

# Environment Description for the EMEC Tidal Test Site Fall of Warness, Orkney



Author	Date	Approved	Date	Revision
Matthew Finn	December 2006	Jennifer Norris	December 2006	0
M.Finn Update	May 2009	Jennifer Norris	May 2009	1

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*The European Marine Energy Centre Ltd*

## Purpose and Scope

The function of this environmental description is to inform potential developers intending to test devices at the European Marine Energy Centre (EMEC) of the environment within which the tidal test site at the Fall of Warness is located. The description covers the character of the physical, biological and human aspects and includes conservation areas around the Fall of Warness. Meteorological and hydrographical information will be supplied separately by EMEC as well as more detailed environmental information as appropriate.

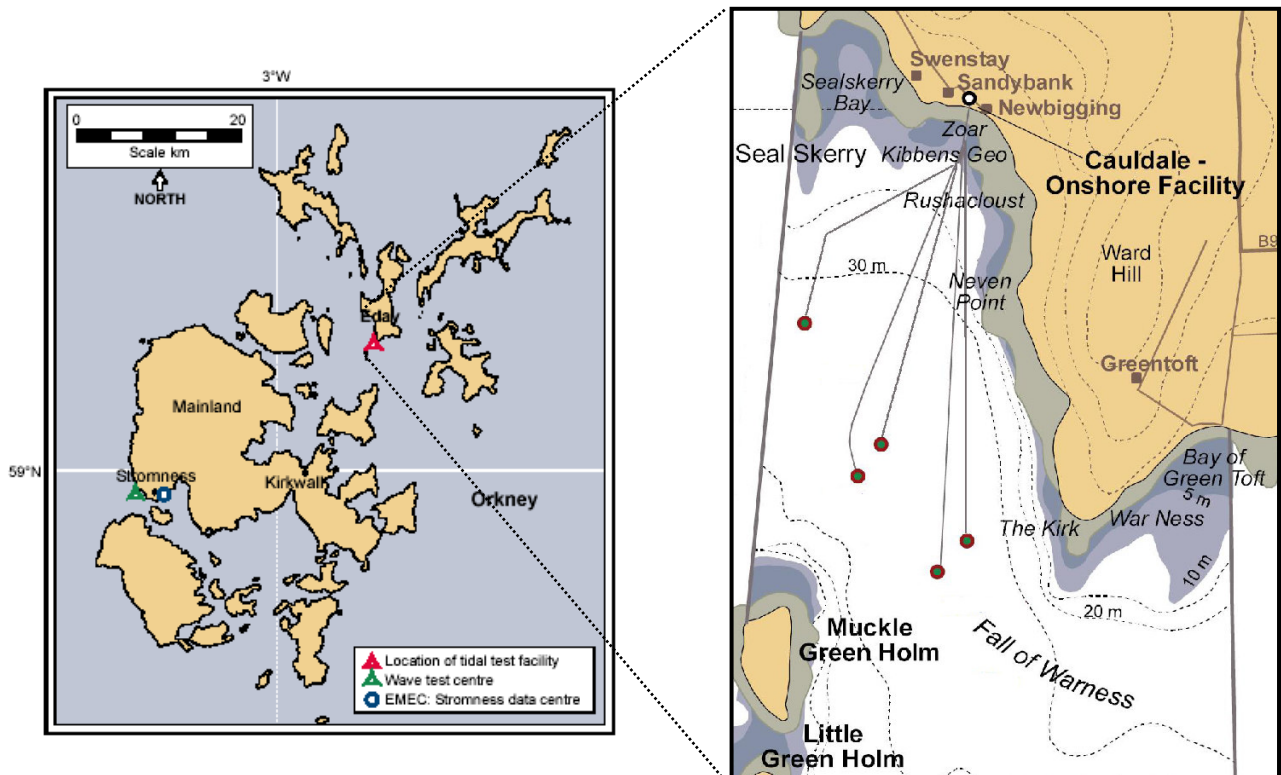
The following sections provide a description of each important environmental characteristic. A summary figure of the environmental and seasonal sensitivities is displayed in Figure 3.1.

## 2 Environmental Description of the Fall of Warness

### 2.1 Seascape

The Fall of Warness, where the EMEC tidal test facility is located, lies between the southwest coast of Eday and the islands of Muckle Green Holm and Little Green Holm. The onshore facility is sited adjacent to Cauldale on the west coast of Eday, as shown below in Figure 2.1.

**Figure 2.1 Location of the Fall of Warness**



The majority of the Orkney Islands are composed of sedimentary rocks of Devonian age (360-410 million years ago), predominantly Middle and Upper Old Red Sandstone. Older metamorphic rocks and younger dykes are found in a few places. The nature of the rock and the glacial features help to determine the present day landscape of the coast (Doody, 1997). The shores around the south west coast of Eday follow the typical pattern of habitats and communities associated with exposed to moderately exposed rocky shores.

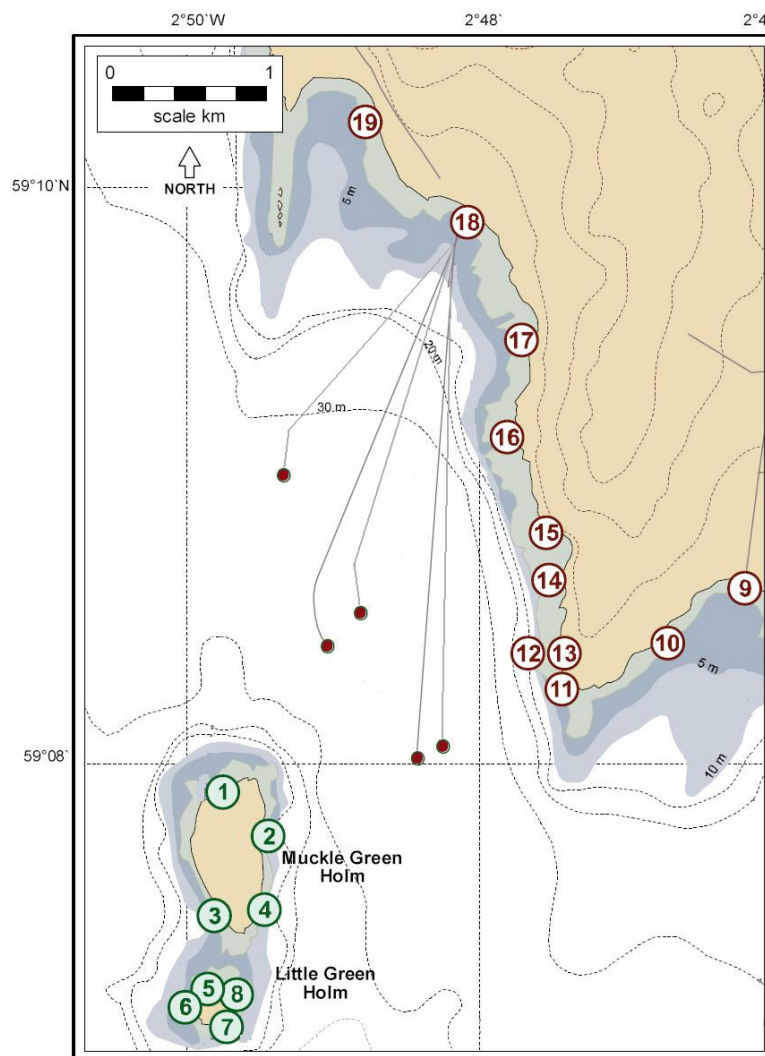
## 2.2 Coastal habitats (littoral)

### 2.2.1 Physical

The south west Eday shoreline essentially comprises superficial sand overlaying rocky outcrops, constrained to the north and south by the rocky headlands at Sandybank and Neven Point. The exposed coastal geology forms sequences of Devonian sandstone, siltstone and mudstone (Barne *et al* 1997). The rock is relatively resistant to erosion by wave action, but parts of the coast are undergoing slow retreat, resulting in low cliff faces above cobble and gravel storm beaches. This is the case at the immediate shoreline of the cable landfall, with the beach backing onto low sandstone/mudstone cliffs, although local observations deem the retreat to be negligible. This dune system has been identified in Dargie (1998) as 'fixed acidic grassland' and the beach which has formed to the front is found to be mobile under severe wave conditions, with superficial sand assumed to be frequently mobile. It is likely that the area of visible bedrock will vary considerably as the sand is drawn down and returned by changing wave conditions. Site information and experience from other similar locations indicate that extreme drawdown during stormy periods may deplete most of the sand across the middle and upper beach, exposing large areas of underlying rock. Conversely, low swell conditions could move sand up the beach face, causing the lower beach and nearshore sand levels to drop. The gross drift rates to the north and south may be large, but the net rate is thought to be low with a northerly residual direction (Aurora, 2005).

Below low tide the intertidal bedrock forms a series of parallel ridges, with sand filling the intervening gullies. The sand cover decreases and boulders become more frequent further out, providing a suitable substrate for kelp. The ridges are orientated in the general direction of the cable route (approximately 30° south of beach normal), providing an opportunity to bury the cable. A selection of the coastal habitats surrounding the test site is displayed in Figure 2.2.

**Figure 2.2 Coastal habitats around the tidal test site**





1 Bedrock and boulder shore.



2 Bedrock ridge shore with boulders.



3 Low-lying bedrock ridge cliffs.



4 Low-lying bedrock ridge cliffs.



5 Broken bedrock sloping shore.



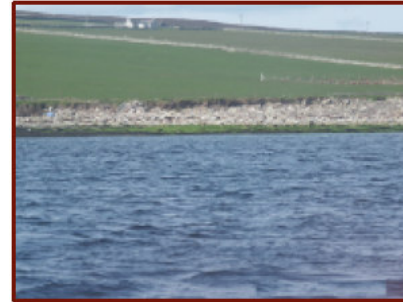
6 Low-lying bedrock ridge cliffs fronted with broken bedrock platform.



7 Smooth bedrock sloping shore.



8 Broken bedrock cliff running to outcrop.



9 Boulder shore by Greentoft Bay.



10 Low-lying broken bedrock cliff.



11 Bedrock cliffs and broken bedrock platform outcrop.



12 Low-lying bedrock ridge cliffs fronted by smooth bedrock platform.



13 Steep bedrock ridge cliff with boulder beach pocket.



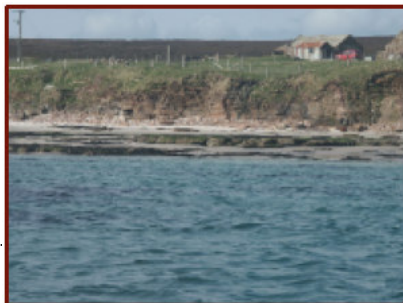
14 Steep bedrock ridge cliff with boulder/shingle collection at base.



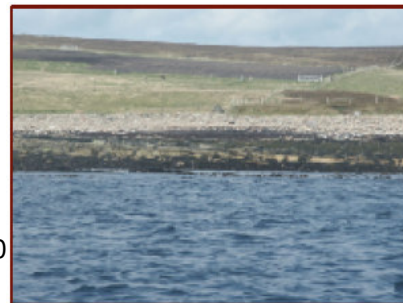
15 Smooth vegetated rock cliff face fronted by bedrock ridge, boulders and shore.



16 Bedrock cliff fronted by boulder beach, Laminaria forest visible.



17 Bedrock platforms with sandy beach cover.



18 Bedrock backed with small boulders/cobbles.



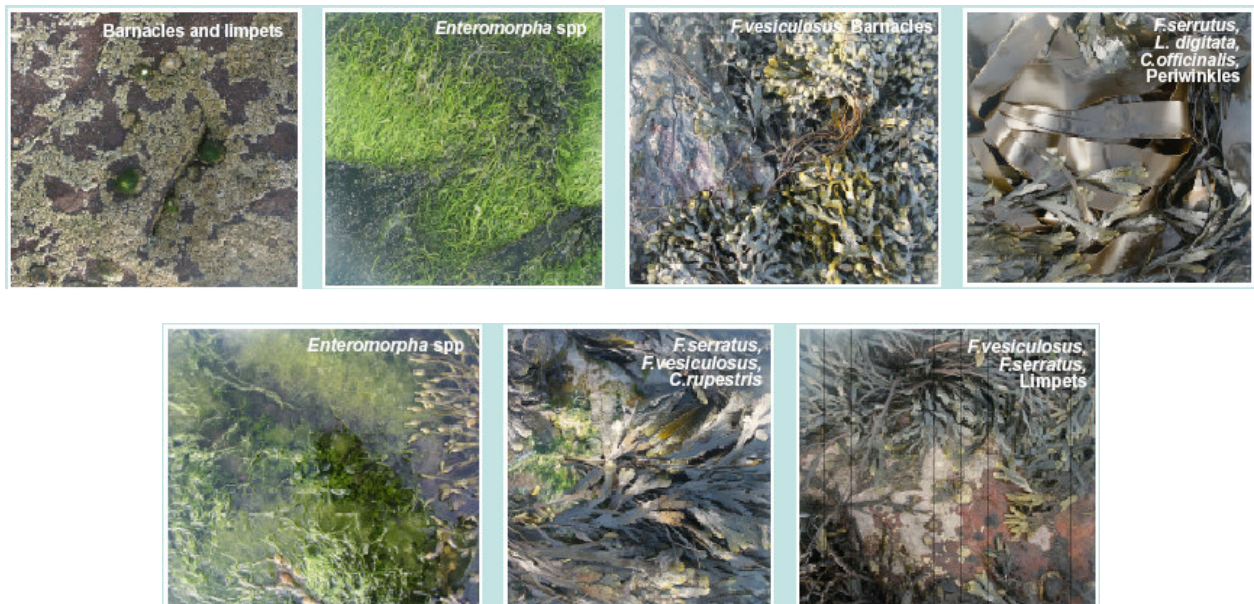
19 Sandy beach, backed with shingle ridge and vegetated dunes.

## 2.2.2 Biological

A survey of the vegetation in the vicinity of the substation took place in May 2005 (Aurora 2005). Where the rocky shore is very exposed the flora is characterised by a typically fucoid-dominated intertidal zone, in particular, saw-wrack (*Fucus serratus*) and the knotted wrack (*Ascophyllum nodosum*). Species of red seaweed, as well as thongweed (*Himanthalia elongate*) and dabberlocks (*Alaria esculenta*) are found on the lower shore. In contrast, the more sheltered areas have a typical sequence from upper to lower shore, comprising of: channel-wrack (*Pelvetia caniculata*); spiral-wrack (*Fucus spiralis*); bladder-wrack (*Fucus vesiculosus*); egg-wrack (*Ascophyllum nodosum*) and saw-wrack (*Fucus serratus*). Further species of algae are found under the canopies; typically *Mastocarpus stellatus*, *Laurencia pinnatifida*, *Corallina officinalis* and *Palmaria palmate* (which tend to grow over a crust of pink coralline algae). Species including pepper dulse (*Laurencia pinnatifida*) and *Cladophora* are found in the damp crevices. The furthestmost upper shore at the less exposed sites has a dense coverage of *Enteromorpha sp.*, with the sublittoral fringe dominated by *Laminaria* forests, particularly around Seal Skerry and further south to War Ness (OIC unpublished data).

The fauna present represent those commonly found on rocky shores with patches between the algal turf colonised by barnacles (*Balanus balanoides*) and limpets (*Patella vulgata*) (OIC, unpublished data). In more exposed areas of the shore, species such as dog whelk (*Nucella lapillus*) are found in cracks and crevices. The flat periwinkle (*Littorina obtusata*), the edible periwinkle (*L. littorea*), the common shore crab (*Carcinus maenas*), the common starfish (*Asterias rubens*) and gammarid amphipod species are also likely to be present. On most sheltered shores in Orkney the coverage is nearly complete underneath the algal canopy as the conditions are damp and ideal for sea anemones, sponges and a variety of molluscs, including chitons, snails and sea slugs. Sheltered pits and crevices in the rock also provide a refuge for anemones, gastropods (*Nucella lapillus* and *Littorina neglecta*) and small mussels (*Mytilus edulis*). Some of the main species identified can be seen in Figure 2.3 below.

**Figure 2.3 Photographs to show intertidal species typical of the area**



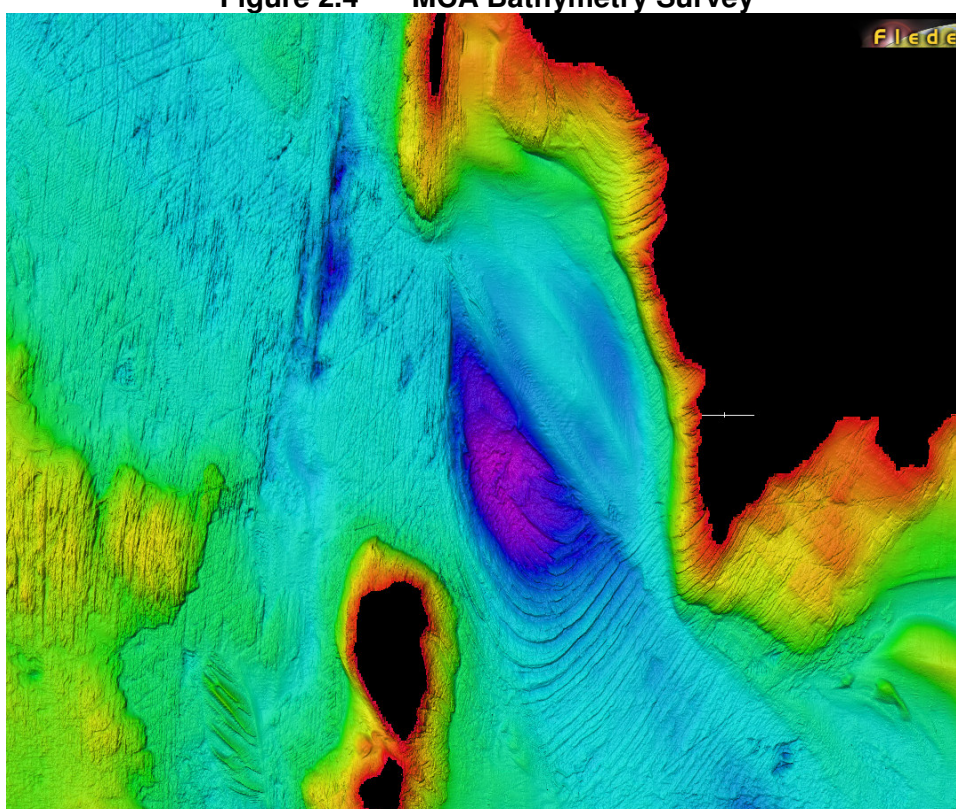
## 2.3 Seabed habitats (sublittoral)

### 2.3.1 Physical

The bedrock is exposed throughout the majority of the test bay area, with occasional boulders, but is swept of any bed load transport as there is little mobile material available (Wallingford, 2005). To the north and east of the deep basin there are some deposits up to 11m thick of boulders, cobbles, gravel and interstitial shelly sand, presumed to be glacial till deposits with a reworked surface layer. Dive and ROV surveys show these rocks to be well covered with flora and fauna, indicating long-term stability and minimal transport of sand or gravel. Close to shore there are sand deposits within the gullies formed by the rock ridges that run along the line of the cable route.

The cable follows a fairly smooth slope from its onshore location, across sand and into the sea where the sand gives way to rocks. The chart depth readings decrease steadily from 1m to between 34-54m where the tidal test devices will be deployed. The Fall of Warness peak spring tide speeds in excess of 3.5 m/s. The bathymetry can be seen in the following diagram taken from the MCA survey (MCA, 2004).

Figure 2.4 MCA Bathymetry Survey



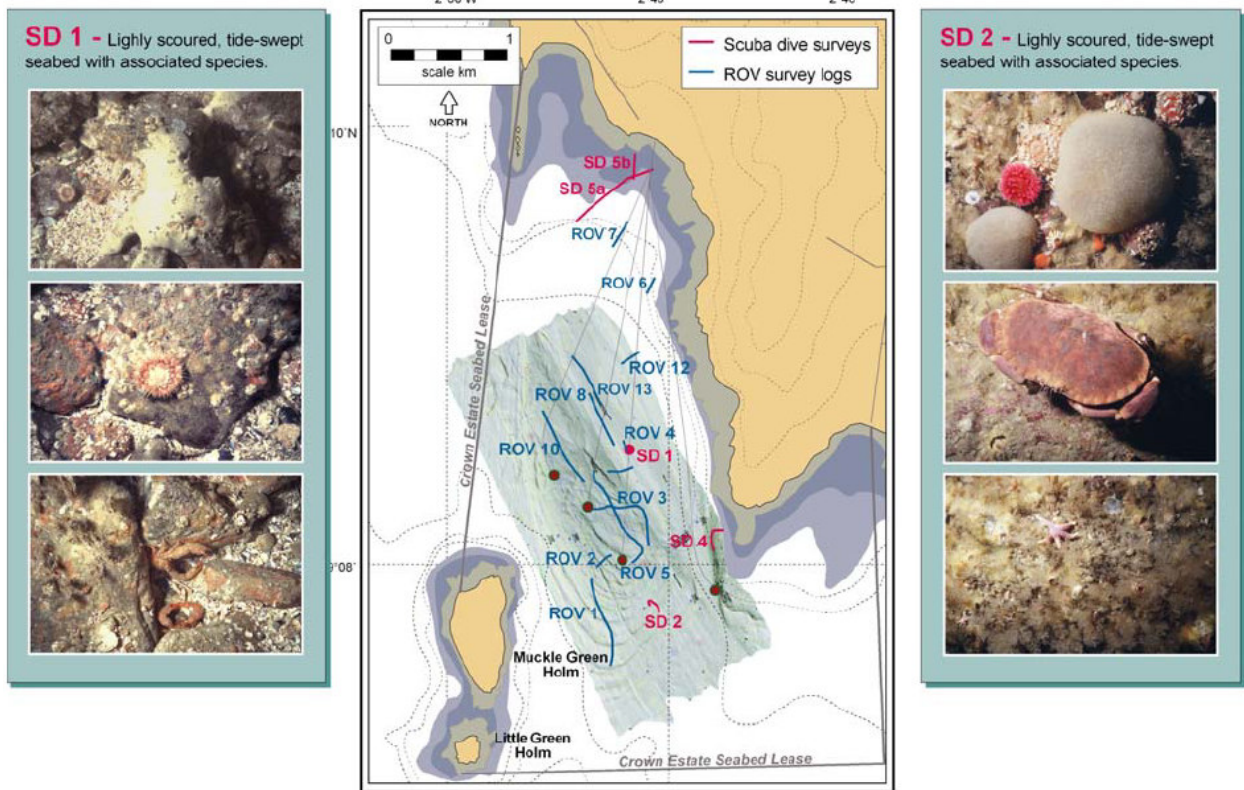
### 2.3.2 Biological

Seabed surveys have identified the sub-littoral areas at the Fall of Warness as sparsely inhabited with no species of conservation value (Aurora, 2005). The majority of areas that had been proposed as seabed survey stations were videoed/photographed and are considered to be representative of the wider habitats of the project area. Species recorded by photography, diver observations, or collected as samples are listed below and displayed in Figure 2.5.

- Velvet crab (*Portunus puber*)
- Starfish
- Squat lobster (*Munida rugosa*)
- Butterfish (*Pholis gunnellus*)
- Cowrie shell (*Trivia monacha*)
- Scorpion fish (pink) (*Taurulus bubalis*)
- Urchin
- Edible crab (*Cancer pagurus*)
- Brittle star
- Rough periwinkle (*Littorina saxatilis*)
- Dog whelk (*Nucella lapillus*)
- Keel worm (*Pomatoceros triqueter*)

- Barnacle (*Semibalanus balanoides*)
- Pointed topshell (*Calliostoma zizyphinum*)
- Hermit crab (*Paragus bernhardus*)
- Goose barnacle plates

**Figure 2.5 Sub-littoral habitats**



## 2.4 Plankton

The zooplankton in this region are composed of neritic (coastal water) and intermediate (mixed water) species, although the inflow from the Atlantic Ocean along the western edge of the North Sea in late summer/autumn may introduce oceanic species. Evidence from surveys suggests that the phytoplankton found is fairly typical for North British coastal waters. The spring increase of phytoplankton (mainly diatoms) begins in March and peaks between April and May. This is followed by a decline in June to steady levels until another peak in September, with the dominant species present including barnacle larvae. The abundance of zooplankton during autumn was noticeably greater than that for phytoplankton, dominated by crustaceans (principally copepods) (Jones and Beards, 1983). The zooplankton within this region are key to the survival of fish species such as herring. Studies by Nellen and Schadt (1992) found that fairly large fluctuations in zooplankton taxa occur, indicating that environmental conditions vary from year to year. However, the overall variability in the zooplankton biomass is low, thus displaying a relatively stable ecosystem.

## 2.5 Fish and shellfish

### 2.5.1 Finfish

Fish fauna studies are poorly represented for this part of Orkney, however general statements can be made considering the exposed locality and bedrock conditions. Fish species likely to be found include mackerel (*Scromber scrombus*) (for spawning) and herring (*Clupea harengus*) (for feeding and spawning) during the summer and autumn periods. Sprat (*Sprattus sprattus*) and sand eels (*Ammodytes sp*) will spawn between May and July and from November to February respectively (Coull *et al*, 1998). Other fish species without defined spawning grounds, but widely distributed in the waters around Orkney, include haddock (*Melanogrammus aeglefinus*), ling (*Molva molva*), saithe (*Pollachius limanda*) and cod (*Gadus morhua*). Flat fish species such as plaice (*Pleuronectes platessa*) and dab (*Limanda limanda*) occur on sandy areas of the seabed, such as the cable landfall site, with juveniles living in nursery areas close inshore.

In addition to the commercially important fish species, the inshore waters of Eday are also likely to support populations of smaller fish species that provide a food source for birds and mammals present in the area. The preliminary seabed survey (Aquatera, 2005) noted the presence of butterflyfish and scorpion fish. Butterflyfish provide an important food source for the black guillemot, which would be sensitive to any detrimental effects on the habitat (Meeks, *pers comm.*). Juvenile monkfish and non-spawning adult monkfish, conger eels (*Conger conger*) and gurnard (*Triglidae*) can be found throughout Orkney waters.

### 2.5.2 Shellfish

The nature of the seabed in the vicinity of the Fall of Warness creates a habitat for Lobster (*Homarus gammarus*), edible crab (*Cancer pagurus*) and velvet crab (*Necora puber*). Scallops (*Pecten maximus*) and queen scallops (*Aequipecten opercularis*) live on sandy/gravelly areas in the Fall of Warness.

## 2.6 Birds and shore birds

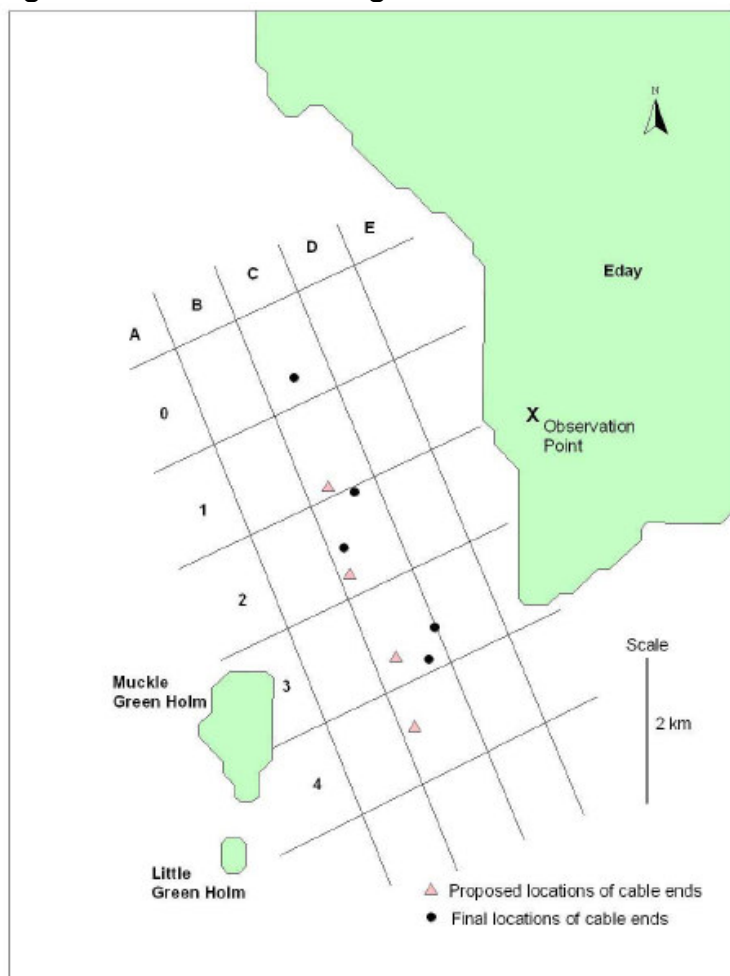
The coastline between the east end of the Bay of Greentoft and the west end of Sealskerry Bay provides shelter, nesting and feeding sites for a variety of bird species (See Appendix 1). The birds most likely to be directly affected by project activities are the shorebirds nesting below Cauldale, and the diving birds - in particular the cormorants (*Phalacrocorax carbo*). Cormorants are known to dive to up to 9 m below the sea surface when feeding. They are protected under the general provisions of the Wildlife and Countryside Act, 1981, and are listed as a local priority species due to declining numbers. Aerial surveys carried out between 1985 and 2000 show a decline in cormorant numbers of approximately 30% (1985 at 570, 1995 at 491, and 2000 at 412) (*Pers comm.*, Eric Meek). Due to the close proximity of the breeding colony on Little Green Holm, these species are potentially at risk from turbines installed in the Fall of Warness, particularly during feeding.

Land-based wildlife surveys over the Fall of Warness have been carried out on behalf of EMEC from the 11<sup>th</sup> July 2005. The observational programme and methodology were produced with significant input from the Sea Mammal Research Unit (SMRU) at St Andrews University (Duck, 2006). The first year's data (to 14<sup>th</sup> July 2006) has been analysed and a report produced by SMRU and DMP (Duck, 2006 and Aurora,



2006). The observations up to the 14<sup>th</sup> July 2006 encompassed a total of 219 days, and 964 hours (Aurora, 2006). The observations are ongoing and the grid established for recording the data can be seen below in Figure 2.6.

**Figure 2.6 Observation grid for the Fall of Warness**



The results from the July 2005 – July 2006 annual report predict an average number of birds sighted across the survey region to be approximately 3 per grid square per daylight hour. Few birds were sighted in sub-areas far from land, whereas an average of 9 birds per hour was sighted close to land. Bird abundance was found to be related to a range of environmental factors. Birds were generally more abundant in early morning, low winds, flood/slack tides, slack water flows, and when the flow direction was North (Aurora, 2006). See Section 5.1 for further details.

## 2.7 Marine mammals

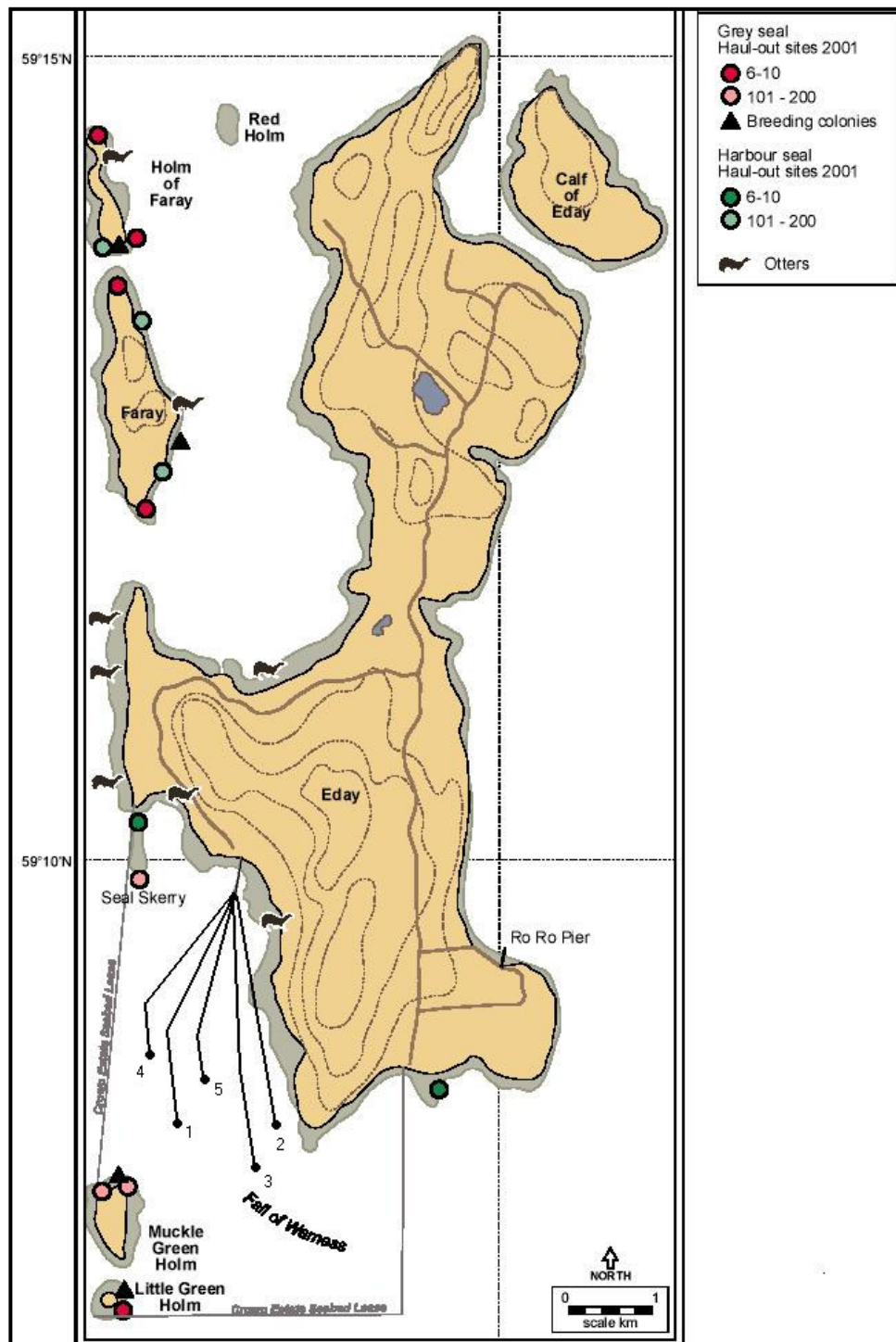
The land-based surveys of the Fall of Warness from July 2005 to July 2006 (as outlined previously) also covered marine mammals (Duck, 2006). Grey seals (*Halichoerus grypus*), harbour/common seals (*Phoca vitulina*), harbour porpoises (*Phocoena phocoena*), minke whales (*Balaenoptera acutorostrata*), white beaked dolphins (*Lagenorhynchus albirostris*) and basking sharks (*Cetorhinus maximus*) were all seen during the study period. See section 5.1 for further details.

### 2.7.1 Otters

Otters (*Lutra lutra*) are largely solitary, nocturnal animals. Females range over relatively long sections of the Scottish coastline, on average about five kilometres, while males average about eight kilometres. Although otters can breed at any time of the year, there is strong evidence to suggest that in this part of Scotland most cubs are born in winter (Conroy & Bacon, 2005). Orkney has long been recognised as an important area for otters with a population of national importance. The otter is well distributed and fairly

common in Orkney on both the coastal and inland waters of many of the islands, where there is fresh water, absence of human disturbance and often the presence of heath-land behind the coastal sites. In 2001, females with cubs at several sites along the west coast of Eday and on Faray (see Figure 2.7) were recorded. There have been sightings on Seal Skerry and Ferness Bay, and on the west coast of Eday north of Sealskerry Bay (OIC, unpublished data, 2000). It is likely that otters occur all round the coastline of Eday and Faray (Booth, unpublished data).

**Figure 2.7 Distribution of Otters and Seals in the vicinity of the Fall of Warness**



The Eurasian otter (*Lutra lutra*) is protected by national and international legislation that makes it an offence to disturb, kill, trap or harm the species, or damage and/or disturb its resting, feeding and breeding sites. The otter is listed on Appendix 1 of CITES, Appendix II of the Bern Convention and Annexes II and IV of the Habitats Directive. It is protected under schedule five of the Wildlife and Countryside Act (1981) and Schedule 2 of the Conservation Regulations (1994) (Regulation 38).

## 2.7.2 Seals

Apart from exposed, steep, west-facing shores, harbour/common and grey seals can be found distributed throughout Orkney and can be seen at all times of the year. During their breeding season, mothers with young pups are susceptible to disturbance. Pups abandoned or separated from their mothers may suffer increased mortality rate and prolonged disturbance can lead to the abandonment of haul-out sites (Renouf *et al.* 1981).

Grey seals range considerably wider than common seals, which appear to be more faithful to particular haulout sites (Thompson & Miller, 1990). The closest common seal haulout sites to the test facility, from the most recent breeding and moulting surveys, are: Seal Skerry; along the south-west coast of Eday; just east of The Graand on Eday's south coast and on Muckle and Little Green Holm. The survey indicated that a small number of single adult males were present along the south west coast of Eday (Aurora, 2005). The presence of these males close to a haulout with a large number of pups strongly suggests that the sea around the Fall of Warness is used as an underwater display area for common seals. Male common seals have underwater display sites where they maintain station, possibly in an underwater territory, and are thought to attract females by a series of complex underwater vocalisations (Van Parijs *et al.*, 2000). The females mate approximately four weeks after giving birth to their pups (Thompson, 1988, Thompson & Miller, 1994). Thus the important time when males are attracting females in oestrus will fall between mid June and the end of July, and this is followed by the moulting period in late July and early August.

The grey seal breeding season begins in early October in the northern Scottish islands and attracts large numbers through to late November. The moulting period follows in January to March (females), and March to May (males). Muckle Green Holm and Little Green Holm also act as a haul-out area during the summer for grey seals, as to a lesser extent does Seal Skerry. Grey seal pups begin their offshore life independently and are notoriously inquisitive, so it is possible they may be attracted by objects moving in the water column.

Both grey and common seals are protected under European legislation and are listed in Annex II of the European Habitat Directive. They are also protected under the Conservation (Natural Habitats, etc.) Regulations (1994) and the Conservation of Seals Act 1970. The islands of Muckle Green Holm and Little Green Holm are designated SSSI sites, contributing around 3% of UK annual pup production (SMRU, 2005). The islands of Faray and Holm of Faray also have national protection from SSSI designation. In addition, the inshore waters surrounding Faray and the Holm of Faray have been designated a marine Special Area of Conservation (SAC). Both designations are due to the grey seal population found there, which is the second largest breeding colony in the UK, contributing to around 9% of UK annual pup production. From their European Protected status, these islands were included despite being some distance from the proposed tidal test site (Figure 2.7).

## 2.7.3 Cetaceans

The harbour porpoise is the most commonly observed cetacean in Orkney waters, although in relatively small numbers. There are records of occurrence throughout the year, but the majority of sightings are from April to September. It has been suggested that this species moves offshore during the winter, with consistently fewer sightings. The numbers of individuals reported are usually between one and five, although groups of up to 17 have been observed. Harbour porpoises use the area for passage between Westray and Stronsay Firths for feeding on shoaling fish such as sand-eels and sprats (Booth 2005, unpublished data).

Killer whales (*Orcinus orca*) have been recorded between March and August, especially over the last five years. These animals were probably in transit and are associated with attacks on common seals at haulout sites to the east of Egilsay and Papa Westray. There have been occasional sightings of minke whales and pilot whales (*Globicephala melas*). There has also been a live stranding of a pilot whale near Ferness Bay. Unidentified dolphins (possibly white beaked and Risso's (*Grampus griseus*) dolphins) have also been reported on several occasions between May and August (Booth 2005, unpublished data).

All species of dolphins, porpoises and whales are listed in Annex II of CITES, Appendix II of the Bern Convention Annex, and in Appendix IV of the European Habitats Directive as species of interest and in need of strict protection. They are also protected under Schedule 5 of the Wildlife and Countryside Act, Fall of Warness Environmental Description REP107-02-03 20090625

1981. The harbour porpoise is covered by the terms of ASCOBANS (Agreement on the Conservation of Small Cetaceans of the Baltic and North Seas), an international agreement with the aim of promoting the conservation of small cetaceans that use sound as their primary sense. It is thought that sound from anthropogenic sources can interfere with echolocation and masks intra-species communication (Whale and Dolphin Conservation Society, 2004).

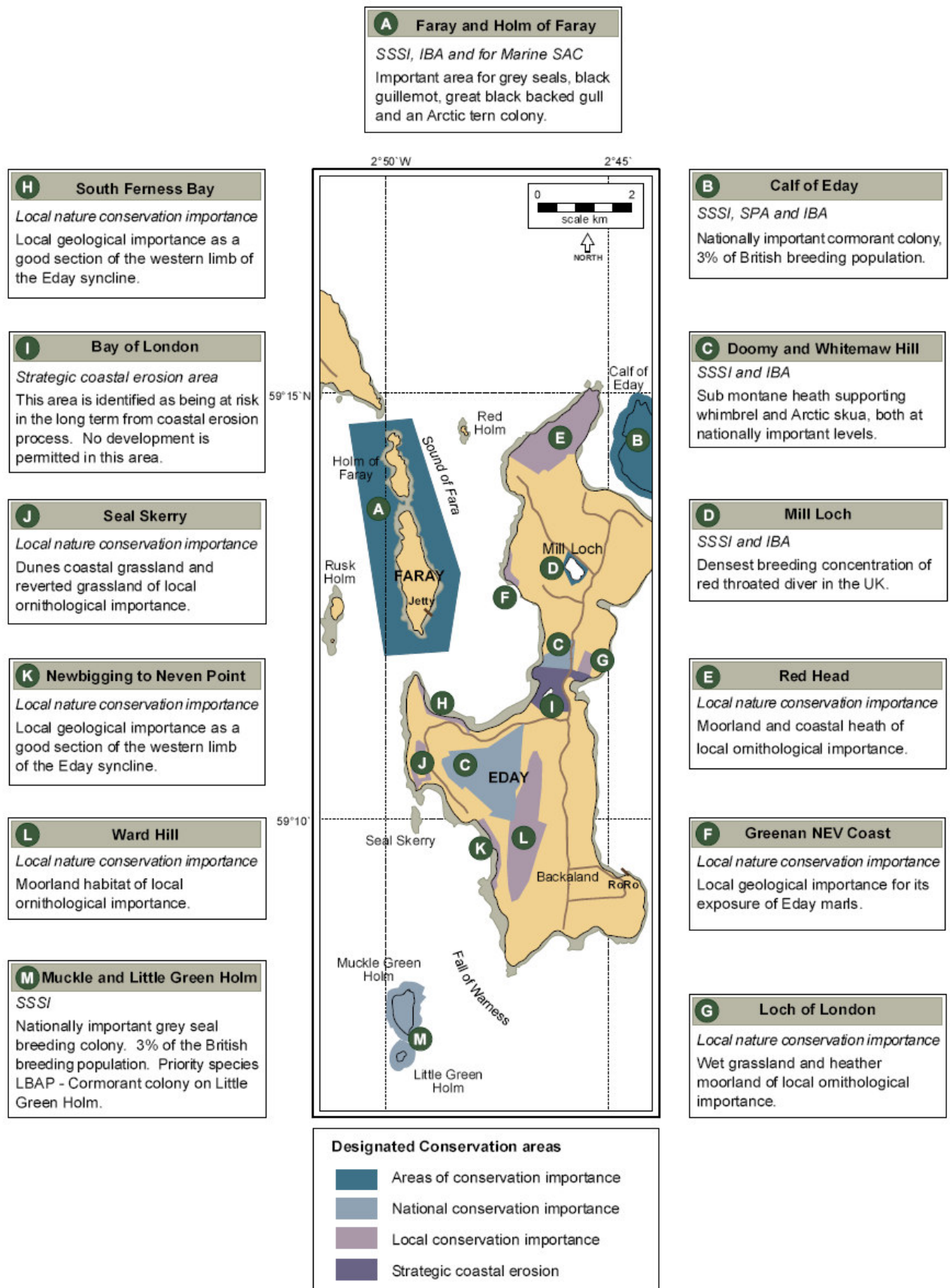
#### **2.7.4 Turtles**

While other species tend to occur as wind blown strays, leatherback turtles (*Dermochelys coriacea*) regularly visit Scottish waters between August and November. The leatherback turtle is most commonly found in tropical and sub-tropical waters, but the influence of the Gulf Stream allows this turtle passage to the North Atlantic. The species is listed by the World Conservation Union as critically endangered. There were nine recorded sightings of individual leatherback turtles in Orkney from 1987 to 1999, and although the majority were in the northern isles, none were sited in the coastal waters surrounding the island of Eday (Booth, 1994).

### **2.8 Conservation**

Details of the conservation and protected sites on Eday are provided in Figure 2.8. The main areas highlighted are the islands of Faray, Holm of Faray, Muckle Green Holm and Little Green Holm. These are all sites with important colonies of grey and/or common seals that are afforded statutory protection at national and European level. Little Green Holm is also considered of local conservation importance due to the colony of cormorants. The survey of Dargie (1998) concluded that the conservation interest of the site is low to moderate.

**Figure 2.8 Conservation and protected sites in the area surrounding Eday**



## 2.9 Other sea users

### 2.9.1 Fisheries

In Scotland there has been a steady decline in the numbers employed in sea fishing, and this trend is reflected in Orkney. The number of boats targeting white fish has reduced to just one out of Westray, with a further four boats in the Orkney fleet fishing from the Mainland. As problems have faced the white fish industry, the shellfish and creel sector now contribute a major part to the Orkney fleet. This spreads throughout the islands, playing a vital economic and social role that is of particular importance to the northern isles. The main species fished are brown, green and velvet crab and lobsters. Approximately 12 creel fishing boats from Mainland Orkney and one from Westray regularly fish on the SW coast of Eday within the Fall of Warness, with the catch amounting to upwards of 30% of their total catch throughout Orkney. Individual vessels may have a greater reliance on the fishing stocks in the area, estimated as up to 50% in some cases (Orkney Fishermen's Association).

With the recurring effects of paralytic and amnesic shellfish poisoning (PSP and ASP), the scallop fisheries in Orkney have show a general decline. The number of vessels has declined from 14 to five in recent years. Due to the severity of the tidal stream, scallop diving rarely takes place in the Fall of Warness and there is no aquaculture taking place within the test site area.

### 2.9.2 Other vessel traffic

The local north isles ferries use alternative routes through the Fall of Warness in poor weather and devices could present navigational challenges in heavy seas and poor visibility if appropriate navigation aids are not used. Figure 2.9 gives an overview of the routes used.

The Fall of Warness is classed as an 'Area To Be Avoided' by the International Maritime Organisation (IMO). This requires all vessels over 5,000 GT, carrying oil or other hazardous cargo, to avoid the area designated. The inherent nature of the channel makes it hazardous for small craft, although it is used by larger vessels. Cruise ships and pelagic fishing vessels also use the channel for passage.

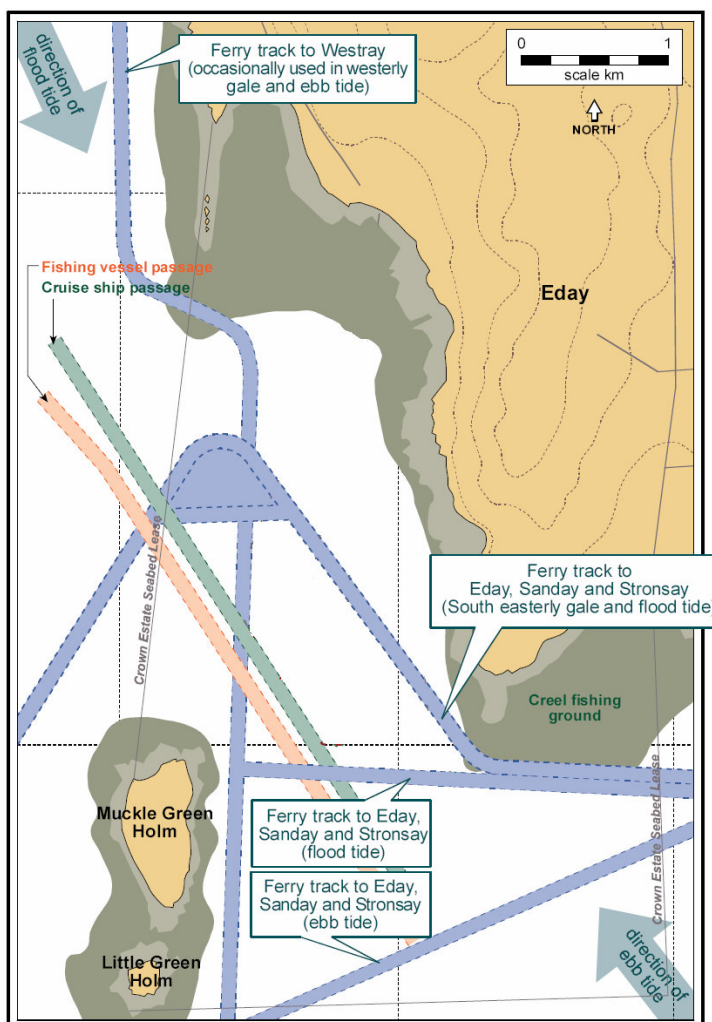


Figure 2.9 Shipping traffic at the Fall of Warness

### 3 Key environmental sensitivities summary

Figure 3.1 Seasonal variations of Key Environmental Sensitivities

Common Seals	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Common seals pup in early June and July, and this is followed by a moulting period in late July and early August. The closest haulout sites are at Seal Skerry, The Graand (on the south coast of Eday) and on Muckle and Little Green Holms, with a European protected population on the near by island of Sanday. The key issues to consider are collision risk and construction/operation/decommissioning disturbance.													
Grey Seals	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
The grey seal breeding season is from early October to late November. The moulting period follows in January to March (females), and March to May (males). Grey seal breeding colonies are located adjacent to the site on Muckle and Little Green Holms, with a European Protected SAC to the north on the islands of Faray and Holm of Faray. The key issues to consider are collision risk and construction/operation/decommissioning disturbance.													
Harbour Porpoise	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
There are no resident populations of Harbour Porpoise, however from observations a moderate number of sightings have been made in the months from July to September. This species has a large ranging nature and it has been suggested that they move offshore during the winter. They are also a European Protected Species. The key issues to consider are collision risk and construction/operation/decommissioning disturbance.													
Cetaceans	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Minke whale, Risso, Orca and White-beaked dolphins have been recorded in the Fall of Warness during the summer months. They carry a high European Protective Species status, but are present in extremely low numbers with a sporadic occurrence. The key issues to consider are collision risk and construction/operation/decommissioning disturbance.													
Birds	See Note	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Bird species are present all year round and of note there is a cormorant breeding colony on Little Green Holm (April-June) adjacent to the test site. The key issue to consider is collision risk.													
Plankton	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
The main components of the zooplankton are copepods, which form an important link in the food chain.													
Finfish & Shellfish	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
The site (and Orkney as a whole) is located within spawning and nursery areas of a number of fish species.													
Basking Sharks	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
From the wildlife observations, low numbers of basking sharks have been sighted in late summer and a regularly spotted in Orkney waters during the summer. They are usually seen along the tidal fronts where mixing water generates the zooplankton on which they feed and are a UK BAP priority species. The key issues to consider are collision risk and construction/operation/decommissioning disturbance.													
Otters	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
A few otter sightings have been recorded adjacent to the test site over the past few years. Otters normally cub in the winter months in Orkney, although they can breed at any time of the year. Due to low number of observations and lack of evidence it is not possible to identify a seasonal sensitivity for the otter. The key issue to consider is and disruption from shore based works.													
Coastal & seabed habitats	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
From baseline EIA studies there is no evidence to indicate any particular sensitivity.													
Key:	High	Moderate	Low	Minor interaction	Unclear due to lack of data								

Note: All birds are protected, so any potential effects must be considered, with particular attention given to diving species.

**Whilst the sensitivities tables indicate times to be avoided if possible, the tables are a guideline, and are not intended to preclude works *per se*, if there is a good justification for works needing to be carried out during 'high' sensitivity months.**

If developers or their contractors do need to carry out operations during these periods of high sensitivity, then developers should ensure full communication with environmental stakeholders (as facilitated by EMEC) in relation to the works. They should also ensure that their documentation includes discussion of the sensitivity in relation to the proposed works, and should give a full explanation of why works proposed during such months need to be carried out at that time.



## 4 References

- Aquatera (2005) *Preliminary seabed surveys for the Fall of Warness* Aquatera Ltd.
- Aurora (2005) *EMEC Tidal Test Facility Environmental Statement* Aurora Ltd.
- Aurora (2006) *Analysis of Bird Data for the Fall of Warness Area*. Report Prepared for AURORA Environmental Limited by DMP Statistical Solutions UK Ltd.
- Barne, JH, Robson, CF, Kaznowska, SS, Doody, JP, Davidson, NC, & Buck, AL, eds. (1997) *Coasts and seas of the United Kingdom. Region 2: Orkney* Joint Nature Conservation Committee (Coastal Directories Series).
- Booth, C & J (1994) *The Mammals of Orkney* The Orcadian Ltd., Orkney.
- Conroy, J & Bacon, P (2005) *Seasonal breeding in Eurasian otters* International Otter Survival Fund.
- Dargie, TCD (1998) *Sand dune vegetation survey of Scotland: Orkney. Volume 1: Main report* Scottish Natural Heritage Research, Survey and Monitoring Report No 123 (Volume 1 of 3).
- Doody, J.P. (1997). Introduction to the region. In: Barne, J.H., Robson, C.F., Kaznowska, S.S., Doody, J.P., Davidsen, N.C. & Buck, A.L. (eds) *Coasts and Seas of the United Kingdom, Region 2 Orkney* Joint Nature Conversation Committee, Peterborough.
- Duck, C., Black, A., Lonergan, M. & Mackey, B. (2006) *The number and distribution of marine mammals in the Fall of Warness, Orkney July 2005 - July 2006* Sea Mammal Research Unit.
- Jones, AM & Beards, F (1983) *Planktonic Cycles in Scapa Flow 1978-1979* Technical Report GEN/PL/1.
- MCA (2004) Hydrographic Survey – Sanday Sound to Westray Firth (Orkney Islands), Specification v1.0, Maritime and Coastguard Agency, Navigation Safety Branch, 10 December 2004. REP109.
- Meek, E (pers comm.) Letter received from Eric Meek, RSPB, Orkney office.
- Nellen, W, & Schadt, J (1992) *Year to year variability in the plankton community on the spawning ground of the Hebrides-Buchan herring* Hydrological variability in the ICES area, 1980-1989, 195:361-387.
- Orkney Islands Council (unpublished data) Database of coastal habitats in Orkney held by the Marine Biology Unit, Orkney Islands Council Harbours Department.
- Pelorus (2004) *Orkney Tidal Site Evaluation for Marine Renewable Energy Test Locations* Report No L4044, Hydrographic & Geophysical Survey, Revision 1. Carried out on behalf of EMEC.
- Renouf D, Gaborko L, Galway G & Finlayson R (1981) *The effect of disturbance on the daily movements of harbour seals and grey seals between the sea and their hauling grounds at Miquelon* Applied Animal Ethology **7**: 373-379.
- Thompson P.M (1988) *Timing of mating in the common seal (Phoca vitulina)* Mammal Review **18**(2): 105-112.
- Thompson PM, Miller, D *et al.* (1994) *Changes in the distribution and activity of female harbour seals during the breeding season: implications for their lactation strategy and mating patterns* Journal of Animal Ecology **63**: 24-30.
- Van Parijs SM, Janik VM & Thompson, PM (2000) *Display area size, tenure length and site fidelity in the aquatically mating male harbour seal* Canadian Journal of Zoology **78**: 2209 – 2217.
- Whale and Dolphin Conservation Society (WDCCS) (2004) *Oceans of noise* WDCCS.

## 5.0 Data sources

### 5.1 Data available from EMEC

The following and additional information, as it is acquired, will be made available to developers who have signed a Non Disclosure Agreement with EMEC.

- (1) Ongoing Wildlife Reports for marine mammal and bird observational data
- (2) Aurora (2006) *Analysis of Bird Data for the Fall of Warness Area*. Report Prepared for AURORA Environmental Limited by DMP Statistical Solutions UK Ltd.
- (3) Duck, C., Black, A., Lonergan, M. & Mackey, B. (2006) *The number and distribution of marine mammals in the Fall of Warness, Orkney July 2005 - July 2006* Sea Mammal Research Unit.
- (4) Osirus Tidal Survey (Covering physical aspects such as bathymetry, sonar, sub-bottom profiling and ADCP profiling)
- (5) Pelorus Survey (Covering physical aspects such as bathymetry, sonar and seismic reflection)
- (6) Tidal Test Site Environmental Statement
  - a. Archaeological survey and impact assessment
  - b. Bird survey
  - c. Coastal and seabed processes review
  - d. Navigational risk assessment
  - e. Otter survey and impact assessment
  - f. Seabed survey - preliminary April 2005
  - g. Seabed survey - supplementary survey May 2005
  - h. Seabed survey analysis of samples
  - i. Seal desk study and impact assessment
  - j. Terrestrial habitat and vegetation survey
- (7) MCA Survey (Covering physical aspects such as bathymetry, sonar and seismic reflection)
- (8) Halcrow Group Limited (2006) Summarising Geological Report

### 5.2 Other sources of environmental data

Organisation	Information available
Orkney Biodiversity Records Centre	Report from the OBRC wildlife records database
British Geological Society	Geological and hydrogeological information and publications
Joint Nature Conservation Committee	Sublittoral and coastal survey data

EMEC has ongoing consultations with the following organisations and appropriate contact details are available:

- Scottish Natural Heritage
- Sea Mammal Research Unit
- Royal Society for the Protection of Birds
- Scottish Environment Protection Agency
- Orkney Islands Council Department of Harbours
- Orkney Fisheries Association
- Orkney Dive Boat Association
- Orkney Sea Angling Association

## Appendix 1

<b>Location</b>	<b>Common Name</b>	<b>Species Name</b>	<b>Additional Information</b>	
Cauldale	Ringed Plover	<i>(Charadrius hiaticula)</i>	Nest regularly from May to July	
	Meadow Pipit	<i>(Anthus pratensis)</i>	Nest regularly from May to July	
	Rock Pipit	<i>(Anthus spinoletta)</i>	Nest regularly from May to July	
	Shelduck	<i>(Tadorna tadorna)</i>	To rear young	
Sandybank	Eider	<i>(Somateria mollissima)</i>	To rear young	
	Lapwing	<i>(Vanellus vanellus)</i>	Fairly important	
	Fulmar	<i>(Fulmarus glacialis)</i>	Nest in cliffs in the winter	
Seal Skerry	Black Guillemot	<i>(Cepphus grille)</i>		
	Sanderling	<i>(Calidris alba)</i>	Significant winter flock feeding area	
	Dunlin	<i>(Calidris alpina)</i>		
	Shag	<i>(Phalacrocorax aristotelis)</i>		
	Grey Heron	<i>(Ardea cinerea)</i>		
	Mallards	<i>(Anas platyrhynchos)</i>		
	Rarer Shoveler	<i>(Anus clypeata)</i>		
	Teal	<i>(Anas crecca)</i>	Region's smallest breeding duck	
	Wigeon	<i>(Anas Penelope)</i>		
	Neven Point	Ringed Plover		
Turnstone		<i>(Arenaria interpres)</i>		
Purple Sandpiper		<i>(Calidris maritime)</i>		
Redshank		<i>(Tringa tetanus)</i>		
Kittiwake		<i>(Rissa tridactyla)</i>		
Gannet		<i>(Morus bassanus)</i>	A few present	
Fulmar			Present over winter	
Eider			Present over winter	
Black Guillemot			Very important	
WarNess		Shag		Very important over winter
	Cormorant	<i>(Phalacrocorax carbo)</i>	Very important over winter	
	Eider		Fairly important	
	Oystercatcher	<i>(Haematopus ostralegus)</i>	Fairly important	
	Puffin	<i>(Fraterecula arctica)</i>	Fairly important	
	Rock Dove		Fairly important	
	Turnstone		Fairly important	
	Purple Sandpiper		Fairly important	
	Redshank		Fairly important	
	Great Blackback Gull	<i>(Larus marinus)</i>	Fairly important	
The chapel area	Kittiwake		Fairly important	
	Arctic Tern	<i>(Sterna paradisaea)</i>	Present through May and July	
	Sandwich Tern	<i>(Sterna sandvicensis)</i>	May and July possibly	
	Ringed Plover		Nest here regularly	
	Rock Pipit		Nest here regularly	
	Fulmar		Fairly important	
	Black Guillemot		Very important	
	Greentoft	Ringed Plover		Fairly important over summer
		Shelduck		
		Eider		
Rock Pipit			Nest under the banks	
Meadow Pipit			Nest under the banks	
Turnstone			Numerous within flocks	
Dunlin			Numerous within flocks	
Purple Sandpiper			Numerous within flocks	
Curlew		<i>(Numenius arquata)</i>		
Bar-tailed Godwit		<i>(Limosa lapponica)</i>		
Muckle Green Holm	Oystercatcher			
	Redshank			
	Grey plover			
	Sanderling			
	Black Guillemot		Important	
	Puffin		Present between April and August	
	Shag		Important (March-August)	
	Cormorant		Important when breeding (April-June)	
	Storm Petrel		Reported sightings	
	Little Green Holm	Cormorant		Important when breeding (April-June)
Arctic Tern			Colony (May-July)	
Black Guillemot			Very important breeding area	