4 SITE SELECTION AND CONSIDERATION OF ALTERNATIVES

4.1 Introduction

4.1 It is a requirement of the Environmental Impact Assessment (EIA) Regulations (Section 3) that alternatives for achieving the objectives of the proposed Project are described and an explanation for the basis for the selection of the preferred proposal should be outlined in the Environmental Statement (ES).

4.2 One of the key drivers in the selection of the preferred proposal for a tidal energy project is the location of tidal resource suitable for exploitation by tidal stream technology. Tidal resource is by its nature very spatially constrained e.g. compared to other offshore renewable energy resources such as offshore wind and wave, and therefore there are only a limited number of areas with the potential resource to develop tidal stream energy projects. Not only are there a limited number of tidal sites with suitable resource, these are further constrained by what is assessed as technically and economically viable resource. The UK Marine Energy Atlas published in 2008 (ABPmer, POL and Met Office, 2008) and subsequent work commissioned by The Carbon Trust (The Carbon Trust, 2011) has identified the key areas of tidal resource around the UK considered suitable for commercial scale tidal projects. These areas are illustrated in Figure 4.1 and it can be seen that the Pentland Firth contains a significant proportion of the UKs tidal stream energy resource.

4.3 The Sustainable Development Commission (2007) and more recently others (Scottish Renewables, 2010; RenewableUK, 2011) have predicted that the Pentland Firth is likely to become the centre of the UK tidal stream energy industry. This is consistent with the findings of the Marine Renewables Strategic Environmental Assessment (SEA) which was undertaken by the Scottish Government in 2007. The SEA concluded that the Pentland Firth has a medium to high potentially achievable tidal energy generating capacity taking into account major, moderate and unknown environmental effects[3]. This work also specifically identified the Inner Sound as a potential tidal development area.

4.4 Following completion of the SEA; in September 2008 The Crown Estate (TCE) announced the world's first licensing round for marine (wave and tidal) projects for the Pentland Firth and Orkney Waters (PFOW). This announcement led to the focus of marine energy development in the UK to the Pentland Firth area.

4.5 Combining the above with the Scotland Government's financial support mechanism at the time of site evaluation (i.e. Marine Supply Obligation Renewable Subsidy (and subsequent Renewables Obligation Certificates (ROCs)), the nine month target for determination of marine energy project consents and the £10 million Saltire Prize for marine renewable energy projects in Scotland, further enhanced the attraction of the Pentland Firth.

4.2 Background to the Project

4.6 The MeyGen Tidal Energy Project, through various iterations, has been developed in parallel with the Scottish Government's marine renewable energy development initiatives.

4.7 In 2008, Atlantis Resources Corporation (ARC) as the founder of the Project undertook a global search to identify potential economically viable sites for commercial scale tidal energy development. It commissioned a study to identify all sites globally with a flow rate in excess of 1.5m/s. This work identified the Pentland Firth as a priority site, in terms of a high tidal flow and the number of tidal turbines that could be deployed.

4.8 At that time ARC together with Morgan Stanley, made a decision to progress a commercial scale tidal energy project in the Pentland Firth. The Caithness coast was identified as being the most attractive medium term tidal opportunity due to infrastructure, logistics and quality of the tidal resources (3 of the top 6 UK tidal sites according to Sustainable Development Commission (2007) including the Inner Sound) with focus around potential sites in the Inner Sound and at Duncansby Head.

4.9 The development of a tidal model (Figure 4.2) was commissioned and tidal current data collected using Acoustic Doppler Current Profilers (ADCPs) during 2008 and early 2009 helped calibrate the model. This work confirmed that the Inner Sound was the preferred location for the Project and an application would be submitted to TCE under the world's first licensing round for marine (wave and tidal) projects.

4.10 Following successful pre-qualification, MeyGen submitted tender documents based on further extensive site investigation conducted over an 18 month period. MeyGen was successfully awarded an Agreement for Lease (AfL) for the Inner Sound site on 21st October 2010.

4.3 Site Evaluation

4.3.1 Overview of Site Evaluation Process

4.11 As described above, the evaluation of sites in the Pentland Firth began back in 2008. This work included the mapping of constraints to development including those listed below.

- Technical (accessibility, bathymetry and grid connection);
- Environmental (species and habitats and designated sites); and,
- Other sea users (navigation, fisheries and recreation).

4.12 Initial site assessment focused on the evaluation of offshore constraints. Once a suitable offshore location for the Project was identified onshore constraints were considered. The constraints were interrogated in Geographical Information Systems (GIS), which has formed the basis of project development from conception to the current time.

4.13 Consultation with various stakeholders was also undertaken to assist in locating the Project in the most appropriate area. These included;

- Scottish Natural Heritage (SNH);
- Joint Nature Conservation Committee (JNCC);
- Chamber of Shipping;
- Marine Scotland (MS);
- The Crown Estate (TCE);
- Ministry of Defence (MoD);
- The Highland Council (THC);
- Scottish Government (SG);
- Maritime and Coastguard Agency (MCA); and
- Royal Society for Protection of Birds (RSPB).

4.14 The Inner Sound between the island of Stroma and the Scottish mainland was assessed as the best site for commercial development. The below sections detail the key reasoning behind proceeding with the Inner Sound as the chosen site and the proposed methods for addressing constraints relating to the Project.

[3] The SEA was designed to 'provide for a high level of protection of the environment and to contribute to the integration of environmental considerations into the preparation and adoption of plans and programmes with a view to promoting sustainable development'.

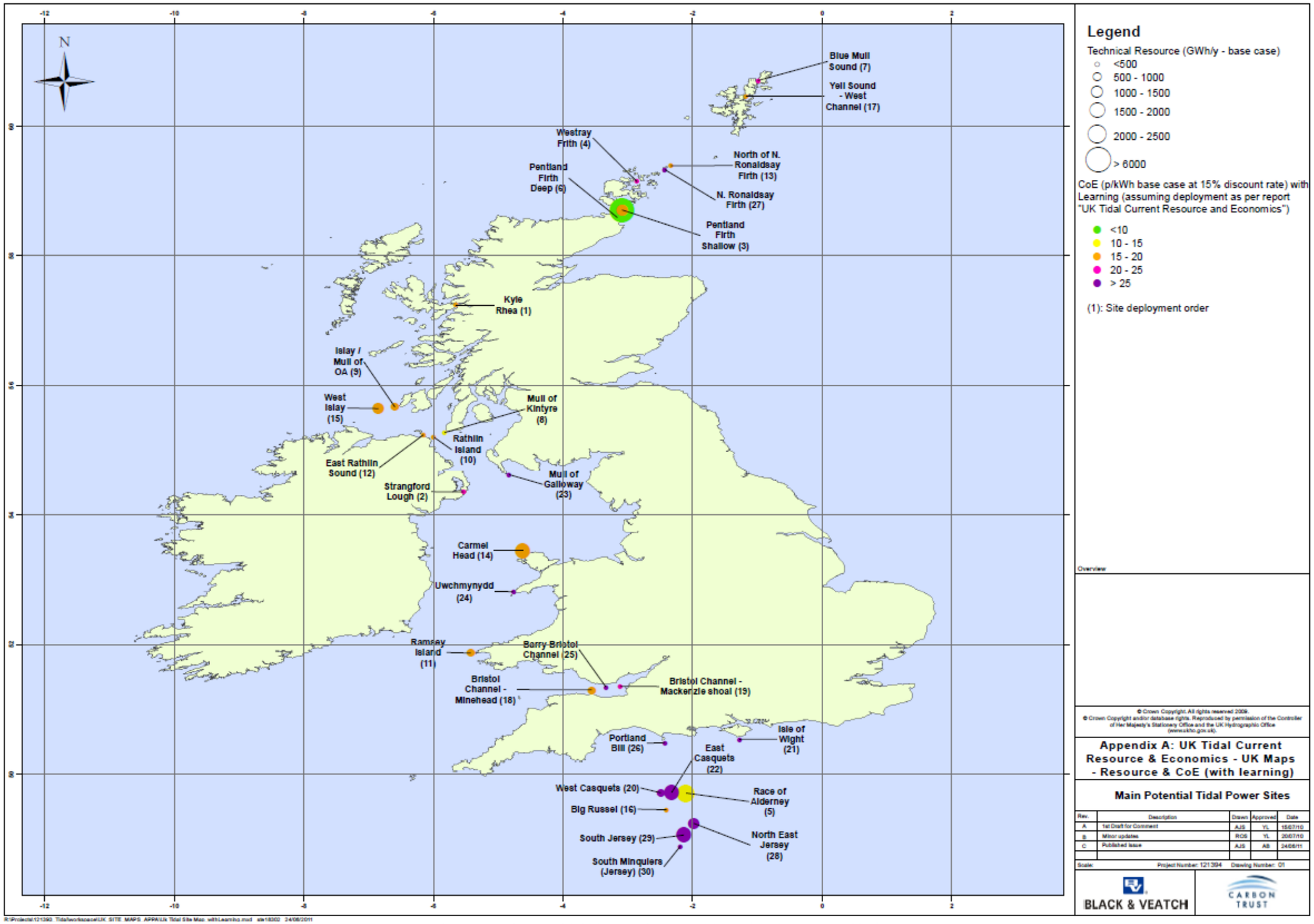

Figure 4.1: Main potential tidal power sites around the UK (The Carbon Trust, 2011)

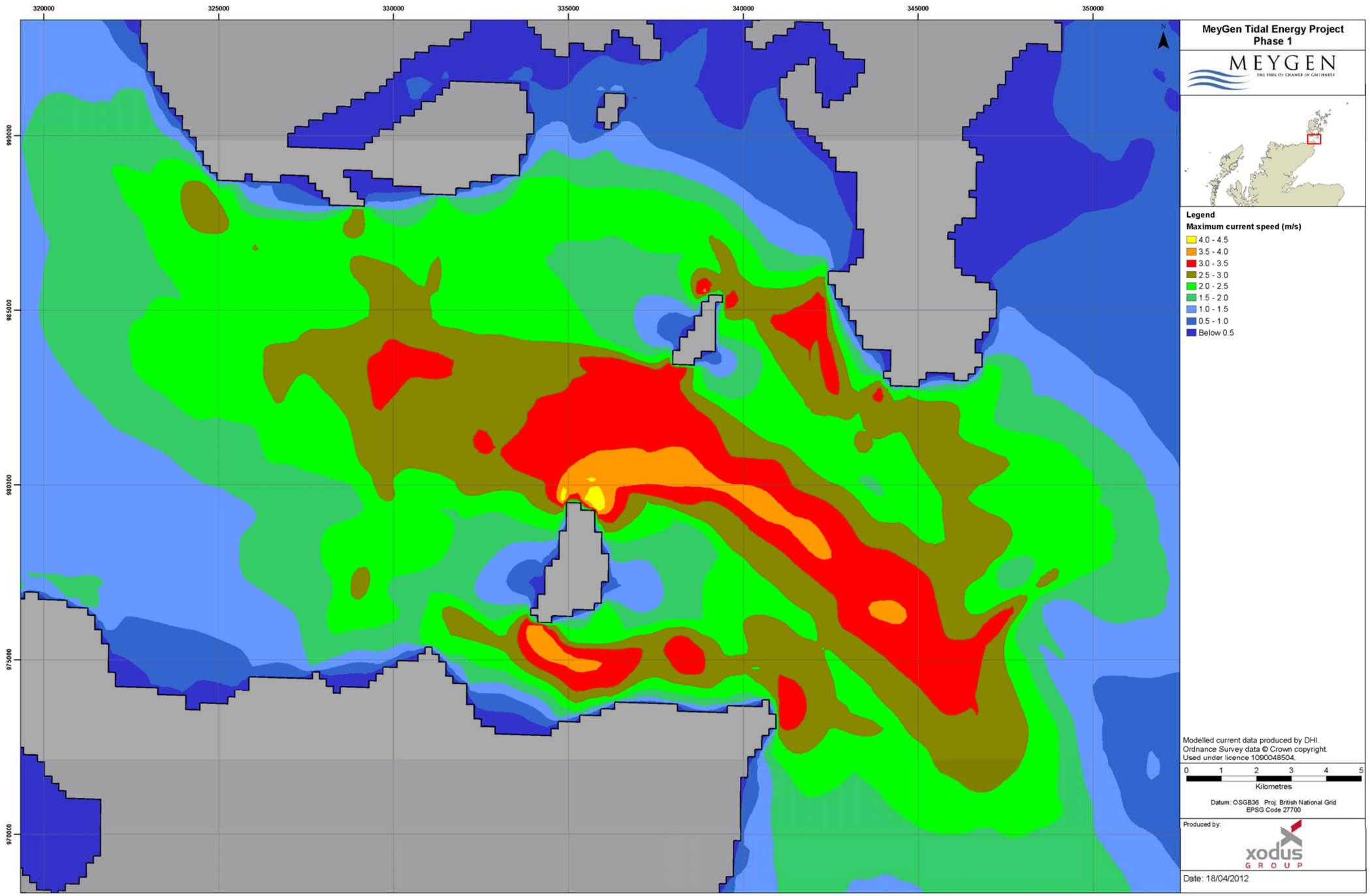

Figure 4.2: Maximum flow speed through the Pentland Firth (initial flow modelling)

4.3.2 Technical

4.15 The site selection process, from international as well as the UK sites has indicated that the Pentland Firth and the Inner Sound especially provides one of the very few high resource sites with suitable bathymetry which is also close to a relatively strong grid connection for the export of electricity. Figure 4.2 (from the initial Pentland Firth model) shows that the Inner Sound has an excellent tidal resource; the maximum current speed reaches 3.5 – 5 m/s.

4.16 MeyGen has continued to investigate the Inner Sound; collating ADCP data in 2011 to recalibrate the flow model and conducting a geophysical survey of the seabed to get more accurate bathymetry data and information on seabed conditions to further inform design of the Project.

4.3.3 Other offshore constraints

4.17 At the same time as establishing the technical constraints for the Project, other key offshore constraints were investigated, including consideration of birds, marine mammals, navigation and fisheries.

4.18 Areas of tidal resource are also known to be ecologically productive areas, and as such will inevitably result in tidal stream energy projects having to be deployed alongside ecological sensitivities. The Pentland Firth supports nationally and internationally important seabirds and is also an important area for mammals including the grey seal, harbour seal and harbour porpoise. As such there are international and national designated sites protecting species and habitats in the area.

4.19 The North Caithness Cliffs Special Protection Area (SPA) which is designated for breeding populations of peregrine falcon, razorbill, northern fulmar, kittiwake, puffin and guillemot overlaps with the Inner Sound AfL area. The SPA was designated on 16th August 1996. The SPA received a marine extension to 2km, classified on 25th September 2009, following the initial tender to TCE for the Inner Sound site in spring 2009. In addition, the western side of the island of Stroma is designated as a Site of Special Scientific Interest (SSSI) for its nationally important colonies of breeding seabirds. Although there are no protected areas designated for marine mammals in the vicinity of the Inner Sound, marine mammal species from protected sites further afield (e.g. Special Areas of Conservation (SACs) in Orkney and elsewhere in Scotland) could be present in the Inner Sound and some species are also protected wherever they are present in European waters.

4.20 MeyGen recognised these ecological sensitivities from the outset of the Project and was proactive in organising surveys of the Agreement for Lease (AfL) area to better understand the presence of birds and mammals in the proposed Project area. With no specific survey methodology guidance available at the time, the methodologies were developed closely with SNH and agreed with Marine Scotland. MeyGen has committed to conducting an extensive and robust survey programme to support the EIA and Habitats Regulations Appraisal (HRA) processes.

4.21 The Pentland Firth is recognised as an important shipping route around the north of Scotland, however initial research on marine traffic through the Firth concluded that the Inner Sound is not a significant navigational route and is generally used by small, shallow draught vessels. The Outer Sound (north of the Island of Stroma) is the designated navigation route through the Pentland Firth.

4.22 Initial consultation indicated that the Inner Sound was not important for aquaculture or for mobile (i.e. trawl) fishing gears and was targeted to only a limited extent by static fishing gears (creelers).

4.4 Project Design

4.4.1 Project design process

4.23 Having secured the AfL in the Inner Sound, MeyGen undertook an initial design phase (Concept Design) to evaluate engineering options and alternatives for the Project. This work was completed in November 2009, following which there has been a two year period of Front End Engineering Design (FEED) which concluded in December 2011. During these initial engineering design phases there has been further refinement of the offshore aspects of the Project and definition provided for the onshore aspects of the Project, in particular in terms of the location at which the Project will connect to the grid and the details for the other onshore infrastructure requirements. The final project design stage (Detailed Design) began in January 2012.

4.24 Through these design stages options for the locations of the offshore and onshore components of the Project were considered and engineering solutions have been developed. Each component is discussed below, including details of the options that are still being considered at the time ES compilation.

4.4.2 Turbine deployment area

4.25 Following the detailed bathymetric survey conducted in the Inner Sound in September 2009, the available seabed suitable for the deployment of tidal current turbines within the lease area was proven to be less than original assessments had predicted due to minimum water depth constraints. Further investigation proved that altering the lease area to extend the site west and east in the sound whilst keeping the same overall area would enable the same generating capacity to be achieved as previously predicted. A revised AfL area was agreed with TCE following this. The originally awarded and subsequently modified areas are shown in Figure 4.3.

4.26 Having refined the AfL area, MeyGen then had to select which part of the area would be developed for the first 86MW (i.e. Phase 1) of the Project. A review of Phase 1 requirements and site characteristics was conducted and the initial development area selected on the basis of the following requirements:

- Provision of an area of 1.1km^2, a conservative estimate (i.e. larger) for the area required for 86 tidal turbines;
- Requirement for high flow velocities;
- Requirement for as close as possible to 180^o return between flood and ebb tide;
- Provision of relatively flat and stable seabed;
- Protection (as far as possible) from potential extreme wave climate;
- Access to suitable cable landing sites; and
- Provision of a cable corridor to shore.

4.27 MeyGen considered two areas for Phase 1; one in the centre and one in the west of the AfL area. Based on the above criteria the decision was made in May 2011 to use the central area of the site as the Phase 1 area.

4.4.3 Tidal array

4.28 The exact location of the turbines within the Project area is yet to be determined and is dependent on a number of factors including:

- Full modelling of the turbine array to optimise the cross-flow and down-flow turbine spacing to maximise energy capture;
- Turbulence;
- Seabed topography;
- Requirements for installation and maintenance vessel operations;
- Location, stability of export cables; and
- Environmental issues.

4.29 Individual studies used to inform the EIA as well as engineering expertise, will inform the micro siting of individual turbines at the Detailed Design stage.

4.4.4 Export cables

4.30 An initial cable option study identified three potential options:

- Array cables collected at an offshore platform for export to grid;
- Turbines linked together offshore in an array and brought together via a single cable directly to shore; and
- Turbines with individual export cables brought directly to shore.

4.31 In Concept Design the offshore platform option was rejected based on engineering and economic constraints. Turbine technology is still developing and therefore linking and critically, controlling turbines as an array instead of individual units has not yet been proven technically and commercially.

4.32 The conclusion of the Front End Engineering Design (FEED) study was that bringing multiple cables to shore was the best technical option based on technology currently available. The system has a number of advantages including, providing fault tolerance in the system so a failure in one turbine would not stop others from generating and retaining flexibility to control turbines individually. This solution will require a relatively wide cable corridor for up to 86 export cables between the turbine deployment area and cable landfall.

4.4.5 Cable landfall

4.33 During the Concept Design a review of desk and site based information and appraisal of environmental and planning issues was conducted on potential beach landfalls. The review concluded that there were few beach landing options in close proximity to Inner Sound suitable for cable landings.

4.34 The turbines will supply electricity for export to onshore at relatively low voltages (up to 6.6kV). These export voltages are limited by the current availability of transformer technology within the turbine nacelle and wet-mate connector technology used to link export cables.

4.35 To reduce electrical losses associated with low voltage individual export cables there needs to be a short distance to grid and with no viable beach landing in the area, the option to bring cables to shore via HDD bores was investigated during FEED.

4.36 During FEED initial site investigations concluded three options for HDD landing point. The options critically required enough area to complete the temporary Horizontal Directional Drill (HDD) works and to house the Power Conversion Centre (PCC), discussed below.

4.4.6 Power Conversion Centre

4.37 The PCC design was developed through FEED. The PCC houses conversion equipment for the turbine array and transformers to increase the voltage ready for export to the grid. The PCC is required to be relatively close to the coast to minimise electrical losses from the cables.

4.38 The site investigation concluded three costal locations provided enough area for the PCC and temporary HDD works:

- St John's Point;
- Ness of Quoys; and,
- Ness of Huna.

4.39 Based on the location of Phase 1 in the centre of the AfL area, St John's Point was not taken forward during FEED and the two more central sites, Ness of Quoys and Huna have been considered as potential alternative development sites in the EIA and results of investigations at both sites included in this ES.

4.40 The designs for both the Ness of Quoys and Ness of Huna sites has been completed for the planning application based on the requirements for the construction and operation of the PCC and HDD activity. The final site designs have been informed by the EIA surveys and studies in due regard to limit the impact of the works.

4.41 At the commencement of the EIA the PCC area was less well defined; as a result the onshore EIA assessment and subsequent ES section write up has considered a larger potential project area then that that will be applied for in the planning application.

4.4.7 Onshore export cables

4.42 The onshore export cables link the PCC to the national grid. MeyGen has, from project conception, always proposed to bury onshore cables, instead of using overhead cables on poles or pylons. This position has been welcomed during stakeholder and public consultation.

4.43 The cable route to the grid connection is dependent on the available grid capacity, proposed grid upgrades both on the distribution and transmission network and the grid applications submitted by MeyGen.

4.44 In 2010, MeyGen secured a 15MW grid connection available on the distribution network (SHEPD). MeyGen has agreed a connection to the transmission network that covers a large proportional of the remainder of the project capacity with the transmission network (SHETL). The SHEPD connection was planned to be made at a new West Gills 33kV substation, whilst the SHETL grid connection would be made at the proposed Gills Bay 132KV substation site (Figure 1.3).

4.45 MeyGen identified possible cable routes from both PCC sites to both grid connection points. The cable routes were based on minimising the impact of the installation on local area, following the road network as much as possible.

4.46 In September 2011 it was agreed that the SHEPD connection would be brought directly to the PCC location. This connection, underground cable and route is now the responsibility of SHEPD. This has therefore reduced the number of export cables that require consent under the planning application for the Project.

4.47 The cable corridor route has been finalised for the planning application based on the technical requirements and the EIA surveys and studies (Figure 5.2). From the results of the EIA the key constraint on the potential underground cable routes was watercourse crossings (Section 17). The selected cable corridor will have to cross waterways but in areas where these are much less deeply incised and therefore this reduces potential disturbance during construction. The cable route has also been designed to avoid cultural heritage assets, and any sensitive habitats.

4.48 MeyGen still requires some flexibility in the underground cable route towards the grid connection as the exact location of the substation is not yet known (Figure 5.2). Once further information is available, MeyGen will begin the design of this final section with due regard to the EIA results.

4.49 At the commencement of the EIA the potential underground cable route was less well defined; as a result the onshore EIA assessment and subsequent ES section write up has considered a more extensive potential project area then that that will be applied for in the planning application.

4.50 **Following the completion of the EIA, landowner consultation has identified potential issues with small areas of the proposed cable route. It has therefore been necessary to include areas outside that surveyed for the onshore impact assessments. The area is 0.50km^2 and is shown in Figure 2.1. Unfortunately this issue was not identified at the time of ES compilation and therefore is not addresses in this document. Work to survey and assessment of any changes required to the original impact assessment as a result of the altered cable route is ongoing and will be provided in an ES addendum.**

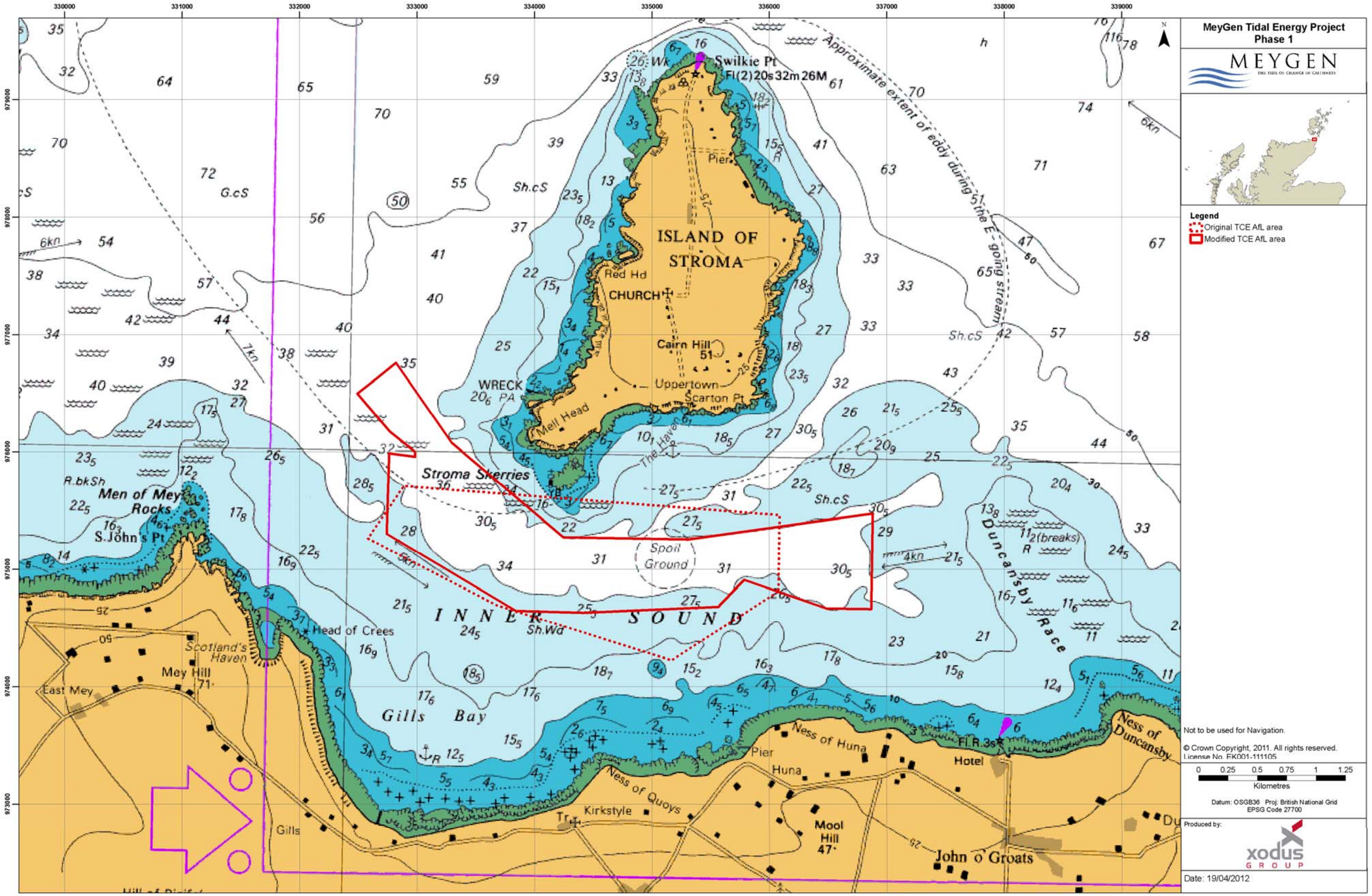

Figure 4.3: Location of MeyGen Tidal Energy Project (original and modified Agreement for Lease area)

4.5 Assessment of Alternative Tidal Technologies

4.51 There are a number of tidal turbine manufacturers that are currently testing prototype turbines. MeyGen has worked closely with a number of these turbine manufacturers throughout the project development process.

4.52 Further site characterisation surveys carried out in 2011 has meant that the turbine specification required for the Inner Sound has changed since the submission of the EIA Scoping Document. MeyGen has subsequently reviewed the turbine parameters to give project design flexibility whilst giving sufficient detail to allow the EIA to be conducted.

4.53 By using a Rochdale Envelope approach for turbine parameters, the procurement process and detailed design of turbines remains flexible and can make use of technology evolution, whilst retaining a competitive market and optimising project economics for MeyGen.

4.54 The turbines will comprise of a 2 or 3 bladed single rotor turning on a horizontal axis. The turbines will be able to capture energy from the flood and ebb tide by either using a rotate system to turn the turbine nacelle, or by having pitching or bidirectional blades. Electricity generated by the turbine will either be converted and transformed in the nacelle and then transmitted to shore through a subsea cable or the converter and transformers will be located in an onshore facility before transmission to the national grid.

4.55 The full details of the turbine Rochdale Envelope can be found in Section 5.3.2. Changes from what was presented in the EIA Scoping Document include the increase of the potential rated capacity of the turbines up to 2.4MW and the maximum rotor diameter to 20m. An increased in turbine rated capacity would mean a reduction in the overall number of turbines required to meet the Project capacity.

4.56 A final decision on the technology used for the Project should be made in 2013 based on the performance of the candidate technology developers.

4.6 Mitigation through Site Selection and Consideration of Alternatives

4.57 Given the detailed deliberation that has been offered to the site selection process, the present Project design is considered to be the most appropriate solution available. It should be noted that mitigation has been applied where possible to this process through the avoidance of specific sensitive receptors and the application of techniques for dealing with remaining constraints and/or residual impacts. Detailed mitigation relating to specific receptors will be outlined in individual ES sections (Sections 9 to 24).

4.7 References

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