17 GEOLOGY, HYDROGEOLOGY & HYDROLOGY

17.1 There were no supporting studies which directly relate to the Geology, Hydrogeology and Hydrology impact assessment.

17.1 Introduction

17.2 This section assesses the effects of the proposed Project on geology, hydrogeology and hydrology. The assessment was undertaken by Mouchel, water and environmental consultants.

17.3 Geology, hydrogeology and hydrology are closely linked resources with the possibility of common effects. For the purposes of this assessment, 'hydrology' is considered to include all fresh surface waters, 'hydrogeology' covers groundwater including water held within superficial drift or soils, and 'geology' includes bedrock and superficial deposits.

17.4 Effects on the geology, hydrogeology and hydrology may result in secondary ecological effects on habitats (e.g. wetland areas) or species (e.g. fish). Any such effects have not been discussed here, but are addressed in Section 18 (Terrestrial Habitats and Ecology).

17.5 During construction there will be physical disturbance and removal of soil and superficial deposits by mobile plant. The onshore infrastructure and cable route will introduce physical changes which may alter the hydrological and hydrogeological characteristics of the site. During the construction and decommissioning phases, and to a lesser extent during operation, potential sources of pollution will be present on site.

17.2 Assessment Parameters

17.2.1 Rochdale Envelope

17.6 In line with the Rochdale Envelope approach, this assessment considers the maximum ('worst case') Project parameters. Identification of the worst case scenario for each receptor (i.e. Environmental Impact Assessment (EIA) topic) ensures that impacts of greater adverse significance would not arise should any other development scenario be taken forward in the final scheme design. Table 17.1 describes the detail of the Project parameters that have been used in this assessment and explains why these are considered to be worst case.

17.7 In terms of the assessment of alternative Project parameters, this assessment has addressed the potential; impacts associated withal potential onshore development areas. However it will only be certain areas of within this footprint that will be developed. Therefore the actual impacts of the Project will be less than those predicted here.

Project parameter relevant to the assessment		'Maximum' Project parameter for impact assessment	Explanation of maximum Project parameter
Onshore Power Conversion Centre (PCC)	Construction, operation/maintenance and decommissioning	Maximum potential footprint at both Ness of Quoys and Ness of Huna (at EIA commencement)	Assessment of potential impacts associated with the construction, operation and maintenance activities and decommissioning of the Power Conversion Centre (PCC) at both the Ness of Huna and Ness of Quoys maximum potential footprint.
Onshore cable routes between PCC and SHETL substation	Construction, operation/maintenance and decommissioning	All potential cable corridors between PCC locations and SHETL substation proposed at Phillips Mains (see Figure 2.1) (at EIA commencement)	Assessment of potential impacts associated with all potential cable corridors identified between PCC locations and SHETL substation proposed at Phillips Mains.
Cable landfall	HDD site	Maximum potential footprint at both Ness of Quoys and Ness of Huna (at EIA commencement)	Assessment of potential impacts associated with the construction, operation and reinstatement of the temporary Horizontal Directional Drill (HDD) site at both the Ness of Huna and Ness of Quoys maximum potential footprint.
Offshore Project parameters	Maximum drill cuttings released into marine environment	29, 0.6m HDD bores, drilled from either Ness of Quoys or Ness of Huna	The majority of drill cuttings generated from the drilling of the HDD bores will be returned to shore and not discharged to sea; however, it is estimated that the contents of the last 10m of each bore could be discharged to sea and the seabed upon breakthrough. Of the two potential HDD scenarios, the greatest potential volume of cuttings discharged to sea will result from 29 boreholes of 0.6m diameter and 700m in length (82m^2). Drill cuttings produced at breakthrough from drilling 86 individual boreholes of 0.3m diameter and 2,000m in length will be less (61m^2).
	Maximum amount of drill cuttings released into the marine environment	86 monopile Turbine Support Structure (TSS)	The drilled monopile TSS will result in the maximum release of drill cuttings to the marine environment. Assuming the maximum number of 86 TSSs, the maximum amount of drill cuttings that can be generated from turbine support installations is 17,200m^2 (total for 86 TSSs).
	Maximum seabed footprint	86 Gravity Base Structure (GBS) TSS	Each GBS TSS has a maximum footprint of 40m x 30m. The total footprint for 86 turbines is 0.103km^2.
	Maximum cable footprint on seabed	86, 250mm unbundled cables each 1,300m in length	The maximum physical area of the seabed occupied by the cables has been calculated as 0.056km^2. Based on a maximum 1.3km of cable from HDD bore exit to turbine, and maximum cable diameter of 250mm (x2 to account for any armouring or weighting) for 86 turbines.

Table 17.1: Rochdale Envelope parameters for the geology, hydrogeology and hydrology assessment

17.2.2 Area of assessment

17.8 It is also important to define the geographical extent of the assessment area. The focus of the geology, hydrogeology and hydrology assessment is potential impacts on:

- The geology of the on- and offshore areas that could be directly impacted by Project infrastructure at Ness of Quoys, Ness of Huna and along the cable corridor to the SHETL substation;
- The hydrology of the Project site has been considered using a surface water catchment based system. As the Project activities may influence watercourses and locations beyond the proposed infrastructure area, relevant areas within catchments have been considered; and
- From a hydrogeological perspective, owing to the nature of the groundwater resources in the area, potential impacts will generally be restricted to the areas directly impacted by, adjacent to and down-catchment of Project infrastructure.

17.9 It should be noted that this assessment was completed on a more extensive Project area; this has since been refined to a smaller footprint at both the Ness of Quoys and Ness of Huna PCC sites and a single

cable corridor to the SHETL substation option areas. The final Project is described in Section 5 and shown in Figure 5.2; the selection process for these is discussed in Section 4.

17.10 **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.**

17.3 Legislative Framework and Regulatory Context

17.3.1 Legislation

17.11 In addition to the EIA Regulations the following are also relevant to this assessment:

- Water Environment and Water Services (Scotland) Act 2003;
- Water Environment (Controlled Activities) (Scotland) Regulations 2011; and
- Private Water Supplies (Scotland) Regulations 2006.

17.3.2 Policy and guidance

17.12 In addition to the EIA guidance published by Marine Scotland and Scottish Natural Heritage (SNH), the following guidance has been taken into consideration during this assessment:

- CIRIA (Construction Industry Research and Information Association) Report C532, Control of water pollution from construction sites: Guidance for consultants and contractors;
- CIRIA Report C648, Control of water pollution from linear construction projects: Technical guidance;
- CIRIA Report C649, Control of water pollution from linear construction sites: Site guide;
- BSI Code of Practice for Earthworks, BS 6031: 2009;
- Forestry Commission (2003), Forests & water guidelines, 4th Edition;
- Scottish Executive (2000), River crossings & migratory fish: Design guidance;
- SNH (2005), A handbook on environmental impact assessment;
- Scottish Planning Policy, 2010;
- Scottish Environmental Protection Agency (SEPA) Policy No. 19, Groundwater protection policy for Scotland;
- SEPA Position Statement WAT-PS-06-02, Culverting of watercourses;
- SEPA WAT-SG-25, Good practice guide – river crossings;
- SEPA WAT-SG-26, Good practice guide – sediment management;
- SEPA WAT-SG-29, Good practice guide – temporary construction works;
- SEPA WAT-SG-31, Special requirements for civil engineering contracts for the prevention of pollution;
- SEAP/CIRIA (2006), Small environmental guide for construction workers; and
- The Highland Council's Caithness Local Plan (2002) and The Highland Councils Structure Plan (2001)[1]. These will be supplemented and eventually superseded by the Highland-wide Local Development Plan (HWLDP)[2].

17.13 SEPA (jointly with the Environment Agency and the Northern Ireland Environment Agency (NIEA)) Pollution Prevention Guidelines:

- PPG1: General guide to the prevention of pollution;
- PPG2: Above ground oil storage tanks;
- PPG3: Use and design of oil separators in surface water drainage systems;
- PPG4: Treatment and disposal of sewage where no foul sewer is available;
- PPG5: Works and maintenance in or near water;
- PPG6: Working at construction and demolition sites;
- PPG7: Safe storage – The safe operation of refuelling facilities;
- PPG8: Safe storage and disposal of used oils;
- PPG13: Vehicle washing and cleaning;
- PPG18: Managing fire water and major spillages;
- PPG21: Pollution incident response planning; and
- PPG26: Safe storage - drums and intermediate bulk containers.

17.4 Assessment Methodology

17.4.1 Scoping and consultation

17.14 Since the commencement of the Project, consultation on geology, hydrology and hydrogeology issues has been ongoing. Table 17.2 summarises all consultation relevant to geology, hydrogeology and hydrology. In addition, relevant comments from the EIA Scoping Opinion are summarised in Table 17.3, together with responses to the comments and reference to the Environmental Statement (ES) sections relevant to the specific comment.

Date	Stakeholder	Consultation	Topic/specific issue
7th April 2011	Marine Scotland and SNH	Pre-Scoping meeting	EIA surveys and studies required and the data needs for each EIA study.
27th May 2011	Marine Scotland, statutory consultees and non statutory consultees	Submission of EIA Scoping Report	Request for EIA Scoping Opinion from Marine Scotland and statutory consultees and request for comment from non-statutory consultees.

[1] Still in force at the time of the EIA and ES compilation.

[2] Not adopted at the time of the EIA and ES compilation.

Date	Stakeholder	Consultation	Topic/specific issue
30th June – 2nd July 2011	Local stakeholders	Public Event - EIA Scoping	Public event to collate information/opinions on proposed EIA scope.
24th August 2011	SEPA	Meeting	Project update.
30th August 2011	SEPA	Submission of draft ES sections	Copy of draft Geology, Hydrogeology & Hydrology and Terrestrial Habitats ES sections provided for comment.
12th September 2011	SEPA	Letter	Comments received on draft Geology, Hydrogeology & Hydrology and Terrestrial Habitats ES sections.
14th September 2011	The Highland Council	Meeting	Planning pre application meeting. Presentation on overall Project and results of EIA studies to date.
31st September 2011	Marine Scotland, The Highland Council, statutory consultees and non statutory consultees	Receipt of EIA Scoping Opinion	Receipt of response to EIA Scoping Report and other comments from non statutory consultees.
10th October 2011	The Highland Council	Receipt of pre application advice	Receipt of pre application advice from The Highland Council.
6th – 7th December 2011	Local stakeholders	Public Event – pre application consultation	Public event to communicate the findings of the EIA to local stakeholders.

Table 17.2: Consultation undertaken in relation to geology, hydrogeology ad hydrology

Name of organisation	Key concerns	Response	ES section within which the specific issue is addressed
The Highland Council	Provided private water supply information for the study area. No formal consultation response received to date.	None required.	Section 17.5 Baseline description
Marine Scotland	Developers are advised to consult with SEPA at an early stage. SEPA's Pollution Prevention Guidelines should be used in ES preparation and during Project development. Prevention and clean-up measures for all stages of the development should be considered. Impacts on the water environment such as increase in sediment load, pollution incidents, watercourse obstruction and drainage issues should all be considered. The ES should identify the locations of, and protective/mitigation measures relating to, all private water supplies within affected catchments. Developers should be aware of CIRIA guidance on control of water pollution and environmental good practice.	Consultations with SEPA were undertaken. All applicable PPGs were consulted and are referenced. Prevention and mitigation measures have been identified. Full assessment has been made in the EIA. Private water supply locations were identified. None lie within affected catchments. Relevant CIRIA guidance documents were consulted and are referenced.	Table 17.2 Consultation Section 17.3 Legislative Framework and Regulatory Context Section 17.5 Baseline Description Sections 17.6.1, 17.7.1 and 17.8.1 Pollution, Sections 17.6, 17.7 and 17.8 Impact Assessment sections
Scottish Environment Protection Agency	ES should identify if the impacts are likely to lead to deterioration of, or provide opportunities to improve, the water environment. Onshore components should be designed where possible to avoid engineering activities in the water environment. Watercourse crossings that do not affect the bed and banks of watercourses are preferred and culverting is not encouraged. Onshore elements of the Project should be assessed for flood risk from all sources. If water abstraction is proposed, details should be provided in the ES. If borrow pits are required, details should be contained in the ES. The ES should systematically identify all aspects of site work that might impact upon the environment and potential pollution risks, and should identify the principles of preventive measures and mitigation. Works should be planned to avoid construction and other potentially polluting activities during periods of high rainfall. Potential impacts on Groundwater Dependent Terrestrial Ecosystems should be assessed.	Full assessment has been made in the EIA. All onshore infrastructure has been sited well away from watercourses as far as possible. No permanent watercourse crossings are proposed. Flood risk has been considered. Water abstraction is not proposed. No borrow pits are required. Full assessment has been made in the EIA. This has been identified as a key control measure and is considered to be good construction practice. Full assessment has been made in the EIA, following discussion with SEPA about the GWDTEs present on site.	Section 17.5 Baseline Description Sections 17.6, 17.7 and 17.8 Impact Assessment
Scottish Water	Provided information on public water supply infrastructure for the study area. No formal consultation response received to date.	None required.	Section 17.5 Baseline Description
Scottish Natural Heritage	Coastal geomorphology should be considered when identifying directional drilling, cable routes and land-based infrastructure. It is recommended that potential decommissioning impacts are assessed in the ES. Potential impacts on designated areas should be considered in the ES. SEPA should be contacted for advice on hydrological and hydrogeological aspects.	Coastal geomorphology has been included as a receptor in the assessment. Decommissioning has been included in the assessment. Full assessment has been included in the EIA. SEPA has been consulted at various stages of the Project for discussion and advice.	Section 17.5 Baseline Description, Sections 17.6, 17.7 and 17.8 Impact Assessment Table 17.6 Designations, Table 17.2 Consultation

Table 17.3: Scoping comments relevant to geology, hydrogeology and hydrology

17.4.2 Desk based study

17.15 The desk based study involved:

- Identification of hydrological catchments, watercourses, springs and boreholes within the study area;
- Estimation of low and peak stream flows;
- Collation of data on public and private abstractions;

- Collation of historical hydrological and flooding information for the immediate area and the main downstream watercourses; and
- Collation of geological and hydrogeological information, including information on offshore geology.

17.16 Data was collated from the following sources:

- Ordnance Survey Landranger 12 (Thurso & Wick; John o' Groats), 1:50,000 scale;
- Ordnance Survey Explorer 451 (Thurso & John o' Groats; Dunnet Head), 1:25,000 scale;
- Ordnance Survey digital raster mapping, 1:50,000 scale and OS OpenData;
- Ordnance Survey digital vector mapping, 1:10,000 scale;
- British Geological Survey DiGMapGB-50 digital geological mapping: Bedrock, superficial and linear geology, 1:50,000 scale;
- British Geological Survey hydrogeological map of Scotland, 1:625,000 scale;
- SNIFFER map of vulnerability of groundwater in the uppermost aquifer, Scotland, 2004;
- Macaulay Land Use Research Institute, Soil Survey of Scotland Sheet 3 soil types and land capability for agriculture, 1:250,000 scale;
- Centre for Ecology & Hydrology flood estimation handbook CD-ROM v3;
- ISIS hydrological software; and
- Wallingford HydroSolutions LowFlows 2 software.

17.4.3 Field survey

17.17 A site visit was undertaken on 19th and 20th July 2011. The visit focused on gaining a good overall understanding of the hydrological and geological regime of the area.

17.18 The site visit consisted of a walkover survey covering all identified potential infrastructure options. The main surface waters were described and assessed visually in the area of all potential crossing locations and additional minor watercourses and site drainage noted as appropriate. Bedrock exposures were assessed where visible, with particular focus along the coastline sections. Sample peat probing was carried out in areas identified as having peat deposits, to inform routing decisions and to give an indication of existing ground conditions.

17.4.4 Significance criteria

17.19 The significance criteria used in this section are based on the methodology described in Section 8. Each assessment section is, however, required to develop its own criteria for the 'sensitivity of receptor' and 'magnitude of impact' aspects since the definition of these will vary between different topics. For geology, hydrogeology and hydrology, the sensitivity of the receptor and magnitude of impact are defined in Table 17.4 and Table 17.5 respectively.

17.20 The consequences of impacts are then considered by reference to the relevant criteria in the EIA Regulations. The significance of impacts in relation to the EIA Regulations is defined in Section 8, Table 8.2.

Sensitivity of receptor	Definition
Very High	The receptor has very little ability to absorb change without fundamentally altering its present character, is of very high environmental value or of international importance.
High	The receptor has little ability to absorb change without significantly altering its present character, is of high environmental value or of national importance.
Medium	The receptor has moderate capacity to absorb change without significantly altering its present character, is of moderate environmental value or of regional importance.
Low	The receptor is tolerant of change with only minor detriment to its present character, is of low environmental value or of local importance.
Negligible	The receptor is tolerant of change without perceptible detriment to its present character or is of negligible environmental value.

Table 17.4: Definitions for sensitivity of receptor

17.21 The magnitude of the various impacts are evaluated taking into account the scale or size of the change, the duration, frequency and likelihood of the impact. Typical criteria used in determining the magnitude of the impacts are shown in Table 17.5.

Magnitude of impact	Definition
Severe	▪ Very high risk of pollution/sediment release during construction, operation or decommissioning, substantial long-term or permanent change in water quality resulting in a permanent reduction in WFD status. ▪ Widespread major change in geomorphological conditions i.e. major change in sediment deposition or erosion patterns, major reduction in morphological diversity, major interruption to fluvial processes such as channel platform evolution, all with major consequences for ecological quality. ▪ Widespread permanent alteration to groundwater level and/or flow pathways with consequent permanent effects on groundwater dependent habitats. ▪ Widespread damage to designated geological sites.
Major	▪ High risk of pollution/sediment release during construction, operation or decommissioning, substantial temporary or long-term change in water quality resulting in a temporary but long-term change in WFD status. ▪ Major change in geomorphological conditions i.e. major change in sediment deposition or erosion patterns, major reduction in morphological diversity, major interruption to fluvial processes such as channel platform evolution, all with major consequences for ecological quality but localised to one section of the watercourse. ▪ Widespread long-term alteration to groundwater level and/or flow pathways with consequent long-term but reversible effects on groundwater dependent habitats. ▪ Widespread change to qualifying interest in designated geological sites.
Moderate	▪ Moderate risk of pollution/sediment release during construction, operation or decommissioning, moderate temporary change in water quality resulting in a temporary reduction in WFD status. ▪ Moderate change in geomorphological conditions i.e. moderate change in sediment deposition or erosion patterns, moderate reduction in morphological diversity, moderate interruption to fluvial processes such as channel platform evolution, all with moderate consequences for ecological quality. ▪ Localised long-term or widespread temporary alteration to groundwater level and/or flow pathways with consequent temporary effects on groundwater dependent habitats. ▪ Localised damage to qualifying interest in designated geological sites.
Minor	▪ Minor risk of pollution/sediment release during construction, operation or decommissioning, relatively minor temporary change in water quality resulting in a temporary, but measurable, reduction in WFD status. ▪ Minor change in geomorphological conditions i.e. minor change in sediment deposition or erosion patterns, minor reduction in morphological diversity, minor interruption to fluvial processes such as channel platform evolution, all with minor and localised consequences for ecological quality.

	▪ Localised temporary alteration to groundwater level and/or flow pathways with consequent temporary effects on groundwater dependent habitats. ▪ Localised damage to geological features of local importance but non-designated.
Negligible	▪ Negligible risk of pollution/sediment release during construction, operation or decommissioning, negligible or minor transient change in water quality with no discernible effect on watercourse ecology or WFD status. ▪ Negligible change in geomorphological conditions i.e. no discernible change in sediment patterns or fluvial processes, negligible change in morphological diversity. Any changes are likely to be highly localised. ▪ There would be no perceptible changes to the groundwater flow or levels, no perceptible changes to groundwater dependent terrestrial ecosystems. ▪ Impacts on geology highly localised.
Positive	▪ An enhancement of the availability or quality of a resource.

Table 17.5: Definitions for magnitude of impact

17.4.5 Data gaps and uncertainties

17.22 The fieldwork followed standard 'reconnaissance level' field methods in which watercourses were visited close to planned development work, bedrock exposures were assessed where visible and sample peat probing was undertaken in locations identified as likely to include peat deposits. The information gathered was then extrapolated for areas where such data were not available, including areas where access was restricted or visibility poor. This extrapolation was informed by other visible characteristics such as vegetation type and landform, use of available satellite imagery and also by professional judgment.

17.23 The Project area is located on the coast, set back from the shore area. Bedrock exposure is extensive along parts of the shore, although in some areas is obscured by beach deposits, high watermarks and intertidal vegetation. Additional bedrock was visible occasionally in burn channels. The area further inland has no bedrock exposure.

17.24 Field surveys were undertaken on 19th and 20th July 2011. Flows observed may not have represented peak flows, although an indication of high flows could be interpreted from channel morphology and debris abandoned by previous high flow levels.

17.25 Private water supply information was provided by The Highland Council. It is recognised that council information may be incomplete and that supplies serving abandoned properties and for the purposes of livestock welfare may not have been identified.

17.5 Baseline Description

17.5.1 Context

17.26 The site of the Project is within the Inner Sound of the Pentland Firth, with the associated onshore infrastructure situated on the coastal section of Caithness immediately south of the offshore area. Details are provided in Figure 5.2.

17.27 The onshore infrastructure is proposed to lie within a section extending to a maximum of 4km inland from the coast. The area is dominated by agricultural land, mainly grazing land with some arable land, areas of rough moorland and commercial forestry. Most of the watercourses in the area are small and many have been extensively modified for drainage purposes.

17.5.2 Designations

17.28 Sites designated for geological, geomorphological, hydrogeological or hydrological reasons that lie within 5km of the study area have been identified and considered within the assessment. One designated site lies partly within the study area. A number of additional designated sites lie within 5km of the study area (SNH, 2011). The 5km study area buffer ensures that all designated sites that may be affected by the development are included for consideration, as hydrological effects in particular have the ability to travel considerable distances. Details of the identified sites with statutory and non-statutory designations are provided in Table 17.6. These include Sites of Special Scientific Interest (SSSIs), Special Areas of Conservation (SACs), Special Protection Areas (SPAs), Ramsar sites and Geological Conservation Review (GCR) sites.

Site name	Designation	Category	Distance & direction	Linkage
Stroupster Peatlands; Caithness & Sutherland Peatlands	SSSI, SAC, SPA	Blanket bog, oligotrophic loch, depressions on peat substrates, wet heathland, quaking bog, otter, acid peat-stained lochs, clear-water lochs, marsh saxifrage, aggregations of breeding birds.	Partly within study area, extending south	None, site lies up-catchment of project.
Phillips Mains Mire	SSSI	Blanket bog.	0.2km, south	None, site lies up-catchment of project.
North Caithness Cliffs	SPA	Aggregations of breeding birds.	0.6km, north 1.2km, east	None, site not cited for hydrological features.
John o' Groats	SSSI, GCR[I]	Palaeontology.	1.0km, east	Site lies along coast from proposed Project work.
Loch of Mey; Caithness Lochs	SSSI, Ramsar site, SPA	Aggregations of breeding and non-breeding birds, transition grassland.	1.9km, west	Site lies downstream of proposed Project work.
Duncansby to Skirza Head	GCR	Coastal geomorphology.	2.9km, east	Site lies along coast from proposed Project work.
Stroma	SSSI	Aggregations of breeding birds.	3.1km, north	None, site not cited for hydrological features.
Duncansby Head	SSSI	Aggregations of breeding birds, coastal geomorphology, maritime cliff.	3.2km, east	Site lies along coast from proposed Project work.
Loch Heilen	SSSI	Aggregations of non-breeding birds, mesotrophic loch.	4.1km, south-west	None, site lies within an unaffected catchment area.
Dunnet Links	SSSI	Coastal geomorphology, sand dunes.	4.6km, south-west	None, site is protected by intervening coastline from any changes to coastal processes.

Note:
[I]GCR: Geological Conservation Review site, a non-statutory designation for geological and geomorphological sites of national or international importance for earth science conservation (JNCC, 2011).

Table 17.6: Designated sites within 5km of the study area

17.5.3 Climate

17.29 The Meteorological (Met.) Office regional climate information (Met. Office, 2011) locates the Project within the Northern Scotland regional climatic area. Whilst much of Northern Scotland is exposed to rain-bearing westerly winds originating from the Atlantic Ocean, the study area which lies on the north coast is relatively sheltered from prevailing winds by the intervening landmass of the Northern Highlands. It is,

however, exposed to heavy seas from the North Atlantic and North Sea. Rainfall across Northern Scotland varies from over 4000mm near Fort William to less than 700mm along the Moray Firth coast.

17.30 The standard annual average rainfall (SAAR) for the site has been estimated from the Flood Estimation Handbook (FEH) CD-ROM as varying from 868mm to 894mm.

17.31 There is one weather monitoring station in the area near the site with a reliable dataset covering more than one year. This is located near Scrabster, at NGR ND 0931 7063, and is approximately 28 km west of the site. The station has been in operation since October 2007 (Weather Underground, 2011). Daily rainfall data have been collated to give monthly totals, with calculated averages where more than one year's data are available. The data are shown graphically in Figure 17.1.

17.32 As the station has been in operation for a relatively short time with occasional missed readings, there is the possibility that the data could be skewed by missing records or unusual rainfall patterns in one or more months. To overcome this problem, long-term historical data from the Met. Office monitoring station at Wick Airport, at NGR ND 3650 5220, has been included in Figure 17.1 for comparison. The Wick Airport station lies approximately 32km to the south-east of the site and has been in operation since 1914.

17.33 Both Scrabster and Wick Airport monitoring stations lie near sea level, with Scrabster at 73m AOD (above Ordnance Datum) and Wick Airport at 36m AOD. The annual average rainfall for the Wick station is 783mm. The Scrabster station reported a total annual rainfall of 783mm for 2008 and 779mm for 2010. The study area is located at a similar elevation to the monitoring stations and is expected to experience similar rainfall values to those shown in Figure 17.1.

17.34 The UK Climate Projections Report (UKCP, 2009) probabilistic projections of climate change would suggest that Northern Scotland will experience slightly increased temperatures in both summer and winter. This may result in a reduction in summer precipitation and an increase during winter. If climate change leads to drier summers, low flows and water shortages may occur in prolonged periods of dry weather. Increase in winter precipitation could increase the risk and extent of flooding.

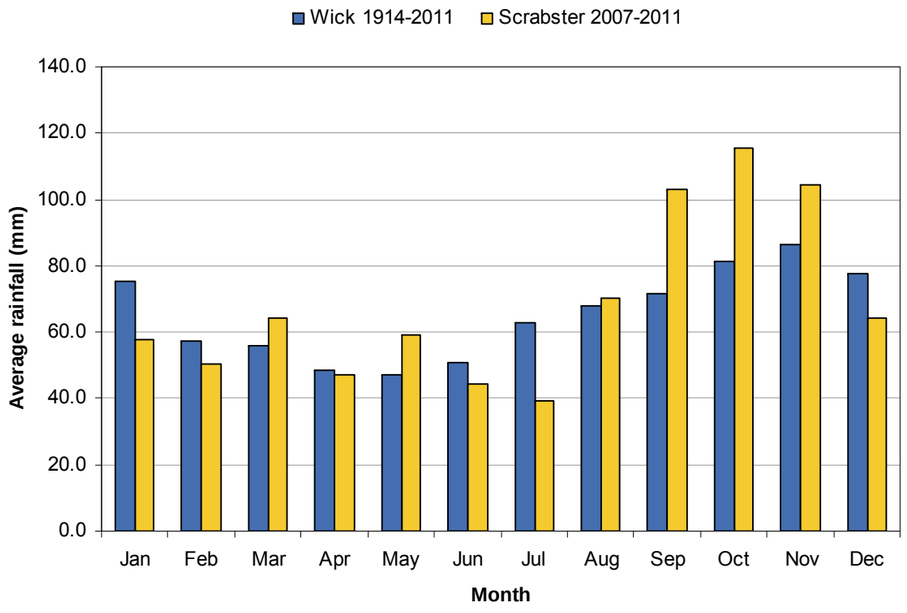

Figure 17.1: Monthly rainfall data for Scrabster and Wick monitoring stations

17.5.4 Geomorphology

17.35 The onshore infrastructure is proposed to occupy an area of agricultural and rough grazing land situated between the coastline and a maximum distance of 4km inland.

17.36 Much of the coastal section is marked by cliff exposures, typically 5 to 10m high, with a wave-cut platform of nearly flat-lying slabs exposed in the littoral zone at the cliff foot. The cliff sections are usually vertical to sub-vertical, with a sloping vegetated bank section at the top, and include good exposure of the local bedrock (Figure 17.2a).

17.37 In areas where cliff exposures are absent, the back wall of the beach is formed by a usually steep, vegetated bank of between 2 and 15m in height. These areas tend to have more beach development, composed largely of cobbles and boulders up to 2m in length. Storm beach development is present in some areas, marked by a steep shore profile of large blocky boulders; a particularly good example is present at Ness of Quoys (Figure 17.2b).

17.38 Inland, the topography is smooth and rolling, sloping gently down towards the coast. Slopes are generally shallow, rising to broad and indistinct hills a short distance inland. The site is cut by a series of watercourses, mainly marked by shallow and indistinct valleys. Some watercourses have more pronounced channels and two, the East and West Burns of Gills, are notable for their deeply incised character in the lower reaches. Most site watercourses have been heavily modified for land drainage.

Figure 17.2: Coastal geomorphology. (a) Cliff section and wave-cut platform, Ness of Huna, view north-west from NGR ND 3767 7155; (b) Storm beach, Ness of Quoys, view east from NGR ND 3458 7335

17.5.5 Onshore geology

17.39 Geological information is summarised from Johnstone & Mykura (1989), Trewin (2002) and BGS (2011a) with reference to information gathered on site.

17.40 The Project area underlain by rocks belonging to the Caithness Flagstone and Eday Groups of the Middle Old Red Sandstone, which are Devonian in age. The Caithness Flagstones (including the Spittal, Mey and Upper Stromness Flagstone Formations), which underlie the majority of the site including Stroma, consist of cycles of laminated, carbonate-rich siltstones and shales with subordinate fine-grained thinly bedded sandstones. These cycles are generally 5 to 10m thick but cycles up to 60m in thickness have been recorded in some locations. The younger Eday Group (including the John o' Groats Sandstone), a dominantly fluvial sequence consisting of medium-grained red sandstones with pebbly lenses, occurs in the area from John o' Groats southwards and in the coastal section around Gills Bay.

17.41 Northern Scotland has been significantly affected by major faultlines, such as the Great Glen Fault. However, the faults in the study area are minor in comparison. These faults traverse the site with either a

north-west to south-east or east-north-east to west-south-west orientation, bringing the younger John o' Groats Sandstone (Eday Group) into contact with the older Mey Flagstone (Caithness Flagstone Group).

17.42 Superficial geology within the area is dominated by glacial till and peat. The glacial till forms a blanket across approximately half of the site with peat covering the remaining portion. Ground investigation undertaken in the area identified that the glacial till typically includes an overlying layer of weathered till (e.g. Ian Farmer Associates, 2007). The weathered till is described as a brown sandy to gravelly clay, including some cobbles and occasional bands of silt, sand and gravel, with a soft to firm texture. The underlying till is described as a grey sandy to gravelly clay with occasional cobbles with a very stiff texture. Along the coastal sections the till is visible forming the steep banks that mark the backwall of the beach area and in some areas is also visible forming a cap at the top of cliff sections (Figure 17.2a).

17.43 Minor hummocky moraine deposits are present in the area around Phillips Mains. Alluvial deposits with minor river terrace deposits are present alongside the Burn of Rattar in the western part of the site. Marine beach deposits can be found along much of the coastal section and blown sand is present at the Ness of Duncansby.

17.44 Maps of the bedrock and superficial geology are provided in Figure 17.3 and Figure 17.4 respectively.

17.5.6 Offshore geology

17.45 The Middle Old Red Sandstone, which dominates the Caithness onshore area, continues offshore under Inner Sound and onto the Island of Stroma. The strata around Gills Bay and Stroma dip variably between 3° and 40°, owing to folding in the area, with dip directions generally to the east or west. The significant dip variations recorded may be due to faulting (RPS Energy, 2009). To the west of Stroma, dykes have intruded the sandstones with orientations of east and east-north-east. It has been suggested that these dykes may also occur within Inner Sound (RPS Energy, 2009).

17.46 The high velocity tidal currents within the sound have scoured the Quaternary deposits and seabed soils from the study area. In consequence, seabed sediments are largely restricted to cobble and boulder grade sediments, which are too heavy to transport far, including glacial erratics (RPS Energy, 2009).

17.47 BGS (1990) indicates that the sea floor between Helmsdale (NGR ND 0250 1550) and Dunnet Head (NGR ND 2010 7730) slopes away from the coast to a depth of approximately 60m in a distance between 5km and 10km. Within the study area RPS Energy (2009) indicates that the seabed depth ranges from 30m to 40m with a shallower slope angle on the Caithness shore than the Stroma shore. Depths greater than 30m are found within 500m of the Stroma shoreline.

17.48 Marine Scotland collected a number of video transects and still images within the Inner Sound in 2009 and 2010. Analysis of the footage indicates that the seabed in the northern part of the Sound is heterogeneous, composed mainly of shell gravel and including small outcrops of scour-polished rock. In contrast, the more southerly transects show a complex, uneven and fissured bedrock seafloor with boulders present in gullys and low areas. The fissures include occasional pockets of sediment.

17.49 iXSurvey (2009) reported that the seabed is largely formed from current-scoured bedrock demonstrating a 'saw tooth' profile. This is considered to form from differential erosion of the different rock types present within the Old Red Sandstone bedrock. Some parts of the offshore study area were mapped as subrock, where rock is at or near the seabed surface. These sections were concentrated mainly to the south and south-west of Stroma, providing additional confirmation to the Marine Scotland data. The remaining areas were characterised by megarippled sand, sandbanks and areas of coarse gravel. Further details of the Marine Scotland surveys and iXSurvey are included in Section 9.

17.50 Sediment samples were collected within the MeyGen Agreement for Lease (AfL) area (ASML, 2011). Analysis of the samples indicated that the loose seabed sediment is dominated by very coarse sand or very fine gravel consisting entirely of carbonate shell fragments. The bedload (particles transported along the seabed by water movement) consists almost entirely of very fine sand and finer, with a near absence of silt and clay material. Details of the sediment analyses are included in Section 10.

17.5.7 Soils

17.51 The following information is summarised from Macaulay Land Use Research Institute mapping (MLURI, 1981a) with reference to MLURI (1982, 2011) and information gathered on site.

17.52 The distribution of soils within the study area is dependent on the geology, topography and drainage regime of the area. The site soils consist of various soil units belonging to the Canisbay and Thurso soil associations, derived largely from the flagstones and sandstones of Middle Old Red Sandstone age. In addition, there are Organic Soils, derived from organic materials, and Alluvial Soils, derived from alluvial materials. The main soil types within the study area are:

- **Blanket peat**: accumulations of partly or completely decomposed organic material that have remained wet to the surface; typically dominated by *Sphagnum* mosses. Organic soils have greater than 60% organic matter and are considered to be 'deep' if the deposits are more than 1m thick;
- **Gleys**: naturally poorly drained soils that develop under conditions of intermittent or permanent waterlogging. Soils are typically greyish or blue-grey with orange mottling. **Peaty gleys** have a peat-rich surface horizon; **noncalcareous gleys** have a low lime content;
- **Brown forest soils**: fertile, usually free draining, often deep soils that are favoured for agriculture. Soils typically have a good crumb structure, mild acidity and are brown in colour, becoming gradually lighter as organic content decreases with depth. They are characteristic of areas originally covered with deciduous woodland, mostly now cleared for agriculture;
- **Rankers**: thin, immature soils usually with bedrock occurring between 10 and 30cm below land surface. Soils generally lack a subsoil horizon and predominate in mountain or hilly terrain, on steep slopes in association with rock outcrops or on glacially eroded rocky terrain. **Brown rankers** are fertile and free draining like brown forest soils; and
- **Alluvial soils**: derived from alluvial material, these soils have a very variable morphology, texture and drainage depending on the age and characteristics of the parent material. They are typically confined to principal river valleys and stream channels.

17.53 Four soil units are found within the environs of the study area and are summarised in order of dominance in Table 17.7. Each soil unit consists of varying proportions of the soil types discussed above, with the proportion of each soil type within a soil unit dictated by the local climatic, topographical and drainage conditions.

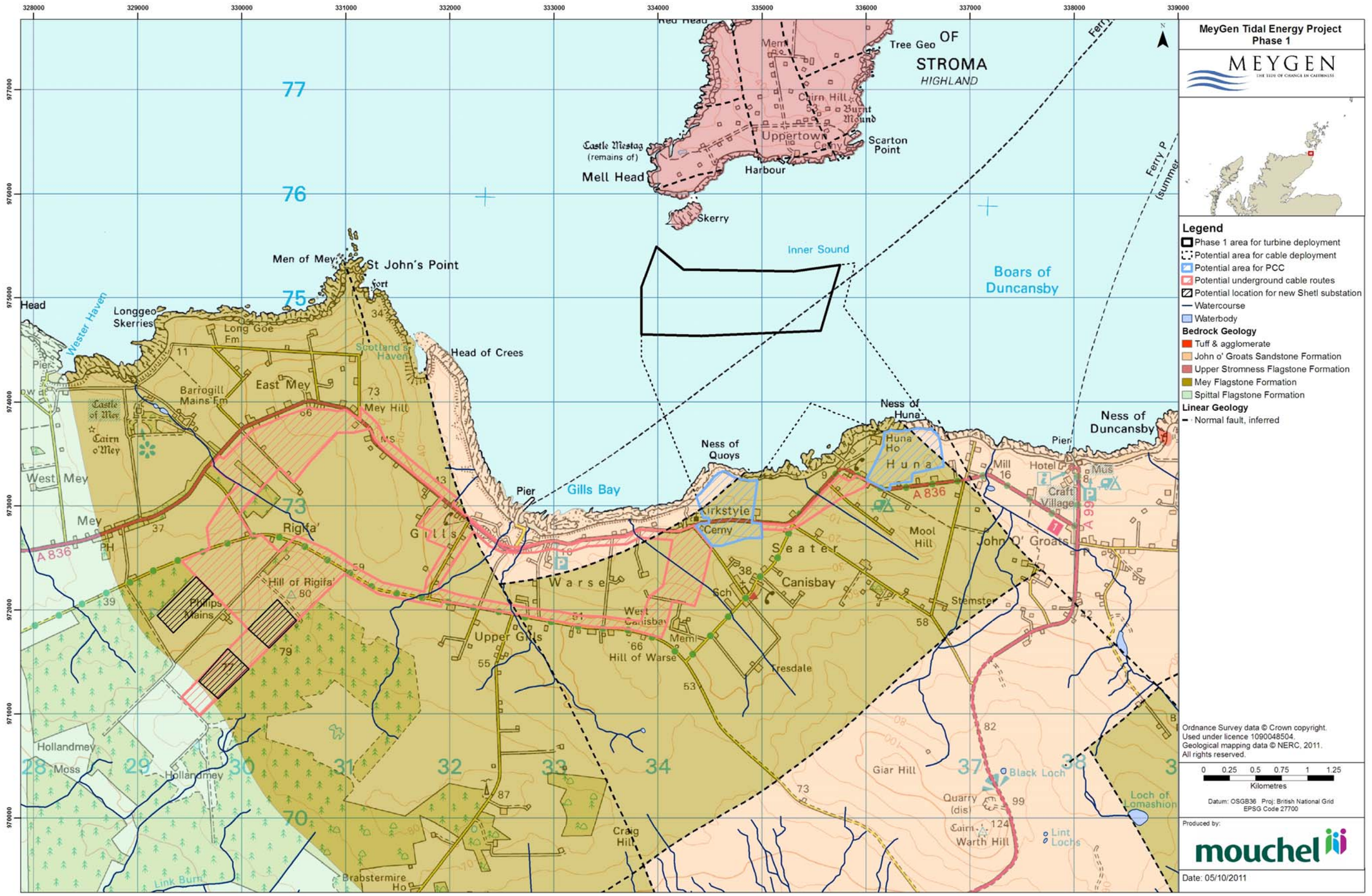

Figure 17.3: Onshore bedrock geology mapping

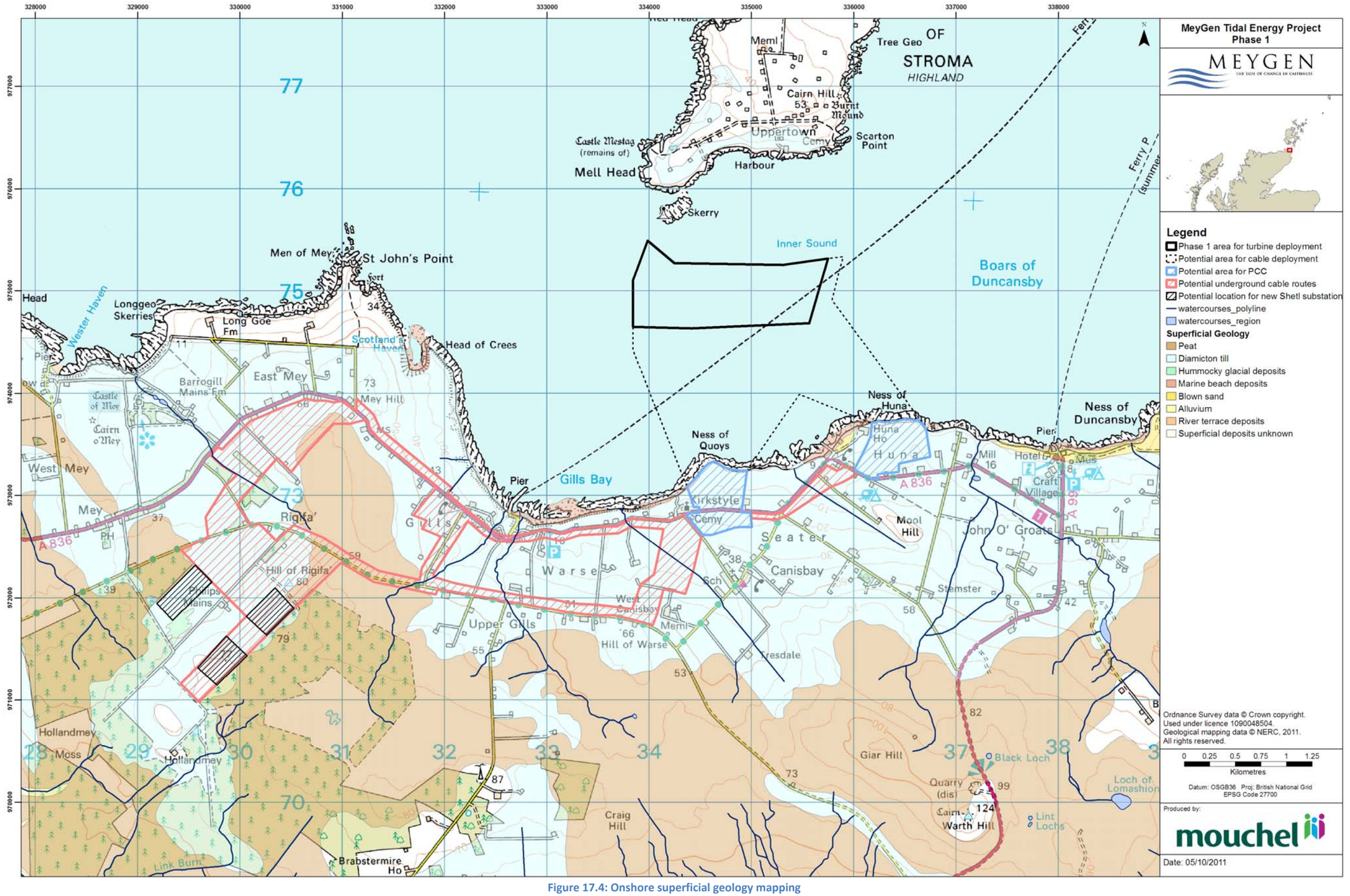

Figure 17.4: Onshore superficial geology mapping

Soil unit	Soil association	Parent materials	Component soils	Landforms	Vegetation
4	Organic Soils	Organic deposits.	Blanket peat (d - deep).	Uplands and northern lowlands with gentle and strong slopes.	Blanket and northern blanket bog; upland and flying bent bog; deer-grass bog; sedge mires.
79	Canisbay	Reddish brown drifts derived from Middle Old Red Sandstone sandstones and flagstones.	Noncalcareous gleys, peaty gleys.	Undulating lowlands with gentle slopes.	Arable and permanent pastures; rush pastures and sedge mires.
537	Thurso	Greyish brown drifts derived from Middle Old Red Sandstone flagstones and sandstones.	Noncalcareous gleys; some peaty gleys, brown forest soils and brown rankers.	Undulating lowlands with gentle slopes.	Arable and permanent pastures; rush pastures and sedge mires; acid bent-fescue grassland.
1	Alluvial Soils	Recent riverine and lacustrine alluvial deposits.	Alluvial soils.	Flood plains, river terraces and former lake beds.	Arable and permanent pastures; white bent grassland; swamp rush pastures and sedge mires.

Table 17.7: Soil units with associated landforms and vegetation land capability for agriculture

17.54 The following information is summarised from MLURI (1981b) with reference to information gathered on site.

17.55 The site is classified largely as land capable of use only as rough grazing. The vegetation is dominated by plant communities with low grazing values, particularly heather moor, bog heather moor and blanket bog (land capability class 6_3). Located mainly to the south of Upper Gills and round to Mey Hill, this land is used mainly for low density rough grazing.

17.56 The coastal section is mainly classified as land capable of producing a narrow range of crops (land capability class 4_2), primarily grassland with some limited potential for other crops. Grass yields can be high and some forage cropping is possible, with occasional cereal crops. This land is used mainly as improved or semi-improved grassland for stock grazing, with hay or silage crops taken from some fields. Arable crops are uncommon but are grown in some areas.

17.57 The western part of the site, around Mey, is situated on land capable of producing a moderate range of crops (land capability class 3_2), with high yields of barley, oats and grass often obtained. Other crops are usually limited to potatoes and forage crops. This area includes some areas of cereal crop, including wheat and oats.

17.58 A small area near the south-west corner of the site is classed as land capable of use as improved grassland (land capability class 5_2). Some parts of the site, around Phillips Mains, have been planted with commercial forestry.

17.5.8 Hydrogeology

17.59 Hydrogeological information is summarised from BGS (1988, 2011a) with reference to SNIFFER (2004a) and information gathered on site.

17.60 The Project site is underlain by the Middle Old Red Sandstone, which is classified as a locally important aquifer in which flow through the bedding planes and joints makes an important contribution to groundwater transport (Robins, 1990). Groundwater flow is generally limited to the upper weathered portion of the flagstones and is largely restricted to cracks and open joints. The bedrock generally consists of fine- to medium-grained sandstones with subordinate siltstones, mudstones and conglomerates. Borehole yields are typically low, usually less than 1 ls^{-1} in the Caithness area. Groundwater infiltration in this part of the study area, based on geology, topography and baseflow data, is estimated to be between 100 and 300$mmyr^{-1}$. The presence of faults within the area may influence groundwater flow and productivity, depending on the nature of the fault planes.

17.61 The glacial till is highly variable in composition and may contain lenses of sand and gravel which can support perched water tables. These are likely to be discontinuous and limited in extent and as such can have limited groundwater potential. The variable composition of the till indicates that it may act as a confining layer to the underlying Middle Old Red Sandstone in some areas and the presence of springs in some parts of Caithness supports this.

17.62 Peat deposits within the study area are discontinuous and occur mainly in the southern part of the study area. Most peat encountered was shallow, typically less than 0.7m in thickness and often dry in character. An area with peat generally deeper than 1m was encountered along the north-east slopes of the Hill of Rigifa'. The discontinuous and generally thin nature of the peat indicates it is unlikely to contribute substantially to groundwater potential. Watercourse catchments with peatland deposits may benefit from lateral seepage through the peat, contributing to baseflow in these areas. Peat deposits are unlikely to provide much additional storage for rainfall as the water table is typically close to or at the surface for much of the year.

17.63 The groundwater in this area has been assigned Class 4c with some areas of Class 4d (vulnerable to pollutants not readily adsorbed or transformed) (SNIFFER, 2004a, b) where peat is present. This reflects the dominantly fracture flow of groundwater within the bedrock, the low productivity which indicates low flow rates, and the variable composition and thickness of the overlying glacial tills. These factors mean that any contaminant would have limited opportunity to be removed or modified before reaching the groundwater. In the areas with significant peat thickness, the peat would act as a barrier to the entry of contaminants into the groundwater, although it would also serve to restrict access of water into the bedrock for dilution purposes.

17.64 Ground investigation results from the surrounding area indicate that water strikes occur variably between 1 and 8m below ground level although some boreholes and trial pits recorded no water strike (BGS, 2011b). Boreholes near the shoreline sometimes demonstrate a tidal influence (Iain Farmer Associates, 2007)

Groundwater dependent terrestrial ecosystems

17.65 Some habitat types identified on or near the potential onshore development areas fall under the description of groundwater dependent terrestrial ecosystems (GWDTE) as identified by SEPA (2010).

17.66 Two areas of potential GWDTE were identified within or near the site:

- Stroupster Peatlands SSSI/Caithness & Sutherland Peatlands SAC and Ramsar site, which includes groundwater dependent habitats within its citation, and
- A small area of habitat E1.7, wet modified bog, is located east of the Hill of Rigifa' along the margin of, and partially within, one of the cable route options. This is shown in Figure 18.3 (Section 18)

17.67 The Stroupster Peatlands SSSI/Caithness & Sutherland Peatlands SAC designated site lies approximately 230m from the nearest proposed infrastructure corridor. The area identified as habitat E1.7 lies immediately adjacent to, and partly within, the proposed infrastructure corridor.

17.5.9 Hydrology

17.68 The hydrology of the Project site has been considered using a surface water catchment-based system. It is recognised that Project activities may influence watercourses and locations beyond the proposed infrastructure area, therefore the baseline description includes areas downstream of any proposed activity.

17.69 The study area is drained by a number of small watercourses rising within the higher land situated to the south of the site. These watercourses mainly follow natural channels although it is apparent from their outline and from field observations that they have been modified by widening, deepening or straightening in order to improve land drainage (Figure 17.5a).

17.70 In addition to the natural watercourses, a large number of artificial drainage channels are present within the area principally for either land or roadside drainage. Land or field drains largely follow field

boundaries. Road drainage is typically located along both sides of public roads and links into the land drainage or natural watercourse network. Some of the observed artificial drains carry water regularly whereas others remain dry for much of the time (Figure 17.5b). Evidence was found on site of buried field drainage; this is likely to be extensive across the agricultural sections of the study area. Constructed drainage channels frequently cross catchment boundaries and may, in consequence, conduct water into or out of the natural catchments. Watercourse catchments are shown in Figure 17.7.

Burn of Rattar

17.71 The westernmost catchment, the Burn of Rattar or Link Burn drains the southern side of the Hill of Rigifa' before turning north to pass west of Loch of Mey. It enters the sea near Kirk o' Tang, at NGR ND 2519 7390. The catchment covers an area of 20.2km^2.

17.72 The upper part of the catchment is largely commercial forestry with the lower part mainly as agricultural land for grazing and crop production. Phillips Mains Mire SSSI lies across the watershed between the Burn of Rattar and the West Burn of Gills and forms an 'island' within forested land. The burn and its tributaries have been modified in some areas, notably in the agricultural area lower in the catchment but also associated with the forestry in the catchment headwaters, and artificial drainage within the catchment is extensive.

17.73 Very little of the potential onshore infrastructure is proposed to lie within this catchment (Figure 17.7).

Figure 17.5: Examples of modified and artificial drainage: (a) Burn of Mey, view south-east from NGR ND 3014 7310; (b) dry drainage ditch, Rigifa', view south-west from NGR ND 3059 7260

Burn of Horsegrow

17.74 Located immediately west of the Burn of Rattar, the Burn of Horsegrow forms the main inflow to the Loch of Mey. It drains the north-western side of the Hill of Rigifa' and flows generally north-west to the Loch of Mey. There is no clear outflow from the loch, although a network of drainage ditches continues north to the coastline from the loch to discharge at NGR ND 2732 7458. The catchment has an area of 7.7km^2.

17.75 As with the Burn of Rattar, the upper part of the catchment includes areas of commercial forestry although the area around Phillips Mains is largely agricultural land. The lower catchment is partly grazing and cropland and partly rough grazing, with the section around the Loch of Mey being dominated by marshy ground. The agricultural and forestry areas have been extensively drained and include a network of ditches and channels.

17.76 Two of the cable route options to potential grid connection points lie within this catchment (Figure 17.7).

Burn of Mey

17.77 Lying north-east of the Burn of Horsegrow catchment, the Burn of Mey is a small watercourse that rises in the marshy ground north of the Hill of Rigifa'. It flows north-west, past the Castle of Mey, to enter the sea at NGR ND 2893 7419. The catchment area is 3.2km^2 in size.

17.78 Although the headwaters rise in an area of peatland, this catchment is dominated by agricultural land with small areas of forestry in the upper section. In consequence, the burn and its tributaries have been straightened for much of their length.

17.79 Sections of the potential cable routes lie within the Burn of Mey catchment (Figure 17.7). .

West Burn of Gills

17.80 The West Burn of Gills flows north and east from the Hill of Rigifa', draining the northern half of Phillips Mains Mire SSSI, and meets the sea at Gills Bay at NGR ND 3259 7285. It has a catchment covering an area of 3.1km^2.

17.81 Much of the upper catchment is peat moorland with some commercial forestry around Phillips Mains Mire. In its lower reaches, the burn flows through agricultural land. In this section the burn channel becomes increasingly incised until, just inland of the coast, the burn flows through a pronounced valley approximately 10 to 15 m deep with a steep bank particularly on the eastern side (Figure 17.6a).

17.82 One potential grid connection point and sections of the potential cable routes pass through the catchment area (Figure 17.7).

East Burn of Gills

17.83 The East Burn of Gills drains the northern side of Craig Hill and the western side of Hill of Warse. The burn runs northwards to enter the sea at Gills Bay at NGR ND 3276 7278. Part of Stroupster Peatlands SSSI and the Caithness and Sutherland Peatland SAC and SPA lie within this catchment and across the watersheds into the adjacent Tresdale Burn and Burn of Freswick catchments. The East Burn of Gills catchment is 4.4km^2 in size.

17.84 The lower catchment and mid-section of the upper catchment are mainly agricultural land with extensive field drainage systems. The remainder of the upper catchment is largely rough grazing and peat moorland, some sections of which have historically been used for peat cutting. Similar to the West Burn of Gills, the burn channel is markedly incised in its lower reaches to a depth of approximately 10 to 15m with a steep bank on the eastern side (Figure 17.6b).

17.85 Parts of the potential cable routes lie within the catchment area (Figure 17.7).

Figure 17.6: Incised watercourse valleys beside the A836: (a) West Burn of Gills, view south from NGR ND 3243 7261; (b) East Burn of Gills, view south from NGR ND 3267 7255

Tresdale Burn

17.86 The Tresdale Burn flows from the lower slopes of Giar Hill, past Canisbay to Gills Bay where it discharges into the sea at NGR ND 3372 7287. A small part of the Stroupster Peatlands SSSI/Caithness and Sutherland Peatland SAC and SPA lies within the south-western corner of the catchment. The catchment covers a total area of 3.3km^2.

17.87 The southernmost part of the catchment, including the burn headwaters, is largely peat moorland and rough grazing. The lower section is agricultural land used for grazing and arable crops. The main burn channel and its tributaries have been modified for most of their length for drainage purposes.

17.88 Parts of the potential cable routes pass through the lower section of this catchment (Figure 17.7).

Burn of Huna

17.89 The Burn of Huna has the smallest catchment of all identified site watercourses, at 1.8km^2. It enters the sea between Ness of Quoys and Ness of Huna at NGR ND 3541 7326.

17.90 The majority of the catchment is occupied by agricultural land, so the Burn of Huna has been straightened and the drainage pattern modified by a network of ditches across much of the catchment. The southernmost part of the catchment is peat moorland.

17.91 Part of the proposed cable route from the potential Ness of Huna landfall / PCC location passes through the Burn of Huna catchment.

Burn of Duncansby

17.92 The Burn of Duncansby forms the easternmost catchment, entering the sea at NGR ND 3724 7354 just west of John o' Groats. The catchment area covers 8.9km^2 and the main watercourses (Burn of Duncansby and Burn of Stemster) flow generally northwards.

17.93 As with the other hydrological catchments, the lower section is agricultural in character with a network of drainage ditches and straightened watercourse channels. Most of the catchment, however, is characterised by peat moorland used for rough grazing and, in some areas, for peat cutting. A number of small lochs are present in the peatland area near the southern catchment boundary.

17.94 There is no proposed infrastructure within this catchment area.

Burn of Freswick

17.95 Lying immediately south of the study area, the Burn of Freswick or Gill Burn has the largest catchment at 26.3km^2. The dominant flow direction is eastwards as the Burn of Freswick enters the sea at Freswick Bay at NGR ND 3783 6714, with tributaries joining the main channel from the north and south.

17.96 The catchment is dominated by peat moorland. Some areas show signs of artificial drainage although much of the moorland remains in good condition. The coastal section is largely agricultural and there are blocks of commercial forestry inland.

17.97 There is no proposed infrastructure within this catchment.

17.5.10 Waterbody status

17.98 The Water Framework Directive (WFD) came into force in December 2003 and is implemented in Scotland through the *Water Environment and Water Services (Scotland) Act 2003*. A key objective of this Directive is the achievement of 'good ecological status' (as a minimum) of all natural waterbodies by 2015. This involves a move towards a risk-based classification system (SEPA, 2005). This risk-based system highlights such issues as stream morphology and existing artificial structures in addition to chemical water quality and ecological diversity. Heavily modified waterbodies, which can no longer be considered to be natural, are classified on the basis of 'ecological potential'.

17.99 Under the terms of the Water Framework Directive, all river basin districts are required to be characterised. This process requires SEPA to produce an initial assessment of the impact of all significant pressures acting on the water environment. Surface water bodies are defined as being whole or parts of rivers, canals, lochs, estuaries or coastal waters. The main purpose of identifying waterbodies is so that their status can be described accurately and compared with environmental objectives.

17.100 The WFD applies to all surface waters, but for practical purposes SEPA has defined a size threshold above which a river or loch qualifies automatically for characterisation. For lochs, the threshold is a surface area of 0.5km^2; rivers must have a catchment area of 10km^2 or more. In addition to these larger waterbodies, smaller waters have been characterised where there is justification by environmental concerns and to meet the requirements of regulatory legislation such as for drinking water supplies

17.101 Coastal water bodies have been classified based on latitude, longitude, tidal range and salinity, with additional information from mixing characteristics, substratum composition and wave exposure used to define the ecology of coastal waters.

17.102 Groundwater bodies have been identified to reflect the main aquifer types. For areas above low productivity aquifers, groundwater bodies have been defined using surface water subcatchments as a surrogate. Areas above high productivity aquifers have been defined using geological and major catchment boundaries.

17.103 Two local rivers have been classified under this system (SEPA, 2011a). In addition, the coastal section lies within one coastal waterbody and the entire onshore study area falls within one groundwater body. The classification results are presented in Table 17.8. The identified rivers are also indicated in Figure 17.8.

17.104 The Link Burn (Burn of Rattar) and Gill Burn (Burn of Freswick) are both regarded as having pass grades for chemical status and a good rating for hydromorphology. The Dunnet Head to Duncansby Head coastal waterbody is regarded has having a pass grade for chemical status and a high rating for hydromorphology. The Wick bedrock and sand and gravel aquifers waterbody is regarded as having a good rating for quality and quantity with no trend for pollutants. The current status of all waterbodies meets WFD requirements and should not be allowed to deteriorate. All site watercourses are considered to be of at least good status.

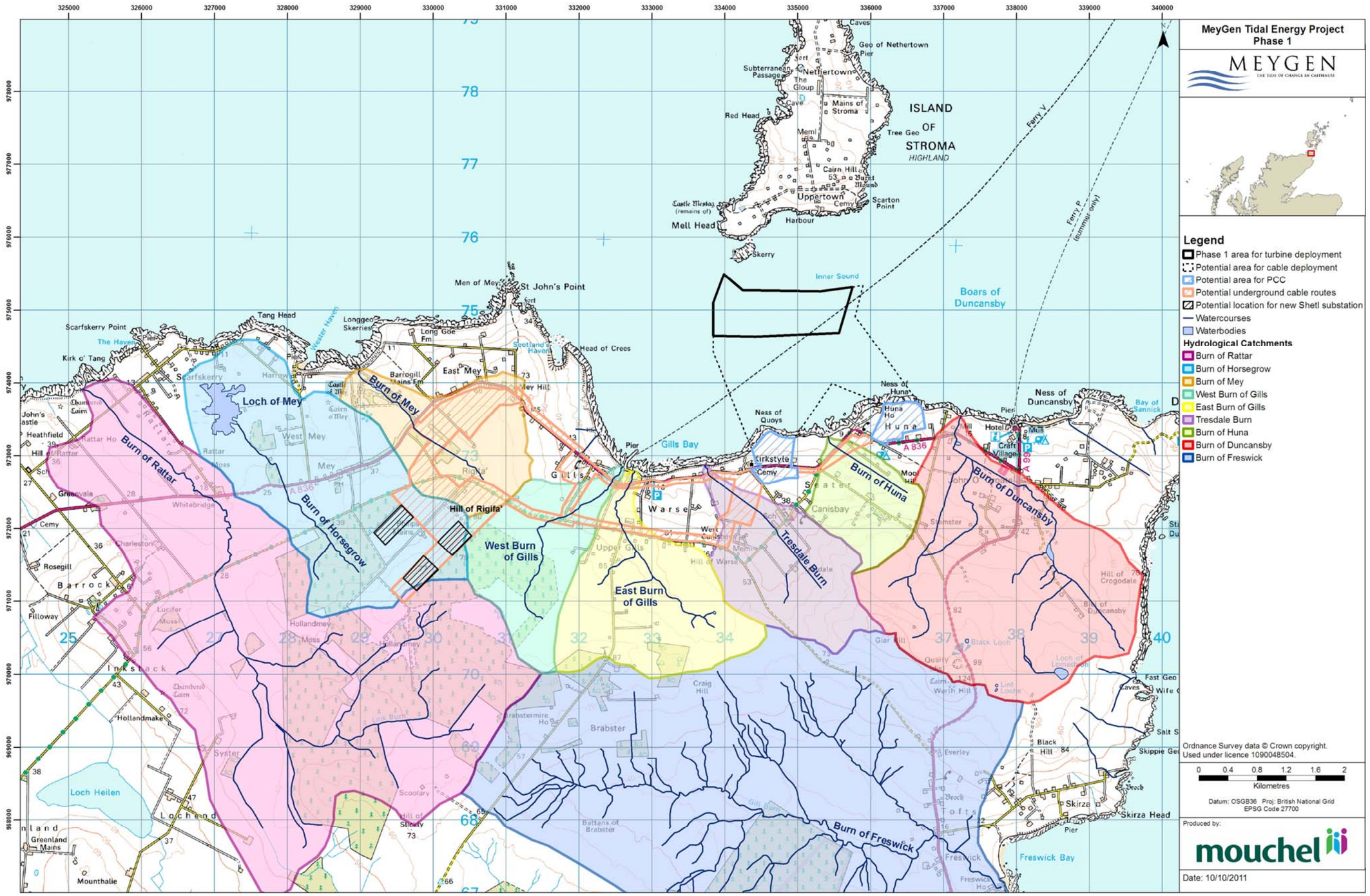

Figure 17.7: Hydrological catchment areas for site watercourses

Waterbody name	Waterbody ID	Waterbody category	Overall classification	Confidence of classification	Summary of pressures
Link Burn (Burn of Rattar)	20632	River	Good	Medium	No identified pressures
Gill Burn (Burn of Freswick)	20000	River	Good	Medium	No identified pressures
Dunnet Head to Duncansby Head	200225	Coastal	High	High	No identified pressures
Wick bedrock and localised sand and gravel aquifers	150361	Groundwater	Good	High	No identified pressures

Table 17.8: Waterbody classification and identified pressures

17.5.11 Flow levels

17.105 Peak runoff rates have been estimated for the full extent of each catchment using the Flood Estimation Handbook (CEH, 2009) catchment characteristics with the ISIS method used to derive a range of peak flow return periods (Halcrow/HR Wallingford, 2004). Low flow measurements have been determined by the Low Flow method (WHS, 2010) and are quoted as $Q_{95}(10)$. These data are shown in Table 17.9.

Catchment	Area (km^2)	Mean daily flow (m^3s^{-1})	$Q_{95}(10)$ (m^3s^{-1})	Estimated peak runoff (m^3s^{-1}) for each return period (years)						
				2	5	10	25	50	100	200
Burn of Rattar	20.2	0.31	0.03	6.11	8.36	9.79	12.1	14.1	16.0	18.5
Burn of Horsegrow	7.7	0.12	0.02	1.59	2.20	2.59	3.20	3.73	4.23	4.91
Burn of Mey	3.2	0.05	0.01	1.42	2.00	2.36	2.87	3.39	3.89	4.56
West Burn of Gills	3.1	0.05	0.01	1.38	1.94	2.28	2.79	3.29	3.75	4.38
East Burn of Gills	4.4	0.07	0.01	1.91	2.67	3.13	3.85	4.52	5.15	5.99
Tresdale Burn	3.3	0.05	0.01	1.56	2.20	2.60	3.16	3.73	4.27	5.00
Burn of Huna	1.8	0.03	0.004	1.08	1.54	1.82	2.23	2.58	3.00	3.55
Burn of Duncansby	8.9	0.13	0.02	1.57	2.18	2.55	3.15	3.68	4.19	4.88
Burn of Freswick	26.3	0.40	0.07	10.1	13.9	16.3	20.2	23.5	26.6	30.9

Table 17.9: Estimated flow statistics for local catchments

17.106 The Hydrology of Soil Types (HOST) is a hydrologically-based classification of soils on the basis of their physical properties and their effects on the storage and transmission of water (IH, 1995). It makes use of the fact that the physical properties of soils have a major influence on the hydrological response of a catchment. Other parameters can then be derived from the HOST classification. For the purposes of hydrological assessment, the Standard Percentage Runoff (SPR) and Baseflow Index (BFI) are the most useful parameters.

17.107 SPR is the average percentage of rainfall that causes the short-term increase in flow seen at a catchment outflow following a storm event (NSRI, 2008).

17.108 BFI is the long-term ratio of baseflow to total stream flow, where a baseflow represents the contribution to total flow from groundwater (SCEG, 2008). BFI values range from 0.1 in relatively impermeable clay catchments to 0.99 in highly permeable chalk catchments. A very low BFI of 0.15 represents a flashy catchment with minimal storage, low BFI values (e.g. 0.3) indicate a catchment with little storage and active runoff, a BFI of 0.7 (or greater) indicates a significant contribution to flow from a major aquifer.

17.109 For the Project area catchments, BFI-HOST values range from 0.24 to 0.29, indicating a low contribution from stored water sources, and SPR-HOST values range from 45-57%, indicating a flashy response to rainfall.

17.5.12 Flooding

17.110 SEPA provides a Scottish Flood Map (SEPA, 2011b) to give a Scotland-wide picture of the areas estimated to be at risk of flooding from rivers and/or the sea, in order to raise awareness of flood risk. The map shows the areas estimated to have a 0.5% or greater chance of flooding each year.

17.111 The map has been reviewed to establish the likelihood of river and/or coastal flooding within the potential development areas. River flooding has not been identified as a concern, with most site watercourses showing only minor flood risk confined to the immediate channel, or no flood risk. Site watercourses indicated as having minor flood risk are the Tresdale Burn, from NGR ND 3389 7264 to the sea, the East Burn of Gills, from Upper Gills (ND 3277 7173) to the sea, and the Burn of Mey, from Barrogill Mains Farm (ND 2932 7387) to the sea.

17.112 Potential flood risk within the Burn of Rattar catchment is slightly more extensive, from ND 2925 6931 to the sea and affecting small areas outwith the immediate watercourse channel. This is particularly notable around the village of Rattar and in the flat-lying area between Hollandmey and Lucifer Mosses around ND 2733 7045.

17.113 The Loch of Mey is indicated to have a flood risk affecting the adjacent low-lying marshy ground mainly to the west and south of the loch, with some flood risk potentially affecting the village of Scarfskerry between the loch and the sea.

17.114 Coastal flooding is indicated to have a limited effect along the coastal strip but is unlikely to reach further than the high water mark as identified on the OS 1:50,000 mapping. This should not affect the proposed onshore infrastructure, as this is planned to be located no less than 5m AOD and will be set back from the immediate coastline.

17.5.13 Water resources

Public water supplies

17.115 There are no Scottish Water supply sources or service reservoirs within the study area. A network of distribution mains is present throughout the study area, largely following the road network. In some areas, notably around Rigifa', Upper Gills/Warse and Canisbay, distribution mains follow cross-country routes. Pipes are variably constructed of iron, asbestos cement and plastic.

17.116 Once a final preferred route has been identified, consultation with Scottish Water to identify the location of distribution mains within the route corridor will be required to avoid inadvertent damage to the distribution network during necessary excavation work.

Private water supplies

17.117 Private water supply information has been provided by The Highland Council. There are no identified private water supply sources within the study area. Two private water supplies have been identified within 5km of the study area, one on Stroma and one at the Biel of Duncansby. As both are located within catchment areas with no proposed infrastructure they have been scoped out of any further assessment.

17.118 SEPA has noted that there are a number of properties using septic tanks present within the study area. Locations of these tanks and their associated pipework are currently unknown. It will be necessary to identify the tank locations and connecting pipe routes prior to undertaking any intrusive ground work to avoid causing damage to this infrastructure.

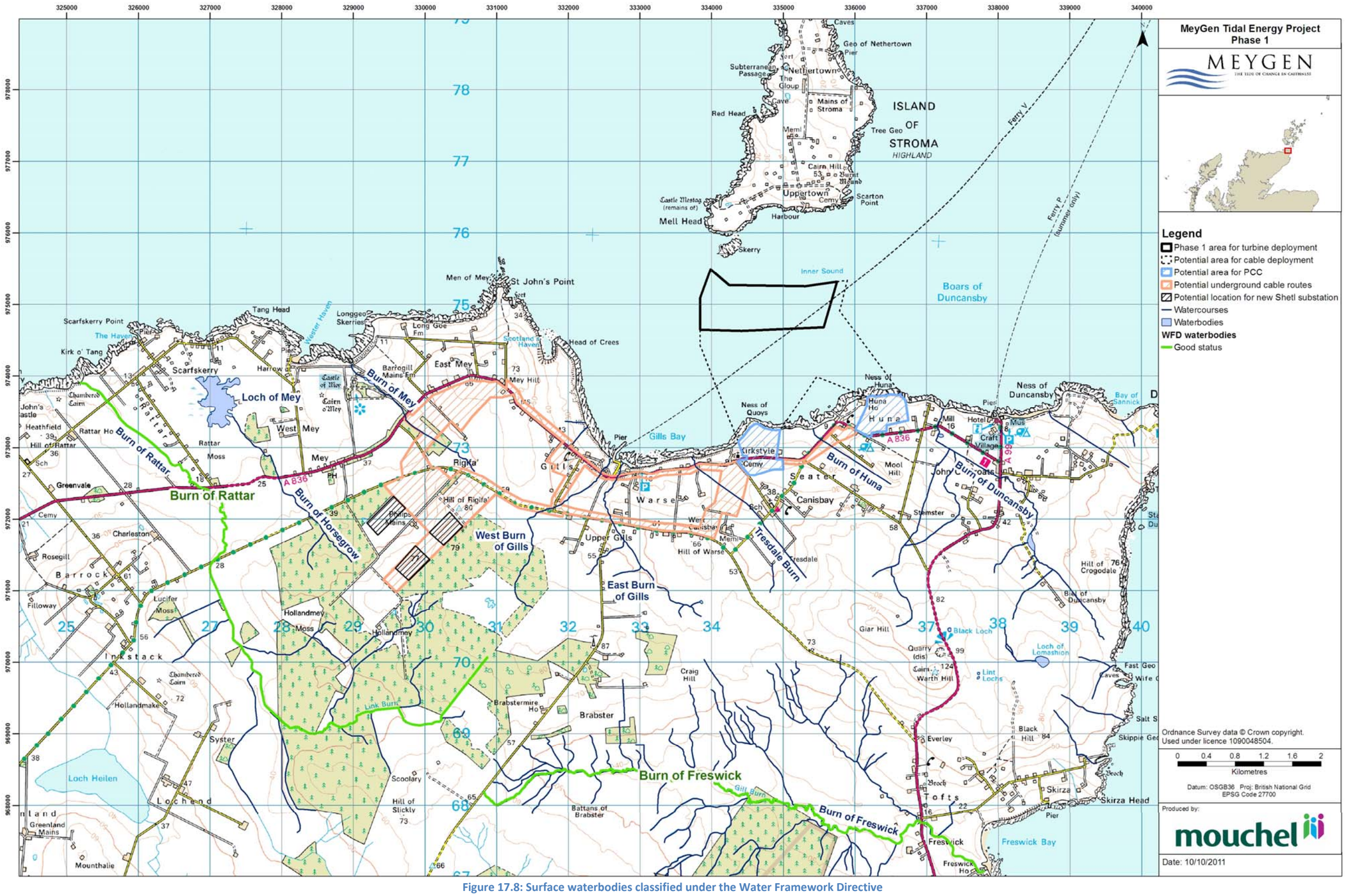

Figure 17.8: Surface waterbodies classified under the Water Framework Directive

17.5.14 Summary of baseline description

17.119 The proposed MeyGen Project area is located within the Inner Sound of the Pentland Firth, between Stroma and north Caithness. Associated onshore infrastructure is proposed to lie within the adjacent coastal section in the Gills Bay area. The area is dominated by agricultural land, mainly grazing and arable fields, with some areas of rough grazing and peat moorland. The littoral zone is characterised by mixed boulder and cobble beaches and wave-cut platform slabs, backed by steep cliffs or banks.

17.120 The underlying geology consists of cyclic sedimentary strata, dominated by fine- to medium-grained sandstones, siltstones and mudstones. Superficial deposits are characterised by glacial tills and peat with marine beach deposits along the coastline section. Site soils are mainly peat, peaty or noncalcareous gleys with minor contributions from other soil types.

17.121 A number of fairly small watercourses are present within or adjacent to the study area. The watercourses flow directly into the sea at various points along the north and east coast. Most watercourses have been modified for drainage purposes. Some public water supply distribution mains are present within the study area, mainly following the road network. No private water supplies were identified within the study area although two are located within 5km of the potential development areas.

17.122 One designated site lies partly within the study area. A watercourse draining part of the study area flows through the Loch of Mey SSSI and Ramsar site.

17.6 Impacts during Construction and Installation

17.123 The impact assessment is based on cable landfall at either Ness of Huna or Ness of Quoys, with a PCC located adjacent to temporary HDD site and cable landfall. The cable routes between the PCC and the grid connection point will be buried and follow one of the identified cable route corridors.

17.6.1 Impact 17.1: Pollution event

17.124 During construction activity, potential pollutants will be present in the site area. These will include fuel, lubrication oils, chemicals, unset concrete, grout and drilling fluid as well as waste and waste water from staff facilities. Any pollution incident occurring on the site may adversely affect the quality of nearby surface waters, groundwater or site soils.

Impact significance

Impact title	Sensitivity of receptor	Magnitude of impact	Consequence	Significance
Pollution event (surface water)	High	Moderate	Major	Significant
Pollution event (groundwater)	High	Moderate	Major	Significant
Pollution event (soils)	Medium	Moderate	Moderate	Significant

MITIGATION IN RELATION TO IMPACT 17.1

- All infrastructure will be located 50m or more from surface watercourses or waterbodies where possible.
- Concrete will not be batched on site.
- Use of wet concrete near watercourses will be minimised and carefully controlled.
- Water-based lubricants and drill fluid will be used where possible and drill fluid will be recycled throughout the drilling process to minimise total volume required. Any surplus drill fluid will be disposed of as controlled waste at the end of construction.
- Waste water and sewage will be disposed of in accordance with PPG4. Where ground conditions permit, disposal to ground will be considered as the preferred option. Locations of existing private septic tanks and associated pipework will be identified prior to undertaking any ground moving activity and will be avoided as far as possible to minimise the risk of damaging this infrastructure.
- Waste materials including drill cuttings generated during HDD (apart from the final 5-10m which will be discharged to sea), will be reused or recycled, and where this is not possible will be disposed of appropriately. A Construction Waste Management Plan will be produced by the appointed principal contractors and will follow guidelines similar to the ones set out in SEPA (2006).
- All equipment, materials and chemicals will be stored well away from watercourses, with at least a 50m separation. Chemical, fuel and oil stores will be stored safely in accordance with PPG2.
- Machinery standing for several days or longer will have drip trays placed underneath to prevent oil and fuel leaks causing pollution.
- Where practicable, refuelling of vehicles and machinery will be carried out in a designated area, on an impermeable surface and well away from any watercourse.
- Only emergency maintenance will be carried out within the Project area, on an impermeable surface and well away from watercourses. If vehicles have broken down, necessitating maintenance at the point of breakdown, special precautions will be taken.
- Construction traffic movements will be limited as far as practicable, to reduce the risk of accidental spillage.
- Washing-out of vehicles used to transport concrete, grout or drilling fluid will not be undertaken on site.
- Contingency plans will be in place to ensure that emergency equipment, such as spill kits and absorbent materials, is available on site and will include advice on actions to be taken and personnel to be informed in the event of a pollution incident.
- All relevant staff and site personnel will be trained in normal operating and emergency procedures and will be made aware of highly sensitive areas on site.
- All activity occurring within the Burn of Horsegrow catchment will be undertaken with particular care to minimise pollution risk to the Loch of Mey SSSI/Ramsar site and its tributary watercourses. Additional protection measures will be installed if necessary to ensure the site is adequately safeguarded.
- A suitably qualified Environmental Clerk of Works will be appointed who will have responsibility for ensuring mitigation measures are in place and are operating effectively.

Residual impact

Impact title	Sensitivity of receptor	Magnitude of impact	Consequence	Significance
Pollution event (surface water)	High	Negligible	Minor	Not Significant
Pollution event (groundwater)	High	Negligible	Minor	Not Significant
Pollution event (soils)	Medium	Negligible	Negligible	Not Significant

17.6.2 Impact 17.2: Erosion and sedimentation

17.125 Soil erosion and sediment generation may occur in areas where the ground has been disturbed. This will include preparation of the working width, excavation of cable trenches and building foundations, construction of open-cut watercourse crossings (where these are proposed), construction of temporary or permanent watercourse crossing structures for vehicle and plant access as required, from plant and machinery movements, construction of new track and hardstanding areas, drilling of cable boreholes, erosion of stockpiled soils, bare ground and new drainage ditches.

17.126 If this sediment reaches natural watercourses in the area it could cause high turbidity in the water, thus reducing light and oxygen levels with consequent effects upon the water quality and aquatic ecology of affected watercourses. The deposition of material could also reduce the flood storage capacity of watercourse channels, introducing a flood risk to the site or nearby area.

Impact significance

Sensitivity of receptor	Magnitude of impact	Consequence	Significance
High	Moderate	Major	Significant

MITIGATION IN RELATION TO IMPACT 17.2

- All earth-moving operations will be undertaken in compliance with BSI Code of Practice for Earthworks, BS 6031:2009. This will include halting of all earthworks during and immediately after heavy rainfall events.
- All heavily sediment-laden discharges will be routed through balancing tanks and one or more suitable filters or silt-busters in series as necessary, to reduce the sediment load.
- Water with light sediment load and supernatant water following treatment to remove heavy sediment load will be discharged onto vegetated surfaces and directed away from surface watercourses and ditches to avoid direct entry into the surface water system.
- In areas where it is necessary to run cable trenches and working width parallel to and within 20m of roadside or field drainage ditches, additional sediment control measures may be required to ensure the existing drainage network continues to operate at its current level. Additional control measures may take the form of silt fences, bunds, straw bales or other suitable barrier as appropriate to local conditions.
- Measures to control surface water runoff will be instigated prior to topsoil stripping. These may include retention of vegetation cover on watercourse banks, installation of straw bales or alternative barrier to intercept runoff or the installation of new land drains.
- Sediment control measures and temporary drainage will remain in place until vegetation cover has been re-established on the working width, to prevent reinstated soils being carried into nearby watercourses.
- Where open-cut cable crossings of watercourses are proposed, preference will be given to isolated open-cut techniques to minimise any potential release of sediment to the watercourse. Watercourse bed and bank material will be fully reinstated prior to the restoration of flow in the channel.
- All activity occurring within the Burn of Horsegrow catchment will be undertaken with particular care to minimise the risk of sediment release to the Loch of Mey SSSI/Ramsar site and its tributary watercourses. Additional protection measures will be installed if necessary to ensure the site is adequately safeguarded.
- A suitably qualified Environmental Clerk of Works will be appointed who will have responsibility for ensuring mitigation measures are in place and are operating effectively.

Residual impact

Sensitivity of receptor	Magnitude of impact	Consequence	Significance
High	Negligible	Minor	Not Significant

17.6.3 Impact 17.3: Soil compaction and loss of quality

17.127 Vehicle movements on site will result in localised compaction of soils under temporary running surfaces. Reinstatement of working width and cable trenches could also result in soil compaction and in mixing of different soil horizons. Poor storage of soil in stockpiles can result in loss of soil structure and erosion of soil particles, causing a reduction in soil quality.

Impact significance

Sensitivity of receptor	Magnitude of impact	Consequence	Significance
Medium	Moderate	Moderate	Significant

MITIGATION IN RELATION TO IMPACT 17.3

- Vehicle movements on site will be restricted as far as practicable, especially on temporary tracks and within the working width, to restrict soil compaction.
- Specialist low ground pressure vehicles will be considered for construction work, to minimise the requirement for temporary tracks.
- For the working width and cable trenches, topsoil will be stripped on a field-by-field basis and stored in a mound running alongside the working width on unstripped land. Where possible, topsoil will be stripped in reasonably dry conditions and stored in a mound no more than 2m high.
- Stored topsoil will be kept free from the passage of vehicles and will be prevented from intermixing with other materials. Erosion protection will be placed around stockpiles if required to minimise soil loss to surface runoff.
- Subsoils removed from the cable trenches will be stored on the opposite side of the working width from stored topsoil and will be laid on undisturbed subsoil.
- Topsoil reinstatement will be carried out under suitably dry conditions in order to limit compaction. Soil loosening may be required in areas where compaction is a problem, such as under the running track or under temporary track routes.
- A suitably qualified Environmental Clerk of Works will be appointed who will have responsibility for ensuring mitigation measures are in place and are operating effectively.

Residual impact

Sensitivity of receptor	Magnitude of impact	Consequence	Significance
Medium	Negligible	Negligible	Not Significant

17.6.4 Impact 17.4: Increase in surface runoff

17.128 Constructed impermeable or poorly permeable surfaces, such as new buildings, temporary or permanent tracks and hardstanding areas restrict infiltration of rainfall and surface water into the soil and underlying superficial deposits. This results in increased volumes of surface runoff and increased surface flow velocities. This impact is largely incremental during construction and the full effect is unlikely to be seen until the works have been completed and the scheme is operational.

Impact significance

Sensitivity of receptor	Magnitude of impact	Consequence	Significance
High	Negligible	Minor	Not Significant

MITIGATION IN RELATION TO IMPACT 17.4

- Although no significant impact has been identified, mitigation measures have been provided as a precautionary approach to ensure this remains the case.
- All temporary tracks and hardstanding areas will be removed and fully reinstated upon completion of the construction work.
- All temporary excavations associated with excavations will be fully reinstated upon completion of the construction work once vegetation has been re-established on previously stripped ground.
- Where permanent modifications to land drainage are required, such as around the PCC site, alternative drainage will be installed prior to construction to provide continuity of flow capacity in the affected area.

17.6.5 Impact 17.5: Modification of drainage patterns

17.129 Interception of diffuse overland flow by temporary drainage alongside foundation and cable trench excavations will disrupt the natural drainage regime of the site by concentrating flows and changing soil drainage. Permanent drainage will be required around the PCC and substation and alongside permanent access tracks.

17.130 The natural drainage regime has already undergone extensive modification relating to land drainage, as a network of surface ditches and buried field drains, and road drainage, alongside the public road network.

Impact significance

Sensitivity of receptor	Magnitude of impact	Consequence	Significance
Medium	Minor	Minor	Not Significant

MITIGATION IN RELATION TO IMPACT 17.5

- Although no significant impact has been identified, mitigation measures have been provided as a precautionary approach to ensure this remains the case.

17.6.6 Impact 17.6: Impediments to surface flows

17.131 Surface flows can be impeded by construction activity in or adjacent to watercourse channels, poor selection of watercourse crossing locations, inadequate design of temporary or permanent watercourse crossing structures or crossing of watercourses by plant in locations with no crossing structure. These activities can also result in permanent bank damage, leading to potential future instability and further restrictions to flow.

17.132 Blockages can be caused by inadequate control of earth-moving plant, increased sedimentation and poor waste management. These can lead to an increase in flooding upstream and could have long term effects on the dynamics of the watercourse.

17.133 Where surface watercourses are used for livestock watering, flow restrictions or changes of this nature can impact upon the long term availability and quality of the water supply.

17.134 A number of watercourse crossings will be required on the identified cable route options. The total number of crossings will depend on the final route selected but is likely to be between four and six. Details of all possible watercourse crossing locations are provided in Table 17.10 with their locations indicated in Figure 17.9; in each case the grid reference indicates the approximate midpoint of the potential cable corridor. Additional crossings of drainage ditches, whether roadside or land drainage, will be also be required although the total number will depend on the final cable routing required.

Watercourse crossing details		Watercourse photograph
Crossing	SC01, Burn of Huna (Figure 17.9)	 SC01, looking upstream (south-east) from A836 crossing
Grid reference	NGR ND 3562 7305	
Description	Modified & straightened burn 0.5m wide by up to 1.5m deep. Bed is stony with gravel & sand. Channel very overgrown for most of its length. Used for cattle watering just upstream of A836.	
Suggested construction	Isolated open-cut with temporary bridge for construction traffic	
Crossing	SC02, Tresdale Burn (Figure 17.9)	 SC02, looking downstream (north-west)
Grid reference	NGR ND 3427 7236	
Description	Modified & straightened burn 1.0-2.0m wide by up to 1.5m deep. Channel very overgrown and water appears nearly stagnant.	
Suggested construction	Isolated open-cut with temporary bridge for construction traffic	
Crossing	SC03, Tresdale Burn (Figure 17.9)	 SC03, looking upstream (south-east) from A836 crossing
Grid reference	NGR ND 3379 7271	
Description	Small burn, modified & straightened, 1.5-2.0m wide by up to 2.0m deep. Gravel & cobble bed with overgrown channel.	
Suggested construction	Isolated open-cut with temporary bridge for construction traffic	

Watercourse crossing details		Watercourse photograph
Crossing	SC04, East Burn of Gills (Figure 17.9)	 SC04, looking downstream (north-north-west) from minor road crossing
Grid reference	NGR ND 3258 7200	
Description	Moderate burn 2.0-3.0m wide by up to 1.5m deep. Bedrock, cobble and gravel bed with well vegetated banks. Becomes incised towards northern edge of cable route.	
Suggested construction	Isolated open-cut with temporary bridge for construction traffic	
Crossing	SC05, East Burn of Gills (Figure 17.9)	 SC05, looking south-east from A836 crossing towards steep slope
Grid reference	NGR ND 3267 7256	
Description	Moderate burn 2.0-4.0m wide by 1.0-2.0m deep. Deeply incised by approximately 15m especially on steep eastern side. Boulder, cobble & gravel bed with very well vegetated banks.	
Suggested construction	Directional drilling or similar non-open-cut method	
Crossing	SC06, West Burn of Gills (Figure 17.9)	 SC06, looking upstream (south-west)
Grid reference	NGR ND 3178 7215	
Description	Moderate burn 1.0-3.0m wide by 1.0m deep with headwaters in peaty ground. Bed is largely gravel with cobbles and channel is very overgrown. Incised in places to 2-3m, although this is less pronounced both up- and downstream.	
Suggested construction	Isolated open-cut with temporary bridge for construction traffic	

Watercourse crossing details		Watercourse photograph
Crossing	SC07, West Burn of Gills (Figure 17.9)	 SC07, looking upstream (south-west) from A836 crossing
Grid reference	NGR ND 3244 7263	
Description	Moderate burn 2.0-4.0m wide by 1.0-2.0m deep. Deeply incised by approximately 15m especially on steep eastern side with undercutting on east bank. Boulder, cobble & gravel bed with very well vegetated banks.	
Suggested construction	Directional drilling or similar non-open-cut method	
Crossing	SC08, unnamed burn (Figure 17.9)	 SC08, looking downstream (north-east)
Grid reference	NGR ND 3204 7307	
Description	Marshy & overgrown ditch approximately 2.0m wide by 0.5m deep. No flow apparent, channel is entirely filled with rushes.	
Suggested construction	Microsite to avoid crossing	
Crossing	SC09, Burn of Mey (Figure 17.9)	 SC09, looking downstream (north-west)
Grid reference	NGR ND 3004 7315	
Description	Modified & straightened burn variably 1.0-1.5m wide by up to 1.5m deep. Bed is mainly gravel & sand with flagstones & cobbles in places. Channel has recently been cleared as it crosses the field (July 2011).	
Suggested construction	Isolated open-cut with temporary bridge for construction traffic	

Table 17.10: Watercourse crossing details

17.135 A number of temporary crossings are likely to be required to facilitate vehicle access to the cable route during the construction work. Regulations relating to the construction of underground crossings and permanent or temporary bridges or fords and the levels of authorisation required are summarised in Table 17.11, extracted from SEPA's CAR Practical Guide v5.

17.136 General advice regarding river crossing techniques includes:

- Ground levels around any watercourse crossing must not be raised, to maintain floodplain storage and conveyance capacity; and
- Any excess spoil arising from the works should be disposed of outwith the flood risk area to avoid loss of floodplain volume.

17.137 It is anticipated that cable crossings of watercourses will be achieved by isolated open-cut as all site watercourses are small in width and typically carry fairly low flow volumes. If crossings in the lower reaches of the West and East Burns of Gills are proposed, directional drilling may be required owing to the incised nature of the watercourse channels in the lower sections. Where possible, multiple crossings of a single watercourse will be avoided to minimise the total effect on the watercourse. In addition, the total number of watercourse crossings will be kept to a minimum to restrict impacts on the water environment as far as practicable.

General Binding Rule	Registration	Simple Licence	Complex Licence
Bridges and other types of crossing structures			
Minor bridges with no construction on bed or banks [General Binding Rule 6]	Bridges with no construction on bed and ≤20m of total bank affected	All other bridges, fords and causeways	N/A
Temporary bridges in rivers <5m wide [General Binding Rule 6]	Pipe or box culvert used for footpaths, cycle route or single track road in rivers ≤2m wide	All other pipe or box culverts used for crossings	N/A
Pipelines or cable crossings by boring beneath the bed of inland surface waters [General Binding Rule 7]	Pipeline or cable crossings beneath bed by isolated open-cut	All other pipeline or cable crossings, e.g. by direct open-cut or laid on channel bed	N/A

Table 17.11: Engineering levels of authorisation from CAR

17.138 No watercourse crossings on permanent tracks are anticipated. Track crossings of roadside and land drainage ditches are likely to take the form of culverts, sized appropriately for the flow capacity of the ditches to ensure their continued operation and prevent increase in flood risk.

Impact significance

Sensitivity of receptor	Magnitude of impact	Consequence	Significance
High	Minor	Moderate	Significant

MITIGATION IN RELATION TO IMPACT 17.6

- All crossings will be constructed taking account of guidance and good practice detailed in SEPA's Engineering in the Water Environment Good Practice Guide: River Crossings (2010) and Scottish Executive's River crossings & migratory fish: Design guidance (2000).

Residual impact

Sensitivity of receptor	Magnitude of impact	Consequence	Significance
High	Negligible	Minor	Not Significant

17.6.7 Impact 17.7: Increase in fluvial flood risk

17.139 Installation of the underground cable will require excavation of a continuous trench from the selected PCC to the substation location. As the cable will have to cross several watercourses and existing drainage ditches, engineering work will be required in or near watercourses and across potential floodplain areas. The existing natural and artificial drainage network across the site area is extensive.

17.140 Engineering work in or near watercourses and in floodplain areas can adversely affect the watercourse flow dynamics and cause loss of flood storage capacity.

Impact significance

Sensitivity of receptor	Magnitude of impact	Consequence	Significance
Medium	Moderate	Moderate	Significant

MITIGATION IN RELATION TO IMPACT 17.7

- Ground levels around temporary and permanent watercourse crossings and along the line of the cable trench will not be raised and care will be taken to ensure that bed reinstatement above cable trench crossings does not impede water flow within the channel.
- Permanent infrastructure will be located outwith the 1-in-200 year flood risk area and at least 5 m AOD to minimise risk from coastal flooding.
- Where possible, siting of the PCC and associated infrastructure will avoid the existing field drainage network. If this is not possible, alternative field drainage will be installed prior to construction work to provide continuity of flow capacity in the affected area.
- Track crossings of watercourses, including field and roadside drainage ditches, will be sized appropriately to ensure flow is not restricted. A programme of inspection and maintenance will be put in place to ensure their continued effective operation throughout the lifetime of the project.
- Should excess spoil arise from engineering works, this will be disposed of outwith the floodplain area to avoid loss of flood storage capacity.

Residual impact

Sensitivity of receptor	Magnitude of impact	Consequence	Significance
Medium	Negligible	Minor	Not Significant

17.6.8 Impact 17.8: Modification of groundwater levels and flows

17.141 Excavation work, such as that required for cable trenching and for building foundations, can disrupt shallow groundwater systems. Groundwater controls, such as physical cut-offs or dewatering, will be used as necessary to prevent excavations filling with water. This may result in a lowering of groundwater levels in the vicinity of the excavations. The effects of dewatering are likely to be localised and temporary. No groundwater discharges were identified in the area during the site visit.

17.142 The cable trenches would be likely to provide preferential flow paths for groundwater. This is particularly likely where trenches are backfilled with more permeable material than the surrounding soil or in areas where the cable requires to be seated on sand. This can have a permanent effect on the groundwater flow regime in the area.

17.143 Potential groundwater dependent terrestrial ecosystems have been identified in two areas. The Stroupster Peatlands SSSI/Caithness & Sutherland Peatlands SAC designated site lies approximately 230m from potential cable route options. The designated site is located uphill and across an existing minor road from the proposed cable routes. The minor road has roadside drainage ditches along both sides. It is therefore very unlikely that additional impacts on the designated site will result from cable trench excavation.

17.144 A small area of wet modified bog, habitat type E1.7, is located partly within a potential cable route. The habitat in this area is already degraded owing to previous use of the area for peat cutting. In addition, a minor road with roadside drainage ditches runs along the north-eastern boundary of the habitat area. The cable route corridor lies along the downhill edge of the habitat area. Excavation of cable trenches through the north-eastern edge of this area would cause some disruption to groundwater flow but the effects would be limited as most of the habitat area is uphill from the cable route and the habitat is already degraded from optimal condition.

Impact significance

Impact	Sensitivity of receptor	Magnitude of impact	Consequence	Significance
Modification of groundwater levels & flows (groundwater)	High	Minor	Moderate	Significant
Modification of groundwater levels & flows (GWDTE)	High	Negligible	Minor	Not Significant

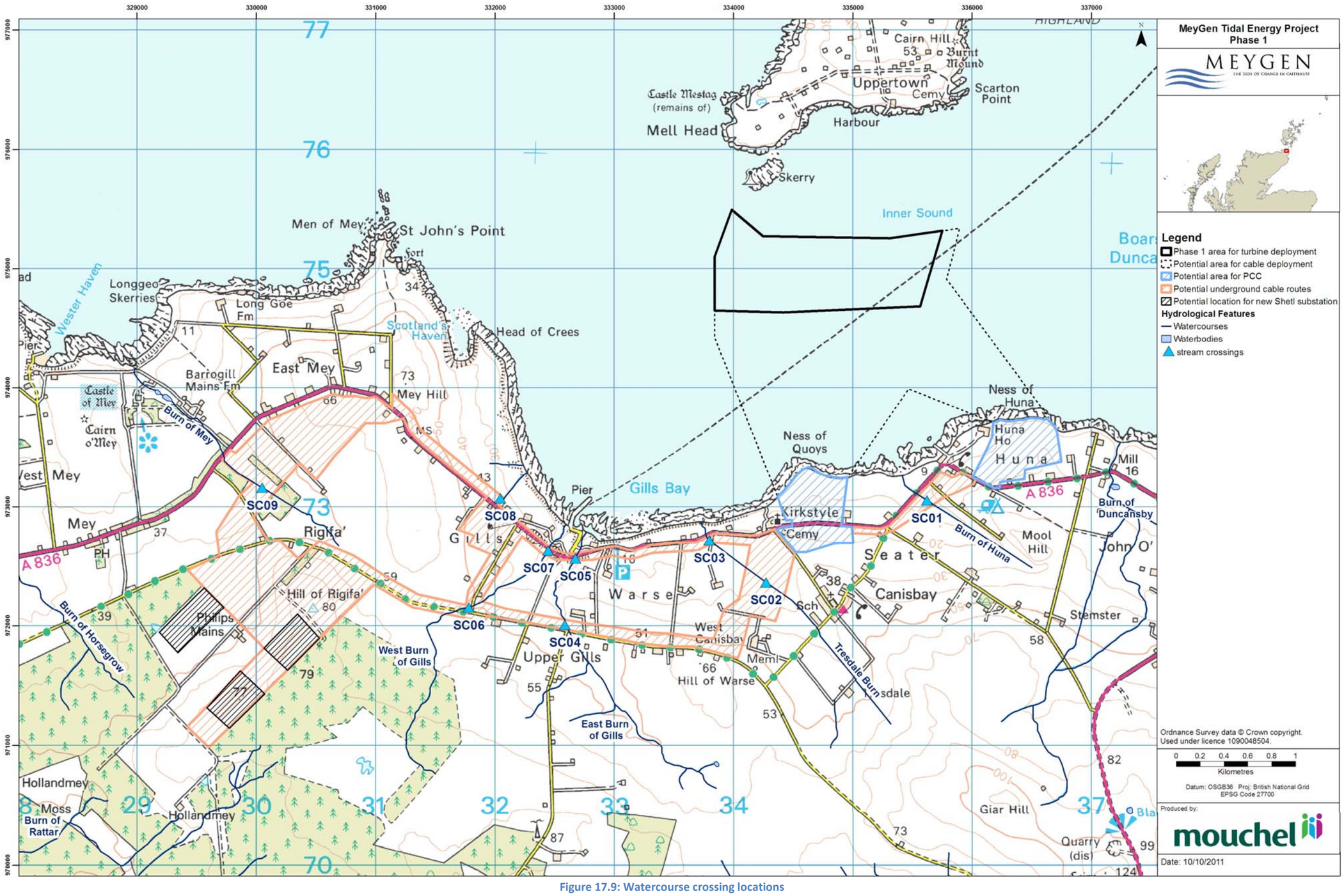

Figure 17.9: Watercourse crossing locations

MITIGATION IN RELATION TO IMPACT 17.8

- Cable trench backfill will be compacted to an appropriate degree to minimise along-trench groundwater flow without compromising the required technical performance.
- Where the cables are required to be seated on sand, use of cement-bound sand or appropriate alternative impermeable barrier will be considered to divert groundwater from the trench.
- If groundwater discharges are identified during construction, cable trenches and infrastructure will be microsited where possible to avoid the identified discharge location.
- In the event that the cable route running from Upper Gills to the Hill of Rigifa' is selected as the preferred option, cables will be located as close to the road as possible in order to minimise disruption to the identified groundwater dependent terrestrial ecosystem in this corridor. Consideration will be given to locating the cable trenches across the road from the identified habitat area to avoid further disruption to groundwater flow.

Residual impact

Impact	Sensitivity of receptor	Magnitude of impact	Consequence	Significance
Modification of groundwater levels & flows (groundwater)	High	Negligible	Minor	Not Significant
Modification of groundwater levels & flows (GWDTE)	High	Negligible	Minor	Not Significant

17.6.9 Impact 17.9: Damage to geological or geomorphological features

17.145 Much of the trench is likely to require cutting through bedrock, to a depth of 1.2m below ground level. For trench crossings of watercourses this will be to at least 1.2m below the natural watercourse bed level. Breaking to facilitate trench excavation through bedrock will cause localised damage to the bedrock geology and may result in additional fracturing within nearby sections of the bedrock.

17.146 Excavation of the cable trench through superficial geology deposits will result in disturbance to the horizons present within the material, including loss of natural structure and sediment mixing during excavation work and storage.

17.147 Surface features of geomorphological interest may be damaged during trench excavation. This is particularly relevant to watercourse morphology. No open trenching is planned within the coastal or littoral area so no damage to coastal geomorphological features is anticipated.

17.148 Coastal processes modelling indicates that no additional erosion or sediment deposition is anticipated along the coastal section near the development area. In consequence, the local sites designated for geological and geomorphological characteristics are not expected to be affected by the development.

Impact significance

Impact	Sensitivity of receptor	Magnitude of impact	Consequence	Significance
Damage to geological/ geomorphological features	Low	Minor	Minor	Not Significant
Damage to geological/ geomorphological features (designated sites)	High	Negligible	Minor	Not Significant

MITIGATION IN RELATION TO IMPACT 17.9

- No mitigation measures proposed as no significant impact predicted.

17.6.10 Impact 17.10: Mobilisation of contaminants

17.149 A number of road crossings will be required on the final cable route, varying between nine and 16 depending on the route selected. Road crossings are likely to be constructed by open-cut trenching, although crossings of the A836 may be better achieved by auger boring or other non-open-cut technique. Construction of road crossings could provide a preferential pathway for fluid flow, providing a direct link into ground and surface water systems and potentially allowing mobilisation of contaminated soil particles as dust or other sediment.

17.150 Road surface and sub-base material may be contaminated with a variety of metals, hydrocarbons and other materials which may be hazardous to the water environment.

Impact significance

Impact	Sensitivity of receptor	Magnitude of impact	Consequence	Significance
Mobilisation of contaminants (surface water)	High	Negligible	Minor	Not Significant
Mobilisation of contaminants (groundwater)	High	Negligible	Minor	Not Significant
Mobilisation of contaminants (soils)	Medium	Minor	Minor	Not Significant

MITIGATION IN RELATION TO IMPACT 17.10

- Although no significant impact has been identified, mitigation measures have been provided as a precautionary approach to ensure this remains the case.
- Excavated material from road surface and sub-base may need appropriate disposal as hazardous waste. Testing will be required to determine if this is required. Disposal would be subject to agreement and licensing by The Highland Council and SEPA.
- Water ingress to the excavation may contain contaminants and would require collection and appropriate treatment to remove contaminant prior to discharge. This may be subject to agreement and licensing by SEPA.

17.7 Impacts during Operations and Maintenance

17.7.1 Impact 17.11: Pollution event

17.151 During operations and maintenance, potential pollutants will be present in the site area. These will be restricted to the power conversion centre, substations and access routes to these locations. Potential pollutants will include fuel, lubrication oils, chemicals and waste water from staff facilities. Any pollution incident occurring on the site may adversely affect the quality of nearby surface waters, groundwater or site soils.

Impact significance

Impact	Sensitivity of receptor	Magnitude of impact	Consequence	Significance
Pollution event (surface water)	High	Negligible	Minor	Not Significant
Pollution event (groundwater)	High	Negligible	Minor	Not Significant
Pollution event contaminants (soils)	Medium	Negligible	Negligible	Not Significant

MITIGATION IN RELATION TO IMPACT 17.11

- Although no significant impact has been identified, mitigation measures have been provided as a precautionary approach to ensure this remains the case.
- It has been assumed that all operations and maintenance activity will be undertaken in accordance with the good practice and mitigation measures set out above with relation to Impact 17.1.

17.7.2 Impact 17.12: Erosion and sedimentation

17.152 Potential levels of erosion and sedimentation will be very much lower than during construction as there will be no excavations or exposed ground, unless required for emergency repair or replacement work. Some erosion could still occur on site access tracks and drainage ditches as a result of scouring during extreme rainfall events, particularly if poorly maintained. The permanent drainage network for the onshore infrastructure is not expected to be large or extensive.

Impact significance

Sensitivity of receptor	Magnitude of impact	Consequence	Significance
High	Negligible	Minor	Not Significant

MITIGATION IN RELATION TO IMPACT 17.12

- Although no significant impact has been identified, mitigation measures have been provided as a precautionary approach to ensure this remains the case.
- A programme of regular inspection and maintenance for all permanent drainage features will be put in place and carried out regularly.

17.7.3 Impact 17.13: Impediments to surface flows

17.153 During operation, impediments to surface flows relate largely to the constriction of drainage channels through poor maintenance.

Impact significance

Sensitivity of receptor	Magnitude of impact	Consequence	Significance
High	Negligible	Minor	Not Significant

MITIGATION IN RELATION TO IMPACT 17.13

- Although no significant impact has been identified, mitigation measures have been provided as a precautionary approach to ensure this remains the case.
- A programme of regular inspection and maintenance will be implemented to prevent constriction of drainage channels and to ensure continued efficient operation of the drainage network.

17.8 Impacts during Decommissioning

17.154 It has been assumed that all above ground onshore infrastructure and associated PCC foundations, will be removed during decommissioning.

17.8.1 Impact 17.14: Pollution event

17.155 During decommissioning activity, potential pollutants will also be present in the site area. These will include fuel, lubrication oils and chemicals as well as waste and waste water from staff facilities. Any pollution incident occurring on the site may adversely affect the quality of nearby surface waters, groundwater or site soils.

Impact significance

Impact	Sensitivity of receptor	Magnitude of impact	Consequence	Significance
Pollution event (surface water)	High	Minor	Moderate	Significant
Pollution event (groundwater)	High	Minor	Moderate	Significant
Pollution event (soils)	Medium	Minor	Minor	Not Significant

MITIGATION IN RELATION TO IMPACT 17.14

- Mitigation relating to Pollution Events is set out above, with relation to Impact 17.1. These good practice and mitigation measures will be implemented during decommissioning. No additional mitigation specific to decommissioning is required.

Residual impact

Impact	Sensitivity of receptor	Magnitude of impact	Consequence	Significance
Pollution event (surface water)	High	Negligible	Minor	Not Significant
Pollution event (groundwater)	High	Negligible	Minor	Not Significant
Pollution event contaminants (soils)	Medium	Negligible	Negligible	Not Significant

17.8.2 Impact 17.15: Erosion and sedimentation

17.156 During decommissioning, activity relating to removal of above ground onshore infrastructure and associated PCC foundations will necessitate ground disturbance. Any activity requiring ground disturbance can lead to soil erosion and the generation of loose sediment. However, this is likely to be contained with the footprint of the PCCs resulting in a lower potential impact.

Impact significance

Sensitivity of receptor	Magnitude of impact	Consequence	Significance
Medium	Minor	Minor	Not Significance

MITIGATION IN RELATION TO IMPACT 17.15

- Although no significant impact has been identified, mitigation measures have been provided as a precautionary approach to ensure this remains the case.
- Mitigation relating to Erosion and Sedimentation is set out above, with relation to Impact 17.2. These good practice and mitigation measures will be implemented during decommissioning.
- Excavation and ground-disturbing work will be kept to a minimum as far as practicable, to minimise the potential for mobilising sediment.

17.8.3 Impact 17.16: Soil compaction and loss of quality

17.157 As for construction, the movement of vehicles and plant on site during decommissioning activity will result in localised compaction of soils under temporary running surfaces. Reinstatement of any excavations could also result in soil compaction and mixing. Poor storage of excavated soils could result in a reduction of soil quality through loss of soil structure and erosion of soil particles.

Impact significance

Sensitivity of receptor	Magnitude of impact	Consequence	Significance
Medium	Minor	Minor	Not Significant

MITIGATION IN RELATION TO IMPACT 17.16

- Although no significant impact has been identified, mitigation measures have been provided as a precautionary approach to ensure this remains the case.
- It has been assumed that all decommissioning activity will be undertaken in accordance with the good practice and mitigation measures set out above with relation to Impact 17.3.

17.8.4 Impact 17.17: Impediments to surface flows

17.158 Impediments to surface flows as a result of decommissioning could be caused by the same site activities as during construction. The level of activity would be considerably reduced from the construction phase as these would be contained within the footprint of the PCC.

Impact significance

Sensitivity of receptor	Magnitude of impact	Consequence	Significance
High	Negligible	Minor	Not Significant

MITIGATION IN RELATION TO IMPACT 17.17

- Although no significant impact has been identified, mitigation measures have been provided as a precautionary approach to ensure this remains the case.
- It has been assumed that all decommissioning activity will be undertaken in accordance with the good practice and mitigation measures set out above with relation to Impact 17.6.

17.8.5 Impact 17.18: Increase in fluvial flood risk

17.159 Ground disturbance and excavations associated with engineering work to remove buried infrastructure (PCC foundations) could affect watercourse flow dynamics and flood storage. However, most activities will be contained within the footprint of the PCC, therefore the level of activity would be reduced from the construction phase.

Impact significance

Sensitivity of receptor	Magnitude of impact	Consequence	Significance
Medium	Minor	Minor	Not Significant

MITIGATION IN RELATION TO IMPACT 17.18

- Although no significant impact has been identified, mitigation measures have been provided as a precautionary approach to ensure this remains the case.
- It has been assumed that all repowering/decommissioning activity in the area of the PCC and associated above ground infrastructure will be undertaken in accordance with the good practice and mitigation measures set out above with relation to Impact 17.7.

17.8.6 Impact 17.19: Modification of groundwater levels and flows

17.160 Groundwater controls may be required to prevent any decommissioning-related excavations from filling with water, resulting in a lowering of groundwater levels around the excavation area. As all excavations will be backfilled and fully reinstated upon completion of the decommissioning activity, any effects are likely to be localised and temporary.

Impact significance

Sensitivity of receptor	Magnitude of impact	Consequence	Significance
Medium	Negligible	Negligible	Not Significant

MITIGATION IN RELATION TO IMPACT 17.19

- Although no significant impact has been identified, mitigation measures have been provided as a precautionary approach to ensure this remains the case.
- It has been assumed that all decommissioning activity will be undertaken in accordance with the good practice and mitigation measures set out above with relation to Impact 17.8.

17.8.7 Impact 17.20: Damage to geological or geomorphological features

17.161 Removal of buried infrastructure for decommissioning would result in increased loss of structure of superficial geology deposits and in increased mixing of sediment layers. No impact on the identified sites designated for geology or geomorphology is anticipated from decommissioning.

Impact significance

Sensitivity of receptor	Magnitude of impact	Consequence	Significance
Low	Negligible	Negligible	Not Significant

MITIGATION IN RELATION TO IMPACT 17.20

- Although no significant impact has been identified, mitigation measures have been provided as a precautionary approach to ensure this remains the case.
- It has been assumed that all repowering/decommissioning activity will be undertaken in accordance with the good practice and mitigation measures set out above with relation to Impact 17.9.

17.8.8 Impact 17.21: Mobilisation of contaminants

17.162 Removal of buried infrastructure for decommissioning is unlikely to lead to any contaminant mobilisation.

Impact significance

Impact	Sensitivity of receptor	Magnitude of impact	Consequence	Significance
Mobilisation of contaminants (surface water)	High	Negligible	Minor	Not Significant
Mobilisation of contaminants (groundwater)	High	Negligible	Minor	Not Significant
Mobilisation of contaminants (soils)	Medium	Negligible	Negligible	Not Significant

MITIGATION IN RELATION TO IMPACT 17.21

- No mitigation proposed as no significant impact predicted.

17.9 Cumulative Impacts

17.9.1 Introduction

17.163 MeyGen has, in consultation with Marine Scotland and The Highland Council, identified a list of other projects (MeyGen, 2011) which together with the Project may result in potential cumulative impacts. The list of these projects, including details of their status at the time of the EIA, and a map showing their location is provided in Section 8; Table 8.3 and Figure 8.1 respectively.

17.164 Having considered the information presently available in the public domain on the projects for which there is a potential for cumulative impacts, Table 17.12 below indicates those with the potential to result in cumulative impacts from a geology, hydrogeology and hydrology perspective. The consideration of which projects could result in potential cumulative impacts is based on the results of the project specific impact assessment together with the professional judgment of the specialist consultant.

Project title	Potential for cumulative impact	Project title	Potential for cumulative impact	Project title	Potential for cumulative impact
MeyGen Limited, MeyGen Tidal Energy Project, Phase 2	✓	SHETL, HVDC cable (onshore to an existing substation near Keith in Moray)	×	OPL, Ocean Power Technologies (OPT) wave power ocean trial	×
ScottishPower Renewables UK Limited, Ness of Duncansby Tidal Energy Project	×	Brough Head Wave Farm Limited, Brough Head Wave Energy Project	×	MORL, Moray Offshore Renewables Ltd (MORL) offshore windfarm	×
Pelamis Wave Power, Farr Point Wave Energy Project	×	SSE Renewables Developments (UK) Limited, Costa Head Wave Energy Project	×	SSE and Talisman, Beatrice offshore Windfarm Demonstrator Project	×
Sea Generation (Brough Ness) Limited, Brough Ness Tidal Energy Project	×	EON Climate & Renewables UK Developments Limited, West Orkney North Wave Energy Project	×	BOWL, Beatrice Offshore Windfarm Ltd (BOWL) offshore windfarm	×

Project title	Potential for cumulative impact	Project title	Potential for cumulative impact	Project title	Potential for cumulative impact
Cantick Head Tidal Development Limited, Cantick Head Tidal Energy Project	×	EON Climate & Renewables UK Developments Limited, West Orkney South Wave Energy Project	×	Northern Isles Salmon, Chalmers Hope salmon cage site	×
SSE, Caithness HVDC Connection - Converter station	×	ScottishPower Renewables UK Limited, Marwick Head Wave Energy Project	×	Northern Isles Salmon, Pegal Bay salmon cage site	×
SSE, Caithness HVDC Connection - Cable	×	SSE Renewables Developments (UK) Limited, Westray South Tidal Energy Project	×	Northern Isles Salmon, Lyrawa salmon cage site	×
RWE npower renewables, Stroupster Windfarm	✓	EMEC, Wave Energy test site (Billia Croo, Orkney)	×	Scottish Sea Farms, Bring Head salmon cage site	×
SSE, Gills Bay 132 kV / 33 k V Substation Phase 1: substation and overhead cables (AC)	✓	EMEC, Tidal energy test site (Fall of Warness, Orkney)	×	Northern Isles Salmon, Cava South salmon cage site	×
SSE, Gills Bay 132 kV / 33 k V Substation Phase 2: HVDC converter station and new DC buried cable	✓	EMEC, Intermediate wave energy test site (St Mary's Bay, Orkney)	×	Scottish Sea Farms, Toyness salmon cage site	×
SHETL, HVDC cable (offshore Moray Firth)	×	EMEC, Intermediate tidal energy test site (Head of Holland, Orkney)	×	Northern Isles Salmon, West Fara salmon cage site	×

Table 17.12: Summary of potential cumulative impacts

17.165 The following sections summarise the nature of the potential cumulative impacts for each potential project phase:

- Construction and installation;
- Operations and maintenance; and
- Decommissioning.

17.9.2 Potential cumulative impacts during construction and installation

17.166 The following projects have potential for cumulative impacts during construction and installation:

- Gills Bay Substation Phase 1; and
- Gills Bay Substation Phase 2.

17.167 The SSE Power Distribution Gills Bay Substation Phase 1 works are proposed to lie within one or more of the East Burn of Gills, West Burn of Gills, Burn of Mey, Burn of Horsegrow or Burn of Rattar catchments. The final substation location has yet to be identified although the three currently preferred sites lie within the upper Burn of Horsegrow catchment. The final substation location will dictate the start of the proposed overhead line routes, which are likely to run roughly south from the substation, through the upper Burn of Rattar and Burn of Freswick catchments, and roughly south-west, through the middle Burn of Rattar catchment.

17.168 As the cables from the MeyGen Project will, during the later stages of Phase 1 of the Inner Sound project, need to link into the substation, there will be cumulative impacts as the infrastructure will, of necessity, be adjacent. Assuming that all substation construction work follows recognised good practice and mitigation similar to that set out for this Project, cumulative impacts on the geology, hydrogeology and hydrology will be minor and not significant. Although the specific details of the construction schedule are not yet known, it is unlikely that MeyGen cable installation works will be undertaken at the same time as the substation construction works, thereby minimising the potential for cumulative impacts during the construction phases of these projects.

17.169 The SSE Power Distribution Phase 2 works include the construction of an HVDC converter station adjacent to the above mentioned Phase 1 substation and installation of an underground cable to run south from the substation towards Wick. Again, there will be cumulative impacts on hydrology, hydrogeology and geology as work from the substation/HVDC cable proposal will be immediately adjacent to elements of the MeyGen project. Assuming that all converter station construction work and cable trench excavation and installation work are undertaken to recognised good practice standards and make use of mitigation similar to that set out for this Project, cumulative impacts on the hydrology, hydrogeology and geology will be minor and not significant. Although the specific details of the construction schedule are not yet known, it is unlikely that MeyGen cable installation works could be undertaken at the same time as the substation construction works, thereby minimising the potential for cumulative impacts during the construction phases of these projects.

17.9.3 Potential cumulative impacts during operations and maintenance

17.170 The following projects have potential for cumulative impacts during their operational phases:

- MeyGen Tidal Energy Project Phase 2; and
- RWE npower renewables Stroupster Windfarm.

17.171 Phase 2 of the MeyGen Tidal Energy Project will comprise the deployment of a further 312 MW offshore and associated cables to shore and onshore infrastructure. The exact geographical location, extent and nature of the onshore facilities required for Phase 2 are not yet defined and will incorporate lessons learned from and technology advancements beyond, Phase 1 of the Project. These factors will influence the potential for, nature of and significance of any cumulative impacts. From a geology, hydrology and hydrogeology perspective the requirement for additional land for onshore infrastructure has the potential for cumulative impacts.

17.172 Stroupster Windfarm lies approximately 3.5km south of the proposed Project area. It is situated largely within the southern part of the Burn of Freswick catchment and the adjacent catchment to the south. All proposed infrastructure for the MeyGen Project is located north of the Burn of Freswick catchment (Figure 17.7). There will, in consequence, be no cumulative impacts on hydrology, hydrogeology or geology from the MeyGen Project in combination with Stroupster Windfarm.

17.9.4 Potential cumulative impacts during decommissioning

17.173 At present it cannot be determined what concurrent works will be ongoing in the area of the Project at the time of decommissioning and therefore is not possible to determine potential cumulative impacts. However, if any other works ongoing at the time are undertaken to recognised good practice standards and make use of mitigation similar to that set out for this Project, cumulative impacts on the hydrology, hydrogeology and geology will be minor and not significant.

17.9.5 Mitigation requirements for potential cumulative impacts

17.174 No mitigation in required over and above the Project specific mitigation.

17.10 Proposed Monitoring

17.175 Monitoring is proposed of any surface watercourses that could be affected by the Project, to provide baseline water quality prior to any construction and to provide reassurance that mitigation measures are effective.

17.176 Surface water monitoring will include regular visual inspections of identified locations, plus regular but less frequent water quality sampling.

17.177 The monitoring will include control sites outwith affected watercourse catchments and/or upstream of all proposed activity as well as areas within the MeyGen Project area and downstream of the proposed activity.

17.178 The construction contractors' Environmental Clerk of Works (or equivalent) will monitor the construction team to avoid any accidental damage to surface watercourses.

17.11 Summary and Conclusions

17.179 An assessment has been carried out of the likely effects of the Project on the geology, hydrogeology and hydrology. The assessment has considered construction and installation, operations and maintenance, and decommissioning/repowering of the project. The predicted impacts are summarised in Section17.6, Section 17.7 and Section 17.8.

17.180 The potential effects on surface water, groundwater, soils, geology and geomorphology that have been considered are:

- Pollution event;
- Erosion and sedimentation;
- Soil compaction and loss of quality;
- Increase in surface runoff;
- Modification of drainage patterns;
- Impediments to surface flows;
- Increase of fluvial flood risk;
- Modification of groundwater levels and flows;
- Damage to geological and geomorphological features; and
- Mobilisation of contaminants.

17.181 A number of layout, design and construction proposals have been identified that will minimise, mitigate or offset these effects. An Environmental Clerk of Works should be appointed to oversee the effective operation of the identified mitigation measures.

17.182 It is concluded that, with the proposed mitigation in place, the identified effects on the geology, hydrogeology and hydrology environments will not be significant.

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