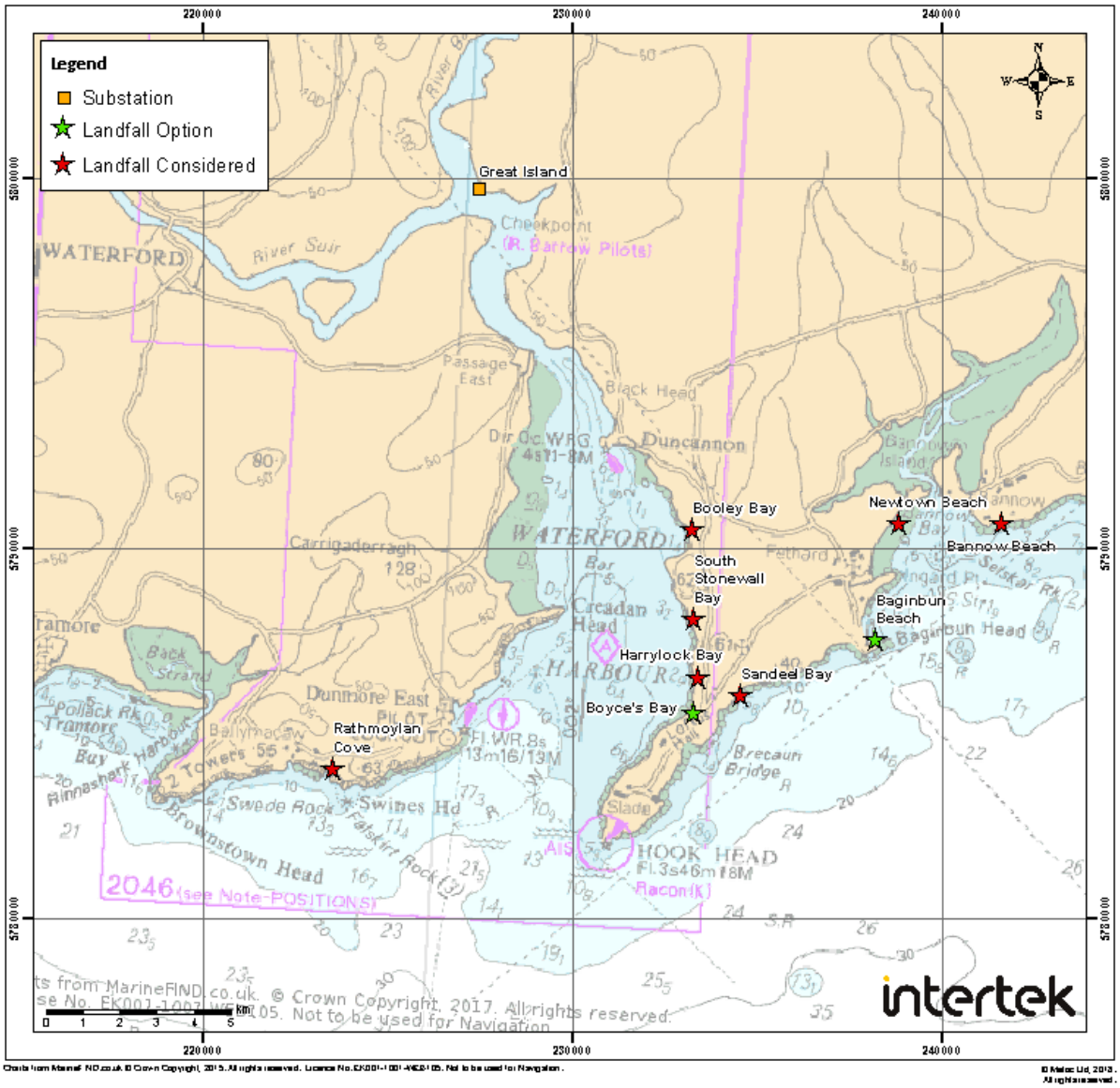
Table 3-1 shows the weighted score criteria outlined in P1975_RN3926_Rev4.

Table 3-1 Weighted Ranking for each Landfall Site

Description	Baginbun Beach	Bannow Beach	Booley Bay	Boyce's Bay	Carnivan Bay	Cullenstown	Dollar Bay	Sandeel Bay
Vessel Access	1.28	0.80	0.96	1.12	1.28	0.8	0.8	0.48
Beach Composition	1.12	0.42	1.12	1.12	0.7	0.7	1.12	0.7
Amenity Impact	0.7	0.20	0.5	0.5	0.5	0.2	0.6	0.2
Environmental Constraints	0.4	0.70	0.3	0.6	0.2	0.7	0.3	0.2
Exposure	0.72	0.16	0.56	0.48	0.16	0.16	0.56	0.24
Working/Site area	0.56	0.56	0.48	0.24	0.64	0.64	0.24	0.56
Coastal Erosion	0.56	0.32	0.56	0.56	0.16	0.16	0.56	0.48
Obstructions & Existing infrastructure	0.64	0.48	0.56	0.56	0.56	0.56	0.56	0.48
Access to beach	0.30	0.24	0.54	0.48	0.42	0.42	0.3	0.42
Cable engineering & protection requirements	0.36	0.18	0.36	0.36	0.42	0.42	0.36	0.36
Overall cable length	0.36	0.24	0.42	0.36	0.42	0.42	0.42	0.54
Total Weighting	**7.00**	**4.30**	**6.36**	**6.38**	**5.46**	**5.02**	**5.82**	**4.66**

Source: P1975_RN3926_Rev4

Figure 3-1 Map of Preferred Irish Landfall Locations



3.2 Baginbun Beach

Baginbun Beach is located to the north of Carnivan Bay on the Baginbun peninsula. It lies within the Hook Head Special Area of Conservation (SAC) but the cable would have less distance in the SAC than at alternative sites such as Sandeel Bay.

The beach faces north east, has excellent access for vessels and is eastward facing protecting the site from prevailing wind conditions. Offshore, lobster / crab pots were observed indicating fishing activity in the area.

Surrounding the beach are heavily vegetated cliffs of moderate height (< 15 m) with only minor signs of erosion on the northern side of the beach. Height and apparent stability would suggest HDD would be possible but would require appropriate geological assessment and survey of ground conditions for confirmation.

3.3 Sandeel Bay

Sandeel Bay is located to the south of the Baginbun peninsula on the east of the Hook peninsula. Sandeel bay lies within the Hook Head SAC and is close to Hookless Village / Sandeel Bay Cottages, a popular holiday resort.

The cliffs surrounding the beach are approximately 10 - 15 m in height with small localised areas of erosion and landslip. There is a rock outcrop to the south of the bay. The beach gradient is shallow but demonstrates large amounts of seaweed and debris. There also appears to be sediment zonation indicative of sediment sorting associated with high-energy condition.

The site would not be suitable for open-cut trenching due to the volume of rock and the seawall approaching the path. HDD may be suitable but geotechnical data assessment would be required to confirm suitability.

Initially, the landfall was not considered a 'preferred' option as the offshore environmental constraints were considered too significant. Following consultation with the National Parks & Wildlife Service (NPWS) (09 December 2015, Appendix D), it was concluded that installing a cable through a SAC could potentially be possible provided that works do not adversely affect the integrity of the protected site and its conservation objectives. In the interest of achieving the most direct offshore cable route, Sandeel Bay was reinstated as a potential landfall location, despite the relatively low score in assessment.

3.4 Boyce's Bay

This landfall location lies on the west coast of the Hook Peninsula, within the Port of Waterford harbour limits. The site is located outside the Hook Head SAC, but it falls within a proposed Natural Heritage Area (NHA). The beach faces the south west making it an exposed site, given the prevailing south-westerly weather conditions. Due to the nature of the 5 and 10 m depth contours, the types of vessel that can reach the beach may be restricted, increasing the chances of requiring anchored barges. The beach extends further north along the coastline for approximately 2 km but a rock outcrop to the north of the site prevents vehicles from passing to the additional coastline and beach.

The beach itself is gently sloping with evidence of a storm berm and seaweed debris on the upper reaches of the beach. The typical slope angle was 2.4° from the cliff to the water. The beach was approximately 200m wide, with approximately 157 m of rock to the south of the beach. Fossils were observed on rock outcrops on the side of the bay.

The surrounding cliffs and headland are high with one large derelict property at the top, close to the dairy farm; this is possibly a heritage site and would require confirmation prior to establishing the location for an HDD point. The surrounding cliffs are densely vegetated with grasses and scrub but there are many indicators of instability and slope movement. Portions of the cliffs were identified as suitable for HDD up to the main track, pending further geotechnical assessments and ground investigation.

3.5 Booley Bay

Booley Bay is approximately 5 km north of Boyce's Bay, within the Port of Waterford harbour limits. Like Boyce's Bay, the landfall faces the west and is moderately exposed to the prevailing south-westerly wind conditions. The beach is approximately 205 m wide and 113 m from the cliff to the water's edge shortly before low water. The beach is predominately flat (0.2°) with fine, water-saturated sand. A storm berm was observed at the upper reaches of the beach.

The surrounding headland is dominated by vegetated cliffs to the north and south, both sides demonstrated low levels of coastal erosion with minor evidence of disruption by landslides.

Adjacent to the access road and track was a freshwater riverine input, surrounded by unmanaged vegetation. The river water flows directly onto the beach where the water flow is diverted along the upper reach of the beach to the southern rock outcrop where it is forced towards the sea by rocks. Options for installation would include HDD and open-cut trenching.

It is likely that the flow of freshwater onto the beach would make keeping a trench open difficult and may risk exposure of the cable during adverse weather conditions.

Consultation with the Port of Waterford was undertaken on 09 March 2016 (Appendix E). At the meeting the Harbour Master advised the Booley Bay landfall be dropped from further consideration. A 100m wide corridor (marked on Admiralty Chart) is dredged at Duncannon approximately 3-4 times a year, to stop the shipping channel from silting up. The offshore approach to the landfall would intersect this area risking both the ports activities and the cable.

3.6 Landfall Selection - Baginbun Beach & Boyce's Bay

Due to the level of dredging at Duncannon, the Booley Bay landfall would be inadvisable; both the cable and the dredging would be put at risk if this landfall was progressed. Therefore, Booley Bay was discounted from any future assessments.

At the nearshore area of the Sandeel Bay landfall, the cable route would transect an area which has been identified to have abundant rocky reef sections which would complicate and increase installation costs. This coupled with the environmental considerations associated with the nearshore and onshore areas has meant that this location has been discounted.

Baginbun Beach has been selected as the preferred Irish landfall location as it yields the shortest overall cable route length and meets the requirements the other landfall options fall short on.

Boyce's Bay has been selected as an alternative for investigation should the proposed geophysical survey identify substantial issues which could result in a route to Baginbun Beach not being feasible. The Port of Waterford has expressed concerns that the proposed route to Boyce's Bay enters the shipping channel passing Hook headland. They have not granted permission for the route to extend into the central channel where there are potentially deeper Holocene sediments. Instead, their preference is for the cable to be routed as close to the headland as possible. A compromise, whereby the route follows the edge of a mapped outcrop to the east of the channel centre, has been proposed. However, this area may have a veneer of sediment overlying rock which would increase installation costs.

Baginbun Beach is the selected landfall for survey. However, should preliminary geophysical survey results identify any issues, a reconnaissance survey of the route to Boyce's Bay has been proposed as an alternative option.

Preferred Irish Route Selection:

- **Baginbun Beach,** Wexford, Ireland. Note that Baginbin is the preferred landfall but is still yet to be selected.

APPENDIX A

Welsh Landfall Report

Experience that Delivers

jp kenny

Client:

ARUP CORK for Element Power

Project Name:

GREENWIRE

Document Title:

Part 2a: South Wales Landfall Options Report

elementpower

Greenwire

ARUP

Document Number:	Document Type:
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Client Document Number:	**Number of pages:**
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Rev	Date	Reason for Issue	Prep. By	Chk. By	App. By	QA	Client Approval
02	27-07-12	Updated with comments	LM	SB	RGB	RGB	
01	20-07-2012	Issued for comment	LM	SB	RGB	RGB	

COMMENTS SHEET		
REVISION	DATE	COMMENTS
R02	31/07/12	Minor comments by Client (Arup) have been incorporated. Document is now to form a standalone report embedded within a larger document.

GUIDELINES ON USE OF REPORT

(1) This report and the assessments carried out in connection with the report (together the "Services") were compiled and carried out by JP Kenny Limited ("JPK") with the skill and care ordinarily exercised by a reasonable surveyor/engineering specialist at the time the Services were performed taking into account the limits of the scope of work as required by the preliminary nature of the assignment.

(2) Other than that expressly contained in paragraph 1 above, JPK provides no other representation or warranty whether express or implied, in relation to the Services.

(3) The passage of time may result in changes (whether natural, man-made or otherwise) in site conditions, while changes of technology, methods of analysis, economic conditions or regulatory or other legal provisions could render the report inaccurate or unreliable. Therefore the information contained herein should not be relied upon after a period of 1-year from the date of this report.

(4) The observations, recommendations and conclusions in this report are based solely upon the Services which were provided pursuant to the Preliminary Engineering scope of work. JPK shall not liable for the existence of any condition, the discovery of which would require performance of additional services not otherwise contained in the agreed scope of work.

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1.0 OVERVIEW

1.1 Project Description

Element Power is developing the Greenwire project which will involve the export of 3 GW of renewable energy from Ireland to the UK via dedicated HVDC cables.

The project comprises a number of wind farms in the Irish midlands, an AC underground cable collector system for gathering wind generated electrical power and transmitting it to a high voltage AC - DC converter station (also in the Irish midlands), two HVDC underground cable routes to the east coast of Ireland, a subsea HVDC cable across the Irish Sea to Wales, HVDC underground cables in Wales to new DC – AC converter stations and connections to the United Kingdom transmission system.

Agreement has been reached with the UK National Grid for two tie-in locations at Pentir in North Wales and Pembroke in southwest Wales. Therefore there are two export HVDC cable routes likely to proceed:

- Northern Route (up to 2.5 GW): from the Dublin area to a North Wales landfall, tie-in to the National Grid at Pentir in northern Wales;
- Southern Route (up to 2.5 GW), from the Rosslare area to a South Wales landfall, to tie-in to the National Grid at the 400kV Pembroke substation on the southern side of Milford Haven,

At the time of writing this report, the number of cables, cable properties and the total capacity of the system have not been confirmed. It is likely that each cable route will include 2 HVDC cables as well as a fibre-optic cable (it might be noted that reference to cable in the rest of this report is to this array of cables). This initial assessment does not consider specific HVDC cable design parameters. However it does consider working area requirements and constructability issues at a macro level.

Element Power has appointed Arup (with J. P. Kenny) to assist them with the preliminary engineering of the onshore and subsea elements of the project.

The purpose of this report is to present the findings of a preliminary assessment of landfalls in South Wales.

1.2 Scope of Work

The scope of work for this technical note is limited to the evaluation of landfall options in south Wales and it includes:

- An initial desk top assessment to identify possible landfalls
- Results of a site visit to possible landfall locations to confirm suitability
- Identification of the extent of Castle Martin firing range activities
- Determination of the physical constraints to near offshore routing and installation, for example rock out-crops, excessive sea bed slopes, sand waves and coastline stability.

Landfall evaluation matrices using the information described in this report are included in Appendix B.

1.3 Limitations

The findings of this report are based on a desktop study and site walkover only and, at this stage, the project has limited technical definition. For any of the proposed landfall options, it will be necessary to obtain additional data and information to finally confirm that the landfall location is suitable.

1.4 Geodesy

All co-ordinates quoted are referenced to the WGS 84 datum.

2.0 ABBREVIATIONS

HDD	Horizontal Directional Drilling
HVDC	High Voltage Direct Current
EP	Element Power
GW	Gigawatt
JPK	J P Kenny
UK	United Kingdom
UXO	Un-exploded ordnances

3.0 SUMMARY OF SOUTH WALES LANDFALL OPTIONS

3.1 South Wales Landfall Options

J P Kenny has identified eight potentially suitable landfall locations for the HVDC cable in Pembrokeshire, South Wales as part of a desk top review. A site visit to South Wales was undertaken by the ARUP Project Manager and a J P Kenny Civil Engineer from the 19th to 21st June 2012 to assess landfall options and subsequent onshore routing from the landfalls to the Pembroke substation.

This technical note summarises the observations of the site visit to South Wales; and presents the advantages and disadvantages of the preferred landfall options.

The location of the Castle Martin and Manorbier firing ranges presents challenges to a proposed cable route to the Southern landfall locations, and therefore locations both North and South of the Pembroke substation were investigated. Note that the Northern landfall options would require a subsea crossing of Milford Haven in order to tie-in to the substation on the southern side of the harbour.

Table 3-1 Potential Southern Wales Landfalls (WGS84 Datum)

LANDFALL LOCATION	AREA	LATITUDE	LONGITUDE
Southern Side of Milford Haven			
Freshwater Bay (North End Broomhill Burrows) preferred southern option	South of Milford Haven	51° 39.789'N	5° 3.956'W
Broad Haven South	South Pembroke	51° 36.466'N	4° 55.353'W
Freshwater East	South Pembroke	51° 38.715'N	4° 51.824'W
Tenby South Beach	South Pembroke	51° 40.028'N	4° 42.176'W
Northern Side of Milford Haven			
Broad Haven [preferred option]	Northwest of Milford Haven	51° 46.944'N	5° 6.210'W
Dale	Northwest of Milford Haven	51° 42.470'N	5° 11.229'W
Whitesands	North Pembroke	51° 53.742'N	5° 17.767'W
Abereiddy LF	North Pembroke	51° 56.182'N	5° 12.355'W
Aber Mawr 1	North Pembroke	51° 58.408'N	5° 4.902'W
Aber Mawr 2	North Pembroke	51° 58.161'N	5° 5.028'W
Strumble Head	North Pembroke	52° 1.523'N	5° 3.229'W

Figure 3-1 South Wales Landfall Options

3.2 Overview of Preferred Options

3.2.1 PREFERED NORTHERN OPTION : BROAD HAVEN

The preferred option north of Milford Haven is a landfall at Broad Haven Beach. The landfall is on a sandy flat foreshore with minimal offshore routing restrictions.

The admiralty chart indicates the offshore geological conditions to be sand/mud/gravel. However there is some exposed bedrock at the northern edge of the beach and a small seawall and stormwater culvert in the vicinity of the proposed landfall.

Onshore, there is a suitable route travelling out to the east just north of Broad Haven town. The onshore route would then turn south towards Milford Haven; where a subsea crossing would be required to run from Venn Farm on the northern side of the Haven across to the vicinity of the power station (total length approximately 3km).

While a crossing of the Haven will be technically challenging options include HDD, or tunnelling. Further studies would be needed to identify the optimal crossing methodology.

Therefore, subject to geophysical and geotechnical survey results there are no technical reasons not to situate the export cable landfall at Broad Haven.

Figure 3-2 Broad Haven

3.2.2 PREFERRED SOUTHERN OPTION: FRESHWATER BAY WEST

Landfall options to the south of the Haven (which would eliminate the need for a harbour crossing) are severely restricted due to the presence of the Castle Martin and Manorbier Firing Ranges which remain in active use for military practice.

The preferred landfall to the South of Milford Haven is at the Northern end of Freshwater Bay West. If the landfall is located at the Northern end of the beach the nearshore route can be positioned just outside the extent of the Castle Martin Firing Range (Refer to Appendix A)

The admiralty chart indicates the presence of rock in the nearshore area and areas of weathered slate and conglomerate were exposed at the northern end of the beach at low tide.

The shore crossing at Freshwater Bay would extend through sand dunes approximately 3m high at the northern extent. The sand dunes are environmentally sensitive areas that impose environmental permitting constraints. The landfall construction method may be restricted to an HDD option in order to avoid disturbance to the dunes.

Due to the proximity to both the firing range and the harbour mouth it is likely that substantial cable burial depth would be required in order to provide protection to the cable (in the order of approximately 4m) from ordnance and anchor dragging. This could be provided by rock dumping a surface laid cable or trenching and backfilling. However, the burial depths of power cables are limited due to the burial providing additional thermal insulation.

The most advantageous factor of selecting this landfall is that it has the shortest onshore route to the converter station and National Grid tie-in point. In order to select this landfall a detailed unexploded ordnance survey would be required to locate any stray munitions on the seabed in the area of the proposed cable route. If this landfall option is to be further considered early consultation should be sought with the Ministry of Defence.

Due to the proximity to the firing range and harbour mouth, further studies (in addition to the usual surveys required at any landfall location) will be needed to determine the effects of ordnance, anchors and thermal insulation in order to prove the feasibility of this landfall.

Figure 3-3 Freshwater Bay West (North end)

4.0 LANDFALLS NORTH OF MILFORD HAVEN

4.1 Broad Haven (Preferred Option)

4.1.1 SUMMARY

The preferred option north of Milford Haven and most favoured option overall is a landfall at Broad Haven Beach, located within St. Bride's Bay to the northwest of Milford Haven. The landfall is on a sandy flat foreshore with minimal offshore routing restrictions.

A landfall at Broad Haven would result in an offshore route distance from Rosslare, Ireland of an estimated 106km and an onshore route from Broad Haven to the northern side of Milford Haven of approximately 16km. A further ~3km crossing of the harbour would be required to connect to the converter station.

Onshore, there is a suitable route inland from the Northern landfall at Broad Haven travelling east just north of Broad Haven town. The large public car park at ~100m from beach could provide a working area for the northern exit. This onshore route to the north is proposed in order to avoid routing causing construction disturbance along the seafront road. The onshore route would then travel south towards Milford Haven; where a subsea crossing would be required to run from Venn Farm on the northern side of Milford Haven across to the national grid tie-in point.

Subject to geophysical and geotechnical surveys and the limitations described in Section 1.3 there are no technical reasons not to situate the export cable landfall at Broad Haven.

4.1.2 ADVANTAGES

The advantages of a Broad Haven landfall location are:

- The nearshore route can avoid the firing ranges;
- Sandy foreshore (with some exposed rocks at northern end);
- Nearshore geology on the admiralty chart is mostly sand, muds and gravels;
- Favourable beach profile;
- Onshore routing is constructable.

4.1.3 DISADVANTAGES

The less favourable aspects of locating the landfall at Broad Haven are:

- It necessitates a technically challenging but feasible crossing of Milford Haven (~3km);
- Broad Haven is a high value recreational amenity area and it is probable that the permit construction window will exclude the summer months;
- Desire to avoid laying the cable along the seafront and through the town where possible;
- Admiralty chart indicates some areas of rock in the nearshore;
- Crossing under seawall is required if routing at the northern end of Broad Haven (not a major concern);
- Stormwater culvert at the northern end of the beach may impact on northern shore crossing route options.

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Figure 4-1 Crossing Option at Northern end of Broad Haven

Figure 4-2 Potential crossing location at Southern end of Broad Haven

Figure 4-3 Further view of Northern end of Broad Haven beach

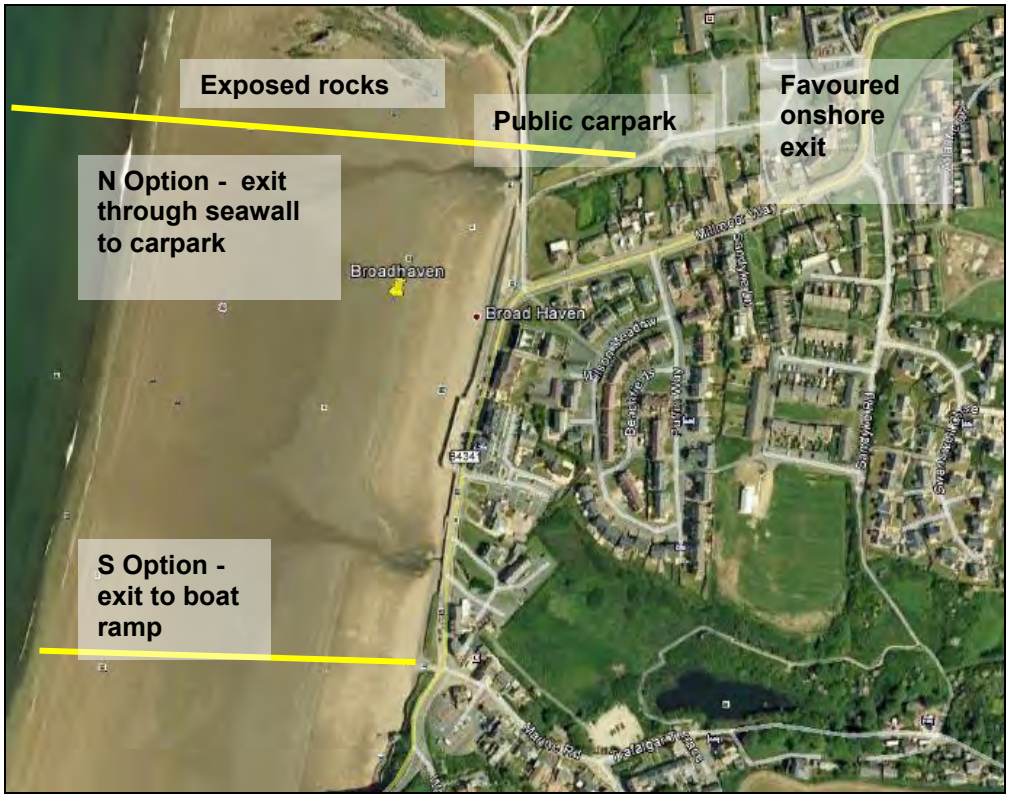


Figure 4-4 Satellite (Google Earth) view of Broad Haven beach

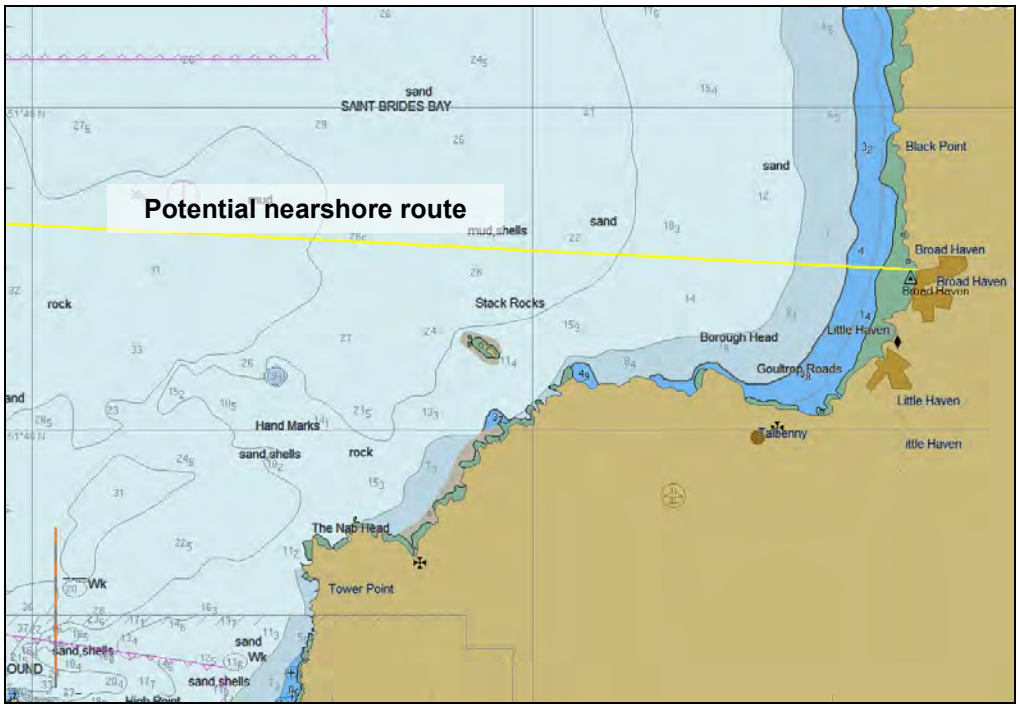


Figure 4-5 Admiralty Chart, Broad Haven

4.2 Newgale

Newgale beach is also located within St Brides Bay, just north of Broad Haven. This landfall was not considered a feasible option because a section of the nearshore is designated as an environmental testing area. Therefore it is highly unlikely that any offshore construction activities would be permitted.

4.3 Dale

The option to the west of Dale town is a difficult landfall, due to geology, topography and access issues, and therefore is not preferable.

Points for consideration:

- Located towards southern end of the peninsula, approximately 3km from Milford Haven harbour entrance;
- Admiralty chart indicates a rocky nearshore;
- Beach on western side of the coast has a only a small strip of sand, with exposed rocks visible both on the beach and just offshore;
- Small ~3-4m bank at the lowest point upon exiting the beach to the valley (farmland);
- Onshore access is difficult, public road is narrow and travels past Dale castle along the top of a steep bank, at some height above the beach. No road access to beach;
- Better access could be gained along the base of the valley from the town on the eastern side of the peninsula. This access would require a crossing agreement with farmer for access of construction equipment through the valley;
- The beach area on the eastern side of the peninsula is used for local moorings;
- This location would result in a longer harbour crossing of Milford Haven than that from Venn farm further to the east.

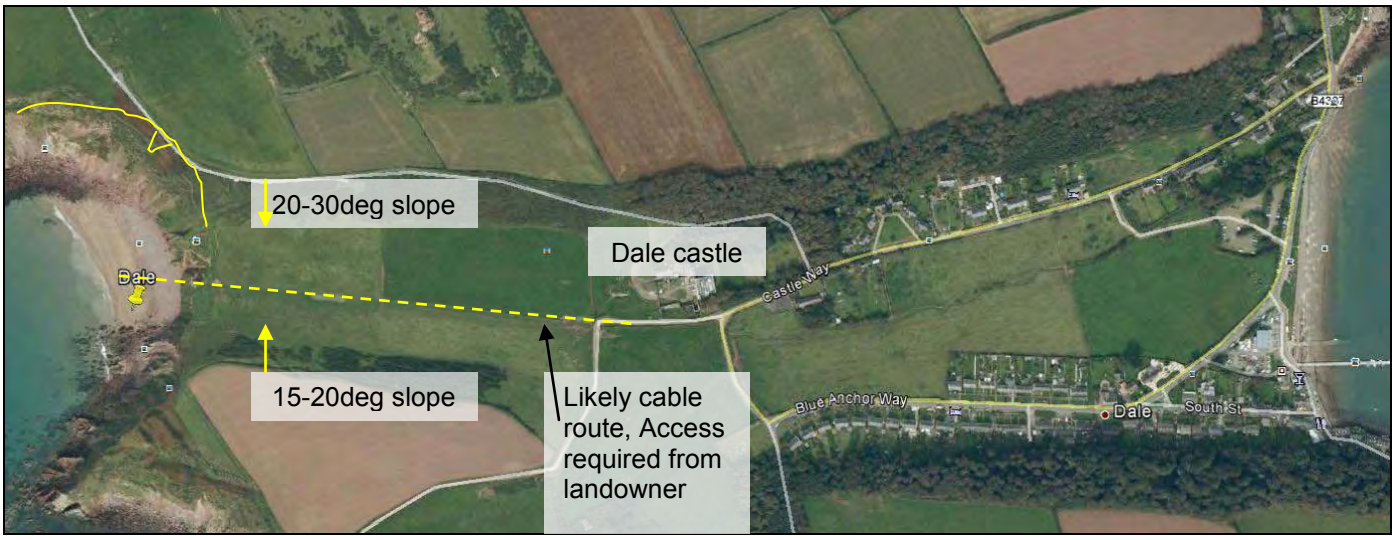


Figure 4-6 Landfall Option (to the left) with Dale Township (to the right)

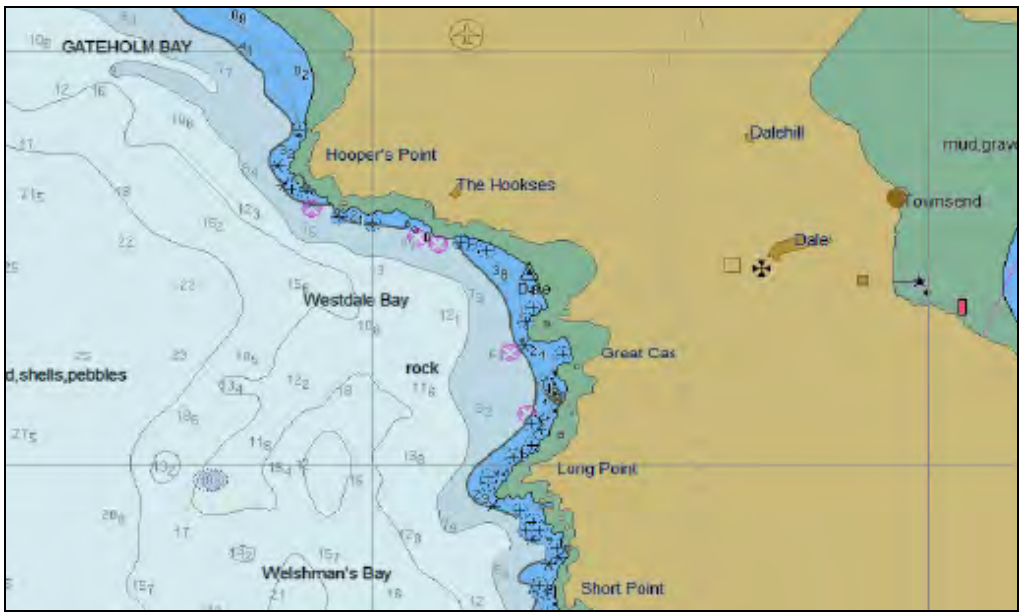


Figure 4-7 Admiralty Chart for Dale

Figure 4-8 View of Dale Landfall

4.4 Options Further North

4.4.1 OVERVIEW

Beaches further to the North of Broad Haven were identified as potential options as part of the desktop study, however these options should be considered only as fall-back options to be further evaluated if obstacles are encountered with a landfall at Broad Haven or Freshwater West. This is due generally to the less favourable landfall conditions, longer onshore routes and difficulties with accessing the northern beaches, often via single lane narrow roads. It might be noted that all northern routes will require a crossing of Milford Haven.

Figure 4-9 Northernmost Landfall Locations

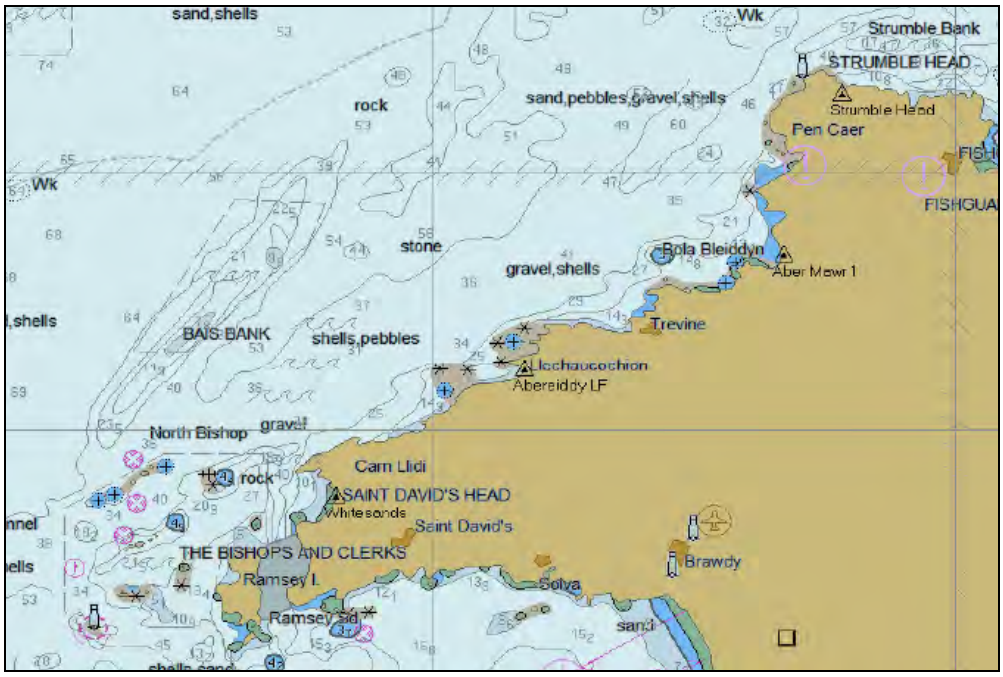


Figure 4-10 Admiralty Chart, Far North Options

4.4.2 WHITESANDS

Whitesands appears technically feasible from a landfall construction viewpoint.

Observations regarding the Whitesands landfall are noted below:

- Sandy beach with rock outcrops at northern extent, although rock noted in the nearshore on the admiralty chart;
- Exit from a beach landfall could be through to the public car-park (approximately 40m x 120m);
- From the car-park a narrow single lane road climbs up in a moderately steeply manner (no parking available on the road);
- Adjacent to the access road at the top of the slope leading down to the beach is the St David's City Golf Course (entrance approximately 700m from the beach). The golf course extends to within 100m of the beach, on the southern side of the access road and south of the public car-park;
- The beach has a high recreational amenity value and is a prominent surfing location;
- The onshore route ~25km longer than that to Broad Haven but correspondingly the offshore route is shorter;
- Most of the onshore main access road is suitable except for narrow congested sections through St David's and Solva town. It may be possible for alternative onshore routes to be proposed.

However the feasibility of the onshore route and the potential for public opposition due to the high recreational amenity value would need to be further investigated if this option is to be considered further.

Figure 4-11 Whitesands Beach, view from the South

4.4.3 ABEREIDDY

Abereiddy is a small beach located to the northeast of Whitesands and the town of St David's. The landfall comprises the following features:

- Exposed bedrock to the west of the beach;
- To the east the foreshore comprises pebbles overlying sand;
- A small (<2m) high concrete seawall is the sea defence for the public carpark which runs along the beachfront (~30m x 120m long);
- Admiralty chart indicates shells and pebbles are present in the nearshore. The water depth increases quickly to ~25m at the end of the inlet approximately 400m offshore;
- Beach is used for access to the nearby "blue lagoon", which is a disused slate quarry which has been infilled with seawater through a breach in the outer wall. This lagoon is a popular location for tourism activities that include coasteering;
- Road access is generally suitable except for the final access to the beach which is approximately 4 to 5m wide. Much longer onshore route than Broad Haven.

Figure 4-12 Abereiddy Beach, looking towards the North

4.4.4 ABER MAWR 1 & ABER MAWR 2

Aber Mawr 1 and 2 are gravel/pebble beaches located north of Abereiddy. Both beaches are similar in terms of geology and difficult access with no public road to the beach. The Pembrokeshire coastal path network passes right across both beaches. The admiralty chart identifies the nearshore geology as gravels and pebbles.

Access to both beaches is difficult:

- The public road is only one lane wide for the last 500-800m;
- For Aber Mawr 1, construction access would be very challenging as behind the beach is a wetland/marsh area extending for approximately 500m;
- For Aber Mawr 2, construction access could be built alongside the coastal walking path which leads at a moderate slope down the cliff, southwest towards the beach. This may require some adjacent landowner permissions.

Figure 4-13 Aber Mawr 1, looking towards the Northwest

Figure 4-14 Aber Mawr 2, looking towards the Southwest

4.4.5 STRUMBLE HEAD

Strumblehead was not accessed during the site visit as there was no public access available to the beach. It is the most northerly landfall that was identified as part of the desk top review. The location identified is a small inlet at the end of small valley to beach. The aerial view indicates a sandy foreshore but with rocks offshore.

The beach is located approximately 500m from the public road and therefore landowner agreement would be required for construction and cable routing.

The admiralty chart identifies the nearshore geology as sand, pebbles, gravels and shells.

5.0 LANDFALLS SOUTH OF MILFORD HAVEN

5.1 Firing Range Restrictions

Landfall options to the south of Milford Haven (which would eliminate the need for a harbour crossing) are severely restricted due to the presence of the Castle Martin and Manorbier Firing Ranges which remain in active use for military practice. Refer to Appendix A for a Figure indicating the extent of the firing ranges.

In order to select any of the landfalls presented that are located south of Milford Haven, a detailed unexploded ordnance (UXO) survey would be required to locate any munitions present along the proposed cable route. Impact ballistic studies would also be needed to identify the level of protection the cable requires (burial depth and armouring) from future firing range activities. If a southern landfall option is to be further considered, early consultation should be sought with the Ministry of Defence.

5.2 Freshwater Bay West (Preferred Southern Option)

5.2.1 SUMMARY

The preferred landfall to the south of Milford Haven is at the northern extent of Freshwater Bay West. If the landfall is located at the northern end of the beach the nearshore route can positioned just outside the extent of the Castle Martin Firing Range.

The admiralty chart indicates the presence of rock in the nearshore area and areas of weathered slate and conglomerate were exposed at the northern end of the beach at low tide.

A landfall at Freshwater Bay West would result in an offshore route distance from Rosslare, Ireland of an estimated 117km and an onshore route of approximately 8km. This is a similar overall distance to the Broad Haven route.

The shore crossing at Freshwater Bay would extend through sand dunes. The dunes increase substantially in height further to the south and are part of an SAC and SSSI. Environmental permitting constraints that are likely could restrict the landfall construction method to an HDD option in order to avoid disturbance to the dunes.

Due to the proximity to both the firing range and the Milford Haven harbour mouth it is likely that substantial cable burial depth would be required in order to provide protection to the cable (in the order of approximately 4m subject to detailed analysis). This could be provided by rock dumping a surface laid cable or trenching and backfilling. However, the burial depths of power cables are limited due to the cover over the cable providing additional thermal insulation which is detrimental to cable performance.

The most advantageous factor of selecting this landfall is that it has the shortest onshore route to the converter station at Pembroke.

5.2.2 ADVANTAGES

The favourable points of this landfall are:

- It has the shortest onshore route of all options under consideration;
- Technically straightforward;
- The nearshore route avoids the firing range;
- Sandy foreshore with favourable nearshore beach profile;
- Reasonable onshore access.

5.2.3 DISADVANTAGES

- Proximity to firing range;
- Proximity to Milford Haven harbour entrance;
- Shore crossing and working area likely to be through dunes to public carpark and subsequently be likely be subject to environmental restrictions;
- Evidence of land movement in the slope behind dunes leading up to the public access road;
- Potential for rock to be encountered in the nearshore (slate and conglomerate exposed on the beach at low tide at far Northern end of beach), areas of rock identified on admiralty chart.

Figure 5-1 Freshwater West, Northern end of beach.

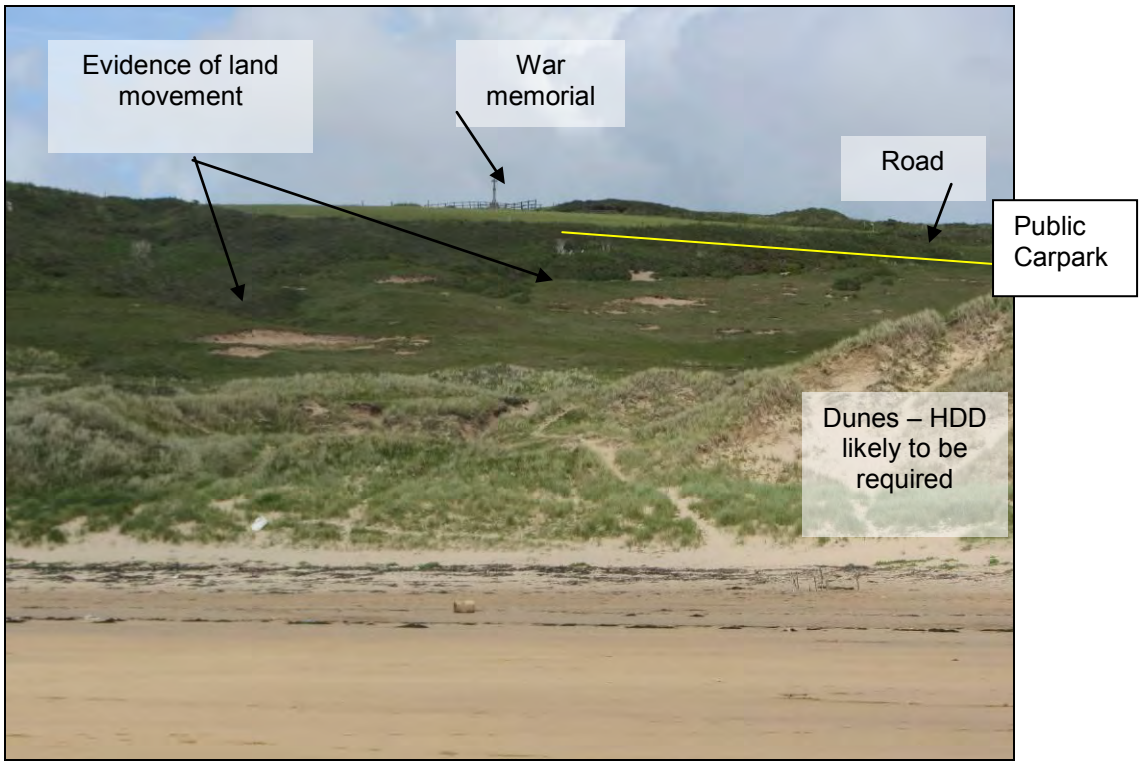


Figure 5-2 HDD exit behind dunes, to carpark

Figure 5-3 View looking towards the NW at Freshwater West Beach

Figure 5-4 Freshwater West, Public access to Beach

5.3 Broad Haven South

Broad Haven South is within the Castle Martin Firing range and as such should not be considered further unless other more favourable options are excluded.

Figure 5-5 Broad Haven South, Public access to Beach

Points of note for Broad Haven South:

- Steep walking path access to down to the beach from the carpark (stairs, ~100m, up to 30deg slope);
- Landfall construction will likely require an HDD into carpark to avoid open cut on the steep slope;
- Tourist information boards identify several bird species local to the area including Guillimots, Razorbills and the area is also a nesting zone for Britain's rarest crows named Cloughs;
- Rocks offshore (visible, castle rock), and also small breaking waves to the west of castle rock;
- Sandy beach;
- High tourist amenity and visual landscape value;
- Significantly longer offshore route than Freshwater West.
- Would require UXO surveys

5.4 Freshwater East

Freshwater East is within the Castle Martin Firing range and as such should not be considered further unless other more favourable options are excluded.

Figure 5-6 Freshwater East, looking south-east

Points of considerations for Freshwater East:

- Gently sloping beach with gravel/pebbles/cobbles overlying sand;
- Admiralty chart indicates gravels and sands in the nearshore;
- The main access to the beach is from a car-park located approximately 20m to 50m from the beach at close to it's southern extent:
    - One walking path passes through small dunes (1-3m high) onto beach;
    - Another concreted footpath provides access alongside a small stream to the beach;
- Difficult onshore route to the southwest:
    - Tight narrow roads, small stream with one way narrow bridge(4 to 5m long bridge at the beach access location) ;

- A two lane road runs from the public access, at the southern end of the beach, towards the north. As soon as it exits the beach the road rises steeply and then run along the top of the slope approximately 300m behind the beach and estimated at over 30m high. Residential properties are located at the top of this steep bank along the length of the beach. There are also some walking access tracks down the slope to the beach and farmbike access which may be able to be improved for onshore cable construction up the slope;
- There are mooring buoys for small watercraft at the southern extent of the beach and buoys marking the boat speed zones;
- Significantly longer offshore route than Freshwater East;
- Would require UXO studies.

Figure 5-7 View of Freshwater East looking North; note steep slope to the West

5.5 Tenby South Beach

A landfall at Tenby South Beach can be routed to narrowly avoid the offshore firing range. However it is the longest offshore route, is a popular tourist area and also has a long onshore route.

Points of consideration:

- Sandy beach, admiralty chart indicates sand and shells in the nearshore area;
- Golf course runs behind the majority of the beach except at the southeastern end;
- Any landfall would likely be located at the SE end of beach, near new apartment blocks in order to avoid the golf course;
- There are other cables making landfall at the SE end of beach for which proximity agreements would need to be negotiated;
- Offshore, the cable would be routed between Caldey Island and Woolhouse rocks;
- Due to proximity to the firing ranges UXO studies would be required.

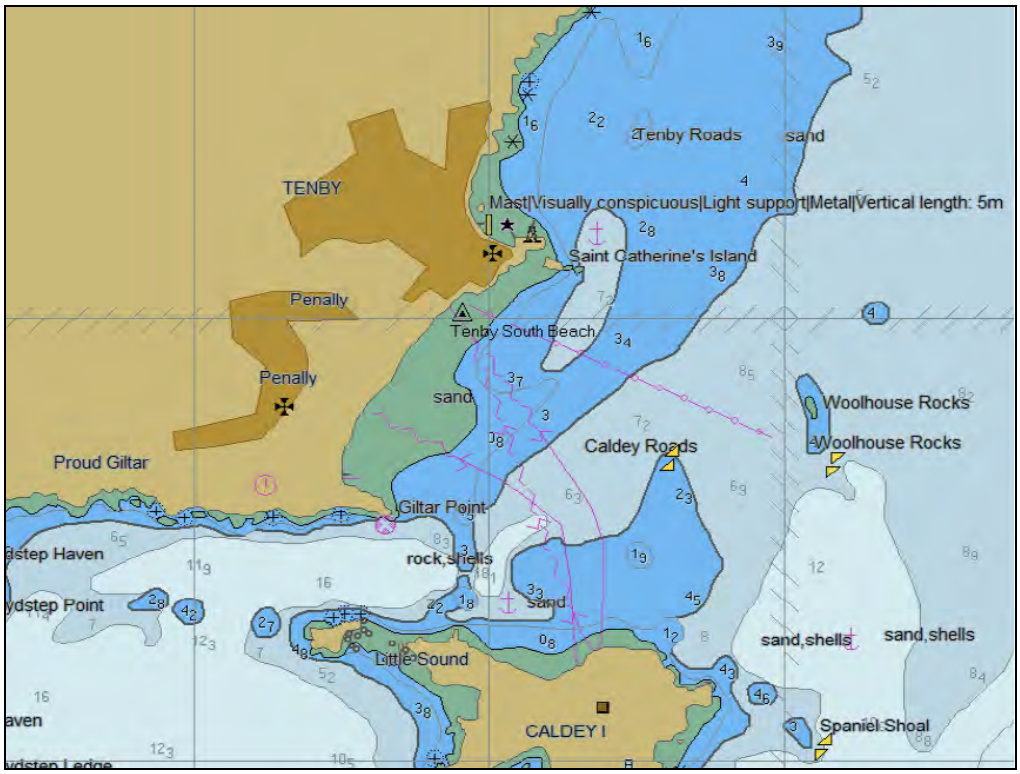
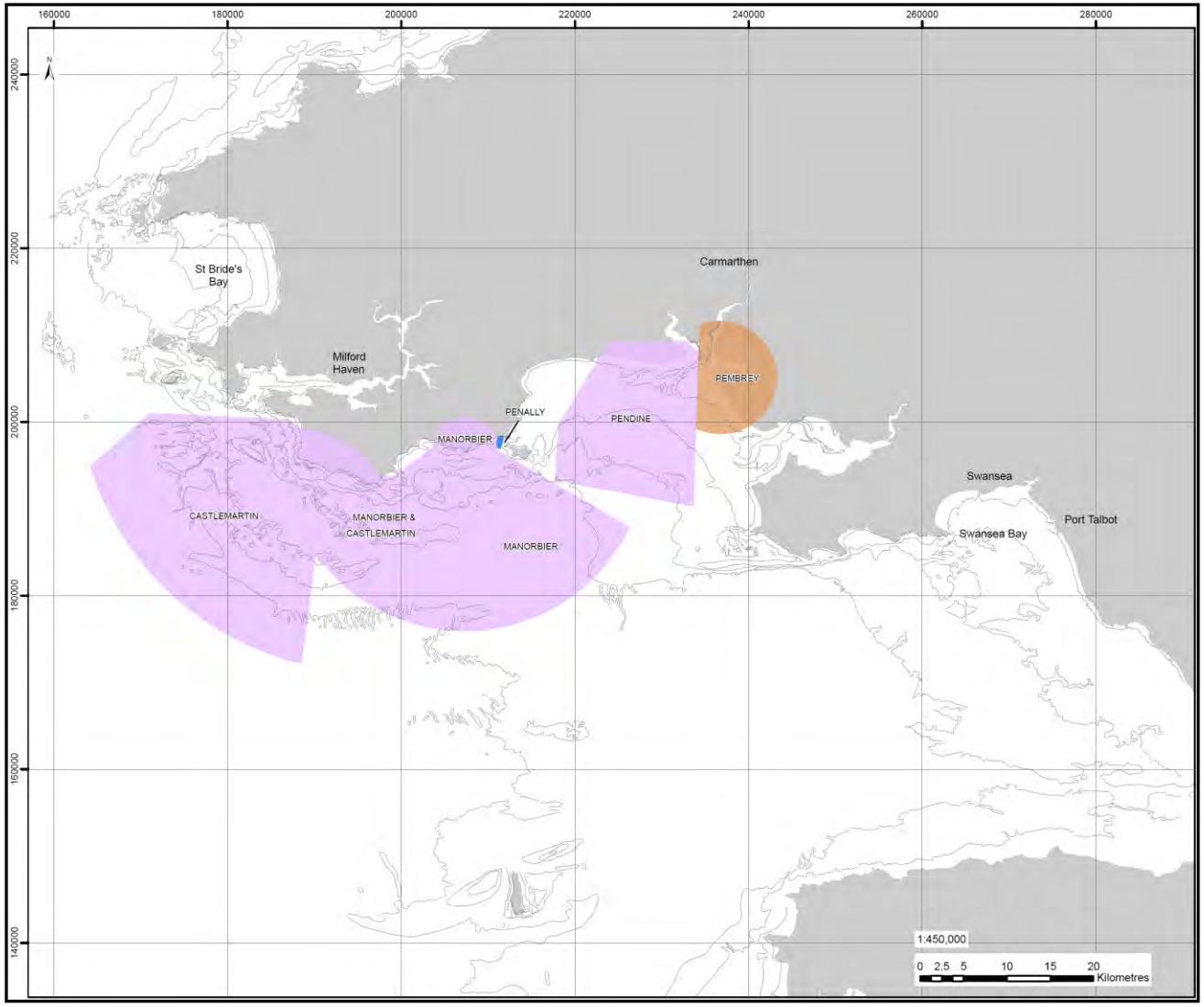


Figure 5-8 Admiralty Chart for Tenby South Beach

Figure 5-9 View of Tenby South Beach towards the Southwest

Appendix A:
Castle Martin and Manorbier Firing Ranges



A 1: Pembroke Range Limits

Appendix B:
Landfall Evaluation Matrices

A Technical Evaluation of the two landfalls is below. The Criteria are evaluated in terms of the colour coding below.

- **Favourable**
- **Slightly Favourable**
- **Neutral**
- **Slightly Unfavourable**
- **Unfavourable**
- **Fatal Flaw**

Category	Broad Haven	Freshwater West
Environment		
Biophysical Environment		
Natura 2000/ Habitats Directive (SPA. SAC)	Pembroke Marine SAC offshore	Pembroke Marine SAC offshore, Limestone Coast of South Wales SAC, Castle Marine Coast SPA
Not designated, contains habitats directive annex 1 habitat or annex 2 species	to be evaluated	to be evaluted
SSSI/NHA not part of SPA or SAC	Newgale to Little Haven SSSI at coast between high tide and low tide level	Broomhill Burrows SSSI
Other designations	Pembroke Coast National Park (St Brides Bay Heritage Coast excludes Broad Haven Beach); marine monitoring area	Pembrokeshire Coast National Park, South Pembrokeshire Heritage Coast
Historical Environment		
Archaelogical and Cultural Heritage	2 concrete defences cubes at the beach	Weapons pit at freshwater west, gun emplacement at Freshwater West; war memorial adjacent to road overlooking the beach.
Wrecks	No charted wrecks	No charted wrecks
Physical Environment		
Onshore Topography	Flat beach, flat - gently sloping behind beach to carpark.	Flat beach. Moderate steep slope behind beach up to public carpark and road. Limited Flat working area.
Onshore Hydrology/Pollutants	Unknown. Stormwater culvert at the N end of beach.	Unknown.

Category	Broad Haven	Freshwater West
Nearshore Geology	Sand/mud/gravel. Some exposed rocks on the beach.	Admiralty chart shows areas of rock in the nearshore, exposed bedrock at Northern end of the beach.
Offshore Route Geology	Majority is sand/mud/gravel. Some areas of rock past the headlands, may be possible to route around.	Rock/gravels/sand.
Offshore Features	None identified.	Harbour entrance.
Nearshore Bathymetry	Favourable	Favourable
Coastal Erosion	Seawall along the beach may effect erosion processes. Unknown.	Unknown.
Meteocean Conditions	Within standard design envelopes.	Higher currents around harbour entrance

Human Factors

Built Environment

Wellheads, platforms etc	No offshore structures.	No offshore structures.
Firing range/UXO/PEXA zones	Outside firing range	On edge of firing zone, UXO survey required
Dredging & Dredge Dumping	To be evaluated	To be evaluated
Adjacent landfalls	SW culvert	None identified

Category	Broad Haven	Freshwater West
Public Utilities/Pipelines/Windfarms/ Other uses	May be considered for future developments	May be considered for future developments
Structures at landfall	Small seawall up to 2m high. Boat ramp at S End of beach, SW culvert at N end.	None
Human Activity		
Shipping	Anchors within St Brides Bay	Close to harbour mouth with shipping activities that include large LNG tankers etc.
Commercial Fishing	to be evaluated	to be evaluated
Adjacent land use - Residential & Commerical Properties	Adjacent to local Broad Haven properties. Carpark area should be available for construction	Farmland
Public Safety and Impact on Community Amenities/Facilities Onshore - Beach Use	Local and tourist use year round.	Local use year round.
Public Amenities Offshore - recreational fishing, boating, yachting, moorings, marinas, navigation buoys	Boat ramp at Southern end of the beach providing access for recreational users.	Minimal
Public Interest in Project	Landfall in tourist area, potentially in or adjacent to town	Landfall in area with environmental designations
Noise & Vibration at Landfall	Landfall works may generate construction noise/vibration disturbance due to proximity to local residents if not managed correctly.	HDD/beach works may generate minimal vibrations and construction noise, but no residential dwellings nearby
Visual Effects	No permanent effects, temporary only during	No permanent effects, temporary only during

Category	Broad Haven	Freshwater West
	construction	construction
Engineering and Economic Factors		
Design and Construction Complexity	Broad Haven landfall is reasonably simple with no notable design challenges identified.	Degree of complexity due to sand dunes environmental considerations, but resolvable by industry standard design and construction methods
Overall Construction Cost	May be able to do an open cut at the landfall	Likely to require HDD under sand dunes
No./type Offshore Crossings	No pipeline or cable crossings	No pipeline or cable crossings
Site Access/ROW/Temp Works Area	Public carpark at N end of beach. Good public road access.	Narrower road access to within 300m of beach. Flat works area will need to be constructed behind sand dunes.
Logistics	Easy access to existing infrastructure. Landfall within /near to existing town/city.	Moderate access to existing infrastructure. Landfall within 10km of existing town/city.
Land acquisition	To be evaluated - ARUP?	To be evaluated - ARUP?
Tie in to onshore PL	Tie-in OK but long onshore route and 2 additional tie-ins from Milford Haven crossing.	Simple tie-in, close to substation

End Of Document

APPENDIX B

Irish Landfall Report

GREENLINK INTERCONNECTOR PROJECT

LANDFALL SELECTION REPORT

Report Reference. P1975_RN3926_Rev4

Issued 8 February 2016

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Rev 2	21/12/15	Final comments following consultation	ELP	APA	CJM
Rev 3	08/01/16	FINAL	SOS	EH	ALF
Rev 4	08/02/16	FINAL – incorporating Clients comments	SOS	EP	ALF

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SUMMARY

Intertek Energy & Water Consultancy Services (Intertek) and Arup have been commissioned, to provide a landfall assessment and study for the proposed HVDC Greenlink Interconnector between Great Island substation in Ireland and Pembroke substation in Wales. The Greenlink Interconnector is a CEF funded project between Ireland and Wales.

The objective of the study is to establish the optimal landfall locations from a marine and onshore perspective for further survey. Site visits to pre-determined landfall locations in Ireland were conducted. Arup conducted a landfall site visit on 15 October 2015 in Ireland. Intertek and Arup conducted joint landfall site visits on 28-29 October 2015 in Ireland. In Ireland, 10 sites were identified of which 4 were visited on the initial Arup visit and 8 were visited on the joint visit, ensuring all options were visited. Site visits were not required for Wales during this phase. The landfall location was previously determined as part of a Welsh landfall assessment process, which included a number of site visits, for the Greenwire project. The Welsh landfall selected is at Freshwater West in Pembrokeshire.

Prior to the visits in Ireland, potential landfall sites were identified using both publicly available and purchased data, and Intertek and Arup ranked each site independently from an offshore and onshore perspective, respectively. The most suitable sites were selected for site visits. Following the site visits, the landfalls were ranked in order of preference by each consultant. Of the 10 sites visited, 3 have been proposed for further investigation; namely Booley Bay, Baginbun Beach and Boyce's Bay on the Hook Head Peninsula, based on their high initial ranking score.

Following a consultation with the National Parks & Wildlife Service (NPWS), it was concluded that installing a cable through a Special Area of Conservation (SAC) could potentially be possible provided that the works would not adversely affect the integrity of the protected site and its conservation objectives. In the interest in achieving the most direct offshore cable route, Sandeel Bay was reinstated as a potential preferable landfall location, despite the relatively low initial ranking score.

In conclusion, Booley Bay, Baginbun Beach, Boyce's Bay and Sandeel Bay have been identified as potential preferable landfall locations and will all be subject to further investigations, including site assessments and stakeholder consultations.

Following detailed site assessments and stakeholder consultations the final landfall selection will be completed and a further Revision of this report will be issued.

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ABBREVIATIONS

HDD	Horizontal Directional Drilling
HVAC	High Voltage Alternating Current
HVDC	High Voltage Direct Current
MLW	Mean Low Water
NHA	Natural Heritage Area
NPWS	National Parks & Wildlife Services
SAC	Special Area of Conservation
SPA	Special Protection Area
TJP	Transition Joint Pit

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1 INTRODUCTION

Intertek Energy & Water Consultancy Services (Intertek) has been appointed by Element Power Ireland to provide a range of marine consultancy & engineering services related to the Greenlink Interconnector.

Arup has been appointed by Element Power Ireland to complete all onshore consultancy and engineering services related to the Greenlink Interconnector.

This report details the selection of suitable landfall locations from an offshore and onshore perspective including the methodology of assessment. This report outlines the methodology and chosen landfall locations before recommending landfalls for further investigation.

This report provides a qualitative analysis of landfalls using a set of criteria established to find an optimum site. There is no quantitative way to measure the suitability of each landfall.

1.1 BACKGROUND

The Greenlink Interconnector is a dedicated interconnector to be constructed between UK and Ireland to connect the two electricity markets; linking the UK National Grid with EirGrid's Irish network. The EU has selected the Greenlink project for funding under the Connecting Europe Facility (CEF). Greenlink has also been included as an EU Project of Common Interest, as well as being shortlisted for assessment by Ofgem for a Cap and Floor Regulatory Regime and application granted for an Interconnector Licence with Ofgem.

It is proposed, for technical reasons that Greenlink will connect to the National Grid system at Pembroke substation in Pembrokeshire, Wales and to the Irish network at Great Island substation in Co. Wexford, Ireland. Convertor stations will be located near each substation to convert the HVAC electrical supply in both countries to HVDC which will be the electrical system to be used in the Greenlink interconnector.

Figure 1-1 demonstrates the study area for the landfall site selection, including the offshore and nearshore sections of the route. The landfall location for the Wales grid connection has already been identified and is marked in **Figure 1-1**.

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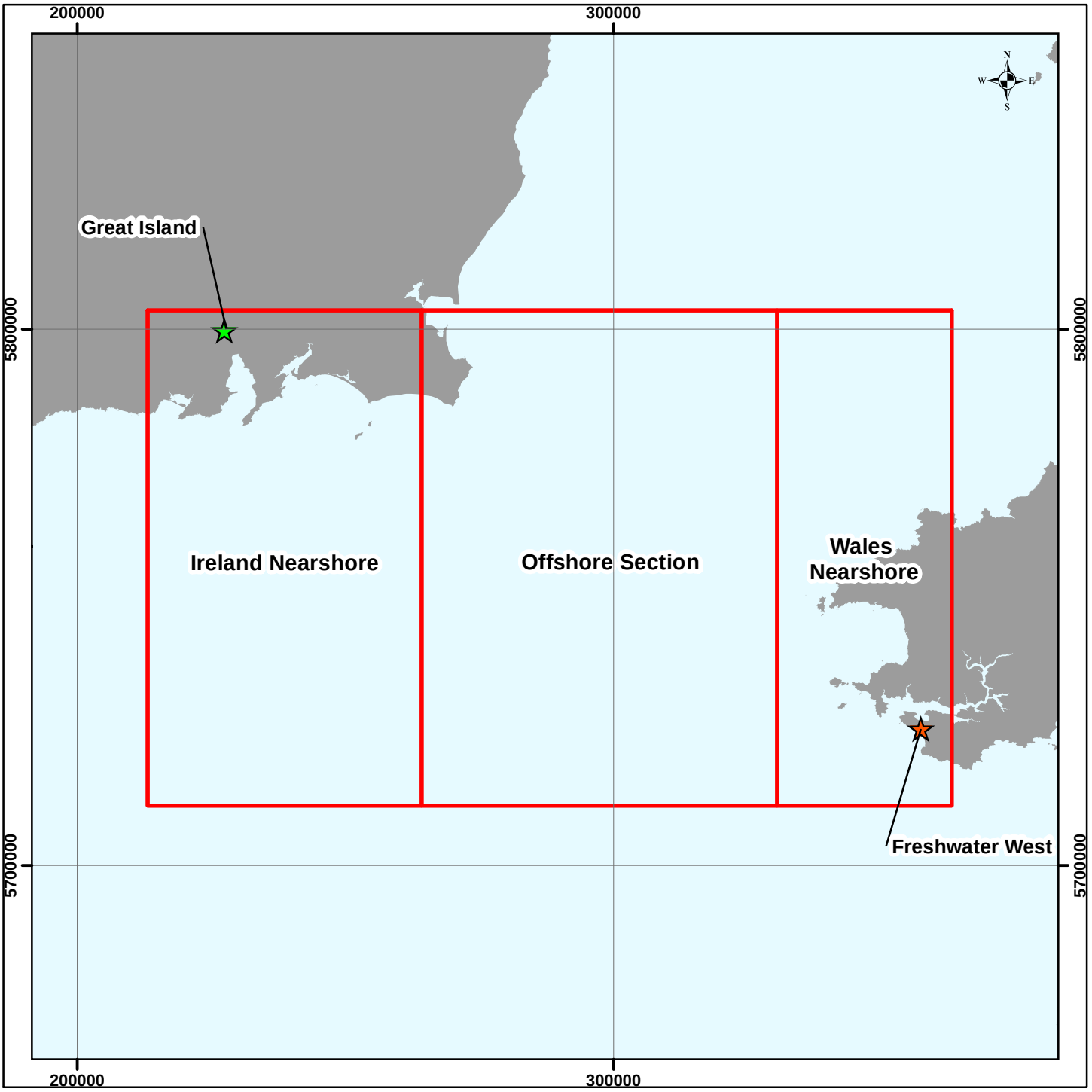

Legend

- Freshwater West
- Great Island
- Study Area

NOTE: Not to be used for Navigation

Greenlink Interconnector Cable

Figure 1-1: Proposed study area for the landfall site selection including the offshore and nearshore sections of the route.

Date	Monday, October 19, 2015 12:34:02
Projection	WGS_1984_UTM_Zone_30N
Spheroid	WGS_1984
Datum	D_WGS_1984
Data Source	OSOD, OSI
File Reference	J:\P1975\Mxd\Figures\ Fig1_1_Overview.mxd
Created By	Ian Charlton
Reviewed By	Emma Langley
Approved By	Emma Pidduck

Greenlink INTERCONNECTOR

Intertek Valued Quality. Delivered.

0 10 20 30 40 50 km

2 METHODOLOGY

Factors to be considered in the identification of a cable landfall site include: the type of beach (with an optimal landfall site characterised by a wide, gently sloping sandy beach area in front of low lying land); good onshore and offshore access; alternative access available for landowners; a suitable lay-down area; minimal existing service ducts or cables; stable cliffs or gradual sloping access; and minimal environmental restrictions (e.g., the presence of protected archaeological or ecological sites or protected species could result in consenting issues, seasonal restrictions, or installation methodology restrictions).

The general selection of the potential landfall locations had previously been made on the basis of the proximity to Great Island substation which will be the connecting point to the existing Irish electrical transmission infrastructure, giving an approximate region in which to obtain data to use in analysing the constraints. For the nearshore region, publicly available and purchased data and mapping were acquired in order to identify landfall locations that comply with the constraints identified in **Table 2-1**.

Table 2-1: Criterion used to identify suitable landfall locations
Note: weighting is indicative only and subject to further review

Parameter	Ideal	Acceptable	Measure	Weighting
Vessel Access	10 m water depth contour is < 500 m from MLW mark. Approaches clear of all dangers. Minimal rock outcropping. No inshore fishing or anchoring.	10 m depth contour < 1 km from MLW mark. Identified dangers must provide sufficient sea room to allow for navigation of vessels/barges. Inshore fixed fishing gear, yacht anchorage, fish farming if clear of cable route.	Pre-visit: Chart 10 m depth contour and MLW to identify areas greater than 1 km and exclude. Use Admiralty charts to exclude marked anchorages. Site-visit: Conduct visit during spring tide to identify any hidden obstructions/dangers and assess accessibility by vessels. Look for indications of fishing.	16%
Beach composition – including nearshore seabed geology.	Gently shelving beach & approaches. Greater than 2 m cover. Stable beach level.	Gently shelving beach with less than 1 m sediment cover; pebbles and boulders acceptable if they can be excavated. Rock seabed provided the profile will not cause cable suspensions.	Pre-visit: Identify areas of sandy beach with low cliffs. Site-visit: measure beach gradient with GPS and assess sand coverage.	14%
Environmental Constraints	No environmental sites such as Special Areas of Conservation (SAC), Special Protection Area (SPA), offshore wrecks, onshore protected archaeological structures or historic estates/demesnes in the vicinity of the landfall and access road.	Installation in the vicinity of archaeological sites and/or through proposed ecological protected sites where no alternatives are available and with proper consideration of environment and minimising installation disruption to the proposed sites.	Pre-visit: Identify landfall locations not within environmental constraints. Site-visit: Observe local signage and tourist information.	10%
Amenity Impact	Least impact on local community and amenities	Multiple access roads to site; no local businesses (cafes, etc.); minimal disruption to	Pre-visit: Identify landfall locations away from major towns and tourist hotspots.	10%

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Parameter	Ideal	Acceptable	Measure	Weighting
		water-users.	Site-visit: Look for indications of beach use such as dog-walking, surfing, swimming, etc.	
Exposure – weather and currents	Sheltered from prevailing weather with currents not exceeding 1 knot.	Partial shelter from prevailing weather with currents not exceeding 2 knots.	Pre-visit: Identify prevailing conditions & find locations that would be sheltered. Use tide-maps/currents to assess strength of flow. Site-visit: Look for signs of turbulent, fast-flowing water.	8%
Working / Site Area	Access via primary roads, no improvements needed and hard standing available for plant. Preferable to avoid ports or busy beaches.	Access via a regional road or track, with ability to upgrade if required. Space available to build hard standing.	Pre-visit: Map access roads Site-visit: Check accessibility and confirm space available.	8%
Obstructions & Existing Infrastructure	No cables or pipelines in area. Good drainage along access road to landfall.	Landing offers sufficient space to achieve adequate separation (to be defined according to cable specifications and cable installation requirements).	Pre-visit: Identify all existing cables/pipelines and avoid, if possible. Site-visit: Look for indications of previous cables, obvious infrastructure, etc.	8%
Coastal Erosion	Landfall location with stable headland/cliffs. Minimal evidence of erosion.	Small signs of cliff erosion; no rock slides.	Pre-visit: Use of public data/journal articles to identify areas where coastal protection has been installed. Site-visit: Observe condition of cliffs during site visit. Document evidence of erosion.	8%
Access to the Beach	Wide road for vehicular access (including heavy plant machinery, etc.) with minimal slope. Public road with alternative for local users.	Single track road with hedges/walls that can be re-established if required. Gentle slope. Tarmac/concrete that can be re-established if required.	Pre-visit: Identify landfalls with access by public roads where alternatives would be viable. Site-visit: Measure gradient and width of track; identify surrounding properties/users.	6%
Cable engineering & protection requirements	Cable can be directly buried on beach and offshore. Area for installation of transition joint pit (TJP).	Cable can be protected with split pipe and pinned to seabed, if required. Large flat area of beach for TJP or empty field where conditions can be returned to normal.	Pre-visit: Identify sheltered areas to reduce risk of erosion or high sediment transport. Identify landfalls with sufficient area to install TJP. Site-visit: Examine sediment type, evidence of underlying rock, etc.	6%
Overall cable length	Shortest overall cable length from Great Island Convertor Station to Freshwater West Landfall in Wales	Cable length not significantly greater than shortest overall cable length from Great Island Convertor Station to	Pre-visit: Map overall cable distance taking identified constraints into account. Site-visit: Examine onshore	6%

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Parameter	Ideal	Acceptable	Measure	Weighting
		Freshwater West Landfall in Wales	and offshore access point constraints modifying route.	

At each location, digital photographs were taken of the actual beach and foreshore areas together with the approaches and surroundings of each site. Photographs taken were marked using in-camera GPS.

The site visits conducted by Intertek were timed to coincide with low water spring tides so that as much of the beach would be visible as possible. Tide times were taken from Cobh, a nearby port (Table 2-2).

Table 2-2: Tide times at Cobh harbour during the landfall assessments. Adjustments of approx. 1.5 h required for Waterford.

Tides at Cobh Harbour	Time:	Tide Height:
Wednesday 28th October 2015	0527	4.6 m
	1200	0.0 m
	1749	4.6 m
	2359	0.1 m
Thursday 29th October 2015	0022	0.0 m
	0610	4.6 m
	1244	0.0 m
	1833	4.5 m

A series of positional measurements of significant features were taken using a hand held GPS unit. The instrument quoted accuracies varying between +/- 4 m to 12 m during the field work. For ease of measurement and calculation, the logged GPS points have been converted to UTM Zone 29 on the ED 50 Spheroid. Consequently, all co-ordinates referred to in this report are in the grid format relevant to Ireland. Elevation measurements were also made with a hand held GPS, but the reader should be aware of the limitations of this method.

Following completion of the landfall visits, for each criterion listed below, the sites were given a score out of 10. The scores were averaged and then a weighting applied according to the relative importance of each criteria (**Table 2-1**).

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3 STUDY AREA / SITE OVERVIEW

The location of the Irish landfall was pre-determined by the location of the grid connection at Great Island, Co. Wexford. The surrounding coastline within a 30 km radius was assessed using purchased and publicly available data.

As discussed in the methodology, the location of the landfall requires a compromise between onshore and offshore constraints, particularly in relation to achieving the shortest possible cable length and minimising project impacts. Alternative landing locations included along the Wexford coast (south-east Ireland), close to Rosslare and further up the east coast of Ireland.

Along the Wexford coast between the eastern edge of our identified study area (refer to Figure 1-1) and Cahore Point, approximately 40km up the east coast of Ireland, the full coastline is protected by environmental designations, including Special Areas of Conservation (SAC) and Special Protected Areas (SPA). These areas of designation are as follows: Ballyteige Burrow SAC, Saltee Islands SAC, Tacumshin Lake SAC, Carnsore Point SAC, The Raven SPA, Long Bank SAC and the Blackwater Bank SAC. Due to the potential for environmental impacts and subsea conditions offshore considered not suitable for cable installation these locations were not investigated further.

Further north along the east coast of Ireland, between Cahore Point and North of Courtown other potential landfalls were identified, from where a cable would not cross any onshore or nearshore designated sites.

However, these potential landfalls would significantly increase the length of onshore cable required and therefore create a significant potential for increased negative impact on the environment and people.

Much of the coastline of southern Ireland is dominated by steep cliffs interspersed with estuarine/riverine inputs and beaches. Within the Waterford, Wexford and Great Island area (identified study area – refer to Figure 1-1), the rock formation is predominately of the Palaeozoic era ranging from Cambrian to Devonian rock types including sandstone, shale and basalt with additional igneous volcanic rock [1]. The area is well-known for its fossil heritage [2, 3, 4] and similar to the south-east Ireland coast detailed above, much of the southern coastline is also protected by environmental designations. The following environmental protection sites were identified within the study area:

- Ballyteigue Burrow SPA
- Ballyteigue Burrow SAC
- Carnsore Point SAC
- Hook Head SAC
- Keeragh Island SPA & NHA
- Lower River Suir SAC
- River Barrow and River Nore SAC
- Saltee Islands SAC & SPA
- Tacumshin Lake SAC & SPA
- Tramore Back Strand SPA

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- Tramore Dunes and Backstrand SAC

Hook Head is of both geological importance and provides important marine habitats including intertidal and subtidal moderate energy reef covering approximately 10,534 ha, vegetated cliff and large shallow inlets and bays. The reef habitat provides homes to rare and scarce species such as: sponge; hydroids; anemone; sea slug; sea squirt; red algae and kelp.

All activities within a European protected area, which may affect the conservation objectives of that site, will be subject to an Appropriate Assessment screening to qualify the significance of the impact. The project would need to demonstrate that it will not affect the integrity of the designated features. Seasonal and installation methodology restrictions on construction activities may also be applied to protect sensitive species, such as nesting, breeding or over wintering birds.

Using the methodology outlined in Section 2, 10 sites were identified as potential landfall visits, of which all 10 were visited.

This report details the results of site visits conducted on 15 October 2015 and on 28 – 29 October 2015 to coincide with spring low tide. Each site was assessed in line with the methodology and criteria presented in Section 2.

A total of 10 sites were identified prior to the site visits on 28-29 October 2015, of which 8 were assessed. The 10 sites are shown in **Figure 3-1**. Sites Rathmoylan Cove and Newtown Beach were visited on 15 October 2015 by Arup but were not visited as part of the site visits on 28-29 October 2015 as both were ranked unfavourable prior to this visit by the onshore and offshore consultant.

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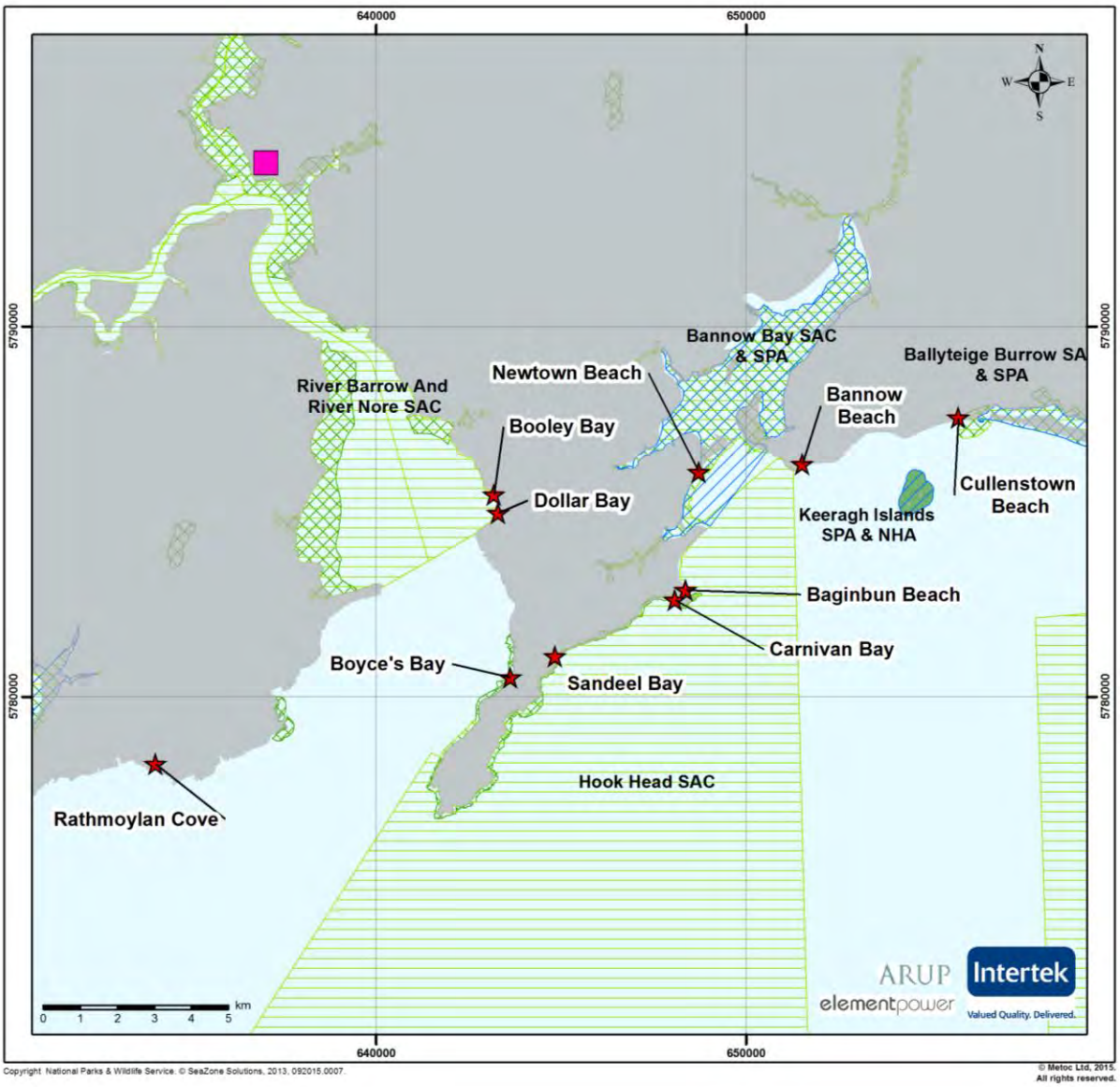
Figure 3-1: Ten proposed landfall sites on the Hook Peninsula within 30 km of the Great Island grid connection.



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4 RATHMOYLAN COVE & NEWTOWN BEACH

4.1 RATHMOYLAN COVE

Rathmoylan Cove is located to the west of the River Nore estuary, across the estuary from all other potential landfall locations identified. It lies outside all SAC and SPAs identified in the area; however, to access the Great Island substation the River Barrow and River Nore SAC would be required to be crossed. To complete this crossing the onshore cable route would be required to traverse numerous areas of ribbon development and/or villages followed by a significant HDD crossing of the estuary with potential for significant ecological and human impacts.

Rathmoylan Cove is an exposed beach facing due south. There are cliffs surrounding the cove on both sides approx. 15 m in height showing evidence of deep erosion, exposing red sandstone geological features including a sea cave on the eastern edge of the cove. Rock protection is installed along the rear of the beach and there is also rock outcrop along the shoreline which was covered in seaweed (see **Figure 4-1 and 4-2**).

Offshore, fishing vessels were observed in the foreshore indicating fishing activity in the area. This is consistent with the location of the cove southeast of the fishing village of Dunmore East.

Birds were observed along the seashore including seagulls and oystercatchers.

Rathmoylan is accessed via a ‘cul-de-sac’ access road, approximately 4m wide and 350m in length. Three permanent private properties, numerous mobile holiday homes and agricultural landowner plots were identified off this access road with no alternative access.

The access road leads directly to the rear of the beach with space for approx. 2 vehicles with metal bollards preventing vehicular access onto the beach. The cove is quite small and space for heavy plant might be limited.

Figure 4-1: View of eroding cliffs from the rear of the cove looking east.

Figure 4-2: View of the shoreline looking south east including outcropping rock and birds.

From an offshore perspective, Rathmoylan Cove is a very exposed site that would likely limit the time that installation could take place. Additionally, the geology of the area indicates rock would further increase the difficulty of installation. It would also increase the length of offshore cable required.

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The geological features of the cove and the onshore route constraint of crossing the River Barrow and River Nore SAC ranked this landfall option as not suitable for further assessment and therefore has not been included in the final ranking and recommendation section of this report.

4.2 NEWTOWN BEACH

Newtown Beach is located to the north east of the Hook Head Peninsula, on the western side of the entrance to Bannow Bay. The landfall lies within the Bannow Bay SAC and SPA and would also require the cable to cross through the Hook Head SAC offshore. Bannow Bay SAC has a number of qualifying aspects including sandflats not covered by seawater at low tide and shifting dunes (see **Figure 4-3**) which would not be suitable for cable installation due to potential ecological impacts.

At the rear of the beach eroding vegetation on shallow cliffs is evident (see **Figure 4-4**). There was rock outcrop uncovered at low tide along the shoreline which was covered in seaweed. Birds were observed along the seashore including seagulls and oystercatchers.

Newtown Beach is accessed via a 'cul-de-sac' access road, approximately 3.5m wide and 50m in length. There are no properties or landowner plots with access from this access road. The access road leads directly to the rear of the beach with little space for vehicles. Private agricultural land runs parallel to the rear of the beach.

Figure 4-3: View from the rear of the beach looking north east.

Figure 4-4: View of the eroding vegetation at the rear of the beach.

The ecological significance and extremely shallow gradient of the beach ranked this landfall option as not suitable for further assessment and therefore, similar to Rathmoylan Cove, has not been included in the final ranking and recommendation section of this report.

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5 BAGINBUN BAY LANDFALL

Baginbun Beach is located to the north of Carnivan Bay on the Baginbun peninsula. It lies within the Hook Head SAC but the cable would have less distance in the SAC than at alternative sites such as Sandeel Bay.

The beach faces north east and has excellent access for vessels. The distance from the 5 m and 10 m contours were 260 m and 1.4 km, respectively. The eastward facing beach is very sheltered from prevailing wind conditions and wave conditions during southerly winds on the day yielded wave heights of up to 0.3 m. Offshore, a number of lobster / crab pots were observed indicating fishing activity in the area.

Baginbun Beach is accessed via a 'cul-de-sac' access road, approximately 4m wide and 450m in length. Five private properties and approximately seven additional agricultural landowner plots were identified off this access road with no alternative access.

At the end of the access road there is space for approx. 3 vehicles and a gravel access track to the east leading to the beach. The parking space at the top could be used for the site construction units or the TJP. The access track is approximately 3.5m wide with grass verges/vegetation on either side of the path. On the hillside of the track there are 3 concrete drainage access points that exit onto the beach; likely freshwater drainage.

The potential onshore route from the Baginbun Beach access road to the R733/L4045 junction, southeast of Great Island, is approximately 12.8km along local roads or 12km along regional roads. The various onshore route options available to the Baginbun Beach access road require environmental constraints to be considered for each route.

At the bottom of the access track there is a seawall of approx. 1 m tall and less than half a metre wide. Additionally, the path is broken into pieces at the bottom and there is bed rock. The angle of the access path relative to the beach was approaching 90°, meaning that open cut trenching on the beach and up the path would not be possible without significant changes in direction for the cable.

Surrounding the beach are heavily vegetated cliffs of moderate height (< 15 m) with only minor signs of erosion on the northern side of the beach. Height and apparent stability would suggest HDD would be possible but would require appropriate geological assessment and survey of ground conditions for confirmation. At the base of the cliffs on the southern side, there were the remains of a large stepped concrete structure but with no indication of what it was. There was also a large letter 'C' installed on one of the cliff faces – possibly a beach monitoring station.

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Figure 5-1: Start of access down to beach and parking spaces.

Figure 5-2: Grass verge on the beach side of the access track.

Figure 5-3: View of the access track from the beach looking north west.

Figure 5-4: View of the beach looking north west including cliffs and outcropping rock.

Figure 5-5: Unknown concrete stepped structures at the south end of Baginbun Beach.

Seaweed was observed on the upper reaches of the beach suggesting the tide reaches the sea wall. The centre of the beach showed no signs of seaweed or debris. Intertidal rock outcrops were covered in seaweed.

The gradient of the beach was flat (1.7°) and the sediment was generally uniformly distributed coarse sand with occasional whole or partial shells. Notably, there was very little man-made debris.

The beach was used by members of public during the visit; there were a number of people with fishing equipment on the beach and there were

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advertising signs in the car park identifying the type of fish that could be caught on the beach (e.g. bass fishing).

There was very little evidence of birds nesting at the site; no foot prints on the sand but there were circling gulls.

Figure 5-6: One of the drainage access points identified on the upper slope.

Table 5-1: Protected sites within 5km of Baginbun Beach landfall

Site Name	Designation	Feature of conservation Interest	Distance from landfall
Hook Head	SAC	**Annex I habitats:** Large shallow inlets and bays Reefs Vegetated sea cliffs of the Atlantic and Baltic coasts	Within
Bannow Bay	SPA	**Annex II species that are the primary reason for selection of this site:** Light-bellied Brent Goose (*Branta bernicla hrota*), Shelduck (*Tadorna tadorna*), Pintail (*Anas acuta*), Oystercatcher (*Haematopus ostralegus*), Golden Plover (*Pluvialis apricaria*), Grey Plover (*Pluvialis squatarola*), Lapwing (*Vanellus vanellus*), Knot (*Calidris canutus*), Dunlin (*Calidris alpina*), Black-tailed Godwit (*Limosa limosa*), Bar-tailed Godwit (*Limosa lapponica*), Curlew (*Numenius arquata*) and Redshank (*Tringa totanus*).	1.9km to the north
Bannow Bay	Ramsar Site	**Internationally important wetland**	1.9km to the north
Bannow Bay	SAC	Estuaries, Mudflats and sandflats not covered by seawater at low tide, Annual vegetation of drift lines, Perennial vegetation of stony banks, Salicornia and other annuals colonizing mud and sand, Spartina swards (Spartinion maritimae), Atlantic salt meadows (Glauco-Puccinellietalia maritimae), Mediterranean salt meadows (Juncetalia maritimi), Mediterranean and thermo-Atlantic halophilous scrubs (Sarcocornetea fruticosi), Embryonic shifting dunes,Shifting dunes along the shoreline with Ammophila arenaria (white dunes) and Fixed coastal dunes with herbaceous vegetation (grey dunes)	3km to the north
Bannow Bay	pNHA		3km to the north

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6 BANNOW BEACH LANDFALL

Bannow Beach is one of two sites not located on the Hook Head peninsula but lies on the coastline to the east. Bannow is a short distance away from Cullenstown Beach.

Bannow Beach is accessed via a 'cul-de-sac' access road, approximately 4m wide and 800m in length. Six private properties and numerous additional agricultural landowner plots were identified off this access road with no alternative access.

At the end of the access road there is parking space for approx. 2 vehicles and two gravel access tracks verge to the right, one leading down to the beach and one leading to a private property. The access track from the access road to the beach is via a reasonably straight broken track that would minimise cable bend angles if it were to be installed up the path.

The potential onshore route from the Bannow Beach access road to the R733/L4045 junction, southeast of Great Island, is approximately 19.5km along local and regional roads. The onshore route option to the Bannow Beach access road requires crossing of numerous bridges and culverts and all other environmental constraints to be considered.

Bannow Beach is an exposed beach facing almost due south and wave conditions during the south-easterly wind conditions yielded wave heights of approximately 1 m close to the shore. The beach was approx. 216 m wide and 51 m from cliff edge to the water at low tide.

The primary benefit of Bannow Bay was the short distance from the beach to the 5 m water depth contour: 1.1 km. This would allow cable vessels to get closer to the shore and reduce the requirement for cable transpooling or barges. The evident wave conditions and likely current conditions would limit the installation time frames.

Offshore, a number of lobster and crab pots were installed with several fishing vessels observed further offshore.

The beach itself was composed of large cobbles and stones with small patches of very coarse sediment and broken shells. The gradient of the beach was 8.6° and a large storm berm had formed approximately 10 m from the base of the cliff highlighting the energetic water conditions the beach is exposed to. Very large piles of rotting seaweed deposited on the beach right up to the edge of the cliff suggesting tides reach the base of the cliff, but only deposited during storm conditions.

Despite not being directly within an environmentally protected area, there were large numbers of birds on and around the cliffs, with evidence of nesting in crevices.

Bannow Beach landfall site is not located within any designated areas. It is within 5km of 5 other protected areas: Hook Head SAC, Bannow Bay SPA and Ramsar Site, Bannow Bay SAC, Bannow Bay pNHA.

The Bannow Beach landfall is adjacent to Hook Head SAC which is of both geological importance and provides important marine habitats. The Bannow Beach landfall location is approximately 1km from the Bannow Bay SPA and

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Ramsar Site; it is possible that bird species from these protected sites are present around the landfall site overwinter.

Figure 6-1: Bannow Beach looking east at a rock outcrop and the vegetated cliffs.

Figure 6-2: Bannow Beach looking west towards the rock headland.

Figure 6-3: Bannow Beach access track to the beach - largely solid and composed of stones and turf.

Figure 6-4: Private property close to the access road down to the beach at Bannow Beach. In good condition and likely used regularly.

Table 6-1: Protected sites within 5 km of Bannow Beach.

Site Name	Designation	Feature of conservation Interest	Distance from Landfall
Hook Head	SAC	**Annex I habitats:** Large shallow inlets and bays Reefs Vegetated sea cliffs of the Atlantic and Baltic coasts	286m to west
Bannow Bay	SAC	**Annex I habitats:** Estuaries, Mudflats and sandflats not covered by seawater at low tide, Annual vegetation of drift lines, Perennial vegetation of stony banks, Salicornia and other annuals colonizing mud and sand, Spartina swards (Spartinion maritimae), Atlantic salt meadows (Glauco-Puccinellietalia maritimae), Mediterranean salt meadows (Juncetalia maritimi), Mediterranean and thermo-Atlantic halophilous scrubs (Sarcocornetea fruticosi), Embryonic shifting dunes,Shifting dunes along the shoreline with Ammophila arenaria (white dunes) and Fixed coastal dunes with herbaceous vegetation (grey dunes)	1km to the north west
Bannow Bay	SPA	**Annex II species that are a primary reason for selection of this site:**	1km to the north

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Site Name	Designation	Feature of conservation Interest	Distance from Landfall
		Light-bellied Brent Goose (*Branta bernicla hrota*), Shelduck (*Tadorna tadorna*), Pintail (*Anas acuta*), Oystercatcher (*Haematopus ostralegus*), Golden Plover (*Pluvialis apricaria*), Grey Plover (*Pluvialis squatarola*), Lapwing (*Vanellus vanellus*), Knot (*Calidris canutus*), Dunlin (*Calidris alpina*), Black-tailed Godwit (*Limosa limosa*), Bar-tailed Godwit (*Limosa lapponica*), Curlew (*Numenius arquata*) and Redshank (*Tringa totanus*).	west
Bannow Bay	pNHA	Habitats and wildlife	1km to the north west
Bannow Bay	Ramsar Site	**Internationally important wetland**	1km to the north west

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7 BOOLEY BAY LANDFALL

Approximately 5 km north of Boyce's Bay (see Section 8) is the Booley Bay landfall. Similar to Boyce's Bay, the landfall faces the west and is moderately exposed to the prevailing south-westerly wind conditions.

Booley Bay is further up the river estuary and therefore the distance from the 5 and 10 m depth contours increases to 3.9 and 6.5 km, respectively. This may restrict the types of vessels that can reach the site and increase the chances of requiring anchored barges. The beach was approximately 205 m wide and 113 m from the cliff to the water's edge shortly before low water. The beach was predominately flat (0.2°) with fine but water-saturated sand. A storm berm was observed at the upper reaches of the beach.

Booley Bay is accessed via a 'cul-de-sac' access road off the L4045, approximately 4m wide and 350m in length. One private property entrance was being constructed at the time of the site visit off this access road. Approximately five additional agricultural landowner plots were identified off this access road with no alternative access.

The potential onshore route from the Booley Bay access road to the R733/L4045 junction, southeast of Great Island, is approximately 5km along the L4045.

The end of the access road is blocked by two large boulders preventing permanent vehicular access down to the beach. These could be removed temporarily to provide access to the beach. An access track, approximately 50m in length, leads from the end of the access road down to the beach.

There is a small area to the north of the access track for parked vehicles (Figure 6-4). In the parking space at the time of the site visit, there was an activity school van and two surfers. Wave conditions offshore were approx. 0.9m and suitable for surfing – indicative of potentially difficult installation conditions during southerly wind conditions and less shelter than Boyce's Bay.

The surrounding headland was dominated by vegetated cliffs to the north and south (Figures 7-3 and 7-6); both sides demonstrated low levels of coastal erosion with minor evidence of disruption by landslides. Adjacent to the access road and track was a freshwater riverine input, surrounded by unmanaged vegetation. The river water flowed directly onto the beach where the water flow was diverted along the upper reach of the beach to the southern rock outcrop where it was forced towards the sea by rocks.

Options for installation would include HDD and open-cut trenching. It is likely that the flow of fresh water onto the beach would make keeping a trench open difficult and may risk exposure of the cable during adverse weather conditions. More information is required regarding the stability of sediment on the beach through an appropriate geological assessment and survey of ground conditions.

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Figure 7-1: Freshwater outlet/river at Booley Bay - facing west-north-west.

Figure 7-2: The view of the access road from the beach - looking east.

Figure 7-3: Rock headland to the north of Booley Bay. Evidence of saturated sand.

Figure 7-4: A small parking area with activity school van and two surfers.

Figure 7-5: View from the access track down to Booley Bay landfall.

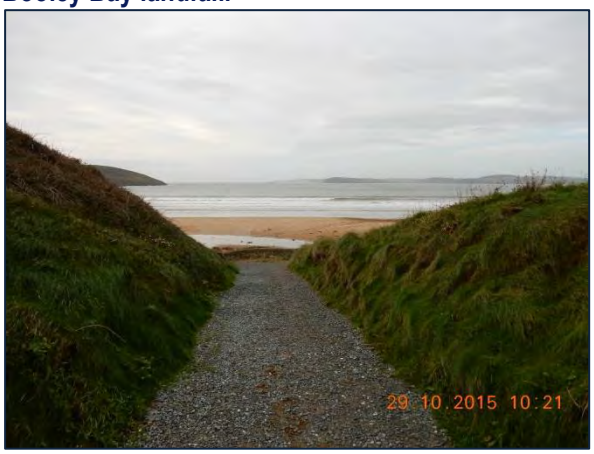

Figure 7-6: View of the rock headland and outcrop looking north-west.

Booley Bay landfall is located within the River Barrow and River Nore SAC and within 5km of the Hook Head pNHA (**Table 7-1**). The project would need to demonstrate that it will not affect the integrity of the River Barrow and River Nore SAC. It is policy of Wexford County Council to protect the pNHAs as if already designated.

Of particular note within the Booley Bay landfall was the presence of honeycomb reef worm (*Sabellaria alveolata)* on the intertidal rocks (**Figure 7-7**). This was also present in Dollar Bay. While not listed as part of the River Barrow and Nore SAC, it is a species that is sensitive to changes in sediment regime and physical disruption (including storm damage). Most of the intertidal rock at the site was covered but the extent offshore would need additional survey.

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Figure 7-7: Honeycomb Worm Reef (*Sabellaria Alveolata*) on intertidal rocks at Booley Bay Landfall.

Table 7-1: Protected sites within 5km of Booley Bay landfall

Site Name	Designation	Feature of Conservation Interest	Distance from landfall
River Barrow and Nore	SAC	Annex I habitats: • Estuaries • Tidal Mudflats and Sandflats • Salicornia Mud • Atlantic Salt Meadows • Mediterranean Salt Meadows • Floating River Vegetation • Dry Heath • Hydrophilous Tall Herb Communities • Petrifying Springs* • Old Oak Woodlands • Alluvial Forests* Annex II Species: • Desmoulin's Whorl Snail (Vertigo moulinsiana) • Freshwater Pearl Mussel (Margaritifera margaritifera) • White-clawed Crayfish (Austropotamobius pallipes) • Sea Lamprey (Petromyzon marinus) • Brook Lamprey (Lampetra planeri) • River Lamprey (Lampetra fluviatilis) • Twaite Shad (Alosa fallax) • Atlantic Salmon (Salmo salar) • Otter (Lutra lutra) • Killarney Fern (Trichomanes speciosum) • Nore Freshwater Pearl Mussel (Margaritifera durrovensis) Waterford Harbour pNHA and Duncannon Sandhills pNHA are now within the boundaries of the SAC.	Within
Hood Head	pNHA	Large kittiwake (gull) colonies on several cliffs	3.9km to south

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8 BOYCE'S BAY LANDFALL

Originally identified as Lumsdin Bay, this beach is actually called Boyce's Bay within Lumsdin Bay and lies on the west coast of the Hook Peninsula. The site is located outside the Hook Head SAC. It does, however, fall within a proposed NHA (pNHA).

The beach faces the south west making it an exposed site, given the prevailing south-westerly weather conditions. During the site visit, the forecast was south-southeast force 4 – 5 (13 – 24 knots) and apparent wave conditions at the site were insignificant (> 0.5 m) indicating a level of protection from the surrounding high cliffs and headland. The 5 and 10 m depth contours are 1.4 and 2.6 km, respectively. This may restrict the types of vessels that can reach the site and increase the chances of requiring anchored barges. The beach extends further north along the coastline for approximately 2 km but a rock outcrop to the north of the site prevents vehicles from passing to the additional coastline and beach.

Figure 8-1: Part of the Access Road to Boyce's Bay.

Figure 8-2: Wave conditions during F4-5 SSE weather.

Figure 8-3: Derelict house to the south of the access road.

Figure 8-4: Evidence of bird presence on the beach.

Boyce's Bay is accessed via a 'cul-de-sac' access road off the L4045 local road, approximately 4m wide and 350m in length with hedge and/or low brick walls on either side. Three private properties and a dairy farm yard and buildings were identified off the access road.

The three private properties consist of a derelict property at the junction with the L4045 local road **(see Figure 8-3)**, a farm house associated with the dairy farm and a private property called 'Lumsdin Lodge' on the southern side of the access path. Alternative accesses appear to be available, off the L4045 local road, to the dairy farm and associated farm house, and the derelict property.

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The dairy farm yard and buildings are located on the northern side of the access track with fields located to both the north and south of the access road.

The potential onshore route from the Boyce's Bay access road to the R733/L4045 junction, southeast of Great Island, is approximately 10.5km along the L4045.

An access track, approximately 50m in length, leads from the end of the access road down to the beach. The access track to the beach is approx. 3 m wide composed of rough terrain, and has an established sea wall of good condition at the bottom. The sea wall is approximately 2 m high and 1.2 m wide at the base. It appears to have been built on solid bed rock with a similar composition to rock outcrops observed to the north and south of the beach (**Figure 8-1**).

The beach itself was gently sloping with evidence of a storm berm and seaweed debris on the upper reaches of the beach. The typical slope angle was 2.4° from the cliff to the water. The beach was approximately 200 m wide, with approximately 157 m of rock to the south of the beach. Fossils were observed on rock outcrops on the side of the bay (**Figure 8-6**).

Figure 8-5: A panoramic overview of Boyce's Bay looking west across the River Barrow and River Nore.

The surrounding cliffs and headland were tall with one large derelict property at the top, close to the dairy farm; this is possibly a heritage site and would require confirmation prior to establishing the location for an HDD point. The surrounding cliffs are densely vegetated with grasses and scrub but there are many indicators of instability and slope movement. Portions of the cliffs were identified as suitable for HDD up to the main track, pending further geotechnical assessments and ground investigation.

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Figure 8-6: A fossil found on the rock outcrop at Boyce's Bay. Fossil appeared to be naturally coated in pyrite.

Boyce's Bay landfall is located within Hook Head pNHA. It is policy of Wexford County Council to protect the Hook Head pNHA as if already designated. The landfall site is also within 5km of two other protected areas: Hook Head SAC, River Barrow and Nore SAC (**Table 8-1**). Due to the proximity of the Hook Head SAC, the project would need to demonstrate that it will not affect the integrity of the site.

At Boyce's Bay the rough ground of the headland begins to give way to the sand and mud of the estuary. Kittiwake colonies may be present at the landfall site, however further information is required to identify if this location is of importance to this species. Wintering flocks of migratory birds are seen along the Barrow Estuary, 3.8 km north of the landfall and Annex II species may be present including resident otter, while sea and river lamprey, Atlantic salmon and shad may be migrating across the landfall approach area at certain times of the year.

Notably, two large seals were observed swimming adjacent to the beach and several gulls were present during the site visit (see **Figure 8-4** for bird footprints). A line of seaweed was observed within the surf zone of the beach possibly indicating rock and potential feeding grounds. Offshore (middle-estuary), a fishing vessel was operating the vicinity recovering a lobster/crab pot.

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Table 8-1: Protected sites within 5km of Boyce's Bay landfall

Site Name	Designation	Feature of Conservation Interest	Distance from landfall
Hook Head	pNHA	Large kittiwake (gull) colonies on several cliffs	Within
Hook Head	SAC	Annex I habitats: • Large shallow inlets and bays • Reefs • Vegetated sea cliffs of the Atlantic and Baltic coasts Hook Head is of geological importance and provides important marine habitats including intertidal and subtidal moderate energy reef covering approximately 10,534 ha, vegetated cliff and large shallow inlets and bays. The reef habitat provides homes to rare and scarce species such as: sponge; hydroids; anemone; sea slug; sea squirt; red algae and kelp.	815m to the East
River Barrow and Nore	SAC	Annex I habitats: • Estuaries • Tidal Mudflats and Sandflats • Salicornia Mud • Atlantic Salt Meadows • Mediterranean Salt Meadows • Floating River Vegetation • Dry Heath • Hydrophilous Tall Herb Communities • Petrifying Springs* • Old Oak Woodlands • Alluvial Forests* Annex II Species: • Desmoulin's Whorl Snail (Vertigo moulinsiana) • Freshwater Pearl Mussel (Margaritifera margaritifera) • White-clawed Crayfish (Austropotamobius pallipes) • Sea Lamprey (Petromyzon marinus) • Brook Lamprey (Lampetra planeri) • River Lamprey (Lampetra fluviatilis) • Twaite Shad (Alosa fallax) • Atlantic Salmon (Salmo salar) • Otter (Lutra lutra) • Killarney Fern (Trichomanes speciosum) • Nore Freshwater Pearl Mussel (Margaritifera durrovensis)	3.8km to the north west

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9 CARNIVAN BAY LANDFALL

Carnivan Bay is on the south side of the Baginbun peninsula and is separated from Baginbun Bay by private fields on the peninsula.

Carnivan Bay is accessed via a 'cul-de-sac' access road, approximately 3m wide and 350m in length. One private property and approximately four additional agricultural landowner plots were identified off this access road with no alternative access.

The potential onshore route from the Carnivan Bay access road to the R733/L4045 junction, southeast of Great Island, is approximately 12km along local roads. The onshore route option to the Carnivan Bay access road requires environmental constraints to be considered.

Along the Carnivan Bay access road there are two vista points located at the rear of the bay. The vista point at the end of the access road would be suitable for a construction site and associated containers.

At the end of the access road an access track verges to the right leading down to the beach and an additional access track continues straight ahead leading to private land. The access track down to the bay is heavily maintained with fencing and warning signs identifying a strong undertow current and eroding cliffs. The access track was very steep with three permanent metal bollards preventing vehicular access. The access track was a combination of gravel and concrete leading down to bedrock and large cobbles, with a seawall at the bottom.

The beach is large and flat. The site is very exposed to southerly wind conditions and weather conditions on the day yielded waves of approx. 1 m. The profile of the beach has a shallow gradient; wide and long with less than 2° of slope. Looking north from the water's edge, patches of stable vegetated cliff were observed in the centre with patches of exposed rock. Cliffs to the east and west demonstrate evidence of coastal erosion and more recent landslips (**Figure 9-6**).

The beach is a popular site with members of the public walking the cliff path and on the beach. The coast path is maintained with fencing along it.

The apparent instability of the cliffs and warning signs combined with the exposed beach make this site unsuitable for HDD without significant and extensive geotechnical survey to determine the ground conditions. Open cut trenching would be a possibility on the beach but the stability of the access path for installation would also need to be assessed.

As with Sandeel Bay and Baginbun Beach, Carnivan Beach is within an SAC, including an Annex I reef habitat.

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Table 9-1: Protected sites within 5km of Carnival Bay landfall

Site Name	Designation	Feature of conservation Interest	Distance from landfall
Hook Head	SAC	**Annex I habitats:** Large shallow inlets and bays Reefs Vegetated sea cliffs of the Atlantic and Baltic coasts	Within
Bannow Bay	SPA	**Annex II species that are a primary reason for selection of this site:** Light-bellied Brent Goose (*Branta bernicla hrota*), Shelduck (*Tadorna tadorna*), Pintail (*Anas acuta*), Oystercatcher (*Haematopus ostralegus*), Golden Plover (*Pluvialis apricaria*), Grey Plover (*Pluvialis squatarola*), Lapwing (*Vanellus vanellus*), Knot (*Calidris canutus*), Dunlin (*Calidris alpina*), Black-tailed Godwit (*Limosa limosa*), Bar-tailed Godwit (*Limosa lapponica*), Curlew (*Numenius arquata*) and Redshank (*Tringa totanus*).	1.9km to the north
Bannow Bay	Ramsar Site	**Internationally important wetland**	1.9km to the north
Bannow Bay	SAC	Estuaries, Mudflats and sandflats not covered by seawater at low tide, Annual vegetation of drift lines, Perennial vegetation of stony banks, Salicornia and other annuals colonizing mud and sand, Spartina swards (Spartinion maritimae), Atlantic salt meadows (Glauco-Puccinellietalia maritimae), Mediterranean salt meadows (Juncetalia maritimi), Mediterranean and thermo-Atlantic halophilous scrubs (Sarcocornetea fruticosi), Embryonic shifting dunes,Shifting dunes along the shoreline with Ammophila arenaria (white dunes) and Fixed coastal dunes with herbaceous vegetation (grey dunes)	3km to the north
Bannow Bay	pNHA		3km to the north

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Figure 9-1: Warning signs at base of cliff as you enter the beach.

Figure 9-2: Another warning and the metal bollards preventing vehicular access to beach.

Figure 9-3: The beach and cliffs looking east towards Baginbun Head.

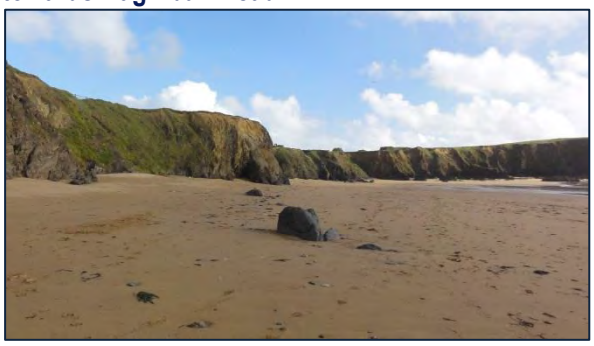

Figure 9-4: Wave conditions at the edge of the beach indicating the exposure.

Figure 9-5: Overview of Carnivan Bay looking east.

Figure 9-6: Evidence of loss of vegetation due to landslip.

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10 CULLENSTOWN BEACH LANDFALL

Cullenstown beach is very large, exposed, south-facing beach east of Bannow Bay. The beach is heavily used by the public all year round and is a popular location for holiday homes.

Cullenstown Beach is accessed via a 'cul-de-sac' access road, approximately 4.5m wide and 260m in length. The village of Cullenstown, including numerous private properties, mobile holiday homes and businesses, is located on this access road with no alternative access.

The potential onshore route from the Cullenstown Beach access road to the R733/L4045 junction, southeast of Great Island, is approximately 19.1km along local and regional roads. The onshore route option to the Cullenstown Beach access road requires crossing of numerous bridges and culverts and all other environmental constraints to be considered.

At the end of the access road a 3.5m wide access track veers to the left leading down to the beach with a large car park with public conveniences, including outdoor showers at the rear of the beach. The carpark is height-restricted and coated in tarmac/concrete which would be suitable for practical construction works, but installation would interrupt the tourists and locals. There is a concrete sports structure likely used for bowls or hand ball. There were signs identifying dangerous bathing conditions due to the strong currents.

The beach is the largest of all visited with enormous variation in morphology from east to west. To the east, an environmentally protected estuary outlet was observed with extreme current flows shown by the turbulent waters. A spit of sand extended outwards along the estuary outlet with evidence of rip currents and an apparent offshore sediment bar where estuarine outlet meets tides and waves. This bar would likely cause problems during installation as indicates shifting sediments.

At the top of the beach, there were grass-covered dunes followed by a beach with heavy zonation of sediment; cobbles at the top, followed by finer gravel and then fine, saturated sand close to the water. The beach gradient was steep, particularly on the spit, where the sand was dry but completely unconsolidated.

The length of the beach was prohibitive for the installation of cable – vessel access would be tricky due to the sediment movement in the area and the shallow depth gradient.

There was some evidence of coastal protection associated with a tourist beach including rock protection on the western side of the beach. There was also evidence of landslides and little vegetation on the cliffs. To the west, there was a rock outcrop.

The was some seaweed likely deposited during storm conditions and also evidence of lobster pots on the beach and further offshore – it is suggested that fishing gear was debris dragged onto the beach, or storage by fisherman before use further offshore.

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Figure 10-1: Sign at the top of Cullenstown Beach indicating dangerous bathing conditions to the east of the beach.

Figure 10-2: Car park and public conveniences at the top of the beach and evidence of vegetated sand dunes. Looking north.

Figure 10-3: View of the concrete sports structure, beach and rock protection. Looking west from the waters edge at Cullenstown Beach.

Figure 10-4: Estuarine outlet with turbulent water flowing towards the sea. Looking east from the spit towards the estuary.

Figure 10-5: Sand patches and breaking waves on an apparent offshore sediment structure.

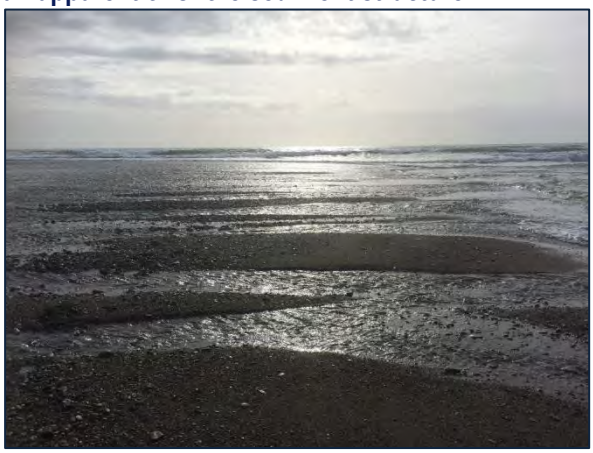

Figure 10-6: Sand dunes and vegetated cliff structures. Looking east.

Cullenstown Beach Landfall is within Ballyteigue Burrow SAC and pNHA. It is within 5km of 6 other protected areas: Ballyteigue Burrow SAC, SPA and pNHA, Keeragh Islands SPA and NHA and Hook Head SAC.

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Table 10-1: Protected sites within 5 km of Cullenstown Beach Landfall.

Site Name	Designation	Feature of conservation Interest	Distance from Landfall
Ballyteigue Burrow	SAC	**Annex I habitats that are a primary reason for selection of this site:** Estuaries Mudflats and sandflats not covered by seawater at low tide Coastal lagoons Annual vegetation of drift lines Perennial vegetation of stony banks Salicornia and other annuals colonizing mud and sand Spartina swards (Spartinion maritimae) Atlantic salt meadows (Glauco-Puccinellietalia maritimae) Mediterranean salt meadows (Juncetalia maritimi) Mediterranean and thermo-Atlantic halophilous scrubs (Sarcocornetea fruticosi) Embryonic shifting dunes Shifting dunes along the shoreline with Ammophila arenaria (white dunes) Fixed coastal dunes with herbaceous vegetation (grey dunes)	28.3m to the east
Ballyteigue Burrow	pNHA	Habitats and wildlife	28.3m to the east
Ballyteigue Burrow	SPA	**Overwinter:** Light-bellied Brent Goose (Branta bernicla hrota) Shelduck (Tadorna tadorna) Golden Plover (Pluvialis apricaria) Grey Plover (Pluvialis squatarola) Lapwing (Vanellus vanellus) Black-tailed Godwit (Limosa limosa) Bar-tailed Godwit (Limosa lapponica)	528m to the east
Keeragh Islands	SPA	Overwinter: Light-bellied Brent Goose (Branta bernicla hrota) Nationally Important breeding colony of Cormorant (206 pairs recorded in 1989), which is considered to be one of the largest in the country.	1.8km to the south west
Keeragh Islands	Ramsar	**Internationally important wetland**	1.8km to the south west
Keeragh Islands	NHA	The Keeragh Islands SPA is of ornithological importance as it has a Nationally Important population of breeding Cormorant. It retains potential for attracting breeding terns, species that are listed on Annex I of the E.U. Birds Directive, though none have been recorded since the 1970s.	1.8km to the south west
Hook Head	SAC	**Annex I habitats:** Large shallow inlets and bays Reefs Vegetated sea cliffs of the Atlantic and Baltic coasts	4.9km to the west

Cullenstown Beach landfall is located in close proximity to three European designated sites on a sand and shingle barrier beach. Ballyteigue Burrow SAC has a range of coastal habitats, including various types of sand dunes, salt meadows, and intertidal sand and mud flats. Former estuarine areas adjacent

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to the site have been reclaimed as polders and are intensively managed for agriculture. This coastal site is of high ecological value for its range of coastal habitats, several being listed on Annex I of the E.U. Habitats Directive. It is a major site for wintering waterfowl, with an internationally important population of Brent Goose and a further six species with populations of national importance. Of particular note is that two of the species, Golden Plover and Bar-tailed Godwit, are listed on Annex I of the E.U. Birds Directive. Little Tern is also listed on Annex I of this Directive. Most of the site is designated as a Nature Reserve.

All activities within or adjacent to a European protected area, which may affect the conservation objectives of that site, will be subject to an Appropriate Assessment screening to qualify the significance of the impact. This will add time to the consent process. Seasonal and installation methodology restrictions on construction activities may also be applied to protect sensitive species, such as nesting, breeding or over wintering birds. The project would need to demonstrate that it will not affect the integrity of European protected features.

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11 DOLLAR BAY LANDFALL

Dollar Bay Landfall is the next beach south of Booley Bay, separated by a rocky outcrop and short headland, and has similar characteristics to Booley Bay.

Similar to Booley Bay, Dollar Bay is accessed via a 'cul-de-sac' access road off the L4045, approximately 4m wide and 200m in length. No private properties were identified off this access road with no alternative access. Two field gates were located along the access road.

The potential onshore route from the Dollar Bay access road to the R733/L4045 junction, southeast of Great Island, is approximately 5.5km along the L4045.

A steep gravel track, approximately 50m in length at the end of the access road, lead down to coarse sand, pebbles and some cobbles at the top of the beach. The remainder of the beach was composed of fine, homogeneous sand with some evidence of water saturation close to the water's edge.

As with Booley Bay, at the start of the track there were two large boulders placed to prevent vehicular access. These could be removed temporarily to provide access to the beach. On either side of the track were heavily vegetated cliffs with little sign of coastal erosion and no man-made sea defences. Rock headland and outcrops were found on the north and south of the bay.

The large headland to the south of Dollar Bay provides additional protection from the prevailing south-westerly weather conditions and the conditions during the site visit (F5 – 6 SE) yielded wave heights of approx. 1 m just offshore.

Similar to Booley Bay landfall, the rock outcrop separating Booley and Dollar Bay was covered with honeycomb reef worm (*Sabellaria alveolata)*. While not listed as part of the River Barrow and Nore SAC, it is a species that is sensitive to changes in sediment regime and physical disruption (including storm damage). Most of the intertidal rock at the site was covered but the extent offshore would need additional survey.

Dollar Bay landfall is located within the River Barrow and River Nore SAC and within 5km of the Hook Head pNHA (**Table 11-1**). The project would need to demonstrate that it will not affect the integrity of the River Barrow and River Nore SAC. It is policy of Wexford County Council to protect the pNHAs as if already designated.

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Figure 11-1: The view of Dollar Bay from the access track (looking west).

Figure 11-2: The access track taken from mid-way down the path (looking east).

Figure 11-3: Honeycomb worm reefs on intertidal rock outcrop separating Dollar Bay and Booley Bay.

Figure 11-4: Dollar Bay landfall looking north west, including vegetated cliffs.

Table 11-1: Protected sites within 5 km of Dollar Bay Landfall.

Site Name	Designation	Feature of Conservation Interest	Distance from landfall
River Barrow and Nore	SAC	Annex I habitats: • Estuaries • Tidal Mudflats and Sandflats • Salicornia Mud • Atlantic Salt Meadows • Mediterranean Salt Meadows • Floating River Vegetation • Dry Heath • Hydrophilous Tall Herb Communities • Petrifying Springs* • Old Oak Woodlands • Alluvial Forests* Annex II Species: • Desmoulin's Whorl Snail (Vertigo moulinsiana) • Freshwater Pearl Mussel (Margaritifera margaritifera) • White-clawed Crayfish (Austropotamobius pallipes) • Sea Lamprey (Petromyzon marinus) • Brook Lamprey (Lampetra planeri) • River Lamprey (Lampetra fluviatilis)	Within

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Site Name	Designation	Feature of Conservation Interest	Distance from landfall
		• Twaite Shad (Alosa fallax) • Atlantic Salmon (Salmo salar) • Otter (Lutra lutra) • Killarney Fern (Trichomanes speciosum) • Nore Freshwater Pearl Mussel (Margaritifera durrovensis) Waterford Harbour pNHA and Duncannon Sandhills pNHA are now within the boundaries of the SAC.	
Hood Head	pNHA	Large kittiwake (gull) colonies on several cliffs	3.9km to south

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12 SANDEEL BAY LANDFALL

Sandeel Bay is to the south of the Baginbun peninsula on the east of the Hook peninsula. Sandeel bay lies within the Hook Head SAC and is close to Hookless Village / Sandeel Bay Cottages, a popular holiday resort.

Sandeel Bay is accessed via a 'cul-de-sac' access road off the local road network, approximately 4m wide and 500m in length. Three private properties with no alternative access were identified off the access road. A rear entrance to the Hookless Village/Sandeel Bay Cottages is also located off the access road.

The potential onshore route from the Sandeel Bay access road to the R733/L4045 junction, southeast of Great Island, is approximately 10.5km along local roads.

There is parking for approximately 4 cars at the southern end of the access road with an access path, approximately 3m wide, leading to the beach.

There is an area suitable for the construction site and possibly the TJP at the southern end of the access path at the rear of the beach. The access path appears to have irregular use by cars. At the end of the access path onto the beach is a grassy verge with large boulders of which some look like they have been placed for protection or are part of a previous structure that has been dismantled. These will likely require removal for vehicles to access the beach. There is also a seawall that is being used to stabilise the access path.

The cliffs surrounding the beach are approx. 10 - 15 m in height with small localised areas of erosion and landslip. There is a rock outcrop to the south of the bay; rock was covered in seaweed and molluscs, but there was no evidence of fossils. There are rocks within the surf zone with evidence of weed attached to rocks. Choppy sea offshore was also evident, with significant wave heights inshore.

The beach gradient is shallow but demonstrates large amounts of seaweed and debris. There also appears to be sediment zonation indicative of sediment sorting associated with high-energy conditions. Beneath the rocky upper shore, fine sand was evenly distributed. Seaweed and debris were observed to reach the base of cliffs. There was a recently-dead grey seal on beach and live seals were observed swimming offshore. Bird life was prominent (black birds, crows, gulls, etc.) and there was some evidence of birds nesting within cliff cracks.

The beach is used recreationally by members of public (dog-walking, building sand castles, etc.). It is possible the beach would be used for surfing as the wave conditions would be suitable under the appropriate weather conditions. However, there were no warning signs associated with use. There was no other infrastructure evident, including power lines, at the beach.

The site would not be suitable for open-cut trenching due to the volume of rock and the seawall approaching the path. HDD may be suitable but geotechnical data assessment would be required to confirm suitability.

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Figure 12-1: Sandeel Bay looking to the north east from the end of the access track.

Figure 12-2: Rocky conditions at the base of the access road and evidence of sea defences.

Figure 12-3: Rock outcrop to the south of the east-facing beach.

Figure 12-4: Evidence of landslip and underlying rock.

Table 12-1: Protected sites within 5 km of Sandeel Bay

Site Name	Designation	Feature of conservation Interest	Distance from Landfall
Hook Head	SAC	**Annex I habitats:** Large shallow inlets and bays Reefs Vegetated sea cliffs of the Atlantic and Baltic coasts	within
Hook Head	pNHA	Large kittiwake (gull) colonies on several cliffs	within

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13 RANKING & RECOMMENDATION

Following the site visit, each of the sites was ranked according to the parameters outlined in **Section 2**. **Table 13-1** demonstrates the results of the initial ranking and highlights the three preferred sites. As per the methodology outlined in Section 2, each criterion was given a score of 10 for each beach. The weighting was applied and the outcome of the initial ranking exercise was that the Baginbun Beach, Booley Bay and Boyce's Bay are the three preferable sites for further investigation. Following a consultation with the National Parks & Wildlife Service (NPWS), it was concluded that installing a cable through a Special Area of Conservation (SAC) could potentially be possible provided that the works will not adversely affect the integrity of the protected site and its conservation objectives. In the interest in achieving the most direct offshore cable route, Sandeel Bay was reinstated as a preferable landfall location, despite the relatively low score.

The four preferable landfall locations, Baginbun Beach, Booley Bay, Boyce's Bay and Sandeel Bay, are proposed for further investigations. Refer to Appendix A for an initial geotechnical assessment of the preferred landfall locations.

Following detailed route assessments and stakeholder consultations final landfall selection will be completed and Revision 5 of this report will be issued.

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Table 13-1: Weighted ranking of each landfall site. Preferable sites are marked in green.
Note: weighting/ranking ansd scoring is indicative only and subject to further review

		Beaches - Scores out of 10								*Beaches - Weighted Scores*							
Description	**Weighting**	**Baginbun Beach**	**Bannow Beach**	**Booley Bay**	**Boyce's Bay**	**Carnivan Bay**	**Cullenstown**	**Dollar Bay**	**Sandeel Bay**	**Baginbun Beach**	**Bannow Beach**	**Booley Bay**	**Boyce's Bay**	**Carnivan Bay**	**Cullenstown**	**Dollar Bay**	**Sandeel Bay**
Vessel Access	16.00%	8	5	6	7	8	5	5	3	1.28	0.8	0.96	1.12	1.28	0.8	0.8	0.48
Beach Composition - including nearshore seabed geology.	14.00%	8	3	8	8	5	5	8	5	1.12	0.42	1.12	1.12	0.7	0.7	1.12	0.7
Amenity Impact	10.00%	7	2	5	5	5	2	6	2	0.7	0.2	0.5	0.5	0.5	0.2	0.6	0.2
Environmental Constraints	10.00%	4	7	3	6	2	7	3	2	0.4	0.7	0.3	0.6	0.2	0.7	0.3	0.2
Exposure	8.00%	9	2	7	6	2	2	7	3	0.72	0.16	0.56	0.48	0.16	0.16	0.56	0.24
Working / Site Area	8.00%	7	7	6	3	8	9	3	7	0.56	0.56	0.48	0.24	0.64	0.72	0.24	0.56
Coastal Erosion	8.00%	7	4	7	7	2	4	7	6	0.56	0.32	0.56	0.56	0.16	0.32	0.56	0.48
Obstructions & existing infrastructure	8.00%	8	6	7	7	7	5	7	6	0.64	0.48	0.56	0.56	0.56	0.4	0.56	0.48
Access to Beach	6.00%	5	4	9	8	7	4	5	7	0.3	0.24	0.54	0.48	0.42	0.24	0.3	0.42
Cable engineering & protection requirements	6.00%	6	3	6	6	7	9	6	6	0.36	0.18	0.36	0.36	0.42	0.54	0.36	0.36
Overall Cable Length	6.00%	6	4	7	6	7	4	7	9	0.36	0.24	0.42	0.36	0.42	0.24	0.42	0.54
	Total	**75**	**47**	**71**	**69**	**57**	**49**	**64**	**56**	**7.00**	**4.30**	**6.36**	**6.38**	**5.46**	**5.02**	**5.82**	**4.66**

14 OVERALL CABLE LENGTH

Separate marine and onshore route assessments are being completed for the Greenlink interconnector by Intertek (P1975_RN3929_Rev3) and Arup respectively. The initial route assessments identify possible cable routes based on a balance between length and environmental, technical and economic constraints.

The length of the currently identified preferable route for each landfall is summarised in Table 14-1 below. Marine Route Option A is common to all suitable landfalls and has been used for the below calculations.

Table 14-1: Overall approximate length of cable for each landfall site

Landfall	Approximate Offshore Length (km)	Approximate Onshore Length (km)	Overall Approximate Length (km)
Baginbun Beach	158.7	28.2	186.9
Booley Bay	165.5	20.3	185.8
Boyce's Bay	161.6	25.7	187.3
Sandeel Bay	156.7	25.9	182.6

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15 REFERENCES

[1] – Geology of Ireland (2003), 1:1,000,000 scale. Geological Survey of Ireland. Composed by B. McConnell, S. Gatley & A. Sleeman.

[2] – McCoy, F. & Griffith, R. (1862). 'A Synopsis of the Characters of the Carboniferous Limestone Fossils of Ireland'.

[3] – Mitchell, W. I., Carlisle, H., Hiller, N. & Addison, R. (1972). 'A Correlation of the Ordovician (Co. Wexford) and Tramore (Co. Waterford)', *Proceedings of the Royal Irish Academy. Section B: Biological, Geological and Chemical Science.* Vol. 72.

[4] – Bruck, P. M. & Vanguestaine, M. (2005). 'An Ordovician age for the Muggort's Bay Lower Palaeozoic inlier, County Waterford, Ireland – the southernmost exposure of the Irish Caledonides'. *Geological Journal.* Vol. 40.

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Appendix A Geotechnical Landfall Assessment

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Technical Note

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Project title	Greenlink Interconnector	Job number	246369-00
cc	Sheila O'Sullivan Ger Breen	File reference	4-03-03-04 (Draft 1)
Prepared by	Marie Fleming	Date	7 January 2016
Subject	Landfall Assessment – Geotechnical Considerations		

Technical Note

246369-00 7 January 2016

1 Introduction

A site walkover was carried out by Marie Fleming (Senior Engineering Geologist) on Thursday 26th November 2015 to access the geotechnical considerations of potential landfalls for the Greenlink Interconnector project.

The following landfall options were assessed:

- Boyce's Bay
- Booley Bay
- Baginbun Beach

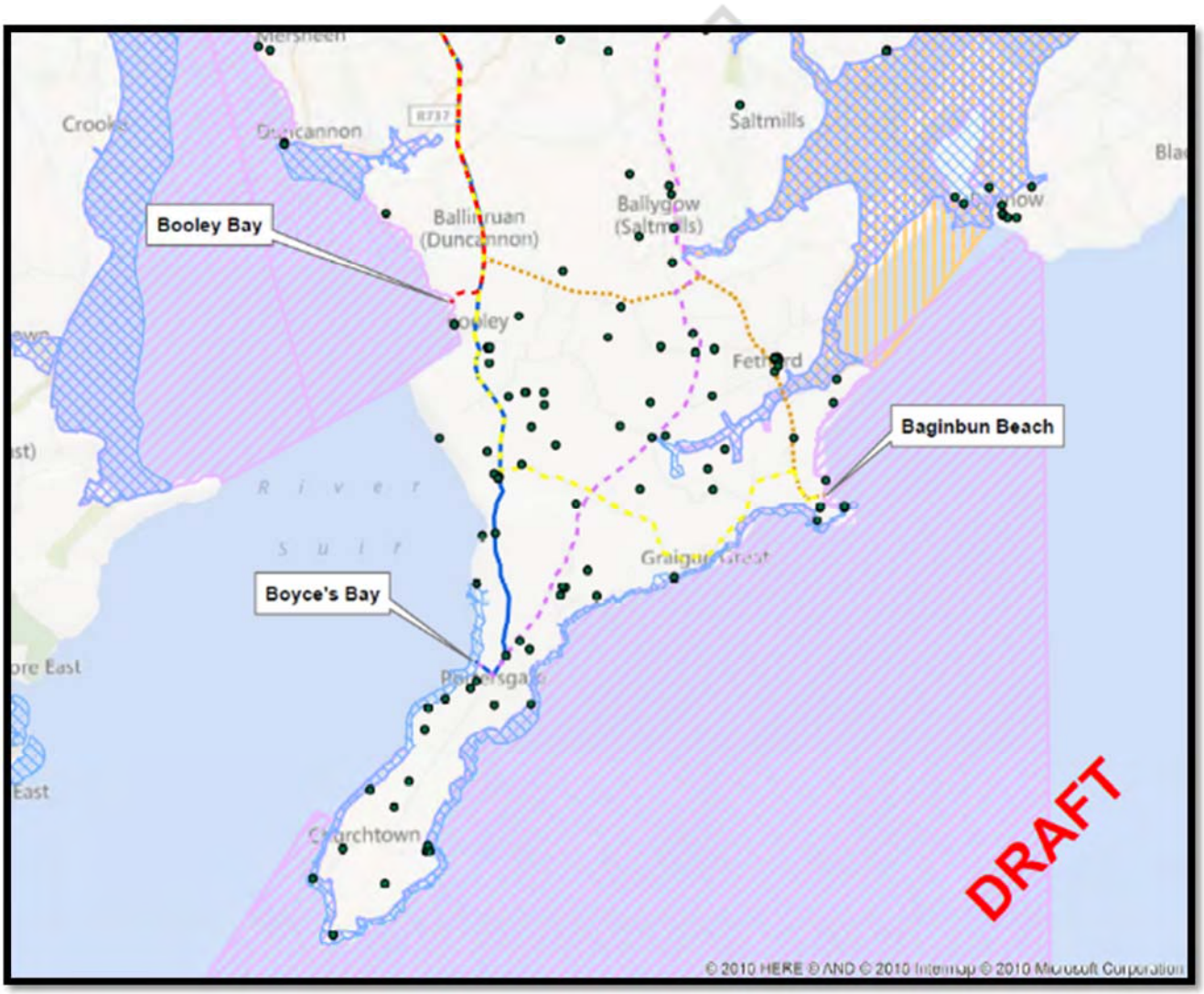

Figure 1: Landfall Sites Assessed

2 Regional Subsoil and Bedrock Geology

2.1 Subsoil Geology

The subsoil geology of the Hook Head area is dominated by a cover of glacial till intersected with alluvial sediments associated with rivers and streams. Where till is absent or subsoil cover is very thin, rock is present close to the surface or outcropping. Beach sediments are located along coastal areas.

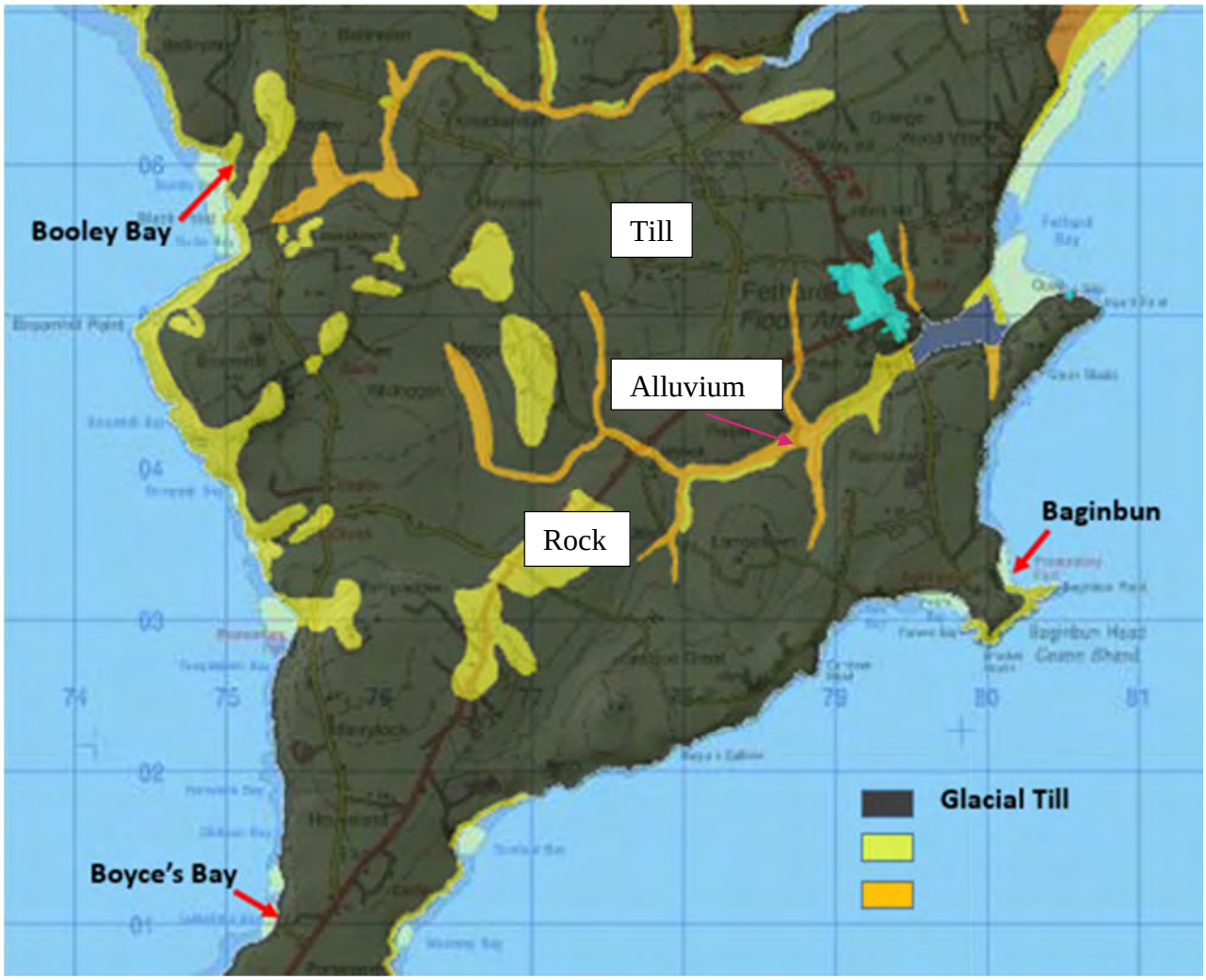

Figure 2: Extract from EPA subsoils mapping

2.2 Bedrock Geology

The Geological Survey of Ireland's (GSI) online mapping database was consulted to determine the regional geology at each location. Figure 2 indicates the underlying regional bedrock geology of the three sites visited.

Boyce's Bay is underlain by Upper Devonian to Lower Carboniferous Old Red Sandstone, sandstone, conglomerate and siltstone. The Porter's Gate Formation is indicated as outcropping in the Boyce's Bay area and is generally described as sandstone, shale and thin limestone.

Both Booley Bay and Baginbun Beach are underlain by much older Cambrian rocks described generally as Cambrian meta-sediments in the form of greywacke, slate and quartzite. These are also described by the GSI as grey to black mudstone with siltstone.

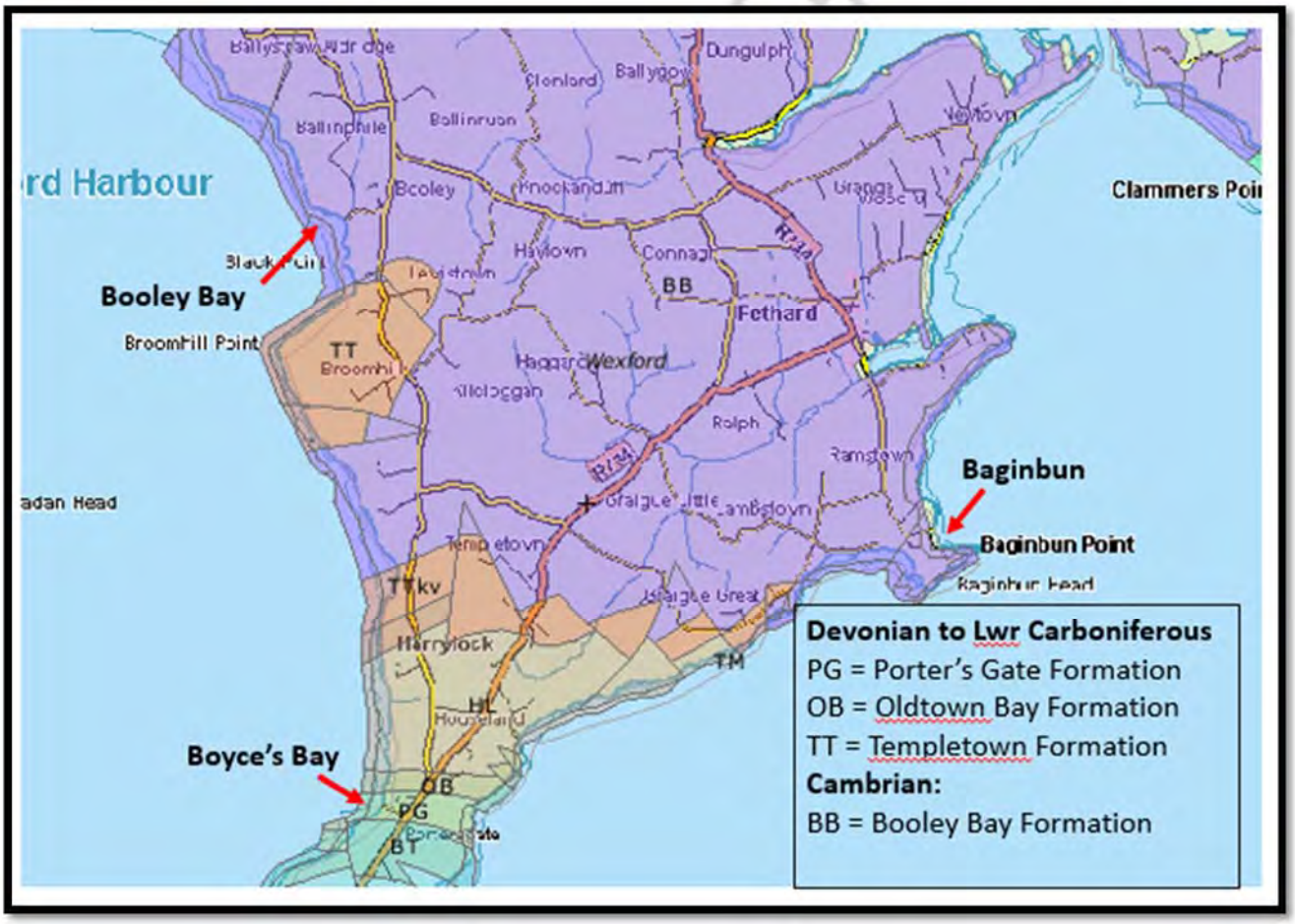

Figure 3: Bedrock Geology (extract from the 1:100,000 scale GSI map; www.gsi.ie)

2.3 Structural Geology

The regional structural geology of the area and at each landfall location is indicated on Figure 4.

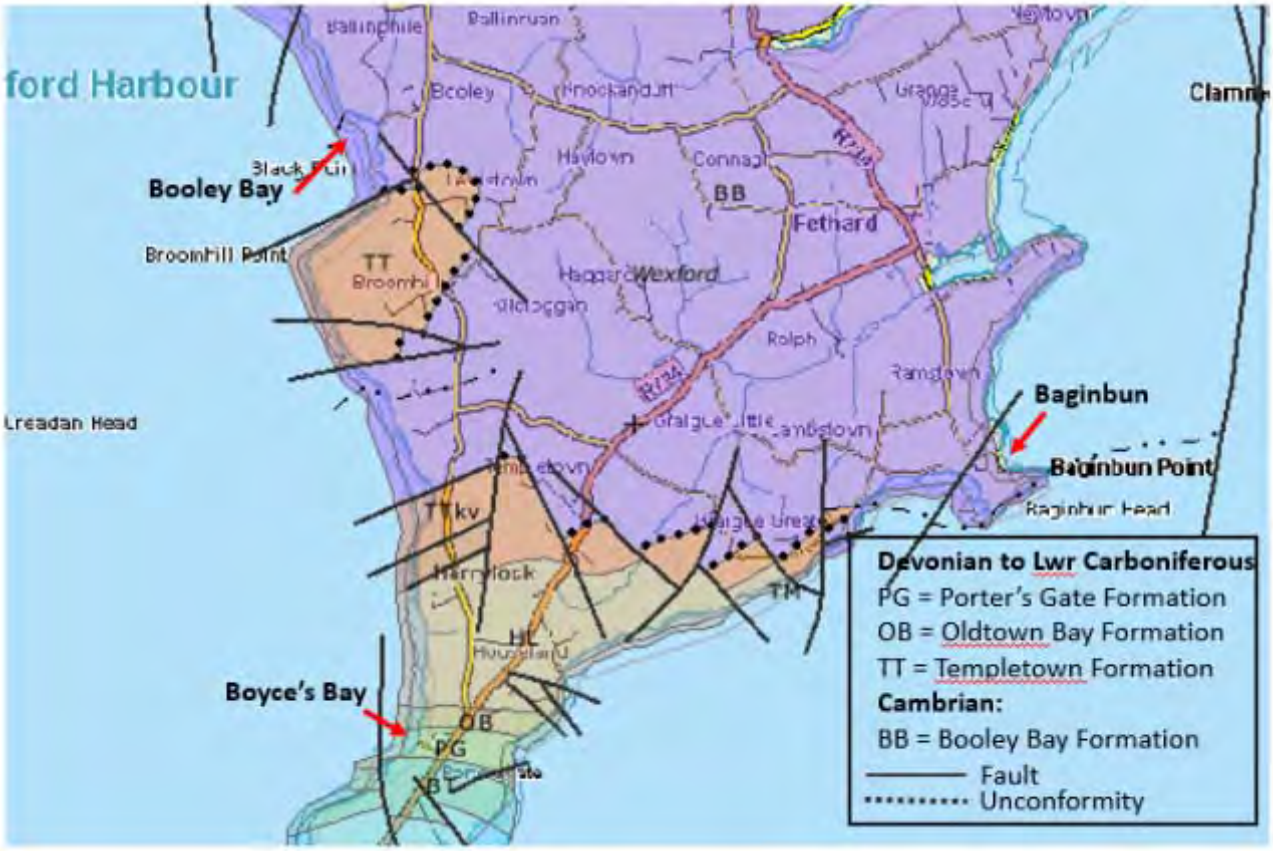

Figure 4: Structural Geology (extract from the 1:100,000 scale GSI map; www.gsi.ie)

2.4 Geological Heritage Areas

Geological Heritage Areas are designated as part of the Irish Geological Heritage Programme; a partnership with the (GSI) and the Department of Environment, Heritage and Local Government. The aim of the programme was to identify, document and protect the wealth of geological heritage in Ireland.

A review of the Geological Heritage Areas in the area has indicated that all three sites are potentially of geological interest as follows:

- Baginbun Head – Cambrian Stratigraphy – County Geological Site (CGS)
- Booley Bay - IGH 2-2: Occurrence of Ediacaran biota.IGH 4-40: Turbidite structures and Ediacaran- type faunas in the Upper Cambrian Booley Bay Formation of the Ribband Group (CGS recommended for Geological National Heritage Area)
- Boyce's Bay - Fossil plants, fossil spores, trace fossils - CGS, recommended for Geological National Heritage Area

The geological heritage audit of County Wexford is currently underway and is scheduled to finish by the end of March 2016. Preliminary consultation with the GSI has indicated that the fossil localities in Hook Head are rare, sensitive areas, and depending on the nature of the high voltage cable infrastructure, it will be a priority to ensure the minimum, if any, impact on the sites.

3 Site Walkover

3.1 Baginbun Bay

Baginbun Bay is underlain by Cambrian stratigraphy in the form of the Booley Bay Formation. The Booley Bay Formation is described by the GSI as comprising meta-sediments in the form of greywacke, slate and quartzite. These are also described by the GSI as grey to black mudstone with siltstone.

Northern Beach

The northern side of the beach is bounded to the west by coastal cliffs with bedrock outcropping in places along the beach but more frequently towards the shoreline as shown in Photo 1.

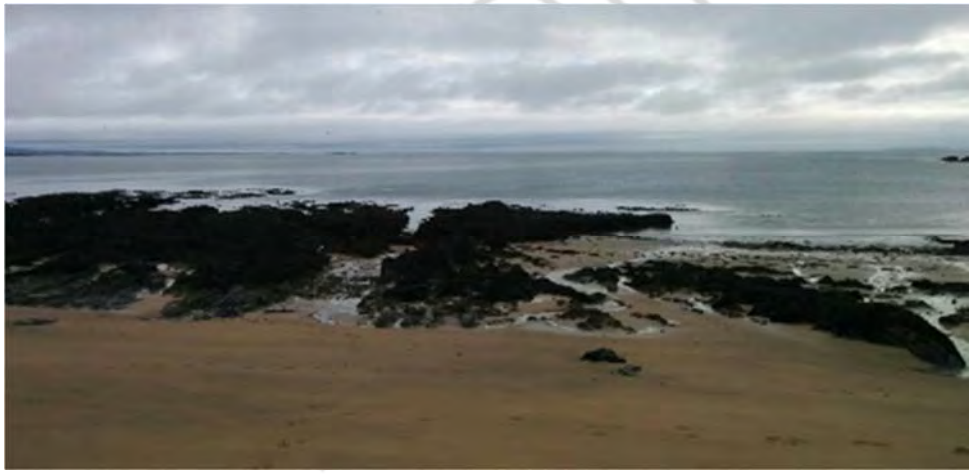

Photo 1: Outcropping rock

The cliffs are comprised of outcropping rock with a cover of 1 to 2.0m of overburden. While the cliffs are vegetated with grass and scrub in places, there is an abundance of unvegetated subsoil (potentially glacial till) towards the top of the slope as indicated in Photo 2.

Photo 2: Subsoil overlying bedrock

The slope morphology changes along the cliff with the greatest variability in the bedrock. Towards the crest of the slope the overburden is either standing at a steep to sub-vertical angle or is densely vegetated**.** Minor visual indicators of slope movement and shallow slumping of the subsoil material were observed along the slope as indicated in Photo 2 and Photo 3 below.

Photo 3: Subsoil overlying bedrock

The bedrock is highly variable along this section of beach ranging from the interlayered meta-sediments indicated in Photos 2 and 3 to more massive greywackes at the northern end of the beach as show on Photo 4.

Photo 4: North side of the Beach.

The structural geology at this location is highly complex manifested by the presence of regular minor folding and faulting visible along the rock faces (see Photo 5 for example). Bedding where present is sub-vertical to vertical.

Photo 5: Faulting visible on rockface (faultline shown in red)

Middle

The middle section of the beach is dominated by a public access track and a culverted land drain.

Southern Beach

The southern side of the beach has a number of geological features which are likely to require protection. Photo 6 is an example of chevron folding in the metasediments.

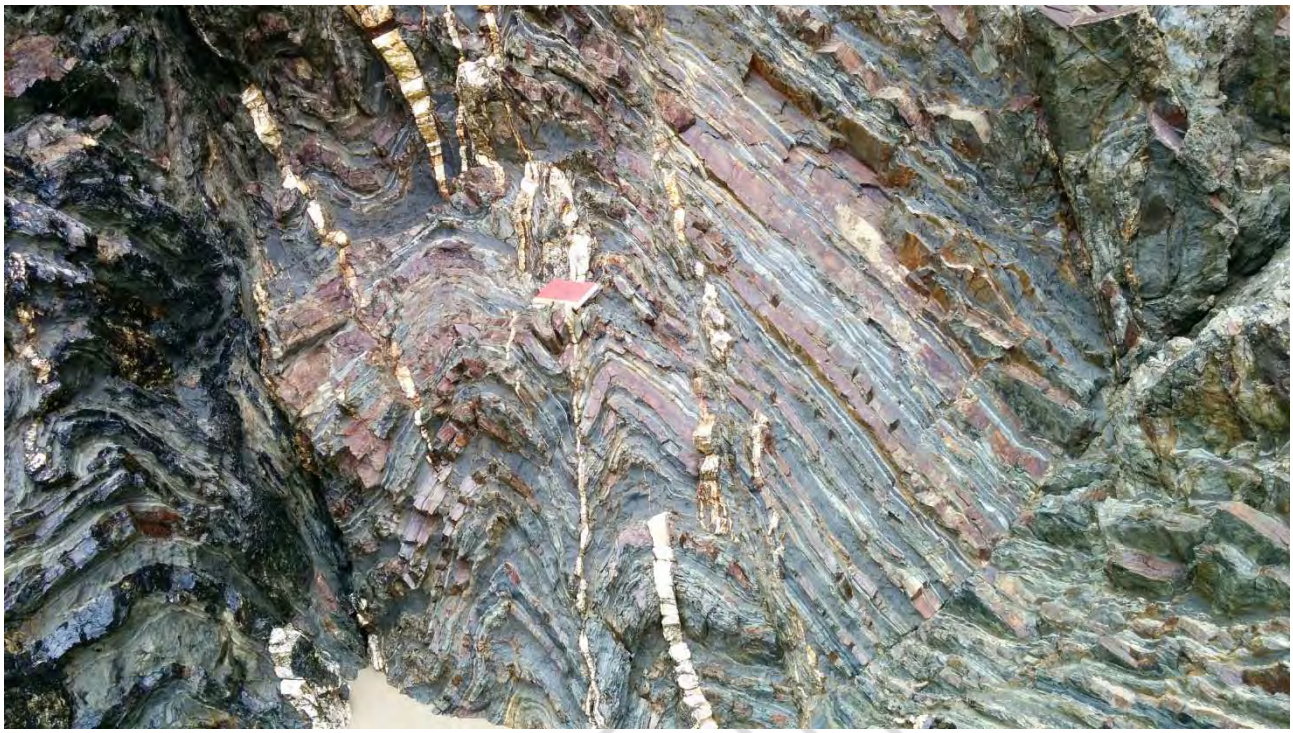

Photo 6: Chevron folding in interlayered meta-sediments.

A number of caves are also present at a number of locations along the cliff face in this location (see Photo 7).

Photo 7: Caves

Landfall potential

Based on the geological sensitivity of this area (as noted in Section 2.4), along with the restrictions due to public access *etc.*, horizontal directional drilling (HDD) is likely to be the optimum solution at this location.

An analysis of the fall required to accommodate the drilled section should be carried out to determine the optimum location for a HDD compound. The land adjacent to Baginbun Bay is predominantly agricultural land sloping towards the cliff with a number of residences in the area (including a Martello Tower towards the southern side of the area). There is potentially sufficient room in the field directly behind the northern half of the beach.

The depth of burial and the thermal resistivity of the surrounding bedrock and soil will be required for the detailed design of the cables for burial. Thermal resistivities that are too high can limit the ability of the cables to achieve rated transmission capacity.

3.2 Boyce's Bay

Boyce's Bay is underlain by Upper Devonian to Lower Carboniferous Old Red Sandstone, sandstone, conglomerate and siltstone. The Porter's Gate Formation is indicated as outcropping in the Boyce's Bay area and is generally described as sandstone, shale and thin limestone.

Limestone visibly outcrops along the southern end of the beach both at the base of the surrounding cliffs in this location and along the beach.

Photo 8: Access to Boyce's Bay with outcropping limestone

The surrounding cliffs at this location are comprised predominantly of subsoil of potentially glacial till. They are densely vegetated with grasses and scrub but there are many indicators of instability and slope movement as shown in Photo 9.

Photo 9: Soil slopes along Southern side of Boyce's Bay

Moving in a northerly direction along the beach, the outcropping rock becomes less frequent and the beach is bounded predominantly by soil slopes.

Photo 10: Looking North along Boyce's bay.

There is an abundance of slope failures visible along the slope. These failures appear to be progressive and predominantly shallow and are likely to have formed due to continual cliff recession due to over-steepening of the slope by erosion of the toe of the slope (Photo 11).

Photo 11: Slope failure along soil slopes.

Landfall potential

Due to the nature of the cliffs in this location and the tell-tale indicators of ongoing slope instability in this location, trenching is unlikely to be a viable option in this location. This along with the geological sensitivity of this area (as noted in Section 2.4), indicates that horizontal directional drilling (HDD) is likely to be the optimum solution at this location.

An analysis of the fall required to accommodate the drilled section should be carried out to determine the optimum location for a HDD compound. The land adjacent to Boyce's Bay is predominantly agricultural land sloping towards the cliff with a number of residences in the area

including a derelict farmhouse adjacent to the top of the cliff. There is potentially sufficient room in the field directly behind the northern half of the beach.

The depth of burial and the thermal resistivity of the surrounding bedrock and soil will be required for the detailed design of the cables for burial. Thermal resistivities that are too high can limit the ability of the cables to achieve rated transmission capacity.

3.3 Booley Bay

Booley Bay Beach is underlain by Cambrian bedrock described generally as Cambrian meta-sediments in the form of greywacke, slate and quartzite. These are also described by the GSI as grey to black mudstone with siltstone.

The access to Booley Bay runs parallel to a freshwater river. On both sides of the river the area is dominated by vegetated headlands to the north and south (Photo 12).

Photo 12: Freshwater stream

Directly north of the river, the area is dominated by a small dune system which is densely vegetated. Minor instabilities, soil creep and shallow slides were observed on the cliff faces as indicated on Photo 13.

Photo 13: Minor instabilities

The dune system transitions into an area of outcropping rock and cliffs. Rockhead is irregular and a thin soil cover is generally present except in areas where depression in the rockhead have been infilled with subsoil material (Photo 14).

Photo 14: Rock outcrops showing variability of rock present

The geology is complex with interlayered meta-sediments and many structural features evident. (Photo 15)

Photo 15: Outcropping fold and adjacent areas of infill and instability

The southern side of Booley Bay is dominated by steeply dipping slate dominated meta-sediment with a thin soil cover vegetated with grass towards the top of the slope as shown on Photo 16:

Photo 16: Southern side of Booley Bay

Landfall Potential

There is the potential for access in this area via the public right of way but the presence of the water body in this location is likely to cause issues from both a construction and maintenance point of view as the channel morphology is likely to change over time which may lead to stability issues.

Trenching across the dune system may not be viable from an environmental point of view and may lead to further instability in this location. Based on the geological sensitivity of this area (as noted in Section 2.4) horizontal directional drilling (HDD) is likely to be the optimum solution at this location.

An analysis of the fall required to accommodate the drilled section should be carried out to determine the optimum location for a HDD compound. The landuse adjacent to Booley Bay is predominantly agricultural land. There is potentially sufficient room in these fields for a HDD compound.

The depth of burial and the thermal resistivity of the surrounding bedrock and soil will be required for the detailed design of the cables for burial. Thermal resistivities that are too high can limit the ability of the cables to achieve rated transmission capacity.

Technical Note

246369-00 7 January 2016

DOCUMENT CHECKING (not mandatory for File Note)

	Prepared by	Checked by	Approved by
Name	Marie Fleming	Sheila O'Sullivan	Ger Breen
Signature			

APPENDIX C

Castlemartin Meeting Minutes

Anna Farley Intertek

From: Tom Brinicombe <Tom.Brinicombe@elpower.com>
Sent: 22 February 2018 12:25
To: Anna Farley Intertek
Subject: Fwd: MoD and Freshwater west
Attachments: MOD Safety Zones.pdf

Begin forwarded message:

From: Tom Brinicombe <Tom.Brinicombe@elpower.com>
Subject: MoD and Freshwater west
Date: 22 October 2013 07:25:59 BST
To: Peter Harte <Peter.Harte@elpower.com>
Cc: Ger Breen <ger.breen@arup.com>

Hi Peter,

As discussed here is a brief overview of our discussions with the MoD regarding Freshwater West to date.

We first discussed the project with Lisa Payne within the MoD estates team. These discussions were open and constructive and lead to a meeting at Freshwater West with Castlemartin staff - Major John Nicholl and Colonel (Retd) Richard Howard-Gash.

During the meeting it was stated that while we were in the safety zone of the firing range - this was a historic safety zone rather than a current practical safety zone. The munitions currently fired from the range would not strike the area. However, they would not reduce this historic safety zone because they currently had issues with third parties entering this area and they didn't want risk third parties entering a current practical safety zone and face serious harm.

We were taken back to the firing range and given the attached document for information.

We have had subsequent conversations with these parties where it is clear that they have no ability to charge us for crossing the zone however Colonel (Retd) Richard Howard-Gash has stated that we need to carry out a munitions survey to ensure that the appropriate H&S issues are considered.

We also looked at ensuring the cables were installed in a manner that protected them from future harm. The discussions were informal. Major Nicholl suggested that we should look at the munitions they were firing and design appropriately. In discussions with Bactec and FirstlineDefence both companies said that two surveys could be of use. The first UXO survey for construction and the second a review of current and future plans for the range.

I have run this past the MoD and they see this route as sensible...although they are unclear on how much information they can share...but are open to discussions.

All the best,

Tom

MINUTES OF MEETING

Project:	P1975 - Greenlink
Subject:	Project Update & Discussion of Offshore Scoping Response
Date and Time:	04 May 2017, 09:30
Duration:	1.0 hrs
Venue:	Castlemartin Firing Range
Present:	Tom Brinicombe (TB) - Element Power Project Manager Anna Farley (AF) - Intertek Marine Consultant Colonel (retd) Richard Howard-Gash (RHG) - Commander, DIO SD Training Wales & West (Castlemartin) Capt Andy Johnson (AJ) - Security and Access Officer, DIO SD Training Wales & West (Castlemartin) Lisa Payne (LP) - Rural Estates Advisor, Defence Infrastructure Organisation Mark Griffiths (MG) - Regional Ops Manager, Landmarc Support Services
Level of Issue:	DRAFT
File Reference:	P1975_ABMAY04_Rev0
Distribution:	Attendees

ITEM	MINUTES	ACTION
1.	**Introductions** • TB is Element Power's Project Manager for the Greenlink Project – a 500MW electricity interconnector connecting the power girds of the UK and Ireland. • AF is Intertek Project Manager contracted to Element Power to provide marine environmental consultancy including marine permits and consents for the project. • RHG is Commander at Castlemartin and has previously been briefed by TB on Greenlink project. • AJ provided Castle martin's response to Greenlink Offshore Scoping Report in letter dated 15 February 2017. • Objective of meeting was to discuss scoping repose and agree way forward on areas of concern.	
2.	**Greenlink Project Update** TB provided brief project update to appraise attendees of progress since last meeting in September 2016. Key points included: • Uncertainty surrounding Irish regulator and how they plan to regulate market pricing mechanism has caused project to slow down. • Greenlink marine surveys (originally planned for May 2017) have been delayed by one year. It is now intention to mobilise survey May – August 2018. • Greenlink Offshore Scoping Document was issued to 29 consultees in December 2017 to appraise stakeholders of project plans and gather opinion on scope and content of future environmental reports. Castlemartin provided response on 15 February 2017. MOD Safeguarding also provided response. • Greenlink onshore scoping document to be issued within next three weeks (i.e. by end May). • Original project (Greenwire) also consider an export cable for Irish wind farm projects. It is no longer an option to connect Greenwire at Pembroke. If the project goes ahead it would look to connect into Devon.	

ITEM	MINUTES	ACTION
3.	**Castlemartin response to Greenlink UK Offshore Marine Scoping Report received 15 February 2017** <u>Access to Danger Area</u> AF explained that the intention is to start the tender process for the marine surveys September / October 2017. Within the tender package Element Power can include specific obligations to ensure that contractors are aware of and comply with conditions set by Castlemartin. It was noted that the range closes during Easter and August and that the preference would be for survey vessels to operate within the Danger Area during this time. AF explained that we could not necessary guarantee the survey could use these windows and raised question of whether 2 weeks' notice period of activities was still feasible option (as previously discussed). RHG and SJ agreed that they were open to co-operation and as long as due notice was given and contractors maintained regular contact with the range it would be possible to operate within the Safety Danger Area (SDA) outside of the closure periods. Castlematin's preference would be that survey work focused on the Castlemartin area in one period (i.e. ran all 5 geophys lines in one consecutive period rather than ran one line then came back a week later to run second line). However, they could accommodate either scenario. RHG noted that the range operate two high speed boats that encourage vessels to move out of the SDA as quickly as possible during live firing. <u>Maintenance and repair</u> AF explained that cables are installed to require minimal maintenance and repair. Repair scenarios are more likely if cable is snagged or at cable joints. TB explained cable joints would all be land based. Any communication protocols agreed for marine survey and cable installation would also be applied to maintenance and repair requirements within Danger Area. <u>Electromagnetic Field (EMF)</u> AF & TB confirmed that EMF studies would be undertaken once cable configuration is known to determine potential for navigation effects on small vessels. Any effects are typically limited to recreational vessels using magnetic compasses. Castlemartin agreed they were happy with the response to date on this issue. **ACTION 1:** AF & TB to issue draft letter for Castlemartin comment that lays out SDA access terms, communication protocols and draft text to be included into survey tender documents. Draft text for survey tenders will outline contractor's obligations to contact Castlemartin 2 weeks ahead of works in SDA and to maintain daily communication during works within SDA. Letter will also include statement on EMF.	AF / TB
4.	**UXO** MG raised question of what Element Power are doing with respect to UXO. AF explained process will be: • Undertake desk-top study of UXO risk (sub-contracted to civilian UXO contractor such as Bactec). • Geophysical survey will be equipped with magnetometer and gravimetric, techniques used with side-scan sonar and multi-beam echosounder to identify potential UXO items on seabed.	

ITEM	MINUTES	ACTION
	• Intrusive survey works (e.g. grab samples, geotechnical samples) will be positioned to avoid potential UXO. If necessary drop down cameras can be used to investigate objects ahead of equipment placement on seabed. • During cable installation options for dealing with UXO include: o Micro-routeing cable around potential UXO o Moving UXO (using specialist equipment) o In-situ detonation using specialist contractor. RHG commented that EOD teams currently available at Castlemartin are land based. Castlemartin do have access to marine teams through Navy if necessary. In his experience, since 1986 no UXO has been washed up on range. RHG also commented that he can identify when the SDA was established to provide indication of how much UXO might be found in area. Artillery is not fired from range. Testing focuses on small arms ammunition and small tank ammunition. **ACTION 2:** How Greenlink intend to undertake UXO risk assessment to be covered in draft letter to Castlemartin.	AF / TB
5.	**Will Brexit have any impact on project?** Short answer is Element Power do not expect it to.	
6.	**Is there any relationship between Greenlink and the Wave Hub project?** TB has spoken to Wave Hub Project Manager (Joe Kidd) in the past. Previously Wave Hub was also looking at bringing an export cable into Freshwater West. They are currently considering different landfall options as their offshore site has had to be moved. Discussions are ongoing but there is potential to collaborate on areas such as marine survey to save mobilisation costs and minimise disruption to stakeholders.	
7.	**Office location** TB asked whether RHG could recommend a location where TB could host a project drop-in office for one day per month from September 2017 onwards for duration of project. RHG commented that Castlemartin have an unoccupied bungalow just outside of boundary fence that would need a little work but might be a suitable location. Has 2-3 bedrooms so could be used to accommodate project staff as necessary as well. **ACTION 3:** TB and RHG to view bungalow after next Rural Steering Group Meeting (September 2017).	TB
8.	**Warrant Tower visit** RHG provided tour of Castlemartin observation tower. Identified different communication methods available e.g. marine VHF, radio, telephone. Tower has AIS monitoring system to track ships in vicinity of SDA. Also use radar to track non-AIS equipped ships. AF raised question whether there was potential that offshore vessels could disrupt communication e.g. by obstruction line-of-sight communications. This is not a concern due to positioning of radar and communications dishes. Within SDA each weapons system being tested has 'envelope' within which ordnance and debris will fall. When firing envelopes are plotted on map of SDA to show vessel movements in relation to live firing. Can quickly communicate with both vessels and range to ensure safe practices.	

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Sennybridge Camp,
Brecon,
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LD38PN

Our ref: P1975F_ABMAY07
Tom Brinicombe
07814 169380

10 July 2017

Dear Colonel (Retd). Richard Howard-Gash,

Greenlink Interconnector Consultation (Letter dated 23 February 2017)

Thank you for your comments dated 23 February 2017 with regards the Greenlink Offshore Scoping Consultation.

We appreciate Captain Johnson taking the time to review the documentation we provided. We also welcomed the opportunity to discuss these comments with yourself and Captain Johnson at our meeting on 04 May 2017. As discussed at our meeting, our preliminary response to your comments is provided below:

Access to Sea Danger Area

We respect that Castlemartin is an active live firing range and that live ammunition is fired daily into the Sea Danger Area (SDA). When designing the cable route Greenlink have sought to minimise the length of route within the area and keep towards the boundary. Greenlink note that the range closes during specific periods of the year (Easter and August) and that ideally survey and installation (construction) work is carried out during this period. However, as was explained at the meeting Greenlink would not be able to guarantee work could be carried out during these periods. Greenlink are therefore looking to agree in writing an access and communication protocol which will provide our programme with greater flexibility whilst ensuring we do not adversely affect your operations.

As discussed at the meeting we are proposing the following:

1. Greenlink will notify Castlemartin Firing Range, a minimum of two weeks prior to commencement, of any works (survey, installation / construction, repair or maintenance) to be carried out in the SDA. This notice will be provided in writing.
2. Prior to works commencing within the SDA, Greenlink and their appointed contractor will arrange a meeting with Castlemartin Firing Range to provide a briefing of the works to be undertaken in the SDA; confirm timescales; confirm lines of communication; and understand what live firing activity will be undertaken during the period.
3. During activity within the SDA, Greenlink's appointed contractor will provide a daily briefing to Castlemartin Control that will cover: name of vessel(s) involved and exact location of works for the day.

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4. Greenlink will include within the Marine Survey and Installation Contract tender documents the following requirements:
   "The appointed CONTRACTOR will be required to attend a meeting at Castlemartin Camp, (Pembroke, Wales, SA71 5HE) within two weeks of mobilisation to provide a briefing of works to be undertaken in the Castlemartin Sea Danger Area. Briefing should include description of works to be undertaken, timescales, works plan, and lines of communication. If the intention is to divide the work scope into phases (e.g. phase 1 - geophysical and environmental, and phase 2 – geotechnical) the CONTRACTOR must budget for attendance at two meetings."

   "Whilst operating with the Castlemartin SDA, or in close proximity, the appointed CONTRACTOR will be required to provide, as a minimum, daily briefings to Castlemartin Control (via VHF radio or telephone) on intended activity for next 24-hour period and position within the SDA."

   "The survey corridor passes through the Castlemartin Sea Danger Area (SDA) for approximately 17km. The appointed CONTRACTOR is required to design the survey [or installation works] *to minimise disruption to Castlemartin Firing Range. The CLIENT envisage that the survey may be split into two phases (e.g. phase 1 - geophysical and environmental, and phase 2 – geotechnical). All activities related to a particular phase within the SDA should be completed before work progresses to a new section of the survey corridor."*

If you are in agreement with the above proposal and contract text, we would be grateful if you confirm in writing your acceptance.

UXO Risk Mitigation

The potential for UXO within the SDA was discussed at the meeting. Greenlink note your comments that the majority of UXO is likely to be small arms ammunition and small ammunition from tank testing; artillery has not been tested at Castlemartin. To inform Greenlink's appointed contractors (survey & cable installation) a specialist UXO desk-based study will be commissioned from a suitably qualified company e.g. 1st Line Defence or Dynasafe BACTEC. This will recommend mitigation measures that should be followed by the project to reduce risk to personnel and equipment.

The geophysical survey will consist of five survey lines, spaced approximately 100m apart (to provide the necessary 500m wide coverage). A magnetometer will be used on each survey line to identify ferrous objects. The results of the magnetometer and side-scan sonar will be analysed to determine if the contacts identified potentially represent UXO. Seabed sampling positions will be reviewed to ensure that equipment is not positioned within close proximity of potential UXO.

Prior to cable installation the appointed contractor may be required to undertake a further UXO survey less than 6 months prior to installation.

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If any significant UXO are identified, typically the following decision making protocol is followed:

1. Avoid by micro-routeing the marine cables.
2. If the UXO cannot be avoided by the minimum acceptable clearance distance of 10m, consider whether it is safe for a specialist sub-contractor to move it.
3. If it cannot be moved, detonate on site.

EMF Interference

The Offshore Scoping Report identified that the electromagnetic field (EMF) generated by the operational marine cables will have a small localised effect which could potentially cause compass deviation in magnetic compasses. The level of deviation at the sea surface will vary according to cable configuration, alignment with the Earth's natural magnetic field and water depth. As discussed at the meeting, inertial navigation systems and global positioning systems have negligible sensitivity to EMF. Although few vessels depend solely on magnetic compasses, they may still be used as auxiliary navigation systems and by recreational craft. Greenlink is aware of the potential risks to navigation and as part of the Environmental Report will provide a full assessment of the effect. If necessary, a specialist report will be commissioned to predict EMF and associated compass deviation to inform cable configuration decisions.

Greenlink appreciates your ongoing commitment to working with us to agree a practical access solution for the Castlemartin SDA. We trust that the above reflects your understanding of our discussions on 04 May 2017 and that you will be able to confirm in writing your agreement to our proposal.

We look forward to receiving your response and meeting again in September at the next Rural Steering Group session.

Yours sincerely,

Tom Brinicombe
Project Manager

APPENDIX D

Sandeel Bay Meeting Minutes

Minutes

ARUP

Project title	Greenlink	Job number	246369-00
Meeting name and number	NPWS Meeting	File reference	9-04
Location	NPWS, Custom House, Galway	Time and date	2.30pm 9 December 2015
Purpose of meeting	Discuss potential landfall options and environmental studies for the Greenlink Interconnector (DAU Ref: G Pre00357/2015)		
Present	NPWS - David Lyons Element Power - Tom Brinicombe Intertek - Anna Farley (Offshore consultant) Arup - Sheila O'Sullivan (Onshore consultant)		
Apologies	Connie Kelleher & Karl Brady (National Monuments Service - DAHG)		
Circulation	Those present		

Action

1. Introductions

David Lyons will be the NPWS point of contact for the project. David will deal with the offshore scope of work. Somebody else from NPWS will be appointed for the onshore scope of work when required at a later date in the project.

Tom Brinicombe represents the client of the project – Element Power.

Intertek are the offshore consultant for the project.

Arup are the onshore consultant for the project.

2. Project Overview

The Greenlink project is proposing to develop a 500MW interconnector between Ireland and the UK.

The project will link the power markets in Great Britain and Ireland.

Prepared by	Sheila O'Sullivan
Date of circulation	6 January 2015
Date of next meeting	N/A

Action

The current proposed connections are Pembroke in Wales and Great Island in Ireland.

Greenlink has obtained EU CEF (Connecting Europe Facility) funding to the end of next year.

Greenlink is also expected to be confirmed as an EU PCI (Project of Common Interest) early in 2016.

3. Draft Landfall Options & Environmental Constraints

A preliminary desk-top assessment & preliminary site visits have been completed to identify potential draft landfall options for the interconnector.

The shortest route corridor is preferable both from an economic point of view and an environmental point of view as it minimises potential impacts – therefore the preliminary assessment has focused on the southeast of Ireland.

The location of the landfall also requires a compromise between onshore and offshore constraints.

The southeast coast of Ireland is protected by numerous offshore environmental designations, including SAC's and SPA's and therefore create an environmental constraint to the landfall location.

While assessment work is an iterative process, the following three landfalls have been identified as preferable based on draft preliminary assessments:

- Booley Bay
- Boyce's Bay
- Baginbun Beach

Booley Bay landfall is located within the River Barrow and River Nore SAC.

Boyce's Bay landfall is location within the Hook Head pNHA.

Baginbun Beach is located within the Hook Head SAC.

Habitat maps and conservations area files are available on the NPWS website.

Booley Bay is located in close proximately to a very important subtidal reef within the River Barrow and River Nore SAC (Duncannon). DL noted the exact boundary of the reef in relation to the landfall and any potential impact should be assessed. Mitigation AF

Action

to be considered would include reinstating the top layer of the trench.

DL noted the pNHA's do not have protected status.

Summer installation would be preferable to avoid disturbance to the kittiwake colony in the Hook Head pNHA. Geese feed regularly on the shores in winter.

DL noted that the route and landfall locations within designated sites are acceptable once it can be demonstrated that there would be no negative impacts to the designated sites.

The Hook Head SAC is a rocky habitat and potential installation methodology would have to be assessed. DL noted it is preferable to use trenching or horizontal directional drilling under the designated sites rather than mattressing and/or rock protection, due to potential impact to the designated site and habitats with rock protection.

The offshore geophysical and geotechnical surveys will confirm the potential cable route installation methodology. Following confirmation of potential installation methodologies an assessment on potential impacts to the designated sites will be completed to evaluate suitability.

The installation is a relatively quick process and therefore potential impacts and mitigation for birds etc. are anticipated to be suitable for the environmental assessment.

Migratory fish species are designated features of the River Barrow and River Nore SAC. DL felt that the geophysical survey and installation would not prove to be a barrier to passage and no specific mitigation would be required.

DL noted that the estuary comprises of a sandy sediment top layer which should be suitable for installation. Within the estuary disturbance of the upper sandy sediment layers is common and therefore the quick installation is anticipated to create no significant impact with high recoverability of the seabed.

The SPA is a Ramsar site – DL to confirm. DL

4. Offshore Survey, Foreshore Licence & Environmental Constraints

A geophysical survey and geotechnical survey are proposed for the offshore route.

	Action
Pre-application has been prepared for the foreshore licence with will be submitted in the near future. DL confirm the DECLG Foreshore department will review this documentation.	
DL noted that the geophysical and geotechnical survey application should be completed together as for ease of NPWS assessment and approval.	
The actual application will be issued to the NPWS (DL) via the DECLG Foreshore department. DL noted all available information should be included within the application.	
It will take approximately 8 weeks to approve the licence once all information is submitted.	
A screening for appropriate assessment and a Marine Mammal Assessment will be required for the foreshore licence for the offshore survey.	AF
As it is a generic survey preliminary information is ok as it is understandable that the actual route is not confirmed and will be modified as results are gathered.	
It was agreed that a 1km wide corridor will be submitted to ensure all areas are covered within the application; however, it is anticipated that the survey will only require an approximate 500m wide corridor.	
It is anticipated that Multi-Beam Echo Sounder, Sidescan Sonar, Sub bottom profilers, magnetometers will be used for the survey.	
DL noted that a marine mammal observer will be required onboard for startups and works to be completed in accordance with the 'Guidance to Manage the Risk to Marine Mammals from Man-made Sound Sources in Irish Waters'. DL highlighted the main concern for marine mammals would be the effect from sub bottom profilers in an embayment. DL outlined the area he considered to be an 'embayment' in the vicinity of the landfall locations.	
The River Barrow and River Nore SAC are protected for lamprey and salmon. DL noted this will not be an issue for the survey as noise levels created will not be significant and works also will be within a small area therefore not creating an obstacle. This will be similar for the cable installation.	
Intertek will issue actual GIS ArcView information to the NPWS, however, this will not be submitted to the Foreshore Department as not required for their systems.	

Action

5. Proposed Surveys & Studies

A separate screening for appropriate assessment (and potential Natura Impact Statement) and Environmental Report will be prepared for the actual cable installation. It is anticipated that a full EIA will not be prepared. A screening for EIA will be completed.

The offshore surveys proposed are as follows: Archaeological assessment, Marine Mammal Risk assessment, Marine Surveys (as detailed in Section 4 above), Intertidal Survey, and UXO survey.

Standard onshore (terrestrial) surveys will be completed. These will be discussed with onshore NPWS representative at a later date.

The standard onshore environmental studies anticipated are as follows: Flora & Fauna, Archaeological / Cultural Heritage, Geotechnical, Traffic, Noise, Air Quality, Flood, and Landscape & Visual.

The standard onshore ecological surveys anticipated are as follows:

- Winter Birds (landfalls)
- Breeding Birds
- Bats
- Badgers
- Otters
- Other Mammals
- Hedgerows & trees

6. Any other business

DL noted that more information may be available for the offshore marine routes from the Infomar website (geophysical data particularly should detail the sand-waves etc.)

There are no offshore marine protected sites (beyond the foreshore).

DL noted offshore Wexford is a busy fishing area with lots of trawling offshore.

Cable protection will be very important (particularly as High Voltage cable) to ensure no impacts to the cable but also to the fishing industry.

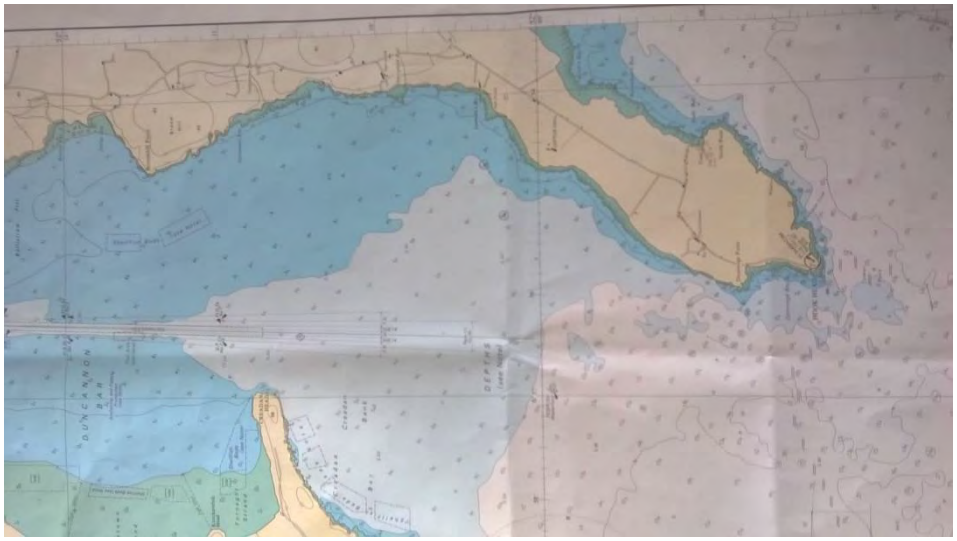
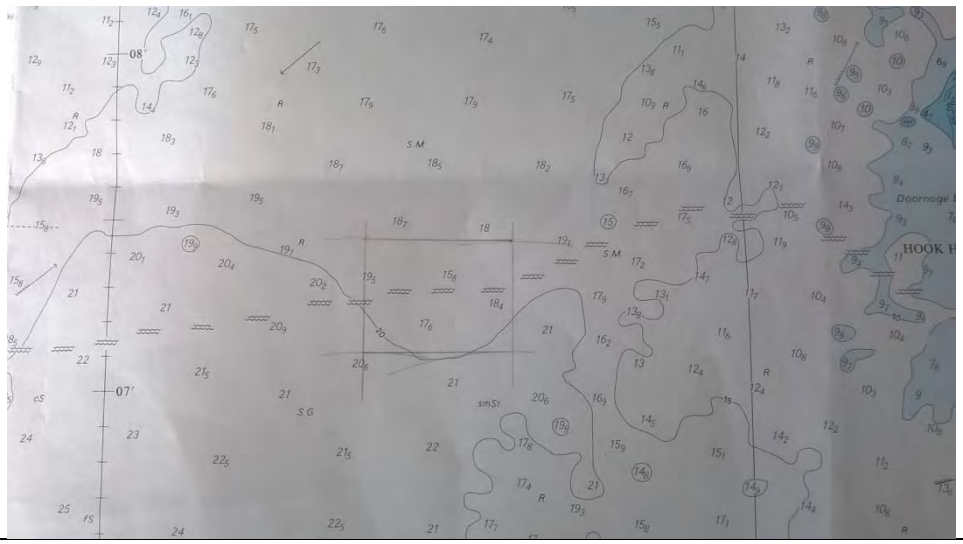
APPENDIX E

Booley Bay Meeting Minutes

MINUTES OF MEETING

Project:	P1975 - Greenlink
Subject:	Introduction to project and discussion of landfall options
Date and Time:	9th March 2016, 10.30am
Duration:	1.5 hrs
Venue:	Port of Waterford, Marine Point, Bellview Port, Waterford
Present:	Tom Brinicombe - Element Power Project Manager Peter Harte - Element Power Ireland Director Anna Farley - Intertek Marine Consultant Frank Ronan - Chief Executive Port of Waterford Company Captain John Foley - Assistant Harbour Master
Level of Issue:	DRAFT
File Reference:	P1975_AAMAR06_Rev0
Distribution:	Element Power, Intertek, Arup

ITEM	MINUTES	ACTION
1.	**Introduction to Greenlink** PH & TB provided overview of Element Power and the Greenlink project. Embedded presentation was used as a talking point. Presentation to Port of Waterford_090316 AF briefly described cable installation requirements, potential anchor spread, positioning of lay vessels and survey techniques proposed. Presentation includes a map showing the proposed offshore routes.	
2.	**Port of Waterford Introduction** FR explained Port of Waterford is a commercial operation; although the main stakeholder is the state. http://www.portofwaterford.com/ Their authority extends to a line between Hook Head and Sheeps Head and 3nm out. They are looking at ways to invest in the Port and explore new areas of revenue. One area of interest is biomass / biofuel power station. They are open to discussing and facilitating projects that are in line with their interests or would not adversely affect future commercial opportunities. FR & JH are not aware of any trends (seasonal or otherwise) in shipping activity using the port. Ships can use the port at all states of the tide. Larger vessels require high tide but will adjust speed so approach is made at the correct time rather than anchoring. Designated anchor area is provided on west side of estuary near Dunmore East. Mainly used by cruise ships. Harbour Master can provide a 2 week look ahead of vessels expected. Website has daily visits listed.	

ITEM	MINUTES	ACTION
3.	**Dredging** The Port spend €1 million per annum on dredging two areas of the estuary: Cheek Point (area where 2 rivers meet); and centre of the channel at Duncannon (widest, slowest part of the estuary). Both areas get dredged 3 times per year to maintain access. A 100m wide corridor is dredged at Duncannon. Noted on Admiralty chart 2046.  Anthony Bates Partnership (Colm Sheehan) is dredging consultants. http://www.anthonybates.co.uk/ Dredged spoil is deposited at estuary mouth in boxed zone indicated below. Dredging licence is available on their website (http://www.environ.ie/planning/foreshore/applications/port-waterford-company). Foreshore Licence reference: FS005701 	

ITEM	MINUTES	ACTION
	 Discussed that in future they may consider or be required to dredge a deeper channel out of the estuary. They would not want to "sterilise the seabed" by having a cable installed in this area. Channel could be 100m wide like at Duncannon or 500m wide. Size would depend on need and modelling.	
4.	**Landfalls** Due to the level of dredging at Duncannon, the Booley Bay landfall would be inadvisable; both the cable and the dredging would be put at risk if this landfall was progressed. The Port would be willing to consider Boyce's Bay if it did not sterilise the seabed for future dredging activity i.e. the route avoided the main channel and hugged closer to the coast. **ACTION:** Booley Bay to be removed from consideration in future assessments. **ACTION:** Element Power / Intertek to consider technical feasibility of Boyce's Bay based on Ports response.	ITRK / ARUP ITRK / Element Power
5.	**Licences / Permits** <u>Marine Survey</u> – No specific permits required from Port for marine survey in their authority area. Requested that they be kept informed of all vessel movements and timings of survey. If necessary contractor may be asked to stand down for short period if impeding shipping activity. AF suggested that we could include conditions in the survey contract regarding open dialogue with the port. **ACTION:** AF to ensure that Survey contracts have appropriate conditions requiring open communication with Port. <u>Cable Installation</u> The Port does not have an application form but would expect that a works licence would be required for installation. As nothing is developed at the moment they would have to discuss it with their lawyers. They would not expect this to be onerous but it was mentioned that a process of negotiation would be necessary. Could take time. A fee would also be charged but they were keen to point out that this would be benchmarked against other ports and 'the going rate' charged.	ITRK

ITEM	MINUTES	ACTION
6.	**CEF Funding** Port has applied for CEF funding for hydrographic surveys of estuary.	
7.	**Facilities** SSE used port facilities when constructing Great Island Power Station. Heavy items were barged across estuary with barges beaching for offloading. Heavy lift crane used to unload. 40-60 tonne loads can be moved by Port dock lifting facilities. However third parties have been bought in to deal with larger loads. 750 tonnes have been accommodated at dock facilities.	
8.	**General Information** Bord Iascaign Mhara (www.bim.ie) and Department of Agriculture have licensed a number of aquaculture sites within the estuary. These are not necessarily in place yet. Good lobster and crab territory offshore. Oysters caught on west coast of estuary. Dolphins seen in estuary.	