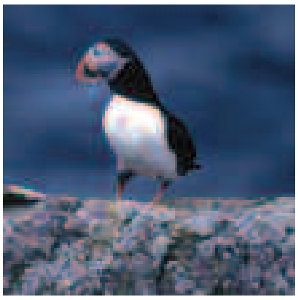
Beatrice

Wind Farm Demonstrator Project

Environmental Statement






INFORMATION SHEET

Project name:	Beatrice Wind Farm Demonstrator Project
DTI Project Reference:	D/2875/2005
Type of project:	Demonstration of offshore wind farm
Undertaker name:	Talisman Energy (UK) Limited
Address:	163 Holburn Street Aberdeen AB10 6BZ
Licensees/Owners:	Talisman Energy (UK) Limited
Anticipated commencement of works:	May 2006
Short description of project:	Proposed installation and operation of two stand-alone wind turbine generating units (WTGs) to provide electrical power to the Beatrice platforms. The WTGs will be supported on small steel jackets piled into the seabed, and will be 88m high with blades 63m long. The WTGs will be linked to the Beatrice AP platform by a buried umbilical containing the electrical cable.
Date and reference number of any earlier Statement related to this project:	Beatrice Decommissioning Programme RDBF/003/00006C-01 and 02 December 2004
Significant environmental impacts identified:	Underwater noise from piling Potential interaction with birds at sea
Statement prepared by:	Talisman Energy (UK) Limited

ACKNOWLEDGEMENTS

Talisman is grateful for the support, advice and comments received from all organisations and individuals during the consultation programme. Thanks are due to the Moray Firth Partnership for help in organising major stakeholder meetings, and to the University of Aberdeen Lighthouse Field Station for access to unpublished data.

This Environmental Statement was prepared with support from BMT Cordah Limited.

Design and production by The Big Picture.

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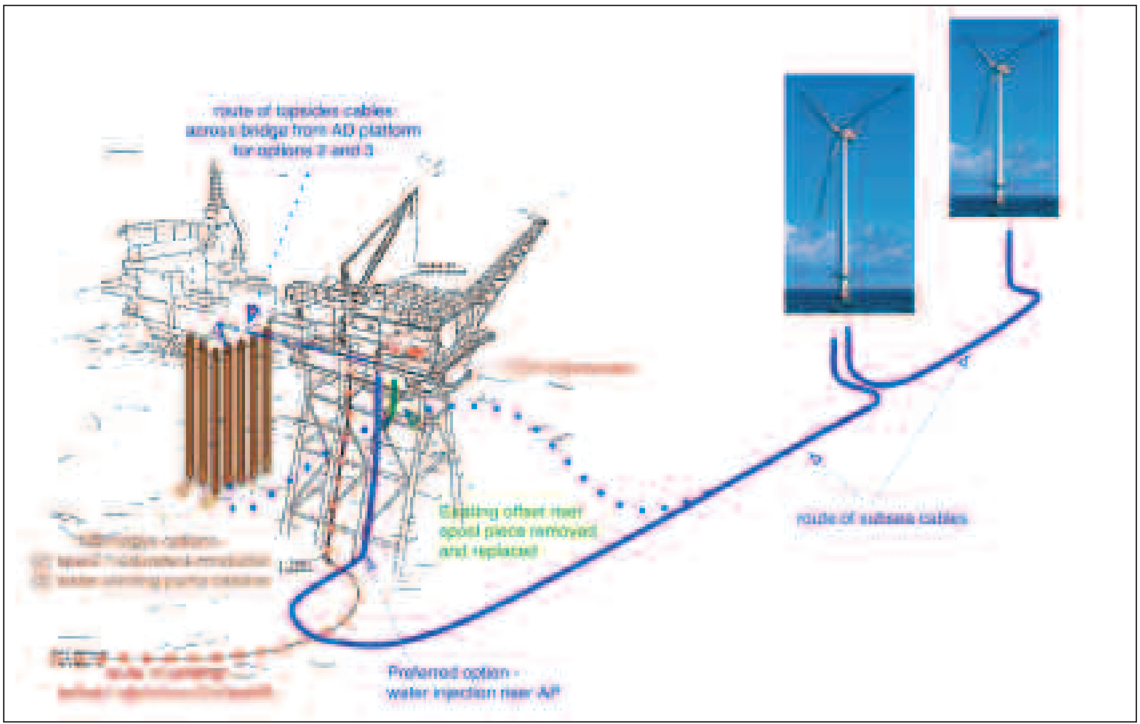
1 NON-TECHNICAL SUMMARY

1.1 INTRODUCTION

Talisman Energy (UK) Limited seeks to provide cost-effective electricity to its Beatrice platforms in the Moray Firth by installing two stand-alone wind turbine generating units (WTGs). These will be located about 1.6km and 2.3km from the Beatrice AP platform, and linked to it by a buried umbilical containing the electrical cable (Figure 1.1). The WTGs will operate as a Demonstrator Project for five years, supplying power to Beatrice and also providing valuable information about the technical, environmental and economic issues associated with creating a commercial deepwater wind farm at this site.

Figure 1.1 Illustration showing the general layout of the proposed Demonstrator site in relation to the existing Beatrice Alpha platforms.



This project is being undertaken by Talisman and its co-venturer Scottish and Southern Energy, and many of the research aspects are part-funded under a European Project called DOWNVInD which is examining the potential for developing wind farms offshore in deepwater where they will result in less visual intrusion than onshore wind farms.

Talisman Energy (UK) is therefore seeking consent for the Demonstrator Project as a variation of its existing consent for the Beatrice field operations. This Environmental Statement presents the results of a comprehensive Environmental Impact Assessment carried out under the Offshore Petroleum Production and Pipelines (Assessment of Environmental Effects) Regulations 1999.

If the Demonstrator Project proves successful and the decision is made to proceed with the creation of a commercial wind farm, a second comprehensive EIA, including consultation, would be undertaken for that development.

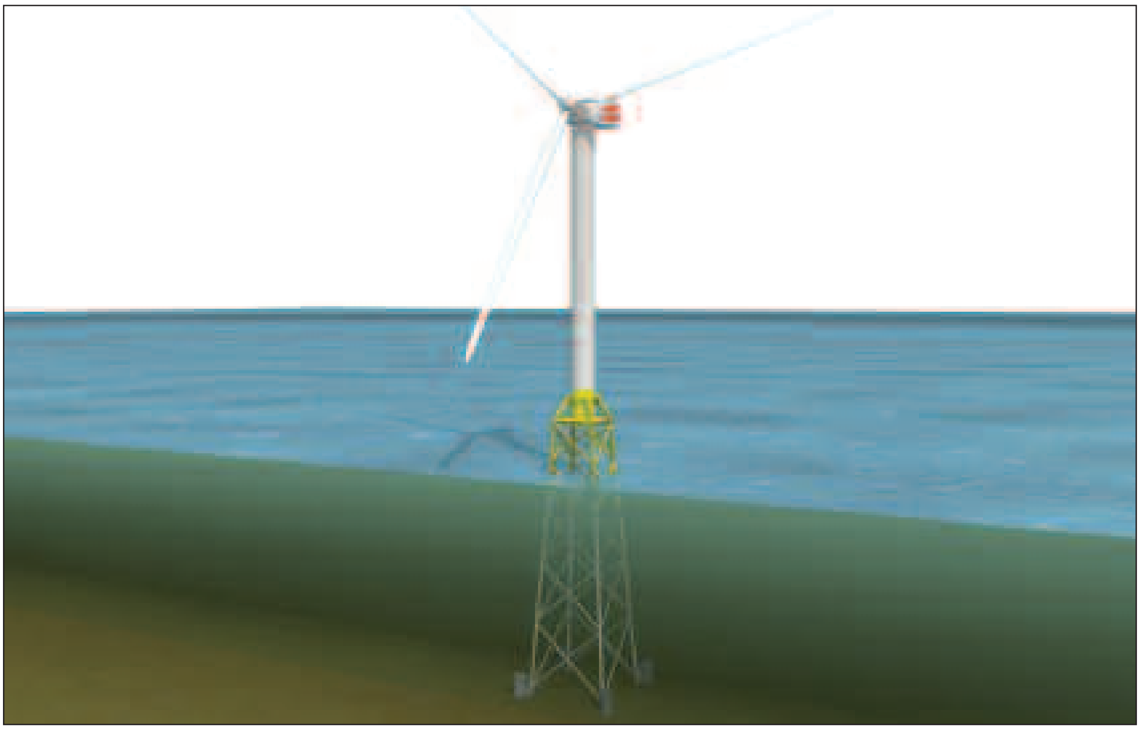
1.2 DESCRIPTION OF PROPOSED PROJECT

1.2.1 WIND TURBINE GENERATORS (WTGs)

The WTGs will each carry a REpower 5MW turbine, and together they will deliver an estimated 10MW of electricity to the platform. Figure 1.2 shows the design of each WTG, which comprises:

- *a substructure, a small, four-legged steel jacket which will be fixed to the seabed using four piles driven into the seabed*
- *a cylindrical steel tower fixed to the top of the substructure and rising to a height of 88m above sea level*
- *the REpower turbine nacelle, which weighs about 400 tonnes and is fitted with three blades 63m long.*

Figure 1.2 The structure of the wind turbine generating units (WTGs) for the proposed Beatrice Demonstrator Project.



The two WTGs and the Beatrice AP platform will be linked by a subsea umbilical containing the main electrical cable, and other lines for the control and monitoring of the WTGs. The umbilical will be buried to a depth of about 0.9m in the seabed, using a remotely-operated vehicle equipped with directed high pressure jets of water that fluidise the seabed, allowing the umbilical to sink into a trench. The umbilical will cross the existing 16” oil export line from Beatrice, and for about 200m, between this crossing and the platform, it will lie on the surface of the seabed protected by concrete “mattresses”.

Some very minor modifications for one of the external pipes running down the leg of the Beatrice AP platform will be required, so that the end of the umbilical can be pulled up through it and on to the platform.

1.2.2 INSTALLATION PROGRAMME

The programme to install facilities at the Demonstrator site will be carried out in two phases in the late spring and summer of 2006.

Firstly, the umbilicals will be laid and then trenched by a pipelaying vessel, in an operation lasting a total of 14 days. Secondly, the WTGs will be installed, in a programme lasting a total of 15 days. This will require the use of several different types of vessel, including a heavy lift crane, a dive support vessel, a cargo barge and anchor-handling tugs.

The main components of the WTGs (substructure, piles, tower, nacelle and blades) will be sourced or manufactured at several locations, and then transported by sea to a port or harbour for final assembly. The onshore site for final assembly has not yet been selected but it is likely to be a port or harbour at which industrial and commercial activities have already taken place. At the assembly site onshore, the nacelle and blades will be fitted to the tower. It is planned that the WTGs can be transported to the Demonstrator site as two units, the substructure plus piles, and the tower plus complete nacelle.

A heavy lift crane will be used to place the substructure accurately on the seabed at the Demonstrator site. The tower and nacelle unit will then be lifted onto the substructure, and mated with it using a unique "soft landing" system to minimise any relative motion between the substructure fixed to the seabed and the tower and nacelle suspended from the floating crane. Finally, the end of the umbilical lying on the seabed will be pulled up through a pipe on the substructure and connected to the electrical circuit inside the tower.

1.3 ENVIRONMENTAL SETTING FOR THE PROPOSED WIND TURBINE GENERATORS

1.3.1 LOCATION

The site of the Demonstrator Project in which the two WTGs and umbilical will be located, lies wholly within the existing licence area for the Beatrice field in Block 11/30a of the UK Continental Shelf. This is approximately 25km off the north-east coast of the Moray Firth, in a water depth of 45m.

1.3.2 SEABED ENVIRONMENT

A project-specific survey of the seabed at the Demonstrator site was carried out in October 2005 to confirm the nature of the benthic environment. The seabed at the site comprises sandy sediments formed into low gently undulating sand waves. The existing levels of contaminants are very low; the sediments have concentrations of metals and hydrocarbons that are within the range of concentrations found at unperturbed locations in other parts of the North Sea, and which may be considered to represent background concentrations. The seabed communities of worms, bivalve snails and crustaceans are diverse, again reflecting the uncontaminated nature of the seabed. The seabed survey in October did not reveal any indications of the presence of beds of the horse mussel *Modiolus modiolus*, and only a single juvenile specimen of this species was recovered in grab samples.

1.3.3 MARINE MAMMALS

Several species of marine mammal have been observed in the area of the Beatrice field or Moray Firth including common seal, grey seal, harbour porpoise, Risso's dolphin, Atlantic white-sided dolphin, stripped dolphin, common dolphin and minke whale.

The Moray Firth population of bottlenose dolphin is thought to number between 100 and 174 individuals. Bottlenose dolphins have not been observed in the area, but it is possible that some of the unidentified dolphin recorded acoustically in the area were bottlenose dolphins. An acoustic monitoring programme carried out in the Moray Firth in 2005 by the University of Aberdeen under the DOWNVInD programme provided more specific information about the way in which different species of cetaceans use the Firth. This showed that in summer harbour porpoises are found widely throughout the Moray Firth SAC and around the Beatrice field, but that dolphin species (they could not be identified to species level using the acoustic monitoring equipment that was used) were found predominantly in the Inner Moray Firth and close to the coast. Visits by dolphin species to the area of the Beatrice field were less frequent, and on average of shorter duration, than those made by harbour porpoise.

1.3.4 BIRDS

The coastline of the Moray Firth and its hinterland offer a wide range of feeding and breeding sites for both resident and migrant birds, and several sites in the Moray Firth are of national or international importance for different species. Nearshore, there are important populations of sea duck and waders, and at cliff nesting sites there are important populations of auks, terns, kittiwake and fulmar.

A year-long survey of the Demonstrator site was completed by experienced ornithologists, based on the nearby Beatrice AP platform. This survey obtained site-specific information about the variety, numbers, densities and flying patterns of all birds seen in and around the Demonstrator site. These data were used to make an assessment of the importance of the Demonstrator site for birds and to quantify the potential collision risk to birds posed by the WTGs. Seven species of birds were observed frequently, and with total numbers in excess of 100 for the year; these were auk sp., herring gull, great black-backed gull, fulmar, gannet, kittiwake and tern sp.

1.3.5 COMMERCIAL FISHERIES

The Demonstrator site is located on the Smith Bank, an important feature for fish, shellfish and commercial fisheries in the area. The most important commercial fishery is for scallops, and overall the area is assessed as having a “high” commercial value for fisheries. Fishing effort in ICES Rectangle 45E6 in 2004 amounted to some 850 fishing days, predominantly by scallop dredge and otter trawl.

1.3.6 OTHER USERS OF THE SEA, CABLES AND SITES OF ARCHAEOLOGICAL INTEREST

The general area of the Beatrice field is used by fishing boats, small and medium-sized cargo vessels and ferries. An area-specific review of vessel traffic has been undertaken and shows that the general level of vessel traffic is low. The Beatrice field lies beyond specific areas in which the MOD conduct exercises, and it does not contain any cables or pipelines (other than those used by Talisman at Beatrice) or any sites (wrecks) that have been notified because of their historic or archaeological interest.

1.3.7 PROTECTED OR DESIGNATED SITES

The Moray Firth contains many sites of national and international importance for wildlife; the Inner Moray Firth itself is a Special Area of Conservation (SAC) established under the Habitats Directive, primarily for its resident population of bottlenose dolphin, one of only two such populations in the UK. Along the coasts of the Firth there are other SACs, and also Special Protection Areas (SPAs) established under the Birds’ Directive. The outer limit of the Moray Firth SAC is 25km from the nearest WTG in the Demonstrator site, and the nearest coastal SAC or SPA is the Berriedale Cliffs, approximately 25km from the closest WTG.

1.4 CONSULTATION PROGRAMME

Starting in 2003, Talisman has conducted an open and wide-ranging programme of consultation with members of the public; organisations representing communities, businesses and environmental groups; NGOs; and statutory consultees. It has published newsletters and articles in newspapers and journals; established and maintained a website (www.beatricewind.co.uk); held open public meetings and presentations; and conducted workshops. Talisman has endeavoured to ensure that all interested parties have been able to find out about the project and to keep track of developments and plans as they have unfolded. To this end, presentations and question and answer sessions were arranged for stakeholders in communities along the whole coast of the Moray Firth.

To inform and support the extensive programme of consultation, Talisman published a detailed Scoping Report in January 2005. This was used to inform the discussions with interested parties about the project, and to identify the potential key environmental effects that the project might have.

1.5 SCOPING THE POTENTIAL IMPACTS OF THE BEATRICE WIND FARM DEMONSTRATOR PROJECT

As a result of the extensive feed-back from the consultation programme, and in the light of the preliminary assessment of key effects from the scoping report, Talisman completed a detailed review of all the potential environmental effects that could arise as a result of the planned, unplanned and accidental events associated with the proposed project.

The outcome of this review is presented in the environmental statement, along with a justification for excluding those effects or risks that were judged to be very small.

Talisman has identified the following issues (Table 1.1) of greatest concern to stakeholders. All of these issues are examined in appropriate detail by the environmental assessment, and reported in the environmental statement.

Table 1.1 Key potential environmental effects associated with the Demonstrator Project.

CAUSE OF EFFECT	POTENTIAL ENVIRONMENTAL EFFECT(S)
Underwater noise from piling operations	Noise disturbance to marine mammals
Physical presence of operating WTGs	Collision risk to birds
	Visual impact on landscape and seascape
	Damage to seabed communities
	Interference with aviation and telecommunications
	Collision risk to commercial and fishing vessels
Presence of subsea electrical cables	Effects of electromagnetic fields on fish

1.6 EFFECTS ON MARINE MAMMALS OF UNDERWATER NOISE FROM PILING

1.6.1 SOURCE AND DURATION OF PILING NOISE

Piles will be driven into the seabed using a piling hammer typical of the systems routinely employed both offshore and at coastal locations. It is estimated that underwater noise from piling may be created for about two hours at each pile, and it is planned that two piles will be driven each day, over a four day period. The piling operations for the Demonstrator Project will be similar to those undertaken to fix oil or gas platforms to the seabed, rather than the larger monopiles associated with free-standing wind turbines typically developed in shallower, near shore locations.

1.6.2 EXTENT OF NOISE EFFECTS FROM PILING

Recent publications were sourced in order to obtain a realistic value for the source noise associated with piling 1.8m diameter piles, and a source level of 225dB was selected (Nedwell and Newall, 2005). Standard equations for the propagation of sound underwater were then used to estimate the physical extent of two zones of effect for marine mammals. The first was the zone in which temporary changes in hearing ability may occur in marine mammals and fish; this change is temporary and data in the literature suggest that it occurs when marine mammals are exposed to noise levels of greater than 240dB which are also 80-90dB above the threshold of their hearing. The threshold of temporary change in hearing ability was selected because it is the least damaging physical effect, and would be found over the largest area. It is therefore the most precautionary physical threshold and there are data in the literature for this threshold level for different species.

The second zone was one in which marine animals may exhibit a "strong avoidance reaction" (i.e. they will tend to swim away from the source). Again, the literature suggests that this behaviour would be elicited when marine mammals are exposed to a noise level at a particular frequency that is >90dB above their hearing threshold (this is expressed as >90dB ht (species). The threshold for strong avoidance reaction was selected because it is the lowest level at which overt behavioural changes occur in the animals which might be exposed to underwater noise and, again, there are data in the literature for this threshold level for different species.

The noise propagation model was run for bottlenose dolphin, harbour porpoise, common seal, harbour seal, and the mysticetes (the group to which minke whale belongs). Different frequencies were examined, to determine the maximum extents of the zones within which temporary changes in hearing, and avoidance, might occur.

For bottlenose dolphin and harbour porpoise, the zone within which temporary changes in hearing might occur was found to extend to about 1km radius around the piling site. For common seal this zone was about 1km, and for mysticetes it was about 0.4km. For bottlenose dolphin, the zone in which a strong avoidance reaction might be elicited extended to about 2km radius from the piling site. The equivalent zone for harbour porpoise was 9km, harbour seal 7km, and mysticetes 33km. It is stressed that all these estimated distances assume that no mitigation measures are in place from the project to try to reduce the absolute source level of piling noise.

On the basis of this assessment, it was concluded that cetaceans and seals within 1km of the piling site might be exposed to noise levels that cause temporary changes in hearing ability, and that mitigation measures should be focused on ensuring that piling did not start if marine mammals were present in this zone.

It was also concluded that marine mammals (excluding mysticetes) out to perhaps 10km from the site might be exposed to noise levels that caused an avoidance reaction. This means that the individuals would be expected to change their behaviour and move away from the site while the noise lasted, but then return to it when the noise ceased. Studies at the Horns Rev wind farm have shown that marine mammals returned to the area within a few hours of the cessation of piling noise (Tougaard *et al.,* 2003).

It does not appear that noise of a level sufficient to cause strong avoidance reaction will reach the boundaries of the Moray Firth SAC, some 25km away.

1.6.3 MITIGATION OF PILING NOISE

Underwater noise from piling will be generated for perhaps four hours each day, over a four day period. Talisman will develop a project-specific environmental protection plan outlining the mitigation measures to be used during piling. This will include a series of mitigation measures based on the principles in the JNCC 'Guidelines for Minimising Accoustic Disturbance from Seismic Surveys', specifically:

- *reduce the source level of piling noise, if possible, using physical barriers*
- *use marine mammal observers and passive acoustic monitoring to ensure as far as possible that no marine mammal is within 1km of the site before piling starts*
- *use a "soft start" technique to alert marine mammals in the immediate vicinity (for example within 10km) to the commencement of the piling operations.*

It may be possible to use various physical devices to reduce the level of noise from piling. Such systems can reduce the source noise level in the water column, and reductions of 3dB to 10dB are claimed (Nedwell *et al.,* 2003). Talisman is currently exploring opportunities for physical noise mitigation, and how to overcome the technical and logistical problems of deploying such arrangements in 45m of water offshore. Clearly, even a reduction of a few dB at source reduces the radius of the zones of effect estimated in the modelling.

The focus of the project's mitigation measures will be firstly, to ensure that no marine mammal is present within 1km of piling operations, and secondly, that individuals present in the zone where perceived noise levels might be expected to cause strong avoidance reactions are encouraged to move further away.

Talisman will follow the principles of the JNCC guidelines for minimising the acoustic effects of seismic operations on marine mammals. Independent marine mammal observers will be present offshore throughout the piling programme. Before operations begin, the area within 1km of the site will be carefully surveyed to ensure that there are no marine mammals present. Piling will not be started during darkness. The environmental protection plan will be based on similar plans produced and operated by Talisman (Talisman, 2000) and will identify clear actions to be taken if marine mammals are detected before and during all operations.

Before full piling operations begin, a "soft start" will be implemented, whereby the force of piling is gradually increased, steadily raising the underwater noise level over a period of time. This will alert animals located more than 1km from the site to the piling activities, without exposing them to more intense levels of noise, and provide an opportunity for them to move away from the noise source.

1.7 EFFECTS OF THE PRESENCE OF WIND TURBINE GENERATORS ON BIRDS

1.7.1 SOURCES OF EFFECTS ON BIRDS

Commercial-scale wind farms present a collision risk to birds, may represent a barrier to bird movement, exclude birds from feeding grounds, displace them from important areas, or adversely affect their food supply. On the basis of the extensive literature on bird distribution in and around the Moray Firth, and using the year-long site-specific monitoring data from the Beatrice field, the environmental assessment has concluded that the greatest risk to birds from the two WTGs is the risk of collision.

1.7.2 MAGNITUDE OF COLLISION RISK FOR BIRDS

Attention was focused on those species that were seen at the site most frequently, and in high numbers. Results from observations made at the Demonstrator site showed that auk species, great black-backed gulls, herring gulls, gannets, fulmars and kittiwakes were the species most likely to interact with the turbine blades.

A standard collision risk model (Band, 2000) was used to estimate the likelihood of a collision with the Demonstrator WTGs for each of these species. Data on bird density were then used to calculate the potential numbers of interactions between birds and the turbine blades, in order to estimate the likely number of additional mortalities as a result of the presence and operation of the two WTGs.

With the exception of great black-backed gull, the additional potential increase in natural mortality of the Moray Firth population for that species as a result of the WTGs was estimated to be <1%. For great black-backed gulls, the potential mortality was estimated to be about 2.5% of the natural mortality of the population. This was based on an estimated average number of 8,000 birds in the Moray Firth area, and must be treated with caution, since numbers of great black-backed gull in the Moray Firth vary significantly with the season.

1.7.3 MITIGATION FOR EFFECTS ON BIRDS

The two WTGs will be sited more than 25km from land, and from all SPAs UKBAP sites, Ramsar Sites, IBA sites, and estuaries. They do not appear to be located in a particularly important feeding ground for any species of sea bird, or in an area that is frequented by large numbers of either flying or moulting birds.

No mitigation can be proposed for short-term disturbance effects on birds during construction, except to complete the activities in a timely manner. During their operational life, the WTGs will bear navigation lights, and the lower parts of the towers will be painted to make them more visible to shipping (Section 3.3.11). The rest of the tower, and the blades, will be painted grey to reduce their overall visual impact.

Inspection and maintenance will be carried out periodically, using the fast rescue craft (ERIC) deployed from the nearby Beatrice platform. Given the present existence of vessel activity around the Beatrice field, and the fact that few birds have been observed at the Demonstrator site on the water surface or feeding, the localised disturbance caused by maintenance visits is likely to be localised and not significant.

1.7.4 FURTHER RESEARCH PROPOSED

The University of Aberdeen will conduct field surveys of the feeding and resting behaviour of marine birds in and around the site of the Demonstrator Project. This work will probably use boat transect and may also use radar observations of seabird movements before and after the installation of the WTGs. Work is continuing to optimise the bird data that can be obtained using offshore radar.

1.8 VISUAL IMPACT OF DEMONSTRATOR PROJECT ON LANDSCAPE AND SEASCAPE

1.8.1 SOURCES OF EFFECTS ON LANDSCAPE AND SEASCAPE

Under good viewing conditions the WTGs will be visible from certain parts of the north-east coast of the Moray Firth, as are the Beatrice platforms themselves. The presence of the WTGs could, therefore, affect people's appreciation of the landscape and seascape by introducing another man-made structure into the field of view, and thus detracting from the "wildness", "openness" or "naturalness" of the wide seascape presented by the Firth. The movement of the turbine blades would be unlikely to be discernible from the coast.

A detailed Landscape and Visual Impact Assessment (LVIA) was therefore completed to determine the possible nature and extent of the visual impact that the WTGs might have. The methodology employed was based on the 'Guidelines for Landscape and Visual Assessment' (Landscape Institute and Institute of Environmental Management and Assessment, (2002)), modified to incorporate elements of Seascape Assessment as recommended within the Guide to Best Practice in Seascape Assessment (Countryside Council for Wales, Brady Shipman Martin and University College Dublin, 2001).

A study entitled "Guidance on the assessment of the impact of offshore wind farms: seascape and visual impact report", by the DTI in association with the Countryside Agency, the Countryside Council for Wales and Scottish Natural Heritage, was published in November 2005, after the LVIA for the Beatrice Demonstrator was completed. Although this study was not available to be utilised in Talisman's assessment, given the wealth of existing material that has been drawn upon to complete this LVIA, and the experience of the landscape architects who undertook the work, Talisman believes that the methods, approach and assessment techniques used for the Demonstrator LVIA will be in broad agreement with any future developments in best practice that may be available later in 2006.

The initial stages of assessment defined the study area and identified landscape character, landscape designations and relevant government policy, to determine the general extent of visibility and to identify a representative range of potential viewpoints from which to carry out the LVIA. These viewpoints were largely concentrated within publicly accessible areas along roads and public footpaths, in residential locations and in areas popular for outdoor recreation.

Maps showing the Zone of Theoretical Visibility (ZTV) were generated to identify the potential extent of visibility of the proposed wind farm over a 60km radius from the centre of the site. The 60km radius was chosen, with support from a number of consultees, because this was the theoretical limit at which the tips of the blades might be seen.

The ZTVs identified a number of viewpoints that would represent the potential range of views to the wind farm that could have significant visual impacts. The final viewpoints selected for the LVIA are listed in Table 1.2.

Some of these viewpoints also represent potential cumulative visual impacts of other wind farms proposed for the North of Scotland. The potential cumulative and sequential impacts of the proposed Demonstrator WTGs with other, onshore wind turbines, were also examined.

Table 1.2 Viewpoints selected for the LVIA.

Viewpoint nr	Location	Main users (receptors)	Grid ref	Approx altitude(m)	Approx distance from edge of wind farm (km)	Direction to centre of wind farm	Other wind farms theoretically visible*
1	Lybster	Local residents and visitors (also similar to views from A9)	324884, 935060	51	26	SSE	B D K > 35km G > 35 km
2	Latheron	Motorists and local residents	319809 933137	72	28	NE	K > 35km G > 35 km
3	Dunbeath Heritage Centre	Local residents, visitors and motorists	315943, 929538	55	26	SE	B D K > 35km
4	Scaraben	Hill walkers and stalkers	308074, 927326	626	32	SE	C, B, G, D
5	A9/Berriedale Borgue area	Motorists and local residents	313171, 924717	135	26	SE	D K > 35km
6	A9 Navidale	Motorists and local residents	303767, 916153	79	33	ESE	B > 35km C > 35 km
7	Creag Riasgain	Local walkers	295746, 912661	415	41	E	B > 35km C > 35 km K, G
8	Brora golf course/car park	Golfers, local residents, visitors	291004, 903966	10	46	ENE	B > 35km C > 35 km D > 35 km K
9	Tarbat Ness	Local residents and tourists	294821, 887641	10	49	SSE	B > 35km C > 35 km D > 35 km K
10	Lossiemouth	Local residents	323321, 871291 or 323317, 871285	3	44	NNE	C > 35 km B> 35 km G> 35 km K> 35 km D> 35 km
11	Durn Hill	Local residents and visitors	357100, 863842	195	53	NNW	C > 35 km B> 35 km G> 35 km K> 35 km D> 35 km

** C=Causeymire, B=Buolfruich, D=Dunbeath, K=Kilbraur, G=Gordonbush*
>35km=outside the study area of the wind farm and thus visibility data not provided

1.8.2 CHARACTER AND MAGNITUDE OF VISUAL EFFECTS

Landscape impacts of the WTGs

Generally the WTGs would relate strongly to many of the key characteristics of the landscapes along the coast, specifically their large scale, sense of exposure, existing patchy composition of features and existing presence of human-made elements. Most importantly, the Demonstrator WTGs would seem closely associated with the existing oil platforms – appearing to complement the energy generation function and focal qualities of these features.

For all local landscape areas, landscape impacts were judged to be of low magnitude. No substantial adverse impacts were identified.

Visual impacts of the WTGs

From most viewpoints the proposed development would be seen as a single cohesive feature within the landscape, of similar prominence to existing foci within the onshore landscape such as telecom masts and distinctive low hills, as well as the existing oil platforms seen offshore. Given its distance from the coast, it would appear clearly separated from the onshore landscape and, alternatively, part of the open sea, and the movement of wind turbine blades would rarely be discernible from the mainland. In addition, although the vertical line of the turbines would contrast to the existing platforms and the surrounding horizontal emphasis of the sea, this disparity would appear as a “clean” contrast of line and form on account of the simple composition of elements.

The proposed WTGs would appear most prominent from the coastal areas that have a simple foreground pattern, with fewer distracting features, especially when views are directed towards the proposed development. Visibility would mainly occur from southern directions and at high elevations.

For the 11 viewpoints, the proposed development would mainly result in only negligible or slight significance of visual impacts, with only two viewpoints resulting in moderate significance of visual impact, reflecting their higher sensitivity. No substantial visual impacts were found.

Sequential impacts of the Beatrice wind turbines

Sequential impacts occur when the observer moves along a linear route, as a series or continuing of points. View from these routes may include other developments. The possible sequential impacts of the Demonstrator WTGs were assessed in both directions along two coastal roads. Most of the views from locations along these routes would result in impacts of ‘no’ or ‘negligible’ magnitude (because of the distance of the proposed development), although low magnitude of impacts would occur along some sections. This would result in impacts of ‘none’, ‘negligible’ or ‘slight’ significance of impacts along all sections of the roads apart from one section travelling south between Wick and Latheron and one section travelling north between Navidale and Dunbeath. From these sections, which equate to 51km of a total sequential assessment of 313km, there would be moderate sequential visual impacts. No substantial sequential impacts were found.

Impacts of the Beatrice wind turbines on areas of landscape and scenic value

The proposed Demonstrator Project would have low or negligible magnitude of impact on areas of recognised landscape and scenic value. It would have no significant impact on any National Scenic Area. However, it would result in moderate adverse impacts on one proposed Area of Great Landscape Value and two Garden and Designed Landscapes, which reflects their medium sensitivity. No substantial significant impacts have been identified on areas of landscape and scenic value.

Cumulative landscape and visual impacts of the Beatrice wind turbines with other wind farms

Cumulative impacts of the proposed WTGs with the existing Causeymire and Buolfruich wind farms were considered, as well as the combined landscape and visual impacts of the Demonstrator WTGs with the proposed Dunbeath, Kilbraur and Gordonbush wind farms.

Generally the Beatrice wind turbines would appear as a separate isolated feature from these wind farms, seen within a different setting and when looking in a different direction from key viewpoints. Thus the Demonstrator WTGs would seem more closely associated with the existing offshore oil platforms than other wind farms within the vicinity of viewpoints. It was judged that direct cumulative impacts during construction and operational phases would have a negligible adverse effect on the landscape and visual resource. This was considered to be a non-significant effect.

Overall effect of the proposed WTGs

The LVIA has established that the proposed WTGs at the Demonstrator site would change the landscape and visual baseline conditions during its construction and operational phases. The WTGs would introduce two new elements into the land and seascape. The construction phase would be relatively short, however, and would have only temporary adverse effects on the landscape and visual resource of the study area.

The design of the WTGs has been determined by technical and practical factors. The resulting design would appear concentrated from all viewpoints, forming a simple feature that would seem to relate to the character of the surrounding land and seascape and the existing oil platforms. In this way, the proposed WTGs would satisfy good practice guidance.

The Demonstrator site is not subject to any statutory or local designations for landscape or scenic interest. In addition, the proposed Demonstrator site would not be visible from any major settlement.

Overall, during construction and operational phases, it was judged that direct impacts would have a slight adverse effect on the landscape resource, and on the visual resource. Both these effects were considered to be non-significant effects.

1.9 EFFECTS ON THE SEABED

1.9.1 SOURCES OF EFFECTS ON THE SEABED

The operations to install the WTGs and the umbilicals, and the presence of the WTG substructures on the seabed, may cause temporary or permanent effects to the seabed and seabed (benthic) communities. Benthic communities may be disrupted when sediments are disturbed, smothered by resettling suspended sediments, or permanently covering by parts of the facilities on the seabed.

1.9.2 MAGNITUDE AND SIGNIFICANCE OF EFFECTS ON THE SEABED

It is estimated that operations to install the umbilicals and substructure will physically disturb only a small proportion of the seabed within the Beatrice field determination boundary. The bases of the WTGs and the mattresses that would be placed at the points where the umbilicals emerged from the seabed, would in total cover about 2,800m^2. The corridor of seabed that would be temporarily disturbed during the burial of the umbilcals would cover an estimated area of about 10,500m^2.

Together, these areas of potential disturbance represent about 0.02% of the seabed within the Beatrice field determination boundary. The sediment is clean and uncontaminated, and although a very small proportion of the benthic community within the bounds of the Beatrice site licence may be impacted, the sediment will be quickly recolonised by animals from adjacent undisturbed sediment. The site-specific benthic survey at the Demonstrator site did not find any evidence of the presence of beds of *Modiolus modiolus*.

1.9.3 MITIGATION PROPOSED

The installation operations for the support structure, mattresses and subsea umbilicals will be carefully planned and executed so as to minimise the area of seabed disturbed. The routes of subsea umbilicals will be designed so as to minimise the length of each umbilical, and hence the extent of seabed disturbance.

1.9.4 SURVEY AND MONITORING OF OPERATIONAL WIND TURBINE GENERATORS

There are no plans to monitor the condition of the seabed around the WTGs. The bases of the support structures may be surveyed from time to time, using an ROV, to determine if any seabed scour is occurring. The umbilical routes may be surveyed periodically, to ensure that the umbilicals remain buried to the required depth.

1.10 EFFECTS ON AVIATION AND TELECOMMUNICATIONS

1.10.1 SOURCES OF EFFECTS ON AVIATION AND TELECOMMUNICATIONS

The presence of the WTG units may affect fixed radio links, maritime radio systems, civil and military radars, and aeronautical radio navigation aids. Wind turbines can, for example, interfere with signals or create blind areas on radar coverage. The magnitude of potential effects depends on the size, extent and location of the wind turbines in relation to the affected instruments. Telecommunications and aviation may be affected by large-scale wind farm developments. Although it is unlikely that the effects of the two WTGs at the Demonstrator site would be significant, the issue was raised during consultation.

A review was made of the nature, location and use of all radar and telecommunication facilities within a 30km radius of the WTGs. Discussions were held with the operators/owners of these facilities to determine the detailed operating parameters of each system, to evaluate whether they would be likely to be affected by the presence of the WTGs. These discussions included the examination of possible mitigation measures. This information was then drawn together by an independent expert to provide a comprehensive assessment of the potential for the WTGs at the Demonstrator site to affect telecommunications or aviation (Spaven, 2005).

1.10.2 CONCLUSIONS OF ASSESSMENT OF EFFECTS ON AVIATION AND TELECOMMUNICATIONS

There are no known telecommunications facilities with the potential to be affected by the development, and television reception will not be affected.

No potential impacts on aviation have been identified other than possible restrictions on existing instrument approach procedures for helicopters to the Beatrice platforms. The WTGs may be marginally visible from the NATS Allanshill radar, but this is not expected to be of any operational significance. A new radar planned for Inverness Airport may be able to detect the Beatrice WTGs but this is not expected to be of operational significance.

1.10.3 MITIGATION PROPOSED

In view of the results of the assessment for potential effects on telecommunications and aviation, Talisman do not propose to undertake any additional mitigation measures.

1.11 COLLISION RISK TO COMMERCIAL VESSELS AND FISHING BOATS

1.11.1 POTENTIAL EFFECTS

The presence of the operating WTGs may present a collision risk for vessels, including fishing boats, in the area, even though the WTGs will be required to have a 500m radius safety zone around them.

Talisman commissioned Anatec UK to undertake an assessment of the collision risk. The Anatec UK database "ShipRoutes" was used to provide data on the numbers, types and sizes of vessels passing in close proximity to the Demonstrator site. These data were then used in the Anatec COLLRISK model, to estimate the likelihood of two types of collision – a vessel under power accidentally hitting one of the structures, and a vessel having lost power drifting into one of the WTGs. This model is based on the premise that the collision frequency is proportional to the volume of traffic interacting with the structures. It is stressed that neither assessment considers or takes account of the potential mitigating effects of potential collision risk management measures, such as use of a guard vessel or a radar warning system.

1.11.2 RESULTS OF COLLISION RISK ASSESSMENT

Six shipping routes pass within 10nm of the WTG locations, with an estimated 232 vessels using them each year (Anatec, 2005). The majority of vessel traffic is associated with the ports of Cromarty, Invergordon, and Inverness, and the Nigg Terminal. A summary of the collision results for each WTG is presented in Figure 1.3.

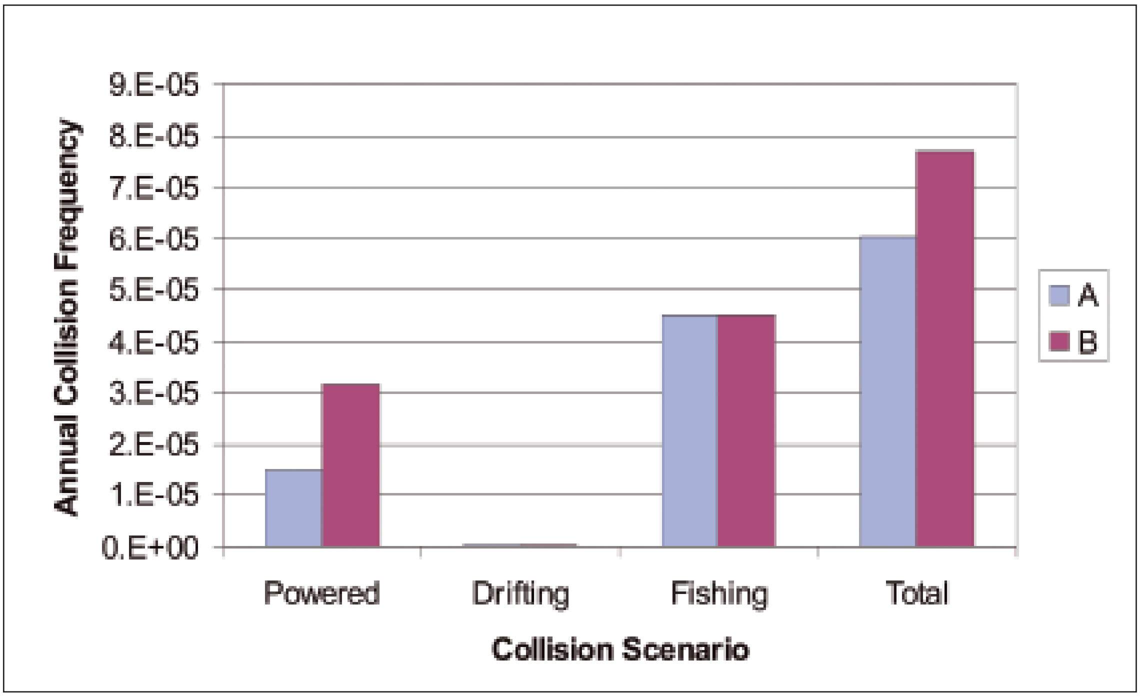


Figure 1.3 Summary of collision risks for powered collisions, drifting collisions and fishing boat collisions for each WTG at the Demonstrator site.

The overall collision risk for WTG 2 is slightly higher than for WTG 1 (a return period of 13,010 years versus 16,585 years). This is mainly due to the higher frequency of passing powered ship collisions. Overall, the collision risks for both turbines were assessed to be low based on the relatively low shipping and fishing vessel activity identified in the Beatrice area.

The relatively low level of fishing activity in the immediate area of the Demonstrator site was confirmed by the results of another study commissioned by Talisman (SML, 2005). This examined the level of vessel activity within 10nm of the Beatrice field, using data from radar surveillance from the Beatrice platform. A very large amount of raw data was made available, and an example of the results of this study is shown in Figure 1.4.

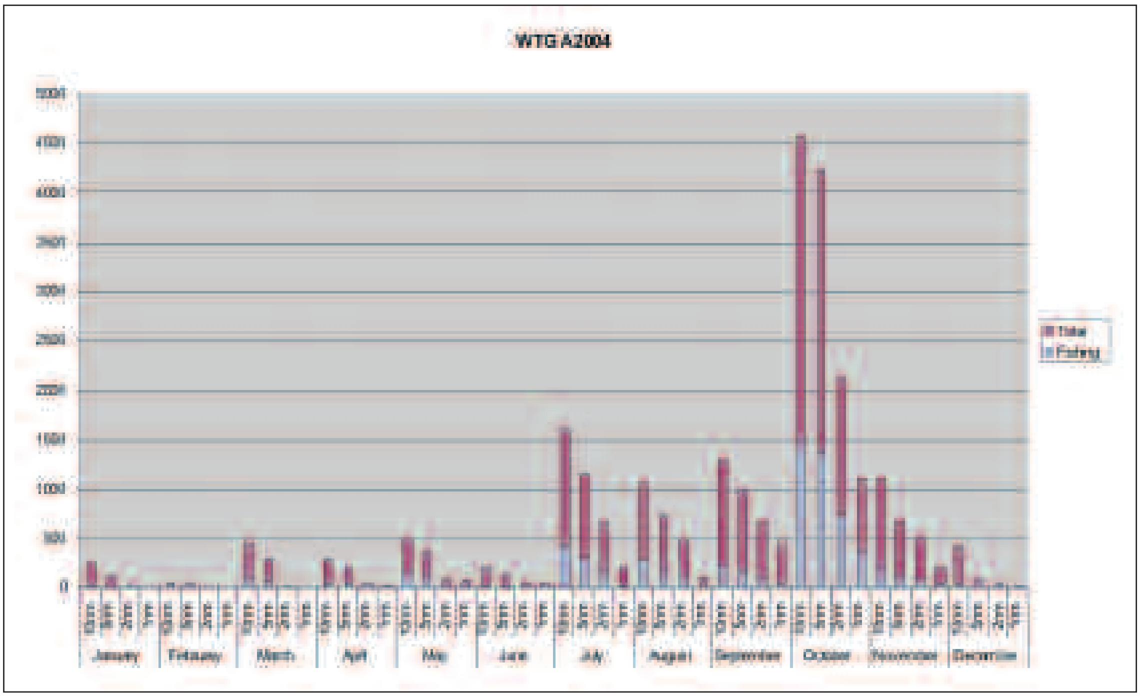


Figure 1.4 shows for each month of 2004, the total numbers of approaches by all vessels, and the numbers of approaches by fishing vessels, to within 10nm, 5nm, 2nm and 1nm of WTG 1 (labelled WTG A on the graph). These data confirm that the WTG sites are not used or crossed at present by a large number of vessels. This underscores the overall assessment that collisions risk is low, and also that the presence of the WTGs and the 500m safety zone around them, will not result in a significant inconvenience to commercial fishing operations.

1.11.3 MITIGATION FOR COLLISION RISKS

The offshore activities associated with the installation of the facilities, and the locations of the WTG units will be notified in Admiralty “Notices to Mariners”. The WTG units will be painted and lit in accordance with International Association of Marine Aids to navigation and lighthouse authorities guidelines, and will be visible on ships’ radar.

The HSE has determined that the two WTGs will become “supplementary units” as defined in the Offshore Installations and Pipeline Works (Management and Administration) Regulations 1995. They will thus effectively become part of the Beatrice Installation, and will therefore attract an automatic 500m safety zone around them, in accordance with Section 21 of the Petroleum Act 1987.

1.12 EFFECTS OF ELECTROMAGNETIC FIELDS

1.12.1 POTENTIAL EFFECTS

Several marine species use magnetic and electrical fields for navigation and for locating prey. The electrical cables linking the WTGs to the Beatrice AP platform may create electrical and magnetic fields that may affect these marine organisms, in particular affecting their ability to navigate or locate food.

1.12.2 MAGNITUDE OF POTENTIAL EFFECTS AT THE DEMONSTRATOR SITE

Electrical fields are produced around electrical cables that are not perfectly shielded. Industry-standard cables are constructed with shielding designed to retain electrical fields within the cabling. Magnetic fields, however, exist beyond even industry-standard cables, and can induce electrical fields in the surrounding environment.

In a typical industry-standard cable conducting 132kV and an AC current of 350A, the size of the magnetic field would be 1.6μT (micro Tesla) (CMACS, 2003). This field would be present only directly adjacent to the cable, and although it would be additive with the earth's natural geomagnetic field (approximately 50μT), the magnitude of magnetic field associated with the cable would fall to background levels within 20m of the cable.

In the same study CMACS showed that for a cable buried 1m below the seabed the magnitude of the induced electrical field at the seabed would be approximately 91μV/m. Although the magnitude of the magnetic field was not affected by the fact that the cable was buried, the induced electrical field dissipated more quickly in sediment than in seawater.

The cable that will be used for the proposed Demonstrator Project is an industry-standard, three-phase 33kV, 175A, 50Hz alternating current (AC) XLPE (cross linked polyethylene) cable carrying 10MW. Extrapolating from studies carried out by CMACS (2003), it is predicted that this cable will generate a magnetic field of approximately 0.8μT. The Beatrice cable will be buried 0.9m below the seabed, so the induced electrical field at the seabed should be approximately 45μV/m adjacent to the cable. As the current flowing in the cable at the Beatrice Demonstrator Project will be half that modelled by CMACS (2003), it is expected that the magnitude of the magnetic field and induced electrical field will be approaching zero at 10m and 20m, respectively.

A species of particular importance in the Moray Firth, both commercially and ecologically, is the Atlantic salmon (*Salmo salar*). Several studies, including those by Quinn and Brannon (1982), Taylor (1986), and Chew and Brown (1989) on several different members of the Salmonid family of fishes suggest that Salmonid fishes are able to detect and orient to artificial magnetic fields of a similar magnitude to the earth's geomagnetic field. However a study by Yano *et al*. (1997) suggests that horizontal and vertical movement of migrating chum salmon (*Oncorhynchus keta*) in an artificial magnetic field (of two orders of magnitude greater than the earth's geomagnetic field) was no different to their normal range of movements in the absence of the artificial field.

Caution should be exercised when extrapolating the results of such studies to the proposed wind farm Demonstrator Project. These studies are usually carried out under controlled, laboratory conditions (with the exception of Yano *et al*.'s 1997 study), that are not representative of those that pertain in the natural world. In addition, knowing that an organism has the ability to detect magnetic fields does not enable accurate prediction as to the effects of those fields on that organism's behaviour or physiology.

Patterns of migration indicated by tagging studies around the Scottish coast (Dunkley, 1985) suggest that Atlantic salmon make landfalls at many different parts of the coast and then redistribute themselves. Other studies such as those by Smith *et al*. (1995) and Dittman and Quinn (1996) highlight the importance of environmental factors such as salinity and temperature, as well as the olfactory sense of salmon, in the return of migrating salmon to their native rivers. The degree to which salmon rely on electrical and magnetic fields compared to degree to which they rely on such olfactory and physical stimuli is not yet known.

Several other major wind farm developments have been planned, or indeed are under construction, in the UK. From a review of the environmental statements produced for these developments, it would appear that there is a general consensus that the electromagnetic fields likely to be present around a wind farm development will not have a significant environmental impact.

1.12.3 POTENTIAL MITIGATION MEASURES

There are no specific additional mitigation measures that will be taken by the project. The electrical cables are one component of the umbilical, and they are sheathed and armoured. This will shield organisms from the electrical field, but not from the induced electrical field arising from the magnetic field.

The umbilicals will be buried, so that they do not interact with bottom-towed fishing gear, and this will also reduce the magnitude of the induced electrical fields to which marine organisms on the surface of the seabed will be exposed. Burial will also mean that demersal species of fish will not come into such intimate contact with the umbilicals, and thus will be exposed to induced electrical fields of a lower magnitude.

1.13 OVERALL EFFECTS OF THE PROPOSED DEMONSTRATOR PROJECT ON NATURA 2000 SITES

1.13.1 POTENTIAL FOR THE DEMONSTRATOR PROJECT TO AFFECT NATURA 2000 SITES

The Demonstrator site does not lie within any site of conservation interest; the nearest such site is the Berriedale Cliffs, about 25km away from WTG 1. However, Talisman is fully aware of the high conservation importance of parts of the Moray Firth, and many coastal sites around its shores. Talisman also appreciates that marine mammals and birds which may be qualifying interests of such sites are not confined to those sites, but, to a greater or lesser extent, use other parts of the Moray Firth. It is therefore possible that the proposed Demonstrator Project could have an effect on those species.

1.13.2 IMPORTANCE OF NATURA 2000 SITES

To comply with the Habitats Directive, Member States must ensure that within Natura sites (Special Protection Areas (SPA) and Special Areas of Conservation (SAC)) appropriate steps are taken to avoid deterioration of habitats, and habitats of species, as well as significant disturbance of species. As part of this process, new plans and projects require to be assessed with respect to a Natura site’s conservation objectives, to determine if it might adversely affect the integrity of the site.

The consideration as to whether a proposed project or development may affect a Natura 2000 site has two important stages. The first is an appraisal as to whether the proposal is “likely to have a significant effect on the site”, and the second is a consideration as to whether the proposal will adversely affect the integrity of the site. Guidance notes (SNH, 2000) define a likely significant effect as “any effect that may reasonably be predicted as a consequence of a proposal that may affect the qualifying interests, but excluding trivial or inconsequential effects”. This test of significance is a coarse filter intended to identify which proposed plans and projects require further assessment, and it is distinct from the subsequent appropriate assessment of adverse effects on the integrity of a site. Guidance notes stress that the importance of the international conservation interest of the site should be at the forefront of decision-making.

1.13.3 TALISMAN'S ASSESSMENT OF POTENTIAL EFFECTS ON NATURA 2000 SITES

In Talisman's view, the environmental assessment indicated that some of the activities associated with the installation and operation of the WTGs at the Demonstrator site might affect some of the qualifying features of SACs and SPAs in the Moray Firth, and thus their integrity. In terms of Natura 2000 sites, therefore, the proposed Demonstrator Project is "likely to have a significant effect" on one or more of these sites.

Talisman has therefore considered whether the proposed project might affect the conservation objectives of any of these sites, using the information and assessments presented in other parts of the ES. The conservation objectives of a site are defined as "the reasons for which the site was classified", and the integrity of a site is "the coherence of its ecological structure and function, across its whole area, which enables it to sustain the habitat, complex of habitats and/or levels of populations of species for which it was classified" (SE Circular 6/95, as amended). The integrity of the site only applies to the qualifying features, and is directly linked to the conservation objectives for the site. If the conservation objectives are met, then the integrity of the site will be maintained, and deterioration of habitat or habitat of species or significant disturbance of species avoided (SNH Guidance document, 2000).

From the above guidance it is clear that if the conservation objectives for which a Natura site was classified can be met, then the integrity of the site will not be adversely affected. Talisman has therefore undertaken a review of the conservation objectives of each of the Natura sites in the Moray Firth that could reasonably be expected to be potentially exposed to adverse effects from the Demonstrator Project, in order to determine if the integrity of any site might be affected.

SNH Guidance (2000) offers checklists with which to consider potential impacts on the integrity of a site, and these are summarised in Table 1.3.

Table 1.3 Checklist of elements for construction of conservation objectives and consideration of impact upon integrity (SNH, 200).

Annex I Habitats Conservation Objectives: To avoid deterioration of the qualifying habitat(s) thus ensuring the integrity of the site is maintained and the site makes an appropriate contribution to achieving favourable conservation status for each of the qualifying features.

To ensure for the qualifying habitat(s) that the following are maintained in the long term:

- *extent of the habitat on site*
- *distribution of the habitat within the site*
- *structure and function of the habitat*
- *processes supporting the habitat*
- *distribution of typical species of the habitat*
- *viability of typical species as components of the habitat*
- *no significant disturbance of typical species of the habitat*

Annex II Species Conservation Objectives: To avoid deterioration of the habitats of the qualifying species or significant disturbance to the qualifying species, thus ensuring that the integrity of the site is maintained and the site makes an appropriate contribution to achieving FCS for each of the qualifying features.

To ensure for the qualifying species that the following are maintained in the long term:

- *population of the species (including range of genetic types where relevant) as a viable component of the site*
- *distribution of species within site*
- *distribution and extent of habitats supporting the species*
- *structure, function and supporting process of habitats supporting the species*
- *no significant disturbance of species distribution and viability of species' host species (where relevant)*
- *structure, function and supporting processes of habitats supporting the species host species (where relevant)*

Bird Species Conservation Objectives: To avoid deterioration of the habitats of the qualifying species or significant disturbance to the qualifying species, thus ensuring that the integrity of the site is maintained.

To ensure for the qualifying species that the following are maintained in the long term:

- *population of the species as a viable component of the site*
- *distribution of the species within the site*
- *distribution and extent of habitats supporting the species*
- *structure, function and supporting process of habitats supporting the species*
- *no significant disturbance of the species*

1.13.4 OVERVIEW OF RESULTS OF THE ASSESSMENT OF EFFECTS ON NATURA 2000 SITES

The potential effects of the Demonstrator Project on the qualifying features of SACs and SPAs in the Moray Firth were assessed in light of this guidance. For each SPA and SAC, a separate table was prepared giving details of:

- *the site's conservation objectives*
- *each of the primary qualifying interests (species or habitats)*
- *other qualifying interests*
- *a summary of the potential effects of the Demonstrator Project on those interests*
- *a review of the main mitigation measures that would be enacted by Talisman*
- *a conclusion as to whether the qualifying interest(s) of the site would be affected by the proposed development.*

The conclusion regarding potential effects was derived by completing an assessment of the relevant checklist (Table 1.3), using the qualitative and quantitative information on predicted specific effects contained in the body of the ES. In total 16 tables were completed.

On the basis of the quantitative assessments of potential impact made in the environmental statement, and bearing in mind the range of mitigation measures that will be enacted by Talisman, Talisman has concluded that the installation and operation of the propose WTGs at the Demonstrator site in the Beatrice field will not affect the viability or integrity of any SAC or SPA in the Moray Firth.

2 Introduction

2 INTRODUCTION

2.1 BACKGROUND

The Beatrice oil field is located in Block 11/30a of the United Kingdom Continental Shelf (UKCS), in the Inner Moray Firth approximately 22km east of Helmsdale on the Caithness coast. Beatrice began production in September 1981, and by July 2005 had produced some 164 million barrels of oil, representing a recovery efficiency of about 33% with a total recovery currently predicted to be 38%. Production in the field has been declining steadily since the mid 1980s. At present rates of extraction, and under existing economic constraints, it is forecast that the field could cease production as early as 2006, although at the current world oil price it is conceivable that production could continue until 2025. An outline decommissioning programme for the Beatrice field was submitted to the DTI in September 2004 and accepted by them in 2004. This programme comprises a phased approach to the end of field life, including further improvements in efficiency on the platforms and alternative use of some structures for a period by the MOD.

The present operators, Talisman Energy (UK) Limited, have undertaken several initiatives to extend the life of the field, and hence the life of the Nigg oil terminal from where crude from Beatrice is exported. These initiatives have included the Beatrice optimisation project (January 1999), Beatrice life extension project (2000) and the Beatrice pipeline replacement programme (May 2001).

Talisman reviewed this Beatrice redevelopment programme in 2001, and screened a range of future options to identify how they could reduce operating costs, increase production, and extend economic life. The studies revealed that finding re-use opportunities for the existing field infrastructure would contribute to these goals, and indicated that there was the potential for the generation of wind energy at Beatrice. This potential exists because Beatrice has a significant wind resource and has a substantial existing infrastructure which could be re-used in a wind farm development.

As a result of this screening study, Talisman conducted a further feasibility study to quantify the development potential. This showed that it could be commercially viable to create a large-scale offshore wind farm at the site using the main Beatrice infrastructure as a hub, but that further detailed evaluation would be required.

The creation of a large offshore wind farm at the Beatrice location could provide up to 1GW of installed capacity for supply to the national grid. This would be equivalent of up to 20% of Scotland's present electricity demand. However, the development of wind farms at more distant locations in deeper water presents significant additional technical challenges for the design, installation, operation and maintenance of facilities and infrastructure. These must be overcome if the potential for commercial, non-visually intrusive offshore wind energy in northern Europe is to be realised. In the north east of Scotland the offshore oil and gas industry is uniquely placed to contribute experience, expertise and resources to further advance the development of commercial wind energy in offshore waters.

The feasibility study also showed that a successful development would require a new range of skills, combining expertise from the offshore oil and gas industry with those of utility businesses. Consequently, Talisman Energy (UK) Limited has partnered with Scottish and Southern Energy (SSE), a major UK utility, to examine the potential of creating a deepwater wind farm at the Beatrice site in the Moray Firth. The companies have co-funded a series of studies to investigate the potential of deepwater offshore wind farms on the UKCS. These consisted of a Design, Fabrication and Installation study, Front End Engineering Design (FEED) study, and Operations and Maintenance (O&M) analysis. The studies, funded in part by grants from the UK public sector, sought to develop an improved definition of the structure, technology and installation process for deepwater wind farms, develop a scope and cost estimate for a demonstrator programme, and develop base line O&M solutions and cost models for a full-scale development. These studies and models are now complete and Talisman now proposes to undertake a demonstrator programme consisting of two wind turbine generators (WTGs).

2.2 SCOPE OF THE ENVIRONMENTAL IMPACT ASSESSMENT AND ENVIRONMENTAL STATEMENT

Talisman and Scottish and Southern Energy intend to construct, install and operate two 5MW wind turbine generators near to the Beatrice field in Block 11/30a of the UK central North Sea. The turbines will be approximately 1.6km and 2.3km away from the existing Beatrice Alpha production platform (Beatrice "AP"), and approximately 22km offshore from Helmsdale on the northern coast of the Moray Firth. The turbines will be linked to Beatrice AP by a buried subsea electrical cable, and electricity from the turbines will be used to power the Beatrice platforms, and thus extend the economic life of the Beatrice field.

Turbine units will be assembled onshore in Scotland, and taken to the site on barges, where they will be installed on the seabed using cranes and other support vessels. Installation offshore is likely to begin in June 2006 and will take approximately six weeks. The substructures for the turbines will be fixed to the seabed by conventional steel piles driven into the seabed. It is planned that piling operations at each WTG would take no more than two days in total. Subsea cables will be installed and buried by deploying a water jetting ROV to fluidise the surface sediments, in an operation that should take about three to four days. Some internal modifications will be made to equipment and facilities on the Beatrice AD platform to import power from the turbines.

It is planned that this Demonstrator Project would last for approximately five years. At the end of this period, the turbines could remain in use until the final decommissioning of the Beatrice platforms, or they may be incorporated into a commercial scale wind farm in the Beatrice area (for which a new consent and ES would be prepared). Alternatively, if the Demonstrator Project proved unsuccessful, the structures would be decommissioned and removed. Any decommissioning activities would comply with relevant legislation applicable at the time, and might be part of a larger decommissioning programme developed for other assets in the Beatrice field.

The wind farm Demonstrator Project will test the technology, and verify the technical and commercial viability, of a full-scale development. Significantly, however, the electricity supplied by the turbines will replace some of the power purchased from the national grid, and this will reduce operating costs and extend the life of the Beatrice field by at least 1.5 years.

The Demonstrator Project will be part of a pan-European initiative called DOWNVInD (Distant Offshore Wind farms with No Visual Impact in Deepwater), comprising 18 different organisations from six European countries, which has been established as a catalyst for commercialising deepwater wind farm technology. It will cost approximately £32 million to develop. The European Commission, the UK Department of Trade and Industry, and the Scottish Executive will provide grant assistance totalling £10.1 million and proposed contributions from other participants total £3.7 million resulting in net costs to Talisman and SSE of approximately £18 million.

2.3 PURPOSE OF THE ENVIRONMENTAL STATEMENT

This environmental statement (ES) presents the findings of an environmental impact assessment for the proposed wind farm Demonstrator Project in Block 11/30a of the UK North Sea. The environmental impact assessment is an evaluation process which enables the team responsible for the project (the developer), persons with an interest in the project (stakeholders), and the statutory authorities to:

- *identify and understand the significant environmental impacts and risks of the project*
- *develop plans or procedures for mitigating or reducing significant risks*
- *appreciate the benefits that would be derived as a result of the implementation of the project.*

The structure of the ES, and the process undertaken by Talisman to complete the assessment, aligns fully with the requirements of the Offshore Petroleum Production and Pipelines (Assessment of Environmental Effects) Regulations 1999, and the appropriate DTI guidelines. It has also taken into account guidelines, best practice, and information relating to the particular potential impacts of offshore wind farms.

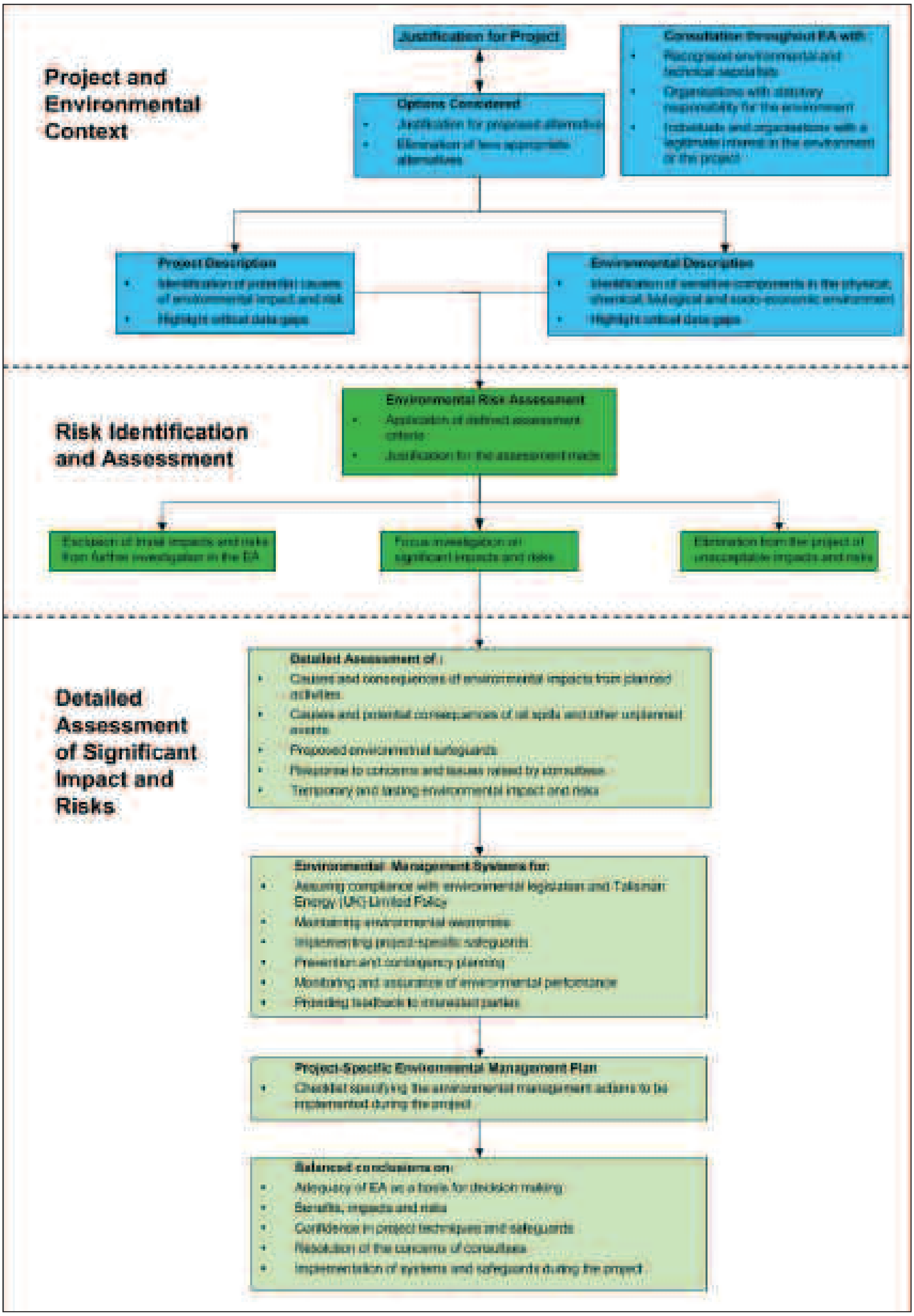
2.4 STRUCTURE OF THE ENVIRONMENTAL STATEMENT

The main sections of the environmental statement, and their purpose, are shown in Table 2.1, and the main stages of the environmental impact assessment process are shown in Figure 2.1.

Table 2.1 Main sections of the environmental statement.

SECTION	CONTENT AND PURPOSE
1. Non-technical summary	• Provides a clear description of the project, its impacts, and the measures that Talisman will take to reduce or eliminate impacts.
2. Introduction	• Sets the scene and describes the process of undertaking an EIA and preparing the formal environmental statement. • Summarises the purpose and benefits of the project. • Outlines the regulatory context for the project.
3. Project description	• Describes the project, from construction to decommissioning. • Describes any alternatives to the project or specific elements of its design, giving reasons for the selections made.
4. Environment description	• Describe the environment(s) that may be affected during construction and operation. • Provides the information with which to assess the significance of potential effects of the project.
5. Scoping potential impacts	• Identifies all the potential impacts that could arise as a result of planned or unplanned activities, and emergency or accidental situations, associated with the project.
6. Consultations	• Describes the process of consultation undertaken by Talisman to identify issues of concern to stakeholders. • Identifies and summarises the main concerns identified during both the scoping exercise and the consultation programme. • Indicates how Talisman intends to address these concerns.
7-12. Significant environmental risks	• Describes each of the significant environmental risks. • Describes the mitigation measures that Talisman intends to enact to eliminate or reduce those risks. • Describes and, as far as possible, quantifies the risk that would remain after implementation of mitigation measures.
13. Effects on status of conservation areas	• Summary of each of the potential effects that any aspect of the Demonstrator Project could have on any of the offshore or coastal conservation areas adjacent to the Beatrice field.
14. Environmental management, research and monitoring	• Summarises the way that environmental risks will be managed. • Describes the continuing programme of research and monitoring that Talisman will undertake during the Demonstrator Project.

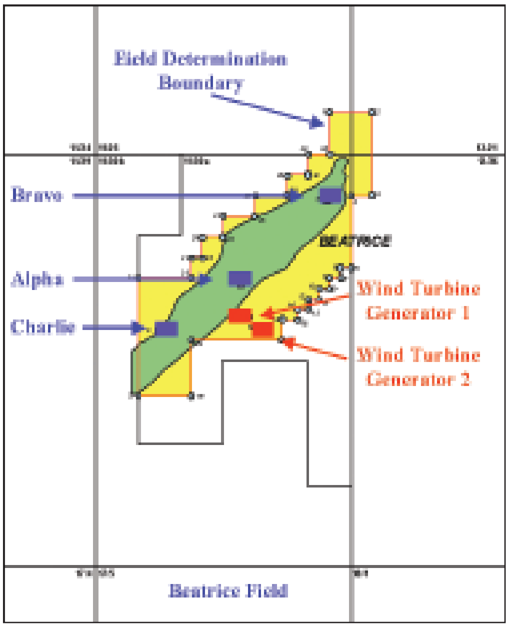
Figure 2.1 A flow diagram of the EIA process.



2.5 LEGISLATION

A consent for the building and operation of the Beatrice Demonstrator Project is being sought by Talisman Energy (UK) Limited as an addendum to the existing field development consent for the Beatrice field operations. The two wind turbines will be located wholly within the area covered by the existing Beatrice field development consent (the Field Determination Boundary, Figure 2.2) and will provide power to the field, facilitating the extraction of hydrocarbons. The addendum will be supported by this formal environmental statement (ES) prepared under the Offshore Petroleum Production and Pipelines (Assessment of Environmental Effects) Regulations 1999. The ES also conforms with the requirements of the EU Habitats Directive (92/43/EEC).

Figure 2.2 The Beatrice Field Determination Boundary.



All of the operations and activities associated with the installation and operation of the wind turbines will take place offshore; no new structures, facilities or cables will be installed onshore. The Demonstrator Project will be managed by means of a project-specific environmental protection plan, under the auspices of Talisman's existing Safety, Health and Environmental Policy (Appendix 1). A summary of the legislation that may have a bearing on the proposed project is given in Appendix 2.

2.6 THE DEMONSTRATOR PROJECT, ITS PURPOSE AND POTENTIAL BENEFITS

2.6.1 INTRODUCTION

This initiative has received funding from the Scottish Executive, the UK Department of Trade and Industry, and the European Commission. The purpose of the Beatrice Demonstrator Project is to:

- *better understand the environmental impact of deepwater wind farms*
- *prove the concept of a deepwater wind farm*
- *explore the cost-effectiveness of deepwater sites*
- *share knowledge and experience across Europe*
- *pioneer the development of deepwater wind farms*
- *improve and commercialise the technology*
- *extend the commercial life of the Beatrice field.*

In the short term the Demonstrator Project will have an immediate impact on the future of the Beatrice field. The energy generated by the turbines will be used to power the platform, and this will contribute to Talisman's strategy of reducing its emissions and minimising the environmental impact of its operations. The Demonstrator Project also aligns with Talisman's programme for the decommissioning of the Beatrice field, which seeks to extend the useful life of the field by finding alternative uses for some of the main facilities and infrastructure (Talisman, 2004).

The entire Demonstrator Project will cost about £32 million and will bring significant benefits to Scotland and the rest of the UK. The design and development, and a substantial part of the research programme, will be undertaken in the UK. The location and management of one of Europe's premier research programmes in the north east of Scotland will provide a unique opportunity for Scottish companies to demonstrate their technology and capabilities.

2.6.2 ECONOMIC JUSTIFICATION

The Demonstrator Project will comprise two REpower 5M turbines each with a nominal output of 5MW. They will supply approximately a third of the Beatrice field's power demand on average over the year.

The purchase of electricity from the grid is the largest single component of Beatrice operating costs and are estimated to account for up to a third of the total Beatrice operating expenditure (OPEX) in 2006. The energy supplied by the Demonstrator Project should result in an annual saving of circa £2.5 million dependant on turbine performance and electricity prices.

Talisman has analysed the future of the Beatrice field based on a range of oil prices and operating scenarios. These have shown that the electricity cost savings resulting from the Demonstrator Project will increase field life by at least 1.5 years under realistic oil price forecasts.

2.7 ALTERNATIVES TO THE DEMONSTRATOR PROJECT

For the Beatrice field, alternatives to the wind farm Demonstrator Project include the various initiatives either undertaken, or considered and rejected by Talisman, as part of the major Beatrice redevelopment initiative described in Section 1. Alternatives considered for the siting and structure of the demonstrator wind turbines themselves are discussed in Section 3.

3 Description of the Demonstrator Project

3 DESCRIPTION OF THE DEMONSTRATOR PROJECT

3.1 SITE SELECTION

The two WTG units would be installed 1.6km and 2.3km from the platform Beatrice AP in the Beatrice field, in the Moray Firth, approximately 22km offshore, in a water depth of about 45m (Tables 3.1 and 3.2). Figures 3.1 and 3.2 show the location of the field and the positions of the proposed WTGs in relation to the existing platforms.

Table 3.1 Beatrice wind turbine location details.

WTG	Block No.	Geographical Co-ordinates (Chart 115)	
		Latitude	Longitude
1	11/30	58º 06′ 03.75″ N	003º 04′ 50.25″ W
2	11/30	58º 05′ 46.62″ N	003º 04′ 17.83″ W

Table 3.2 Location of existing Beatrice installations in relation to the proposed WTGs.

Installation	WTG 1		WTG 2	
	Distance (nm)	Bearing (°)	Distance (nm)	Bearing (°)
Beatrice AP Platform	0.8	341	1.2	333
Beatrice AD Platform	0.8	345	1.2	335
Beatrice C Platform	2.3	260	2.6	267
Beatrice B Platform	3.3	34	3.4	27

Figure 3.1 Location of the two WTGs in the Moray Firth.

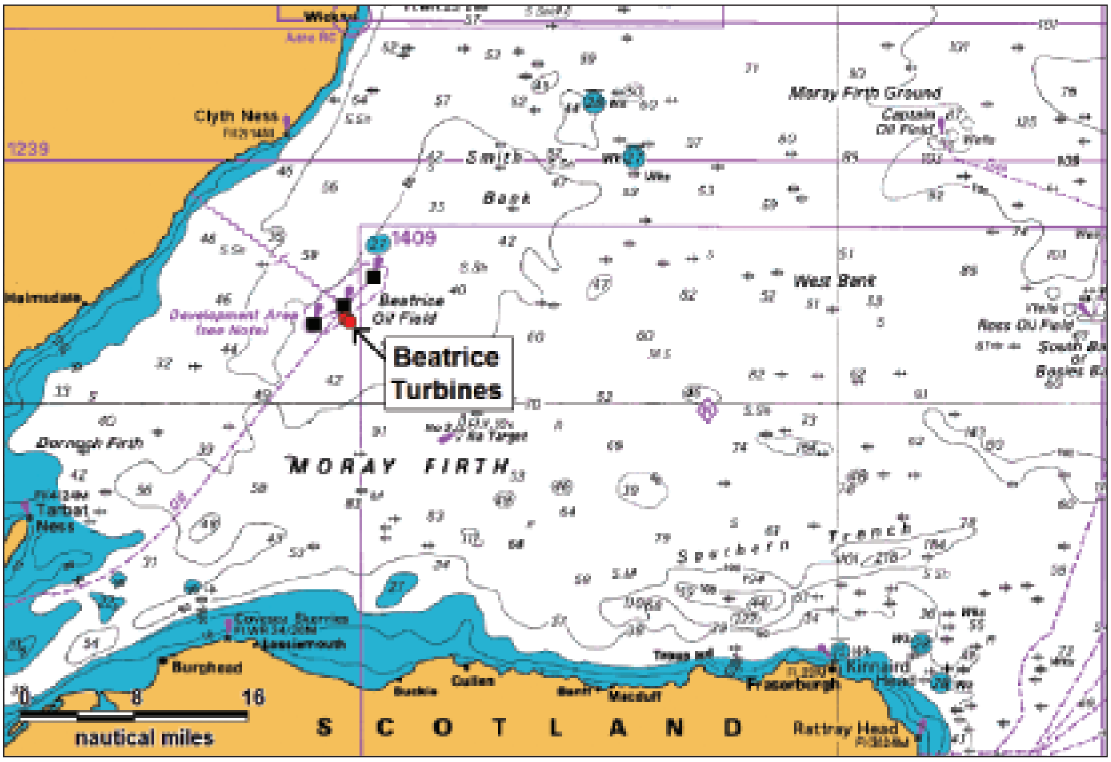
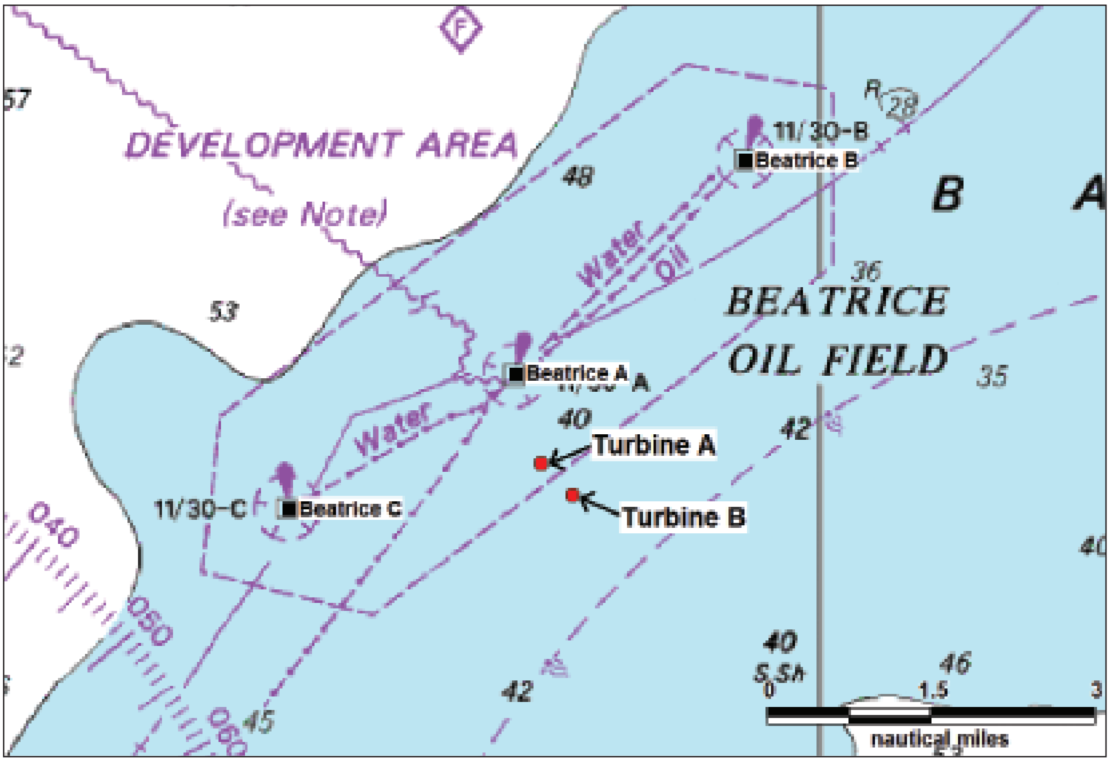


Figure 3.2 Location of the WTGs in relation to the existing Beatrice platforms.



The location of the Demonstrator WTGs is dictated by the existing infrastructure of the Beatrice field, and in particular the Beatrice AP platform which provides a site for the offshore electrical substation. The WTGs would be located as close as possible to the existing platforms, without compromising safety or operational efficiency for the field. It would not be prudent to place the WTGs closer to the existing platforms because of the presence of umbilicals and pipelines on the seabed. The other factors that have been taken into account during the selection of exact locations for the two WTG units are:

- *the presence of existing oil and gas infrastructure on the seabed around Beatrice*
- *the topography and depth of the seabed.*

3.2 COMPONENTS OF THE WIND TURBINE GENERATORS

3.2.1 OVERVIEW

Each WTG will comprise a substructure fixed to the seabed, a support tower and a turbine complete with rotor and blades.

3.2.2 SUBSTRUCTURE

Selection of design for substructure

Two potential designs for the substructure, both tripods, were developed during the FEED study which was completed in early 2004. Later in 2004, the Talisman project team identified another potential structural design – the Jacket Quadropod – developed by OWEC Tower, a specialist Norwegian structural design consultancy. This design, called the OWEC Jacket Quadropod (OJQ), is a lightweight lattice space frame design.

AMEC, Talisman's engineering design contractor, then undertook a detailed review of the substructure designs in early 2005. This analysis eliminated one of the original tripod designs, and concluded that there was little to choose between the remaining designs from an engineering point of view. The study suggested that the final decision would be driven by the fabricators who would identify which design would be more cost effective, require less steel and offer the greatest potential for up-scaling in larger developments.

The fabrication tenders included two potential designs; the remaining tripod and the OJQ. Based on the responses received from the fabrication contractors and subsequent clarifications the project team has selected the OWEC Quadropod Jacket for the Demonstrator Project. Although this design requires more intricate fabrication engineering it uses about a third of the steel needed for the tripod. Talisman believes that this is the most cost-effective solution for the Demonstrator Project, whilst offering the greatest long-term potential.

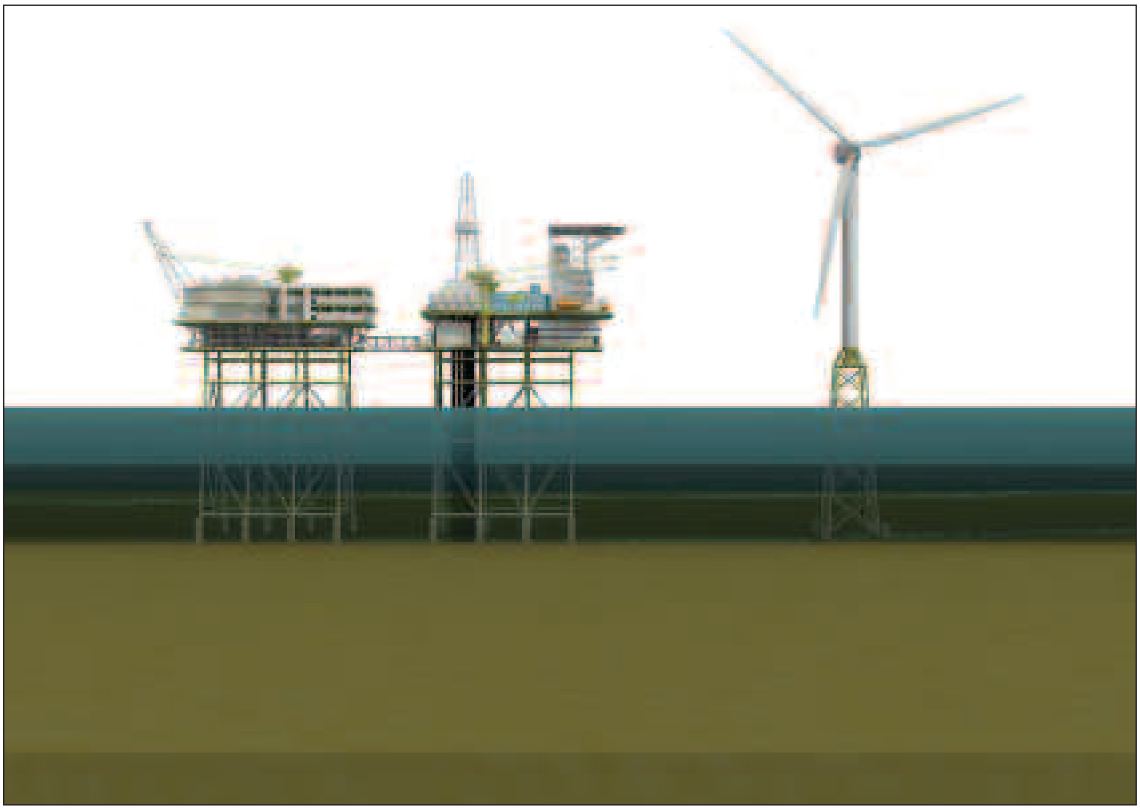
The OWEC Jacket Quadropod

The four-legged OJQ looks very similar to the small steel jackets used for oil and gas platforms. It will be constructed of tubular steel members and fixed to the seabed by steel piles. The substructure will be coated with glass flake epoxy, except in the splash zone where thermally sprayed aluminium will be applied. The OJQ will be manufactured by Burntisland Fabrications in Fife, Scotland. Table 3.3 gives details of the construction and dimensions of the OJQ, and Figure 3.3 shows its general appearance in relation to the Beatrice Alpha platforms.

Table 3.3 Details of the OJQ substructure.

ASPECT	DATA
Construction	Steel
Cathodic protection	Aluminium/zinc alloy anodes, total of 72 weighing 240kg
Paint system	Glass flake epoxy
Total height	62m to base of transition piece
Base dimension	20m x 20m
Total weight of substructure	Approximately 750 tonnes, including transition piece, pile sleeves and mud mats
Other features on substructure	Access and egress systems; platforms; ladders; boat landings; J-tubes for the cables
Piles	Four steel tubular piles per jacket; 44m long, 72" diameter, 60mm wall thickness; total weight 460 tonnes per jacket

Figure 3.3 Artist's impression of the size and appearance of a WTG relative to the Beatrice Alpha complex.
***Note:** this illustration does not show the true separation between Beatrice and the WTG.*



3.2.3 TRANSITION PIECE

An important design feature of the OJQ is the transition piece which is located between the top of the substructure and the bottom of the tower, and transfers loads from the tower to the four jacket legs. The transition piece itself is 9m high and weighs approximately 150 tonnes, and like the substructure it will be coated with glass flake epoxy. It will have a door to permit access to the turbine tower, and will house local switchgear and an emergency refuge. Details of the transition piece are shown in Figure 3.4.

Figure 3.4 Diagrams illustrating the main components of the transition piece.

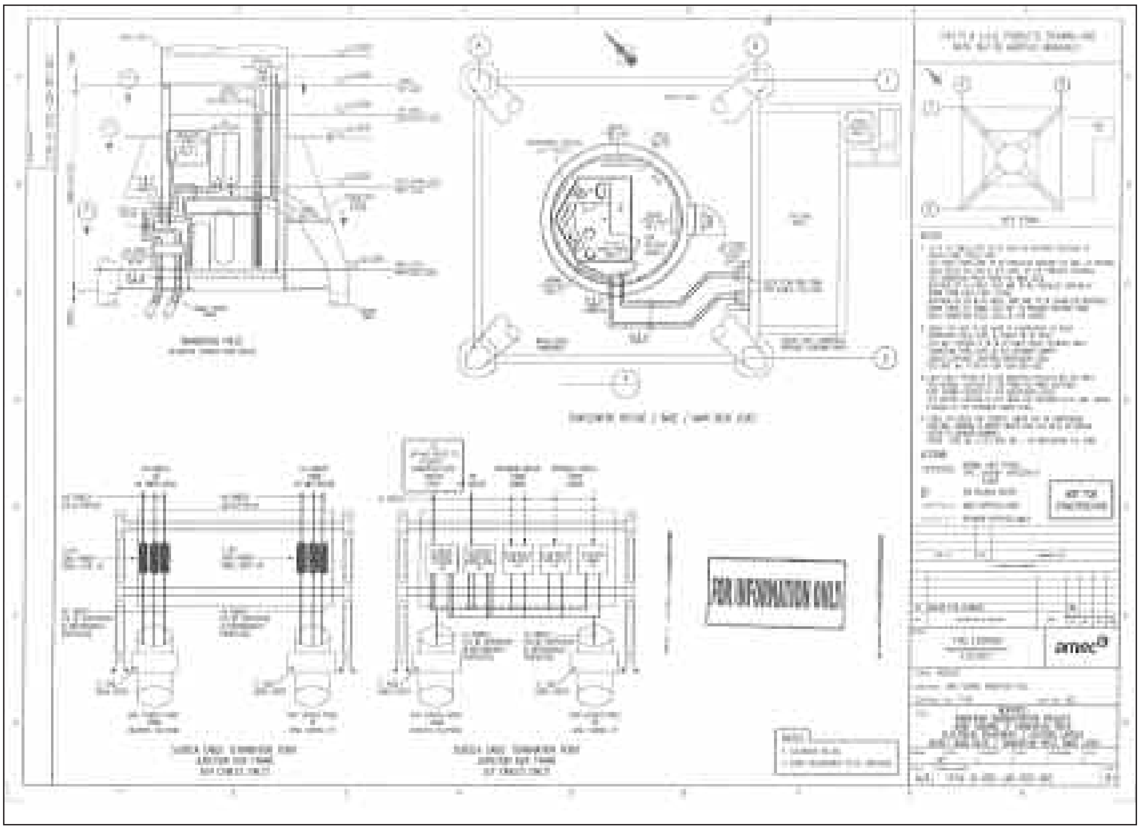
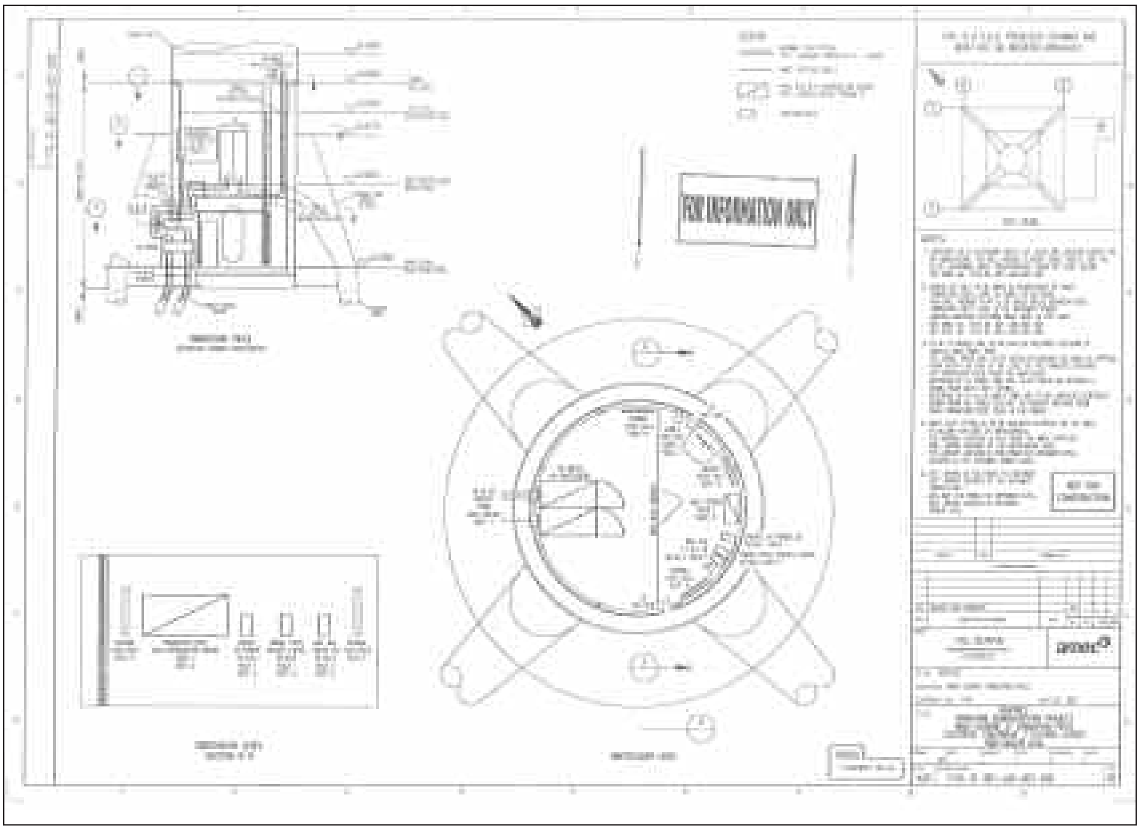
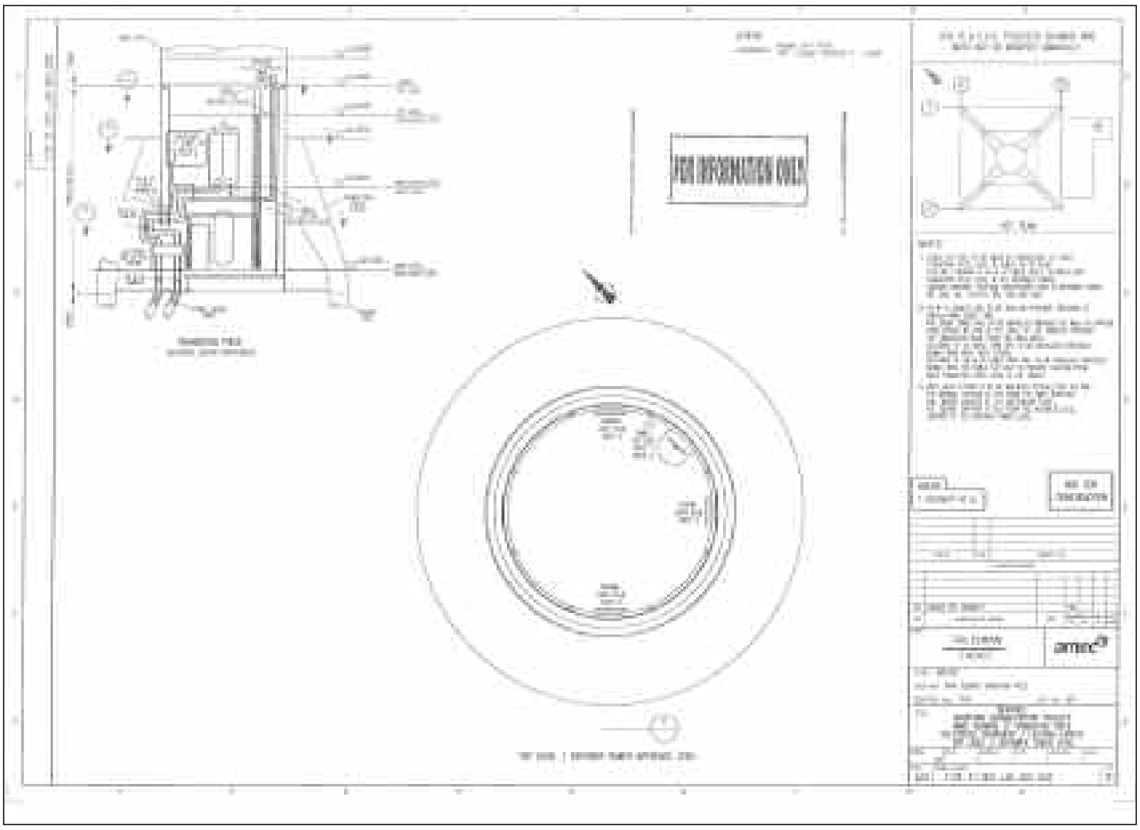


Figure 3.4 (cont)   Diagrams illustrating the main components of the transition piece.





3.2.4 SUPPORT TOWER

The support tower is a 5.5m diameter, 60m long steel column, which weighs about 220 tonnes. It will be protected from corrosion by epoxy paint. This part of the WTG will contain a lift for personnel and equipment, and a ladder providing access to the turbine.

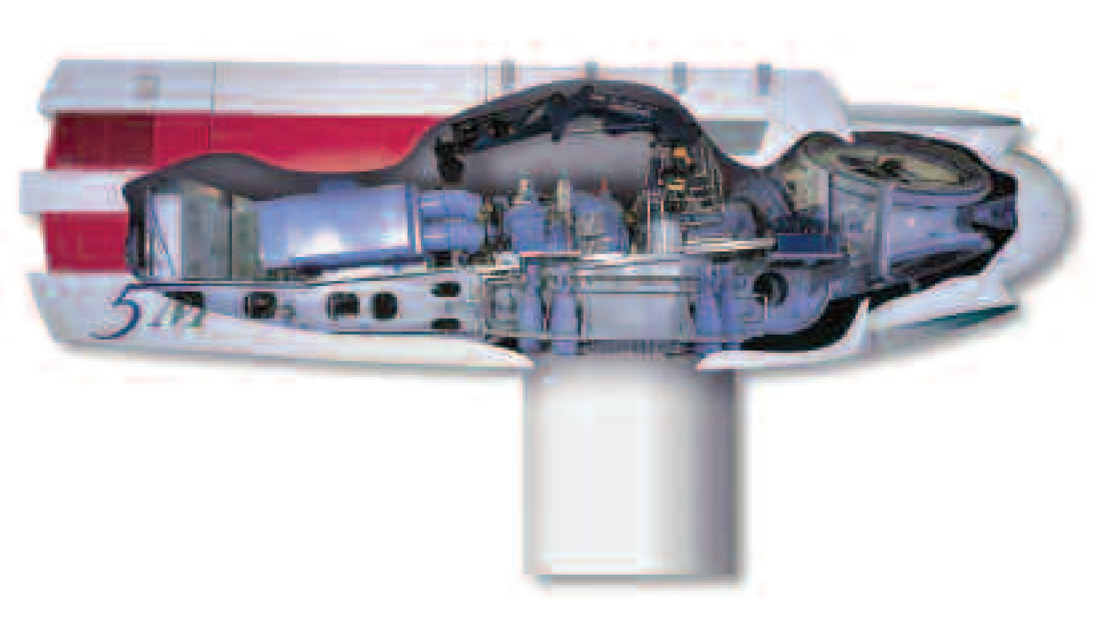
3.2.5 TURBINES

After a comprehensive review of commercially available turbines, and discussion with selected manufacturers, Talisman selected the REpower 5M turbine for the Demonstrator Project. At present this is the most powerful commercially-proven turbine, with a nominal output of 5MW. Importantly, the manufacturers have incorporated several design and construction features that will protect it from the rigours of the offshore marine environment. Table 3.4 gives technical details of the turbines and blades, and Figure 3.5 shows a cut-away view of the nacelle. This part of the WTG will contain a transformer, electrical switchgear, control systems, and communication equipment.

Table 3.4 Details of the REpower 5M turbines.

ASPECT	DATA
Turbine	REpower 5M
Nominal output	5MW
Nacelle weight	410 tonnes
Nacelle size	Approximately 19m long, 6m wide, 7m high
Blades	Three carbon fibre blades 63m long
Operational wind speeds	3.5m/s to 25m/s (about 8mph to 56mph)
Rotation speed	Seven to 12 revolutions/minute, turning clockwise when viewed from windward side

Figure 3.5 A cut-away view of the nacelle.



3.2.6 SUBSEA UMBILICALS

The two WTG units will be linked by a 900m long subsea umbilical, and WTG 1 will be linked to the Beatrice AP platform by a 1,900m long subsea umbilical. Figure 3.6 shows the proposed routes for both umbilicals, Figure 3.7 shows a cross-section of the umbilical, and Table 3.5 gives details of their construction and of the power and other cables they will contain. The 33kV power cables will be jointed inside the wind turbine tower and on the Beatrice platform topsides using standard HV jointing kits. All other cables will use dedicated cable junction boxes in the same location.

Figure 3.6 Map showing proposed routes for subsea umbilicals.

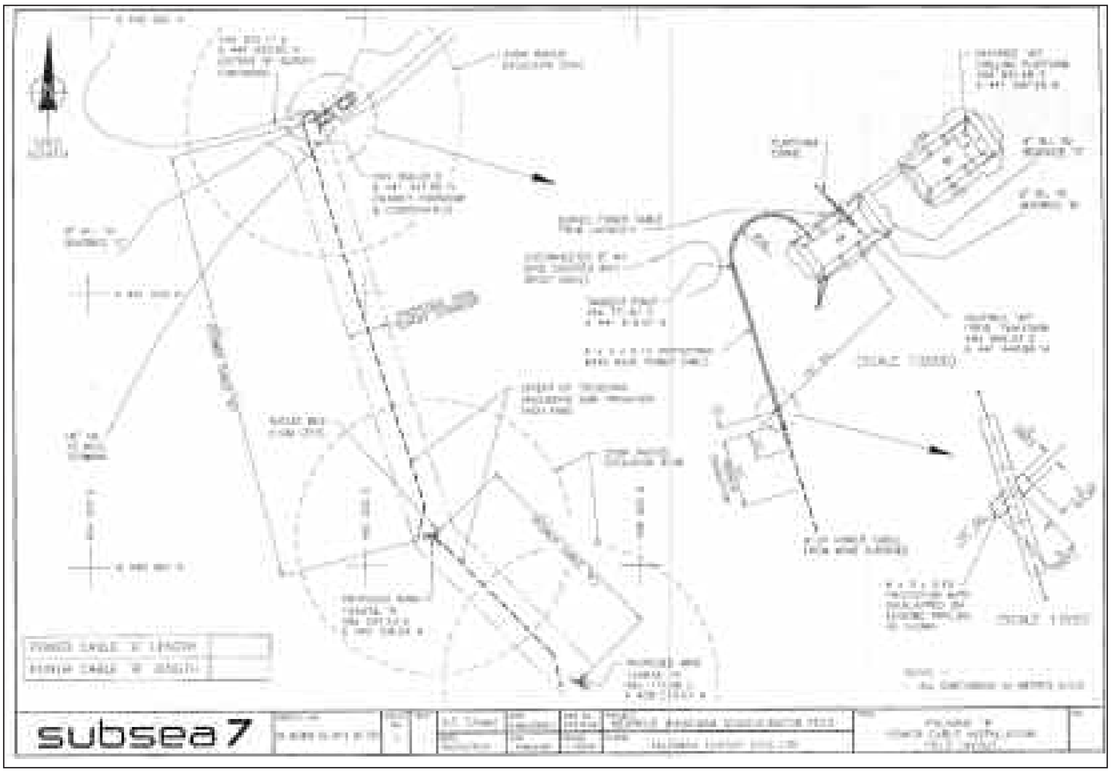
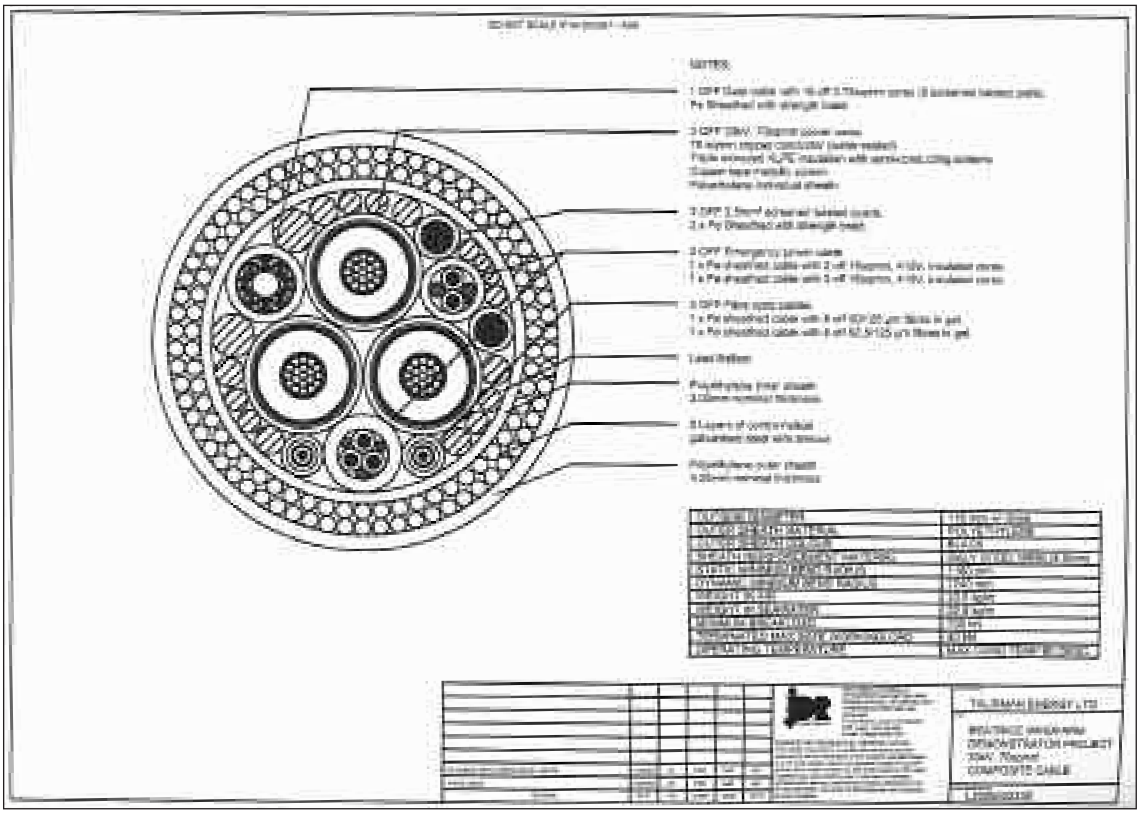


Table 3.5 Details of subsea electrical umbilicals.

ASPECT	DATA
External diameter	118mm
Sheathing	Double armoured with an extruded thermoplastic outer sheath
Power cable	3 x 70mm^2 33kV, 50HZ AC copper power cables with triple-extruded XLPE (cross-linked polyethylene) insulation
Emergency power cables	5 x 16mm^2 415V
Data cables	Eight copper twisted pairs of 0.75mm^2 cables
Fibre optics	Two fibre optic bundles each containing eight fibre cores in a gel-filled sheath

Figure 3.7 Cross-section showing arrangement of main components within the subsea umbilical.



3.3 INSTALLATION OF THE UMBILICALS AND WIND TURBINE GENERATORS

3.3.1 ASSEMBLY OF COMPONENTS ONSHORE

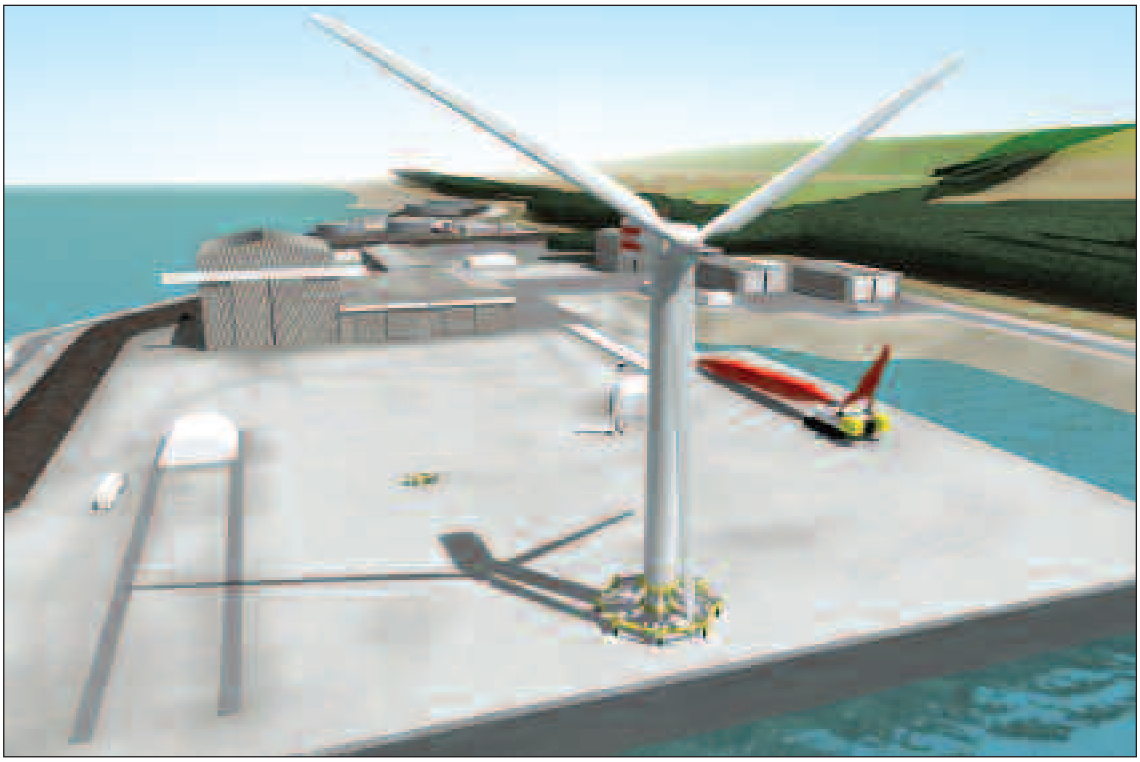
The various components of the WTGs and the subsea umbilicals will be manufactured at different sites in Europe, including the UK, and then transported by barge to a coastal location for further assembly before being taken offshore. It is planned that the WTGs will be transported offshore as two large units comprising (i) the substructure and (ii) the support tower plus turbine and blades.

The location of the final assembly site on the east coast of the UK has not yet been decided. Onshore assembly will involve the following activities:

- *delivery of all materials and components by cargo vessel*
- *off-loading by crane, and lay-down/storage at the assembly site*
- *manoeuvring of components at site, using fixed and mobile cranes*
- *assembly of components by welding and bolting*
- *painting of components*
- *construction of project-specific grillage (supporting structures) for the cargo barges*
- *loading and sea-fastening of major units onto cargo barges for shipping to Demonstrator site.*

One of the main tasks at the onshore site will be assembling the support tower, turbine nacelle and blades into a single unit. This will be achieved by fixing the tower to the upper part of the "soft landing system" (Section 3.8.8), then lifting the nacelle onto the tower, and finally fitting the nacelle's hub with blades attached. An illustration of how this will look at the onshore assembly site is given in Figure 3.8.

Figure 3.8 Illustration showing the nacelle, tower and soft landing system at the onshore assembly site.



3.3.2 SCHEDULE FOR OFFSHORE INSTALLATION OF WIND TURBINE GENERATORS AND UMBILICALS

The WTGs and umbilicals will be installed at the Demonstrator site during a phased programme that will take place during the spring and summer of 2006. Installation will require the carefully planned and orchestrated use of several different types of vessels (a "vessel spread") that will be active in and around the Demonstrator site for the duration of the installation programme. It is likely that the vessel spread will comprise one heavy lift vessel, two to three tug boats, two transportation barges, and one supply boat.

For practical, logistical reasons, the two umbilicals will be installed first, then the substructures and then the towers and turbines. Figure 3.9 shows the proposed schedule of work.

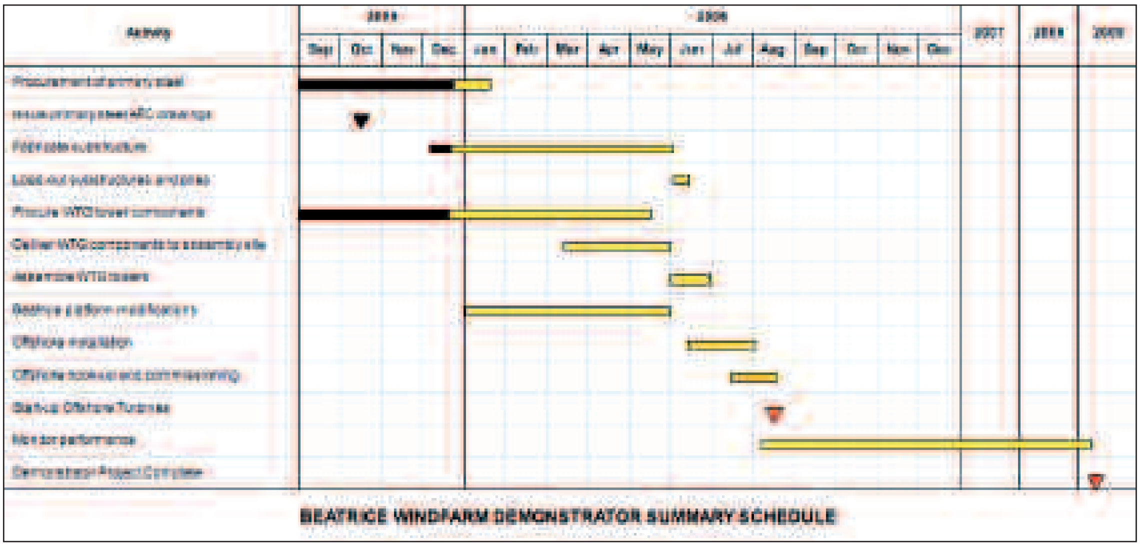
In summary, the proposed programme, which will be subject to fine-tuning once contractors have been selected, comprises the following main stages:

- *laying and trenching of the umbilicals from Beatrice AP to WTG 1, and from WTG 1 to WTG 2 – estimated duration, three to four days*

- *installation of the two substructures and fixing to the seabed by piling – estimated duration, two days per WTG*

- *installation and attachment of the two WTG assemblies (comprising tower, nacelle and blades) onto substructures – estimated duration, a total of four days*
- *pulling-in and connection of the previously laid umbilicals to the WTGs, and protection with concrete mattresses.*

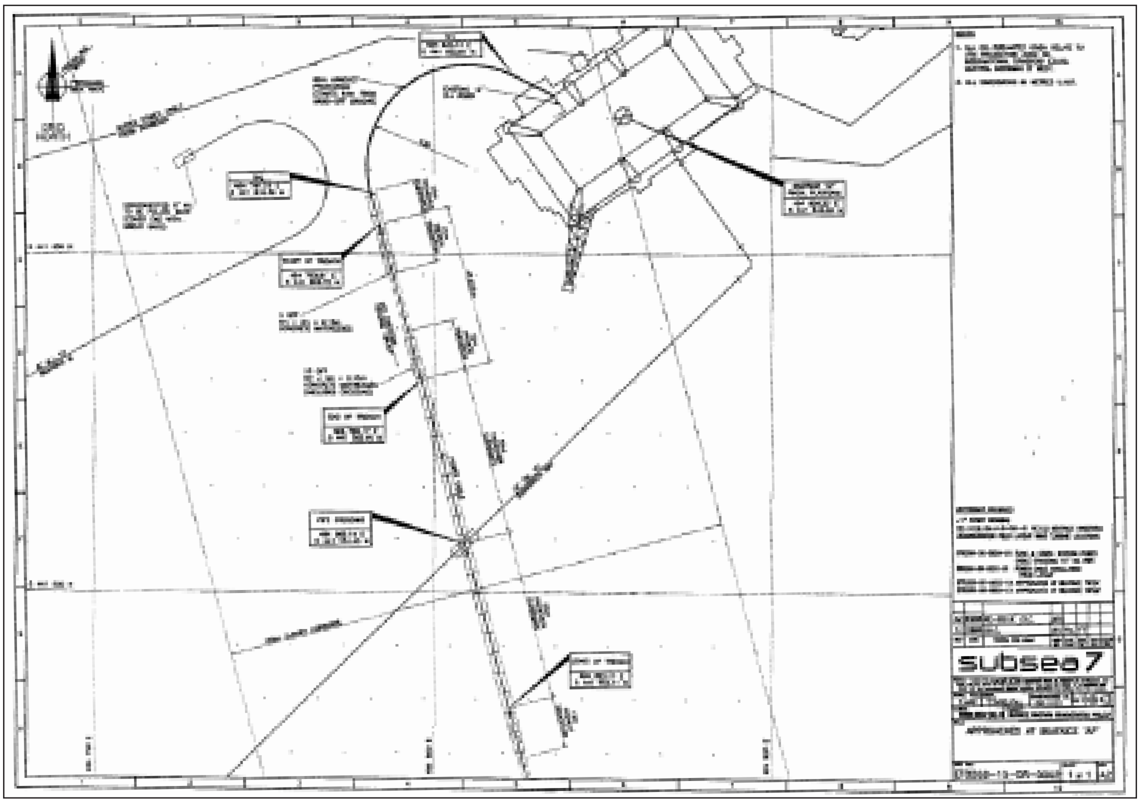
Figure 3.9 Outline schedule for offshore programme of work to install the WTGs and umbilicals.



3.3.3 INSTALLING THE UMBILICALS

The installation of the umbilicals will be carried out in two phases. In Phase 1, a crossing will be made over 16” oil export pipeline. The crossing will be created by placing one or more concrete mattresses over the buried pipeline, resting the umbilical on this layer, and then protecting the whole arrangement with another mattress (Figure 3.10).

Figure 3.10 Detail of the route of the umbilical and the pipeline crossing at Beatrice AP.



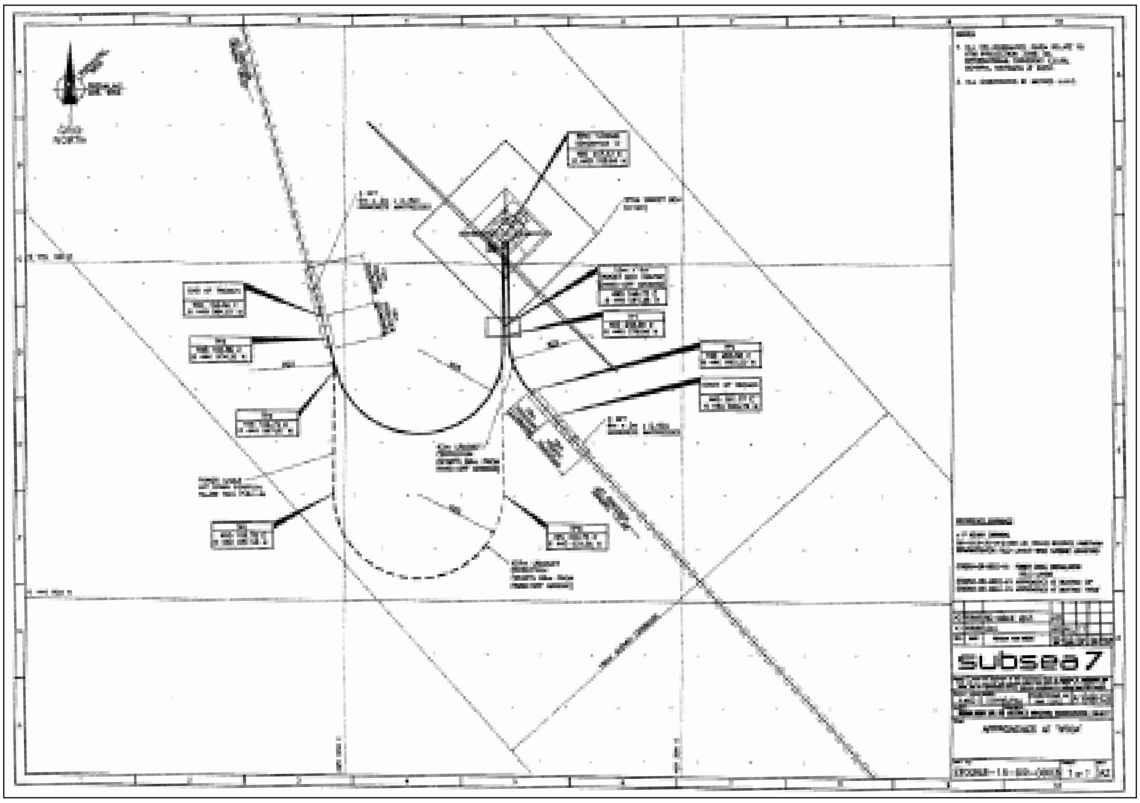
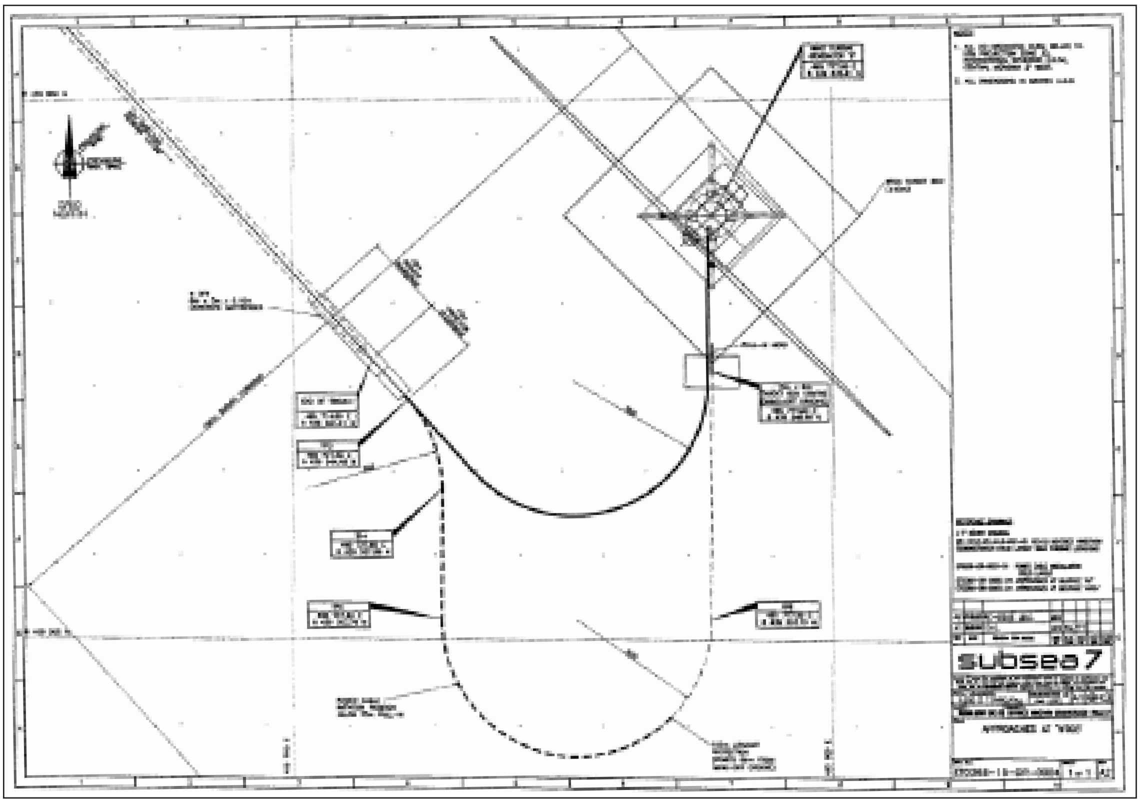


Figure 3.10 Detail of the routes of the umbilicals at WTG 1.

Figure 3.10 Detail of the routes of the umbilicals at WTG 2.



The laying operations will then begin at Beatrice AP, where the end of the umbilical will be pulled up through the modified 12” water injection riser onto the platform. The remainder of the umbilical will be laid on the surface of the seabed to the location of WTG 1.

Subsea umbilicals will be laid by a cable-laying vessel, which will move under its own power using its thrusters and dynamic positioning (DP) capability to maintain station accurately along the planned umbilical route.

The second umbilical, from WTG 1 to WTG 2, will be laid on the seabed in a similar fashion, and the two umbilicals will then be surveyed to confirm their positions and condition.

The cable-laying vessel will then be repositioned and carry out a trenching operation to bury the majority of both umbilicals to a minimum depth of 0.9m, measured from mean seabed level to the top of the umbilical. Trenching will be performed by a “work remotely operated vehicle” (WROV) fitted with an underwater jetting tool. The tool will “crawl” across the seabed and direct high pressure jets of water vertically into the seabed. This fluidises the surface sediments, allowing the umbilicals to drop through the fluidised layer and come to rest on solid sediments below. As the WROV moves along the umbilical, the fluidised sediments resettle on top of the umbilical and bury it. This method of burial is commonly used offshore for umbilicals and small diameter pipelines, and creates very limited and restricted impact on non-fluidised sediments adjacent to the umbilical route. Trenching will be performed by a single pass of the trenching equipment (i.e. the trench will be created and then the umbilical positioned in the trench, in one operation).

At Beatrice AP, about 200m of the umbilical, from the crossing over the 16” export pipeline to the riser on Beatrice AP, will lie on the surface of the seabed. Most of this section will be protected and held in place by approximately 23 concrete mattresses. Concrete mattresses comprise a matrix of 10-30 concrete “tiles”, measuring about 6m x 3m x 0.15m, linked by strong rope or steel wire. The mattresses are flexible and can be draped over pipes or cables to anchor them to the seabed and give protection from towed fishing gear or dropped objects. The mattresses will be lowered to the seabed by crane, and carefully placed using ROVs.

At the Beatrice AP end of the umbilical, an 88m long section of the umbilical will not be covered by mattresses, but will be protected by Uraduct, an additional strong outer sleeve made of plastic. Similarly, sections of the umbilical will be protected on the surface of the seabed by Uraduct at WTG 1 (107m) and WTG 2 (102m).

3.3.4 PREPARATION OF THE WIND TURBINE GENERATOR SITES

The two sites for the WTGs and the routes of the umbilicals will be prepared by undertaking short surveys of the seabed using an ROV, and then completing a "debris sweep" of the small areas of seabed on which the substructures will sit. The debris sweep will be undertaken by a specially chartered fishing vessel using a modified net, capable of capturing small- and medium-sized items that may have been accidentally deposited on the seabed from oil and gas activities, fishing and commercial vessels, or uncharted wrecks. The site preparation works will confirm that the seabed is clear of obstructions and ready to receive the substructures.

3.3.5 INSTALLING THE SUBSTRUCTURES

The two substructures will be loaded onto a cargo barge and towed to the Demonstrator site by a single tug.

Prior to the arrival of the cargo barge, a heavy lift crane vessel (HLV) with a lifting capacity of at least 1,000 tonnes will be moored at the first site by a "spread" of eight to 12 anchors. The anchors will be deployed by anchor-handling tugs, and their locations will be carefully chosen to avoid interference with existing oil and gas infrastructure on the seabed.

The cargo barge will be manoeuvred alongside the HLV, and held in the required position using a combination of anchors and moorings to the HLV.

The HLV will then lift the substructure from the barge and carefully place it at the required location on the seabed. The base of each leg is fitted with "mudmats", large, flat horizontal steel plates, which help to spread the load of the jacket onto the seabed and also provide temporary stability prior to piling. No additional measures are required at the WTG sites to protect the foundations of the jackets against scour (undermining of the foundations caused by the removal of sediments by currents).

The HLV will then be moved by tug to the other WTG site and repeat this process with the second substructure.

3.3.6 PILING THE SUBSTRUCTURES TO THE SEABED

Selection of method for fixing the substructures

The substructures could be fixed to the seabed using "suction" piles or driven piles. During the detailed design phase Talisman put a significant effort into assessing the feasibility of using suction piles in the Demonstrator. These were felt to offer considerable environmental and technical benefits to the project.

The project team undertook a detailed review of the potential to use suction piles. This included commissioning an expert assessment by Oxford University, leading experts on this technology (Houlsby, 2005). These studies showed that the soil conditions at Beatrice do not favour the use of suction piles. As a result, the design of suction piles would vary significantly between the two turbine locations and additional soils data would be required before the design could be finalised.

In addition to the engineering design of the suction piles themselves, the project team considered the feasibility of installing the substructures with suction piles attached. It was determined that the operations to install the substructures fitted with suction piles would be technically difficult, given the experience of the potential installation contractors and the operating parameters and capability of the installation vessels. The Talisman project team therefore concluded that suction piles did not provide a viable and safe solution at this time, and so the option of using suction piles for the Demonstrator Project was discounted.

Fixing substructures using driven piles

The substructures will be fixed to the seabed by steel piles; there are four piles on each jacket, attached to the legs by pile “sleeves”. The piles will be driven to a depth of about 32m into the seabed by a pile-driving hammer, deployed from the heavy lift vessel.

The hammer is a standard piece of equipment used in marine and coastal environments for many different operations, such as sheet-piling and installing temporary coffer dams. The pile hammer is connected to the top of the pile by a short transition piece. At the beginning of piling the hammer is located in air, but as the pile is driven into the seabed, the pile hammer descends and becomes immersed in the sea. The hammer works by repeatedly applying the force of a hydraulic ram onto the top of the pile, at a rate of about 30 blows per minute. It is anticipated that it will take less than two hours to drive each pile, and only one pile will be driven at a time. After piling the hammer will be redeployed to the next pile, and each “cycle” of piling operations is expected to take about eight hours. In the long summer days, therefore, it is planned to complete two piling operations each day, in daylight hours.

The exact make of hammer has not yet been decided, but Table 3.6 shows the characteristics of some types of hammer that would be suitable for use on the WTG piles. It is possible that the AHC S-280 hammer will be selected for the Demonstrator WTGs. Table 3.7 gives some technical details for this model and Figure 3.11 shows the hammer in use.

Table 3.6 Characteristics of some hammers suitable for piling the WTGs.

PRODUCT	TYPE	BLOWS PER MIN	WEIGHT (TE)	STRIKE ENERGY (KNM)
HBM 3000	Hydraulic underwater	50-60	175	1,430
HBM 3000A	Hydraulic underwater	40-70	190	1,520
HBM 3000P	Slender hydraulic underwater	40-70	170	1,550
Menck MHU900	Slender hydraulic underwater	48-65	135	960
IHC S-280	Slender hydraulic underwater	45-100	30	279
IHC S-300	Slender hydraulic underwater	40	30	300
IHC S-800	Slender hydraulic underwater	40	80	800
IHC S-160	Slender hydraulic underwater	30	160	1,600

Table 3.7 Technical details of the IHC S-280 hammer.

ASPECT	DATA
Maximum blow energy on pile (kNm)	280
Minimum blow energy on the pile (kNm)	20
Blow rate at maximum energy (per min)	45
Weight of hammer with ram (tonnes)	29
Length (m)	10.2
Diameter (m)	0.9

Figure 3.11 The IHC S-280 hammer in use.

After piling, the substructure will be levelled to ensure that the mating flange is level, before the piles are firmly linked to the jacket legs by a process known as "swaging". This is a mechanical process which avoids the use of cement grout, and takes about two hours for each pile.

When driven to a depth of 32m, approximately 12m of each pile will remain within the pile sleeves. In the swaging process, a tool is deployed inside the pile through which water is pumped at very high pressure. This forces the pile to expand and it is permanently deformed outwards into a groove cut on the inside wall of the pile sleeve. No significant underwater noise is generated by this process.

Once the substructure is secured to the seabed, the end of the umbilical lying on the seabed at each WTG will be pulled up through the I tube, ready for connection to the support tower.

3.3.7 INSTALLING THE SUPPORT TOWER AND TURBINE UNIT

The single unit of support tower, turbine and blades, will be transported to the site upright, on the deck of the crane vessel. The crane vessel will be towed to the site by a tug, and carefully positioned by the deployment of anchors on the seabed.

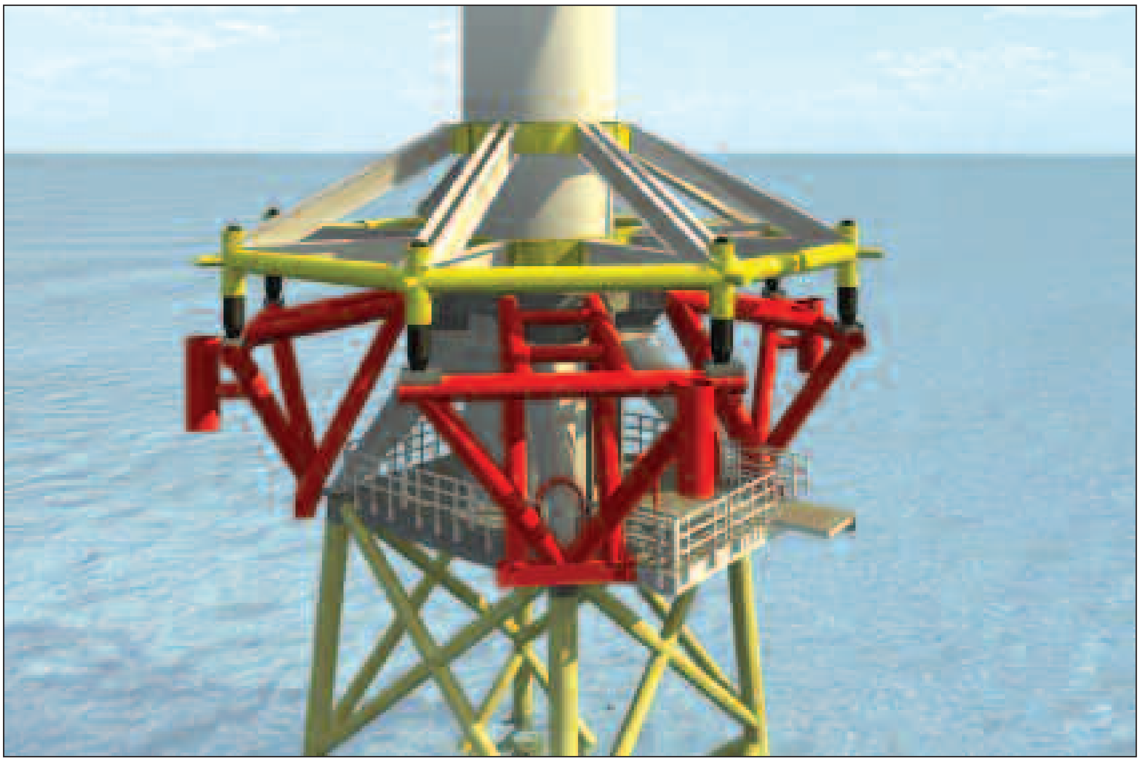
The tower and turbine unit will be lifted by the deck cranes onto the top of the transition piece on the substructure, and bolted into place. The operations to lift and connect each unit will take about two days.

3.3.8 THE SOFT LANDING SYSTEM

To facilitate the safe placement of each unit onto the transition piece, the substructures and towers will be fitted with a temporary structure called the "soft landing system". This is designed to remove the relative motion between the fixed substructure and the tower/turbine unit as it is lowered by the crane, and eliminate any shock loadings on the turbine assembly.

The system comprises two components (Figure 3.12). The lower part is the "jacket interface frame" (JIF), which will be temporarily attached to the top of the substructure at the onshore assembly site. It consists of eight radiating arms bearing damping devices. The upper part, the "tower interface frame" (TIF), also has eight arms and will be temporarily fixed to the bottom of the support tower. As the support tower and nacelle unit is lowered onto the substructure, the two sections of the soft landing system will be aligned and engaged, and the damping devices will absorb the shock of mating and (within certain limits) the relative motion between the fixed substructure and the tower suspended from the floating crane.

Figure 3.12 Diagram of the soft landing system.



After initial contact, the damping devices will be adjusted to bring the flanges on the tower and substructure into contact so that the tower section can be bolted to the jacket. The soft landing system will then be removed and redeployed on the second WTG.

3.3.9 MODIFICATIONS ON THE BEATRICE AP PLATFORM

Modifications to the switchgear and other electrical equipment on Beatrice AP will be required so that the platform can receive and utilise the power generated by the turbines. The bulk of the work will be carried out within the confines of the present platform, and will include operations such as modifying the top of the 12" riser, re-routing existing electrical cables, and installing new cables, connections, switchgear and associated equipment. This programme of work will take about three weeks, and will be carried out under Talisman's "permit to work" system. Normal production operations on the platform will not be affected.

Some modification of the base of the 12" riser will be required, and this will be undertaken by divers and a work-class ROV. A short section of the riser near the seabed will have to be removed using diamond-wire cutting, and a new section clamped in place.

3.3.10 TESTING AND COMMISSIONING THE WIND TURBINE GENERATORS

Once installation is complete, standard electrical tests will be conducted on all equipment prior to energisation. Commissioning and compliance testing will be done in line with national grid requirements for connection to the grid.

3.3.11 COMPLETED APPEARANCE AND SIZE OF WIND TURBINE GENERATORS

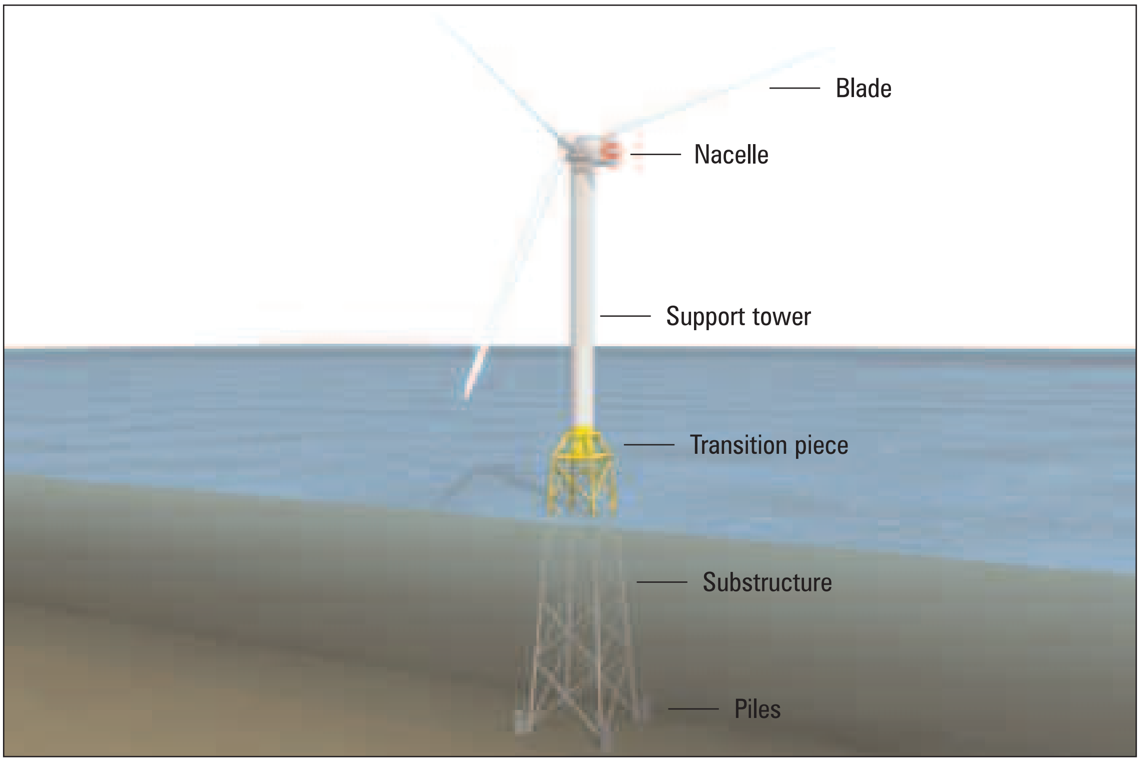
Table 3.8 gives details of some of the main features of final dimensions and appearance of each WTG, and Figure 3.13 illustrates their configuration. On the roof of each nacelle there will be a vane, an ultrasonic windspeed monitor and two cup anemometers to measure wind speed and direction, two navigation lights (Section 3.3.13), and two lightning conductors.

Table 3.8 Size and appearance of each WTG.

FEATURE	DETAILS
Height of jacket from seabed to top of transition piece	Approximately 62m
Height of landing stage above sea	17m
Height of turbine	88m
Diameter of blades	126m
Maximum height to tip of blades	151m
Minimum clearance from sea surface to lower blade tip	21m
Colour of jacket legs exposed above sea surface	Yellow to LAT +19m
Colour of support tower	RAL 7035 matt light grey
Colour of turbine	RAL 7035 matt light grey
Colour of blades	RAL 7035 matt light grey

Note: All heights above the sea are with reference to lowest astronomical tide (LAT).
The tidal range at the Demonstrator site is about 4m.

Figure 3.13 Artist's impression of the final appearance of a WTG.



3.3.12 SAFETY ZONE

The HSE has determined that the two WTGs will become "supplementary units" as defined in the Offshore Installations and Pipeline Works (Management and Administration) Regulations 1995. They will thus effectively become part of the Beatrice Installation, and will therefore attract an automatic 500m safety zone around them, in accordance with Section 21 of the Petroleum Act 1987.

3.3.13 LIGHTING

The detailed requirements for lighting the WTGs have been discussed with the Maritime and Coastguard Agency and the Civil Aviation Authority. Some details still have to be agreed but lighting is likely to comprise the following components:

Aeronautical obstruction lights

Two red aeronautical obstruction lights will be installed on the roof of the nacelle.

Aids to navigation lighting

Two yellow flashing navigational lights will be installed on the access platform at approximately 19m above sea level at diametrically opposite corners to provide 360° visibility. The lights will be yellow and will have a minimum range of five nautical miles.

On the deck at approximately 19m above LAT, area lighting will be provided for the lay-down area and crane. Flood lights will also be installed beneath the lay-down area to light the access to the sea and boat access point. These lights on the deck and access point will be permanently lit.

3.3.14 ADDITIONAL SYSTEMS AND EQUIPMENT IN THE WIND TURBINE GENERATORS

An uninterruptible power supply (UPS) will be installed on each turbine to maintain the control system and navigational aids for a period of about four hours in the case of power failure; gel-filled lead acid batteries will be used.

The nacelle gearbox will contain about 800 litres of oil, but no oil will be present elsewhere on the WTGs.

3.3.15 OPERATION, MONITORING AND MAINTENANCE

The turbines are designed to operate automatically, with the minimum of intervention and maintenance, and have a design life of 20 years. They will be controlled from the Beatrice AP platform, and their condition and performance will be monitored throughout the period of the Demonstrator Project.

The REpower 5M turbine is designed to operate over a wide range of windspeeds from approximately 8mph to 56mph. For the purposes of maintenance, or when the wind exceeds the maximum operating speed, the turbine is fitted with an automatic locking system that "feathers" the blades (to minimise wind resistance) and virtually stops the blades rotating.

The WTGs will be visited by maintenance personnel several times a year throughout the project; the number of visits will vary throughout the lifetime of the project, and will depend largely on turbine performance. Maintenance activities would include inspection, preventative maintenance of key components, and changing lubricating oil and hydraulic fluids.

During the first year of the project, frequent visits (about one each week) will be made to gather essential research data on the performance and condition of the WTGs. Performance testing will compare the measured wind speed with the power generated.

After the first year, it is estimated that there would be four routine and perhaps eight unscheduled maintenance visits each year. The lengths of these visits will vary, but personnel will not normally stay on the structures overnight. The support tower will, however, contain an emergency shelter and rations in case of unexpected and unavoidable overnight stays.

In suitable weather conditions, maintenance personnel and light equipment would be transported to the WTGs by sea, using the existing emergency rapid intervention craft (ERIC) based on the Beatrice platform. Access to the WTGs from the vessels will be gained via two boat landing stages at sea level, with stairs leading to the platform at the base of each tower (the +17m LAT platform). Equipment from supply boats will be transferred to the WTGs using a small crane located on this platform.

Under certain circumstances, such as an emergency evacuation, personnel may be transferred from the WTGs using a helicopter.

3.3.16 DECOMMISSIONING

At the end of the Demonstrator Project, it is envisaged that the WTGs will remain in place, either as part of a commercial wind farm or to continue to supply power to the Beatrice platform until the field ceases production. The WTGs would then be decommissioned as part of the final Beatrice field decommissioning programme. The details of this programme have not yet been drawn up, but it would be conducted in accordance with the requirements of the Petroleum Act 1998 and OSPAR decision 98/3.

For the WTGs, any decommissioning programme would essentially be the reverse of the installation process. It is likely that the blades, turbines and towers would be completely removed and transported to shore for re-use or recycling. The steel piles would be cut below the level of the seabed to allow the whole of the substructure to be lifted from the seabed and returned to land for recycling. In line with DTI guidelines, a comparative assessment would be undertaken of the decommissioning options for the umbilicals.

Figure 3.14 Artist's impression of the final appearance of the WTGs installed offshore at the Demonstrator site.

4 Description of the Environmental Setting

4 DESCRIPTION OF THE ENVIRONMENTAL SETTING

This section presents a description of the baseline conditions of the physical, chemical, biological and socio-economic environment of the Moray Firth, within which the proposed Beatrice Wind Farm Demonstrator Project would be located.

4.1 DESIGNATED SITES AND ENVIRONMENTAL SENSITIVITY

4.1.1 INTRODUCTION

To ensure the conservation and enhancement of habitats and species in both a national and international context, the UK has established a system of protected sites. The main designations for statutory and non-statutory protected area designations in Scotland are summarised in Table 4.1. Examples of all these designations can be found in the Moray Firth area.

4.1.2 COASTLINE AND CLIFFS

The Moray Firth coastline has significant national and international conservation value, with numerous environmentally sensitive areas and some of the most important breeding sites in the UK for seabird and seal populations. Consequently, extensive stretches of the Moray Firth coastline have been designated as conservation sites.

Sites of Special Scientific Interest (SSSI) are the primary nature conservation designation in the area and there are 45 SSSIs along the Moray Firth coastline. Some of these SSSIs have also been recognised under a network of European protected areas, known as Natura 2000, where there are two types of designation. Areas known to support significant numbers of wild birds and their habitats are designated as Special Protection Areas (SPAs) and those areas that support rare, endangered or vulnerable natural habitats and species of plant or animals (other than birds) are designated as Special Areas of Conservation (SACs).

Table 4.1 Summary of statutory and non-statutory conservation designations.

<table>
<tr><th colspan="2">DESIGNATION</th><th>DESCRIPTION</th></tr>
<tr><td colspan="2">Wetlands of International Importance (Ramsar)</td><td>Ramsar sites are designated under the Convention of Wetlands of International Importance. The Convention was adopted in Ramsar, Iran, in 1971 and ratified by the UK Government in 1976. Sites are internationally important wetland sites protecting wildfowl habitat and are primarily designated as SSSIs.</td></tr>
<tr><td rowspan="2">NATURA 2000</td><td>Special Protection Areas (SPA)</td><td>Classified under the EC Directive on the Conservation of Wild Birds (79/409/EEC), commonly known as the Birds' Directive. The Directive requires the Member States of the European Community to identify and classify the most suitable territories, in size and number, for certain rare or vulnerable species (listed in Annex I of the Directive) and for regularly occurring migratory species. SPAs are intended to safeguard the habitats of the species for which they are selected and to protect the birds from significant disturbance. SPAs form part of the Natura 2000 network of sites.</td></tr>
<tr><td>Special Areas of Conservation (SAC)</td><td>Areas designated under the European Directive commonly known as the 'Habitats' Directive. SACs form part of the Natura 2000 network of sites.</td></tr>
</table>

Table 4.1 (cont) Summary of statutory and non-statutory conservation designations.

DESIGNATION	DESCRIPTION
Site of Special Scientific Interest (SSSI)	SSSIs are notified under the Nature Conservation (Scotland) Act. Sites are "special" for their plants, animals or habitats, their rocks or landforms, or a combination of such natural features. In addition they provide the basis for other national and international designations.
National Nature Reserve (NNR)	NNRs are designated under the National Parks and Access to the Countryside Act 1949 or the Wildlife and Countryside Act 1981 and are all Sites of Special Scientific Interest (SSSIs). NNRs are areas of land, set aside for nature, where the main purpose of management is the conservation of habitats and species of national and international significance.
National Scenic Area (NSA)	These sites are nationally important areas of outstanding natural beauty.
Local Nature Reserve (LNR)	LNRs have a special local natural interest.
Regional Landscape Designations (RLD)	RDLs provide a mechanism whereby planning authorities can identify sites where there should be a strong presumption against development. They are recognised to be areas that have considerable unexploited potential for tourism, therefore benefiting local economies.
Local Landscape Designation (LLD)	Non-statutory and locally designated areas outside the national landscape designations, which are considered by the local planning authority to be of particular landscape value to the local area.
Geological Conservation Review (GCR)	Non-statutory sites identified as having national and international importance for earth science. They are sites with unique natural areas that represent examples of geology, paleantology, minerology or geomorphology.
Preferred Conservation Zones (PCZ)	Non-statutory coastal areas of particular national, scenic, environmental or ecological importance. Usually areas where the local inhabitants are dependent on the natural state of the area.
Areas of Outstanding Natural Beauty (AONB)	Statutorily designated and are intended to conserve and enhance the area's natural beauty, its amenities, wildlife, historic objects or natural phenomena.
Areas of Special Protection (AoSP)	Designation aims to prevent the disturbance and destruction of the birds for which the area was identified, by making it unlawful to damage or destroy either the birds or their nests. They are usually unique natural bird habitats.

Examples of Special Protection Areas (SPA) include the sea cliffs at Duncansby Head which support breeding populations of peregrine and guillemot of European importance. During the breeding season, the Moray Firth regularly supports 110,000 individual seabirds including puffin, razorbill, kittiwake, fulmar and guillemot (JNCC, 2004). Other notable SPA sites include the tidal flats of the Dornoch Firth, which are of value for breeding osprey and over-wintering bar-tailed godwit; and the Cromarty Firth, which is important for breeding common tern and over-wintering whooper swan (JNCC, 2005).

Sites along the Moray Firth coastline which have been designated as SACs include the Culbin Bar, which is of particular importance for Atlantic salt meadows and embryonic shifting dunes, and Mound Alderwoods SAC which is selected primarily because of its alluvial forests with alder and ash. Figure 4.1 and Table 4.2 summarise the Natura 2000 sites along the Moray Firth coastline.

In addition to the Natura 2000 sites, the Moray Firth also has several Ramsar sites. The areas chosen for as Ramsar sites are the Dornoch Firth, Loch Fleet, Loch Eye, Cromarty Firth, Inner Moray Firth, and the Moray and Nairn coast.

The nearest designated site to the proposed Demonstrator site are the Berriedale Cliffs, which lie approximately 24km from Beatrice. The Berriedale Cliffs are SSSI-designated and are internationally important for breeding seabirds and maritime vegetation. All species of marine bird that breed in the UK are protected via a network of breeding site SPAs. Such protection is largely limited to land above mean low water (or mean low water springs in Scotland).

Table 4.2 Natura 2000 sites along the Moray Firth coastline.

SPECIAL PROTECTION AREAS	
East Caithness Cliffs	Cliff ledges, stacks and geos provide ideal nesting sites for internationally important populations of seabirds, especially gulls and auks. The seabirds nesting on the east Caithness Cliffs feed outside the SPA in inshore waters as well as further away. The cliffs also provide important nesting habitat for Peregrine *Falco peregrinus*. The cliffs overlook the Moray Firth, an area that provides rich feeding areas for fish-eating seabirds.
Berriedale and Langley Waters	Supports small, but high-quality populations of salmon *Salmo salar.*
Dornoch Firth and Loch Fleet	Extensive sand-flats and mud-flats are backed by saltmarsh and sand dunes with transitions to dune heath and Alder *Alnus glutinosa* woodland. The tidal flats support internationally important numbers of waterbirds on migration and in winter, and are the most northerly and substantial extent of intertidal habitat for wintering waterbirds in the UK, as well as Europe. The Firth is also of importance as a feeding area for locally breeding osprey *Pandion haliaetus.*
Cromarty Firth	Contains a range of high-quality coastal habitats including extensive intertidal mud-flats and shingle, bordered locally by areas of saltmarsh, as well as reedbeds around Dingwall. The rich invertebrate fauna of the intertidal flats, with beds of eelgrass *Zostera* spp., glasswort *Salicornia* spp., and *Enteromorpha* algae, all provide important food sources for large numbers of wintering and migrating waterbirds (swans, geese, ducks and waders). With adjacent estuarine areas elsewhere in the Moray Firth, it is the most northerly major wintering area for wildfowl and waders in Europe. The Firth is also of importance as a feeding area for locally breeding osprey *Pandion haliaetus* as well as for breeding terns.
Inner Moray Firth	Site contains extensive intertidal flats and smaller areas of saltmarsh. The rich invertebrate fauna of the intertidal flats, with beds of eelgrass *Zostera* spp., glasswort *Salicornia* spp., and *Enteromorpha* algae, all provide important food sources for large numbers of wintering and migrating waterbirds (geese, ducks and waders). With adjacent estuarine areas elsewhere in the Moray Firth, this site is the most northerly major wintering area for wildfowl and waders in Europe. The Firth is also of importance as a feeding area for locally breeding osprey *Pandion haliaetus* as well as for breeding terns.

Table 4.2 (cont)   Natura 2000 sites along the Moray Firth coastline.

SPECIAL PROTECTION AREAS	
Moray and Nairn Coast	The site comprises the intertidal flats, saltmarsh and sand dunes of Findhorn Bay and Culbin Bar, and the alluvial deposits and associated woodland of the Lower River Spey and Spey Bay. It is of outstanding nature conservation and scientific importance for coastal and riverine habitats and supports a range of wetland birds throughout the year.
Loch Flemmington	Small (14ha), shallow, eutrophic loch formed in a kettlehole situated among a suite of fluvioglacial landforms produced in the last glaciation. The loch has a limited exchange of water with no obvious outlet, and supports a largely undisturbed aquatic plant community associated with eutrophic conditions, including diverse submerged and emergent vegetation and sedge fen.
Loch Spynie	Shallow naturally eutrophic loch with adjoining reedbeds, freshwater marshes, and Alder *Alnus glutinosa* and willow *Salix* spp. carr. The calcareous dunes and dune slacks within the site are relatively undisturbed and contain a rich flora. The loch constitutes the largest dune slack pool in the UK (200ha) and the largest waterbody in the north-east Scottish lowlands. It is separated from the sea by a 0.5-1km wide dune system.
Troup, Pennan and Lion's Head	9km stretch of sea-cliffs along the Banff and Buchan coast of Aberdeenshire in north-east Scotland. As well as cliffs, the site also includes adjacent areas of grassland and heath, and several small sand or shingle beaches punctuate the otherwise rocky shore. The cliffs rise to 150m and provide ideal nesting sites for seabirds, which feed in the rich waters offshore and outside the SPA. Different parts of the cliffs are used by different species of seabirds according to varying ecological requirements. The site is particularly important for its numbers of gulls and auks.
East Caithness Cliffs	Annex 1 Habitat : Vegetated sea cliffs of the Atlantic and Baltic coasts.
Ledmore Wood	Ledmore Wood represents old sessile oak woods in north-east Scotland. This is the largest oak-dominated wood in Sutherland, and the most northerly large oakwood in eastern Britain.
Moray Firth	***Annex I Habitats present (not primary feature):*** Sandbanks which are slightly covered by seawater all of the time. ***Annex II Species (primary feature):*** The Moray Firth in north-east Scotland supports the only known resident population of bottlenose dolphin *Tursiops truncatus* in the North Sea. The population is estimated to be around 130 individuals (Wilson *et al.* 1999). Dolphins are present all year round, and, while they range widely in the Moray Firth, they appear to favour particular areas. An additional qualifying feature are the sandbanks covered with seawater all of the time.
Mound Alderwoods	Mound Alderwoods in north-east Scotland is the most northerly site selected and is the largest estuarine alder *Alnus glutinosa* wood in Britain.

Table 4.2 (cont) Natura 2000 sites along the Moray Firth coastline.

SPECIAL PROTECTION AREAS	
Dornoch Firth and Morrich More	***Annex I Habitats (primary features):*** Estuary, mudflats and sandflats, *Saliornia* and other colonising annuals, Atlantic salt meadows *(Glauco-Puccinellietalia martitimae),* embryonic shifting dunes, white dunes, fixed dunes, decalcified fixed dunes, Atlantic decalcified fixed dunes, humid dune slacks and coastal dunes with *Juniperus* spp. Also present are sandbanks which are slightly covered by seawater all the time and reefs. ***Annex II species (primary reason):*** Otter *Lutra lutra* and common seal *Phoca vitulina.*
Conon Islands	***Annex I Habitats (primary): Alluvial forests with Alnus glutinosa and Fraxinus excelsior (Alno-Padion, Alnion incanae, Salicion albae)*** Conon Islands, at the mouth of the River Conon in north-east Scotland, is an example of a relatively unmodified dynamic alluvial forest system – a rare situation in Europe. It provides one of the most complete examples in the SAC series of a transition from woodland through scrub and freshwater fen to saltmarsh communities. The upper part of the site supports alder *Alnus glutinosa* wood, which is subject to regular inundation and which gives way downstream to alder and willow *Salix* spp. woodland.
Lower River Spey	The most significant feature of the site is the complex of wet and dry vegetation types, depending on the physical relief of the shingle ridges and hollows. Species-rich dry heath and grassland occurs on the ridges, while in the wetter hollows there is species-rich wet heath and transitions to a vegetation type comparable to that of dune slacks. Large areas of scrub, mainly of gorse *Ulex europaeus,* also occur.
Culbin Bar	***Annex I Habitats (primary): Perennial vegetation of stony banks.*** Dominant species are heather *Calluna vulgaris,* crowberry *Empetrum nigrum* and juniper *Juniperus communis.* ***Annex I Habitats (secondary): Atlantic salt meadows.*** *(Glauco-Puccinellietalia maritimae)* and embryonic shifting dunes.
River Oykel	***Annex II species (primary):*** Freshwater pearl mussel *Margaritifera margaritifera.* ***Annex II species (secondary):*** Atlantic salmon *Salmo salar.*
River Moriston	***Annex II species (primary):*** Freshwater pearl mussel *Margaritifera margaritifera.* ***Annex II species (secondary):*** Atlantic salmon *Salmo salar.*

SNH and JNCC are in the early stages of considering areas along the coast of Scotland for possible designation as marine SPAs for wild birds. At present, it is too early to identify any possible sites, but sea areas adjacent to estuaries and cliff nesting concentrations are known to be important, as are offshore feeding areas (JNCC, 2002 and 2003; *pers. comm*., 2005). Various types of marine SPAs are being considered for UK territorial and offshore waters, including the following (JNCC, 2005):

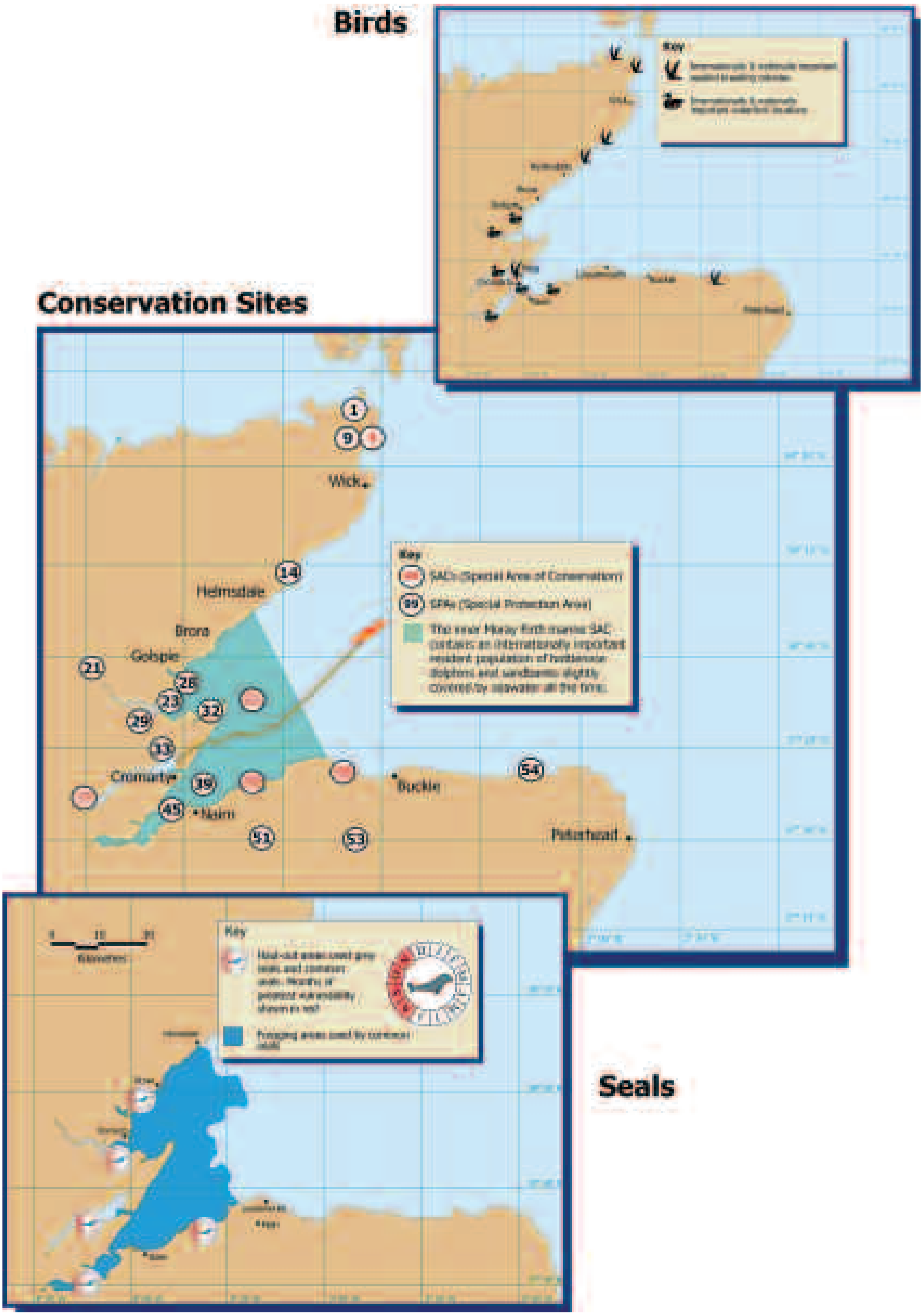
- *seaward extensions to existing seabird breeding colony SPAs. Current work aims to identify those areas of the sea adjacent to breeding colonies that are important to seabirds for essential activities. To date, extensions into the sea of 1km for those SPAs at which common guillemot, razorbill and Atlantic puffin breed, and 2km for breeding gannet SPAs, have been recommended*

- *inshore aggregations of non-breeding waterbirds. An initial review of various survey data has resulted in a list of inshore sites for seaduck, divers and grebes that might be considered for SPA status*

- *offshore aggregations of seabirds. The European Seabirds at Sea database hosts year-round data on the at-sea distributions of all birds that occur in the waters of the north-west European continental shelf. These data will be analysed by JNCC and SNH in order to identify possible hotspots for seabirds with a view to possible SPA classification*

- *other types of SPA. Some important aggregations of seabirds may not be captured by the above categories and are being considered individually. For example, diurnal concentrations of Manx shearwaters during the breeding season, which occur at varying distances and locations from the breeding colonies, are being studied using radio-tracking. Similarly, the feeding locations of red-throated divers are being investigated using the same technology. Feeding concentrations of terns in the breeding season are also the focus of specific study.*

Figure 4.1 Conservation areas of the Moray Firth [Source: JNCC, 2005; pers. comm., 2005].



4.1.3 OFFSHORE SACs

The Offshore Petroleum Activities (Conservation of Habitats) Regulations 2001 implemented the European Union (EU) Habitats Directive (92/43/EEC) into UK law. These regulations apply to UK waters up to 200 miles offshore. Table 4.3 indicates habitats and species from Annex I and II of the EU Habitats Directive (92/43/EEC) which are currently under consideration for identification as possible SACs in the UK offshore waters (European Commission, 2005). In addition, all cetacean species, otters, several fish species, and a range of marine invertebrates are listed on Annex IV (Animal and Plant Species of Community Interest in Need of Strict Protection) of the Habitats Directive (DTI, 2004a; European Commission, 2005). Several marine species are also protected in UK waters under Schedule 5 of The Wildlife and Countryside Act, 1981; these include otters, all species of cetacean, all species of turtle and several species of fish and marine invertebrates (DTI, 2004a; European Commission, 2005).

Presently, there are no SACs or cSACS in UK offshore waters. However, one possible SAC and five draft offshore sites that have not yet been submitted to the European Commission have been identified in UK offshore waters, but these are situated in the southern North Sea and in the North Atlantic (JNCC, 2005).

Table 4.3 Annex I and II habitats and species occurring in UK offshore waters (Source: European Commission, 2005).

Annex I habitats considered for SAC selection in UK offshore waters	Species listed in Annex II known to occur in UK offshore waters
• sandbanks which are slightly covered by seawater all the time • reefs (bedrock, biogenic and stony) ***Bedrock reefs*** – made from continuous outcroppings of bedrock which may be of various topographical shape ***Stony reefs*** – these consist of aggregations of boulders and cobbles which may have some finer sediments in interstitial space ***Biogenic reefs*** – formed by cold water corals (e.g. *Lophelia pertusa*) and *Sabellaria spinulosa.* • submarine structures made by leaking gases • submerged or partially submerged sea caves	• grey seal • common seal • bottlenose dolphin • harbour porpoise

Though there are no marine SACs in the Moray Firth, a number of Annex I habitats and Annex II species occur in the area of the Moray Firth. In addition, two coastal areas have been designated due to their Annex I and Annex II qualifying features.

Annex I habitats

Of the sites designated along the Moray Firth coastline, the Moray Firth and the Dornoch Firth and Morrich More have been designated as SACs due to the presence of sandbanks which are slightly covered by seawater all the time. No qualifying subtidal sandbanks have been identified in the region of the proposed Beatrice Wind Farm Demonstrator Project (Talisman, 2003).

Annex II species

All of the Annex II species listed in Table 4.3 have been sighted within the vicinity of the proposed Beatrice Wind Farm Demonstrator Project. The Moray Firth is designated as a SAC, primarily to protect the population of bottlenose dolphins. The Dornoch Firth and Morrich More SAC have been designated due the presence of common seals.

Marine mammals occurring in the vicinity of Beatrice are discussed in more detail in Section 4.3.5.

4.2 PHYSICAL AND CHEMICAL ENVIRONMENT

4.2.1 GEOGRAPHICAL LOCATION AND GENERAL CONTEXT

The Moray Firth is a large embayment in the north east of Scotland, covering approximately 5,230km^2 (Harding-Hill, 1993). Its coastline extends from Duncansby Head in the north to Fraserburgh in the east, and ranges in character from high rocky cliffs to areas of broad sandy beaches and muddy estuaries. The south western part of the Firth, the Inner Moray Firth, contains four smaller firths, the Inverness, Cromarty, Dornoch and Beauly Firths (Wilson *et al.*, 1997). Figure 4.2 shows some of the important features of the Firth, including the Smith Bank on which the proposed Demonstrator Project will be located, and some of the rivers discharging into the Firth.

4.2.2 SITE-SPECIFIC INFORMATION

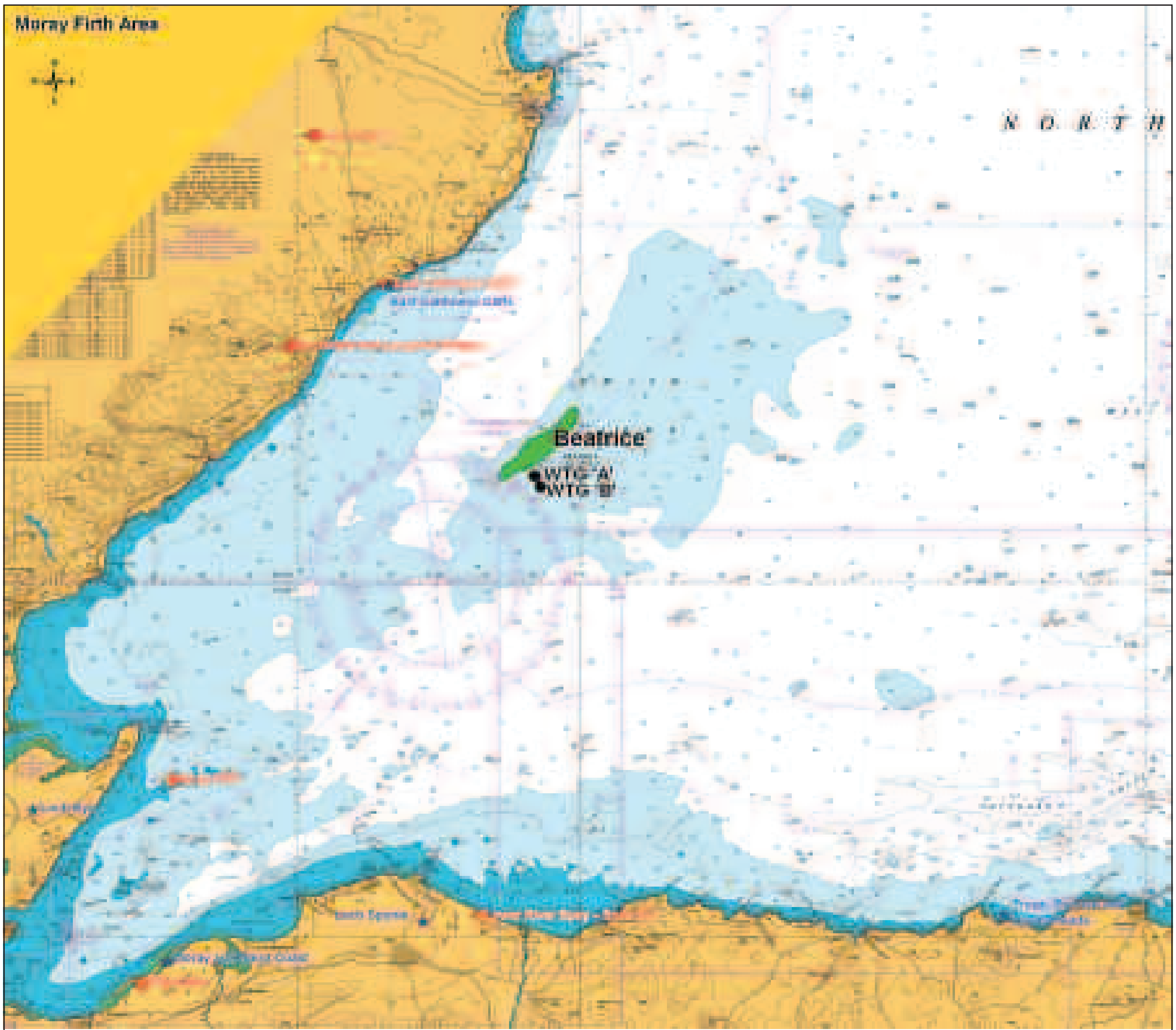
In October 2005 a site-specific survey was carried out to examine the nature of the seabed around the proposed Demonstrator site, to investigate the possible present of beds of the horse mussel *Modiolus modiolus*, determine the present levels of contamination in the sediments, and characterise the benthic communities. Since frequent reference is made to the results of this survey, it is briefly described below.

Acoustic survey

The acoustic survey was carried out using a GeoSwath interferometric system from GeoAcoustics, and a RoxAnn AGDS (Acoustic Ground Discrimination System). Information from the AGDS was used in the interpretation of the swath/side scan sonar data. Interpretation was further aided by a high-quality drop-down video system; this was used to photograph the sea bed and investigate any anomalies that could potentially indicate the presence of seabed features such as mussel beds.

Areas of seabed within a 1km radius of each WTG location were surveyed, since it was estimated that this would be the maximum extent of seabed that would be likely to be disturbed or influenced by the operations to install the WTGs and umbilicals (Figure 4.3). Survey lines were run in a north-west to south-east direction at 200m line spacing with a total swath width of 300m which gave a 50% overlap of the whole site. Two cross-tracks were run to coincide with the proposed turbine locations, and the swath width for these was decreased in order to increase the resolution of the resulting data. AGDS data were logged at two-second intervals for the duration of the survey. The swath bathymetric data were processed to remove the products of vessel movement, tide and speed of sound through the water, and a bathymetric grid produced.

Figure 4.2 Map showing location of Demonstrator site in relation to Beatrice field and major features of the Moray Firth.



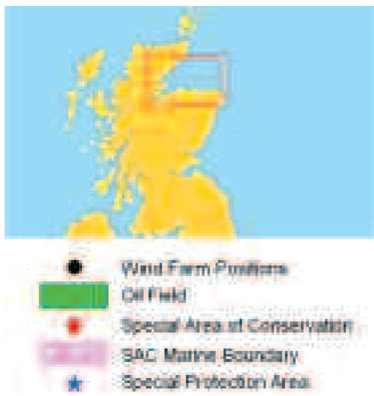
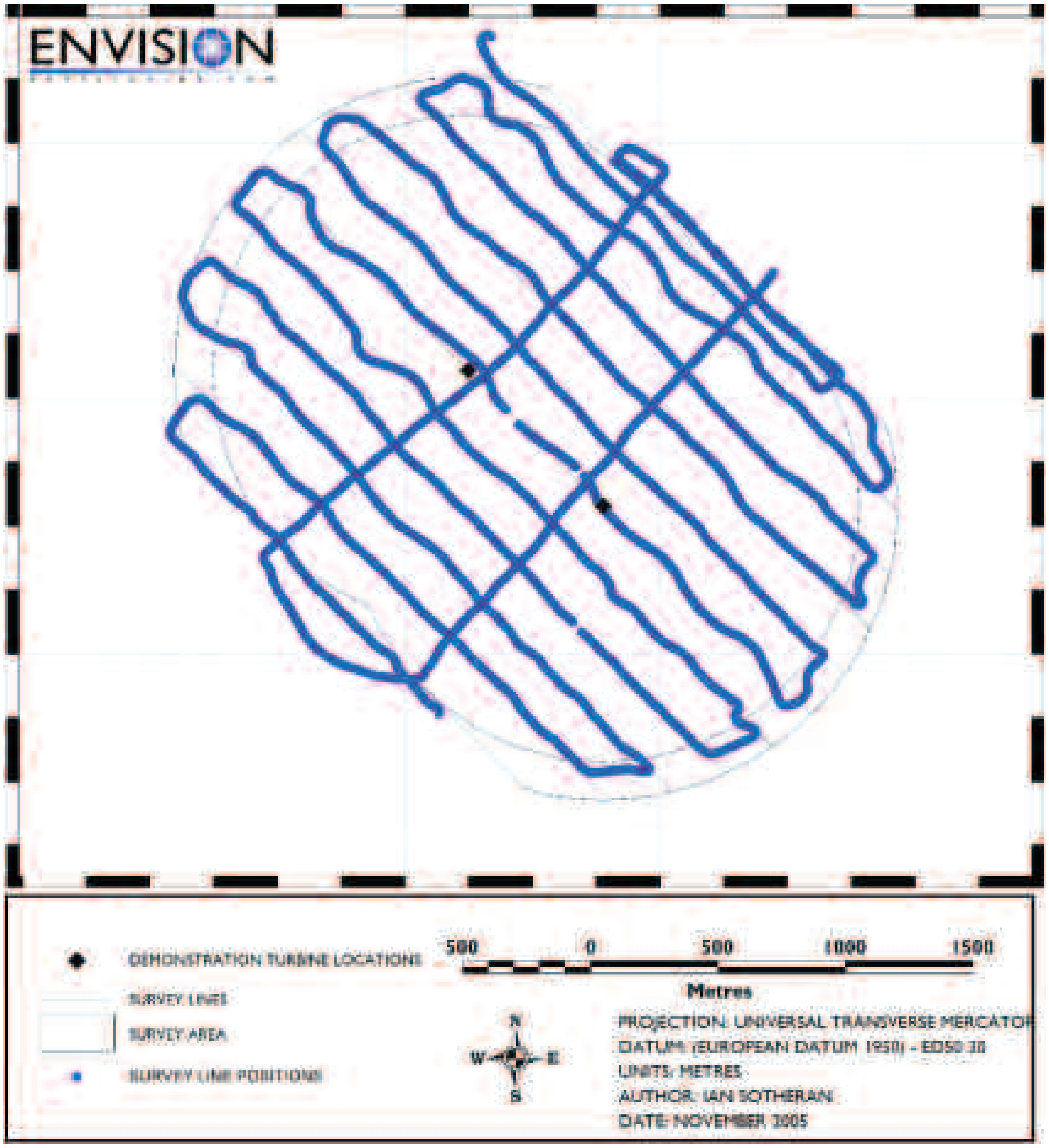


Figure 4.3 The position of the acoustic survey track and cross-tracks across the site of the Demonstrator Project, October 2005 (ERT, 2005).



Benthic sampling

Seabed samples were taken at stations located on a grid which encompassed both the turbine locations (Figure 4.4, Table 4.4). One grab sample (0.1m^2 Day grab with video camera and light attached) at each station provided sediment for the analysis of particle grain size, organic matter content, metals and hydrocarbons. Two further replicate samples were taken for the analysis of the macrobenthos; these samples were washed and sorted over a 0.5mm sieve.

Figure 4.4 Location of seabed grab samples sites within 1km of WTGs, October 2005.

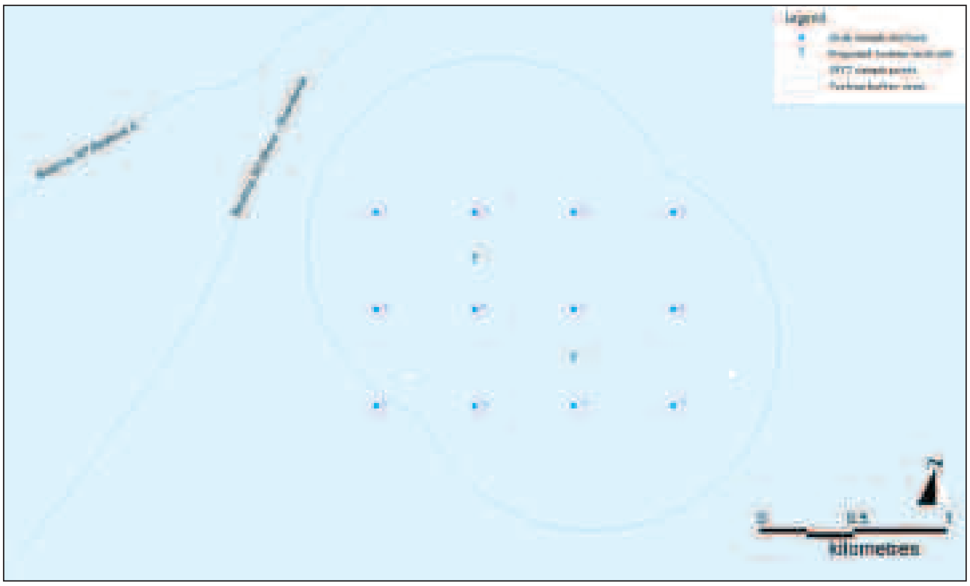


Table 4.4 Station positions (degrees and decimal minutes; WGS84) for grab sampling at the Beatrice Wind Farm Demonstrator site, October 2005.

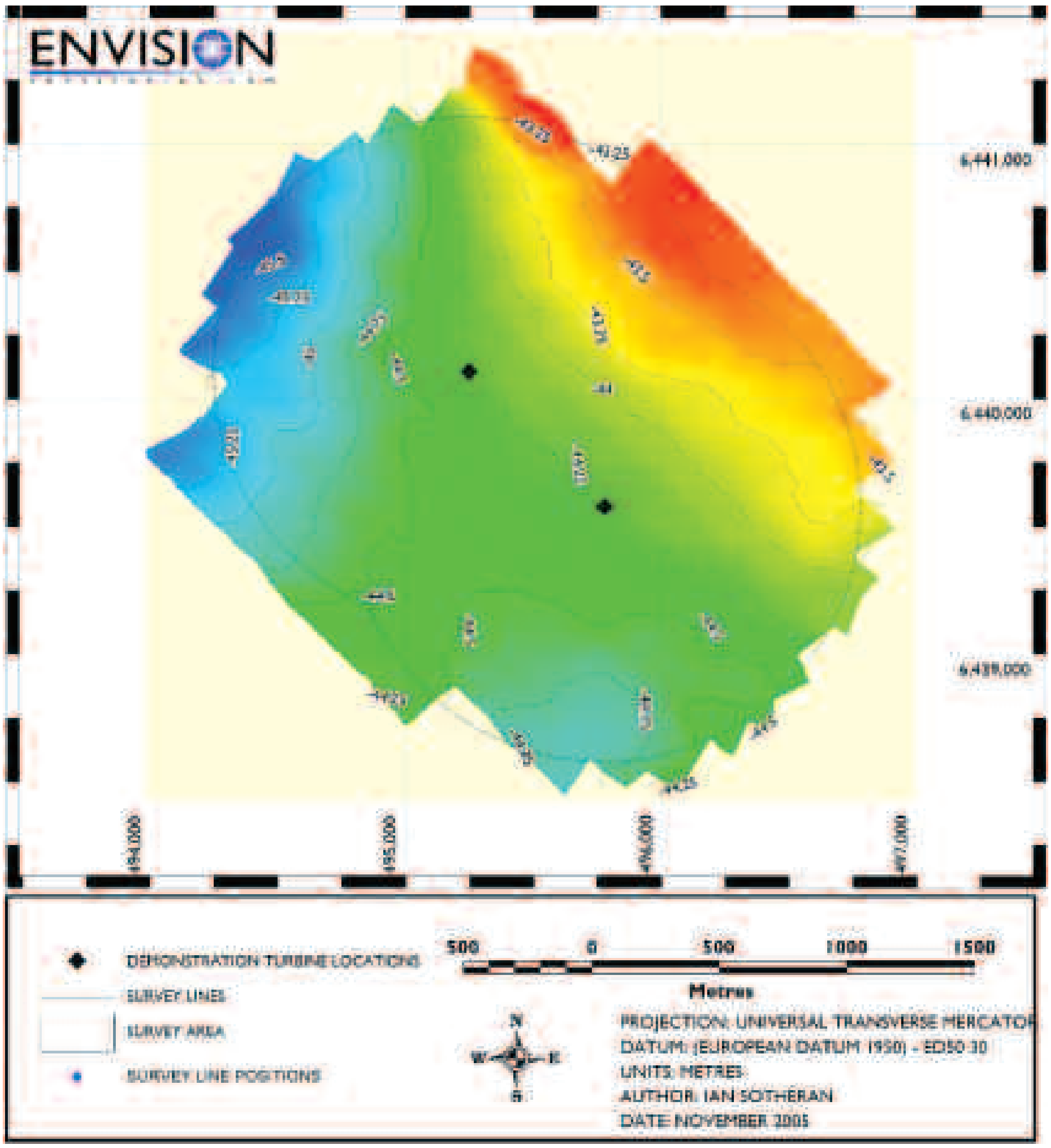
Station no	X co-ordinate (longitude)		Y co-ordinate (latitude)	
	Deg	Dec min	Deg	Dec min
1	-003	5.47968	058	6.15738
2	-003	4.94214	058	6.15720
3	-003	4.40130	058	6.15768
4	-003	3.86058	058	6.15774
5	-003	5.48016	058	5.87736
6	-003	4.94232	058	5.87766
7	-003	4.40160	058	5.87778
8	-003	3.85992	058	5.87808
9	-003	5.48016	058	5.59980
10	-030	4.94244	058	5.59896
11	-003	4.40154	058	5.60022
12	-003	3.86046	058	5.59956

4.2.3 BATHYMETRY

The proposed Beatrice Wind Farm Demonstrator Project would be located on the Smith Bank, a large sandbank in the north-west area of the Moray Firth, approximately 25km south-east of the Caithness coast. The bank is approximately 35km long from south-west to north-east and 20km wide, and rises from a base level of between 50m and 60m below sea level to approximately 35m (Andrews *et al.*, 1990; DTI, 2004a). Approximately 40km^2 of the bank is covered by water less than 50m deep (Holmes *et al.*, 2004).

The site-specific survey carried out in November 2005 using swath bathymetry and AGDS indicated that the seabed is generally flat over the central part of the area of the Demonstrator site, with depths of 44m to 44.75m. Within the survey area, the minimum water depth was approximately 43m (in the north-east of the area) and the maximum was 46m, to the north-west (Figure 4.5).

Figure 4.5 Water depths and sea bed topography at the wind farm Demonstrator site (ERT, 2005).



4.2.4 WATER MASSES, CURRENTS AND TIDAL STREAMS

The Moray Firth contains both "coastal" water and "mixed" (coastal and oceanic) water. A weak south, south westerly coastal current, flowing from the east side of the Shetland Islands towards Rattray Head, transports water westwards into the Moray Firth from where it is weakly circulated clockwise around the Smith Bank (SNH, 1993).

Further offshore, the Fair Isle Current enters the North Sea between the Orkney Islands and the Shetland Islands. After entering the North Sea, the current flows south-east across the approach to the Moray Firth, and then flows east, following the 100m contour line of the Fladen Ground, which is a deeper area lying further offshore in the northern North Sea (North Sea Task Force (NSTF), 1993).

Currents within the Moray Firth are primarily tidal, influenced by wind, and generally weak, with speeds of less than $0.5m.s^{-1}$ over the bulk of the Moray Firth during spring tides. Tidal currents in excess of $0.5m.s^{-1}$ are found in the Inner Moray Firth, with speeds of over $1.6m.s^{-1}$ between Fort George and Chanonry Point, and off Invergordon, during spring tides.

Residual currents in the area are weak ($<0.1m.s^{-1}$) and form a gyre in the inner part of the Moray Firth. Data from current meter deployments south-east and north-west of the Smith Bank (February to November 1981) showed residual southerly flows, with more frequent northerly components at the north-west location (Adams and Martin, 1986). At both locations, residual currents were seasonal, with minimal flow during summer months due to the relative absence of wind-forcing.

4.2.5 TEMPERATURE AND SALINITY

The Moray Firth and adjacent coasts experience a mild maritime climate due to the prevailing south westerly winds and the warming influence of the North Atlantic Current. At sea level, the mean air temperature varies from a minimum of about 6°C in March, to a maximum of 12.5°C to 13.0°C in July and August (UKDMAP, 1998).

Water temperature varies with depth and season. During the summer, the water becomes layered due to temperature-induced density differences between the surface and deep water, forming a thermocline at a depth of 20-50m. Water temperature near the surface may reach 13°C, whereas water near the bottom remains at about 6°C to 7°C. The layering breaks up at the end of summer and water is completely mixed during the winter months. In the Moray Firth, the temperature and the salinity of the waters close to the coast fluctuate more than those in the Outer Moray Firth, because of tidal current mixing and influence of river inputs. Nearshore, local temperature stratification in summer is associated with relatively warm run-off overlying colder North British Coastal water (Adams and Martin, 1986).

4.2.6 WINDS

In this area of the North Sea the wind direction is predominantly south westerly between September and April; south easterly in May and June; and westerly to north westerly in July and August. Figure 4.6 shows the monthly wind roses for the area 57.7° to 58.7°N and 02.8° to 03.8°W for the period 1923-98; winds of Force 1 and 3 (light to gentle breeze) are much more likely during the summer months (May to August); winds of Force 4 or 5 (moderate to fresh breeze) are common throughout the year; and in winter, winds may reach or exceed Force 7 (moderate gale) for about five days each month.

Figure 4.6 Seasonal wind rose data for the Moray Firth (Meteorological Office, 1998).

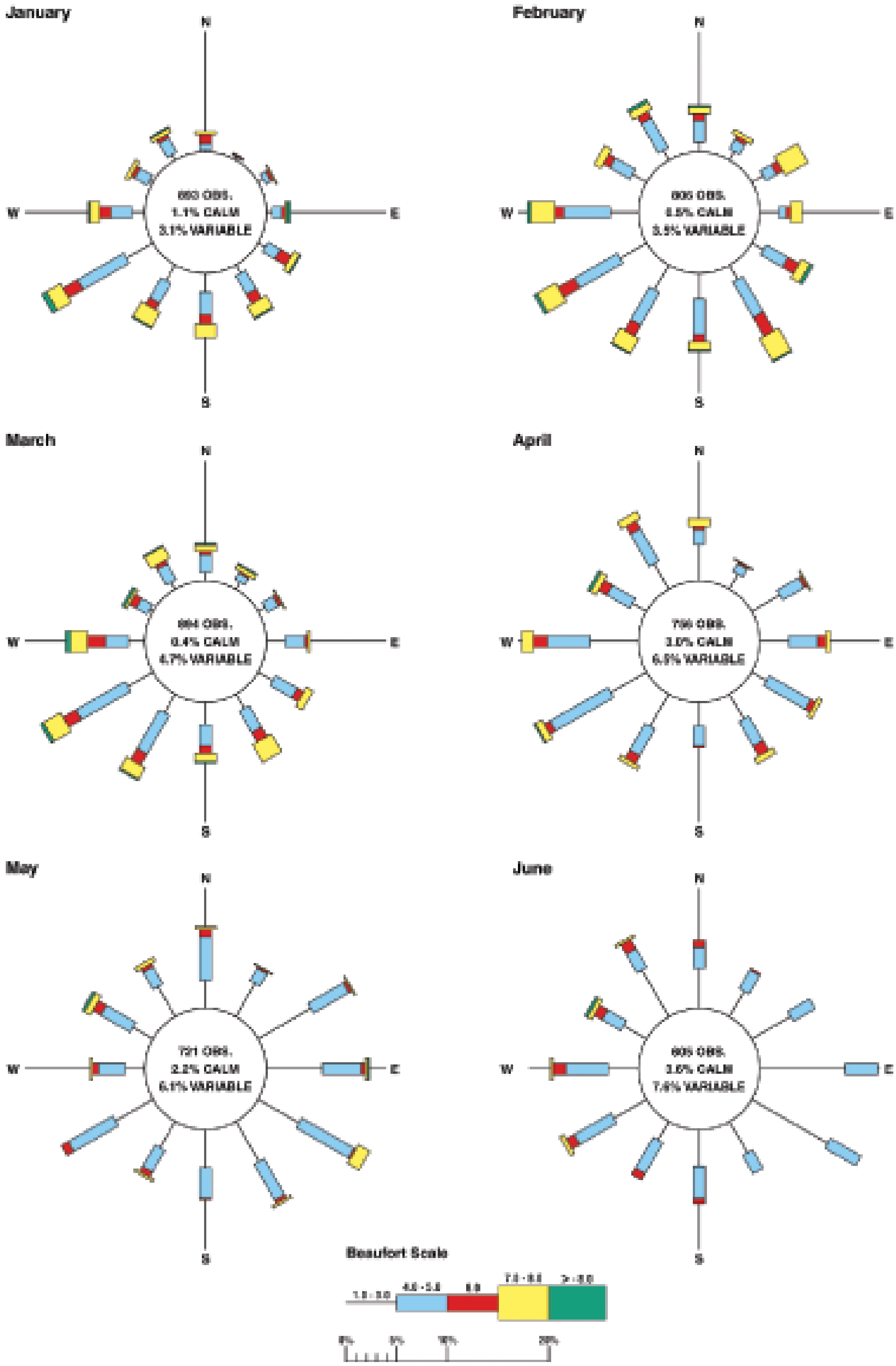
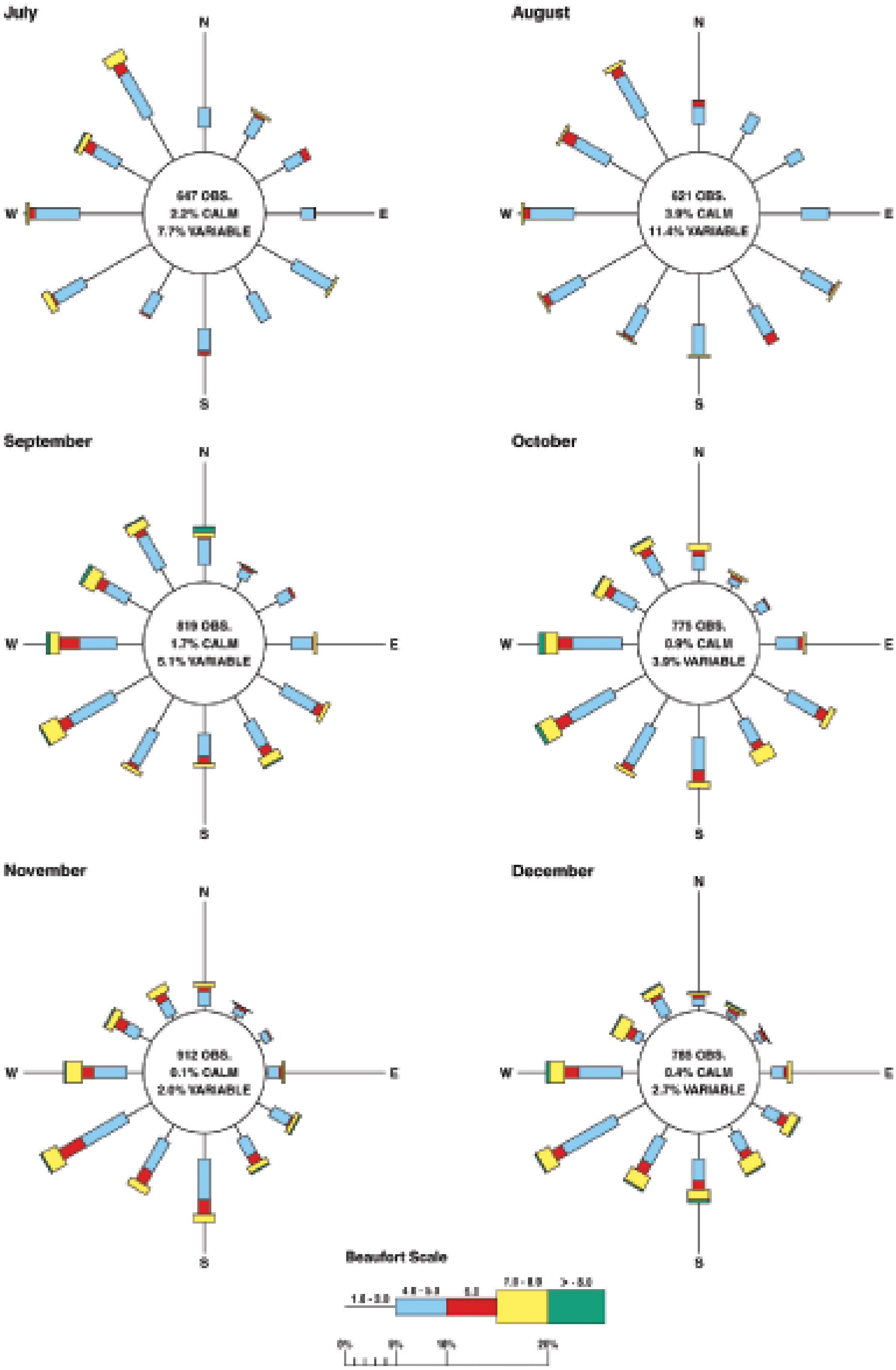


Figure 4.6 (cont) Seasonal wind rose data for the Moray Firth (Meteorological Office, 1998).



4.2.7 SEABED CHARACTERISTICS AND FEATURES

Throughout the Moray Firth, surface sediments form a relatively thin (<15m) uniform cover, and in the central and northern parts of the Firth sandy sediments predominate (Chesher and Lawson, 1983). These sandy sediments are, generally, moderately to well sorted, fine to medium grained, with a small percentage of shell debris, and for most of the area form a layer 1m to 2m thick. The sandy sediments of the central Moray Firth grade into muddy sand sediments in the southern areas. These muddy sands are moderately well sorted, with mud content less than 20% by weight.

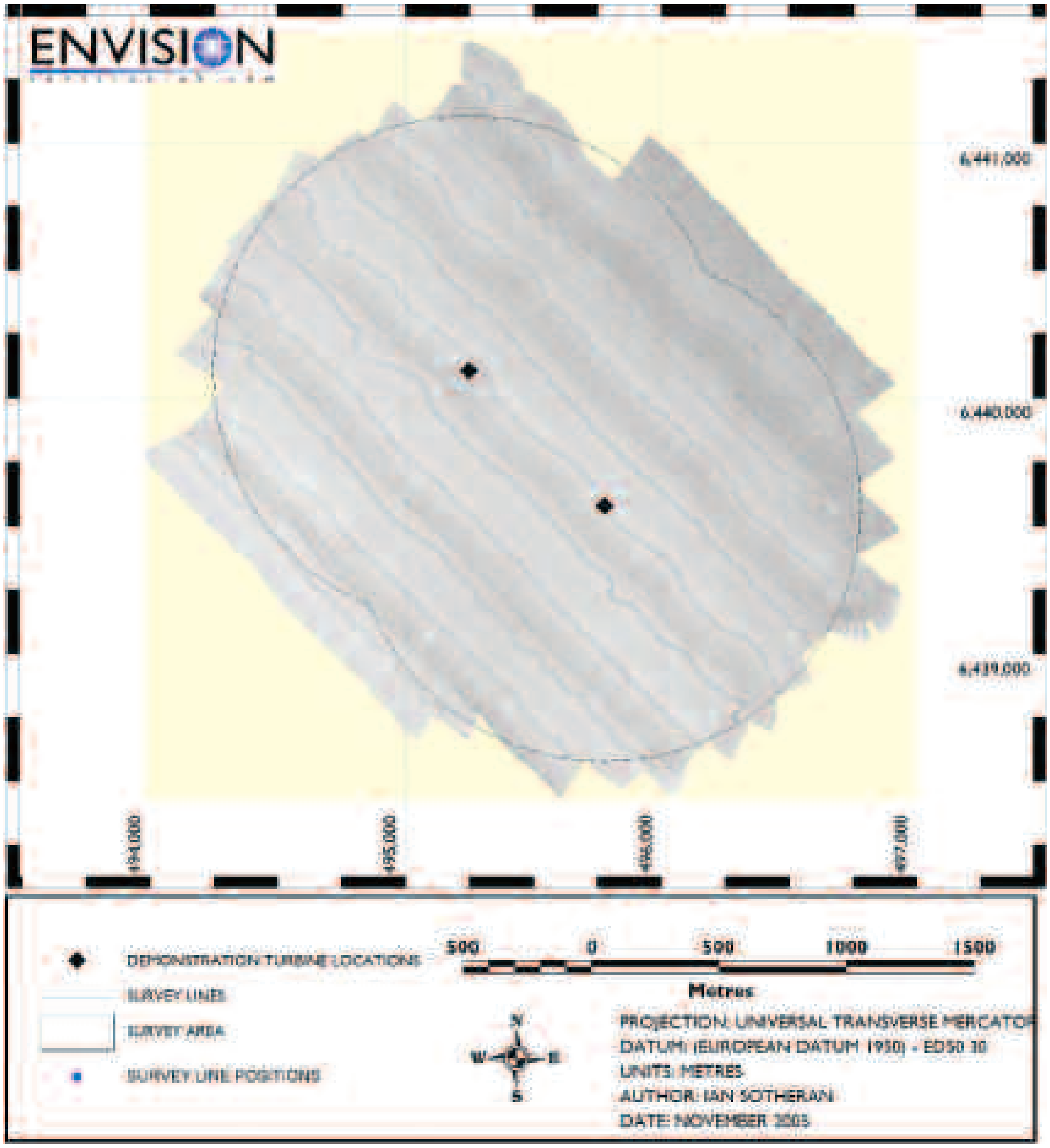
On the Smith Bank, the coarsest sediments (sandy gravels) are found on the shallower north and east flanks, whereas finer sediments occur in the deeper western area (DTI, 2004a; Holmes *et al.*, 2004). In water depths <40m on the Smith Bank the sediments are moderately to poorly sorted, fine to medium sands, with uniformly low mud content (1.4% to 2.4%) and variable gravel contents (Geoteam 1981, 1990 and 1991).

The AGDS and sidescan sonar data obtained during the site-specific survey of the Demonstrator site (Figure 4.7) indicate a slightly coarser seabed in the north eastern area and softer sediments to the south-east and north-west. Overall, there is little variation indicated in seabed type over the site and no anomalies or features of interest were identified.

Information derived form the subsea videos taken during deployment of the Day grab showed a similar lack of variation, and confirmed the absence of apparent anomalies.

These analyses confirmed the absence of any beds of *Modiolus modiolus,* and only one juvenile individual was found in grab samples. All five video clips taken showed the seabed to consist of fine clean sand with shells and broken shell material, and the occasional presence of hydroids, and individual specimens of common whelk *(Buccinum undatum)* and scallop *(Pecten maximus).*

Figure 4.7 Side scan sonar image of the sea bed at the Beatrice Wind Farm Demonstrator site, showing sand ripples running in a north-west to south-east direction (ERT, 2005).



The results of particle size analysis of the sediment samples taken during this survey show close agreement with the field observations, and confirm that the predominant sediment type over the survey area is clean fine sand with broken shell material. The silt/clay content (particles $<63\mu m$) varied from approximately 3% to 4.5%. Typical views of the seabed, obtained from the video footage, are shown in Figure 4.8.

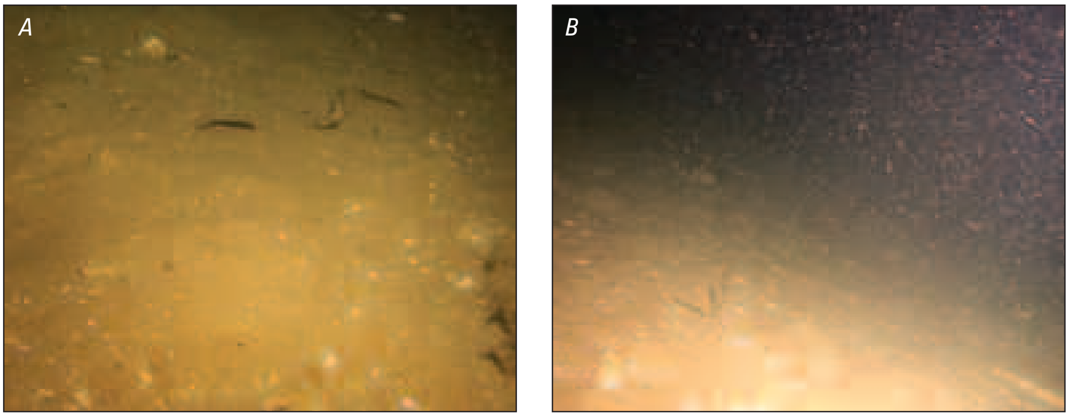


Figure 4.8 (A): A view of Station 6 showing a 50-75cm wide area of the seabed, which consists of sand with shell and some silt. Hydroids are seen on larger pieces of shell, and there is one common whelk Buccinum undatum.
(B): A view at the intended location of WTG 2 showing a 1.5m wide area of the seabed, which consists of sand with shell and silt. A specimen of the scallop Pecten maximus is also present. (ERT, 2005).

4.3 SEABED ENVIRONMENT

4.3.1 SEDIMENT BIOLOGY

Benthic communities comprise the animals living on the seabed *(epifauna)* and those living in the seabed sediment *(infauna).* Several studies have examined the characteristics of benthic communities throughout the North Sea, including a comprehensive assessment by the ICES Benthos Ecology Working Group (Künitzer *et al.*, 1992). Information about the benthic communities in and around the site of the proposed Demonstrator Project is derived from these general studies, and from site-specific seabed monitoring programmes that have been conducted around the Beatrice field and the Demonstrator site

Infauna

With the exception of the Smith Bank (McIntyre, 1958; Hartley and Bishop, 1986) and the Beatrice field (Hartley and Bishop, 1986), there have been few studies of the offshore benthic habitats of the Moray Firth. Hartley and Bishop (1986) described the benthic fauna of the Beatrice area from surveys undertaken in 1977, 1980 and 1981, and from previously published information.

Variations in the water depth (33m to >60m) over the area were mirrored by sedimentary and faunal gradients. Sediments ranged from very fine, through fine to medium sands and were inhabited by faunal communities characterised by mollusc species such as *Thyasira flexuosa, Fabulina fabula* and *Moerella pygmaea.* Two fine-sand communities were distinguished, typified by the abundance of *Thyasira flexuosa* in muddier sediments and *Crenella decussata* in coarser deposits. Localised patches of shell gravel were characterised by reduced densities of *Fabulina fabula* with elevated numbers of polychaete worm species such as *Scoloplos armiger* and *Lumbrineris gracilis.* Comparison of these data with earlier reports (McIntyre, 1958) suggested a degree of long-term persistence of the fauna in qualitative and quantitative terms.

A seabed survey conducted at the Beatrice field for BP Exploration in 1992 (AURIS, 1992) indicated that undisturbed communities were dominated numerically by the polychaete worms *Spiophanes bombyx* and *Scoloplos armiger*. On behalf of Shell, other biological surveys have been undertaken at exploration sites north of Beatrice in Block 11/25 (Hartley Anderson, 2000). The infaunal communities described from these surveys were similar to those found at Beatrice and the Smith Bank (described by Hartley and Bishop, 1986), being characterised by the bivalves *Thyasira* spp., *Crenella decussata* and *Goodallia triangularis.*

In the Outer Moray Firth the numerically dominant taxa include the polychaete worm *Galathowenia oculata,* the amphipods *Ampelisca tenuicomis* and *Harpinia antennaria* and the echinoid *Echinocyamus pusillus;* the polychaete *Peresiella clymenoides* are also widely distributed. On the Smith Bank, the dominant taxa are characteristic of fine sand and include the amphipods *Bathyporeia elegans* and *B. guilliamsoniana,* the polychaetes *Spiophanes bombyx* and *Ophelia borealis*, the bivalve molluscs *Moerella pygmaea* and *Abra prismatics* and echinoid *Echinocardium cordatum* (DTI, 2004a).

Epifauna

The epifauna of the Moray Firth is characterised by sponges, the bryozoan *Flustra foliacea,* the anemone *Bolocera tuediae,* and the crab *Hyas coarctatus.* Boulder "islands" on sand or gravel are found within the Smith Bank and the Inner Moray Firth, and have a diverse hydroid fauna (Basford *et al.*, 1989; 1990). The horse mussel *Modiolus modiolus* is common throughout the Moray Firth, and various hydroids, bryozoans and barnacles are associated with the substrate provided by living and dead *Modiolus* shells (Basford *et al.*, 1989; 1990).

The cold water coral *Lophelia pertusa* has been observed on several oil installations in the North Sea (Bell and Smith, 1999; BMT Cordah, 2004), and may occur on suitable substrates in the Outer Moray Firth. A dead fragment of *Lophelia* has been found in the south eastern Moray Firth (Wilson, 1979), but may have been discarded by a fishing vessel. At present there is no evidence to suggest that this species has established colonies of conservation interest in the Moray Firth (DTI, 2004a).

4.3.2 BENTHIC COMMUNITIES AT THE DEMONSTRATOR SITE

The site-specific survey completed in November 2005 recorded a total of 233 macrofaunal taxa from nine sampling stations (poor weather curtailed the survey, and macrofauna at the other stations was not sampled). The number of taxa ranged from 62 to 725 from each replicate and from 519 to 1,004 from each station. Diversity, as measured by the Shannon-Weiner information function and Pielou's evenness index, was uniformly high at all stations and in all samples. Values for the Shannon-Weiner information function ranged from 5.17 at station 4, to 5.78 at station 5 (Table 4.5), reflecting the high species richness across the survey area, whilst values for the Pielou evenness index varied from 0.77 to 0.87 at the same stations, indicating that the fauna was not dominated by any one species.

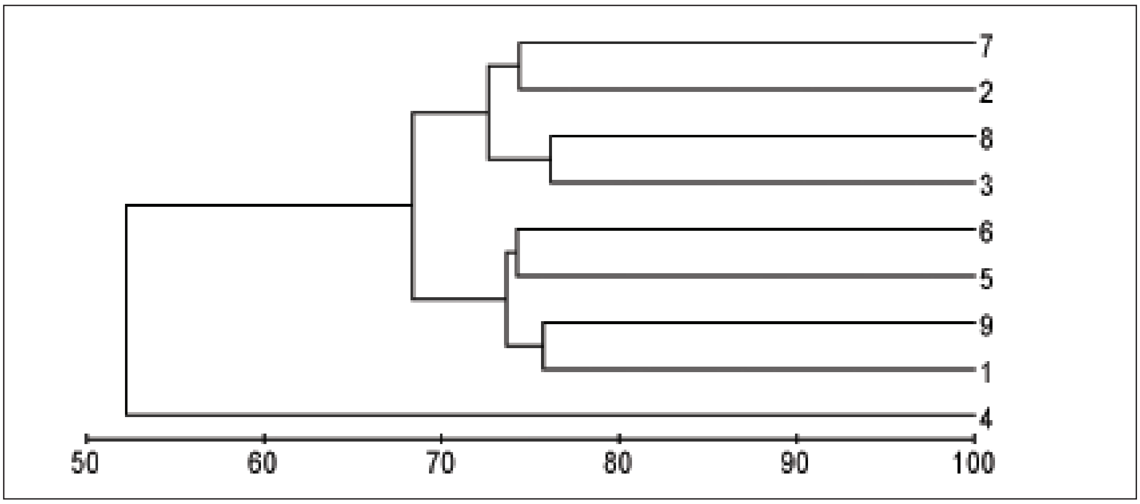
Table 4.5 Summary of benthic community statistics for nine stations (per 0.2m²) from the October 2005 survey of the Demonstrator site (ERT, 2005).

Station	No of species	No of individuals	Shannon-Wiener diversity function	Pielou evenness index
1	98	519	5.48	0.83
2	106	727	5.59	0.83
3	100	646	5.51	0.83
4	105	1004	5.17	0.77
5	102	609	5.78	0.87
6	100	702	5.66	0.85
7	99	558	5.67	0.86
8	105	846	5.50	0.82
9	106	822	5.59	0.83

In numerical terms polychaetes were dominant, although crustaceans and molluscs were also well represented. The macrofauna appears diverse and relatively uniform across the survey area, and is characterised by the polychaetes *Chaetozone setosa, Lumbrineris gracilis* and *Exogone hebes,* the amphipods *Urothoe elegans, Ampelisca tenuicornis* and *Bathyporeia* spp., the bivalve mollusc *Fabulina fibula* and the small sea urchin *Echinocyamus pusillus.* While station 4 featured particularly high numbers of the sabellid polychaete *Jasmineira caudata,* as well as other species in smaller numbers that might be expected due to the high coverage of the sea bed here with old shells (such as the squat lobster *Galathea intermedia,* the chiton *Leptochiton asellus* and the brittle star *Amphipholis squamata*). No individuals of *Modiolus modiolus* were recorded from any station

Analysis using multivariate clustering procedure indicates a 50% similarity for all stations, but that within this, stations 1-3 and 5-9 cluster much more tightly at a similarity level of nearly 70%. It is also possible to pick out a trend based on the geographical proximity of stations: i.e. stations 1, 5, 6 and 9 on the western side of the survey grid have been grouped together, as have stations 2, 3, 7 and 8 representing the eastern and central stations (Figure 4.9). Station 4 is an outlier on the basis of slight differences in the macrofauna present as noted above.

Figure 4.9 Hierarchical agglomerative clustering of samples on log(x+1)-transformed macrobenthos station abundance data, for the Beatrice Wind Farm Demonstrator sites, November 2005.



Cluster analysis of the replicate samples indicated that most of the replicates from each station were similar, with the exception of the two replicates from station 4. It is noticeable that replicates from the same location do not cluster together, and the implication of this is that within-station variability is greater than between-station variability

4.3.3 METALS AND HYDROCARBONS IN SEDIMENTS AT THE DEMONSTRATOR SITE

Historical discharge of cuttings at Beatrice

The drilling of development wells at Beatrice AD over the period 1978 to 1990 resulted in the permitted discharge of cleaned oily cuttings onto the seabed. In total, 13 wells were drilled with water-based mud, and 18 with low toxicity oil-based mud (Hartley Anderson, 2000), and it is estimated that this resulted in the discharge of 21,000 tonnes of cuttings with approximately 913 tonnes of oil (Watson, 1995). The cuttings accumulated on the seabed under and around Beatrice AD, forming a cuttings "pile".

Contamination of seabed sediments by oily cuttings can result in the creation of a modified benthic invertebrate community, typically dominated by high densities of disturbance-tolerant species such as the polychaete *Capitella capitata*.

State of sediments at the Demonstrator site

Carbonate content varied from 8.64% at station 1, to 23.56% at station 4. Overall, carbonate content appeared to be highest at stations 3, 4 and 8 on the eastern side of the survey grid, probably indicating a relatively high contribution to these sediments from old shell material. Organic matter content in the sediment was generally low, varying between 0.36% and 1.53% and with no particular distribution pattern evident.

The concentrations of metals from the two stations analysed (Table 4.6) were similar and, therefore, suggest a relatively uniform sediment type over the survey area.

Table 4.6 Comparison of sediment heavy metal concentration for two stations at the Beatrice Wind Farm Demonstrator site with offshore sediments in the North Sea at distances >5,000m from oil and gas installations (SEA 2).

Heavy metal	Beatrice survey mean metal content	Offshore sediments in the North Sea	Oil and gas installations
THC (μg g^{-1})	3.55	17-120	10-450
PAH (μg g^{-1})	0.029	0.2-2.7	0.02-74.7
Mercury (mg/kg)	0.002	0.16	0.1-33
Vanadium (mg/kg)	6.385		
Barium (mg/kg)	11.1		86,000
Strontium (mg/kg)	107		
Iron (mg/kg)	2303.5		40,000
Arsenic (mg/kg)	1.245		
Cadmium (mg/kg)	<0.01	0.43	0.1-8
Chromium (mg/kg)	7.645		
Copper (mg/kg)	0.922	3.96	110
Lead (mg/kg)	4.23		16-173
Manganese (mg/kg)	28.4		
Nickel (mg/kg)	1.295	9.5	1-49
Zinc (mg/kg)	4.46	20.87	2-435

Hydrocarbons

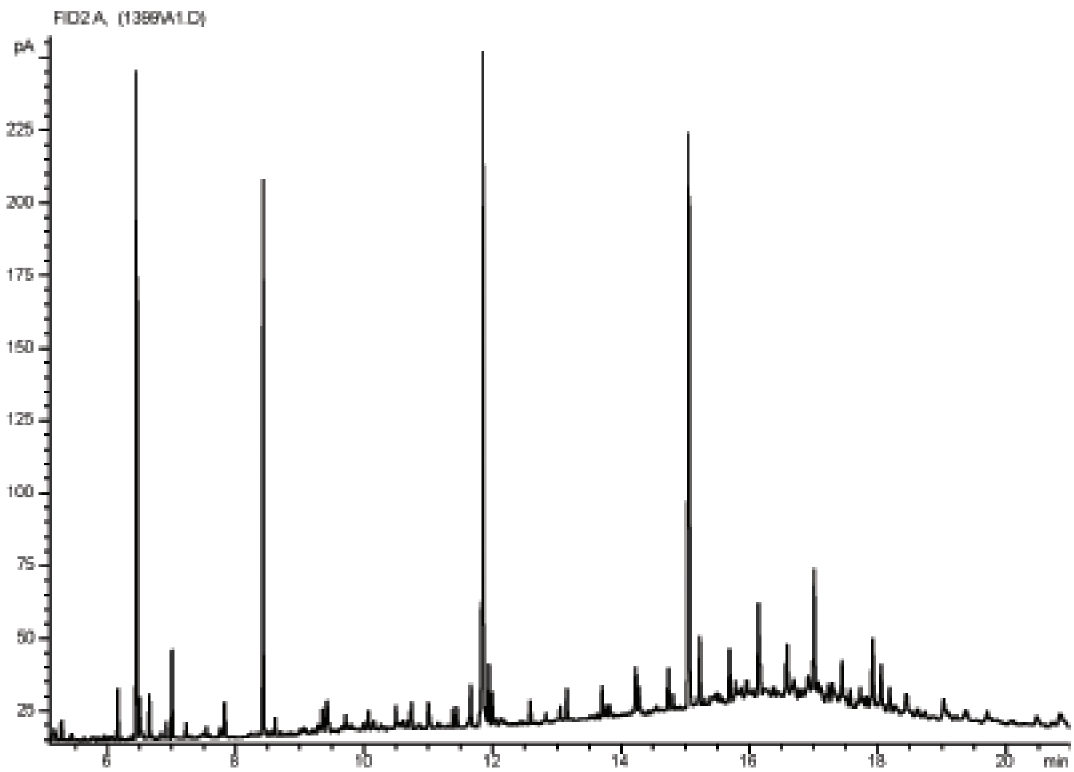
The total hydrocarbon content (THC) of benthic sediments at stations 2 and 6 was low, ranging from 3.4 to 3.7μg.g^{-1}. The quantity of unresolved complex mixture (UCM) at each station was similarly low, ranging from 2.8 to 3.1μg.g^{-1}. These figures are lower than the background levels quoted for the adjacent area of the North Sea in the 1993 North Sea quality status report (North Sea Task Force, 1993), and also lower than the mean background level for area over the period 1975 to 1995 (UKOOA, 2001).

The results of Poly Aromatic Hydrocarbon (PAH) analysis indicate low levels of these compounds in this part of the Beatrice field, and are lower than the background reference concentration levels quoted for the greater North Sea by OSPAR (2000).

The gas chromatography traces from the two stations analysed (Figure 4.10) are very similar, and indicate a hydrocarbon content characteristic of marine sediments that are remote from significant anthropogenic inputs.

The UCM in these samples is very small, but indicative of diffuse and weathered historic inputs of oil from shipping and industry. The dominant features are the resolved n-alkane peaks which, in both cases here, result chiefly from terrestrial plant run-off.

Figure 4.10 GC trace for station 2, Beatrice Wind Farm Demonstrator Site (ERT, 2005).



Overall conclusions from the seabed survey of the Demonstrator site

The sediment concentrations of both metals, including barium, and hydrocarbons are consistent with levels that would be considered background concentrations for the UK North Sea. The hydrocarbon content appeared characteristic of marine sediments that are remote from significant anthropogenic inputs. The dominant features in the GC traces were the resolved n-alkane peaks, which have resulted chiefly from terrestrial plant run-off. There is no evidence of influence from the exploration and production operations that have taken place in the Beatrice field or at other locations nearby.

The macrofauna is diverse and characterised by the polychaetes *Chaetozone setosa, Lumbrineris gracilis* and *Exogone hebes,* the amphipods *Urothoe elegans, Ampelisca tenuicornis* and *Bathyporeia* spp., the bivalve mollusc *Fabulina fibula* and the small sea urchin *Echinocyamus pusillus.*

No beds of *Modiolus modiolus* were indicated or encountered, and only a single, juvenile specimen of this species was found in the macrofaunal samples.

4.4 PELAGIC ENVIRONMENT

Plankton forms the basis of the marine food chain and comprises microscopic plants (phytoplankton), and animals (zooplankton) which are suspended in the water column and drift with prevailing currents. Zooplankton and some fish species graze on the phytoplankton and, in turn, form the primary diet for many fish species. The composition and abundance of plankton communities vary throughout the year and are influenced by physical parameters such as temperature, salinity and nutrient level.

The plankton community in the Moray Firth is typical of the North British Coastal waters and found over a band from the southern tip of Shetland to about the Humber, roughly delineated by the 100m depth contour in the vicinity of the Moray Firth (Adams, 1987; Hay *et al.*, 1990). The community is characterised by neritic (coastal water) species which are associated with nearshore waters.

Phytoplankton

Phytoplankton account for all the primary production and there are four main groups – picoalgae, flagellates, diatoms and dinoflagellates (Heath *et al.*, 1999).

The standing stocks of phytoplankton in the Moray Firth peak in March to April and again in August to September (Heath *et al.*, 1989). The highest concentrations of phytoplankton in the Moray Firth are found over the Smith Bank (Heath *et al.*, 1989). The phytoplankton population here comprises a mixed diatom/dinoflagellate assemblage of the species *Rhizosolenia shrubsoli, Stephanopyxis turris, Lauderia borealis, Ceratium* spp. and *Peredimium* spp. The most frequently recorded taxa are dinoflagellates *(Ceratium)*, and this is in line with the rest of the North Sea where there is an increasing trend of dinoflagellate dominance (DTI, 2004a).

Zooplankton

The zooplankton comprise a diverse range of herbivores, omnivores and carnivores, which are grouped into four size categories – microzooplankton, mesozooplankton, macrozooplankton and gelatinous zooplankton (Heath *et al.*, 1999).

Zooplankton communities in the Moray Firth are dominated by copepods, including *Centropages hamatus, Temora longicornis,* (Adams and Martin, 1986), *Acartia clause, Pseudocalanus elongatus* (Heath *et al.*, 1989), *Calanus helgolandicus* and *C. finmarchicus* (DTI, 2004a). Copepod abundance reaches a peak in May following the phytoplankton bloom and remains high throughout the summer before declining sharply between September and November.

4.5 FINFISH AND SHELLFISH

4.5.1 INTRODUCTION

The Moray Firth supports a wide range of finfish and shellfish species and communities. Shellfish species are demersal (bottom-dwelling) molluscs and crustaceans such as shrimps, crabs, *Nephrops* (Norway lobster), mussels and scallops. Finfish can be separated into pelagic and demersal species:

- *pelagic species: occur in shoals swimming in mid-water, typically making extensive seasonal movements or migrations between sea areas. Pelagic species include, herring, mackerel, blue whiting and sprat*

- *demersal species: live on or near the seabed. Demersal fish include, cod, haddock, plaice, sandeel, sole and whiting.*

Generally, there is little interaction between fish species and offshore developments. However, some species are vulnerable to offshore activities and discharges to sea. The most vulnerable period is during the egg and juvenile stages of their life cycles. Fish that lay their eggs on the sediment (e.g. sandeels and most shellfish) are susceptible to smothering by discharged solids.

4.5.2 DEMERSAL SPECIES

The most common commercially fished demersal fish in the Moray Firth are sandeels, haddock, cod, whiting, lemon sole, plaice and dab. The main spawning and nursery grounds are illustrated in Figure 4.11. The proposed Beatrice Wind Farm Demonstrator Project would be located in spawning grounds for plaice (December-March), cod (January-April), lemon sole (April-September) and sandeels (November-February).

The Moray Firth contains one of the most important plaice spawning grounds in the northern North Sea, which is centred on the Smith Bank. The Smith Bank is also an important spawning area for cod, which migrate from offshore. The juvenile cod nursery areas are generally on the Scottish west coast and around the Firths of the Forth and Tay (Coull *et al.*, 1998). The Outer Moray Firth is also an important ground for adult, spawning and juvenile lemon sole. Whiting spawn at relatively low densities in the area of the Moray Firth, outwith the vicinity of the proposed Beatrice Wind Farm Demonstrator Project.

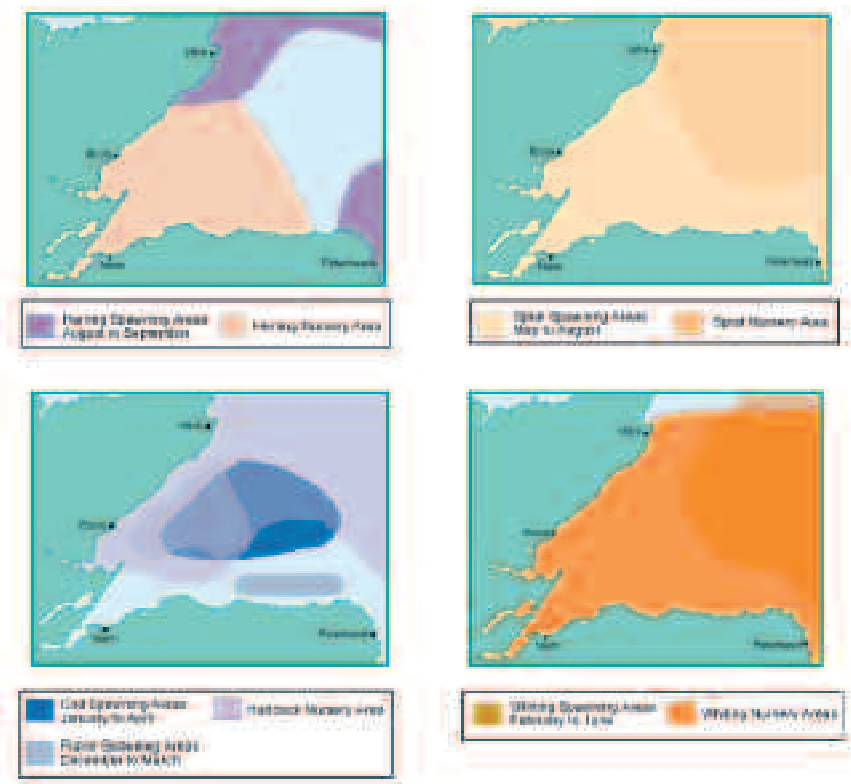
Sandeels are abundant in the Moray Firth living and spawning on suitable sediments. Sandeel eggs are demersal and after hatching, the larvae spend two to four months in the water column before adopting the benthic/hyperbenthic habit of the adults. Due to the hydrographic conditions of the Moray Firth, the eggs and larvae are retained within the Firth.

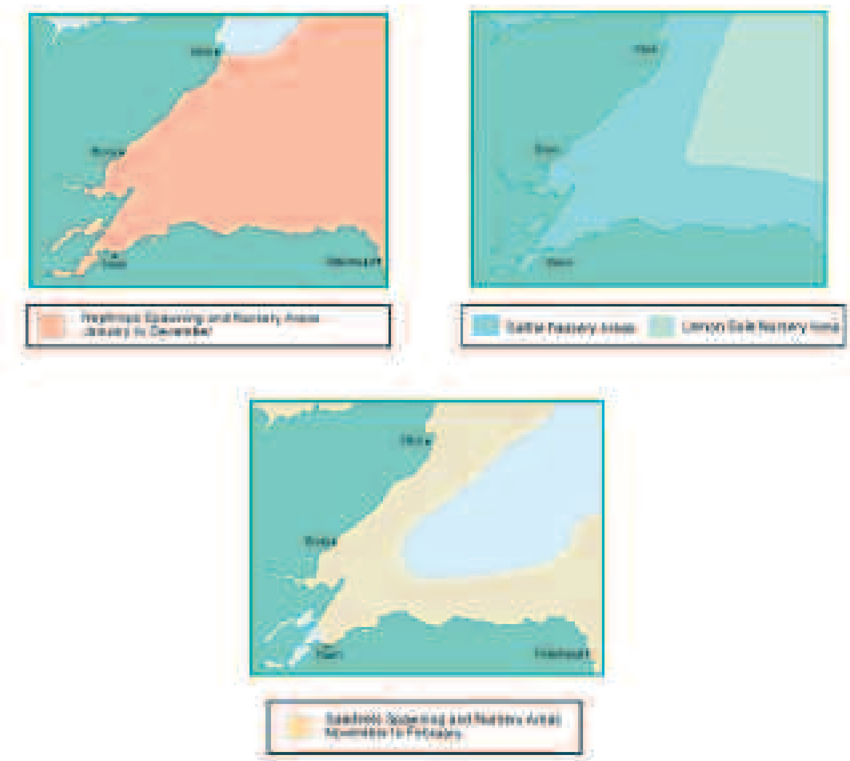
In addition, juvenile haddock, saithe and whiting live within the shallow water areas of the Firth and generally use these as nursery grounds.

4.5.3 PELAGIC SPECIES

Sprat, herring and mackerel are the most abundant pelagic species in the Moray Firth. There are no spawning grounds for pelagic species that coincide with the proposed Beatrice Wind Farm Demonstrator Project. However, herring and sprat have spawning grounds within the Moray Firth area (Figure 4.11).

Figure 4.11 Key fish spawning and nursery areas in the vicinity of the proposed Beatrice Wind Farm Demonstrator Project.





Source: Coull *et al.*, 1998

4.5.4 BASKING SHARKS

In British waters the basking shark has full protection from intentional capture or disturbance (up to 12 miles offshore) under a 1998 listing on the Wildlife and Countryside Act (1981), Schedule 5 and is listed under CITES Appendix III in UK waters. In February 2003, the basking shark was listed on Appendix II of the Convention on International Trade in Endangered Species (CITES). This listing still allows for trade in basking shark products but requires all trade to be closely monitored and a thorough assessment of the sharks biology and ecology. The species is also listed as "Vulnerable" (VU A1ad+2d) under the IUCN Red List (2000) of endangered species (IUCN 2004).

The distribution of basking sharks in British waters is known to be predominantly located along the west coast of the British Isles (MCS, 2005) (Figure 4.12) with peak sightings occurring in May to August. Tagging studies using satellite transmitters tracked the distribution and movement of basking sharks and results indicated that seasonal migration routes were exclusively associated with the continental shelf (Sims *et al.*, 2003). Migrations were found to result in the occupation of habitats with enhanced productivity on both inshore (English Channel and Clyde Sea) and offshore shelf-edge areas (Pingree *et al.,* 1975, Adams 1986, Le Fevre 1986). The principal prey of basking sharks, calanoid copepods, are known to over-winter in these shelf and shelf-edge deep waters (100 to 2200m) (Hirche 1983, Williams & Conway 1984, Heath *et al*., 2000). Mating behaviour in basking sharks is known to occur between May and July (Sims *et al*., 2000) during which time individuals also congregate along oceanographic fronts in rich patches of prey, suggesting that frontal areas are important for basking sharks to locate mates as well as food in the pelagic ecosystem (Sims *et al.,* 2000).

Studies conducted by the Marine Conservation Society over the past 17 years indicate an increase in the numbers of basking sharks sighted in British waters (Figures 4.12a and 4.12b). Patterns of increased sightings reveal a 65% increase in Scottish waters between 2001 and 2004, the majority of these increased sightings were located on the west coast of Scotland. On the east coast of Scotland data from the MCS indicate that no basking sharks were recorded in the Moray Firth or surrounding area between 1993 and 1998, whilst in more recent years

(1999 to 2004) a few individuals have been recorded in the Moray Firth (MCS June 2005). Sightings recorded by MCS between April and November 2005 indicate that there have been seven sightings of basking shark in the Moray Firth, but these sighting were all confined to the southern Moray coast with three of the seven sighting in the outer Moray Firth (MCS, 2005). The evidence therefore indicates that the proposed site for the off-shore wind farm in the Moray Firth is not an important area for basking sharks during feeding and mating or during periods of migration, and so the effects of the Demonstraotor WTGs on this species are likely to be minimal.

Figure 4.12 Map of UK Basking shark sightings a) 1993 to1998, b) 1999 to 2004. (MCS, June 2005).

4.5.5 SHELLFISH

Crustacean species found within the Moray Firth include *Nephrops* (Norway lobster), scallops, pink shrimp, European lobster, edible crab, velvet crab and shore crab (Figure 4.13). Molluscan species include king scallop, cockles, mussels, whelk and periwinkles (DTI, 2004a).

Nephrops are abundant in the mud and muddy sands of the Moray Firth and are an important shell fishery in the area. The grounds occupied by *Nephrops* are mainly in the Inner Firth and within the vicinity of the proposed Beatrice Wind Farm Demonstrator Project. The spawning season occurs from January to December with peak spawning from April to June.

Edible crabs *(Cancer pagurus)* are common and widely distributed around the coasts and offshore in the Moray Firth and are commercially fished, mainly by creels (potting). Creels are also set for lobsters *(Homarus gammarus),* which are also common in the Moray Firth and mainly occur offshore on rocky beds within dense seaweed cover.

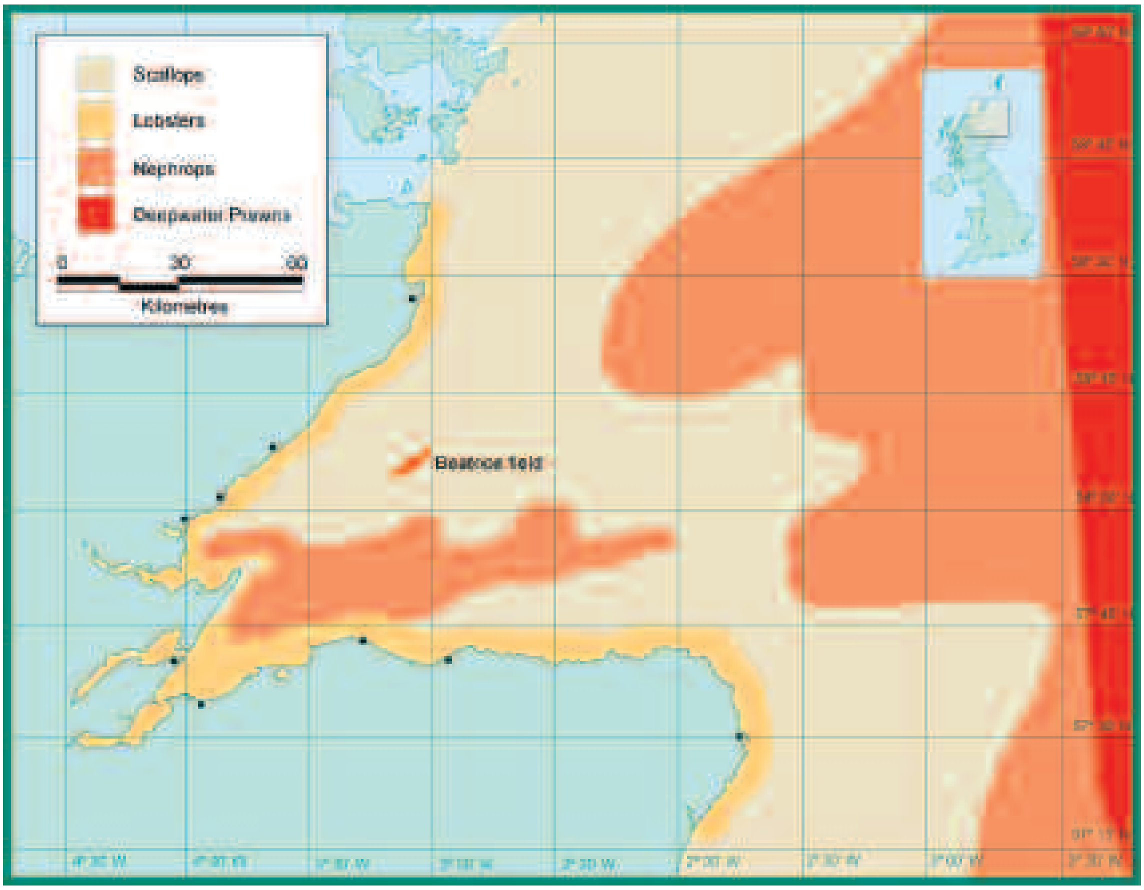
Scallops and queen scallops can be found on the widespread sandy, gravely and muddy sediments of the Moray Firth, generally in waters 50m or less. The Smith Bank has been identified as one of the most important scallop fishing grounds in the Moray Firth, and there are other scallop fishing grounds off the north-west coast between Wick and Golspie and a small patch just west of Lossiemouth on the south coast.

Exploitable populations of cockles are found in the intertidal mud and sandflats of the Dornoch and Cromarty Firths. Mussels are found in the eulittoral and sublittoral zone in particularly important areas such as the Dornoch, Cromarty, Inverness and Beauly Firths (DTI, 2004a).

Other shellfish common to the Moray Firth include, edible winkles *(Littorina littorea),* edible mussels *(Mytilus edulis),* whelks *(Buccinum undatum),* razorfish *(Ensis siliqua and E. arcuatus),* and cockles *(Cerastoderma edule)* (Barne *et al.*, 1996).

Fifteen species of cephalopod have been recorded in the Moray Firth; squid *(Loligo forbesi)* are abundant in the Moray Firth and also form a profitable by-catch of trawling and are a targeted fishery in late summer. Octopus *(Eledone cirrhosa)* is also a marketable by-catch (DTI, 2001a).

Figure 4.13 Distribution of shellfish in the Moray Firth (FRS, 2005).



4.5.6 DIADROMOUS SPECIES

Within the Moray Firth there are five common species that migrate between fresh and salt waters. These are Atlantic salmon, sea trout, river lamprey, sea lamprey and eel.

Salmon and sea trout spend the early part of their lives in freshwater, and then migrate to sea before returning to their river of origin to breed. The north-east coast of Scotland has several rivers which are important to such species, a number of which have been designated as SACs for their populations of Atlantic salmon *Salmo salar* (Table 4.7 and Figure 4.14). In addition, the District Salmon Fishery Boards (DSFB) responsible for the Spey, Moriston, Oykel and Cassley SACs secured EU LIFE funding in partnership with SNH for the "Conservation of Atlantic Salmon in Scotland LIFE Project". This will run until 2008 and aims to improve access to the upper reaches of rivers so that fish can spawn, to install fish counters, and for the purchase of sweep netting rights (Butler, 2004).

Parr (young salmon) become smolts (migratory juvenile salmon) in their second, third, or fourth year of life and migrate to the sea in April, May and June (Mills and Graesser, 1992).

Typically, salmon of two, three or more sea-winters return to their rivers from February to May, whereas the one-sea winter grilse (salmon which have matured at sea) tend to return mainly between June and August (Shearer, 1992). During the return migration to their home rivers, salmon move in a southerly direction following the coastline of the Moray Firth. A proportion of the population may travel diagonally across the Moray Firth passing by Wick and Fraserburgh (Shearer, 1992).

In 2003 the all-method (net and rod) catch of wild salmon (multi-sea winter fish) and grilse (one-sea winter fish) in the Moray Firth was 17,876 which represented 21% of the total Scottish catch of 85,615. In 2002, the Moray Firth catch represented 24% of the Scottish catch. Rod catches alone reached 16,960 salmon and represented 32% of the total Scottish rod catch.

Following the reduction of the netting industry in the late 1980s, the in-river abundance of salmon appeared to increase in the early 1990s. Since this period there has been a decline in salmon stocks, where runs have decreased by 59% since peak abundance in 1979 (Butler, 2004). Despite this decline, however, monitoring of the Moray Firth rivers suggests that in general sufficient spawners are returning to exceed Conservation Limits, maintaining optimum smolt production. However, there is concern that egg deposition may not be maintaining optimal smolt output and recruitment in upper-catchment areas of the Moray Firth (Butler, 2004).

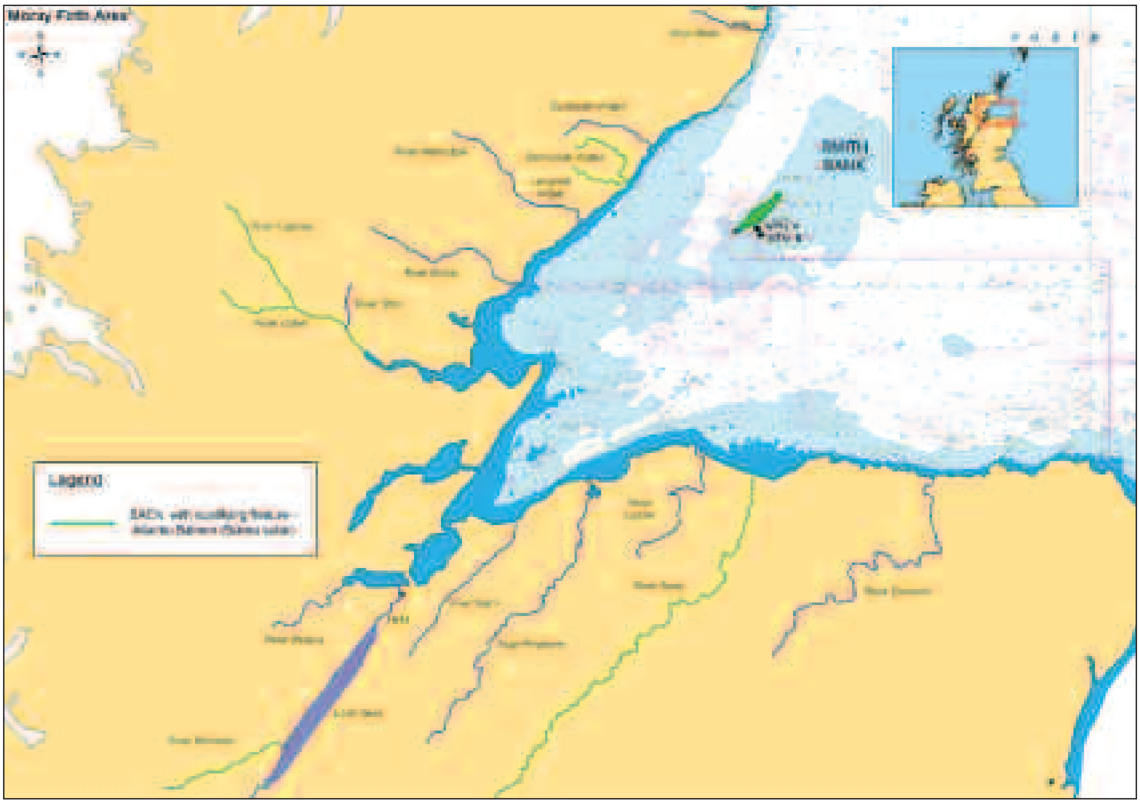
Sea trout are the anadromous form of the brown trout and under the Salmon Act 1986 are also managed by DSFBs. Sea trout also return to their natal rivers to spawn after feeding and maturing at sea, and within the Moray Firth sea trout catches tend to be variable from year to year. Between 1952 and 2003 net and rod catches ranged from 5,202 to 44,329. However, since the reduction of netting effort in the late 1980s, rod catches during the 1990s declined, which perhaps indicates a declining abundance and there is still concern regarding sea trout stocks (Butler, 2004).

Other migratory fish include the river lamprey *(Lampetra fluviatillis),* sea lamprey *(Pteromyzon marinus)* and eels. The River Spey supports important numbers of sea lamprey, and this is the primary reason for the selection of the River Spey as SAC (Section 4.1). Eels are present in most, if not all, of the river systems along the Moray Firth coastline (DTI, 2004a), but there is no tradition of exploiting them in Scotland.

Table 4.7 Key rivers in the north east of Scotland for diadromus species and numbers of salmon caught and retained in 2004 [Source: Mills and Graesser, 1992; FRS, 2005].

	River System	Conservation Designation	No of fish caught and retained	
			Salmon	Grilse
1	Wick	None	184	711
2	Dunbeath	None		
3	Berriedale	**SAC** Qualifying feature Atlantic salmon *Salmo salar*		
4	Langwell		No data	No data
5	Helmsdale	None	571	350
6	Brora	None	309	113
7	Shin	None	No data	No data
8	Cassey	**SAC** Qualifying feature Atlantic salmon *Salmo salar*	No data	No data
9	Oykel		No data	No data
10	Beauly	None	262	422
11	Moriston	**SAC** Qualifying feature Atlantic salmon *Salmo salar*	No data	No data
12	Ness	None	738	820
13	Loch Ness	None	No data	No data
14	Nairn	None	173	632
15	Findhorn	None	889	722
16	Lossie	None	16	188
17	Spey	**SAC** Qualifying feature Atlantic salmon *Salmo salar*	1,984	1,264
18	Deveron	None	1,551	1,283

Figure 4.14 Map Showing the key rivers important for salmon [Source: Mills and Graesser, 1992; Butler, 2004].



4.6 MARINE MAMMALS

4.6.1 CETACEANS

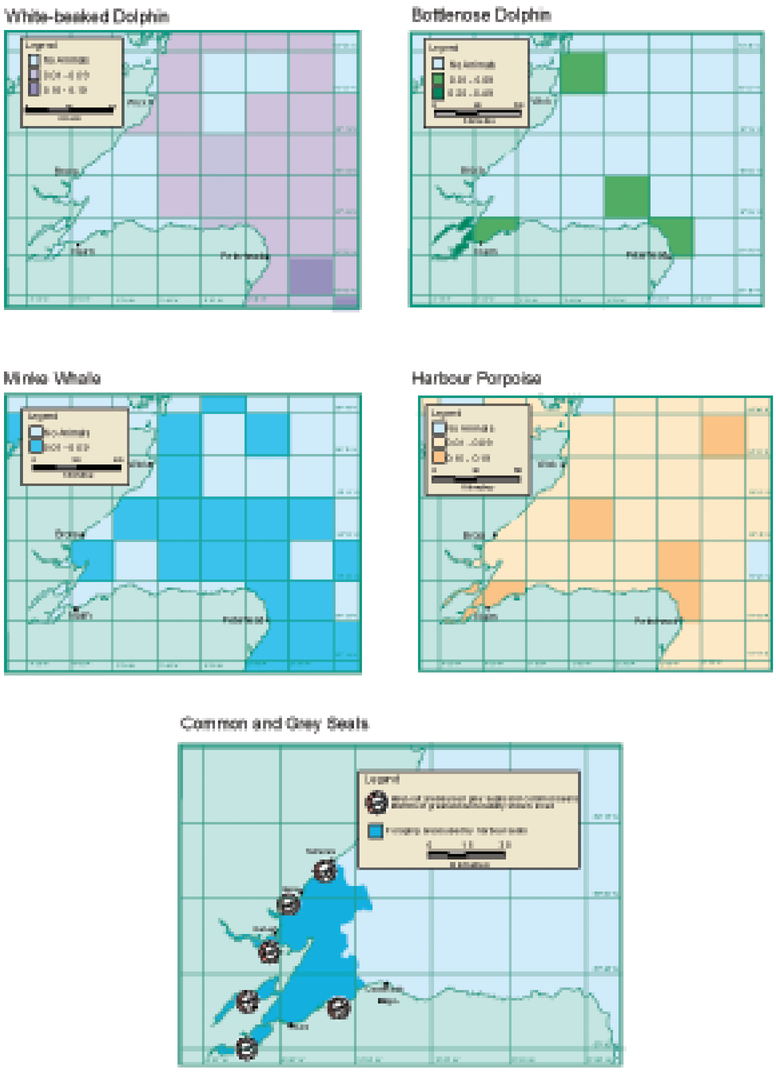
The Moray Firth is used by a variety of marine mammal species. Several occupy the Firth all year round while others occur on a seasonal or sporadic basis (Figure 4.15).

The common species of marine mammal in the Moray Firth are white-beaked dolphins *(Lagenorhynchus albirostris),* harbour porpoises *(Phocoena phocoena),* bottlenose dolphins *(Tursiops truncatus),* and minke whales *(Balaenoptera acutorostrata).* The majority of these species occur all year round, but abundances for all species are highest in the summer months (Evans *et al.*, 1992; Wilson *et al.*, 1997; UKDMAP, 1998; Reid *et al.*, 2003). It must be noted, however, that reliable data on relative abundance in different seasons is limited, except for inshore areas (Paul Thompson, *pers comm.,* 2005).

The harbour porpoise is the most numerous marine mammal species in the Moray Firth and its adjacent waters (Mudge *et al.*, 1984; Hammond *et al.*, 2002). It is a protected species and is included on the OSPAR Initial List of Threatened and/or Declining Species and Habitats (DTI, 2004a). Harbour porpoise and bottlenose dolphin are also included in Annex II species list of the EU Habitats Directive (92/43/EEC), currently under consideration for identification as possible SACs in the UK offshore waters (JNCC, 2002).

The Moray Firth has a resident population of bottlenose dolphins, one of only two such populations in the UK. The designation of the Moray Firth as a SAC is based on this internationally important population. Individuals are most frequently found within the Inner Moray Firth, particularly the Kessock Channel, the Chanonry narrows and around the mouth of the Cromarty Firth, but over the years the species' range has extended south to waters off Aberdeen, St. Andrews Bay and the Firth of Forth (Wilson *et al.*, 2004).

Figure 4.15 Distribution of marine mammals in the Moray Firth.



Several other cetacean species are sighted less frequently, because they use the Moray Firth seasonally and occasionally. These are the common dolphin *(Delphinus delphis),* striped dolphin *(Stenella coruleoaba),* Atlantic white-sided dolphin *(Lagenorthynchus acutus),* Risso's dolphins *(Grampus griseus),* pilot whale *(Globicephala melas),* killer whale *(Orcinus orca),* fin whale *(Balaenoptera physalus)*, sei whale *(Balaenoptera borealis)* and humpback whale *(Megaptera novaeangliae)* (CRRU, 2004).

4.6.2 PINNIPEDS

British populations of grey seal *(Halichoerus grypus)* and common seal *(Phoca vitulina)* represent 40% and 39% respectively of the total world populations of these species (UK SCOS, 2004).

A significant proportion of the Inner Moray Firth population of common seal is found in the Dornoch Firth, and represents almost 2% of the UK population (JNCC, 2004). Common seals use sand-bars and shores at the mouth of the estuary as haul-out and breeding sites (JNCC, 2004). Generally it has been accepted that common seals forage relatively close inshore within a range of 60km from their haul-out sites (Thompson *et al.*, 1996). However, recent information on foraging movements and the distribution at sea of common seals has highlighted greater travel distances, ranging from 10km to 120km, with a mean of 46km. Duration of trips ranged from a few hours to 23 days, with a mean of 4.5 days (Hammond *et al.*, 2002). Though foraging by common seals in the Moray

Firth was mostly closer to shore than those located in Orkney and Shetland, it has now been accepted that common seals travel more widely than previously thought and would be likely to be in the vicinity of Beatrice, especially during winter.

Grey seals generally form breeding colonies on rocky shores, beaches and in caves in areas such as the Moray Firth, and on small, largely uninhabited, islands (JNCC, 2004). The journeys undertaken by grey seals fall into two categories: long and distant travel (up to 2,500km) to known haul-out sites; and local but repeated trips from haul-out sites to offshore locations. The offshore locations are often characterised by gravel/sand seabed sediment. This is the preferred burrowing habitat of sandeels, an important component of the grey seal diet, which implies that these locations are foraging sites. Grey seals limit their foraging excursions to no more than 60km and such excursions are typically two to three days in duration (Hammond *et al.*, 2002).

Figure 4.16 Distribution of grey seal around the UK [Source: Hammond et al., 2002].

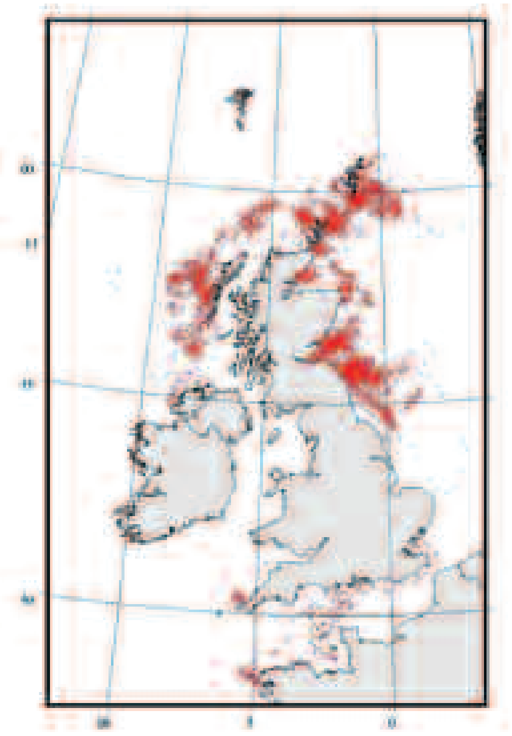
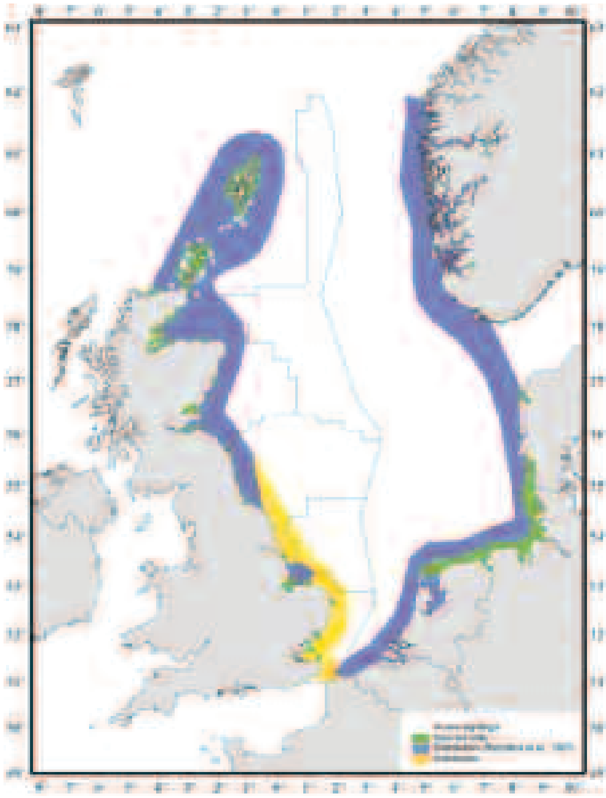


Figure 4.17 Distribution of common seal around the UK [Source: Hammond et al., 2002].



4.6.3 PRESENCE OF DOLPHINS AND HARBOUR PORPOISE IN THE BEATRICE FIELD

Surveys were carried out in 2004 and 2005 to assess the distribution of dolphins and porpoise within the Moray Firth SAC and at the Demonstrator site. This work was partially funded by the EU DOWNiND project, and the preliminary results are reported by Lusseau *et al.*, 2005, from which the following material is derived.

While there is good information on the distribution of bottlenose dolphins in the Inner Moray Firth (Wilson *et al.,* 1997; Hastie *et al.,* 2001; Hastie *et al.,* 2003; Gridley, 2005), there are few data on the offshore distribution patterns of dolphins and porpoises, particularly in those areas where noise levels from the Demonstrator site may be expected to be highest. The existing data suggest that dolphins are rarely found in these areas. Importantly, there is little information on the distribution of bottlenose dolphins across the adjacent SAC for bottlenose dolphins, and it is currently difficult to identify in which areas these animals may be most sensitive to noise disturbance. This study particularly aimed to quantify the spatial and temporal heterogeneity in the way bottlenose dolphins and harbour porpoises use the SAC as well as the area of the Demonstrator Project.

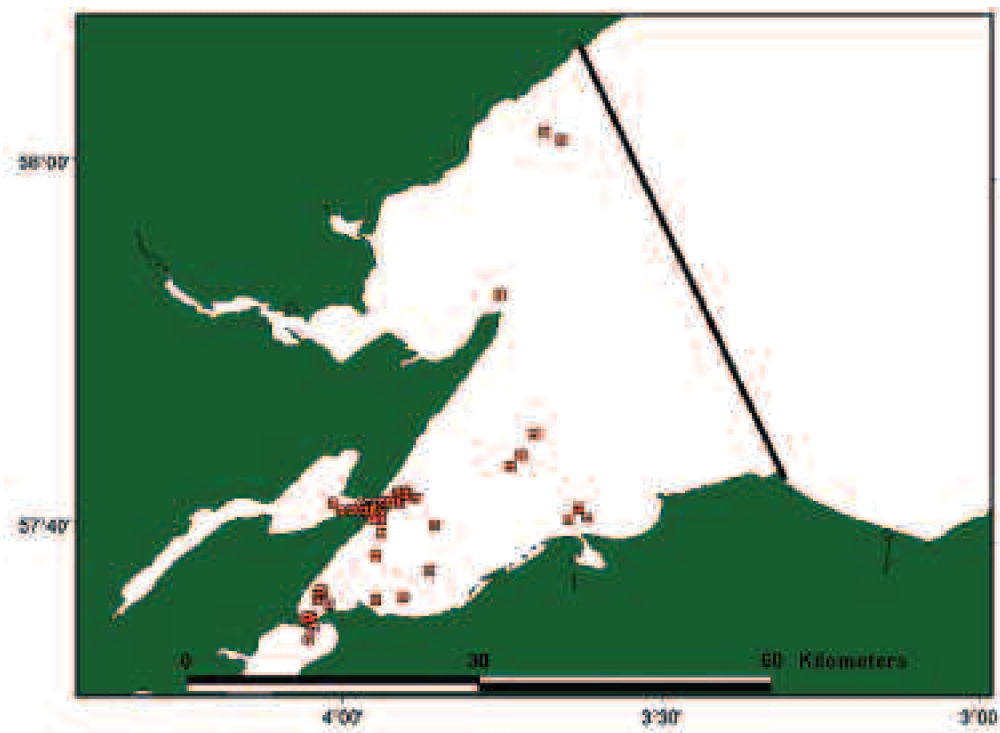
Spatial patterns of cetacean distribution within the Moray Firth were investigated using a combination of visual and passive acoustic boat-based line-transect surveys. The presence of cetaceans in key areas was also recorded over longer periods using acoustic data loggers (TPODS), deployed at two control sites, Lossiemouth and the Sutors in the Cromarty Firth, and one in the Beatrice field. These sites were chosen to assess the effects of the project on the temporal variation in habitat use (two control sites and one site at the proposed wind farm location).

TPODS consist of a hydrophone, a clock and a processor that is programmed to record the emission of echolocation clicks detected by the hydrophone. The TPODS were tuned to be able to discriminate between dolphins and harbour porpoise, but it is worth noting that several other species of dolphins (common, Atlantic white-sided, and white-beaked dolphins) could be encountered in the more offshore waters of the Moray Firth (Mudge *et al.*, 1984). It was, therefore, not possible to determine whether bottlenose dolphins or one of the other species of dolphin were being detected by the TPODS.

4.6.4 SPATIAL DISTRIBUTION ACROSS THE SAC

Combined passive acoustic and visual surveys were carried out in the Inner and Outer Moray Firth during summers 2004 and 2005. Twelve surveys were conducted between August and October 2004, and 15 between April and July 2005, covering a total of 1,930km. A total of 230 marine mammal sightings were logged, and of these 63 were of bottlenose dolphin and 88 harbour porpoise schools. Detailed analyses of these data in relation to local habitat characteristics are underway, but initial inspection of the raw sightings data indicate that bottlenose dolphins tend to remain close to inshore, with both the Chanonry Narrows and the mouth of the Cromarty Firth representing "hotspots" for sightings hotspots (Figure 4.18a). In contrast, harbour porpoise sightings were more diffuse and this species was regularly seen further offshore (Figure 4.18b).

Figure 4.18a Sightings of bottlenose dolphin during surveys in 2004 and 2005.



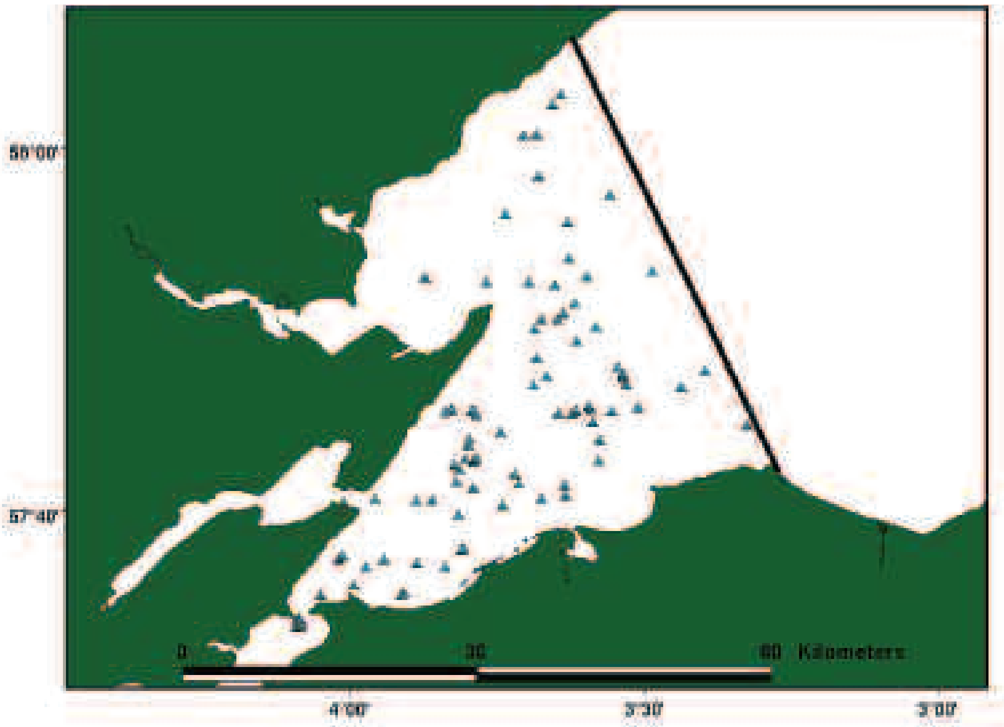


Figure 4.18b Sightings of harbour porpoise during surveys in 2004 and 2005.

4.6.5 TEMPORAL USE OF THE SITES BY DOLPHINS

As expected the Sutors site was often visited by bottlenose dolphins (five to six visits per day) and visits lasted close to an order of magnitude longer than those at the Lossiemouth site. The Lossiemouth site was more rarely visited by bottlenose dolphins (less than one visit per day). Deployment at the Beatrice site showed that dolphin species are more rarely visiting the area but are still present regularly (Figures 4.19 and 4.20). The visiting pattern at Beatrice seemed to be composed of long bouts without visits (100 to 200 hours) followed by burst of activity (>1 visit per day). The visits to Beatrice were shorter than those at other sites.

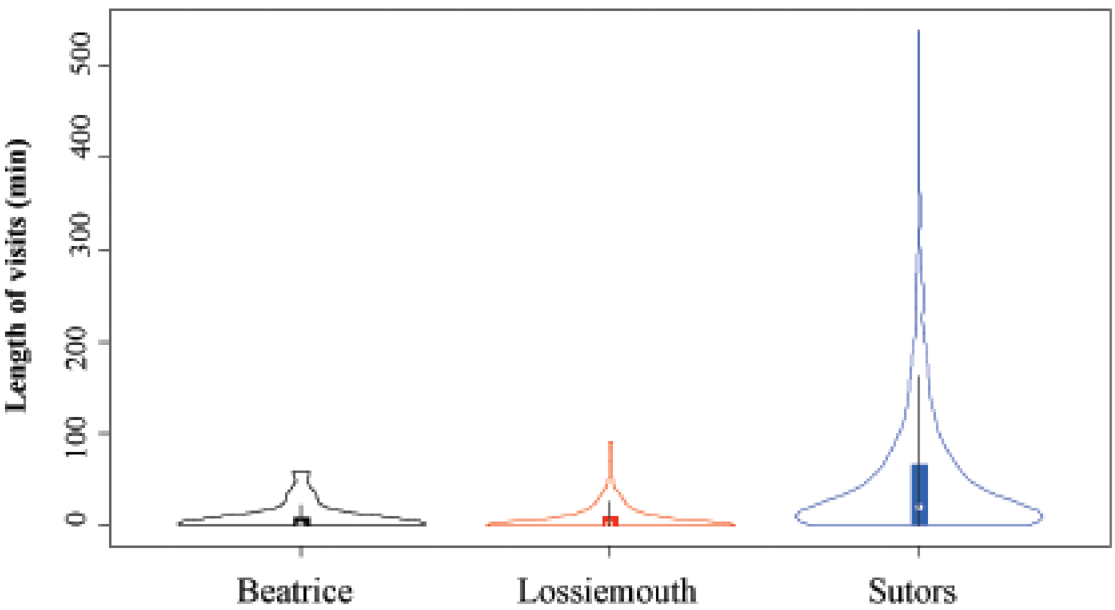


Figure 4.19 Summary of dolphin visit lengths (in minutes) at each site displayed as violin plots. Each plot is composed of a boxplot (white dot is the mean, box represents the interquantile interval, and vertical bar is the 95% confidence interval of the mean), and the frequency distribution of visit length displayed vertically and mirrored around the boxplot.

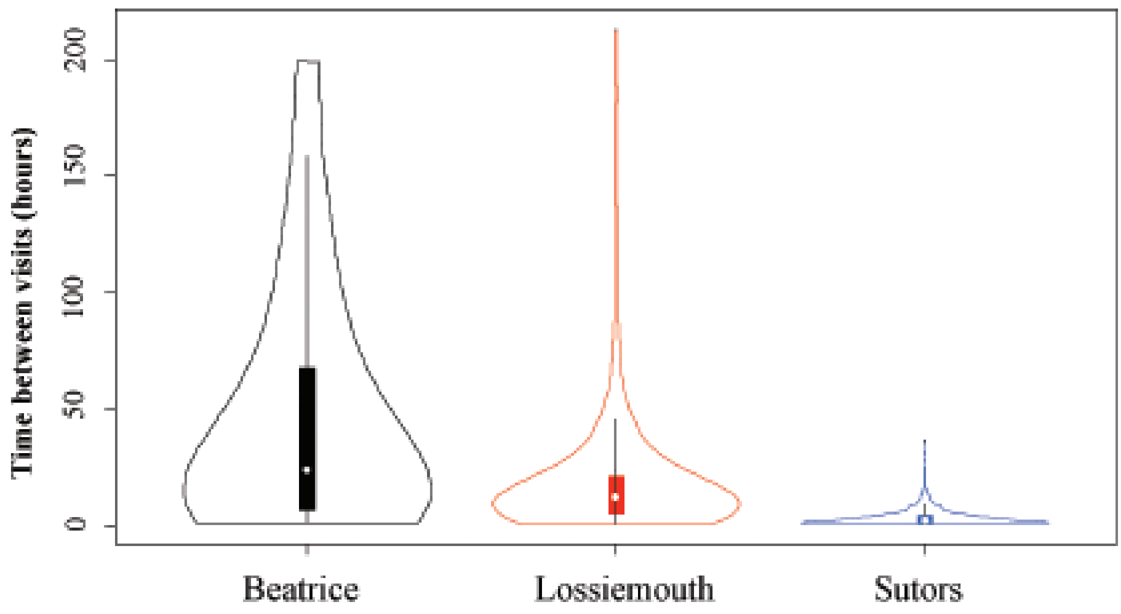


Figure 4.20 Summary of the time spanned between dolphin visits (in hours) at each site displayed as violin plots. Each plot is composed of a boxplot (white dot is the mean, box represents the interquantile interval, and vertical bar is the 95% confidence interval of the mean), and the frequency distribution of the inter-visit interval displayed vertically and mirrored around the boxplot.

4.6.6 TEMPORAL USE OF THE SITE BY HARBOUR PORPOISE

Visits at Lossiemouth varied from less than once a day to a couple of times a week throughout the summer. Although most visits were very short, it appears that porpoises did spend some more prolonged periods at the site (Figure 4.21, note the fatter tail of the frequency distribution). This pattern in visit length was prevalent at the other sites too; yet the Sutors site was used much less by this species. Harbour porpoises were regularly detected at the Beatrice site, typically several times a day Figure 4.22).

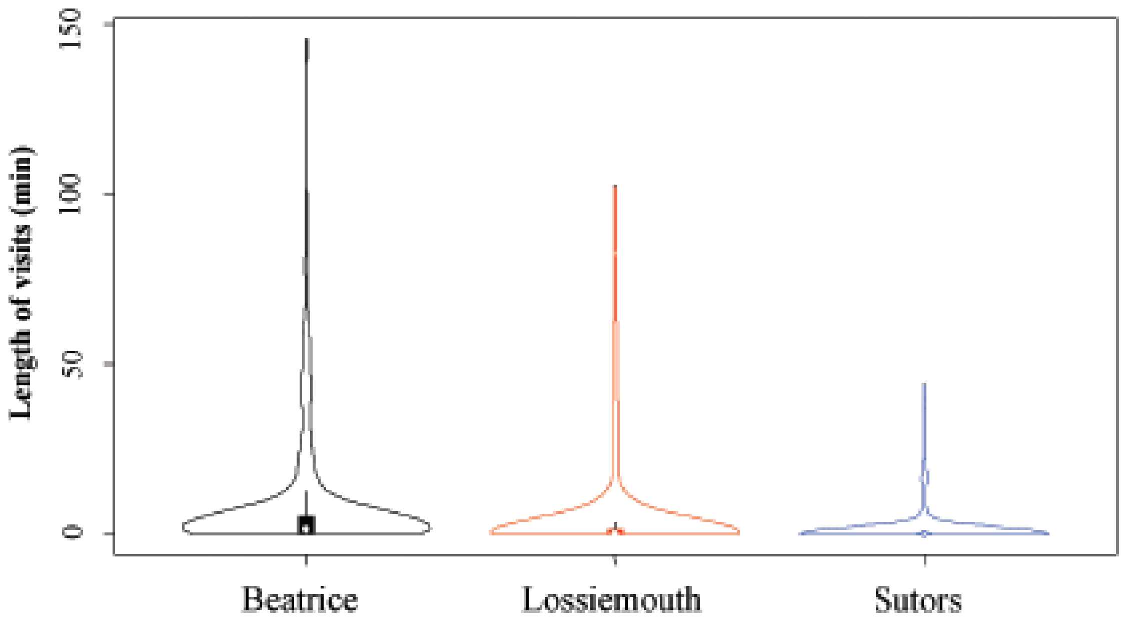


Figure 4.21 Summary of harbour porpoise visit lengths (in minutes) at each site displayed as violin plots. Each plot is composed of a boxplot (white dot is the mean, box represents the interquantile interval, and vertical bar is the 95% confidence interval of the mean), and the frequency distribution of visit length displayed vertically and mirrored around the boxplot.

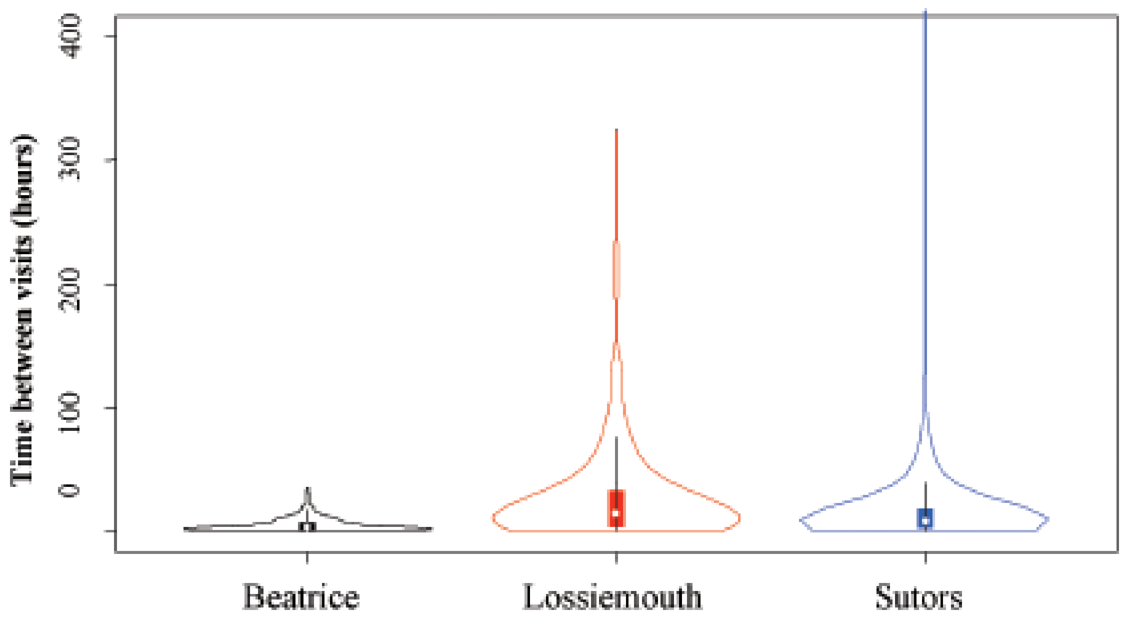


Figure 4.22 Summary of the time spanned between porpoise visits (in hours) at each site displayed as violin plots. Each plot is composed of a boxplot (white dot is the mean, box represents the interquantile interval, and vertical bar is the 95% confidence interval of the mean), and the frequency distribution of the inter-visit interval displayed vertically and mirrored around the boxplot.

4.6.7 SUMMARY OF SITE-SPECIFIC MONITORING RESULTS

Bottlenose dolphins tend to have a coastal distribution in the Moray Firth, which means that their exposure to the construction activities is likely to be minimised. However, some regular, but sporadic, dolphin activity was present at the Beatrice site during the late summer/autumn sampling period. Harbour porpoises are more likely to be encountered offshore. TPOD studies are being continued through the year to improve understanding of harbour porpoise distribution and activity around Beatrice. Further visual and/or audio band acoustic surveys are also planned to identify which species of dolphins are occurring in the Beatrice area.

4.7 SEABIRDS

4.7.1 INTRODUCTION

The Moray Firth's coastal and offshore waters are internationally important for populations of seabird, seaduck, wader and wildfowl. The area has been notified as a Special Protection Area (SPA) under the EU Birds Directive (Kalejta-Summers, 2004).

In addition to resident birds, the area is used for breeding, over-wintering or as a temporary feeding ground during the spring and autumn migrations of species breeding in the North (Siberia, northern Scandinavia, Iceland, Greenland and the Canadian Arctic). Various studies (including regular counts) indicate that while some changes in relative abundance of some species or areas of use have occurred, overall the importance of the Moray Firth for seabirds and waterbirds has remained unchanged for the last decade (Kalejta-Summers, 2004).

Many sites around the Moray Firth are designated as protected sites because of their importance for birds (Table 4.8)

Table 4.8 Internationally and nationally important seabird breeding colonies along the coastline from Duncansby Head to Rattray Head (JNCC Seabird Colony Register, 2000; Lloyd et al., 1991).

	Fulmar	Cormorant	Shag	Kittiwake	Guillemot	Razorbill
Duncansby Head SSSI					3%GB 1%INT	
Scaps Geo to Dunbeath				3%GB	6%GB 2%INT	5%GB 1%INT
Berridale Cliffs SSSI	1%GB		2%GB	5%GB 1%INT	6%GB 2%INT	4%GB
North Souter		2%GB				
Troup Head				2%GB	3%GB 1%INT	
Lion's Head				2%GB		
Aberdour Bay				1%GB		

4.7.2 SEABIRDS AND SEADUCKS

Numerous sites along the coast of the Moray Firth from Duncansby Head to Rattray Head support internationally and nationally important breeding populations of kittiwake, guillemot, razorbill, fulmar and cormorant (Table 4.8).

During the breeding season (April to June) large numbers of seabirds are concentrated at breeding sites and in the coastal waters of the Moray Firth. Following the breeding season, many seabirds disperse offshore to feed; the sandeel population of the Smith Bank is a particularly important food source, especially for auks, guillemots, razorbills and puffins. However, during the benthic survey carried out in October 2005 only one juvenile was found in grab samples at the proposed WTG locations (ERT, 2005). Based on expert judgement, if sandeels had been present in abundance it is likely that some evidence in the form of sightings would have been gathered during the survey (ERT pers. com., 2005).

Seaducks, including eider, goldeneye, long tailed duck, common scoter and velvet scoter over-winter in the Inner Moray Firth in large flocks; the Moray Firth regularly holds in excess of 20,000 birds (Lloyd *et al*., 1991). Red-throated divers, great crested grebes, long-tailed duck and significant numbers of unidentified scoter species are present in large numbers during winter (Dean *et al.*, 2003) (Table 4.9).

Ariel surveys were conducted in the Moray Firth by Dean *et al.* (2003) in the winter months of 2000-01 and 2001-02. Red-throated divers, great crested grebes, long-tailed duck and significant numbers of unidentified scoter species were recorded in large amounts. Of the birds recorded in the Moray Firth a number of species are listed in Annex I of the EC Birds Directive and these include the red-throated diver *(Gavia stellata)*, black-throated diver *(Gavia arctica)* and great northern diver *(Gavia immer)* (Table 4.9).

Table 4.9 Total Numbers of selected species recorded in the Moray Firth area (Source: Dean et al., 2003).

	January 2001	January 2002	February 2002
Red-throated diver	150	74	32
Black-throated diver	1		
Great northern diver	1	9	54
Diver sp.	2	114	38
Great crested grebe	3	0	0
Greater scaup	2		
Common eider	1,455	559	548
Long-tailed duck	925	593	587
Black scoter	1,551	1,861	417
Velvet scoter	32	14	43
Scoter sp.	891	9	2,630
Common goldeneye	0	0	16
Seaduck sp.	217	0	0
Red-breasted merganser	92	12	23

Wetland Bird Surveys (WeBS) and seaduck counts were collected in 2003-04 (RSPB, 2004). The WeBS counts are designed to mainly count waders and dabbling ducks and the seaduck counts are designed to monitor numbers of divers, grebes and seaducks. Such birds are also noted in the WeBS counts, but poor counting conditions often mean that large numbers might be missed. Overall, it is believed that the seaduck counts provide a more accurate determination of seabird numbers (Table 4.10).

Data collected for the red-throated diver in the Moray Firth suggested a continuous distribution from the Inverness Firth along the northern shore to Tarbat Ness and along the southern shore to Spey Bay. The 2001-02 data suggest, however, a more patchy distribution with three distinct concentrations recorded in both January and February: one around the Inverness and Moray firths, from Nairn to Tarbat Ness, a second within Spey Bay and a third within the Dornoch Firth. For the 2003-04 data re-throated divers were slightly higher than the pre-last winter, where a vast majority of birds occurred between Nairn and Spey Bay. Only the Dornoch Firth qualified as a site of national importance, supporting 2.2% of the British wintering population (Kalejta-Summers, 2004).

Small numbers of black-throated diver and great northern diver were recorded in the Moray Firth area. Unidentified diver species were recorded in relatively large numbers particularly in the Dornoch and Moray Firths and such numbers are significant when compared to other areas in the UK. The Moray Firth qualifies as a whole as a site of national importance for this species, supporting 6.9% of the British wintering population. The Dornoch and Beauly Firths were the most favoured areas (Kalejta-Summers, 2004).

Table 4.10 Moray Firth seabird counts for winter 2003-04, indicating species which have international or national importance [Source: Kalejta-Summers, 2004].

			WeBS Count				Seaduck Count		
Species	**International Importance**	**National Importance**	**Oct 2003**	**Dec 2003**	**Jan 2004**	**Feb 2004**	**Nov 2003**	**Dec 2003**	**Jan 2004**
Red-throated diver	1,000	50	166	7	28	7	133	82	48
Black-throated diver	1,000	7	48	2	2	–	9	9	4
Great Northern diver	50	30	33	2	7	2	61	42	21
Little grebe	3,400	78	50	23	25	27	3	2	9
Great Crested grebe	1,500	100	–	–	–	–	3	2	–
Slavonian grebe	35	4	130	1	19	5	54	62	45
Cormorant	1,200	230	522	191	203	197	259	261	210
Shag	2,400	N/A	516	52	38	6	394	413	323
Grey heron	2,700	N/A	230	89	71	84	–	–	–
Mute swan	2,500	N/A	363	487	246	252	–	–	–
Whooper swan	210	57	523	144	75	245	–	–	–
Shelduck	3,000	782	74	632	1,034	1,407	–	–	–
Wigeon	15,000	4,060	31,032	29,714	14,105	10,632	–	–	–
Teal	4,000	1,920	6,932	5,062	3,806	4,977	–	–	–
Mallard	20,000	3,520	4,952	4,230	3,820	3,539	–	–	–
Pintail	600	279	92	757	728	501	–	–	–
Shoveler	400	148	11	24	10	4	–	–	–
Tufted duck	12,000	901	52	212	187	365	18	47	48
Scaup	3,100	76	197	558	582	372	258	606	496
Eider	15,600	730	1,285	459	376	218	1,637	729	1,639
Long-tailed duck	20,000	160	126	2,522	2,440	1,414	2,986	2,985	5,446
Common scoter	16,000	500	3,157	3,104	4,847	7,987	4,534	4,113	2,386
Velvet scoter	10,000	30	18	200	617	1,753	794	828	2,103
Surf scoter	–	–	1	3	0	0	2	1	0
Goldeneye	4,000	249	100	625	814	429	161	534	899
Red-breasted merganser	1,700	98	380	70	155	115	209	222	230
Goosander	2,500	161	21	20	10	14	3	3	2
Moorhen	–	–	9	3	0	0	–	–	–
Coot	17,500	1,730	145	244	20	32	–	–	–
Oystercatcher	10,200	3,200	14,517	8,753	13,092	12,063	–	–	–
Ringed plover	730	330	579	498	307	430	–	–	–
Golden plover	8,000	2,500	1,290	1,460	559	1,074	–	–	–
Grey plover	2,500	530	62	35	11	41	–	–	–
Lapwing	20,000	20,000	3,507	2,911	998	654	–	–	–
Knot	4,500	2,800	1,982	7,177	9,556	5,719	–	–	–
Sanderling	1,200	210	191	139	162	130	–	–	–
Purple sandpier	900	180	2	147	328	197	–	–	–
Dunlin	13,300	5,600	1,597	10,023	11,645	12,002	–	–	–

Table 4.10 (cont) *Moray Firth Seabird counts for winter 2003-04, indicating species which have international or national importance [Source: Kalejta-Summers, 2004].*

			WeBS Count				Seaduck Count		
Species	**International Importance**	**National Importance**	**Oct 2003**	**Dec 2003**	**Jan 2004**	**Feb 2004**	**Nov 2003**	**Dec 2003**	**Jan 2004**
Black-tailed godwit	350	150	9	3	0	0	–	–	–
Bar-tailed godwit	1,200	620	1,442	4,553	1,928	2,937	–	–	–
Curlew	4,200	1,500	4,616	3,749	4,936	4,496	–	–	–
Redshank	1,300	1,200	5,202	6,122	6,000	4,322	–	–	–
Greenshank	–	–	11	0	7	7	–	–	–
Turnstone	1,000	500	585	499	468	417	–	–	–
Great black-backed gull	4,700	400	–	–	–	–	674	460	365
Herring gull	13,000	4,500	–	–	–	–	6,468	5,359	5,402
Common gull	16,000	9,000	–	–	–	–	5,208	2,162	1,833
Black-headed gull	20,000	19,000	–	–	–	–	454	773	267
Auks	Guillemot	–	–	99				333	
Razorbill	–	–				92	92		
Little Auk	–			6					
Black guillemot	–	–					12		
Puffin	–	–					5		

Key
International Importance
National Importance

Common eider were found to be widely distributed across the Moray Firth area and large numbers of long-tailed duck were recorded, especially in the winter months. Other species recorded included black scoter, velvet scoter, common goldeneye and the red-breasted merganser (Dean *et al.*, 2003).

Overall, the Moray Firth is an important area for divers, reflecting their northern distribution in the UK. It is also an important area for the long-tailed duck, black scoter, and velvet scoter (Dean *et al.*, 2003).

4.7.3 WADERS AND WILDFOWL

The Moray Firth coasts include mudflats, and sandy and rocky shores which are of national and international importance as feeding and testing areas for many species of waders and wildfowl. The most important areas are Findhorn Bay, Cubin Sands, Beauly Firth, Cromarty Firth, Dornoch Firth and Loch Fleet.

The sheltered Dornoch, Cromarty and Inner Moray Firths and their saltmarsh, mudflat and estuarine habitats are important for migrating waders and wildfowl in spring and autumn, containing extensive and important feeding areas. The Moray basin, firths and bays regularly hold 130,000 wintering and 31,000 passage waterfowl (wildfowl and waders). Sand and shingle areas along the Moray Firth coastline are used by soft-shore breeding birds, such as breeding colonies of terns (Lloyd, *et al.*, 1991).

4.7.4 SEABIRD VULNERABILITY

The proposed Beatrice Wind Farm Demonstrator Project is located in UKCS Quadrant 11 and is adjacent to the coastline, therefore bird densities throughout the year are much higher than for other blocks further offshore (Figure 4.23).

The Joint Nature Conservation Committee (JNCC) Seabirds at Sea Team (SAST) have developed an index to assess the vulnerability of birds species to the threat of oil pollution. This offshore vulnerability index is derived from an assessment of the following four factors for each species (Williams *et al.*, 1994):

- *the amount of time individuals spend on the water*
- *the total size of the biogeographic population*
- *the reliance of the species on the marine environment*
- *the potential rate of population recovery.*

A regional view of the seabird vulnerability around the Beatrice area is shown in Figure 4.23, and Table 4.11 shows the seasonal vulnerability of the seabirds in the block that coincides with the proposed Beatrice Wind Farm Demonstrator Project (JNCC, 1999).

Table 4.11 Seasonal vulnerability of seabird concentration to oil pollution at the proposed Beatrice Wind Farm Demonstrator Project [Source: JNCC, 1999].

Block	**Jan**	**Feb**	**Mar**	**Apr**	**May**	**Jun**	**Jul**	**Aug**	**Sep**	**Oct**	**Nov**	**Dec**
11/29	1	1	1	1	1	1	1	1	1	1	1	1
11/30	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**
17/3	1	1	1	1	1	1	1	1	1	1	1	1
17/4	1	1	1	1	1	1	1	1	1	1	1	1
17/6	1	1	1	1	1	1	1	1	1	1	1	1
17/7	1	1	1	1	1	1	1	1	1	1	1	1
17/8	1	1	1	1	1	1	1	1	1	1	1	1

Table 4.11 indicates that seabird vulnerability in the area of the Beatrice Wind Farm Demonstrator Project is “very high” (1) throughout the year. This is because a large number of seabirds disperse into these coastal waters at the end of the breeding season. At such locations, between June and August, they are particularly vulnerable to surface pollution, especially if they are moulting and therefore unable to fly.

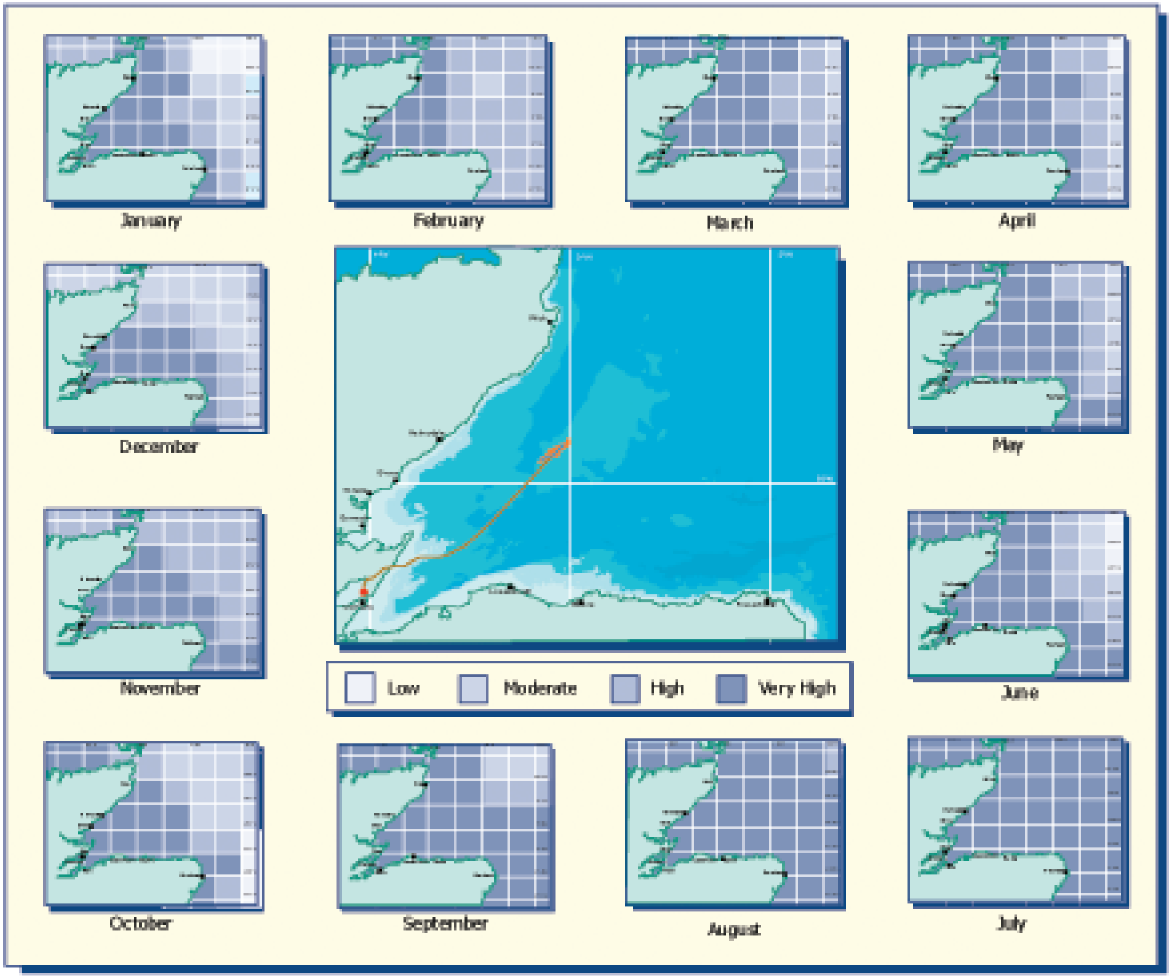


Figure 4.23 Seasonal seabird vulnerability to oil pollution around the Beatrice Wind Farm Demonstrator Project (JNCC, 1999).

4.8 BIRD MONITORING PROGRAMME AT THE BEATRICE PLATFORM

4.8.1 INTRODUCTION

A year-long survey of birds at the Demonstrator site has been completed by experienced ornithologists. The survey programme, which was discussed with JNCC and RSPB both before and during the survey, does not follow the methodology adopted for other, commercial scale wind farms, which seek to determine bird data over a large area of sea. Rather, the Beatrice programme was designed to obtain very site-specific data about the use that birds make of the offshore area in which the Demonstrator Project would be located, using the nearby Beatrice Alpha installation as an observation platform. It was recognised that the Beatrice platforms themselves and the day-to-day offshore activities associated with oil and gas operations in the area might already be influencing the local presence, distribution and activities of bird. It was, therefore, concluded that a survey programme focussed on the Beatrice site, and the area of the Demonstrator WTGs in particular, was most appropriate for the purposes of the proposed, small-scale Demonstrator Project. Such a survey would build on the existing data from wide-scale surveys of the Moray Firth, including the existing two year data gathered in 1982-83 (Mudge *et al*, 1984).

Observations were made from the nearby Beatrice AP platform, which is situated 1,581m and 2,331m to the north-west of the proposed locations for WTG 1 and WTG 2 respectively. Two vantage points were used to give a view from the platform to the south-east, overlooking the Demonstrator site. One was located at a height of 30m and the other 41m above sea level; the 30m site was more exposed, and so the 41m site was used in poor weather. To an observer positioned at a height of 41m the horizon will be approximately 25km away, whereas at a height of 30m it will be about 20km away. No correction for variation in the accuracy of observation and counting with distance from the observer has been applied to these data.

Vantage point watches lasting five to nine hours were conducted for two consecutive days, giving a total of 171 hours of observation in 2005 (Table 4.12). Two periods of observation were undertaken each month during August and October, when bird numbers were expected to be higher as a result of seasonal migration.

Table 4.12 Total number of hours of ornithological observation of Demonstrator site from Beatrice platform

MONTH	TOTAL HOURS
January	7
February	12
March	16
April	9
May	10
June	12
July	11
August	27
September	14
October	25
November	11
December	17
Total hours observation for 2005	171

Constant scanning was undertaken in a 90° arc using a telescope (x20 eyepiece) and binoculars (x10). These optical aids were alternated, with the wide field of view of the binoculars complementing the magnification of the telescope. Naked eye scans were also used to increase the detection of very close and high-flying birds. When strong winds or platform vibration rendered the telescope unusable, only binocular and naked eye scans were used. Count periods were of one-hour duration followed by a short break.

Each time a bird was detected the observer recorded: time, species, number of individuals, distance from Beatrice, average height of flight, direction of travel, and any behaviour of interest. The distance of birds from Beatrice, and their average flying height, was assigned to one of the following bands shown in Table 4.13.

Table 4.13 Distance and height bands used for recording bird activity at the Demonstrator site.

FOR DISTANCE FROM THE BEATRICE AP PLATFORM		
BAND	**Distance (m)**	**Remarks**
A	0-250	
B	250-500	
C	500-1,00	
D	1,000-2,000	This band encompasses WTG 1
E	>2,000	WTG 2 is located approximately 2.3km from Beatrice AP
FOR AVERAGE FLYING HEIGHT ABOVE SEA LEVEL		
BAND	**Distance (m)**	**Remarks**
0	0	Bird on the water
A	Less than 20	This is the zone below the turbine blades
B	20-150	This is the zone covered by the turbine blades
C	Above 150	This is the zone above the turbine blades

Immediately prior to each period of counting, a note was made of any birds associated with the platform. During the counting period, records were also made of any marine mammal or fishing activity. Records were also made of weather and sea conditions, and visibility, immediately before each counting period.

4.8.2 OVERVIEW OF THE USE OF THE DEMONSTRATOR SITE BY BIRDS

Species and numbers present

A total of 42 species or species aggregates were observed over the course of the year in the Beatrice field. All observations of auk species have been aggregated because, for many sightings, the individual could not be identified with certainty to species level. This group includes black guillemot, guillemot, little auk, puffin and razorbill. Tern species have also been aggregated for the same reason; this group includes Arctic tern, common tern and sandwich tern.

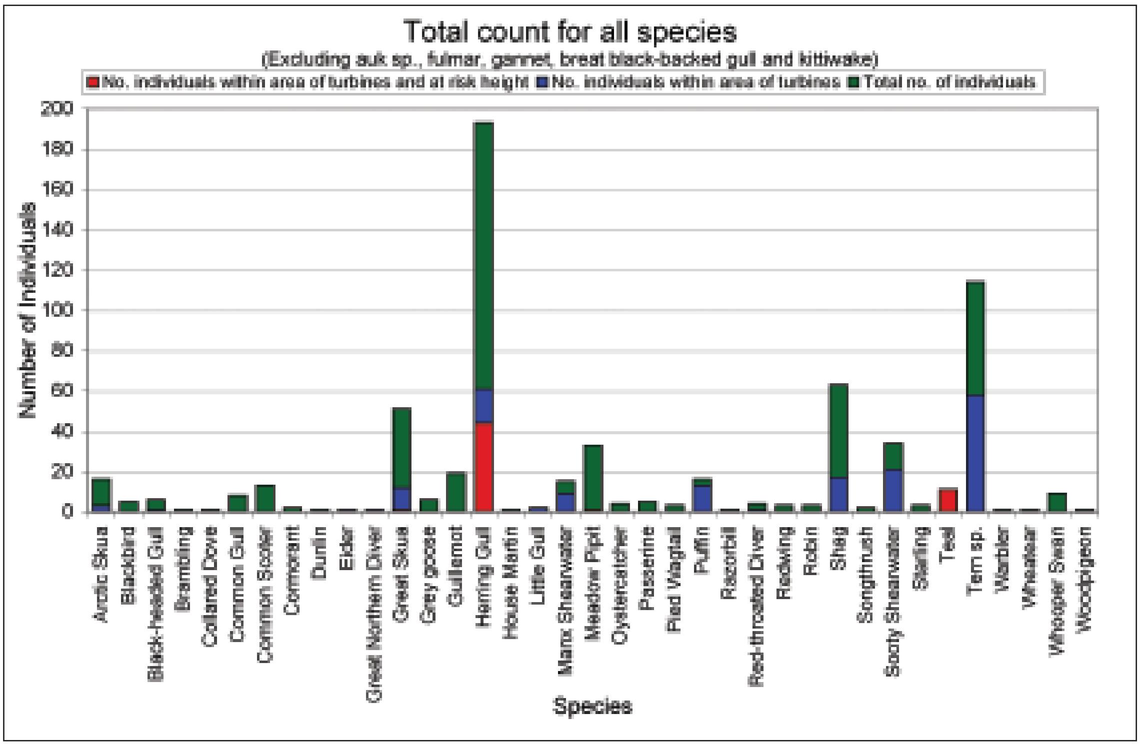
For observation made from the vantage points 1 and 1A which overlooked the proposed turbine locations (excluding March) and vantage point 2 (for March observations only due to strong winds at point 1 and 1A) which covered the area north of the proposed turbine locations, Table 4.14 shows the total number of observations recorded for each species and the total number of individuals recorded. This information is further sub-divided, showing the number of individuals in distance band D (which includes the location of WTG 1), and of these how many were flying at a height that would be swept by blades (height band B).

Table 4.14 Total number of observations and total number of individuals recorded for each species of bird observed in the 90° arc covering the area of the Demonstrator site during year-long survey from Beatrice platform.

SPECIES	OBSERVATIONS			INDIVIDUALS		
		IN DISTANCE BAND D			IN DISTANCE BAND D	
	TOTAL	TOTAL	AT HEIGHT B	TOTAL	TOTAL	AT HEIGHT B
Arctic skua	14	3	0	16	3	0
Auk sp.	1113	381	3	5757	2302	11
Blackbird	3	0	0	5	0	0
Black-headed gull	2	1	0	6	1	0
Brambling	1	0	0	1	0	0
Collared dove	1	0	0	1	0	0
Common gull	8	0	0	8	0	0
Common scoter	1	0	0	13	0	0
Cormorant	1	0	0	2	0	0
Dunlin	1	0	0	1	0	0
Eider	1	1	0	1	1	0
Fulmar	887	212	0	1078	280	0
Gannet	528	196	60	707	268	80
Great black-backed gull	246	72	52	424	141	84
Great Northern diver	1	1	0	1	1	0
Great skua	49	12	1	51	12	1
Greylag goose	1	0	0	6	0	0
Guillemot	10	0	0	19	0	0
Herring gull	137	43	33	193	61	44
House martin	1	0	0	1	0	0
Kittiwake	1384	358	239	2943	930	507
Little gull	1	1	0	2	2	0
Manx shearwater	8	6	0	15	9	0
Meadow pipit	25	1	1	33	1	1
Oystercatcher	2	0	0	4	0	0
Passerine	4	0	0	5	0	0
Pied wagtail	3	0	0	3	0	0
Puffin	7	5	0	16	13	0
Razorbill	1	0	0	1	0	0
Red-throated diver	2	1	0	4	1	0
Redwing	2	0	0	3	0	0
Robin	2	0	0	3	0	0
Shag	30	9	0	63	17	0
Songthrush	1	0	0	2	0	0
Sooty shearwater	17	9	0	34	21	0
Starling	2	0	0	3	0	0
Teal	1	1	1	11	11	11
Tern sp.	17	6	0	114	58	0
Warbler	1	0	0	1	0	0
Wheatear	1	0	0	1	0	0
Whooper swan	1	0	0	9	0	0
Woodpigeon	1	0	0	1	0	0

The most frequently recorded species were, in descending order, kittiwake, auk sp., fulmar, gannet, great black-backed gull and herring gull. All other species were observed on fewer than 50 occasions. The most numerous species, again in descending order, were auk sp., kittiwake, fulmar, gannet, great black-backed gull, herring gull and tern sp. All other species counts recorded fewer than 100 individuals. Figure 4.24 shows the total counts for all species, excluding the five most common species, and indicates the proportions found in the area of the Demonstrator site and at the height of the blades.

Figure 4.24 Total number of individuals recorded for each species observed over the survey period, excluding the five most common species.



Species and numbers in the risk zone for the Demonstrator Project

For the purposes of assessing potential effects of the WTGs on birds, attention was focussed on bird activity in distance band D (1km to 2km) and height band B (20m to 150m above sea level).

Eight species were recorded flying within Area D and at Height B: Auk sp. aggregate, gannet, great black-backed gull, great skua, herring gull, kittiwake, meadow pipit and teal. Of these eight species, great skuas, meadow pipit and teal were only recorded once each within this zone.

The species most commonly found in this risk zone were the kittiwake, gannet, and great black-backed gull (Figure 4.25). The kittiwake was the most common species in the risk zone, with 507 individuals out of a total of 2,943 recorded (17.2%, 239 observations) flying within this zone. For gannets, 11.3% were recorded in the risk zone (80 out of 707 individuals (60 observations)) and for great black-backed gulls 19.8% were recorded in this zone (84 out of 424 individuals (52 observations)).

Figure 4.25 Total number of individuals recorded for each of the five most common species observed over the survey period.

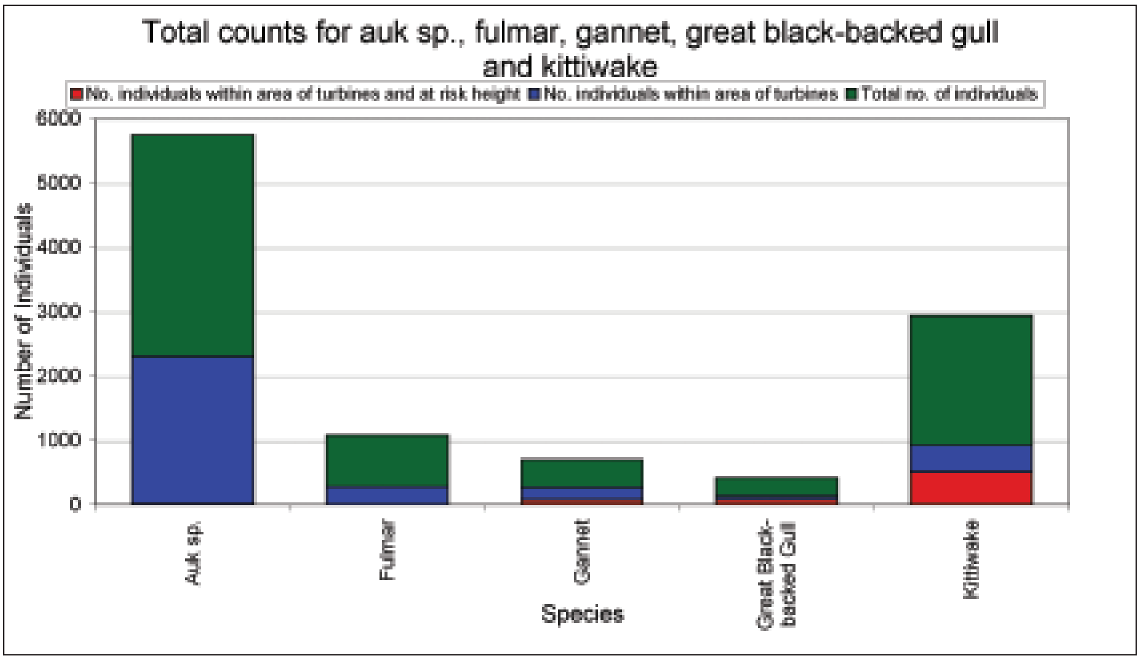


Table 4.15 shows the data for the average flock size for each species recorded at Beatrice. This is a measure of the number of observations in relation to the number of individuals present. Teal showed the greatest flock size, with 11 individuals being recorded on one occasion. Whooper swan (nine individuals) and grey goose (six individuals) were also only recorded on one occasion in large groups. Tern species were recorded on 17 occasions and had a mean flock size of 6.71 birds. Auk species were recorded on 1,113 occasions and had a mean flock size of 5.17 birds. All other species recorded showed a mean flock size of between one and three birds.

Table 4.15 Average flock size for each species recorded.

SPECIES	AV FLOCK SIZE	SPECIES	AV FLOCK SIZE
Arctic skua	1.14	Little gull	2.00
Auk sp.	5.17	Manx shearwater	1.88
Blackbird	1.67	Meadow pipit	1.32
Black-headed gull	3.00	Oystercatcher	2.00
Brambling	1.00	Unidentified passerine	1.25
Collared dove	1.00	Pied wagtail	1.00
Common gull	1.00	Puffin	2.29
Common scoter	13.00	Razorbill	1.00
Cormorant	2.00	Red-throated diver	2.00
Dunlin	1.00	Redwing	1.50
Eider	1.00	Robin	1.50
Fulmar	1.22	Shag	2.10
Northern gannet	1.34	Song thrush	2.00
Great black-backed gull	1.72	Sooty shearwater	2.00
Great northern diver	1.00	Starling	1.50
Great skua	1.04	Teal	11.00
Grey goose	6.00	Tern sp.	6.71
Guillemot	1.90	Warbler	1.00
Herring gull	1.41	Wheatear	1.00
House martin	1.00	Whooper swan	9.00
Kittiwake	2.13	Wood pigeon	1.00

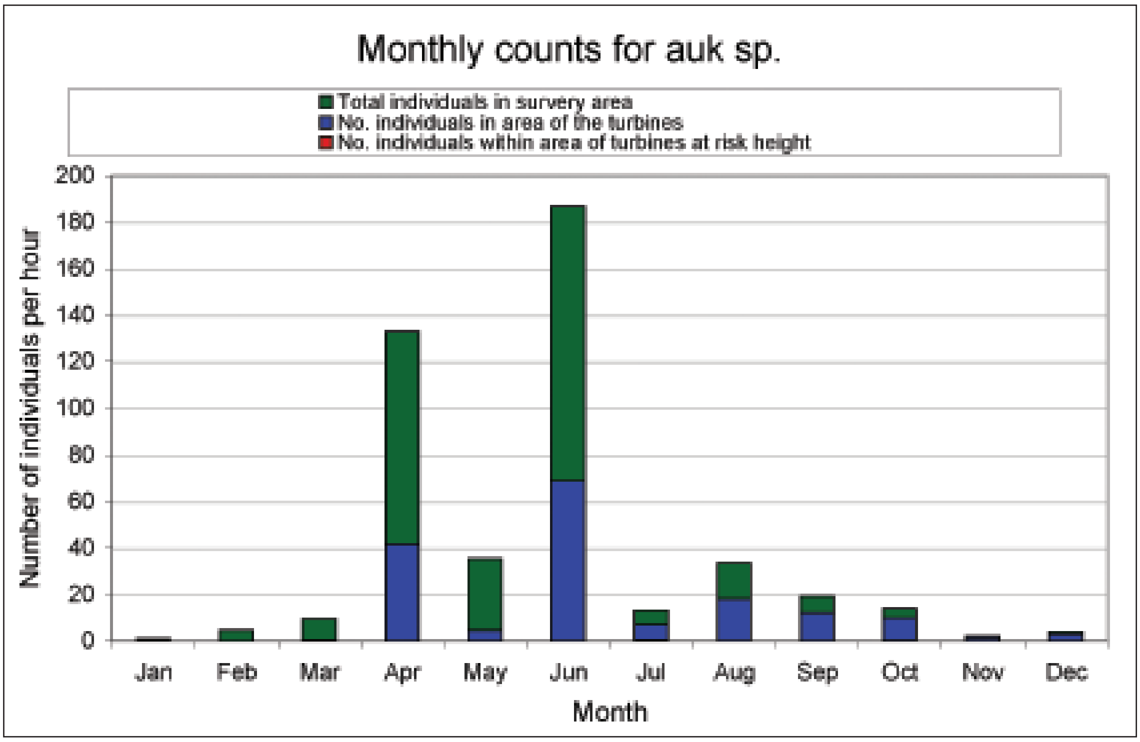
Note: The monthly count data are not corrected for observation effort.

4.8.3 ANALYSIS OF FIVE MOST COMMON SPECIES IN BEATRICE FIELD

Auk sp.

The numbers of Auk species recorded per hour peaked in April and again in June (Figure 4.26). The decrease in numbers from June probably represents a general movement of individuals to wintering grounds at sea.

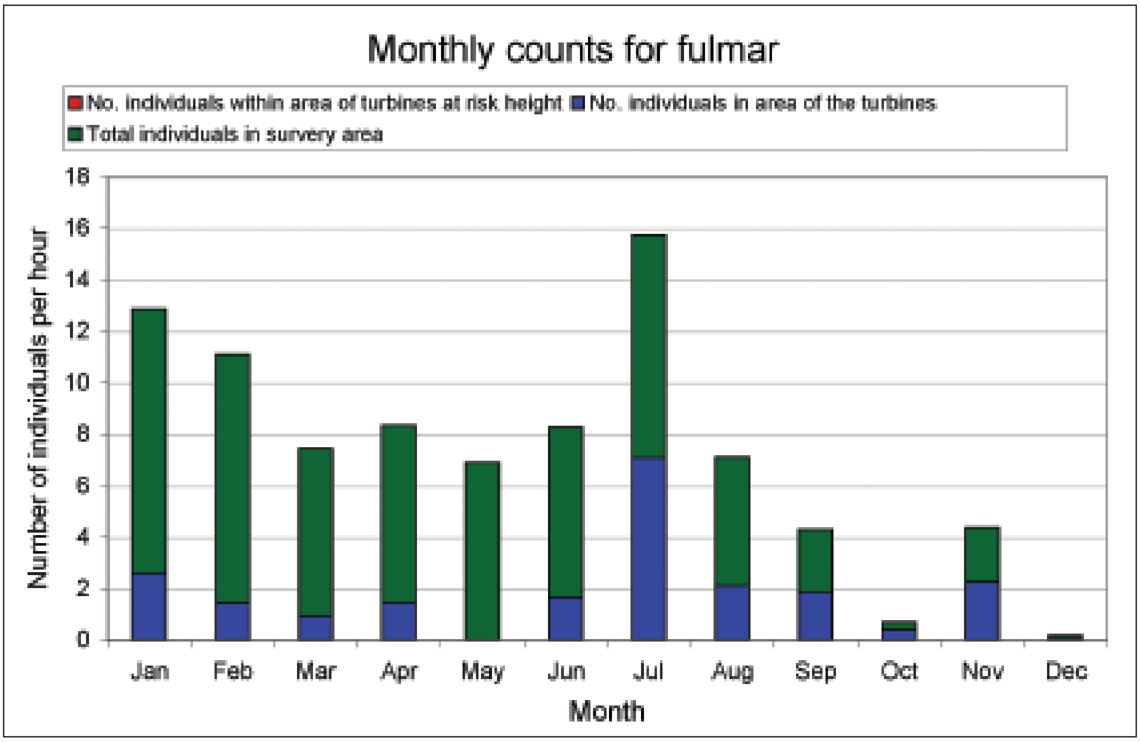
Figure 4.26 Number of individuals per hour recorded each month for Auk sp.



Fulmars

The numbers of Fulmars recorded per hour were high in the early part of the year but declined after July (Figure 4.27). No birds were recorded flying through the risk zone at any time during the survey.

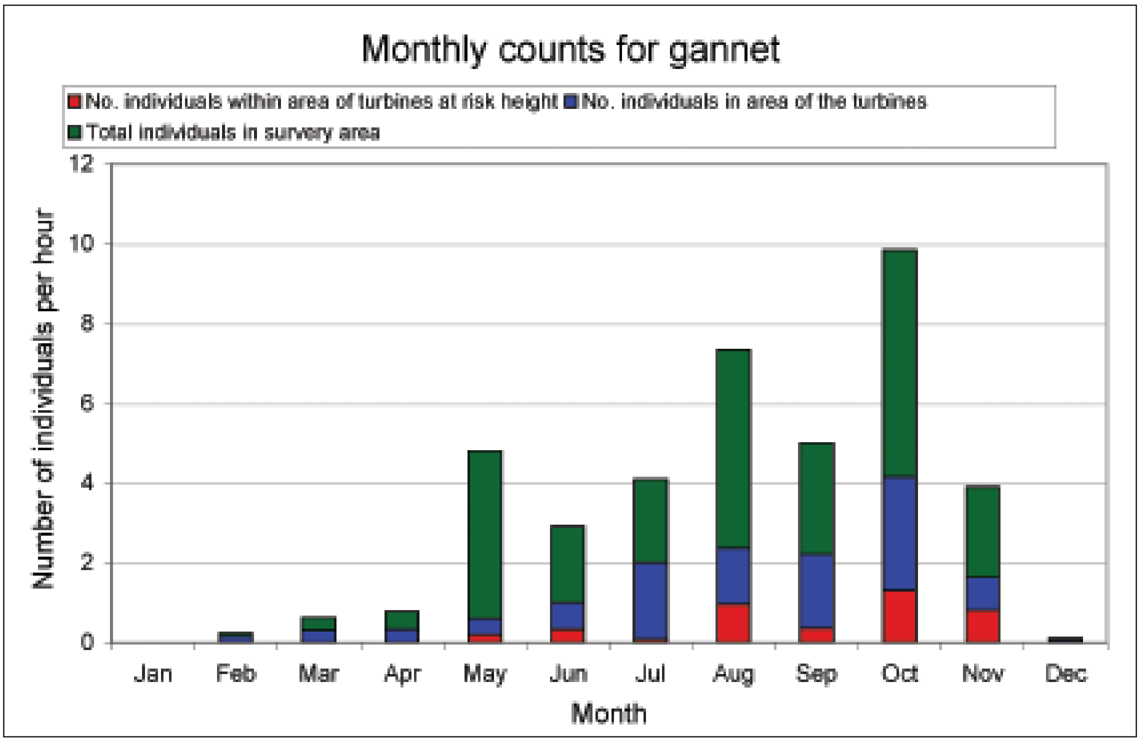
Figure 4.27 Number of individuals per hour recorded each month for fulmar.



Gannet

The numbers of Gannets recorded per hour increased from January, reaching a peak in October (Figure 4.28). This may correspond to the presence of fledged juveniles in the late summer and autumn months. Gannets were recorded flying through the risk zone in seven months, particularly in August, and October.

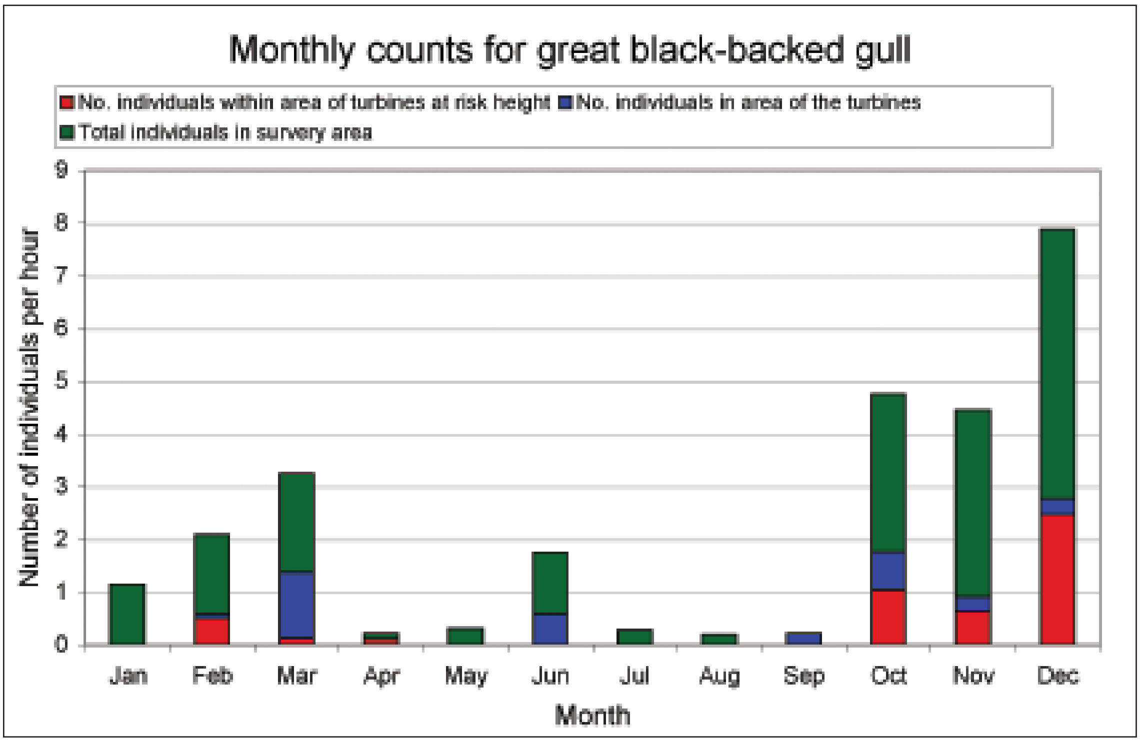
Figure 4.28 Number of individuals per hour recorded each month for gannet.



Great black-backed gull

The numbers of Great black-backed gulls recorded per hour varied during the year, but were markedly higher in October, November and December than at other times (Figure 4.29). 134 individuals were recorded in December, and 119 in October whereas in all other months fewer than 50 individuals were recorded. The higher numbers recorded in the autumn months may reflect the presence of fledged juveniles after the breeding season has ended. A total of 84 individuals were recorded flying through the risk zone, in six of the 12 months surveying.

Figure 4.29 Number of individuals per hour recorded each month for great black-backed gull.

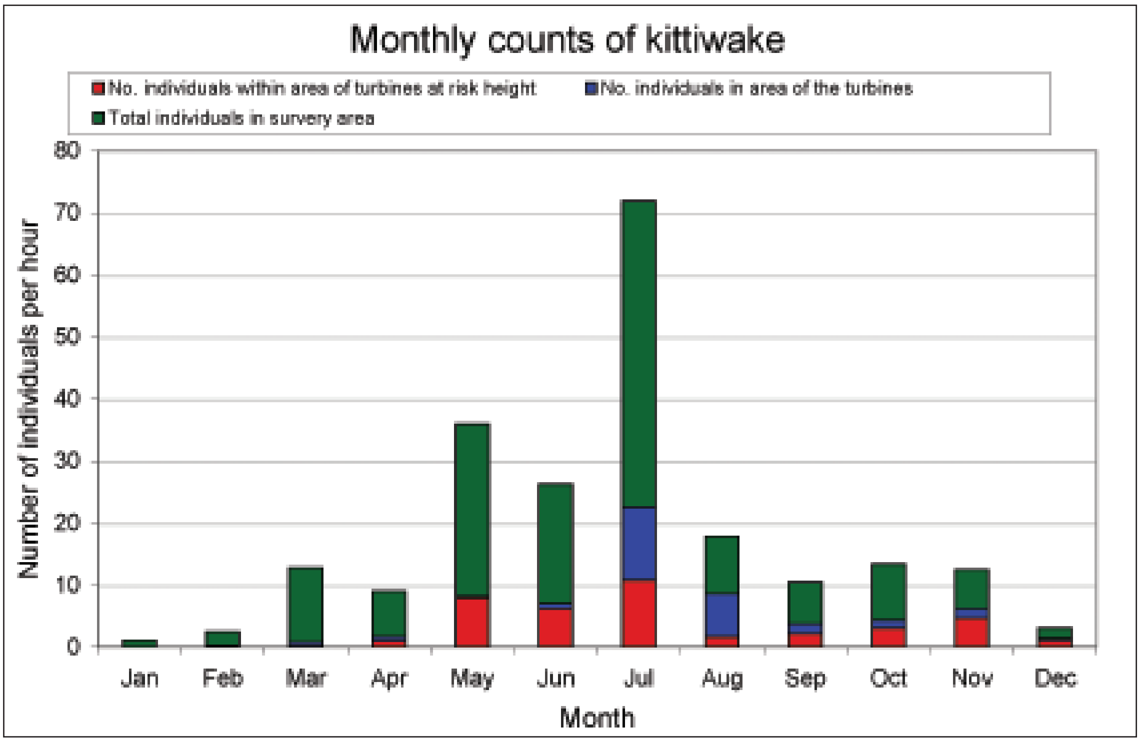


Kittiwake

The numbers of Kittiwakes recorded per hour in the area reached a peak in July with 791 individuals recorded in this month (Figure 4.30). Numbers observed per hour then decreased markedly.

Eleven of the 12 months recording showed observations of Kittiwake flying through the risk zone. Numbers flying through this zone were high in May through to November, with a peak number of 119 individuals seen in July.

Figure 4.30 Number of individuals per hour recorded each month for kittiwake.



4.8.4 DATA ON BIRD DENSITY

The year-long bird survey in the Beatrice field provided data on the use that different bird species made of the Demonstrator site, of the proportion of time they were flying, and the heights at which different species flew. It also provided data on the times of year when greatest numbers per hour of observation of particular species were present in the area.

Data from the bird surveys were used to estimate the number of transits by birds through turbines. For the months of August, September, October, November and December bird densities were obtained by an experienced ornithologist during the periods of observation from the Beatrice platform. The density of each species was obtained by counting the number of birds present in an area about once every hour, during the daily observation periods. The area used was a 90° arc covering the demonstrator site, and all distances up to 2km from the platform. Over the course of five months a total of 173 observations were made. The density of each species at each individual observation was calculated by dividing the number of birds seen by the area of the arc; for the purpose of collision modelling, birds flying outside turbine height were ignored. The average density per month is the average of the individual observation densities for that month. The overall average is the average of the monthly densities. Table 4.16 summarises the density data.

Within the risk height band, a total of 66 kittiwakes, 34 gannets, 26 great black-backed gulls, 10 herring gull, four tern sp. and two fulmar were seen. Other species were only seen in the lower height bands (i.e. below the level of the turbine blades). Only the density of birds observed in the risk height band is used in the following calculations.

Table 4.16 Average bird densities (birds/km^2) for all species observed during density observations between August and December 2006.

Species	Month	Number of Observations	Number of Birds	Average Density (individuals/km^2)
Tern sp.	August	24	0	0
	September	28	4	0.05
	October	72	0	0
	November	19	0	0
	December	20	0	0
	Average	–	–	0.009
Fulmar	August	24	0	0
	September	28	1	0.01
	October	72	0	0
	November	19	0	0
	December	20	1	0.02
	Average	–	–	0.01
Herring gull	August	24	0	0
	September	28	0	0
	October	72	0	0
	November	19	2	0.03
	December	20	8	0.13
	Average	–	–	0.01

Table 4.16 (cont) *Average bird densities (birds/km²) for all species observed during density observations between August and December 2006.*

Species	Month	Number of Observations	Number of Birds	Average Density (individuals/km2)
Herring gull	August	24	0	0
	September	28	0	0
	October	72	0	0
	November	19	2	0.03
	December	20	8	0.13
	Average	–	–	0.03
Gannet	August	24	20	0.27
	September	28	0	0
	October	72	14	0.06
	November	19	0	0
	December	20	0	0
	Average	–	–	0.07
Great black-backed gull	August	24	0	0
	September	28	0	0
	October	72	3	0.01
	November	19	11	0.18
	December	20	13	0.21
	Average	–	–	0.08
Kittiwake	August	24	10	0.13
	September	28	28	0.32
	October	72	22	0.10
	November	19	6	0.10
	December	20	0	0
	Average	–	–	0.13

Densities of seabirds were low (<0.33 birds/km²) throughout the survey period for all species recorded during observation periods (Table 4.16). The seasonal variation in distribution of each species is discussed below in order of increasing average density found in the 2005, and with reference to the findings of the Moray Firth surveys carried out in the early 1980s and reported in Mudge *et al.*, 1984).

Tern sp. recorded the lowest average density over the 2005 bird survey period, with observations of this species only occurring during September. This species is generally typical of coastal and estuarine areas with the Inner Moray Firth holding the largest concentrations with abundances peaking during August; in the 1982-83 survey only occasional individuals were recorded more than a few kilometres offshore (Mudge *et al*., 1984).

Fulmar were recorded in very low densities (average 0.01 birds/km²) during the 2005 bird survey, and individuals were only present during September and December. The distribution of fulmar during the 1982-83 survey proved to be very widespread and abundance indices did not vary greatly through the year (two to four birds/linear km) (Mudge *et al*., 1984). During that survey a high proportion of birds were recorded in flight and were thought to be passing through the Moray Firth on route between colonies in Caithness and Orkney and feeding grounds in the North Sea. Consistent with this, moderate and major concentrations of fulmar were found near the Caithness coast and towards the outer edge of the Moray Firth (Mudge *et al.*, 1984).

Herring gull were absent from Beatrice survey area during the first part of the survey (August to October), but showed increasing densities from November (0.03 birds/km^2) to December (0.13 birds/km^2). These results are consistent with the results from the 1982-83 surveys where birds were absent or in very low numbers during the post-breeding season (August to September) and peak densities were observed during the winter period (October to February). Whilst birds were recorded from all parts of the Moray Firth they were found to be most abundant in the southern Moray Firth and the southern part of Smith Bank. Generally the largest concentrations of herring gull were associated with the activities of the fishing fleets off the north Grampian coast (Mudge *et al.*, 1984).

Bird observations in the Beatrice area in 2005 indicate that gannets occur in low densities and are frequently absent from the area. Average densities of 0.27 birds/km^2 were recorded in August towards the end of the breeding period (May to August). August sightings may coincide with early migrations south during the post-breeding period (September to November), and increased densities during October (2005 survey) are likely to coincide with the main migration period. Similar patterns of abundance were recorded during the 1982-83 survey, where lowest abundances were recorded in the Moray Firth during the breeding period (May to August) then numbers rapidly increased in the post-breeding season (September to November) where concentrations were regularly observed over the north-east corner of Smith Bank (Mudge *et al*., 1984).

Great black-backed gull were absent from density measurements during the post-breeding period (August and September 2005) (Table 4.16), when historically numbers would generally be increasing during this period (Mudge *et al*., 1984). Increases in density during the early winter period (October to December 2005) may reflect an increase in population size owing to incoming migrants from Norway, as suggested in previous surveys (Mudge *et al*., 1984). During the 1982-83 surveys densities of great black-backed gull tended to be higher in the inner and southern area of the Moray Firth.

The highest average density of any species recorded was the kittiwake (0.32 birds/km^2 in September 2005). This species was also observed during the greatest number of months in the observation period, between August and November, with no kittiwake observed during December 2005. Historical observations of kittiwake in the Moray Firth are consistent with these seasonal patterns of abundance. Data indicate that kittiwake abundances peaked in the Moray Firth during the post-breeding season (August 1982 (11.03 birds/km^2) and September 1983 (17.58 birds/km^2)), with abundances declining steeply during the winter period (November) reaching minimal levels between December and March (of the order of 1 birds/km2) (Mudge *et al.* 1984). Concentrations of kittiwake were commonly observed along central and north-eastern areas of Smith Bank.

4.9 SOCIO-ECONOMIC ENVIRONMENT

4.9.1 MARICULTURE

The Moray Firth is relatively unimportant for mariculture and there are no active fish farms along the coast of the Moray Firth (DTI, 2004b).

Shellfish production in Scotland is dominated by mussels and Pacific oysters, but small amounts of scallops, queen scallops and native oyster are also produced. The only shellfish production in the Moray Firth is a production area for the common cockle in the Moray Firth itself, and an area of mussel production in the Dornoch Firth (DTI, 2004b).

4.9.2 COMMERCIAL FISHERIES

The Moray Firth has been historically important for the development of Scottish fisheries and encompasses the fishing districts Fraserburgh, Buckie and Wick; the main fishing ports for each district are listed in Table 4.17.

Table 4.17 Fishing ports and districts.

Fraserburgh District	Buckie District	Wick District
Fraserburgh	Buckie	Helmsdale
Rosehearty	Lossiemouth	Lybster
Macduff	Burghead	Wick
Whitehills		Keiss
		John O'Groats
		Scrabster
		Portmahomack
		Invergordon
		Inverness

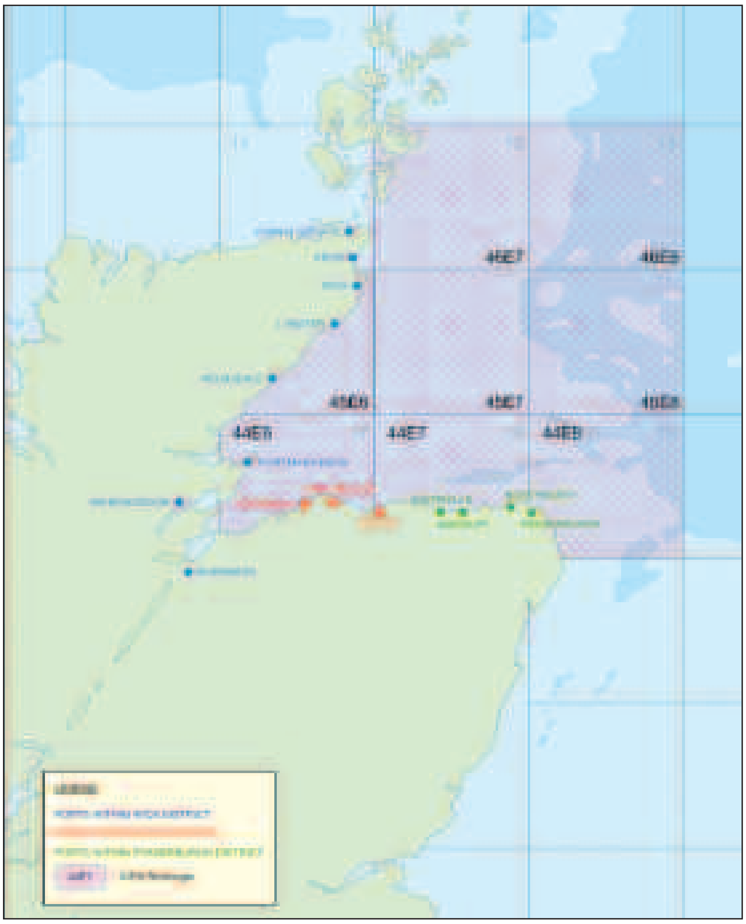
Fraserburgh is one of the largest white fish ports in the UK, and many vessels based there fish throughout the North Sea and off the west of Scotland. The numbers and relative sizes of vessels based in the Moray Firth are given in Table 4.18.

Table 4.18 Number of vessels based in Moray Firth districts and their relative sizes (2001) [Source: FRS 2002].

	Vessel lengths in metres							
District	**10 & under**	**>10<15**	**15<24**	**24<30**	**30<40**	**40<50**	**50 and over**	**Total**
Fraserburgh	100	9	86	37	3	3	11	249
Buckie	31	2	37	16	4	-	-	90
Wick	101	16	12	2	-	-	-	131
Total	232	27	135	55	7	3	11	470
Scottish based fleet	1,671	280	631	120	42	16	23	2,513
Moray %	**13.9**	**9.6**	**21.4**	**46**	**16.7**	**18.7**	**47.8**	**18.7**

Data relating to commercial fishing effort, species taken, and amounts landed are normally reported with reference to designated ICES statistical rectangles, each of which covers an area of 30 minutes of latitude by 60 minutes of longitude. The Beatrice Wind Farm Demonstrator Project is located within ICES rectangle 45E6, and the immediately adjacent ICES rectangles are 45E7, 44E6 and 44E7 (Figure 4.31).

Figure 4.31 ICES rectangles and Fishing Districts Associated with the Beatrice Wind Farm Demonstrator Project.



Fishing effort

Demersal fishing, using gears deployed on or close to the seabed, is the predominant technique used in the Central and Outer Moray Firth (Table 4.19). Creel fishing, mechanical dredging, and otter trawling account for the majority of fishing effort in the area of the proposed Beatrice Wind Farm Demonstrator Project (Coull *et al.,* 1998).

Table 4.19 Fishing methods adopted within the Moray Firth (45E6 and 44E6 are directly in the Beatrice vicinity). [Source: FRS 2005].

	Number of Days Fished (2004)			
Fishing Method	45 E6	45 E7	44 E6	44 E7
Beam Trawls				1
Bottom Trawls			8.5	
***Nephrops* Trawls**	2	1	1,228	3
Otter Trawls	81	198.5	1,199	1,954
Pair Trawls		2	2	11
Boat Dredge	353.5	491	418.5	320.5
Scottish Seines	5	120.8	12	72
Creels (covered pots)	405.5	1	113	283
Handlines and Polelines (manual)				446.17
Handlines and Polelines (technical)				1
Purse Seine operated by one vessel				1
Nephrops Twin Multitrawls		11	15.5	62
Otter Twin Multitrawls	2	24.5	16	387.5
Total	**849**	**849.8**	**3,021.5**	**3,542.17**

Commercial fishing is undertaken in the vicinity of the proposed Beatrice Wind Farm Demonstrator Project throughout the year, but the main fishing effort (days spent fishing) is concentrated in the periods July to January (Figure 4.32). In 2004 fishing effort within ICES rectangles 45E6, 45E7, 44E6 and 44E7 resulted in over 8,474 days of fishing. With respect to the location of the proposed Beatrice Wind Farm Demonstrator Project (ICES rectangle 45E6), fishing effort equated to 849.5 fishing days which is approximately 10% of all fishing effort for the area encompassed by ICES rectangles 45E6, 45E7, 44E6 and 44E7 (Figure 4.33).

Figure 4.32 Monthly fishing effort (days spent fishing) around the proposed Beatrice Wind Farm Demonstrator Project in 2004 [Source: FRS 2005].

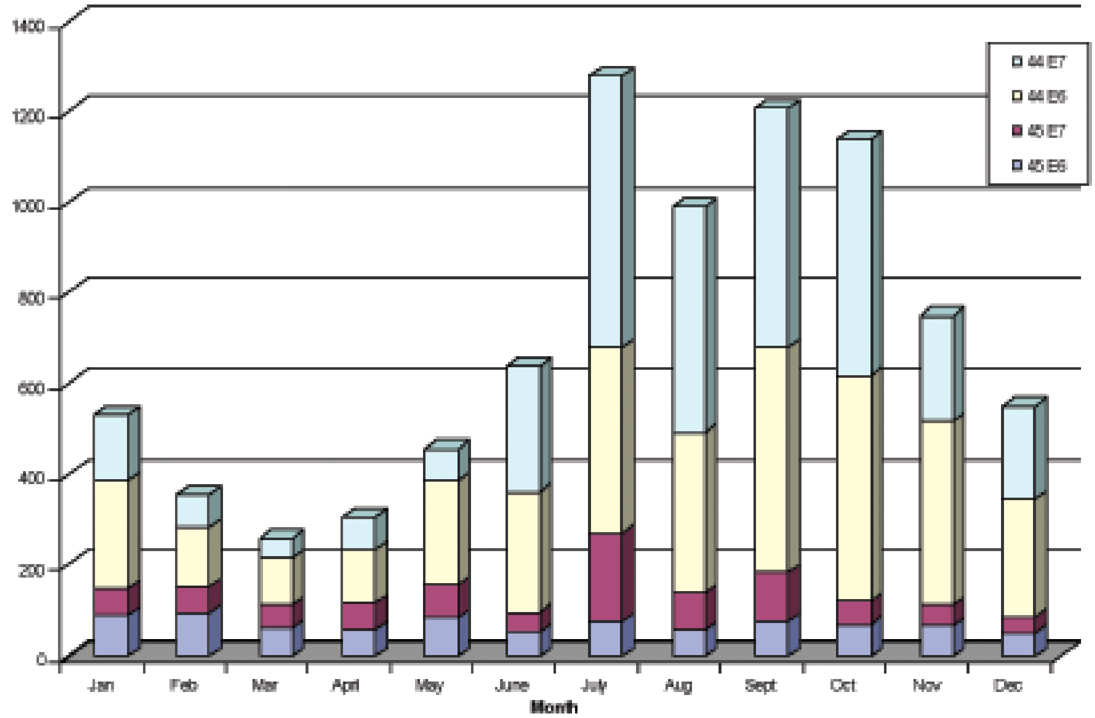
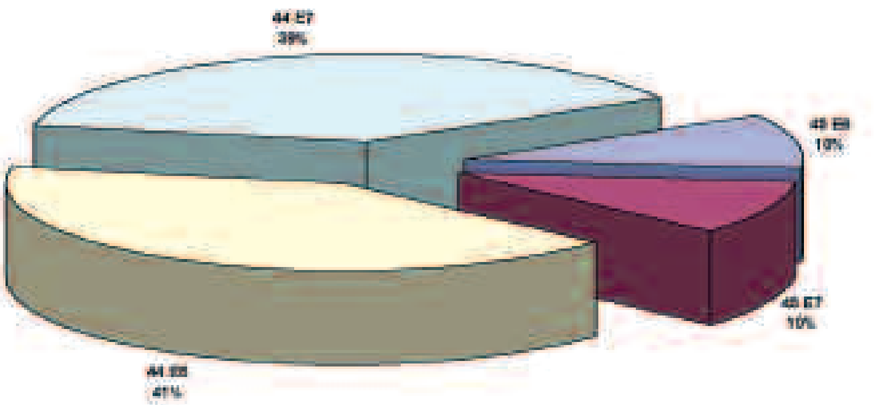


Figure 4.33 Proportion of fishing effort of each ICES rectangle in the vicinity of the proposed Beatrice Wind Farm Demonstrator Project in 2004 [Source: FRS 2005].



4.9.4 COMPOSITION AND VALUE

The total annual landings of all species by UK vessels in the vicinity of the proposed Beatrice Wind Farm Demonstrator Project in 2004 was 5,210 tonnes. Annual landings of all species from 45E6 totalled 633 tonnes, which is the equivalent to 12% of all landings within the vicinity of Beatrice. Landings were dominated by shellfish (scallops and *Nephrops*). The remaining landings were primarily demersal species including haddock, mackerel, monkfish, whiting and plaice. Landings of pelagic species contributed a very small percentage (<0.5%) and comprised predominantly herring (Table 4.20 and Figure 4.34).

Table 4.20 Main species landed by live weight (tonnes) in 2004 [Source: FRS 2005].

Species	Weight per ICES rectangle (tonnes)				Total weight (tonnes)
	44 E6	45 E6	44 E7	45 E7	
Scallop	373.94	321.776	299.353	547.671	1542.74
Nephrops	392.665	8.543	595.107	126.725	1123.04
Haddock	54.124	18.989	385.608	436.868	895.589
Squid	303.733	36.019	432.679	18.136	790.567
Edible crab	30.289	184.686	18.058	0	233.033
Mackerel	0.767	0.279	100.005	0.001	101.052
Velvet crab	34.817	23.132	21.907	0	79.856
Monkfish	12.086	3.254	36.56	24.098	75.998
Whiting	6.111	1.379	22.692	18.69	48.872
Plaice	2.603	0.096	26.502	7.323	36.524
Cod	1.756	0.76	21.356	10.373	34.245
Skates and rays	2.118	0.29	14.249	2.898	19.555
Megrims	0.877	2.631	0.35	10.454	14.312
Lobster	3.095	8.616	0.47	0	12.181
Lemon sole	0.456	0.255	7.347	2.562	10.62
Witches	1.308	0.265	4.965	2.059	8.597
Hake	0.018	0.07	1.569	6.51	8.167
Halibut	0.182	0.01	1.449	0.395	2.036

One of the most important fisheries in the northern North Sea is the mixed demersal fishery that targets cod, haddock and whiting; the fishery also takes a number of important by-catch species including saithe and monkfish (ICES 2003). The significant decline in the mixed demersal fishery (e.g. haddock and cod) over recent years, however, has led to the increasing importance of monkfish and *Nephrops* landings (DTI, 2004a).

Figure 4.34 Main species landed by live weight (tonnes) in ICES rectangles 45E6, 45E7, 44E6 and 44E7in 2004 [Source: FRS 2005].

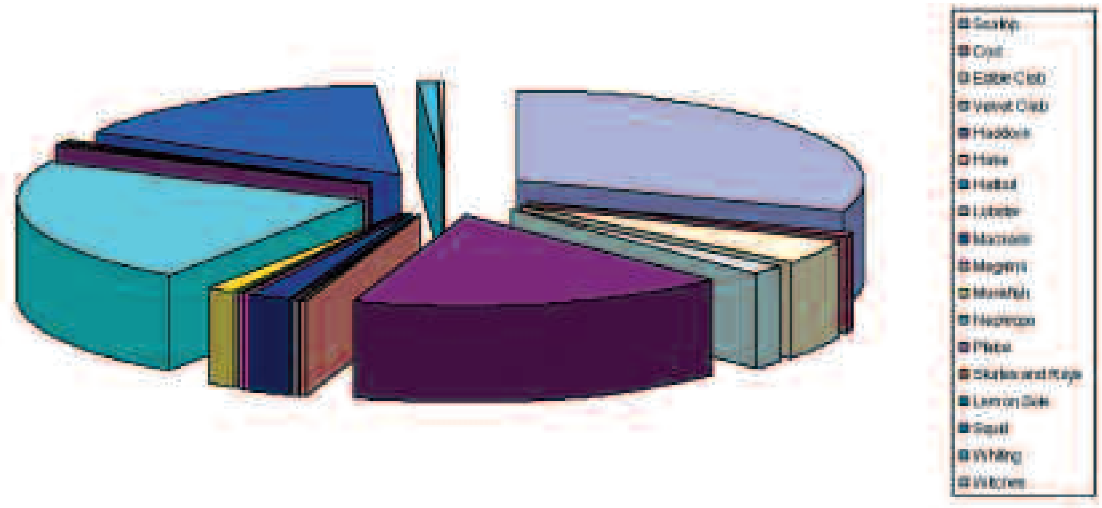


Table 4.21 Main value of species landed from ICES rectangle 45E6 in 2004 [Source: FRS 2005].

Species	**Value for 45E6 (£)**	**Total Value (£)**	**% of 45E6 value of total value**
Scallop	467,662	2,716,598	17.2
Edible crab	212,213	253,665	83.7
Lobster	97,963	137,361	71.3
Squid	73,741	2,049,961	3.6
Velvet crab	37,256	113,859	32.7
Nephrops	17,539	2,153,571	0.8
Haddock	11,069	540,615	2.0
Monkfish	5,101	138,465	3.7
Megrims	3,803	24,516	15.5
Cod	854	45,568	1.9
Whiting	729	24,383	3.0
Lemon sole	506	17,423	2.9
Witches	222	7,212	3.1
Skates and rays	147	7,516	2.0
Plaice	103	21,753	0.5
Mackerel	80	60,020	0.1
Halibut	34	8,351	0.4
Hake	8	8,867	0.1

From data provided by FRS (2005) the most important species landed in terms of value for ICES rectangle 45E6 are scallop, edible crab, lobster, squid and velvet crab (Table 4.21), where each species represents 17%, 84%, 71%, 3% and 33% respectively of the total landings for adjacent ICES rectangles in the vicinity of Beatrice.

Scallop and shellfish fisheries are important in terms of their economic value within the Moray Firth area and this has been stressed in the SEA 5 report, prepared by Chapman (2004) detailing the northern North Sea shellfish and fisheries. Scallop has been especially highlighted as having a high economic importance. Peak scallop landings occur July to September (Figure 4.35) and peak value corresponds with these months with the exception of April and May where scallop value is at its highest: (Figure 4.36). Historically, this has generally been the case (Chapman, 2004).

Figure 4.35 Total scallop landings by weight in 2004 for ICES rectangles 45E6, 45E7, 44E6 and 44E7 [Source: FRS, 2005].

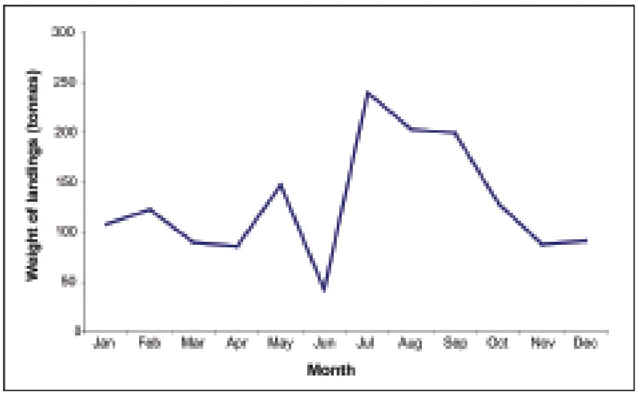
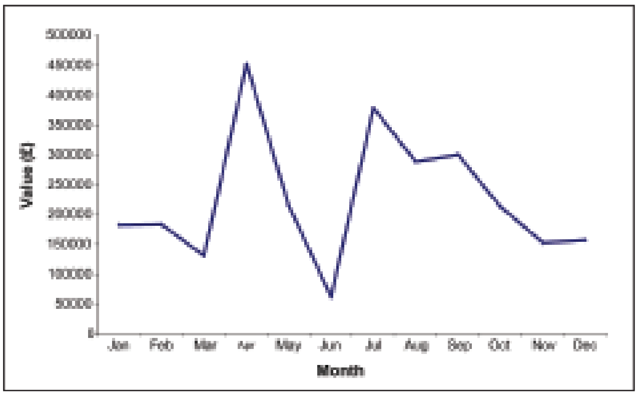


Figure 4.36 Total scallop value in 2004 for ICES rectangles 45E6, 45E7, 44E6 and 44E7 [Source: FRS, 2005].



4.10 SHIPPING AND FISHING VESSEL ACTIVITY

The Moray Firth has a high level of shipping activity, dominated by vessels associated with the fishing industry and the oil service industry. Since the physical presence of the two WTG units at some distance from the present Beatrice AP platform may pose a small additional risk to shipping in the area, an assessment was made in order to quantify the potential collision risk (Anatec, 2005). The results of this assessment, and the quantitative data on vessel types, routes and densities used to estimate potential collision risks, are presented in Section 12.1.

- *identify the shipping routes passing the Beatrice wind turbines*
- *identify the fishing vessel activity in the vicinity of the Beatrice wind turbines*
- *estimate the ship-to-turbine and fishing vessel-to-turbine collision frequencies associated with each turbine*
- *estimate the likely total impact energies.*

The assessment only considered third-party vessels, and excluded collision risks associated with vessels visiting the Beatrice oil field, e.g., supply vessels, and vessels visiting the wind farm once it becomes operational; e.g., for inspection and maintenance (Anatec, 2005). The risks associated with these vessels are not a major consenting issue and are likely to be assessed as part of the health and safety requirements of the project.

An additional analysis of fishing boat activity in the area of the Beatrice field was commissioned by Talisman and the results are summarised in Section 12.

4.11 OIL AND GAS DEVELOPMENTS

There are no other oil or gas facilities close to the Beatrice field. The nearest oil development to Beatrice is the Captain field, operated by Chevron, which lies 83km to the east in UKCS Block 13/22a (DTI, 2004c).

4.12 OTHER COMMERCE AND USERS OF THE SEA

4.12.1 DREDGING AND DISPOSAL AREAS

In 2003 and 2004 several sites in the Moray Firth were licensed for the disposal of dredge spoil, including sites in the south of the Firth off the coast of Burghead, Lossiemouth, Buckie (Findochty) and Macduff. The nearest disposal site to the wind turbines is off Lossiemouth, about 50km from Beatrice.

There are no designated dredge sites or ordnance dumping sites in the vicinity of the Beatrice field (DTI, 2004a).

4.12.2 MILITARY SITES AND ACTIVITIES

The MOD conducts both surface and subsea activities in several areas of the Inner and Outer Moray Firth, including an extensive area to the east of Orkney, extending south into the Moray Firth. The area is predominantly utilised by the Royal Air Force for various types of activities (DTI, 2004a). The types of activities conducted are detailed in Figure 4.37 and Table 4.22.

Figure 4.37. Military activity in the vicinity of the Moray Firth [Source: DTI, 2004c]

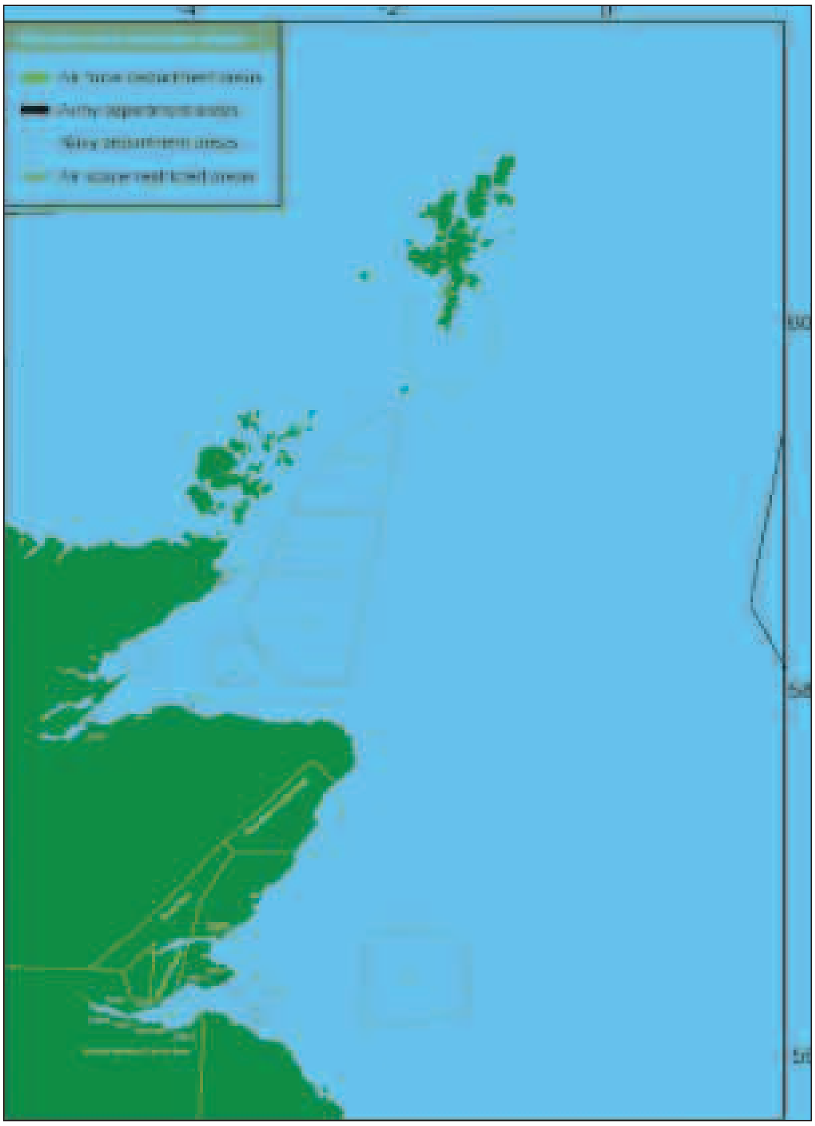


Table 4.22 Ministry of Defence (RAF) Activity in the Moray Firth (DTI, 2004c).

Serial No.	Name	Practice Type	Altitude (m)
D807	Moray Firth	Radar training buoy, B, firing	457
D809(N)	Moray Firth (North)	High/low angle gunnery; Air to sea or ground firing; Aircraft; Submarine exercises; Torpedo from ship or shore; Anti-submarine practice; Pilotless target aircraft; Air to air flying; H.M. Ships.	16,764
D809(C)	Moray Firth (Central)	High/low angle gunnery; Air to sea or ground firing; Aircraft; Submarine exercises; Torpedo from ship or shore; Anti-submarine practice; Pilotless target aircraft; Air to air flying; H.M. Ships.	16,764
D809(S)	Moray Firth (South)	High/low angle gunnery; Air to sea or ground firing; Aircraft; Submarine exercises; Torpedo from ship or shore; Anti-submarine practice; Pilotless target aircraft; Air to air flying; H.M. Ships.	16,764

Altitude = Altitude range above surface, m

4.12.3 SUBSEA POWER AND TELECOMMUNICATION CABLES

With the exception of the submarine power cable which runs from Dunbeath to the Beatrice Alpha production platform, there are no operational or disused subsea power or telecommunications cables in Block 11/30.

4.12.4 MARINE ARCHEOLOGY AND WRECKS

A total of 375 marine archeology sites have been identified along the Moray Firth coastline (Historic Scotland, 2003). Most of these are intertidal sites.

In addition to the marine archaeological sites, there are many wrecks in the Moray Firth including fishing boats, commercial vessels, and vessels and aircraft lost during both world wars. The locations of many wrecks have been logged on the wrecks database maintained by the UK Hydrographic Office, but the final resting place of many other vessels known to have been lost in the Firth is not known with certainty (UKHO, 2005).

The highest concentrations of wrecks are found at the mouth of the Moray Firth to the east of the Smith Bank, in the Cromarty Firth and along the southern Moray Firth coastline (Table 4.23).

Table 4.2.3 Key wrecks located in and around the Moray Firth [Source: www.shipwrecksofscotland.com; www.ww2inthehighlights.co.uk; www.bsactrvelclub.co.uk].

Name	History	Location
San Tibercio	Tanker hit by a mine in 1940	Moray Firth
Verona	Luxury yacht used by navy during WWI	
Tantivy	Submarine	
Unity	Small fishing boat	Lossiemouth harbour
Fram Bow	Sunk by U-boat	4 miles from Pennan harbour
Inverlane	Sunk by a mine	Near the Cromarty Firth
Gratafield	Tanker torpedoed in 1940	157 miles off the coast of Wick
Marsona	Small minesweeper lost in 1940	Outer Moray Firth
RMS Remuera	Torpedoed aircraft	Off the coast of Fraserburgh

In the Moray Firth there are no "restricted areas" under either The Protection of Wrecks Act, 1973 or The Ancient Monuments and Archaeological Areas Act 1979 (MCA, 2004).

The Protection of Military Remains Act 1986 (Designations of Vessels and Controlled Sites) Order 2002 is intended to protect wrecked military vessels and aircraft and any associated remains of personnel who lost their lives in them. It applies to all aircraft that have crashed and also to any ship of any nationality lost on military service in UK waters since 4th August 1914. The Act allows wrecks to be designated either as controlled sites or as protected places. To date six wrecks in Scottish waters have been designated as controlled sites, on which all intrusive activity (including diving) is prohibited without a licence from the MOD. Two of the designated controlled sites are located in the Moray and Cromarty Firth (Table 4.24) (MCA, 2004; English Heritage, 2005; UKHO, 2005).

Designation as a protected place allows a wreck site to be visited on a "look but don't touch" basis, though any intrusive activity would again require a licence from the MOD. There are no vessels designated as "protected vessels" under this Act in the vicinity of the Moray Firth (MCA, 2004; English Heritage, 2005; UKHO, 2005).

Table 4.24 Controlled sites designated under The Protection of Military Remains Act 1986 (Designations of Vessels and Controlled Sites) Order 2002 in the vicinity of the Moray Firth [Source: UK Hydrographic Office].

Name	Location		Distance from Beatrice
HMS EXMOUTH (WWII)	Moray Firth, North East Scotland	An area 750m radius around 58^{0}18'467"N 2^{0}28'938"W	40km East
HMA NATAL (WWI)	Cromarty Firth, North East Scotland	An area 100m radius around 57^{0}41'244"N 4^{0}05'310"W	76km South-west

4.13 TOURISM AND LEISURE

The Moray Firth can be divided into two distinct regions of interest: the Highlands (covering the north-east coastline from Wick to Nairn); and the Aberdeen and Grampian Highlands (covering the coastal trail from Elgin through to Stonehaven).

The Moray Firth extends northwards beyond the mouths of the Cromarty Firth and Dornoch Firth to Duncansby Head and eastwards along the Moray and Aberdeenshire coast to Fraserburgh. The waters of the Inner Moray Firth, which includes the Inverness Firth between Inverness and Fort George, stretch out as far as Helmsdale to the north and Buckie to the east and receive the waters of the Rivers Spey, Lossie, Findhorn and Nairn. The Outer Moray Firth beyond includes the Smith Bank. Bounded on two sides by over 500 miles (800km) of coastline, the Moray Firth has a diverse array of coastal landscapes (including sandy beaches, estuaries, cliffs and coves), an abundance of wildlife and an economy that thrives on tourism, fishing and the oil industry. In 1996 the Moray Firth Partnership was created, bringing together a wide range of people and organisations with a view to developing an integrated management plan for the complex area of sea, shoreline and coastal hinterland that makes up this so-called “super-firth”.

The Moray Firth provides a wide variety of land- and water-based recreational activities. Primary land-based activities include walking, cycling and orienteering. Along the coastline, many coastal pathways attract residents and visitors with respect to the wildlife and scenic coastal landscapes. Other land-based activities include off-road cycling and horse riding in forested areas and rock climbing along some of the coastal cliff sites. In addition, some of the best known golf courses in Scotland are located at Royal Dornoch and Nairn.

The primary water-based activities include sailing and wild-life watching. Eight sailing clubs and approximately 460 yachts and dinghies are based in the Moray Firth. Other activities include wind-surfing, surfing, scuba diving, power-boating and water skiing. The easily accessible and scenic beaches also encourage swimming and beach activities. Angling within the rivers surrounding the Moray Firth also contributes significantly to the economy. A study into the economic impact of water-based recreation on the River Spey has concluded that angling in the Moray, Badenoch and Strathspey Enterprise area generates £11.8m in revenue and supports 367 jobs. The report also shows that recreational water sports add a further £1.7m to the local economy and supports 42 jobs (Tourism and Environment Forum, 2004).

The last 10 to 15 years has seen general tourism in the area decline, but an increase in the establishment of niche tourist activities. Eco-tourism is a growing industry within the area, with visitors appreciating its varied and unspoilt scenery, and rich wildlife. It is estimated that the tourism market in the Highlands and Islands had a net annual expenditure of £84.5m in 2002-03, which in turn supported 1,651 jobs (Tourism and Environment Forum, 2005).

5 Project Consultation

5 PROJECT CONSULTATION

5.1 INTRODUCTION

Talisman has carried out an extensive programme of consultation with statutory consultees, non-statutory organisations, interested parties and the public. The purpose of the consultation programme was to ensure that the views and concerns of all stakeholders were fully understood and taken into consideration during the planning and preparation for the Demonstrator Project.

This section describes the programmes undertaken to complete the consultation exercise. The findings are presented in Table 5.1 which identifies the issues that were raised, and gives an initial response from Talisman. The views expressed during the consultation programme are incorporated in the detailed scoping assessment presented in Section 6.

5.2 PRELIMINARY SCOPING STUDY

An important aspect of the extensive consultation programme was the preparation and dissemination of a comprehensive consultation document – The Beatrice Wind Farm Demonstrator Project Scoping Report. The purpose of this report was to describe the potential environmental, socio-economic and visual impacts that might arise from the project to inform and stimulate the process of dialogue, consultation and project development. The scoping report was sent to many interested parties, and was made available on request in hard copy or via the internet as a download from www.beatricewind.co.uk.

5.3 CONSULTATION PROGRAMME

5.3.1 INTRODUCTION

The consultation programme included a series of Talisman-hosted events at various locations around Scotland over a period of several years, aimed at gathering the views of stakeholders and the wider public. The consultation culminated with the release of the scoping report and local consultation events throughout the Moray Firth region that invited the public to participate fully in the consultation.

In detail the consultation programme comprised:

- *preliminary consultation with selected organisations*
- *the production and dissemination of a comprehensive scoping report*
- *the ongoing publication of a newsletter called Windward*
- *the completion of a series of public exhibitions at local venues around the Moray Firth*
- *the maintenance of a website (www.beatricewind.co.uk) with project information and links*
- *written consultation with statutory consultees.*

Figure 5.1 Stakeholders participating in the Dingwall workshop, May 2005.

5.3.2 ORGANISATIONS CONTACTED

During the course of consultation, a wide range of organisations (Appendix 3) was contacted, either directly by Talisman or through the Moray Firth Partnership, and made aware of the proposal and/or invited to specific consultation events.

Statutory consultees were contacted by letter, and were given access to the scoping report (Talisman, 2005) either through the website or sent a printed copy. The specific purpose of these consultations was to identify:

- *important local issues and concerns*
- *issues of environmental importance that may affect the proposed development*
- *existing information that would be of assistance in the assessment of environmental effects*
- *the need for further consultation*
- *planning authority expectations and requirements for the ES and planning application*
- *the status of current and forthcoming planning policy documents.*

Other organisations and individuals contacted with respect to potential telecommunications and air traffic issues are identified in Section 12.

5.3.3 PUBLIC CONSULTATIONS

Early workshops on the concept of a wind farm development associated with the Beatrice platform were conducted in 2003 with key environmental stakeholders to review potential environmental issues of the development concept. Discussion at these events built upon an early report commissioned by Talisman (Talisman, 2001) to identify key environmental issues and potential consenting processes.

Talisman has consulted on the proposal with a broad range of fishermen and fisheries interest representatives.

This has been conducted through specific Moray Firth Partnership Fisheries Action Group seminars, presentation to the UKOOA fisheries liaison seminar, and through direct discussion at other consultation events.

Public consultation was carried out by means of local consultation events, newspaper articles, radio broadcasts, posters, a website and a newsletter. To advertise the events widely, public notices were placed in 11 local and regional newspapers covering the full Moray Firth region and several TV and radio interviews were given to further publicise the exercise.

A series of open meetings for interested individuals and members of the public was then conducted on the following dates and locations:

Wick	25th July	Cromarty	22nd August
Lybster	26th July	Inverness	23rd August
Helmsdale	15th August	Nairn	24th August
Brora	16th August	Burghead	25th August
Golspie	17th August	Buckie	29th August
Dornoch	18th August	Banff	30th August
Tain	19th August	Fraserburgh	31st August

To further publicise the event and the opportunity to consult locally, Talisman distributed posters giving the dates and locations of all the presentations to the following groups, with a request that they be displayed:

- *all community centres in the target area*
- *all libraries and mobile libraries*
- *all Harbourmasters*
- *all venues used for the meetings*
- *all local fisheries offices.*

Every person who requested either a scoping report, newsletter or enquired about some aspect of the project was contacted personally with an invitation to attend the local consultation event.

This intensive coverage ensured that if an interested party could not attend their preferred location, they had information concerning alternatives.

At each local consultation event, presentations were given throughout the day, from noon to 8pm, so that people could attend at a time convenient to them. Information about the project was freely available at all presentations, and members of the public were encouraged to formally submit comments. Approximately 200 people visited the local consultation events.

5.3.4 CONSULTATION MEETING AT DINGWALL, 6TH MAY 2005

As part of the consultation for the project, Talisman asked the Moray Firth Partnership (MFP) to organise a meeting specifically to discuss the scoping report.

The Moray Firth Partnership was established in 1996 to provide a forum to share information, discuss, plan and implement integrated ways of addressing issues arising from the many competing demands on the Moray Firth. Its mission is "to promote integrated management of the natural, economic, recreational and cultural resources of the Moray Firth area in order to retain and enhance a high quality of life for all its residents and visitors". The Partnership, which is a limited company and Scottish charity, is a voluntary coalition of a wide range of organisations and individuals, with over 600 members. Membership is free and open to anyone with an interest in the Moray Firth. Members include local authorities and statutory agencies, fishing interests, port and harbour authorities, oil and other commercial interests, local community and recreation groups, and individuals who live, work and have an interest in the Firth.

The meeting at Dingwall was aimed at representatives of organisations, community and interest groups. Its purpose was to provide an opportunity for comment on how well the scoping report covered the issues, what else needed to be done to identify and address issues, any further concerns on, and benefits to be gained from, the proposal and how different stakeholders would like to be involved in the consultation process proposed through 2005.

The meeting was attended by 47 participants who came as individuals or representing a wide range of organisations including community councils, local authorities, fishermen's organisations, salmon boards, Aberdeen University, environmental organisations, harbour authorities, agencies and government. Six representatives from the Demonstrator Project attended and three from the Moray Firth Partnership.

The workshop received a presentation from Talisman on the proposed wind farm Demonstrator Project, and then split into five working groups to discuss and present: (1) their views on the project; (2) the environmental and other risks that the project might present; (3) the environmental and economic benefits that the project might bring; (4) their views on the scoping report; and (5) their suggestions for further consultation.

A full description of the event, the participants, and its outcomes may be found on www.morayfirth-partneship.org/Talisman.html. During the event, many questions were asked regarding technical, economic, social, environmental and safety aspects of the project. Answers to all these questions may be found at the above website, and the main environmental questions, with Talisman's response, are included in Table 5.1.

A short presentation on the proposed Demonstrator Project was given by Talisman at the Moray Firth Annual conference, on 23 May 2005. Environmental questions raised following this presentation are included in Table 5.1.

5.3.5 RESULTS OF CONSULTATION PROGRAMME

Talisman has also summarised the key questions raised during the consultation programme on the project website, www.beatricewind.co.uk.

Table 5.1 provides a summary of the issues raised by consultees, and Talisman's initial responses regarding actions taken to address these concerns. All of the issues listed in Table 5.1 are examined in more detail in Sections 6 to 13 of the environmental statement.

Table 5.1 Summary of statutory and non-statutory conservation designations.

ISSUES RAISED	TALISMAN'S RESPONSE
Highlands and Islands Airports Ltd	
Assurance required that the radar service provided from RAF Lossiemouth to Inverness and Wick will not be affected. Consultation should be undertaken with Defence Estates to address this issue.	An assessment of the potential impact on the radar service has been carried out (Section 4).
Joint Nature Conservation Committee	
Consider a bird radar study.	A bird radar study has been initiated.
Establishment of baseline: A discussion of, and justification for, the selection of baselines should be included in the ES, particularly with respect to establishing a baseline for measuring effects on sediments and benthic communities and on seabirds and cetaceans.	A detailed review of the baseline conditions in the Beatrice field has been completed (Section 4).
Data on seabird presence and activity in the area should be robust.	A comprehensive review of data has been undertaken, and a year-long survey programme completed in the Beatrice field (Section 4).
Impacts on sand and sediment flow: Site-specific survey data should be included in the ES, to enable survey work to determine the precise location and method of piling and cable-laying.	A detailed description of methods for cable laying and piling is given in the ES (Section 3).
The absence of *Modiolus modiolus* beds at the site and along the cable route should be established as a minimum.	A site-specific seabed survey using side-scan sonar has been carried out. No evidence was found of the presence of *Modiolus* reefs (Section 4). In addition Talisman conducted a benthic survey to verify consistency with past surveys of the region and carried out oil and heavy metal analysis of sediments.
The ES should contain information about sediment displacement and suspension caused by construction works (including cable laying), justify the type of scour protection used at the base of the wind turbine generators and seek to quantify the level of scour that may occur during the life of the project.	The issue of sediment displacement and scour protection has been assessed ES (Section 8).
Impacts on designated species: Disturbance to breeding sites and resting places even where not within Natura sites should be avoided, in accordance with the Birds Directive, the Habitats Directive, national legislation and European obligations.	It is not anticipated that there will be any effects on breeding sites used by birds or marine mammals. The potential impact on areas used by designated species for other purposes has been fully assessed in the ES (Section 13).
The discussion of each predicted impact should consider how that impact might affect each relevant designated receptor species. Impacts on relevant Annex I Birds Directive, species and Annex IV Habitats Directive, species should be specifically discussed.	The potential impacts of the proposed Demonstrator Project on each designated species have been fully assessed (Section 8 to 13).

Table 5.1 (cont) *Summary of statutory and non-statutory conservation designations.*

ISSUES RAISED	TALISMAN'S RESPONSE
Joint Nature Conservation Committee *continued*	
Impacts on seabirds: It should be considered whether or not collision modelling would be appropriate to the proposals.	Collision risk modelling has been considered using both the SNH model and a refinement of the method, using site-specific data gathered over one year (Section 12).
Reference should be made in the ES to Pettersson, J. (2005) *The Impact of Offshore Windfarms on Bird Life in Southern Kalmar Sound, Sweden,* Lunds Universitet/Swedish Energy Agency.	The information in this report was taken into consideration when assessing potential impacts on birds.
Non-qualifying species: Impacts on a number of species and habitats not protected by legislation should be considered in the ES. Discussion of the relevant species and habitats listed within the UK Biodiversity Action Plan (UKBAP) should be included both within the description of the environmental setting of the project and within the appraisal of impacts.	The potential impacts on those species and habitats listed in UKBAP that are present in the Moray Firth have been assessed in the ES (Section 13).
Noise and marine mammals: The impact on the Moray Firth dolphins, and on other cetacean species, should be fully considered.	The potential impact of noise on marine mammals has been fully assessed using predictive models and site-specific survey data (Section 9).
Since suction piling is the preferred method of construction for this project, JNCC are unsure how data on deepwater pile driving would be available to fully assess the use of driven piles on any full-scale project, and how noise models supporting an environmental assessment of any full-scale project would be verified. JNCC would welcome further discussion on this point.	The two WTGs will be installed using driven piles. The Demonstrator Project itself will provide site-specific data to inform the modelling that might be undertaken in the future for any possible commercial wind farm.
Modelling of source noise levels for the deepwater driven piling operations prior to the construction of the project may be more appropriate than providing assessment data, to inform the assessment of effects of future developments, after the installation of the project.	The source levels expected from pile driving have been modelled and are presented in Section 9. Measurements of actual underwater noise levels will be gathered during installation.
Impacts on cetaceans caused by vessel and helicopter movements involved in the maintenance, maintaining or promotion of the project should be considered. Further consideration of maintenance activities should be made in the ES.	The potential effects of vessels, helicopters and maintenance activities have been quantified and assessed (Section 9).
Impacts on designated sites: The multiple designations attached to various sites of conservation importance mean that the ES must make clear which impacts are being assessed.	It is recognised that the proposed Demonstrator Project may have one or more effects on one of more of the qualifying interests of designated sites. Where appropriate, these have been examined separately in the ES (Section 8 to 13).

Table 5.1 (cont) Summary of statutory and non-statutory conservation designations.

ISSUES RAISED	TALISMAN'S RESPONSE
Joint Nature Conservation Committee *continued*	
Where it can be concluded that a site or qualifying feature/species will not be impacted upon by the proposals, then this should be specifically stated in the ES.	The ES makes clear those features and/or species of a designated site that might be impacted and those that are not likely to be impacted.
Predicted impacts on individual sites (and, in the case of qualifying species, impacts upon specific populations using those sites) will need to be quantified in the ES.	Wherever possible, the magnitude of any potential impact on sites, species or features has been quantified in the ES.
Future marine SACs and SPAs: In terms of the work currently underway to identify and designate marine SPAs and SACs, there are likely to be three main categories of marine SPA – seaward extensions of existing colonies, inshore marine areas used in non-breeding seasons and marine feeding areas.	A detailed and up-to-date review of SACs and SPAs has been carried out. The potential for the proposed Demonstrator Project to impact any aspect of a SAC or SPA has been rigorously assessed (Section 8 to 13).
There are currently no sites formally identified and notified to DEFRA by the JNCC as being suitable for marine SACs in the area of the Beatrice proposals. However, further consideration of Annex I Habitats is being carried out.	As far as it was possible so to do, the establishment of marine SACs was taken into consideration during the review of potential impacts.
Visual and landscape effect of WTG units: The CCW Contract Science Report No. 631 *"Studies to inform advice on offshore renewable energy developments: visual perception versus photomontage",* Symonds Group Ltd, should be referred to when assessing visual impact.	This report, and many other guidelines and reports, informed the process of undertaking the visual impact of the proposed Demonstrator Project (Section 11).
Royal Society for the Protection of Birds	
The EIA must assess any possible impact upon the qualifying interests of the East Caithness Cliffs Special Protection Area (SPA) and other designated sites in the area. Bird surveys should be undertaken on both the development site and extend into the SPAs to ensure that there is adequate knowledge of the distribution of birds that could potentially be affected by the proposed development.	The scope of the bird survey programme that has been undertaken at Beatrice, and the scope of the subsequent assessment of potential impact of the proposed Demonstrator Project, have been discussed and agreed with RSPB. It has been agreed that a survey of birds in the onshore SPAs themselves would not be appropriate for an offshore Demonstrator Project of this size.
According to Article 4 of EEC Directive 79/409 on The Conservation of Wild Birds, member states must *"strive to avoid pollution or deterioration of habitats"* for all wild birds, and particularly those listed in Annex I, outside SPAs.	The potential impacts on birds has been fully assessed, using data from the literature, historical data from surveys of the Moray Firth, and site-specific data for a year-long monitoring programme in the Beatrice field.

Table 5.1 (cont) Summary of statutory and non-statutory conservation designations.

ISSUES RAISED	TALISMAN'S RESPONSE
Royal Society for the Protection of Birds *continued*	
Work required: RSPB would like to see two years' worth of baseline data but as a minimum one full year (e.g. one non-breeding and one breeding season) for the proposed Demonstrator Project. The degree to which individual birds move around or are faithful to patches when foraging is critical in assessing impact on the SPA. The size of catchment for birds using the proposed area and the frequency of foraging trips (diurnally) should also be addressed. Seasonal patterns and the effect of weather and shipping should also be considered.	Two years of baseline data for the Beatrice field were gathered in 1982 and 1983. Talisman's additional one-year study is designed to provide validation of some of the findings of this study, and give greater detail of birds in the proposed development area. This year-long monitoring programme based on the Beatrice Alpha platform has assessed: • the presence of different bird species in the area of the WTGs • the numbers of birds present • their presence and numbers in the area in which the proposed demonstrator WTGs would be located • the activities undertaken by birds in the area (flying, swimming, feeding, resting) • diurnal and seasonal changes in species richness, bird numbers, and behaviour • the presence of any obvious "fly-ways" used for diurnal or seasonal migration.
The effect of navigation lighting on the species associated with the site, as well as those that migrate across the area, should be considered.	A review of the literature has been undertaken to assess the magnitude of this effect from two WTG units.
Potential effects on fish stocks either negative or positive should be considered.	The potential effects of the installation and operation of the two WTG units on stocks of fish and shellfish have been assessed (Section 8).
In addition to using a combination of radar and visual monitoring to establish the pattern of use of breeding and other seabirds in the area, RSPB recommends that: • a control site is monitored • observations are undertaken throughout the year observations are undertaken over a two-year pre-construction period and a remote monitoring system is put in place, based on the recommendations from the current COWRIE research study. The RSPB's *Guidance on methods for studying birds in relation to offshore wind farms* should be followed particularly with respect to baseline monitoring.	The potential impacts on birds has been fully assessed, using considerable baseline data from the literature and data from historical surveys of the Moray Firth, as well as site-specific data from a year-long monitoring programme in the Beatrice field. A remote monitoring study is being developed using radar which it is hoped will provide new data on seabird movement in relation to the turbines. Talisman believes that the work undertaken so far is appropriate and proportional to the size and location of the proposed Demonstrator Project. It is stressed that one of the main purposes of the project is to gather more information about the potential impacts of offshore wind farms.

Table 5.1 (cont) Summary of statutory and non-statutory conservation designations.

ISSUES RAISED	TALISMAN'S RESPONSE
Scottish Fishermen's Federation	
The wind farm proposals will present challenges to the fishing community, and the Federation should be kept abreast of developments and regularly consulted in respect of the wind farm proposals. Scallop fishermen, though minimally concerned with the demonstrator stage development, raised concerns of a potential lack of access to fishing grounds should the commercial development gain approval. In addition, they were concerned about the level of disturbance that would occur during construction phases.	Talisman's fisheries liaison officer has been in frequent contact with the Scottish Fishermen's Federation during the build-up to the project. Since the project was publicly announced, the SFF has been consulted regularly about the proposed Demonstrator Project. Talisman is working to minimise the overall construction activities to meet their environmental objectives, in line with the concerns of the fishermen and their associations. The current proposal is designed to pose the least disruption to the area and industry. Should a commercial development be planned, concerns of access will be addressed on an individual basis.
Scottish Natural Heritage	
Policy Considerations: Reference should be made to SNH's Policy Statement on Marine Renewable Energy and the Natural Heritage.	Noted.
Nature Conservation Designations: The ES should address likely impacts on the international, national and locally designated terrestrial sites located around the coastline and any mitigation required, including any information required if an Appropriate Assessment is likely to be required to be undertaken by the competent authority (DTI) under the Habitats Directive.	Effects on the qualifying interests of designated sites have been examined in the ES (Section 8 to 13).
The locations and qualifying features of the SPAs and SACs along the Moray Firth coastline should be adequately identified.	A detailed and up-to-date review of SACs and SPAs has been carried out. The potential for the proposed Demonstrator Project to impact any aspect of an SAC or SPA has been rigorously assessed (Section 4 and 13).
The ES should assess all possible impacts, both direct and indirect, on features of European importance. All impacts related to European Protected Species will require to be assessed.	Effects on the qualifying interests of designated sites have been examined in the ES (Section 13).
Ecology. Baseline surveys: Rigorous and robust methodologies to collect and assess data should be devised, which allow the assessment of potential impacts (direct and indirect). SNH is concerned that there may be insufficient data against which to assess impacts and for Talisman to demonstrate that there will be no adverse effect on the integrity of European sites.	Talisman has initiated several site-specific studies and surveys, including ornithological observations offshore, seabed benthic surveys, and cetacean acoustic monitoring surveys. These were discussed with key consultees and are designed to provide specific data to inform the detailed assessment of the proposed two WTG Demonstrator Project.

Table 5.1 (cont) Summary of statutory and non-statutory conservation designations.

<table>
<tr><th>ISSUES RAISED</th><th>TALISMAN'S RESPONSE</th></tr>
<tr><td colspan="2">Scottish Natural Heritage continued</td></tr>
<tr><td>Birds: SNH recommends that survey work should span all periods when birds are present during at least one full year. All survey methodologies should be agreed with consultees and should consider:
• appropriateness to species present with particular emphasis on sea ducks, sea birds and geese
• records of presence, numbers, distribution, population turnover and seasonal change
• baseline information and surveys of the Demonstrator Project area and the wider Moray Firth for different species and the influence of weather conditions, and should also include night-time surveys
• assessment of local, regional, national and international significance of species present
• an assessment of potential disturbance and avoidance arising from the operation of the Demonstrator Project
• an assessment of the collision risk for sea birds, sea ducks and geese/swans.
Assessments should consider the construction and operational phases of the project and detail any impacts identified and any mitigation proposals. Post-construction monitoring schemes, if the Demonstrator Project goes ahead, should also be detailed and, if necessary, a control site against which to compare the results should be identified.</td><td>The potential impacts on birds has been fully assessed, using the existing two-year baseline, data from the literature, historical data from surveys of the Moray Firth, and site-specific data for a year-long monitoring programme in the Beatrice field.
A year-long monitoring programme based on the Beatrice Alpha platform has been completed. This has assessed:
• the presence of different bird species in the area of the WTGs
• the numbers of birds present
• their presence and numbers in the area in which the proposed demonstrator WTGs would be located
• the activities undertaken by birds in the area (flying, swimming, feeding, resting)
• diurnal and seasonal changes in species richness, bird numbers, and behaviour
• the presence of any obvious "fly-ways" used for diurnal or seasonal migration.
The ES provides a description of the future monitoring and other work that will be undertaken around the demonstrator site, including studies that will be completed as part of the European DOWNVInD project.</td></tr>
<tr><td rowspan="2">Marine Mammals: All survey methodologies should be agreed with consultees to include:
• an assessment of the significance of impacts on local, regional, national and international species present
• records of presence recorded, including seasonality, utilisation of the Moray Firth, feeding areas and any breeding behaviour within a localised context of the Demonstrator Project and the wider Moray Firth.
When surveying bottlenose dolphins, it should be identified whether any surveyed are part of the resident Moray Firth population.</td><td>Talisman has initiated several site-specific studies and surveys, including cetacean acoustic monitoring surveys. These were discussed with key consultees and are designed to provide site-specific data to inform the detailed assessment of the proposed two WTG Demonstrator Project.</td></tr>
<tr><td>Surveys of marine mammals were undertaken by the University of Aberdeen Lighthouse field station. Data have been analysed to determine if it is possible to say with any certainty if members of the resident population of bottlenose dolphins are among those cetaceans frequenting the demonstrator site.</td></tr>
</table>

Table 5.1 (cont) Summary of statutory and non-statutory conservation designations.

ISSUES RAISED	TALISMAN'S RESPONSE
Scottish Natural Heritage *continued*	
Fish: The ES should provide detail of how impacts on fish of conservation importance, particularly salmon, will be assessed. Consideration of impacts during construction and operation will be required to assess whether or not traditional salmon migratory routes/behaviour will be impacted, particularly migratory routes to and from spawning grounds. Basking shark distribution/presence should also be addressed during both construction and operation with any likely impacts identified and, if necessary, mitigation proposed. The Moray Firth supports commercial fin and fishery interests. Consideration of impacts arising during construction and operation will be required, with mitigation proposals, with consideration given to potential impacts on conservation species and habitats.	The potential effects of the Demonstrator Project on fish have been assessed. This has included an assessment of the installation, operation and decommissioning of the two WTGs and the umbilicals linking them to the existing Beatrice AP platform (Section 8). The ES has examined potential impact on commercial fish and shellfish, salmon, and basking sharks.
Marine Benthos and Invertebrate Species: Marine benthic and invertebrate communities survey methodologies should be agreed with consultees, and SNH would recommend that the JNCC Marine Monitoring Handbook – Procedural Guidelines is referred to.	A site-specific seabed survey of the location has been carried out, to inform the assessment of potential impacts on the benthos (Section 4). The acoustic survey methodology was discussed and agreed with the JNCC.
Wider consideration of how the Demonstrator Project impacts on the eco-system as a whole will also be required.	An assessment has been made in the ES of the wider potential effects of the Demonstrator Project on the Moray Firth.
Impacts on sandbanks and coastal processes: SNH recommends an assessment on potential sediment transport and patterns of sedimentation and erosion within the vicinity of the two turbines. If there is any potential for increased turbulence around structures, due to wave reflection and consequent suspension of fine sediments, this will need to be addressed within the ES.	This has been assessed with respect to information on the superficial seabed sediments, and the hydrographic regime in the vicinity of the Beatrice field. Because of the small scale of the two WTG Demonstrator Project, and the relatively small size of the substructures, measurable effects on sediment transportation are not anticipated.
Any assessment should also address the potential for climate change, e.g. assess how sea level change and storminess may affect the project.	These aspects were taken into consideration when designing the substructure and assessing the operating parameters for the turbines.
Landscape and Visual Impacts: Any methodology for landscape and visual impact assessment should follow *The Guidelines for Landscape and Visual Impact Assessment, The Institute of Environmental Assessment* and the Landscape Institute, 2nd edition, 2002. For the assessment of seascape, *the Guide to Best Practice on Seascape Assessment* (2001), CCW/Brady Shipman Martin and University College Dublin, should be referred to.	These guidelines, and many other guidelines and reports, informed the process of undertaking the visual impact of the proposed Demonstrator Project (Section 11).

Table 5.1 (cont) Summary of statutory and non-statutory conservation designations.

ISSUES RAISED	TALISMAN'S RESPONSE
Scottish Natural Heritage *continued*	
Landscape/seascape and visual impacts should be considered separately. This separation will also be required for the consideration of cumulative impacts.	Where appropriate, landscape and seascape effects have been considered separately. Final selection of viewpoints was undertaken after consultation.
Cumulative impacts with onshore wind farms located within the radius of the 60km ZVI should be assessed.	Cumulative impacts with other existing or planned wind farms (for which location data are available) has been undertaken.
Consideration should also be given to any onshore assembly sites and whether any landscape and/or visual impacts will arise from this temporary facility.	Potential visual impacts at onshore assembly sites have been considered.
Recreation, Access and Use: Assessment of impacts on commercial and recreational shipping will need to address any navigational closures and safety requirements that may impact on other interests, e.g. lighting on the turbines which may increase bird collisions, etc. Consideration should be given to impacts arising from the increased boat traffic for maintaining the turbines, and also from the fact that structures are present where previously there were none.	Potential effects on commercial shipping and other users of the sea have been assessed in detail. The HSE has confirmed that the two WTGs will become 'supplementary units' as defined in the Offshore Installations and Pipeline Works (Management and Administration) Regulations 1995. They will thus effectively become part of the Beatrice installation and will therefore attract an automatic 500m safety zone around them, in accordance with Section 21 of the Petroleum Act 1987. Maintenance activities will be carried out using small vessels deployed from the existing Beatrice platform.
Whale and Dolphin Conservation Society	
Specific questions were raised regarding the planned methods of mitigation to protect marine wildlife from any potential impacts both during construction of the wind farm and its subsequent operation.	Potential impacts and effects of the construction have been evaluated. This has influenced the planned mitigation measures which are likely to include both engineering and non-engineering solutions.
The White Fish Producers Association Ltd	
Consultation should take place at an early stage in the development with our members and representatives.	The White Fish Producers Association has been consulted, and is being kept informed about progress with the proposed Demonstrator Project.
Issues raised by members of the public during the local consultation events	
During the local consultation events members of the public made the following comments, or asked questions or raised concerns about the following issues: • Most people had little or no concern with two turbines being located far offshore, but a few people said they may not be happy with a wind farm, on the basis that they would experience a change in the view from onshore. All respondents said they would have no problem with a wind farm offshore that could not be seen from onshore.	The visual impact of the WTGs has been fully assessed in the ES Section 11.

Table 5.1 (cont) Summary of statutory and non-statutory conservation designations.

ISSUES RAISED	TALISMAN'S RESPONSE
Issues raised by members of the public during the local consultation events *continued*	
• Some people had concerns about transferring the electricity from an offshore wind farm through the Highlands and into the grid to the south. Large pylons were a cause for concern, and most, if not all, people preferred a subsea route to somewhere south of the Highlands to join the grid.	The Demonstrator Project will only supply electricity locally to the Beatrice platforms, not to the national grid. No electricity pylons will be built onshore for this project.
• A few people questioned the impacts of noise and vibration from the two turbines and the effect on people, fish, cetaceans and birds.	The potential effects of noise and vibration on birds, fish and cetaceans have been fully assessed in the ES (Section 10).
• A few people were concerned about birds flying into turbine blades.	The potential collision risk for birds has been assessed in the ES (Section 10).
• The fishermen at Burghead were concerned about wind farms in the Moray Firth shutting out vast areas to traditional fishing activities in the area.	The two WTGs of the Demonstrator Project, and the short lengths of buried umbilical linking them to the Beatrice AP platform, will not result in any significant impact to existing commercial fishing operations. The HSE has confirmed that the two WTGs will become 'supplementary units' as defined in the Offshore Installations and Pipeline Works (Management and Administration) Regulations 1995. They will thus effectively become part of the Beatrice installation and will therefore attract an automatic 500m safety zone around them, in accordance with Section 21 of the Petroleum Act 1987.
Environmental issues during the Consultation Workshop at Dingwall, May 2005. (Edited from MFP website)	
What are the environmental implications?	The Demonstrator Project will have minimal impact on the environment, although it will undergo a detailed Environmental Impact Assessment (EIA). The full project would also be subject to a dedicated EIA.
What about noise pollution during construction/ operation phases?	The noise generated during construction will be fully described in the environmental impact statement. Talisman will minimise the noise generated from the project and mitigate the impact on the environment by adhering at all times to the procedures agreed with the UK Regulatory Authorities. Given the distance of the demonstrator from the shore, about 25km, there will be no impact on the local population. During operation of the turbines, the noise generated will not be significant and given the distance from the shore will have no impact on the local population. The design of the structures will minimise any transfer of noise to the marine environment.

Table 5.1 (cont) Summary of statutory and non-statutory conservation designations.

ISSUES RAISED	TALISMAN'S RESPONSE
Environmental issues during the Consultation Workshop at Dingwall, May 2005. (Edited from MFP website) *continued*	
Will there be any risk to dolphins, birds, or fish?	The DOWNVInD Project will undertake comprehensive studies of the effect of offshore wind farms in the Moray Firth on birds, fish and cetaceans. The impact on these animals and their environment will be fully addressed in the environmental impact statement. The DTI and its statutory consultees and others will provide expert advice during the environmental impact assessment process. Talisman will work with these organisations to ensure that only techniques which pose no threat to these animals are used or effective management and mitigation measures are developed.
What impact will the two turbines have on bird migration?	We do not know at this stage. Our environmental study programme will address this and includes evaluation studies run from the Beatrice platform. These results, together with complementary research being carried out by the Swedish participants in DOWNVInD, will be publicly available.
How visible from the shore both at night (lights) and during daytime will the demonstrator be? Will the turbines be lit?	The distance from shore, about 25km, will minimise the visual impact of the demonstrator. The Government consultation "Future Offshore" stated that developments located more than 15km from shore would have negligible visual impact. There will be statutory navigational lights on the turbines, but given the current lighting in the Beatrice field there will be minimal incremental effect. The level of lighting will be determined by a standard being developed to ensure marine and aviation safety whilst selecting appropriate lights to mitigate visual impacts onshore.
Will there be an exclusion zone around the turbines?	We have recently had a direction on this issue from the HSE. The two WTGs, as described, will become 'supplementary units' as defined in the Offshore Installations and Pipeline Works (Management and Administration) Regulations 1995. In this respect they will become effectively part of the Beatrice Installation. They will therefore attract an automatic 500m safety zone as per Section 21 of the Petroleum Act 1987.
Has there been any consultation with fisheries bodies with regard to this project? Is there any danger to fishermen fishing near the demonstrator?	Full consultation will continue with statutory consultees and all other interested parties including fisheries bodies.
Could one of the two turbines have anti-fouling on it and the other not, to see the difference?	We do not use any active anti-fouling on our oil platforms and do not intend to use anti-fouling on the WTG units. All steel surfaces will be protected from corrosion by a glass flake-epoxy based coating with zero added biocide activity.

Table 5.1 (cont) Summary of statutory and non-statutory conservation designations.

ISSUES RAISED	TALISMAN'S RESPONSE
Environmental issues during the Consultation Workshop at Dingwall, May 2005. (Edited from MFP website) *continued*	
What is the height of the turbines? Will that impact on the interests of the MOD?	The hub of the turbine will be 88m above sea-level. The blades are 63m long. The MOD is aware of the project and has acknowledged that it has no concerns with the proposal.
What are the long term plans after five years?	The two demonstrator turbines will displace power supplied to the Beatrice platform from the national grid for the duration of the Demonstrator Project or the commercial life of Beatrice, whichever is the longer. After this time the turbines would either be decommissioned with the Beatrice platform or incorporated into a commercial development.
Will the turbines be removed at the end of five years?	While the turbines are prototype machines, assuming they are still operational at the end of the Demonstrator Project they will form part of the oilfield infrastructure and remain there until the field is decommissioned. If the demonstrator proves successful the turbines could remain in situ and form part of a commercial wind farm development.
Environmental question raised after presentation on wind farm to the Moray Firth Partnership Annual Conference, 23 May 2005. (Edited from MFP website)	
What will be the effect of vibration transmitted through the structure by the turbines?	There is at present no real knowledge on this aspect and it will be closely monitored as part of the assessment process.

6 Scoping Potential Environmental Impacts

6 SCOPING POTENTIAL ENVIRONMENTAL IMPACTS

6.1 INTRODUCTION

A range of activities associated with the proposed project may affect the environment. These include routine events and accidental and emergency situations. This section identifies and ranks the environmental and socio-economic risks that could arise directly or indirectly from routine, accidental and emergency situations during the lifetime of the Demonstrator Project. It includes those concerns expressed, and issues raised, by stakeholders during consultation, and presents the outcome as a matrix which identifies the main potential environmental risks associated with the Beatrice Wind Farm Demonstrator Project.

6.2 METHOD USED TO SCOPE POTENTIAL IMPACTS

6.2.1 METHOD

In the light of the findings of the scoping report, and the information and feedback received during the consultation exercise, Talisman identified a range of activities and operations that could affect one or more environmental receptors. The potential significance of each of these potential environmental risks was assessed and assigned to one of three defined risk categories (Table 6.1).

6.2.2 ENVIRONMENTAL RISK CATEGORIES

In line with DTI guidelines, Talisman has developed a method for categorising each of the environmental risks resulting from the activities that would be carried out during the project. The three categories,"highly significant", "significant" and "not significant" are defined in Table 6.1.

Table 6.1 Definition of significance categories used in the risk assessment.

HIGHLY SIGNIFICANT
• substantial environmental, socio-economic and technical risks which cannot be reduced with the resources available to the project • major gaps and uncertainties in the data • serious concerns from consultees which cannot be resolved • non-compliance with environmental legislation and company policy
SIGNIFICANT
• discernible environmental and socio-economic risks which are well understood but require further investigation to establish the causes, consequences and/or provisions for risk management • risk-reduction measures available which generally have a history of successful use and acceptance • environmental impact generally localised, and readily assimilated by the receiving environment. Impact would not compromise the integrity, viability, conservation status, commercial use or social amenity of particular habitats or species

SIGNIFICANT *continued*
• socio-economic impacts which represent inconvenience to third parties rather than loss or degradation of socio-economic or cultural assets • evidence of adequate contingency planning and response capabilities for hydrocarbon spills or other emergencies • concerns expressed by consultees which can be adequately resolved
NOT SIGNIFICANT
• no or negligible environmental, socio-economic or technical risks • risk-reduction measures not required, or are industry standard • no concerns from consultees
NOT APPLICABLE
• this activity will not affect this environmental receptor

6.3 RESULTS OF THE RISK ASSESSMENT

The results of the risk assessment are shown in Tables 6.3 to 6.10. The left-hand columns in the tables identify the aspects of the project that would cause, or have the potential to cause, impacts to sensitive receptors. These environmental aspects include routine, abnormal and emergency events during the lifetime of the project. The remaining columns of the tables identify and categorise the significance of the environmental risk to the sensitive physical and chemical, biological and socio-economic receptors. The two right-hand columns of the tables present the overall assessment of significance (i.e. the highest assessed risk) and the sections of the report which give a detailed justification of the assessment made.

6.4 SUMMARY OF THE RISK ASSESSMENT

The results of the assessment are summarised in Table 6.2. In total some 209 potential environmental risks were identified for the lifetime of the project. No risk was categorised as being "highly significant"; 30 risks were judged to be "significant"; and 179 risks to be "not significant".

Table 6.2 Summary of environmental risk assessment.

	Category of risk			
	Not Significant		Significant	
Stage and activity of Demonstrator Project	**Routine**	**Accidental**	**Routine**	**Accidental**
Assembly onshore	7	0	0	0
Construction and installation offshore	39	24	10	0
Operation of WTGs offshore	37	18	18	0
Decommissioning of WTGs and umbilicals	41	13	2	0

Table 6.3 Risk assessment for assembly at the onshore location.

	Physical and Chemical Environment					Biological Environment						Human Environment								Visual			
	Sediment characteristics	Water quality	Air quality (local)	Trans-boundary issues	Cumulative impacts	Sediment biology (benthos)	Water column (plankton)	Finfish and shellfish	Seabirds	Sea mammals	Conservation sites	Commercial fishing	Shipping	Military operations	Oil & gas operations	Onshore communities	Aviation & telecommunication	Other users	Stakeholder concerns	Seascape	Landscape	OVERALL SIGNIFICANCE	JUSTIFICATION SECTION REFERENCE
Transportation to onshore site by cargo vessel																							6.7
Assembly onshore																							6.7

Table 6.4 Risk assessment for the construction and installation of the WTGs at the offshore location.

	Physical and Chemical Environment					Biological Environment						Human Environment								Visual			
	Sediment characteristics	Water quality	Air quality (local)	Trans-boundary issues	Cumulative impacts	Sediment biology (benthos)	Water column (plankton)	Finfish and shellfish	Seabirds	Sea mammals	Conservation sites	Commercial fishing	Shipping	Military operations	Oil & gas operations	Onshore communities	Aviation & telecommunication	Other users	Stakeholder concerns	Seascape	Landscape	OVERALL SIGNIFICANCE	JUSTIFICATION SECTION REFERENCE
Construction and Installation																							
Physical presence of vessels																							6.8
Deployment of HLV anchors																							6.8
Gaseous emissions from power generation on vessels																							6.8
Permitted discharge of treated bilge from vessels																							6.8
Discharges of sewage and galley waste from vessels																							6.8
Disposal of solid waste onshore																							6.8
Noise from vessels																							9.5
Placement of substructure on seabed																							8.1
Noise from piling																							9.4
Attachment of tower and nacelle to substructure																							6.8
Umbilical trenching & installation																							8.1
WTG & Beatrice subsea work																							6.8
Placement of concrete mattresses																							8.1
Modifications to topside of Beatrice AP																							6.8
Accidental Events																							
Dropped objects																							6.8
Accidental release of hydrocarbons from Beatrice AP																							6.8
Fuel spill at site as a result of vessel collision																							6.8

Table 6.5 Risk assessment for the operation of the WTGs at the offshore location.

	Physical and Chemical Environment					Biological Environment						Human Environment								Visual			
	Sediment characteristics	Water quality	Air quality (local)	Trans-boundary issues	Cumulative impacts	Sediment biology (benthos)	Water column (plankton)	Finfish and shellfish	Seabirds	Sea mammals	Conservation sites	Commercial fishing	Shipping	Military operations	Oil & gas operations	Onshore communities	Aviation & telecommunication	Other users	Stakeholder concerns	Seascape	Landscape	OVERALL SIGNIFICANCE	JUSTIFICATION SECTION REFERENCE
Demonstrator Operation																							
Physical presence of substructure located on the seabed	green	green			green	yellow													yellow			yellow	8.1
Transmission of electricity by subsea cables								yellow			green								yellow			yellow	8.2
Physical presence of WTGs in relation to finfish and shellfish								green				green							yellow			yellow	8.3
Creation of underwater noise by operating WTGs					green			green		yellow	yellow								yellow			yellow	9.0
Physical presence and operation of WTGs in relation to birds					green				yellow		yellow								yellow			yellow	10.0
Visual effects of physical presence and operation of WTGs					green											green			yellow	yellow	yellow	yellow	11.0
Physical presence of WTGs in relation to shipping													yellow	green	green			green	yellow			yellow	12.1
Physical presence of WTGs in relation to commercial fishing					green							green							yellow			yellow	12.2
Physical presence of WTGs in relation to aviation and telecommunications														green	green		green		yellow			yellow	12.3
Maintenance Operations																							
Physical presence of maintenance vessels		green								green		green	green		green							green	6.9
Gaseous emissions from power generation on vessels		green		green																		green	6.8
Permitted discharge of treated bilge from vessels		green					green	green		green												green	6.8
Sewage and galley waste discharged from vessels		green					green	green		green												green	6.8
Emergency helicopter visits									green	green												green	6.9
Accidental Events																							
Dropped objects						green		green				green										green	6.8
Fuel spill at site as a result of vessel collision	green	green			green	green	green	green	green	green	green	green	green		green	green		green	green			green	6.8

Table 6.6 Risk assessment for the decommissioning of the WTGs.

	Physical and Chemical Environment					Biological Environment						Human Environment								Visual			
	Sediment characteristics	Water quality	Air quality (local)	Trans-boundary issues	Cumulative impacts	Sediment biology (benthos)	Water column (plankton)	Finfish and shellfish	Seabirds	Sea mammals	Conservation sites	Commercial fishing	Shipping	Military operations	Oil & gas operations	Onshore communities	Aviation & telecommunication	Other users	Stakeholder concerns	Seascape	Landscape	OVERALL SIGNIFICANCE	JUSTIFICATION SECTION REFERENCE
Vessel Operations																							
Noise from vessels			green							yellow		green	green		green				yellow			yellow	9.5
Gaseous emissions from power generation on vessels			green		green																	green	6.8
Permitted discharge of treated bilge from vessels		green					green	green		green												green	6.8
Sewage and galley waste discharged from vessels		green					green	green		green												green	6.8
Decommissioning																							
Removal of tower and nacelle using HLV	green					green		green				green										green	6.10
Cutting pile and removal of substructure	green	green				green	green	green		green		green	green									green	6.10
Exposing and removal of umbilicals	green	green				green	green	green		green		green	green									green	6.10
Removal of concrete mattresses	green	green				green		green														green	6.10
Transportation of material to shore site(s)													green									green	6.10
Onshore recycle/disposal of material			green													green						green	6.10
Accidental Events																							
Dropped objects						green		green				green										green	6.8
Fuel spill at site as a result of vessel collision		green					green	green	green	green	green	green	green					green	green			green	6.8

6.5 JUSTIFICATION OF "NOT SIGNIFICANT" RISKS

For the risks that were categorised as being "not significant", Tables 6.7 to 6.10 provide the justification for the assessment made by the Talisman, and for excluding these impacts and risks from further investigation in the EIA. Wherever possible, risks of similar nature have been grouped to avoid repetition.

Table 6.7 Assembly of the WTGs at the onshore location: Justification for excluding the causes of risks assessed to be "Not Significant" from further investigation in the EIA.

ENVIRONMENTAL ASPECT	ENVIRONMENTAL IMPACT OR RISK	PROPOSED CONTROL AND MITIGATION	JUSTIFICATION
Transportation by cargo vessel.	Potential impedance to fishing and navigation.	Normal cargo vessels will be used, and they will be operated using good seamanship. It is not anticipated that they will present unusual berthing or off-loading problems in the port.	Cargo vessel movements would be no different to other cargo vessel operations in and around assembly location. Movements of vessels bringing in the material and taking out the assembled units will not interfere with any fishing vessels at the selected port, and will be planned and managed under the existing harbour management system. Any small inconvenience to other users of the facilities (for example during berthing operations) would be very localised and temporary.
Assembly operations onshore.	Deterioration of local air quality caused by use of machinery, emission of combustion gases, or the release of dust particles into the atmosphere. Inconvenience or nuisance to local residents caused by noise, lights or vehicular traffic.	Although the site has not yet been chosen, it will be an existing port facility with the capacity to handle the WTG components and their assembly. The port and its environs will, therefore, be used to a certain amount of industrial activity from cargo vessels, and associated shore-based operations. The port will be selected after a rigorous review by Talisman. Onshore assembly will be carried out to an agreed Environmental Management Plan. A local Oil Spill Contingency Plan will be in place. Most assembly activities will be carried out during daylight, and during normal working hours. Areas for laydown and assembly will be agreed with site and will be selected to ensure minimal interference with other users.	Emissions and releases to atmosphere would be very similar in nature to those that might normally occur at the site. Maximum concentrations would occur in the immediate vicinity of emissions, and would be well below any air quality objectives. There would be no discernable impact to the onshore location. Use of additional machinery, generators and cranes will be limited to a relatively short period of assembly. The period of time that the assembled WTGs will be an obvious feature in the landscape will be relatively short.

Table 6.8 Construction and installation of the WTGs at the offshore location: Justification for excluding the causes of risks assessed to be "Not Significant" from further investigation in the EIA.

ENVIRONMENTAL ASPECT	ENVIRONMENTAL IMPACT OR RISK	PROPOSED CONTROL AND MITIGATION	JUSTIFICATION
Construction and Installation			
Physical presence of vessels.	Potential interference with fishing activity. Potential impedance to navigation.	Vessels will work within a well-defined, relatively small areas for a total period of two months in spring and summer. Mariners will be notified of the presence of vessels associated with the project and will be advised of the potential hazards to navigation.	Inconvenience to other users of the sea would be very localised and temporary, and caused by a small number of vessels. There will be appropriate communication/notification to vessels in the vicinity, immediately prior to operations commencing. Temporary loss of a very small area of fishing grounds during construction and installation; the impact on commercial fishing would be negligible.
Deployment of HLV anchors.	Anchor mounds may form as a result of using the HLV for the installation of the WTGs. Possibility of anchors interfering with existing oil and gas infrastructure and with fishing operations. Physical disturbance of seabed sediments and benthic fauna in localised areas around anchors (chain and wires) during positioning and removal. Physical disturbance to fish spawning grounds.	Anchors will be carefully deployed by anchor-handling tugs and their locations will be planned and selected to avoid existing infrastructure. Anchors will be removed from the seabed after use. A dedicated guard vessel will be on location to ensure that traffic is aware of the presence of the HLV anchors. Extent of anchor pattern and duration of operations will be notified to sea users.	Sediments at Smith Bank are sandy, so it is unlikely that large anchor mounds would be created. Any impact to the benthic community from anchoring and physical disturbance to the sediment would be very localised and short-term. After anchors are removed, sediments will be re-colonised from undisturbed benthic communities immediately adjacent to the anchor sites. The temporary unavailability of a very small area of potential fishing grounds would have a negligible impact on commercial fisheries.

Table 6.8 (cont) Construction and installation of the WTGs at the offshore location: Justification for excluding the causes of risks assessed to be "Not Significant" from further investigation in the EIA.

ENVIRONMENTAL ASPECT	ENVIRONMENTAL IMPACT OR RISK	PROPOSED CONTROL AND MITIGATION	JUSTIFICATION
Construction and Installation			
Gaseous emissions from power generation on vessels.	Deterioration in local air quality around exhaust outlets on vessels. Contribution to global processes such as global warming and acid rain deposition (cumulative and trans-boundary impacts).	Atmospheric emissions from the vessels are inevitable but would be managed through use of well-maintained equipment, and burning low-sulphur diesel fuel in line with the requirements of MARPOL. Operations would be carefully planned and managed so as to minimise numbers of vessels and durations of offshore operations.	Short-term deterioration of local air quality within a few metres of the point of emission. Rapid dispersion and dilution of the emissions in offshore conditions. Overall very small scale contributor to global warming and to cumulative affects such as acid rain. No sensitive receptors in the area.
Permitted discharge of treated bilge from vessels.	Highly localised and transient deterioration in seawater quality around the discharge point, and the potential for formation of a small oil slick.	Operations would be carefully planned and managed so as to minimise numbers of vessels and durations of offshore operations. Compliance with MARPOL which requires: • *oil-water separation and filtration equipment* • *monitoring and discharge to ensure oil concentration is compliant with current limits* • *retention of the bulk oil fraction after separation for recycling or incineration onshore* • *UK or International Pollution Prevention Certificate for vessel drainage systems.*	The permitted intermittent discharge of low concentrations of hydrocarbons in bilge water would be dispersed and broken down rapidly in the offshore environment. A slick should not form at the permitted concentration. Any possible effects on water quality and marine fauna inhabiting the upper water column (plankton and pelagic fish) will be confined to the immediate vicinity of the discharge pipe. Duration of vessels activity will be less than two months in total.

Table 6.8 (cont) Construction and installation of the WTGs at the offshore location: Justification for excluding the causes of risks assessed to be "Not Significant" from further investigation in the EIA.

ENVIRONMENTAL ASPECT	ENVIRONMENTAL IMPACT OR RISK	PROPOSED CONTROL AND MITIGATION	JUSTIFICATION
		Construction and Installation	
Sewage and galley waste discharged from vessels.	Localised increase BOD (Biological Oxygen Demand) around the point of discharge (caused by bacterial degradation of the sewage). Input of organic nutrients results in localised increase in productivity in fish, plankton and micro-organisms.	Operations would be carefully planned and managed so as to minimise numbers of vessels and durations of offshore operations. Sewage will be macerated before disposal at sea or contained and shipped to shore.	Relatively few people would participate in vessel operations, and the offshore programmes are short. The BOD and organic input from sewage would, therefore, be low. Sewage would be readily dispersed in currents offshore and broken down.
Onshore disposal of solid waste.	Onshore impacts as a result of the need to transport waste to recycling sites and landfill sites. Impacts resulting from the use of recycling and landfill sites.	Operations would be carefully planned and managed so as to minimise numbers of vessels and durations of offshore operations. Food waste would be segregated and shipped to shore for disposal as per Talisman's Waste Management Plan. Compliance with UK legislation and Duty of Care requirements. Segregation of waste to allow maximum possible re-use/recycling as per Talisman's environmental goal and targets. Use of designated licensed onshore waste disposal facilities only.	Volumes of waste generated during construction and installation will be small and will be stored, handled, transported and disposed of following the best environmental practice as detailed in Talisman's Waste Management Plan. Overall, the wind farm project's contribution to the use of onshore recycling and landfill sites would be negligible.
Attachment of tower and nacelle to substructure.	Refer to sections on "Presence of vessels" and "Deployment of HLV anchors".	Refer to sections on "Presence of vessels" and "Deployment of HLV anchors".	Refer to sections on "Presence of vessels" and "Deployment of HLV anchors".

Table 6.8 (cont) Construction and installation of the WTGs at the offshore location: Justification for excluding the causes of risks assessed to be "Not Significant" from further investigation in the EIA.

ENVIRONMENTAL ASPECT	ENVIRONMENTAL IMPACT OR RISK	PROPOSED CONTROL AND MITIGATION	JUSTIFICATION
Construction and Installation			
Subsea work at the WTGs and Beatrice AP.	Creation of small amounts of steel 'swarf' from using a diamond wire saw to cut a short section of the 12" riser on Beatrice AP. Disturbance to seabed sediments and communities during manoeuvring of the umbilical ends into the bellmouths at the bottom of the J-tubes.	Carefully planning and management of subsea operations.	Very small amount of underwater cutting by mechanical methods, creating a very small amount of inert steel swarf. Disturbance to the clean seabed would be very localised. A tiny area of benthic communities will be affected, and will be rapidly re-colonised.
Modifications to topside of Beatrice AP.	Use of equipment and possible separate generators may lead to very small addition to local gaseous emissions for the duration of the modifications.	Proper planning and management of activities under the existing Beatrice permit to work system. Use of well maintained equipment to minimise emissions.	Short-term localised gaseous emissions would be rapidly dispersed in the offshore environment.
Accidental Events			
Dropped objects, i.e. accidental overboard loss of major items such as equipment, and loss of minor items such as hand-tools. Accidental release of hydrocarbons or other contaminants to the sea from Beatrice topsides.	The creation of artificial substrata to be colonised by marine organisms. Possible obstruction to fishing. Contamination of water column, pelagic communities or benthic communities.	Management of lifting and handling procedures. Careful timing of major lifting and emplacement operations to coincide with permitted operational conditions for vessel and equipment used. Use of certified equipment for lifting. Accurate accounting for all major items of equipment. Requirement to retrieve major items of debris from the seabed after construction and installation. Proper planning and management of modification activities under the existing Beatrice permit to work system.	The majority of work will be confined within the Beatrice modules, so there would be little risk of dropping objects into the sea. Accidental loss of major items is unlikely as experienced lifting contractors will be used and operations will be carefully planned and managed. Loss of individual hand-tools and other minor items of equipment would not constitute a threat to species, habitats or fishing. No pipework or vessels containing fluids or gases would have to be cut or modified.
Accidental release of hydrocarbons as a result of a vessel collision.	Contamination of the water column, seabed, marine organisms, and possibly coastline adjacent to Beatrice field.	The programme of work to install the WTGs and umbilicals will be carefully planned, to minimise the risk of accidents and collisions. The vessels will be managed by experienced teams well-used to undertaking offshore engineering work in the North Sea and in close proximity to fixed structures and other vessels. Good seamanship and proper communication will be employed to ensure that all vessel activities are co-ordinated and managed properly. The installation operations will take place in summer, when weather is good and daylight hours long. Talisman has a comprehensive oil spill plan in place to deal with a wide range of possible oil spill scenarios that might arise in the Beatrice field as a result of oil and gas operations which was revised in 2004. All the operations for the Demonstrator Project will come under the auspices of this oil spill plan.	The risk of collisions in vessels associated with oil and gas operations is very low. The site-specific risk of vessel collisions with the WTGs is estimated to be very low indeed (Section 12). Vessels will be carrying relatively small amount of hydrocarbons.

Table 6.8 (cont) Construction and installation of the WTGs at the offshore location: Justification for excluding the causes of risks assessed to be "Not Significant" from further investigation in the EIA.

ENVIRONMENTAL ASPECT	ENVIRONMENTAL IMPACT OR RISK	PROPOSED CONTROL AND MITIGATION	JUSTIFICATION
		Accidental Events	
		Talisman will establish bridging documents with all contractors to ensure that they are aware of the oil spill response plans and procedures, and of their responsibilities and responses under it. All vessels will be audited by Talisman prior to start of operations to ensure that they comply fully with MARPOL and have onboard necessary equipment for containing and cleaning up small spills of oils or lubricants that might arise during normal vessel operations. Talisman has a set of oil spill response equipment on the Beatrice platform, capable of dealing with oil spills up to and including Tier 2 event. Talisman has a contract with Oil Spill Response Limited (OSRL) for the provision of Tier 3 response services.	

Table 6.9 Operation of the WTGs during the Demonstrator Project: Justification for excluding the causes of risks assessed to be "Not Significant" from further investigation in the EIA.

ENVIRONMENTAL ASPECT	ENVIRONMENTAL IMPACT OR RISK	PROPOSED CONTROL AND MITIGATION	JUSTIFICATION
		Maintenance Operations	
Physical presence of maintenance vessels.	Potential interference with commercial fishing operations. Potential impedance to navigation. Noise from vessels may disturb cetaceans.	Vessels will work within well defined, small areas around WTGs. Mariners will be notified of the presence of vessels associated with the project and will be advised of the potential hazards to navigation. The selection of reliable equipment and the proper design of the WTGs will reduce the need for maintenance. Planning and management of any required maintenance visits will be controlled by the Beatrice OIM.	Planned maintenance visits will be of short duration (about one day every month), and will require the use of small vessels deployed from the nearby Beatrice platform. Transit times will, therefore, be short and for most of the time maintenance vessels will be operating in the immediate vicinity of one or other WTG. Inconvenience to other users of the sea would be very localised and temporary, caused by the small number of vessels. There will be appropriate communication/notification to vessels in the vicinity, immediately prior to operations commencing. Generally small numbers of cetaceans occur in the area. Cetaceans may move away from vessels in transit, but would return when noise has ceased.
Gaseous emissions from power generation on vessels.	Refer to corresponding topic in Table 6.8.	Refer to corresponding topic in Table 6.8.	Refer to corresponding topic in Table 6.8.
Permitted discharge of treated bilge from vessels.	Refer to corresponding topic in Table 6.8.	Refer to corresponding topic in Table 6.8.	Refer to corresponding topic in Table 6.8.
Sewage and galley waste discharged from vessels.	Refer to corresponding topic in Table 6.8.	Refer to corresponding topic in Table 6.8.	Refer to corresponding topic in Table 6.8.

Table 6.9 (cont) Operation of the WTGs during the Demonstrator Project: Justification for excluding the causes of risks assessed to be "Not Significant" from further investigation in the EIA.

ENVIRONMENTAL ASPECT	ENVIRONMENTAL IMPACT OR RISK	PROPOSED CONTROL AND MITIGATION	JUSTIFICATION
Accidental Events			
Dropped objects, i.e. accidental overboard loss of major items such as equipment, and loss of minor items such as hand-tools.	Equipment and materials may be dropped during transfer to and/or from WTGs or while being used on the WTGs. Dropped objects may impact benthic communities and introduce contaminants.	All maintenance programmes will be carefully planned and procedures for accessing and leaving the WTGs will be developed. WTGs have a proper landing stage and small cranes and winches for moving material and equipment. WTGs have proper illumination for all external work areas. Materials will be transferred securely in crates and/or baskets.	No large items will be transferred and there are no anticipated transfers of liquid contaminants during maintenance visits. Very localised area of seabed immediately beneath the substructure may be affected by any dropped objects. Manoeuvring of equipment and material will mainly be within the confines of the tower and nacelle.
Accidental release of hydrocarbons as a result of a vessel collision.	Refer to corresponding topic in Table 6.8.	Refer to corresponding topic in Table 6.8.	Refer to corresponding topic in Table 6.8.

Table 6.10 Decommissioning the WTGs: Justification for excluding the causes of risks assessed to be "Not Significant" from further investigation in the EIA.

ENVIRONMENTAL ASPECT	ENVIRONMENTAL IMPACT OR RISK	PROPOSED CONTROL AND MITIGATION	JUSTIFICATION
Vessel Operations			
Gaseous emissions from power generation on vessels.	Refer to corresponding topic in Table 6.8.	Refer to corresponding topic in Table 6.8.	Refer to corresponding topic in Table 6.8.
Permitted discharge of treated bilge from vessels.	Refer to corresponding topic in Table 6.8.	Refer to corresponding topic in Table 6.8.	Refer to corresponding topic in Table 6.8.
Sewage and galley waste discharged from vessels.	Refer to corresponding topic in Table 6.8.	Refer to corresponding topic in Table 6.8.	Refer to corresponding topic in Table 6.8.
Decommissioning			
Removal of tower and nacelle using HLV.	Refer to section on "Deployment of HLV anchors".	Refer to section on "Deployment of HLV anchors".	Refer to section on "Deployment of HLV anchors".
Cutting the piles and removing the substructures.	Disturbance to sediments and benthic communities as the substructure is lifted clear of the seabed. A small amount of swarf will be created inside the pile from the diamond cutter.	Proper planning and execution of cutting operations to ensure that all cuts are made below the mudline. Proper planning and execution of lifting programme to ensure the substructure is cleanly lifted off the seabed.	Area of seabed disturbance caused by removing the substructure would be very small. Sediments would be re-colonised by benthic organisms from areas immediately adjunct to former sites of WTGs.
Decommissioning the umbilicals.	Removal of the trenched umbilicals would disturb the seabed sediments in a narrow trench along the umbilical route, and impact the associated benthic communities. If the umbilicals are left *in situ,* they would remain buried and would not cause any impact to benthic communities, fish or fishermen.	Proper planning and execution of any removal programme to ensure a minimal area of disturbance. Any decision to leave the buried umbilicals *in situ* would be reached in conformance with requirements of the Petroleum Act 1996, DTI Guidelines and OSPAR Decision 98/3.	The area of seabed sediments and benthic communities that might be disturbed would be very small in relation to adjacent habitats. The disturbed sediments would be clean, and natural re-colonisation would proceed immediately after operations ceased. The seabed at the Beatrice area is stable. The buried umbilical would, therefore, remain *in situ* and would not present a snagging risk to fishing gear. The umbilical does not contain any fluids, and, therefore, would not present a source of contamination to the environment.

Table 6.10 (cont) Decommissioning the WTGs: Justification for excluding the causes of risks assessed to be "Not Significant" from further investigation in the EIA.

ENVIRONMENTAL ASPECT	ENVIRONMENTAL IMPACT OR RISK	PROPOSED CONTROL AND MITIGATION	JUSTIFICATION
Decommissioning			
Removal of concrete mattresses.	Temporary disturbance of seabed sediments and benthic communities. Small positive effect, because the removal of the mattresses would return a relatively small area of the seabed to its original condition.	Proper planning and execution of any removal programme to ensure a minimal area of disturbance.	Area of seabed disturbance would be very small, and would be re-colonised quickly after operations were completed.
Onshore recycling/disposal of material.	Gaseous emissions during cutting and recycling. Where materials are disposed of, use of landfill space and loss of resources. Possible short-term inconvenience to communities adjacent to the disposal site. Small positive effect from re-use and/or recycling of materials such as steel.	Compliance with UK legislation and Duty of Care requirements. Segregation of waste to allow maximum possible re-use/recycling as per Talisman's environmental goal and targets. Use of designated licensed onshore waste disposal facilities only. Auditing of waste management to ensure compliance.	Majority of materials would be recycled. The contributions of the wind farm Demonstrator inventories to the effects, emission and discharges at European recycling and disposal sites would be very small.
Accidental Events			
Dropped objects, i.e. accidental overboard loss of major items such as equipment, and loss of minor items such as hand-tools.	Refer to corresponding topic in Table 6.8	Refer to corresponding topic in Table 6.8	Refer to corresponding topic in Table 6.8.
Dropped objects, i.e. accidental overboard loss of major items such as equipment, and loss of minor items such as hand-tools	Refer to corresponding topic in Table 6.8.	Refer to corresponding topic in Table 6.8.	Refer to corresponding topic in Table 6.8.

7 Effects of Assembly at Onshore Location

7 EFFECTS OF ASSEMBLY AT ONSHORE LOCATION

7.1 STATUS OF THE SITE

The elements of each WTG unit will be transported to a port or other facility for final preparation, assembly into larger components and load-out. This site has not yet been selected, but will be located on the east coast of the UK, for ease of access to the Beatrice field.

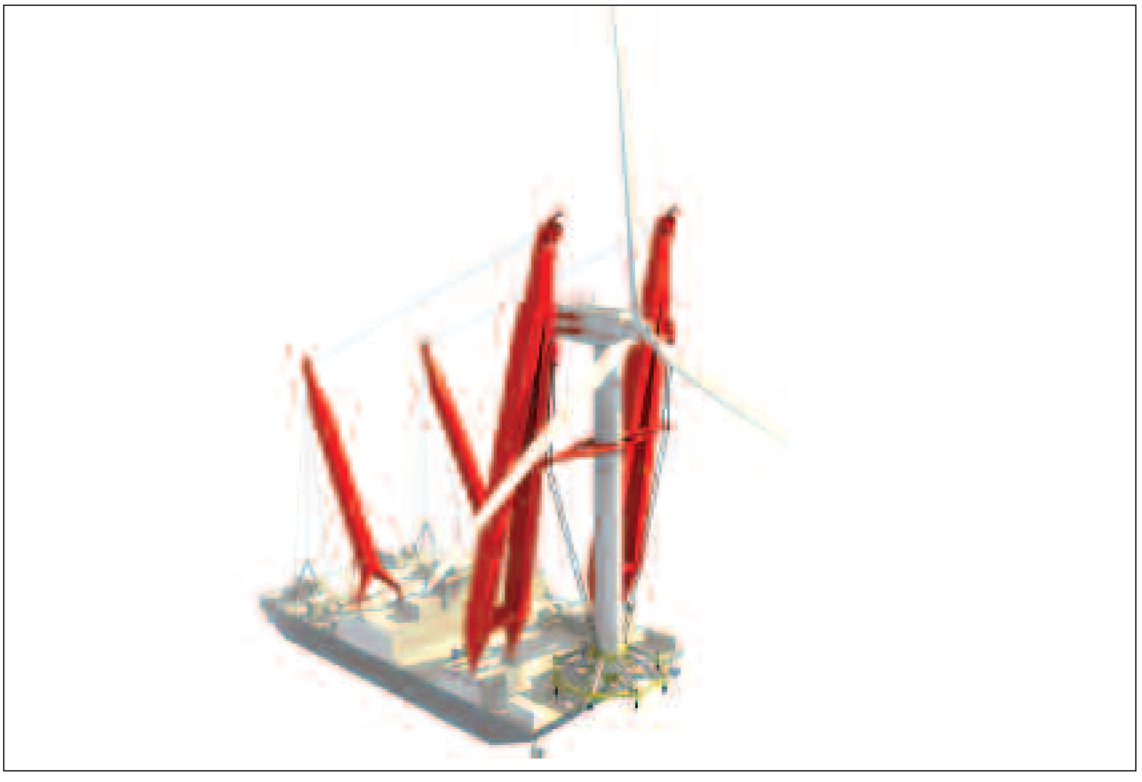
The assembly location will be a port or other similar site at which commercial or industrial activity is already being undertaken. It is, therefore, likely that the effects of assembling the components of the WTGs would be similar to some of the effects already occasionally experienced at the site from other activities carried out there.

7.2 POTENTIAL IMPACTS AND MAIN RECEPTORS

The main elements or components that are likely to be transported to the site, and stored for a time awaiting assembly, would be the substructure and its piles, the soft landing system, the tower, the turbine nacelle, and the blades.

The transportation of these components by sea, and their storage at the site, might impact shipping activity close to any port or harbour that is used, other users of the site, and local communities. The assembly of components at the site might cause local short-term visual impacts, and be a source of additional noise, light, dust and gaseous emissions.

Figure 7.1 Tower and turbine ready for transportation.



7.3 MAGNITUDE OF EFFECTS

All components will be delivered by sea using regular cargo vessels. This is unlikely to cause inconvenience to other users of the sea, or unusual impacts within the port itself.

Once delivered, the items will be stored at the site. Cranes and other equipment will then be used to manipulate them into position, and assemble them into a larger unit. Items will be joined together by bolting, although some welding may be required for the fixing and removal of temporary steelwork. These activities may result in transient nuisance to people living in close proximity to the site, but the effects will be no different in nature or scale from those arising already from the other types of activity that are carried out at the site.

Consultees have expressed concern about the visual intrusion of the partially assembled WTGs at the onshore site. Figure 7.1 illustrates how the WTG unit would look immediately before being loaded onto a cargo barge for transportation offshore. The partially assembled unit would comprise the upper part of the soft lander (used as a temporary base), the tower, and the turbine fitted with three blades. The total height of the unit to the tip of a vertical blade would be about 151m, and it is planned that these units would remain onshore for a short time between assembly and loading out. The unit onshore would not bear any lights.

There would also be short-term positive effects for the assembly location, as a result of the additional commercial activities necessary for the handling and assembly of the WTGs.

7.4 MITIGATION AND MONITORING

The site selected for assembly will be suitably equipped to handle the different components and the vessels required to take them offshore. Before awarding a contract, Talisman will visit the site and undertake an audit, to confirm that its operations meet the environmental standards required by Talisman. The selected site will have an environmental management system (EMS) in place, and bridging documents will be established between the site’s EMS and Talisman’s EMS to ensure that all potential sources of environmental impact are addressed and covered by the respective systems. If necessary, Talisman will ensure that the selected site has appropriate storage areas with bunds or closed drains, for items containing liquid contaminants, to ensure that if spilled they do not escape into the sea.

Because an existing working facility will be used, all activities at the assembly site would be controlled by the existing regulations, practices, and emergency procedures, and would be subject to inspection by regulatory agencies.

7.5 FURTHER RESEARCH PROPOSED

Talisman will select the site for onshore assembly based on several factors including their capacity to deal with the WTG components, accessibility, distance from the Beatrice field, management and technical capability, socio-economic benefits and commercial proposal.

Figure 7.2 Assembled turbines and towers arriving at offshore location.

8 Effects on the Seabed and Marine Ecosystems

8 EFFECTS ON THE SEABED AND MARINE ECOSYSTEMS

8.1 EFFECTS ON SEDIMENTS AND BENTHIC COMMUNITIES

8.1.1 DESCRIPTION OF IMPACTS

Operations to install the WTGs and the subsea umbilicals will disturb seabed sediments, and this may disrupt areas of the benthic community and smother nearby sites with resettled sediment. The bases of the WTGs and the concrete mattresses placed on the seabed to protect unburied sections of the umbilicals will cover the seabed and the benthic communities for the duration of the project.

8.1.2 MAGNITUDE OF EFFECTS

Sensitivity of the site

The characteristics and status of the benthic communities in and around the Beatrice field have been surveyed and assessed on several occasions, and a site-specific seabed survey was carried out at the Demonstrator site in October 2005 (Section 4.2.2). There are no designated sites or species on the seabed in the area of the WTGs, and beds of the horse mussel *Modiolus modiolus* were found (Sections 4.2.7 and 4.3.1). The characteristics of the seabed sediments in the area of the Beatrice field, where the water depth ranges from 40m to 50m, are relatively uniform, and there are no remarkable, threatened or vulnerable physical features or habitats (Talisman, 2003). The benthic community found in these sandy sediments is diverse, and typical of the communities found at such depths in sandy sediments in the North Sea.

The WTGs, the subsea umbilical linking them, and the subsea umbilical linking WTG 1 to the Beatrice Alpha platform, will all be installed on an area of seabed that is not affected by any contaminants that may be present in the historic cuttings pile located beneath Beatrice AD. The concentrations of metals and hydrocarbons in sediments around the Demonstrator site are all low, and typical of the "background" concentrations found in unpolluted sediments in the North Sea (Section 4.3.3). The sediments that may be disturbed by the operations to install the facilities, therefore, comprise clean, unpolluted material.

Long-term covering of the seabed

The base of each WTG unit will enclose an area of seabed of about 900m^2, although the area of seabed actually covered by the legs and lowest horizontal members of the support structure will be much smaller than this. Mattresses placed around the ends of the subsea umbilicals, over the pipeline crossing, and around the bases of the substructures, would cover an additional area of about 886m^2 of seabed. In total, it is estimated that the area of seabed physically covered by the WTGs would be about 2,686m^2, (Table 8.1) i.e. about 0.005% of the area of the existing Beatrice determination boundary (Figure 2.2).

Table 8.1 Summary of area of seabed permanently covered by presence of two WTGs

Components	Area covered (m^2)
Area of seabed enclosed by bases of two WTGs (2 x 900m^2)	1,800
Amount actually covered by mud mats (2 x 92m^2)	184
Mattresses at Beatrice AP en route to WTG 1 (23 mattresses)	486
Mattresses at WTG 1 (8 mattresses)	144
Mattresses at WTG 2 (4 mattresses)	72
Total area of seabed physically covered	**2,686**

Disturbance of the seabed

The subsea umbilicals linking the WTG units, and the units with Beatrice AP, would be installed using a high pressure water jet to fluidise the sediments (Section 3.3.3). This method does not rely on the physical excavation or displacement of sediment. An example of the type of equipment that might be used is shown Figure 8.1. The ROV trenching vehicle runs over the seabed on tracks that are about 4.5m apart, but the actual area of seabed that is fluidised is about 0.5m.

Figure 8.1 Example of the type and size of machine that would be used to fluidise the seabed for the burial of the umbilicals.

The equipment can be deployed with precision, but it is likely that a narrow strip of seabed, centred on the final route of the umbilicals, will be disturbed. Although the fluidising technique does not deliberately discharge substantial amounts of sediment into the water column, small amounts of fine-grained material will inevitably be suspended and will, therefore, drift away from the site and resettle, potentially smothering benthic communities located at a distance from the umbilical routes.

For the purpose of estimating potential impacts to the benthos, it has been assumed that all of the seabed area within the width of the ROV trenching vehicle's tracks (5m) will be disturbed. In these circumstances, it is estimated that the burial of the two subsea umbilicals would disturb a total area of about 10,500m^2 of seabed sediment. This would represent about 0.02% of the seabed within the Beatrice field determination boundary.

The sediment is clean, and although a very small proportion of the benthic community within the bounds of the Beatrice site licence may be killed, the sediment will be quickly recolonised by animals from adjacent undisturbed sediment.

8.1.3 MITIGATION PROPOSED

The installation operations for the support structure, mattresses and subsea umbilicals will be carefully planned and executed so as to minimise the area of seabed disturbed. The routes of subsea umbilicals will be designed so as to minimise the length of each umbilical, and hence the extent of seabed disturbance.

8.1.4 SURVEY AND MONITORING OF OPERATIONAL WIND FARM

There are no plans to monitor the condition of the seabed around the WTGs, although the bases of the support structures may be surveyed from time to time, using an ROV, to determine if any seabed scour is occurring. The umbilical routes may be surveyed periodically, to ensure that the umbilicals remain buried to the required depth.

However, data gathered by Talisman during surveys of the Beatrice Alpha platform and pipelines indicate there has been no significant movement of sediments that would be classed as scour. Since Talisman became operators of Beatrice in 1997, no remedial works have been required as a result of scour around jacket or pipelines.

8.2 EFFECTS OF ELECTROMAGNETIC FIELDS

8.2.1 INTRODUCTION

Several marine species use magnetic and electrical fields for navigation and for locating prey. This section provides a brief review of the literature, an overview of the electromagnetic fields typically generated by power transmission cables, and an assessment of the potential for the subsea electric umbilicals for the proposed Demonstrator Project to cause adverse effects in marine organisms.

8.2.2 ELECTROMAGNETIC FIELDS

Electrical and magnetic fields are both generated by the movement of electrical charge. Electrical fields (E fields) are proportional to the voltage (V) in a cable, and magnetic fields (B fields) are proportional to the current (A). The motion of an organism, or even seawater, through an existing B field causes the generation of an electrical field known as an induced electrical field (iE field) (electromagnetic field abbreviations after Gill *et al.*, 2005).

E fields are produced around electrical cables that are not perfectly shielded. Industry-standard cables are constructed with shielding designed to retain E fields within the cabling. B fields, however, exist beyond even industry-standard cables and, as described above, are able to induce electrical fields in the surrounding environment. Therefore, although E fields generated directly by the movement of charge in the conductor will be contained within the cable, iE fields will still exist due to the effect of the B fields generated by the current in the conductor. It is important, therefore, to consider the effects of both magnetic and electrical fields on the environment surrounding the cable.

In a typical industry-standard cable conducting 132kV and an AC current of 350A, the size of the B field produced would be 1.6μT (micro Tesla)(CMACS, 2003). This B field would be present only directly adjacent to the cable, and although it would be additive with the earth's natural geomagnetic field (approximately 50μT), it was shown that the magnitude of B field associated with the cable would fall to background levels within 20m of the cable. Furthermore, the modelling conducted by CMACS showed that the magnitude of a B field is not affected by any non-magnetic sediment in which a cable may be buried.

In the same study CMACS showed that for a cable buried 1m below the seabed the magnitude of the iE field at the seabed would be approximately 91μV/m. Although the magnitude of the B field was not affected by the fact that the cable was buried, the iE field dissipated more quickly in sediment than in seawater. At a distance of approximately 8m from the cable the iE field in the sediment was only 1 or 2μV/m, whereas in seawater the iE field at this distance was still approximately 10μV/m.

8.2.3 EFFECTS OF ELECTROMAGNETIC FIELDS ARISING FROM THE DEMONSTRATOR PROJECT

Magnitude of fields

The cable that will be used for the proposed Demonstrator Project is an industry-standard, three-phase 33kV, 175A, 50Hz alternating current (AC) XLPE (cross linked polyethylene) cable carrying 10MW. Extrapolating from studies carried out by CMACS (2003), it is predicted that this cable will generate a B field of approximately 0.8μT (halving the current has a proportional effect on the magnitude of the B field). The Beatrice cable will be buried 0.9m below the seabed, so the iE field at the seabed should be approximately 45μV/m adjacent to the cable. As the current flowing in the cable at the Beatrice Demonstrator Project will be half that modelled by CMACS (2003), it is expected that the magnitude of the B field and iE field will be approaching zero at 10m and 20m, respectively.

Potential effects of fields from Demonstrator Project

There is little information regarding the effects of interactions between sensitive marine species and anthropogenic electromagnetic fields arising as a result of offshore wind farm developments (Gill *et al.*, 2005). Studies of the effects of anthropogenic E and B fields from other types of development or activity may give indications of likely effects.

Gill *et al*. (2005) list the known electrically sensitive species occurring in UK coastal waters. The elasmobranchs (the sharks and rays) are known to possess electro-receptors, and four common species of bony fish (European eel, cod, plaice and Atlantic salmon) have all been shown to be electrically receptive, but few species have been studied in detail. For the lesser spotted dogfish *(Scyliorhinus canicula),* an E field of 1000μV/m elicits a (variable) avoidance response, whereas an E field of 10μV/m elicits an attraction response (Gill and Taylor, 2002).

The strength of the iE field in the vicinity of the cable at the Demonstrator site is likely to be below 45μV/m. Therefore, although it is likely that marine organisms will be able to detect iE fields generated by the electrical cable running between the WTGs, and from WTG 1 to the Beatrice Alpha platform, it is not possible to predict with any certainty the effect that such an electromagnetic field will have.

Previous studies have shown that marine species make use of geomagnetic fields for navigation (Walker *et al*., 1992, Dittman & Quinn 1996, Kenney *et al.,* 2001). However, little work has been done on determining the effect of artificial B fields on species that are known to use geomagnetic fields.

Souza *et al*. (1988) showed that freshwater eels *(Anguilla rostrata)* displayed a preference for travel in a different direction when an artificial B field was applied, compared to that observed under the influence of the earth's geomagnetic field alone. Walker *et al.* (1992) were able to correlate the location of whales in different seasons with areas of low geomagnetic intensity, and they concluded that this supported the existing hypothesis that fin whales possess a magnetic sense. A study of the orientation of plaice *(Pleuronectes platessa)* in the southern North Sea by Metcalfe *et al.* (1993) showed that plaice were able to orient themselves in the absence of visual and tactile clues, and it was suggested that the orientation mechanism may involve the earth's geomagnetic field.

A species of particular importance in the Moray Firth, both commercially and ecologically, is the Atlantic salmon *(Salmo salar)*. Several studies, including those by Quinn and Brannon (1982), Taylor (1986), and Chew and Brown (1989) on several different members of the Salmonid family of fishes suggest that Salmonid fishes are able to detect and orient to artificial B fields of a similar magnitude to the earth's geomagnetic field. However, a study by Yano *et al.* (1997) suggests that horizontal and vertical movement of migrating chum salmon *(Oncorhynchus keta)* in an artificial B field (of two orders of magnitude greater than the earth's geomagnetic field) was no different to their normal range of movements in the absence of the artificial B field.

Caution should be exercised when extrapolating the results of such studies to the proposed wind farm Demonstrator Project. These studies are usually carried out under controlled, laboratory conditions (with the exception of Yano *et al.'s* 1997 study), that are not representative of those that pertain in the natural world. In addition, knowing that an organism has the ability to detect B fields does not enable accurate prediction as to the effects of B fields on that organism's behaviour or physiology.

Patterns of migration indicated by tagging studies around the Scottish coast (Dunkley, 1985) suggest that Atlantic salmon make landfalls at many different parts of the coast and then redistribute themselves. Other studies such as those by Smith *et al.* (1995) and Dittman and Quinn (1996) highlight the importance of environmental factors such as salinity and temperature, as well as the olfactory sense of salmon, in the return of migrating salmon to their native rivers. The degree to which salmon rely on E and B fields compared to degree to which they rely on such olfactory and physical stimuli is not yet known.

Several other major wind farm developments have been planned, or indeed are under construction, in the UK. From a review of the environmental statements produced for these developments, it would appear that there is a general consensus that the electromagnetic fields likely to be present around a wind farm development will not have a significant environmental impact.

8.2.4 POTENTIAL MITIGATION MEASURES

There are no specific additional mitigation measures that will be taken by the project. The electrical cables are one component of the umbilical, and they are sheathed and armoured. This will shield organisms from the electrical (E) field, but not from the induced electrical (iE) field arising from the magnetic (B) field.

The umbilicals will be buried, so that they do not interact with bottom-towed fishing gear, and this will also reduce the magnitude of the induced electrical fields to which marine organisms on the surface of the seabed will be exposed; iE fields do not propagate as well through sediment as through seawater. Burial will also mean that demersal species of fish will not come into such intimate contact with the umbilicals, and thus will be exposed to iE fields of a lower magnitude.

8.2.5 CONCLUSION

It is likely that the B and iE fields produced by the subsea electrical cables for the Demonstrator Project will be large enough to be detected by receptive marine organisms. Because the cables will be buried, marine organisms on the surface of the seabed will be exposed to lower fields than they would be if the cables were exposed. It is not possible, however, to make any accurate predictions as to how these relatively weak B and iE fields will affect these species. Given the localised scale over which these electromagnetic fields are likely to propagate, however, it is likely that any effects which may occur would be highly localised. It is expected that the magnitude of the B field and iE field will be approaching zero at 10m and 20m, respectively, from the cable.

8.3 EFFECTS ON COMMERCIAL STOCKS OF FISH AND SHELLFISH

8.3.1 DESCRIPTION OF IMPACTS AND MAGNITUDE OF EFFECTS

The operations to install the WTGs and umbilicals, and the presence of the WTGs throughout their operating life, could have effects on commercial fisheries resources in the area. The potential sources of effects on fish and shellfish, which could be both short-term (installation phase effects) and long-term (duration of wind farm life), are as follows:

- *disturbance and redistribution of sediments during installation of WTGs and umbilicals*
- *scouring of sediments around bases of support structures, mattresses and pipeline crossing*
- *re-suspension of pollutants*
- *accidental release of chemicals or hydrocarbons during installation*
- *physical presence of structures in the water column*
- *loss of food resources for faunal groups.*

Disturbance and redistribution of sediment

Fish and shellfish may be affected by increased burdens of suspended sediment in the water column. This may cause, for example, increased egg or larval mortality, loss of prey species, lethal and non-lethal effects due to clogging of gills, and reduction in feeding due to decreased visibility.

Disturbance to commercially important fish and shellfish species as a consequence of sediment disturbance would potentially impact; for example, spawning grounds of herring, sprat and sandeels, all of which lay their eggs in or on the substrate; and beds of cockles, clams, oysters and mussels. It could also potentially interfere with the burrowing behaviour of sandeels, normal activities of the flatfish species (such as sole and plaice), and also the benthic feeding activities of demersal species (such as cod, whiting and haddock).

The only activity that is likely to disturb seabed sediment is the operation to bury the umbilicals by fluidising the seabed (Section 3.3.3). This may cause some sediment to be resuspended into the water column, and then settle at some distance away. Using conservative assumptions, however, it is estimated that the area of seabed that is likely to be disturbed in this way will be very small.

Given the uniform nature of the seabed throughout the area of the Demonstrator site, and the very precise nature of the fluidising technique using the ROV trenching vehicle, it is concluded that the potential effects on fish and shellfish from this source will be small.

Scouring of sediments

There is no evidence of scouring around the existing Beatrice platforms or pipelines (Section 8.1.4), and it is thought unlikely that scouring will occur around the bases of the WTGs. Scouring is, therefore, unlikely to occur as a result of the presence of the WTGs or umbilicals and will not be a source of impact to stocks of commercial fish and shellfish.

Re-suspension of pollutants

The 2005 benthic survey at the Demonstrator site (Section 4.3.3), concluded that the sediments at all stations at the site were uncontaminated, exhibiting concentrations of metals and hydrocarbons that were low and consistent with "background" concentrations for sandy sediments in the North Sea. The re-suspension of pollutants will, therefore, not occur as a result of the installation or operation of the WTGs at the Demonstrator site.

Accidental release of chemicals or hydrocarbons during installation

During installation activities, the vessels will carry bunker fuel, and the WTG nacelles will contain hydraulic fluid (Section 3.3.14), and there is a very low risk that these might be accidentally released to the sea. For the offshore oil and gas industry, the incidence of vessel collisions is very low (HSE, 2003). It is, therefore, very unlikely that such an accident would occur. Activities at the Demonstrator site would be covered by the existing Beatrice field oil spill plan, and there are resources at Beatrice to deal with a Tier 1 oil spill. Any chemicals or oils released to the sea surface would be rapidly dispersed and diluted by the prevailing conditions offshore, and so potential effects on pelagic and benthic species of fish and shellfish would be very small.

Physical presence of WTGs

The area of seabed that will be covered by the WTGs is very small (Section 8.1.2), and will have no significant impact on the standing stocks of shellfish or demersal fish.

The support structures will provide a very small additional area of hard surface that will be colonised by sessile marine organisms (fouling) (Forteath *et al.,* 1982). This in turn will provide habitat for crustacean, and will create a *de facto* artificial reef community based on the steel support structures. Diverse and mature fouling communities already exist on the nearby Beatrice platforms (Forteath *et al.,* 1983). Various species of pelagic and demersal fish are found around offshore oil and gas platforms, and it is likely that the WTGs will also exhibit locally increased numbers of species such as saithe, cod and ling. No detrimental effects on fish have been found for working offshore oil and gas platforms, and it is unlikely that the WTGs would be a source of negative effects. The "reef" effect of the WTGs is likely to provide a small positive effect, although one which would not be significant in terms of commercial stocks.

Changes to food resource

The area of seabed that will be covered by the WTGs is very small (Section 8.1.2), and will have no significant impact on the standing stocks of shellfish or demersal fish. Once installation is complete, any areas of clean sediment that were disturbed will be quickly recolonised by fauna typical of the area. It is, therefore, very unlikely that the operations to install the WTGs, and their operations at the site, will result in a noticeable decrease in the range or quantity of food resources available to fish and shellfish in the area.

8.3.2 MITIGATION PROPOSED

The potential effects on fish and shellfish stocks will be very small and localised. The majority of potential negative effects would arise only during the installation phase in summer. This avoids the spawning periods for installation activities during the period between December and April when a number of species, namely plaice, cod, lemon sole and sandeels, spawn locally during this period.

In view of the very low risk of negative effects to stocks of fish and shellfish, Talisman does not believe that additional mitigation measures are required.

9 Potential Impacts of Underwater Noise and Vibration

9 POTENTIAL IMPACTS OF UNDERWATER NOISE AND VIBRATION

9.1 INTRODUCTION

This section presents:

- *a review of possible sources of underwater noise from the Demonstrator Project, and a summary of the planned duration of each activity causing noise*
- *a description of the method used to assess potential effects of noise on marine animals*
- *a quantitative assessment, using standard models and equations, of the noise levels to which marine organisms might be exposed during the installation and operation of the Demonstrator WTGs*
- *a summary of the mitigation measures that Talisman will employ to reduce further the potential effects of noise from different operations.*

Talisman recognise that there are uncertainties in the modelling of noise propagation underwater, and the precise way in which different species may react to various noises under different conditions (for example, ambient level and types of background noise, behaviour or activity of the individual immediately before exposure to the noise, and any level of conditioning that may have taken place in respect of an existing or previous noise). However, where there are uncertainties, Talisman has taken a precautionary approach in using conservative published data on, for example, peak hearing frequencies and threshold values. Talisman believes that the results presented in this section provide the necessary data to assess the potential effects of underwater noise from the project and how these effects might be mitigated.

9.2 SOURCES OF UNDERWATER NOISE FROM THE DEMONSTRATOR PROJECT AND KEY RECEPTORS

9.2.1 SOURCES OF UNDERWATER NOISE

Results from the scoping report and from the consultation programme indicate that underwater noise could arise from the following sources:

Noise generated by vessels during construction, installation and maintenance

During construction, varying levels of vessel noise would be present in and around the site for the months of June and July.

Noise generated by piling operations to fix the structures to the seabed

Pile-driving is expected to take less than two hours to drive each 1.8m diameter pile to the required depth. It is planned that two piles would be fixed each day, and that piling operations would last a maximum of four days. This results in a maximum total pile-driving time of 16 hours for both WTGs.

Noise generated by trenching operations to bury subsea cables

The umbilicals would be buried in late May or early June, in an operation that is planned to take about 12 hours total for both WTGs.

Noise and vibration generated by the turbines themselves when in use

The turbines would operate throughout the lifetime of the project, whenever meteorological conditions were suitable.

9.2.2 KEY RECEPTORS

From a consideration of the environmental sensitivities of the Demonstrator site (Section 4), the key marine species that would be exposed to underwater noise are bottlenose dolphins, harbour porpoise, the grey seal, the common (or harbour) seal, minke whale and salmon. This section, therefore, focuses on potential effects on these species. Bottlenose dolphin may be present around the Demonstrator site (Section 4.6) and a precautionary approach has been used by modelling noise effects for dolphins using the audiogram for bottlenose dolphin.

9.3 METHOD USED TO ASSESS NOISE EFFECTS

9.3.1 HEARING IN MARINE MAMMALS AND FISH

Marine mammals and fish use underwater noise in a wide variety of ways, to gather information about their environment, and to communicate with other individuals of their own species (for a review see Richardson *et al.,* 1995). Many species of both groups are able both to detect underwater noises and to produce underwater noise of their own.

The hearing ability of marine organisms is commonly expressed by means of an audiogram. This is a plot of the species' threshold hearing level for different frequencies, and indicates (a) the range of frequencies that a species can detect; and (b) the frequency range over which the species' hearing is most acute. Audiograms have been obtained for a number of species (Vella *et al.,* 2001; Popper *et al.,* 1998; Richardson *et al.,* 1995), and work is going on to obtain more detailed information (Nedwell and Howell, 2004). Table 9.1 shows the audible frequency ranges for some of the marine mammals and fish that may be present at the Demonstrator site, and indicates the threshold value at the peak frequency (i.e. the frequency at which their hearing is most acute).

Table 9.1 Hearing characteristics of some species of fish and mammals likely to be present at the Demonstrator site. (Data from Nedwell et al., 2004b; Nedwell and Howell, 2004; Richardson et al., 1995; Ketten, 1998).

Species	Hearing range (Hz)	Approximate peak frequency (Hz)	Threshold at peak frequency dB re 1μPa*
Bottlenose dolphin	100–300,000	50,000–80,000	40–50
Harbour porpoise	200–200,000	100,000–200,000	30–60
Grey seal	200–200,000	20,000–30,000	61–70
Common seal	100–200,000	7,000–30,000	63–67
Killer whale	500–200,000	10,000–30,000	30–45
Mysticetes (baleen whales)	15–30,000	400	–
Risso's dolphin	2,000–110,000	8,000–30,000	64–67
Cod	10–800	20–100	63–95
Dab	20–300	110	89
Haddock	30–500	100–300	80–85
Herring	20–4,000	50–200	75
Ling	40–600	200	81
Pollack	40–500	200–300	92–93
Atlantic salmon	30–400	160	95
Little skate	100–1000	200	123

* *Values rounded*

9.3.2 APPLICATION OF THE dB_{ht}*(species)* CONCEPT

Each species' sensitivity to a noise depends on its frequency, and the minimum noise level they are able to hear (the threshold) varies with the frequency of the noise. Nedwell and Turnpenny (1998) have therefore proposed the use of a weighted measure dB_{ht}*(species)* which models the noise level that a species would experience. The dB_{ht}*(species)* value for each species is a function of its sensitivity to noise, as derived from its audiogram; ht refers to the "hearing threshold" of the species which reflects a particular species' ability to detect sounds at different frequencies. It is argued that the application of this measure permits proper examination of the true likely effect of external noises on marine mammals and fish.

The noise level that may be perceived by a particular species can be calculated by applying the dB_{ht} "filter" – a correction factor – to the source noise level at different frequencies. The correction factors can be derived from the species' audiogram.

9.3.3 EFFECTS OF UNDERWATER NOISE

There is a considerable body of literature studying the different threshold levels for different species (for a review see Richardson *et al.,* 1995; Nedwell and Howell, 2004). The effects of underwater noise on marine mammals and fish vary depending on the received noise level, and the literature typically quotes five different levels of response (Vella *et al.,* 2001; WDCS, 2004):

- *a detection level – the noise level that the species would normally be able to detect in a quiet sea state*
- *an avoidance level – the noise level at which the species would start to exhibit active avoidance behaviour, such as swimming away, in order to avoid the noise level that it was experiencing*

- *a temporary hearing damage level – the noise level that would cause a temporary but reversible shift in the individual's hearing sensitivity*
- *a permanent hearing shift level – the noise level that would cause a permanent shift in the individual's hearing sensitivity*
- *a physical damage level – the noise level or pressure level that would result in gross physical damage to the organism's auditory system, other organs or tissues.*

9.3.4 SELECTION OF THRESHOLD LEVELS FOR ASSESSING POTENTIAL EFFECTS AT THE DEMONSTRATOR SITE

For the purposes of managing the potential effects of underwater noise as a result of the proposed Beatrice Demonstrator Project, Talisman focused on determining which activities might produce noises loud enough either to result in an animal displaying a "strong avoidance reaction", or to cause a temporary change in hearing ability (or "temporary threshold shift" (TTS)).

The threshold for strong avoidance reaction was selected because it is the lowest level at which overt behavioural changes occur in the animals which might be exposed to underwater noise, and there are data in the literature for this threshold level for different species. The threshold of temporary change in hearing ability was selected because it is the least damaging physical effect, and would be found over the largest area. It is therefore the most precautionary physical threshold and, again, there are data in the literature for this threshold level for different species.

Avoidance reaction

From a review of the available literature, Nedwell and Howell suggest that a behavioural response in a marine organism would be elicited if the dB_{ht}*(species)* noise level was greater than 90dB (Nedwell *et al.,* 2004a). At this noise level, individuals have been found to show an avoidance reaction, typically swimming away from the source of noise. Some individuals would express avoidance reaction beyond this range, but on the basis of available evidence this is the distance at which this species might be expected to exhibit avoidance. For the purposes of determining potential effects on marine organisms from the Demonstrator Project, therefore, the $90dB_{ht}$*(species)* value has been taken as a threshold.

Temporary change in hearing ability

When an animal is exposed to a loud noise for a period of time, the acuteness of its hearing may be temporarily diminished, i.e. it may be unable to detect noise levels that it would normally be expected to hear. This phenomenon is reversible (or disappears) some time after the animal is removed from the loud noise source. In a review of threshold levels, Ketten (1998) concluded that a noise level of 140dB, that is also 80-90dB above the species hearing threshold at each frequency, is necessary to produce a significant temporary change in hearing ability.

9.3.5 MODELLING UNDERWATER NOISE LEVELS AND THEIR EFFECTS

The noise levels that might be found in the water column at different distances from the Demonstrator site have been predicted by modelling the propagation of sound in water. The model used was the Source Level – Transmission Loss model described by Nedwell and Howell (2004). This method uses the following expression:

$$SPL = SL - TL$$

where SPL is the Sound Pressure Level, SL is the Source Level and TL is the Transmission Loss, all of which are measured in dB. The Source Level refers to the level of sound measured at one metre from the noise source, expressed in dB re 1 μPa @ 1m.

As an acoustic signal travels through the ocean, it becomes distorted as a result of multi-path effects, and weaker because of various loss mechanisms (Jensen *et al*, 1994). The standard measure of the change in signal strength in underwater acoustics is called Transmission Loss. This is calculated as the sum of a loss due to geometrical spreading and a loss due to attenuation, and can be expressed as follows:

$$TL = N \cdot \log(r) - \alpha \cdot r$$

where N is the coefficient relating to geometrical spreading, r is the range, i.e., the distance from the noise source, and α is the absorption coefficient.

The equations used also take into account the spreading loss, a measure of the way in which the signal weakens as it propagates outward from a source. There are two main geometrical spreading laws to be considered in underwater acoustic modelling – spherical spreading and cylindrical spreading – (Jensen *et al.,* 1994; Richardson *et al.,* 1995). It is generally considered that cylindrical spreading would occur in water depths of less than 200m (Jensen *et al.,* 1994) and in these circumstances it is appropriate to use a value of N=10 from transmission loss in the above equation.

The model was also used for assessing the propagation of noise caused by different noise sources, which could be situated at the same or different location. If the difference between the two noise levels is great, then the lower noise level will contribute very little

Table 9.2 Approximate values for determining the combined noise level from two noise sources (Norton, 1989).

Difference between two source pressure levels (dB)	Value to be added to the higher SPL (dB)
0–1	3
2–3	2
4–9	1
>10	0

The sound propagation modelling methodology used did not take into account the variations of the speed of sound in seawater with varying temperature, salinity and hydrodynamic pressure. Other factors affecting underwater sound propagation such as noise source depth, bathymetry, type of seabed or interactions with the seabed and the sea surface were not considered.

9.4 ASSESSMENT OF THE POTENTIAL NOISE EFFECTS OF UNDERWATER PILING

9.4.1 INTRODUCTION

Using the equations described in Section 9.3.5, modelling was carried out for source noise levels at several different frequencies, in order to assess the maximum size of the areas in which the different species might be exposed either to a noise level that resulted in an avoidance reaction, or to a level that caused a temporary change in hearing ability. Care was taken to ensure that both peak frequencies for the source noise level, and peak frequencies for the species hearing ability, were examined.

9.4.2 SOURCE AND CHARACTER OF NOISES FROM UNDERWATER PILING OPERATIONS

The piling operations for the two WTG substructures will require the use of a piston-type hammer (as opposed to a rotary-type), delivering repeated blows to a 1.8m diameter open-ended steel pile, being driven into sands and clays in a water depth of 45m. Piling operations at the Demonstrator site will therefore be more similar to the routine piling undertaken by the offshore oil and gas industry, rather than to the piling of large diameter monopile towers for nearshore wind farms. As described in Section 3.3.6, it is anticipated that it will take no more than two hours to drive each pile, and that two piles can be fixed each day. Piling noise might therefore be generated for a total of about four hours on four consecutive days.

Piling operations create underwater noises of a frequency and level that are audible to seals, toothed and baleen whales, and fish (Richardson *et al.,* 1995; Nedwell and Howell, 2004; Nedwell *et al.,* 2004a). Noise from piling can enter the marine environment by four pathways; the most significant pathway is thought to be by transmission of vibration through the pile itself directly into the water column. The noise produced during piling is dependent on several factors including the type of equipment used, the water depth, and the characteristics of the seabed (Nedwell *et al.,* 2001; Nedwell *et al.,* 2004a).

9.4.3 SOURCE NOISE LEVEL FOR PILING AT THE DEMONSTRATOR SITE

There are no specific measurements available for the noise that would be produced during operations to fix 1.8m diameter piles in a sand/clay seabed in a water depth of 45m. From noise measurements taken under different circumstances, however, there appears to be a correlation between the diameter of the pile or monopile being driven and the Source Noise Level (Nedwell, Workman and Parvin, 2005). The best fit line shows SL = 24.3D +179dB re 1µPa @1m, where D is pile diameter in metres, and this would suggest that the source noise level for a 1.8m diameter pile might be about 225dB re 1µPa @ 1m.

The frequency profile for piling noise is rather “flat” with no obvious peak, but maximum pressure levels are attained over the range 300-1,000Hz (Figure 9.6), which overlaps the hearing range of the key species under consideration.

During piling the noisiest vessel that is likely to be under way and in close proximity to the piling operations would be a supply vessel. The difference between the source level noise for piling (225dB) and source level noise for a supply vessel (164dB) is more than 10dB, so the presence of this additional noise source would make no contribution to the total source noise level at the site.

9.4.4 ESTIMATED RECEIVED NOISE LEVELS FROM PILING AT DEMONSTRATOR SITE

The potential effect of a piling noise of SL 225dB was examined by modelling the extent of the zone in which an avoidance reaction might be elicited, and the extent of the zone in which temporary change in hearing ability may be caused. Different frequencies were modelled to determine the largest extent of each zone, depending on the species’ hearing ability.

Extent of zone for avoidance reaction

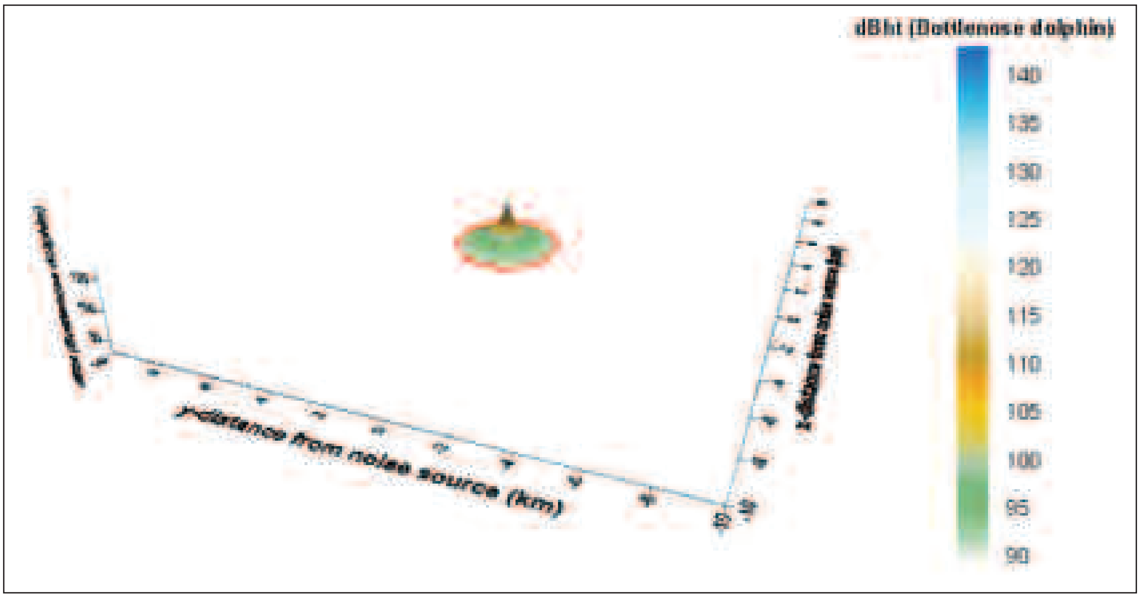
The extent of the avoidance zone was set at a perceived noise level of $90dB_{(ht)}$ (Section 9.3.4). The significant frequencies, and the equivalent $90dB_{(ht)}$ distances for the species examined are given in Table 9.3.

Table 9.3 Radius of maximum area for >90dB($_{ht}$) noise levels, and corresponding frequency, for selected species exposed to source noise level of 225dB from piling operations at Demonstrator site.

Species	Frequency (Hz)	Radius (km)
Bottlenose dolphin	1,000	2.0
Harbour porpoise	1,000	9.3
Common seal	1,000	7.5
Minke whale	400	33.0
Salmon	160	2.2

The model was also used for assessing the propagation of noise caused by different noise sources, which could be situated at the same or different location. If the difference between the two noise levels is great, then the lower noise level will contribute very little to the total noise level, as illustrated by the guide values given in Table 9.2.

Figure 9.1 The extent of the avoidance zone (>90dB($_{ht}$)) for bottlenose dolphin exposed to a source noise of 225dB at 1,000Hz.



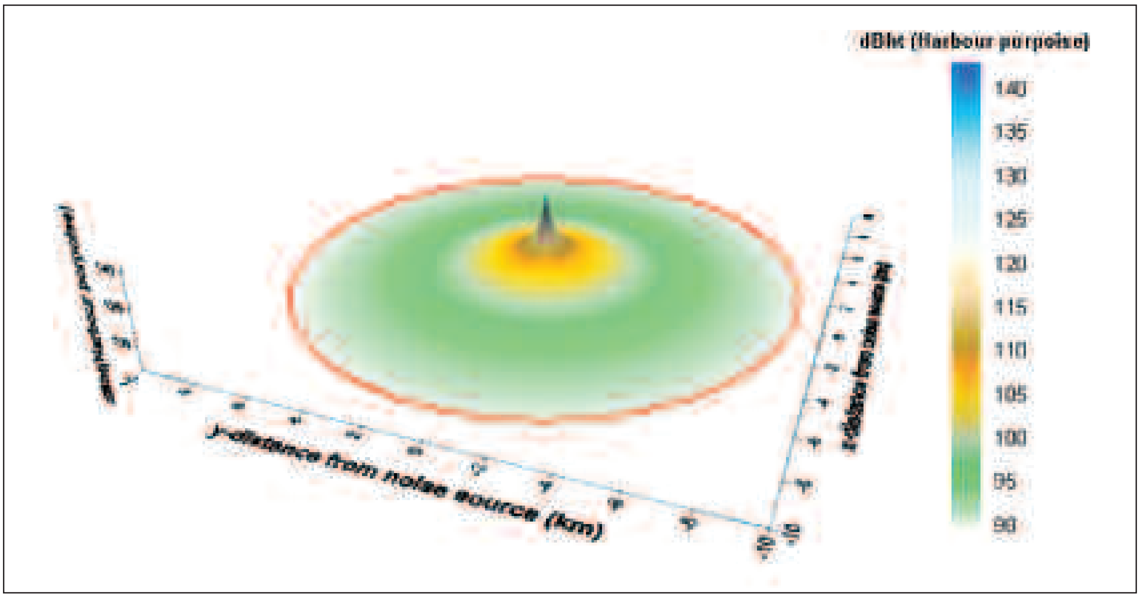


Figure 9.2 The extent of the avoidance zone (>90dB(ht)) for harbour porpoise exposed to a source noise of 225dB at 1,000Hz.

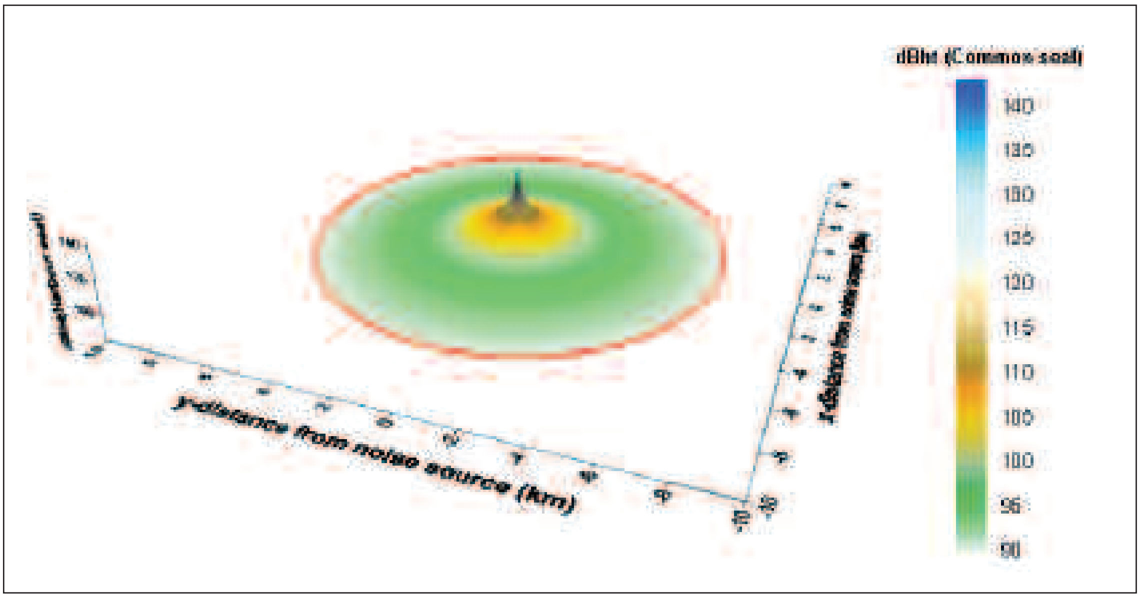


Figure 9.3 The extent of the avoidance zone (>90dB(ht)) for common seal exposed to a source noise of 225dB at 1,000Hz.

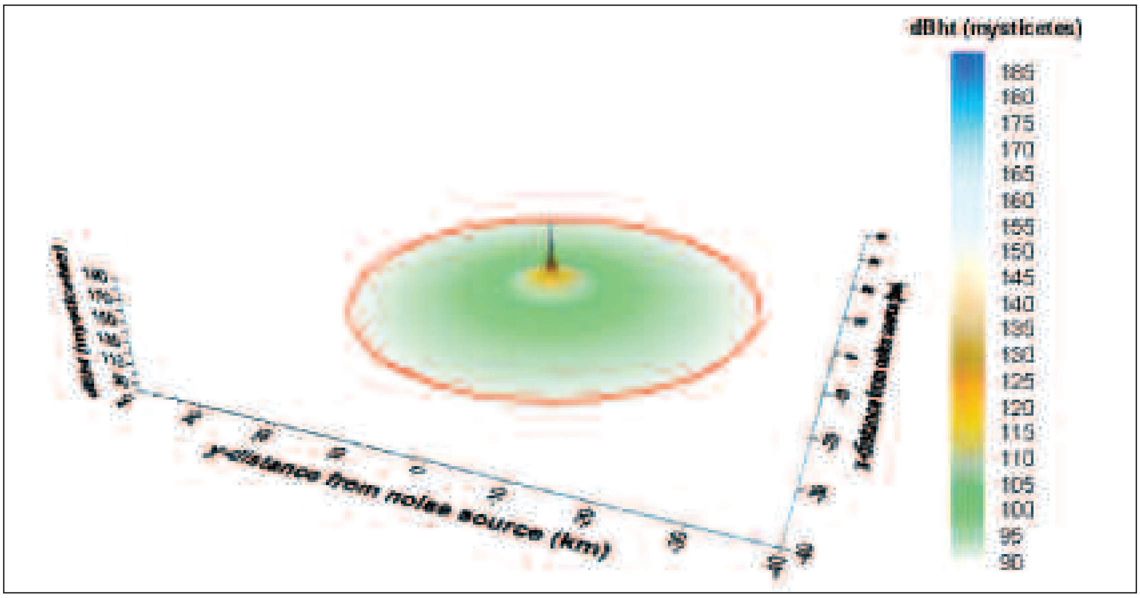


Figure 9.4 The extent of the avoidance zone (>90dB(ht)) for minke whale exposed to a source noise of 225dB at 400Hz.

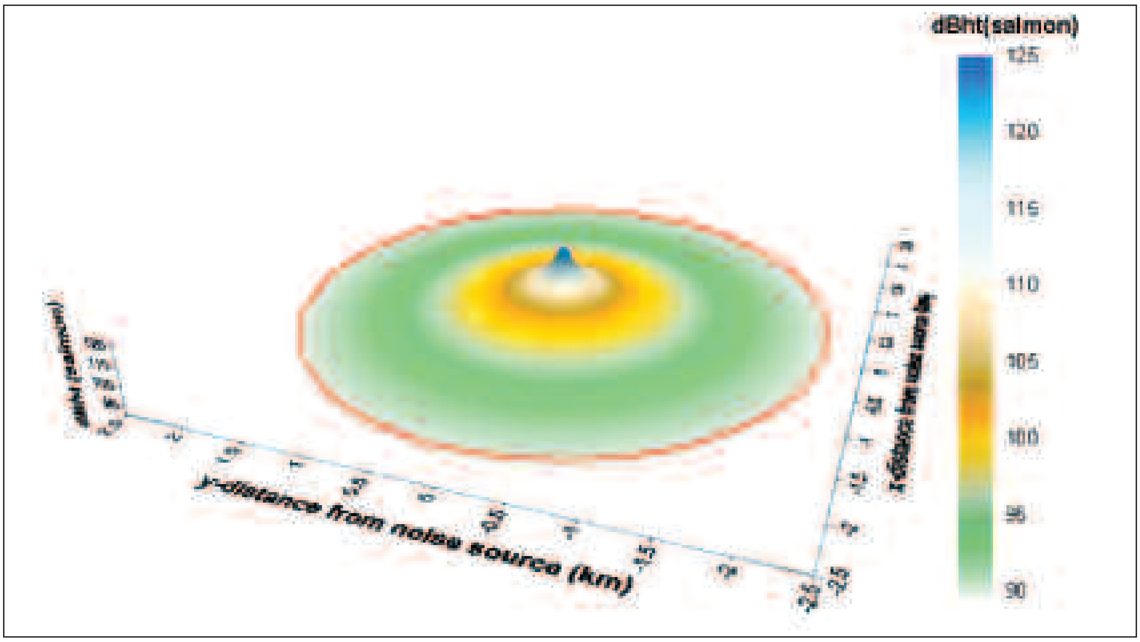


Figure 9.5 The extent of the avoidance zone (>90dB(ht)) for salmon exposed to a source noise of 225dB at 160Hz.

Extent of zone in which temporary change in hearing ability might occur

When examining noise propagation within 10km of a source, the noise attenuation due to absorption can be ignored (Nedwell *et al.,* 2003) so the equation for noise propagation can be simply expressed as:

$SPL(r) = SPL(source) - N \log(r)$, where r is the distance from the source and N is the transmission loss coefficient, in this case with a value of 22 (Nedwell *et al.,* 2003 for piling noise).

The propagation of the noise generated at several different frequencies was modelled for each species, using this equation, to estimate the maximum area of the zone in which temporary change in hearing ability might occur. The results of these assessments are shown in Figure 9.6 which shows:

- *the frequency profile for the pile source noise, peaking at 225dB around 300Hz*
- *the predicted profiles for temporary change in hearing ability (TTS) for bottlenose dolphin, harbour porpoise and common seal*
- *the predicted noise level from piling at a distance of 0.5km from source*
- *the predicted noise level from piling at a distance of 1km from source.*

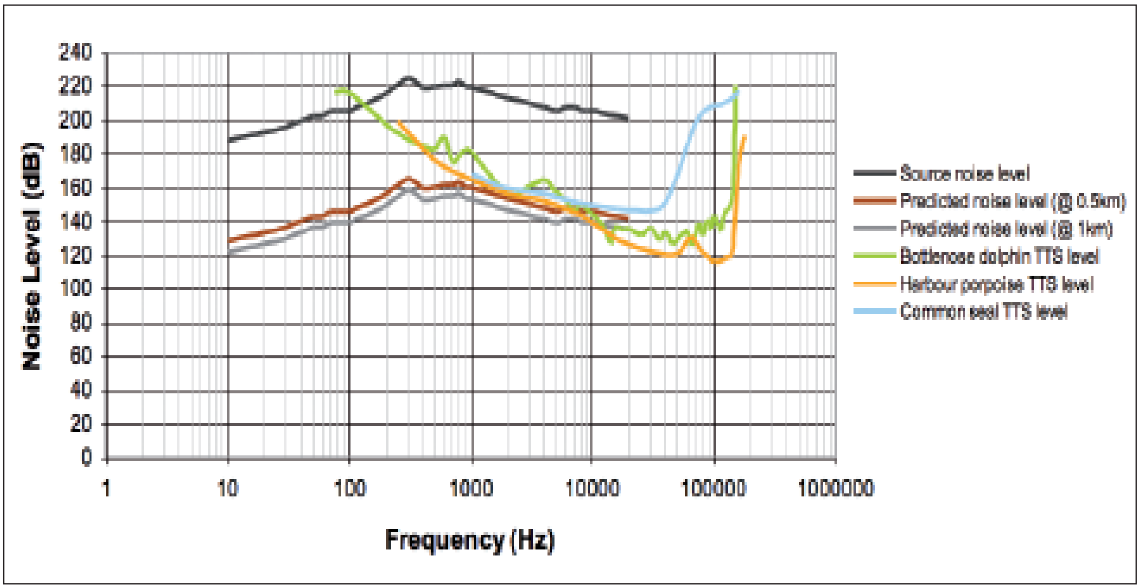


Figure 9.6 Piling noise and predicted noise level at two distances from source, in relation to predicted profiles for temporary change in hearing ability for selected species.

Figure 9.6 shows that at a distance of 500m from the source, for all three species, the predicted noise for frequencies below 5,000Hz falls below the level at which temporary change in hearing ability might occur. At frequencies above 5,000Hz, the predicted noise level exceeds the level at which temporary change in hearing ability might occur for bottlenose dolphin and harbour porpoise.

At a distance of 1km from the source, for all three species, the predicted noise for all frequencies below 10,000Hz falls below the level at which temporary change in hearing ability may occur. At this distance, noises at frequencies above 10,000Hz are predicted to reach a level that would cause temporary change in hearing ability for bottlenose dolphin and harbour porpoise.

A similar assessment for minke whales shows that the level that might result in temporary change in hearing ability is just reached, at a distance of about 0.4km from the source, at a frequency of about 400Hz.

9.4.5 PUBLISHED DATA IN RESPONSES TO UNDERWATER NOISE FROM PILING

The perceived noise levels from piling operations exceed ambient noise levels and are inevitably detectable by marine mammals. The responses of marine mammals to sounds of different noise levels are summarised in Section 9.3.3. Loud noises are potentially physically damaging to marine mammals if individuals are in close proximity to the source when piling operations begin.

Few marine mammals are exposed to the full force of underwater piling noise because of the range of mitigation measures enacted by piling operations associated with wind farms. Attention has focused on displacement and behavioural responses, and most studies have shown that with regard to noise from installation operations, these effects are likely to be temporary and localised, even though evidence suggests that marine mammals would be able to hear piling noise over a large area (Laidre *et al.,* 2001). Monitoring studies conducted for the Horns Rev offshore wind farm found that harbour porpoises returned to the area quickly after cessation of the noise (Tougaard *et al.,* 2003). This temporary displacement of marine mammals, however, may have been exacerbated by the displacement of their food source. At the Horns Rev project, it was found that more seals entered the water during piling than during periods without piling, but this may have been because the seals were taking advantage of local fish mortality caused by the piling. A Danish summary paper (Gastrup *et al.,* 2000) on the first four offshore wind farms in Denmark speculates that the effect of piling noise on marine life is short-term avoidance, and that there are no long-term effects directly linked to the construction phase.

Noise levels from underwater piling have been shown to induce avoidance reactions, injuries and even mortality in fish (Nedwell *et al.,* 2004). Further research undertaken indicated a lack of reaction to piling noise and it was demonstrated that piling activities only affected fish behaviour within a radius of 600m (Nedwell *et al.,* 2003; Feist *et al.,* 1996). Anderson (1992) reports similar results, and also observed that habituation to piling occurred almost immediately.

9.4.6 PROJECT MITIGATION MEASURES FOR PILING NOISE

Table 9.4 summarises the predicted extent of areas in which an avoidance reaction, and a temporary change in hearing ability, might be expected, for each of the species exposed to the predicted piling noise.

Table 9.4 Estimated maximum radius for zones of avoidance reaction, and temporary change in hearing ability, for selected species exposed to 225dB source noise from piling operations at the Beatrice wind farm Demonstrator site.

Species or group	Estimated maximum radius (km)	
	Avoidance reaction	TTS
Bottlenose dolphin	2.0	1
Harbour porpoise	9.3	1
Common seal	7.5	<1
Minke whale	33.0	0.4
Salmon	2.2	<0.1

Talisman will develop a project-specific environmental protection plan outlining the mitigation measures to be used during piling. This will include a series of mitigation measures based on the principles in the JNCC 'Guidelines for Minimising Accoustic Disturbance from Seismic Surveys', specifically:

- *reduce the source level of piling noise, if possible, using physical barriers*
- *use marine mammal observers and passive acoustic monitoring to ensure as far as possible that no marine mammal is within 1km of the site before piling starts*
- *use a "soft start" technique to alert marine mammals in the immediate vicinity (for example within 10km) to the commencement of the piling operations.*

It may be possible to use various physical devices to reduce the level of noise from piling. Such systems can reduce the source noise level in the water column; and reductions of 3dB to 10dB are claimed (Nedwell *et al.,* 2003). Talisman is currently exploring opportunities for physical noise mitigation, and how to overcome the technical and logistical problems of deploying such arrangements in 45m of water offshore. Clearly, even a reduction of a few dB at source reduces the radius of the zones of effect estimated in the modelling.

The focus of the project's mitigation measures will be firstly, to ensure that no marine mammal is present within 1km of piling operations, and secondly, that individuals present in the zone where perceived noise levels might be expected to cause strong avoidance reactions are encouraged to move further away.

Talisman will follow the principles of the JNCC guidelines for minimising the acoustic effects of seismic operations on marine mammals. Independent marine mammal observers will be present offshore throughout the piling programme. Before operations begin, the area within 1km of the site will be carefully surveyed to ensure that there are no marine mammals present. Piling will not be started during darkness. The environmental protection plan will be based on similar plans produced and operated by Talisman (Talisman, 2000) and will identify clear actions to be taken if marine mammals are detected before and during all operations.

Before full piling operations begin, a "soft start" will be implemented, whereby the force of piling is gradually increased, steadily raising the underwater noise level over a period of time. This will alert animals located more than 1km from the site to the piling activities, without exposing them to more intense levels of noise, and provide an opportunity for them to move away from the noise source.

9.4.7 CONCLUSIONS FOR EFFECTS OF PILING NOISE AT DEMONSTRATOR SITE

Marine mammals located within the Moray Firth SAC are not likely to experience noise levels above 90dB($_{ht}$) from pilling that would elicit an avoidance reaction. The boundary of the SAC is about 25km from the Demonstrator site, and a source noise of 225dB will have fallen to about 160db at this distance, giving dB$_{ht}$*(species)* levels of approximately 60-80dB at 300Hz for both bottlenose dolphin and harbour porpoise.

It is therefore concluded that, with the mitigation measures in place, some cetaceans and pinnipeds at distances of 1km to 9km from the site might be exposed to non-damaging noise levels above the 90dB($_{ht}$) threshold. These individuals are likely to display varying degrees of avoidance behaviour, and are likely to swim away from the source of the noise. Marine mammals exposed to noises of less than 90dB$_{ht}$*(species)* would be expected to stay away from the source of noise, and not swim closer to it. All species of marine mammal that may be displaced during piling operations would be expected to return to the area very soon after piling ceased, and to resume their normal pattern of visits to the Beatrice area.

Therefore, given the relatively short duration of pile driving operations (16 hours in total) and hence the short exposure time for marine mammals, we consider that the worst effects of the likely underwater noise (a temporary change in hearing ability that would be confined to an area within 1km of the site), can be avoided through the application of the proposed mitigation measures outlined in this section.

It is likely that some fish will be exposed to high levels of noise, and those within about 60-80m of the site may be injured or killed (Nedwell and Howell, 2004). However, at distances of more than about 100m, physical injury is less likely and most species would display an avoidance reaction.

9.4.8 POTENTIAL COMBINED EFFECTS OF NOISE FROM OTHER OFFSHORE ACTIVITIES IN THE MORAY FIRTH

The Moray Firth is an active area for oil and gas exploration and development. Underwater noise may be generated by other projects using vessels, drilling, or piling structures to the seabed. It is possible that seismic surveys may be conducted in parts of the Moray Firth in 2006 as a result of new licence awards made in the 23rd licensing round. Such surveys are subject to licensing, and strict controls are put in place to minimise effects of marine life.

Seismic surveys use short pulses of high-energy, low frequency sound which are emitted by a towed array of air-guns. Large areas of sea may be covered during seismic surveys, which typically last 30-90 days. Firing normally occurs at intervals of 10-15 seconds, continuously day and night, with breaks only for bad weather and making line turns.

Talisman understands that while other operators may be planning such surveys in the Moray Firth for 2006 it is unlikely that they would take place at the same time as the proposed piling operations, because of possible interference with seismic signals. Piling noise from the Demonstrator site would, therefore, not be additive to possible seismic noise. The proposed operations at the Demonstrator site would be of very short duration in comparison to a seismic programme, and so it is unlikely that the piling noise would result in a cumulative effect on marine life.

9.5 ASSESSMENT OF THE POTENTIAL NOISE EFFECTS OF VESSELS DURING INSTALLATION

9.5.1 SOURCE AND CHARACTER OF NOISES FROM VESSELS

Several different types of vessel will be used at the Demonstrator site during the installation programme (Section 3). All would be typical of the vessels routinely used in the UK North Sea for oil and gas operations and other activities.

The underwater noise that is produced by vessels arises from two sources – propeller cavitation and the propulsion machinery inside the vessel. Vessel noise may be considered to be a continuous, rather than transient noise source, which is a combination of broadband noise and tonal sounds at specific frequencies. Table 9.5 summarises published data on the sound source levels and frequencies for the types of vessels that would be used during the installation programme. Where no data exist for a specific type of vessel, data from a vessel of similar size and power to that proposed for the Demonstrator Project are given.

Table 9.5 Sound frequencies and source levels produced by the types of vessel that will be used for installing the WTGs. (Richardson et al., 1995; Heathershaw et al., 2002; Hildebrand, 2004; WDCS, 2004).

Vessel Type	Frequency (kHz)	Source Level (dB re 1µPa @ 1m)
Fishing boat for seabed sweep	0.25 –1.0	151
Tug (pulling empty barge)	0.037–5.0	145–166
Tug (pulling loaded barge)	1.0–5.0	161–170
Pipelaying vessel using dynamic positioning (DP)	0.05->1	177
34m twin diesel work boat	0.63	159
Supply vessel supplying the platform or HLV	0.1	164

9.5.2 PREDICTED NOISE LEVELS FROM THE VESSEL SPREAD AT THE DEMONSTRATOR SITE

The noise that will be generated by the vessel spread will be determined by the types and numbers of vessels that are present at the site at any one time. Because the decibel scale used to measure sound is a logarithmic scale, the presence of several sources of noise at any location at any one time leads to only a small increase in the total source level of noise at that site. For example, a tug creating 170dB and a supply vessel creating 164dB, if operating in close proximity to each other could be viewed a constituting a single noise source with a level of 170 + 1 = 171dB.

For the Demonstrator Project, examination of the proposed installation schedule shows that there would be a maximum of two vessels that would be likely to be working (under way) in close proximity to each other at any one time. The potentially noisiest realistic combination of vessels would be the pipelaying vessel on dynamic positioning (DP) and an attendant supply vessel. Noise from both vessels has a similar frequency spectrum, and the total noise created would be some 177+0=177dB. This scenario was therefore used to model potential noise impacts from vessels at the site. Other scenarios involving different combinations of vessels would give rise to lower source noise levels, and their potential effects would therefore be smaller than those predicted below. Table 9.6 expresses the source noise level of 177dB in terms of dB_{ht}*(species)* for the four species of principal concern at the site.

Table 9.6 Source noise level of 177dB at 500Hz and 1,000Hz expressed as dB_{ht}(species) for bottlenose dolphin, harbour porpoise, common seal and salmon.

Source Noise Level, dB_{ht} *(species)*	Species			
	Bottlenose dolphin	**Harbour porpoise**	**Common seal**	**Salmon**
At 500Hz	79	85	96	–
At 1,000Hz	82	96	94	–

No information is available in the audiograms for salmon at 500Hz.

The 90dB_{ht}*(species)* threshold value is exceeded at 500Hz for common seal, out to a distance of about 50m from the source. This same threshold level is exceeded at 1,000Hz for harbour porpoise and common seal (to a distance of about 10m in both species). The threshold levels for bottlenose dolphin, salmon and minke whale are not exceeded by this noise.

9.5.3 PUBLISHED DATA ON RESPONSES TO VESSEL NOISE

Literature on the response of marine mammals to vessel noise has been reviewed by Richardson *et al.,* (1995) and Vella *et al.,* (2001). Many marine mammals are tolerant of vessel noise and are regularly observed in areas where there is continuous heavy traffic (WDCS, 2003). However, at times, a species that used to show tolerance may show avoidance. For example, resting dolphins tend to avoid boats, feeding dolphins ignore them, and socialising dolphins may approach boats (Richardson *et al.,* 1995). It is not clear if such observations are related to production of noise or disturbance caused by the presence of boats.

Generally, fish only respond to very low or very high frequency sounds and studies have shown that vessel noise can either cause avoidance or attraction (Vella *et al.,* 2001). Experimental studies of fish reactions to vessel noise show that avoidance occurs at 118dB within the frequency range of 60-3,000Hz, whereas sounds in the range of 20-60Hz have no effect (Engas *et al.,* 1995). Changes in schooling behaviour have also been noted, such as forming tighter formations, increased swimming speeds and turning away from the noise source (McCauley, 1994).

9.5.4 PROJECT MITIGATION MEASURES FOR VESSEL NOISE

Vessel noise in the Beatrice field is not a new phenomenon, and no project-specific measures for the Demonstrator Project are planned. Importantly, vessel noise associated with the installation of the Demonstrator

WTGs would not start suddenly, but would vary gradually throughout the course of the installation programme, as vessels came and went from the field, and undertook a variety of tasks while both under way and "on station" close to the Demonstrator site. Marine mammals and fish that frequent or visit the general area of the Beatrice field might therefore be expected to be accustomed to some level of vessel noise in the area. In addition, the variable nature of the noise created by the relatively short-term installation operations at the Demonstrator site would provide some opportunity for individuals to move away from, or not approach, sources of noise that would elicit strong avoidance reactions in them.

9.5.5 CONCLUSIONS FOR EFFECTS OF VESSEL NOISE AT DEMONSTRATOR SITE

It is unlikely that individual marine mammals or fish at the Demonstrator site would be suddenly and without warning exposed to a high level of noise created by vessel operations. Marine mammals and fish may move away from the area in which numbers of vessels are routinely operating, and in which higher levels of vessel noise (>90dB_{ht}*(species)*, maximum radius of about 50m) may be experienced. This is a small area given the known ranges of these species. Dolphins, harbour porpoise and common seal roam widely in search of food, and if they avoid a small area in the immediate vicinity of the Demonstrator for short periods of time during installation, this is unlikely to lead to any significant or long-term detrimental effect.

It is therefore concluded that the noise from vessels, at the frequencies considered, would result in some degree of avoidance only for any individuals located in very close proximity (<100m) to vessels, and for short periods of time.

9.6 ASSESSMENT OF THE POTENTIAL NOISE EFFECTS FROM OPERATIONS TO BURY THE UMBILICALS

9.6.1 SOURCE AND CHARACTER OF NOISES FROM BURIAL OPERATIONS

The umbilicals will be buried by deploying a self-propelled underwater tool to traverse the seabed and fluidise the surface sediment using a directed jet of high-pressure water (Section 3.3.3). Burial operations are expected to take about 12 hours total for both WTGs. There are no measurements for the character or source sound level produced by such equipment.

The noises produced by subsea trenching operations depend on the equipment used and the nature of the seabed sediments. A trenching noise spectrum reported in Richardson *et al.* (1995) has peak levels of 178dB re 1µPa @ 1m at 160Hz, with an overall source level 185dB re 1µPa @1m; this agrees with data reported by Nedwell *et al.,* 2004. These levels are for mechanical dredging operations, and may be noisier than the fluidising equipment proposed for the Demonstrator.

9.6.2 PREDICTED NOISE LEVELS FROM BURIAL OPERATIONS AT THE DEMONSTRATOR SITE

For the purposes of modelling, a source noise level of 185dB re 1µPa @ 1m was assumed, with a frequency spectrum that paralleled that of the audiograms for the key species under consideration (i.e. a worst-case scenario in terms of frequency).

From the project schedule, the noisiest situation would be the deployment of the seabed fluidiser from a vessel operating under dynamic positioning. In such circumstances the combined source noise level might be about 185+1=186dB re 1µPa @ 1m. Figure 9.7 shows this source noise level expressed as dB_{ht}*(species)* for the key species.

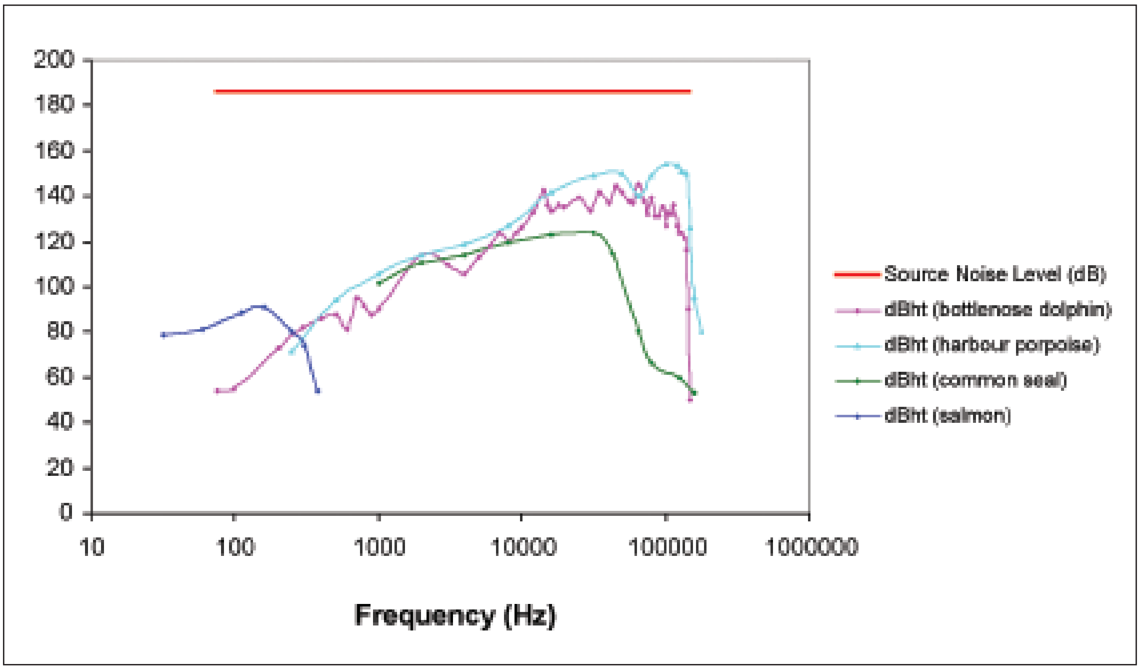


Figure 9.7 Source noise level of 186dB expressed as dB_{ht}(species) for bottlenose dolphin, harbour porpoise, common seal and salmon.

In the absence of a frequency spectrum for this noise source, the propagation of a 185dB noise was modelled several times, once for each of the key species under consideration. The selected frequencies corresponded to the frequency to which the species is most sensitive (i.e. this would be the worst scenario for each species).

Table 9.7 shows the frequency value used for each species, the corresponding received noise level at the source (dB_{ht}*(species)* at 1m) and the distance at which the received noise level falls below 90dB_{ht}*(species)*.

Table 9.7 Frequency values, perceived source noise level, and distance to 90dBht(species) threshold level for bottlenose dolphin, harbour porpoise, common seal and salmon exposed to 185dB noise from operations to bury umbilicals.

Data	**Species**			
	Bottlenose dolphin	**Harbour porpoise**	**Common seal**	**Salmon**
Frequency (Hz)	65,000	100,000	32,000	160
Source Noise Level, dB_{ht}*(species)*	145	154	124	90.8
Distance to *90*dB_{ht} *(species)* threshold (m)	*500*	*600*	*<50*	*<5*

It should be noted this assessment is a simplification, an attempt to capture the possible combined effects of two sources of noise vertically separated in the water column. One source is on the surface and is radiating noise downward and outwards, whereas the other is on the seabed radiating noise both into the sediment and upwards into the water column.

9.6.3 PUBLISHED DATA ON RESPONSES TO NOISE FROM BURIAL OPERATIONS

There is no published information about the effects of seabed fluidisers on marine mammals and fish. Noises from the burial operations are likely to be similar to those that very frequently arise offshore as a result of the use of vessels and equipment on the vessels or deployed by them.

9.6.4 PROJECT MITIGATION MEASURES FOR NOISE FROM BURIAL OPERATIONS

The areas in which noises $>90dB_{ht}$*(species)* would be experienced is very small, and therefore the numbers of animals that may be exposed to levels eliciting a behavioural or physical response when burial operations begin will be low. Operations to bury the umbilicals will start gradually (with the manoeuvring of vessels, the deployment of the fluidiser to the seabed and the beginning of jetting) so marine mammals in the immediate vicinity would be alerted to this activity and have the opportunity to move away. Individuals within the $>90dB_{ht}$*(species)* zone would be able to swim out of the area in a few minutes (a harbour porpoise swimming at $0.9m.s^{-1}$ would take about 11 minutes to cover 600m).

9.6.5 CONCLUSIONS FOR EFFECTS OF BURIAL NOISE AT DEMONSTRATOR SITE

Trenching and burial operations will be preceded by general vessel activity, alerting animals in the vicinity to ongoing operations. The trenching and burial operations themselves, on the seabed, will last a relatively short period of time, about 12 hours in total for both WTGs. Although there is no published data on the noise produced by the fluidising equipment that would be used, estimates made using information from mechanical burying operations suggest that the area in which the selected species might be exposed to noise levels $>90dB_{ht}$ would be less than 600m wide. It is therefore concluded that there will be not significant or long-term effects on any marine mammal or fish in the area.

9.7 ASSESSMENT OF THE POTENTIAL NOISE EFFECTS FROM THE OPERATION OF THE DEMONSTRATOR TURBINES

9.7.1 SOURCE AND CHARACTER OF OPERATIONAL NOISE

When the turbines are operational, the main source of underwater noise will be from the working of the gears in the nacelle at the top of the tower (Nedwell and Howell, 2004). This noise/vibration is transmitted into the sea by the structure of the tower itself, and manifests as low frequency noise. Other transmission pathways are via the tower and the seabed, or through the air and air/water interface, but these are unlikely to be as important as the pathway directly through the tower (Nedwell and Howell, 2004). The received level of sound from turbines depends on a number of factors including local wind speed, sound propagation profile, water column depth, sea surface roughness and seabed geology (Nedwell and Howell, 2004).

Published data on the source noise levels from operating wind farms (reviewed by Nedwell and Howell, 2004), indicate that noise generated may have a peak frequency in the range 16 to 60Hz, and that the sound level may be up to 153 dB re µPa @ 1m (Nedwell and Howell, 2004). The available field data showed that although the absolute level of turbine noise increases with increasing wind speed, the noise level relative to background noise (i.e. from wave action, entrained bubbles) remains relatively constant. It should be noted, however, that these data are all for monopole or gravity structures located in relatively shallow water. The character and level of noise generated by operating turbines is dependent not only on the characteristics of the turbine itself, but also on the nature of the support structure and the way in which this may efficiently transmit noise and vibration into the water column.

9.7.2 PREDICTED UNDERWATER NOISE LEVELS FROM OPERATING TURBINES AT THE DEMONSTRATOR SITE

There are few data on the operational noise levels of the REpower 5M turbine, or on the way noise from such a turbine might be transmitted into the sea by a "jacket-like" substructure such as that proposed for the Demonstrator WTGs. For this reason, no assessment has been made of the possible effects of underwater vibration (as opposed to noise) from the proposed WTGs.

For the purposes of modelling underwater noise, however, it has been assumed that the Demonstrator WTGs would create a source level of 153dB re μPa @ 1m, and that the noise frequency spectrum would be similar to those reported in the literature (i.e. peaking at 16Hz).

If the underwater noise from the operating WTGs is of a low frequency range, it would essentially not detectable by bottlenose dolphin, harbour porpoise, common seal or salmon. The <90dB_{ht}*(species)* level is attained within 80–90m of the source for all the selected species.

Because the operating WTGs will be located adjacent to the operating Beatrice platforms, however, the possible combined effects of noise have been examined. Table 9.8 examines different combinations of WTG noise, Beatrice platform noise, and vessel noise, to estimate the maximum likely combined source noise level. Ignoring differences in frequency spectra, the total combined noise source under operating conditions is unlikely to exceed 188dB re μPa @ 1m if the source noise level of a WTG itself is about 153dB re μPa @ 1m. In cases where the noise from the operating platform is taken into consideration, the total source noise level is largely attributable to that noise rather than noise from the WTGs. Table 9.9 then expresses the estimated maximum source noise level as dB_{ht}*(species)* source noise for the selected species. The results show that the 90dB_{ht}*(species)* threshold is not exceeded for any of the selected species.

It should be stressed that there are very few data giving the underwater noise levels for operating oil and gas platforms. The data given in Table 9.8 is for the Douglas platform in Liverpool Bay. Unlike the Beatrice platforms, this installation has large gas turbines running all the time, to provide power to the platform. This is likely to be a significant source of underwater noise.

Table 9.8 Estimated combined source level noise for an operating WTG in combination with other sites or activities.

Scenario	**Combined source level (dB re μPa @ 1m)**
2 WTGs (at mid-point) (1)	113
1 WTG + working Beatrice Alpha platform (1, 2)	187
1 WTG with supply vessel + working Beatrice Alpha platform (1, 2)	188
1 WTG + supply vessel + Beatrice platform with supply vessel (1, 2)	188

(1) Assuming a peak frequency of 16Hz
(2) Combined noise calculated at the WTG location

Table 9.9 Source level noise of 188dB (300Hz) expressed as dB_{ht}(species) for bottlenose dolphin, harbour porpoise, common seal and salmon.

	Species			
	Bottlenose dolphin	**Harbour porpoise**	**Common seal**	**Salmon**
Source Noise Source Noise Level dB_{ht}*(species)*	84	77(*)	106 (**)	76 (*)

(*) The weighting value for harbour porpoise and salmon were obtained by an interpolation of the species audiogram.
(**) The weighting value for common seal was obtained by an extrapolation of the species audiogram.

9.7.3 PUBLISHED DATA ON RESPONSES TO NOISE FROM TURBINE OPERATIONS

The operational phase of offshore wind farms has been reported to produce broadband low frequency noise above ambient levels and at the lower end of the threshold frequency spectra of odontocetes (Richardson *et al.,* 1995). The zone of audibility and potential zone of exclusion around operational offshore wind farms has not been clearly defined. Different studies have reached different conclusions, perhaps affected by local conditions. By comparing auditory sensitivities of marine mammal species for different frequencies with wind turbine sound characteristics it was predicted by Henriksen *et al.,* (2001) that the maximum detection distance for harbour porpoises is likely to be 50m. Detection distances in relation to Vindeby (Denmark) and Gotland (Sweden) were predicted to be in the region of 20m (Bach *et al.,* 2000), but studies at the Vindeby site were not able to demonstrate any noticeable change in behaviour or numbers of animals present during its operation. Koschinski *et al.,* (2003) reported on the behavioural reactions of harbour porpoises and seals to the noise of a simulated 2MW wind turbine. Results indicated that porpoises and seals were able to detect the low-frequency sound generated and that they showed distinct reactions to the noise. In addition, the number of time intervals during which porpoise echolocation clicks were detected increased by a factor of 2 when the sound source was active (Booij, 2004).

Investigations conducted by Westerberg (1999) of the operational noise effects of the Svante wind farm (Sweden) on eels concluded there was no difference between migration speed or distance from the turbine or that no changes in behaviour could be related to the presence of the turbine.

Studies of the effects of noise on fish at the small wind farm site at Vindeby, Denmark, and oil and gas platforms in the UK sector, have also concluded that fish appear to be undisturbed by the background noise generated by wind turbines. Further, as noted elsewhere, fish may actually accumulate in the area of the turbines and foundations as occurs at other offshore structures. Fish have been noticed in close proximity to wind turbines at Blyth, Northumberland and sea birds have been observed diving within 20m of the turbines to catch fish (Vella *et al.,* 2001).

9.7.4 PROJECT MITIGATION MEASURES FOR OPERATIONAL NOISE FROM THE WIND TURBINE GENERATORS

The WTGs will be maintained and operated to a high standard, and this will help to minimise the amount of noise produced in the turbine nacelle and transmitted through the tower and substructure to the sea.

9.7.5 CONCLUSIONS FOR EFFECTS OF OPERATIONAL NOISE FROM THE WIND TURBINE GENERATORS

The degree to which turbine noise in the nacelle will be transmitted through the tower and substructure to the sea is not known for a WTG of the design proposed for the Demonstrator Project. It is likely that the construction and stiffness of the steel jacket will not transit sound as effectively into the water column as do free-standing monopiles. It is therefore not clear if the WTGs would create as much underwater noise as turbines reported in the literature.

The noise from wind turbines increases with increasing wind speed, but so does the background noise level of the sea. The relative noise of the turbines is, therefore, thought to remain fairly constant. Using published information from other types of turbine, it is estimated that the noise level from the WTG would fall to $<90dB_{ht}$*(species)* for all the selected species within 100m of the site. Using a single published estimate of underwater noise from a working platform, with different characteristics from the Beatrice platforms, it is estimated that at the midpoint between the Beatrice platform and WTG 1, the noise level would have fallen to $<90dB_{ht}$*(species)* for all the selected species.

The underwater noise from the working WTGs will vary depending on wind speed and sea state, and can be expected to vary during the day, from day to day, and from season to season. Changes in underwater noise levels are likely to be gradual, not sudden. Marine mammals will therefore be able to modify their local behaviour around the WTGs, in order to remove themselves from sources of noise that they find disturbing. Given the densities of marine mammals in the area of the Demonstrator Project, it is likely that only a very small number of marine mammals, if any, would be exposed to noise levels around a WTG at which avoidance reactions might be elicited.

It is therefore concluded that if the Beatrice Demonstrator turbines installed on top of the jacket-like substructures produce underwater sounds similar in level and frequency to those measured for smaller monopile turbines in shallower water, then very few marine mammals are likely to be exposed at any one time to noise levels that would be sufficiently high to elicit an avoidance reaction.

10 Effects of the Demonstrator Project on Birds

10 EFFECTS OF THE DEMONSTRATOR PROJECT ON BIRDS

10.1 INTRODUCTION

There is extensive literature on the potential and actual effects that wind farms have on birds (e.g. *Birdlife International* 2003; Percival 2003). The construction and operation of commercial scale wind farms onshore or offshore has been found to produce a variety of effects including:

- *presenting a barrier to bird movement*
- *displacing birds from the area*
- *adversely affecting birds' feeding grounds or food sources*
- *presenting a collision risk to birds.*

The installation and operation of the two WTG units in the Beatrice field may give rise, in varying degrees, to some or all of these effects. This section therefore presents:

- *a review of site-specific data on use that birds make of the site throughout the year*
- *a quantitative assessment of the potential collision risk for birds*
- *a qualitative or quantitative assessment of the other potential sources of impact to birds*
- *an assessment of the significance of each of these potential sources of impact for birds.*

Site-specific information about the use that birds make of the Demonstrator site is presented in Section 4.7, based on the results of 12 months of observation from the Beatrice platform.

10.2 ASSESSMENT OF POTENTIAL EFFECTS OF THE DEMONSTRATOR WIND TURBINE GENERATORS ON BIRDS

10.2.1 BARRIER EFFECTS

Nature of potential effect

There is some indication that wind turbines may act as offshore barriers to bird movement (*BirdLife International*, 2003; Percival, 2001; OSPAR 2003), with birds flying around groups of turbines rather than through them. Several studies have shown that some bird species alter their flight routes to avoid flying through wind farms. For example, tufted duck and pochard at Lely in the Netherlands (Dirksen *et al.,* 1998); eiders at Tuno Knob in the Danish Baltic (Tulp *et al.,* 1999); and eiders at Utgrunden in the Swedish Baltic (Petterson and Stalin, 2003). In general, it is believed that birds will tend to avoid passing through wind farms, even when the total number of turbines is only 20 or 30 (Percival, 2001).

The consequence of such a response by birds will be dependent on the species in question, the physical condition of the individuals and the magnitude of the displacement that the wind farm causes. Issues of spacing between individual turbines and between clusters of turbines may be important and may offer the potential for mitigation. Generally, the closer turbines are sited to the shore, the greater the potential for interception of bird movements associated with feeding, roosting, breeding and migration (Desholm and Kahlert, 2005).

Assessment of barrier effect at Demonstrator site

The two WTGs are spaced about 900m apart, and WTG 1 is located about 1.6km from the Beatrice Alpha complex. They would present a small additional physical feature in the offshore environment close to the Beatrice field. Each WTG would occupy about 58,612m^3, of airspace ($C*\pi*r^2$, where C = blade maximum chord of 4.7m and r = blade length of 63m) (length of blade).

On the basis of the 12 months of observation, there do not appear to be marked diurnal or seasonal movements of birds across the proposed site of the two Demonstrator WTGs.

It is concluded that the presence of the two WTGs, spaced about 900m apart at the offshore location in the Beatrice field, is not likely to create a significant barrier to those species of birds that use the area.

10.2.2 DISPLACEMENT AND DISTURBANCE EFFECTS

Nature of potential effect

Generally speaking, birds will be sensitive to disturbance from offshore activities during all phases of the wind farm life-cycle. Birds will depart from the area of influence to avoid the source of disturbance and consequently will be excluded from that location for the duration of the disturbance. The risk of a potentially significant impact from displacement is dependent on:

- *the availability of alternative localities, such as other feeding areas*
- *the scale of the disturbance, including the distance from the disturbance within which the bird reacts to the disturbance*
- *the frequency and duration of the disturbance*
- *the sensitivity of the species to the disturbance*
- *the degree to which each species might habituate to the disturbance.*

The extent to which birds avoid turbines has variously been estimated as ranging from 100m to 1,500m, with a typical range of 400m to 800m (Percival, 2001, Guillemette *et al.,* 1998, Painter *et al.,* 1999). There is generally more evidence of displacement of birds around wind farms located in coastal habitats; most of the examples of such disturbance relate to waterfowl (Percival, 2003).

Assessment of displacement and disturbance effects at Demonstrator site

The operations to install the WTGs will be completed in a relatively short period of time (a total of about 20 days in May and 30 days in June or July), and would affect a small area of the sea adjacent to an existing offshore structure, the Beatrice field. The operations and equipment that would be used would be very similar to those employed for other activities associated with offshore oil and gas activities.

Once in place, the substructures would occupy a tiny area of the sea surface (about $900m^2$ each) and the airspace that could be swept by the blades would be about $58{,}612m^3$. If the Demonstrator site is represented as a rectangle 126m wide (blade diameter) by 900m long (separation of WTGs), around which it is assumed that there is a zone of 800m, from which birds may be displaced as a result of the presence of the WTGs, then the Demonstrator site could affect birds using an area of some $4.3km^2$. This is a very small proportion of the available area within the Beatrice field determination boundary around Beatrice.

Periodic monitoring and maintenance of the WTGs will be carried out by the deployment of the emergency rapid intervention craft (ERIC) from the nearby Beatrice platform. Birds in the Beatrice field are well-used to the frequent presence and activities of supply boats and other offshore support vessels, and it is unlikely that the additional use of the ERIC and other small vessels for maintenance visits would result in significant additional disturbance or displacement effects.

It is, therefore, concluded on the basis of the existing literature on birds in the Moray Firth (Section 4.7), and the year-long sequence of observational data from the Beatrice platform, that the operations to install the WTGs, and their presence at the Demonstrator site, is not likely to result in the significant disturbance of species for which the Demonstrator site is an important area; or the displacement of birds from an area of the sea, or an area of airspace, that is important to them. Birds flying close to the WTGs will tend to avoid them (Section 10.2.3), and birds may not use the immediate area (within perhaps 400-800m) of the Demonstrator site. This area (about $4.3km^2$), is small in relation to both the area within the field determination boundary and the area of the Smith Bank, and similar habitat is available beyond the very local influence of either the proposed WTGs or the existing Beatrice platforms.

10.2.3 LOSS OF OR CHANGES TO FOOD HABITATS

Nature of potential effect

Habitat loss occurs mainly through displacement of birds from an area around the wind turbines and includes reduced access to feeding areas and other important locations for specific activities, such as moulting. Physical changes to the habitat include the loss of the area of seabed covered by the turbine foundations, and the creation of new underwater substrate, in the form of the submerged parts of the WTGs, for the settlement of marine organisms (Noer *et al.,* 2000).

Existing studies (e.g. ABPmer, 2002) on the effects on bird populations of the loss of feeding habitat through the physical loss of seabed habitat indicate that changes to sediment character and physical processes are of small scale and restricted to the wind farm site. It is important that any proposed site should avoid important areas of suitable feeding habitat for particular species of interest.

In addition to the physical loss of habitat, there is also a potential "zone of avoidance" around turbines and wind farms where foraging birds are displaced. The probability of this effect occurring is high for at least some species which are sensitive to disturbance (DTI, 2003). Research carried out in Denmark on small wind farm developments, noted that both eider and common scoter were more abundant in the wind farm area immediately after construction was completed (reviewed by Percival, 2001). It was concluded that their distribution was more strongly mediated by food availability than any turbine avoidance behaviour. This suggests that exclusion may not affect all bird species, and some species and individuals are likely to forage amongst turbines. The consequence of exclusion on bird populations would be dependent on the extent of the exclusion and the availability of an alternative habitat. One of the important issues associated with the loss of, or change to, habitat is that of cumulative impacts, in particular those that potentially affect limited habitats that are important feeding areas (DTI, 2003).

A range of prey species for seabirds and sea ducks may be attracted to turbine structures following colonisation by shellfish (DTI, 2003). Increased abundance of fish species around the structures may potentially attract divers, auks, terns and gulls (DTI, 2003).

Assessment of this effect at the Demonstrator site

As stated above, it is postulated that the presence of the two WTGs could affect the use that birds may make of an area of about 4.3km^2 centred on the Demonstrator site. This is a very small proportion of the available habitat within the Beatrice field determination boundary, and of the Smith Bank.

Bird behaviour at the site was recorded in all months from August to December. Four species were observed feeding at the site, and the total numbers of observations of feeding for each species (of a total of 2,185 observations of behaviour) were as follows: tern sp., nine observations (0.4% of total); kittiwake, eight observations (0.4%); auk sp., one observation (0.05%); and Arctic skua one observation (0.05%). In addition, the site-specific benthic survey did not indicate that there were dense populations of sandeels on the seabed at the Demonstrator site (Section 4).

It is, therefore, concluded that the presence of the two WTGs will not result in any significant change to, or loss of, any offshore habitat that is used by birds for feeding.

10.3 ASSESSMENT OF POTENTIAL COLLISION RISK FOR BIRDS

10.3.1 INTRODUCTION

Wind turbines can pose a potential collision risk in relation to several types of bird movements (Noer *et al.,* 2000; Christensen *et al.,* 2003) including:

- *annual migration between breeding and wintering areas*
- *daily flights between roosting sites and foraging areas*
- *evasion or avoidance flights following disturbance by humans*
- *flights towards turbines, as a result of attraction to the wind farm area*
- *active foraging flights.*

Overall, it is clear that birds are generally able to avoid collisions (Percival, 2003) and the majority of studies to date have demonstrated low rates of collision mortality per turbine (Percival, 2001; *BirdLife International*, 2003). The risk of collision, however, will vary considerably depending on several factors such as species, flock size, normal flight behaviour (speed, direction, altitude), migration and local inter-site routes, weather conditions, population of birds adjacent to the wind farm, feeding habitats and seasonal variability in flight capability (as affected by, for example, moulting) (Noer *et al.,* 2000; Christensen *et al.,* 2003).

Data from the ornithological observations carried out at Beatrice were, therefore, used to estimate the collision risks for birds found at the Demonstrator site. The aim was to determine if the presence of the two WTGs would be likely to pose a "significant" risk to any species. In line with the definitions employed by SNH, a significant collision risk was defined as one that would be likely to represent additional mortality to the species equal to $>1\%$ of that species' natural mortality.

10.3.2 METHODS USED TO CALCULATE COLLISION RISK

Assessing collision risks

The effects of collisions with turbines can be determined by:

- *calculating the potential risk that a bird flying though the turbines would be struck by the blades*
- *multiplying this by the number of "bird transits" that would be made by each species in the year*
- *applying an avoidance factor to take account of the fact that a large proportion of the birds encountering the turbines would take some form of avoidance action and not be struck.*

The resultant estimate of additional annual mortality is then compared with natural mortality levels in order to assess the significance of mortality associated with the proposed wind farm.

A collision model provides a probability of collision given that a single bird flies through the swept area of a turbine once, assuming that the bird takes no avoiding action. The probability of collision is dependent on several variables such as the diameter, chord (width) and rotation speed of the turbine blades; and the length, wingspan and flying speed of the species of bird (Band, 2000).

The SNH model does not fully take account, however, of two variables, which may be important in obtaining a more accurate estimate of collision risk. For large-diameter blades, the flying height of the bird within the zone swept by the blades is important because birds flying near the centre of the blades are more likely to be struck than those flying near the tips of the blades (McAdam *et al.*, 2005). Secondly, the speed of the bird across the ground (and hence its transit time through the blades) also influences the collision risk (Brookes *et al.,* 2005). Both these factors were assessed in the collision risk models that were applied to the Beatrice data.

Models used for Demonstrator site

Four models were applied to assess collision risk for birds at the Demonstrator site, and as described later in the results (Section 10.3.3) these different models may be more or less applicable to some of the species observed at the Demonstrator site.

Model A: Uniform height distribution and constant speed. Bird speeds through the turbine are constant and birds are distributed uniformly in height. The collision probabilities are found for birds flying upwind and downwind, and the mean of these two probabilities is used to find the number of collisions. This is the approach taken in most wind farm EIAs (Band, 2000).

Model B: Skewed height distribution and constant speed. Bird speeds through the turbine are constant, and birds are distributed towards the lower part of the turbine. The use of this model is intended to reflect the fact that most sea birds fly close to the water, especially in relation to turbines of the size proposed for the Demonstrator Project. Lower flight reduces the probability of collision.

In the skewed height distribution, the calculations of individual collision probabilities depending on the radius at which a bird passes through the turbine are exactly the same as in the standard SNH model (Band, 2000).

Model C: Uniform height distribution, speed is affected by wind. Bird speeds and direction are affected by wind conditions, and birds are distributed uniformly in height. The use of this model is intended to capture the fact that bird speed through the turbine can be extremely low if the bird approaches the turbine obliquely or is flying into a headwind. These low speeds substantially increase the probability of collision.

A large data set for wind conditions in the Moray Firth (approximately 1.3 million records sampled at one-minute intervals from 2003 to 2005) was used to inform this model. The data set was reduced to contain only records where the turbine would be operational (10 minute average wind speed is between $3.5m.s^{-1}$ and $30m.s^{-1}$). The model randomly sampled wind conditions from the data set. For each sample of wind velocity, bird direction was randomly sampled (uniform distribution 0-360°), and bird height was randomly sampled (uniform distribution from the bottom to top of the turbine). Every probability quoted is the mean of 5,000 samples.

Model D: Skewed height distribution and constant speed. Bird speeds and direction are affected by wind conditions, and birds are distributed towards the lower part of the turbine. This combines features of models B and C.

Characteristics of key bird species

Table 10.1 shows the data used for the sizes of each species and their flight speeds.

Table 10.1 Sizes and flight speeds for key species at risk from collision (Pennycuick, 1997, 2001; Mularney et al., 1999).

CHARACTERISTIC	VALUE
	KITTIWAKE
Body length	42cm
Wingspan	105cm
Flight speed	$13.1m.s^{-1}$
	GREAT BLACK-BACKED GULL
Body length	74cm
Wingspan	166cm
Flight speed	$12.8m.s^{-1}$
	FULMAR
Body length	52cm
Wingspan	117cm
Flight speed	$13m.s^{-1}$
	GANNET
Body length	97cm
Wingspan	192cm
Flight speed*	$10m.s^{-1}$
	AUK sp.
Body length**	46cm
Wingspan**	73cm
Flight speed	$16m.s^{-1}$

Table 10.1 (cont) Sizes and flight speeds for key species at risk from collision (Pennycuick, 1997, 2002; Mularney et al., 1999).

CHARACTERISTIC	VALUE
	HERRING GULL
Body length	60cm
Wingspan	148cm
Flight speed	12m.s^{-1}
	TERN SP.
Body length***	37cm
Wingspan***	80cm
Flight speed***	12m.s^{-1}

* *No published data for gannet, speed is for herring gull which is the lowest speed for any comparatively sized bird. Using a low speed is a conservative assumption.*

** *Size is for guillemot.*

*** *Size and speed is for common tern.*

Calculating the number of transits

The number of transits through the turbines was calculated in a similar manner to that described by Band (2005) for foraging birds, using the estimates of density for each species (Section 4.8.3). The calculations were simplified slightly by using the density of birds per square metre of sea surface rather than per cubic metre of air. The area of distance Band D is 2,400,000m^2, and the combined area of all distance bands is 3,100,000m^2.

For the purposes of collision modelling a transit is considered to be when a bird passes through the square containing the turbine blades, i.e. a bird must be in the risk height band and must cross the plane of the turbine within a horizontal displacement of the turbine radius or less. Viewed from overhead, the turbine occupies a rectangle of sea surface with an area of $A=2RT$, where R is the turbine radius and T is the thickness of the disc. If d is the density of birds occupying the turbine, then the mean number of birds in the turbine at any one time, $n=Ad$. Each bird takes time $t=T/v$ to cross the turbine, where v is the speed of the bird through the turbine. So the rate at which birds must enter the turbine, $r = Ad$, which can be expressed as $2Rdv$. (It should be noted that other studies only count as transits the birds which pass through the smaller area of the turbine circle; this requires higher collision probabilities but does not alter the resulting number of collisions.)

It was assumed that the birds were active for half the year (mean activity per day of 12 hours). The data for the turbines indicate that they would be operational when wind speeds are in the range 3.5m.s^{-1} to 30m.s^{-1}, and the weather data set indicated that these conditions would be obtained for 89% of the time. The total number of transits per year was thus calculated by multiplying the transit rate by half the number of seconds times 89%.

Turbine characteristics

Table 10.2 shows the input data used for the turbine characteristics. The blade profile (variation in blade chord width with radius) was modelled as varying linearly between four points. The variation in blade pitch was modelled as varying linearly between three points.

Table 10.2 Turbine characteristics used in collision risk modelling.

CHARACTERISTIC	VALUE
Radius	63m
Angular velocity	12.1 rpm
Hub height	88m
CHORD WIDTH	
• at 0m	3.32m
• at 3.5m	3.32m
• at 15.5m	4.73m
• at 63.0m	1.28m
BLADE PITCH	
• at 0m	10°
• at 3.5m	10°
• at 63m	0°

Applying a factor for avoidance

It is known that birds avoid collision with turbine blades, both by keeping at a distance from turbine sites, and by dodging blades if they pass through the plane of the turbines (Christensen *et al.,* 2003). To obtain a realistic estimate of the potential increase in mortality caused by birds colliding with the blades of wind turbines, an estimate of avoidance rate has to be factored in. SNH guidelines suggest the use of a 95% avoidance rate for preliminary assessment of risk, but this is acknowledged as a conservative value.

In the absence of quantitative data on the likely avoidance rates for the species that frequent the Demonstrator site, the collision risk assessment has used the conservative value of 95% avoidance for all species.

Calculating number of collisions and impact on population

For birds with large populations, the expected number of deaths per year is the product of the expected number of transits through the turbine, the collision probability and the inverse of the avoidance rate. The relative effect of the Demonstrator WTGs can then be assessed if the total size of the population in the Moray Firth is known.

10.3.3 RESULTS

Collision risk

In this section the estimated collision risk from the two WTGs are presented for seven species (section 4.8.2) at the Demonstrator site, namely kittiwake, gannet, fulmar, great black-backed gull, herring gull, tern sp. and auk sp.

Kittiwake

Kittiwakes were the most numerous bird in all the surveys, particularly flying at turbine height. Only birds flying at turbine height have been considered in this analysis. The densities in August, September, October, November and December were 1.33×10^{-7}, 3.18×10^{-7}, 9.73×10^{-8}, 1.011×10^{-7} and 0.0 birds.m^{-2} respectively. This gives an average density of 1.30×10^{-7} birds.m^{-2}.

Based on this density, and a flight speed of 13.1m.s^{-1}, it is estimated that there would be a total of 6,754 transits each year through the area swept by the blades of the two WTGs.

Collision Model A gives a collision probability of 4.6% if the bird is flying downwind or 6.3% if flying upwind. The mean collision probability is, therefore, 5.5%. This is for birds passing through the circle described by the turbine blades. Model B gives a probability of 2.8% for birds flying downwind and 3.8% for birds flying upwind, with a mean of 3.3%. Model C gives a probability of 7.8%, and Model D gives 5.5%.

Because kittiwakes are relatively high fliers, the most applicable model is Model C (uniform height distribution and speed affected by wind). Table 10.3 gives the expected mortality for kittiwakes for a range of avoidance rates.

Table 10.3 Estimated additional mortality for kittiwakes caused by two WTGs at the Demonstrator site.

Additional mortality	**Avoidance Rate**				
	90%	**95%**	**98%**	**99%**	**99.5%**
Model A	33	17	7	3	2
Model B	20	10	4	2	1
Model C	**47**	**23**	**9**	**5**	**2**
Model D	31	16	6	3	2

All values round to the nearest whole number.

Average hourly counts for kittiwake varied widely throughout the year (Section 4.8.2), from two per hour of observation in January to more than 70 per hour in July.

The total population of kittiwakes in the Moray Firth is around 75,675 (data from period 1998-2002, Mitchell *et al.*, 2004). The annual adult survival rate is 0.81 (Garthe and Hoppop, 2004), so in a population of this size about 14,378 natural deaths would be expected each year, and a 1% increase in mortality would be 144 individuals. The 33 extra deaths per year estimated using a 95% avoidance factor in Model C thus equates to an increase in mortality of 0.2%.

Great black-backed gull

The density survey only detected birds in October, November and December, with a density of 1.3×10^{-8} , 1.84×10^{-7} and 2.07×10^{-7} birds.m^{-2} respectively. This gives an average density over the five month period of 1.3×10^{-8} birds.m^{-2}.

Based on the density and a flight speed of 13.1m.s^{-1}, it is estimated that there would be a total of 4,114 transits each year through the area swept by the blades of the two WTGs.

Model A gives a collision probability of 7.7% for birds which pass through the turbine flying upwind and 5.9% for birds which pass through downwind. This gives is a mean of 6.8%.

Model B gives probabilities of 3.9% and 4.9% for downwind and upwind flight respectively, with a mean of 4.4%. Models C and D give probabilities of 10.2% and 7.8% respectively.

Great black-backed gulls are a manoeuvrable bird, so it is proposed that the most relevant model is Model D. Table 10.4 gives the expected mortality for great black-backed gulls for a range of avoidance rates.

Table 10.4 Estimated additional mortality for great black-backed gulls caused by two WTGs at the Demonstrator site.

Additional mortality	**Avoidance Rate**				
	90%	**95%**	**98%**	**99%**	**99.5%**
Model A	25	12	5	2	1
Model B	16	8	3	2	1
Model C	37	19	7	4	2
Model D	**28**	**14**	**6**	**3**	**1**

All values round to the nearest 0.1.

Average hourly counts for great black-backed gull varied widely throughout the year (Section 4.8.2), from 0.2 per hour of observation in August to almost eight per hour in December.

The breeding population of great black-backed gulls in the Moray Firth is around 850 (at East Caithness cliffs SPA), but the individuals found in the Moray Firth, and observed at the Demonstrator site, will have come from other sites. The numbers of great black-backed gulls in the Moray Firth vary greatly with season (Skov *et al*., 1995), and the increase in monthly average density observed at the Demonstrator site from October to December reflects the movement of birds into the area in autumn. Skov *et al*., 1995 estimated that over the period 1980-1994 there were on average 8,000 birds in the Moray Firth area during November to February, 100 in March to April, 1,900 in May to July (including Orkney) and 22,000 (excluding Orkney) in August to October.

Clearly, the birds in the Moray Firth, and those observed at the Demonstrator site particularly in autumn, do not originate only from the breeding colony at Troup Head, and it would not be justifiable to express additional mortality that may be caused by the WTGs solely in terms of this breeding population. The average population size given in Skov *et al.*, 1995 is 8,000.

The annual adult survival rate is 0.93 (Garthe and Hoppop, 2004), so in a population of 8,000 about 560 natural deaths would be expected each year. A 1% increase in mortality would be six individuals, and the results from the model show that such an increase might occur if the gulls' avoidance rate was 98%. This assessment should be treated with caution, however, in view of the considerable seasonal variations in numbers in the Moray Firth, and the observed seasonal variations in numbers per hour of observation at the Demonstrator site.

Herring gulls

Herring gulls were seen particularly in late autumn and winter. Only birds flying at turbine height have been considered in this analysis. No birds were seen at turbine height during surveys in August to September. The densities in November and December were 3.35×10^{-8}, and 1.27×10^{-7} birds.m^{-2} respectively. This gives an average density over the five month period of 3.22×10^{-8} birds.m^{-2}.

Based on the density, and a flight speed of 12m.s^{-1}, it is estimated that there would be a total of 1,534 transits each year through the area swept by the blades of the two WTGs.

Collision Model A gives a collision probability of 5.5% if the bird is flying downwind or 7.4% if flying upwind. The mean collision probability is therefore 6.4%. This is for birds passing through the circle described by the turbine blades. Model B gives a probability of 3.5% for birds flying downwind and 4.5% for birds flying upwind, with a mean of 4.0%. Model C gives a probability of 9.4%, and Model D gives 7.6%.

The most applicable model is Model D, because the birds generally fly below blade height (and so have a skewed distribution) and may fly into headwinds. Table 10.5 gives the expected mortality for herring gulls for a range of avoidance rates.

Table 10.5 Estimated additional mortality for herring gull caused by two WTGs at the Demonstrator site.

Additional mortality	Avoidance Rate				
	90%	95%	98%	99%	99.5%
Model A	9	4	2	1	0
Model B	6	3	1	1	0
Model C	13	6	3	1	1
Model D	**10**	**5**	**2**	**1**	**1**

All values round to the nearest whole number.

The total breeding population of herring gulls in the Moray Firth is about 13,570 pairs (27,140 individuals) (JNCC). The annual adult survival rate is 0.93 (Garthe and Hoppop, 2004), so in a population of this size about 1,900 natural deaths would be expected each year, and a 1% increase in mortality would be 19 individuals. The five extra deaths per year estimated using a 95% avoidance factor in Model D thus equates to an increase in mortality of about 0.3%.

Fulmar

The average density of fulmar for the period August to December was of 5.45 x 10^{-9} birds.m^{-2}. The total number of transits for this species was estimated to be 250 per year.

Model A gives a collision probability of 6.8% for birds which pass through the turbine flying upwind and 5.0% for birds which pass through flying downwind. This gives a mean of 5.9%.

Model B gives probabilities of 3.1% and 4.1% for downwind and upwind flight respectively, with a mean of 3.6%. Models C and D give probabilities of 8.4% and 6.4% respectively.

It is proposed that the most relevant model for fulmar is Model D. Table 10.6 gives the expected mortality for fulmar for a range of avoidance rates.

Table 10.6. Estimated additional mortality for fulmar caused by two WTGs at the Demonstrator site

Additional mortality	**Avoidance Rate**				
	90%	**95%**	**98%**	**99%**	**99.5%**
Model A	1.5	0.7	0.3	0.1	0.1
Model B	0.9	0.5	0.2	0.1	0.0
Model C	2.1	1.1	0.4	0.2	0.1
Model D	**1.6**	**0.8**	**0.3**	**0.2**	**0.1**

All values round to the nearest 0.1.

Average hourly counts for fulmar varied from between six and 16 birds per hour of observation over the period January to August (Section 4.8.2), to less than four per hour of observation for the period September to December.

The total population of fulmar in the Moray Firth is around 55,516 (Mitchell *et al.*, 2004). The annual adult survival rate is 0.986 (Garthe and Hoppop, 2004), so in a population this size about 777 natural deaths would be expected each year, and a 1% increase in mortality would be eight individuals. The 0.8 extra deaths per year estimated using a 95% avoidance factor in Model D thus equates to an increase in mortality of around 0.1%.

Gannet

Gannets were the second most abundant bird flying at turbine height, but they generally flew lower than kittiwakes. The density survey revealed densities in the period August to October of 2.65 x 10^{-7}, 0, and 6.19 x 10^{-8} birds.m^{-2}, which gave a mean of 1.09 x 10^{-7} birds.m^{-2}. The total number of transits for this species was estimated to be 2,314 per year.

Model A gives a collision probability of 9.7% for birds which pass through the turbine flying upwind and 7.4% for birds which pass through flying downwind. This gives a mean of 8.6%.

Model B gives probabilities of 5.2% and 6.5% for downwind and upwind flight respectively, with a mean of 5.9%. Models C and D give probabilities of 13.0% and 10.4% respectively.

It is proposed that the most relevant model for gannets is Model D. Table 10.7 gives the expected mortality for gannet for a range of avoidance rates.

Table 10.7 Estimated additional mortality for gannet caused by two WTGs at the Demonstrator site.

Additional mortality	**Avoidance Rate**				
	90%	**95%**	**98%**	**99%**	**99.5%**
Model A	20	10	4	2	1
Model B	14	7	3	1	1
Model C	30	15	6	3	1
Model D	**24**	**12**	**5**	**2**	**1**

All values round to the nearest whole number.

Average hourly counts for gannet varied considerably throughout the year (Section 4.8.2), from zero per hour of observation in January to nearly 10 per hour in October.

The average number of gannets in the Moray Firth ranges from 1,500 (November to February) to 4,000 (September to October) (Skov *et al*., 1995). This increase in numbers during the latter part of the summer and autumn seems to have been reflected in the numbers observed at the Demonstrator site, where elevated numbers per hour were observed over the period July to November. Gannets range widely during the breeding season, with many birds being found at considerable distances from their colonies. In September to October, Gannets are widely distributed over the western part of the North Sea, from the Humber to the Shetland Islands.

The total breeding population of gannet in the Moray Firth is around 3,094 (Mavor *et al.,* 2004), but the total numbers of individuals that may use the Moray Firth may be much higher. The Troup Head gannet colony on the eastern edge of the Moray Firth is the nearest one to the proposed WTGs, and the next nearest ones are in Shetland, and are much larger than the Troup Head colony. The Centre for Ecology and Hydrology at Banchory has carried out tracking studies, and found that gannets have very large foraging ranges; in addition there is evidence that birds from larger colonies forage further than those from smaller colonies. It is therefore likely that the Troup Head gannets will be feeding in the Beatrice area, and there is also a high chance that birds from other colonies (eg. Shetland) may also be present (Matt Parsons, *pers. com.,* 2006).

The annual adult survival rate is 0.93 (Garthe and Hoppop, 2004). If the total population using the Moray Firth were some 35,000 (Table 10.18) about 2,450 natural deaths would be expected each year, and a 1% increase in mortality would be 25 individuals. The results from the model indicate that this level of additional mortality might be obtained if gannets had an avoidance rate of 90%.

Auk sp.

Auks generally fly below the level of the turbine blades and only 11 (0.2% of all individuals seen) were detected at the relevant height band during the density surveys. Model A gives a collision probability of 5.3% for guillemots.

Tern sp.

Few terns were seen during the density surveys. Birds were only seen at turbine height during September, giving a density of 4.55 x 10^{-8} birds m^{-2} for this month. This gives an average density for the five month period of 9.09 x 10-9 birds m^{-2}. The total number of transits for this species through the two WTGs would therefore be 434 transits per year.

Collision Model A gives a collision probability of 4.4% if the bird is flying downwind and 6.3% if the bird is flying upwind. The mean collision probability is therefore 5.4%. Model B gives a probability of 2.7% for birds flying downwind and 3.8% for birds flying upwind, with a mean of 3.3%. Model C gives a probability of 7.6%, and Model D gives a probability of 5.1%.

The most applicable Model for tern sp. is Model D, because the birds generally fly below blade height (and so have a skewed distribution) and may fly into headwinds. Table 10.8 gives the expected mortality for tern sp. for a range of avoidance rates.

Table 10.8 Estimated additional mortality for tern sp. caused by two WTGs at the Demonstrator site.

Additional mortality	Avoidance Rate				
	90%	95%	98%	99%	99.5%
Model A	2.1	1.0	0.4	0.2	0.1
Model B	1.3	0.6	0.3	0.1	0.1
Model C	2.9	1.5	0.6	0.3	0.1
Model D	**2.0**	**1.0**	**0.4**	**0.2**	**0.1**

All values round to the nearest 0.1.

The total breeding population of tern sp. in the Moray Firth is about 604 pairs (1,208 individuals) (JNCC). The annual adult survival rate is 0.88 (Garthe and Hoppop, 2004), so in a population of this size about 144 natural deaths would be expected each year, and a 1% increase in mortality would be one to two individuals. The one extra death per year estimated using a 95% avoidance factor in Model D thus equates to an increase in mortality of about 0.7%.

10.4 ASSESSMENT OF SEVERITY OF IMPACTS ON BIRDS

10.4.1 INTRODUCTION AND METHOD

An assessment of the severity or significance of potential impacts on birds was made using the methodology developed by SNH and the British Wind Energy Association (Percival *et al.*, 1999). This takes into account the sensitivity (Table 10.9) of each species and an assessment of the magnitude of effects (Table 10.10), in order to present an assessment of the potential significance of effects on birds (Table 10.11). This type of approach is useful when seeking to assess the potential impact of new developments in new locations; it gives a clear indication of where problems are likely to occur, and what is likely to constitute an unacceptable effect (Percival, 2001).

Table 10.9 Definitions of the sensitivity categories describing the ornithological features of a site (Modified from Percival et al., 1999).

SENSITIVITY	DEFINITION
Very High	Bird species for which an SPA or SAC is designated or a SSSI notified.
High	Other bird species that contribute to the integrity of an SPA or SSSI. Ecologically sensitive species, e.g. large birds of prey or nationally rare species (<300 breeding pairs in the UK).
Medium	EU Birds Directive Annex I species, EU Habitats Directive priority habitat/species and WCA Schedule 1 species (if not covered above). UK BAP species (if not covered above).
Low	Any other species of conservation interest, such as those birds of Conservation Concern lists (if not covered above).

Table 10.10 Definitions of the categories used to assess the magnitude of effects on birds (Percival et al., 1999).

MAGNITUDE	DEFINITION
Very High	Total loss or very major alteration of key elements/features of the baseline (pre-development) conditions such that post-development character/composition/ attributes of baseline condition will be fundamentally changed and may be lost from the site altogether. Guide: >80% of population/habitat lost.
High	Major alteration of key elements/features of the baseline condition such that post-development character/composition/attributes of baseline condition will be fundamentally changed. Guide: 20-80% of population/habitat lost.
Medium	Loss or alteration to one or more key elements/features of the baseline conditions such that post-development character/composition/attributes will be partially changed. Guide: 5-20% of population/habitat lost.
Low	Minor shift away from baseline conditions. Change arising from the loss/alteration will be discernible but underlying character/composition/attributes of the baseline condition will be similar to pre-development circumstances/patterns. Guide: 1-5% of population/habitat lost.
Negligible	Very slight change from baseline condition. Change barely distinguishable, approximating to the "no change" situation. Guide: <1% of population/habitat lost.

Table 10.11 The impact matrix showing the significance of the combined effects of different levels of "sensitivity" and "magnitude of effect" (Percival et al., 1999).

Magnitude of effect	Sensitivity			
	Very High	**High**	**Medium**	**Low**
Very High	Very High	Very High	High	Medium
High	Very High	Very High	Medium	Low
Medium	Very High	High	Low	Very Low
Low	Medium	Low	Low	Very Low
Negligible	Low	Very Low	Very Low	Very Low

Effects categorised as being of "very high" or "high" significance would be unacceptable, effects rated as "medium" would be borderline (ones which could be amenable to mitigation by altering the design and lay-out of a wind farm), and effects categorised as "low" or "very low" would be acceptable (Percival, 2001).

10.4.2 ASSESSMENT OF SENSITIVITY

Table 10.12 shows the conservation status for each species recorded during observations from the Beatrice platform. The national status of a species takes account of whether it is listed on Schedule 1 of the Wildlife & Countryside Act 1981 (WCA 1981); all wild birds in the UK are protected under the WCA 1981. It is an offence to kill, injure or take any wild bird, egg or nest. Rare, endangered, declining or vulnerable bird species in need of special protection in the UK are listed under Schedule 1 of the WCA and are afforded additional protection from disturbance at the nest. A species' national status is also determined by whether it is amber-listed or red-listed as a Bird of Conservation Concern (RSPB *et al.*, 2002) or if it is subject to a UK Biodiversity Action Plan.

The international status of a species takes account of whether it is listed on Annex I of the EU Birds Directive 1979. Bird species protected under European legislation are listed under Annex I of the Birds Directive, which is translated into UK legislation under the Conservation (Natural Habitats, etc.) Regulations 1994. It is an offence to capture, kill or disturb any Annex I species, or to damage or destroy its breeding site. A species' international status is also determined by whether it is a qualifying interest for a neighbouring Special Protection Area (SPA) or Site of Special Scientific Interest (SSSI), or whether it is listed as a species that contributes to the integrity of an SPA or SSSI.

Table 10.12 The conservation status of all the species recorded at Beatrice. (Sources: RSPB et al., 2002; UK BAP; WCA, 1981; EC 1979).

SPECIES	NATIONAL STATUS				INTERNATIONAL STATUS		
	AMBER LIST	RED LIST	UK BAP	WCA 1981 SCHEDULE I	EU ANNEX I	QUALIFYING INTEREST FOR NEIGHBOURING SPA OR SSSI (numerical code shown)	SPECIES CONTRIBUTING TO INTEGRITY OF SPA OR SSSI (numerical code shown)
Arctic skua	–	–	–	–	–	–	–
Auk sp.	YES	–	–	–	–	YES (*) (1,9,54)	YES (1,9,54)
Blackbird	–	–	–	–	–	–	–
Black-headed gull	YES	–	–	–	–	–	–
Brambling	–	–	–	YES	–	–	–
Cormorant	YES	–	–	–	–	YES (9)	YES (9)
Collared dove	–	–	–	–	–	–	–
Common gull	YES	–	–	–	–	–	–
Common scoter	–	YES	YES	YES	–	YES (45)	YES (45)
Dunlin	YES	–	–	–	–	YES (23,33,45)	YES (23,33,45)
Eider	YES	–	–	–	–	–	–
Fulmar	YES	–	–	–	–	YES (1,9,54)	YES (1,9,54)
Great black-backed gull	–	–	–	–	–	YES (9)	YES (9)
Grey goose	YES	–	–	–	–	–	–
Northern gannet	YES	–	–	–	–	–	–
Herring gull	YES	–	–	–	–	YES (9,54)	YES (9,54)
Kittiwake	YES	–	–	–	–	YES (1,9,54)	YES (1,9,54)
Little gull	–	–	–	YES	YES	–	–
Meadow pipit	YES	–	–	–	–	–	–
Manx shearwater	YES	–	–	–	–	–	–
Great skua	YES	–	–	–	–	–	–
Sooty shearwater	–	–	–	–	–	–	–
Pied wagtail	–	–	–	–	–	–	–
Robin	–	–	–	–	–	–	–
Redwing	YES	–	–	YES	–	–	–
Red-throated diver	YES	–	–	YES	YES	–	–
Shag	YES	–	–	–	–	YES (9)	YES (9)
Teal	YES	–	–	–	–	–	YES (23,33,45)
Tern sp.	YES**	–	–	–	YES	YES (***) (9,33,39)	YES (9,33,39)
Wheatear	–	–	–	–	–	–	–
Woodpigeon	–	–	–	–	–	–	–
Whooper swan	YES	–	–	YES	YES	YES (32,33)	–

Auk sp. = black guillemot, guillemot, little auk, puffin, razorbill
Tern sp. = Arctic tern, common tern, Sandwich tern
(*): For guillemot and auk assemblage
Grey goose = greylag goose or pink-footed goose
(**): For Arctic tern and Sandwich tern
(***): For common tern

Table 10.13 SPA codes as shown in Table 10.13.

NUMBER	SPA NAME
1	North Caithness Cliffs
9	East Caithness Cliffs
23	Dornoch Firth and Loch Fleet
32	Loch Eye
33	Cromarty Firth
39	Inner Moray Firth
45	Moray and Nairn Cost
54	Troup, Pennan and Lion's Head

Based on the above information and status of bird species in the Beatrice area, the sensitivity of each species recorded in the area of the Demonstrator Project is shown in Table 10.14.

Table 10.14 The sensitivity of each bird species recorded at Beatrice.

SENSITIVITY	DEFINITION
Very High	Auk sp. (black guillemot, guillemot, little auk, puffin, razorbill) Common scoter Cormorant Dunlin Fulmar Great black-backed gull Herring gull Kittiwake Shag Tern sp. (Arctic tern, common tern, Sandwich tern)
High	Teal
Medium	Brambling Little gull Red-throated diver Redwing Whooper swan
Low	Black-headed gull Common gull Eider Gannet Great skua Grey goose Manx shearwater Meadow pipit
Negligible	Arctic skua Blackbird Collared dove Pied wagtail Robin Sooty shearwater Wheatear Woodpigeon

All species present that are qualifying interests or that contribute to the integrity of any neighbouring SPAs or SSSIs are considered to belong specifically to these designated areas, and the significance of any potential impact is judged accordingly.

All species of medium sensitivity may become high sensitivity if it is found that they are present in the wind farm area in numbers that surpass 1% of international or national populations. All species of low sensitivity may become medium sensitivity if it is found that they are present in numbers that are regionally important.

10.4.3 ASSESSMENT OF POTENTIAL MAGNITUDE OF THE EFFECTS OF THE TWO WIND TURBINE GENERATORS AT THE DEMONSTRATOR SITE

For the purposes of the environmental statement for the Demonstrator Project, the magnitude of possible effects on birds was assessed in relation to the populations of birds using the wider Moray Firth region. This is a conservative approach, and does not take into account the fact that the individuals observed from time to time at the Demonstrator site may originate from colonies or sites outside the area of the Moray Firth.

The potential for the Demonstrator WTGs to present a barrier to bird movement, to displace birds away from the area, or to give rise to habitat loss or loss of access to food sources, is addressed in Section 10.2. On the basis of the fact that only two WTGs will be installed, and that the area around the WTGs in which bird behaviour might be affected is small (about 4.3km^2), it is believed that after installation the presence of the two WTGs at the Demonstrator site is not likely to make a discernible difference to the pre-development baseline conditions, to exclude any species of bird from a significant part of the available offshore habitat, or to damage or degrade that habitat. The focus of attention for judging the potential magnitude of any effects from the Demonstrator Project, therefore, falls on the potential collision risk that the WTGs represent.

The quantitative assessments given in Section 10.3 show that, using conservative assumptions regarding average annual density at the site, and conservative values for the degree of avoidance (95%), no species is likely to suffer additional mortality that would exceed 1% of the population of that species in the Moray Firth. Table 10.15 summarises this evaluation for the five most numerous species observed at the Demonstrator site.

Table 10.15 Moray Firth populations of key species observed at the Demonstrator site, and estimates of total annual fatalities from the two WTGs.

	MF population			Estimated annual mortality from WTGs		
	Total number	**1% of MF population**	**Natural mortality**	**Total number**	**1% of MF population**	**As % of natural mortality in MF population**
Kittiwake	75,675	757	14,378	23	0.03	0.16
Great black-backed gull (1)	8,000	80	560	14	0.18	2.5
Fulmar	55,516	555	777	0.8	0.001	0.1
Gannet (2)	35,000	350	2,450	12	0.04	0.49
Herring gull	27,140	271	1,900	5	0.018	0.26
Tern sp.	1,208	12	144	1	0.08	0.69
Auk sp.	Not observed flying at blade height.					

All estimated numbers of mortality are made using the avoidance rate stated in the text.
(1) Estimated average number of birds in the Moray Firth, derived from Skov et al., 1995.
(2) See discussion, 10.5.

10.4.4 ASSESSMENT OF POTENTIAL SIGNIFICANCE OF THE EFFECTS OF THE TWO WIND TURBINE GENERATORS AT THE DEMONSTRATOR SITE

On the basis of these data, an assessment of the significance of potential effects on birds was made and is shown in Table 10.16.

Table 10.16 Assessment of the significance of potential effects on birds caused by the presence and operation of the two WTGs at the Demonstrator site in the Beatrice field.

SENSITIVITY	SPECIES	MAGNITUDE OF EFFECTS	SIGNIFICANCE
Very High	Auk sp.	Negligible	Low
	Common scoter	Negligible	Low
	Cormorant	Negligible	Low
	Dunlin	Negligible	Low
	Fulmar	Negligible	Low
	Great black-backed gull	Negligible	Low
	Herring gull	Negligible	Low
	Kittiwake	Negligible	Low
	Shag	Negligible	Low
	Tern sp.	Negligible	Low
High	Teal	Negligible	Very Low
Medium	Brambling	Negligible	Very Low
	Little gull	Negligible	Very Low
	Red-throated diver	Negligible	Very Low
	Redwing	Negligible	Very Low
	Whooper swan	Negligible	Very Low
Low	Black-headed gull	Negligible	Very Low
	Common gull	Negligible	Very Low
	Eider	Negligible	Very Low
	Gannet	Low	Very Low
	Great skua	Negligible	Very Low
	Grey goose	Negligible	Very Low
	Manx shearwater	Negligible	Very Low
	Meadow pipit	Negligible	Very Low
	Arctic skua	Negligible	Very Low
	Blackbird	Negligible	Very Low
	Collared dove	Negligible	Very Low
	Pied wagtail	Negligible	Very Low
	Robin	Negligible	Very Low
	Sooty shearwater	Negligible	Very Low
	Wheatear	Negligible	Very Low
	Woodpigeon	Negligible	Very Low

10.5 DISCUSSION

The coastline and waters of the Moray Firth together represent an internationally important area for several bird species (Section 10.7) there are resident populations, over-wintering populations, and birds on passage. The coast provides sites for breeding, and the coastal and offshore areas offer important feeding grounds. With respect to the two Demonstrator turbines in the Beatrice field, it is likely that the species that might be affected to the greatest extent would include those that:

- *use the area for feeding*
- *congregate in the area during moulting*
- *traverse the area at relatively low level on feeding excursions or during passage.*

The Smith Bank, on which the Demonstrator turbines are located, is an important feeding ground for seabirds (Mudge and Crooke, 1986). This area is particularly important in spring and autumn for guillemots, razorbills, kittiwakes, gannets and sooty shearwaters, but bird numbers are low in winter. Data for the Moray Firth indicate a predominantly coastal distribution for sea duck and coastal waterfowl (Dean *et al.*, 2003), with nationally important numbers of common scoter, long-tailed duck and eider.

There is concern that offshore wind farms may have a significant effect on sea ducks and waterfowl through collision and habitat exclusion. Although swans and geese are present in this region and migrate to nearby locations (Barton and Pollock, 2004), reports have shown that these birds are generally able to detect the presence of turbines and avoid them (Larsen and Madsen, 2000; Percival 1998; Koop, 1997 reported in *BirdLife International*, 2003). Though the Moray Firth is an important area for sea ducks (Lloyd *et al.*, 1991), eiders and common scoters are generally confined to areas within 5km of the shore and are, therefore, unlikely to be influenced by the Demonstrator Project.

Razorbills forage up to 55km from the coast, although most are likely to forage much closer to colonies and the highest densities occur close to coasts (Leaper *et al.*, 1988; Stone *et al.*, 1995). Webb *et al.* (unpublished) studied auks off Bempton Cliffs and reported few breeding adults foraging beyond 30km, but noted important concentrations of guillemots between 26km and 30km from Bempton. With respect to collision risk, guillemots and razorbills are thought generally to fly below the level of turbine blades, but are likely to fly higher when arriving and exiting breeding sites on cliffs, and in conditions of tail wind (A. Webb, *pers. comm.*).

Observations of red-throated divers suggest that the frequency of bird strike is low (Cramp and Simmonds, 1977), but the conservation importance of the species means that the effects of any mortality caused by collisions could have an effect on population size at a national scale. Observational data on the average flying heights of cormorants is limited, but studies in the Netherlands (Dirksen *et al.*, 1998) provide some evidence that cormorants may actively avoid turbines when flying between roosts and feeding areas.

Ten of the species observed during the 2005 monitoring programme at the Demonstrator site are considered to be of very high sensitivity and one of high sensitivity. Five species are judged to be of medium sensitivity and 16 of low sensitivity (Table 10.14).

The most frequently recorded species were, in descending order, kittiwake, auk sp., fulmar, gannet, great black-backed gull and herring gull. All other species were observed on fewer than 50 occasions. The most numerous species, again in descending order, were auk sp., kittiwake, fulmar, gannet, great black-backed gull, herring gull and tern sp. All other species counts recorded fewer than 100 individuals (Section 4.8.2). Since tern sp. were observed on fewer than 50 occasions, it is considered that the six species listed in Table 10.17 are more likely to be affected by the proposed development, and to a greater extent, than the other species recorded.

Table 10.17 Sensitivity and percentage of flights in the risk zone for the most common species recorded at the Demonstrator site.

SPECIES	SENSITIVITY	% FLIGHTS IN RISK ZONE
Herring gull	Very High	24.0
Great black-backed gull	Very High	21.1
Kittiwake	Very High	17.3
Gannet	Low	11.4
Auk sp	Very High	0.3
Fulmar	Very High	0

Of the four species most commonly found within the risk zone the herring gull, great black-backed gull and kittiwake are of high sensitivity, whereas the gannet is of low sensitivity.

A quantitative assessment of the potential effects of the proposed development has been carried out using the SNH collision risk model, with various stated assumptions, and where appropriate modifications to account for the specific size of the proposed turbines or differences in the flying behaviour of certain species. For herring gull, it was estimated that about five individuals might collide each year as a result of collisions with the WTGs, assuming that the species exhibited an avoidance rate of 95%. This would represent about 0.02% of the local population of this species. In the case of the kittiwake, it was estimated that there might be 23 collisions each year, if the species' avoidance rate was 95%. This would represent about 0.03% of the local population for this species.

For the great black-backed gull, it was estimated that perhaps 14 individuals from the local Moray Firth population of some 850 individuals might collide each year with the WTGs, assuming that the species exhibited an avoidance rate of 95%. This would represent about 1.6% of the local population of this species.

The great black-backed gull is a "very sensitive" species, but its numbers in the Moray Firth vary widely with the season (Skov *et al.,* 1995). Birds move offshore at the end of the breeding season and this was reflected in the data from observations at the Demonstrator site, where numbers seen rose from 0.2 birds per hour in August to nearly eight birds per hour in December. The additional mortalities that might arise from collisions with the WTGs offshore therefore need to be considered in the context of a wider population, which, based on data in Skov *et al.,* 1995 may average about 8,000. If this value is more representative of the sub-population that may be exposed to additional risk as a result of the WTGs, then the increase in mortality of about 14 individuals each year would represent about 0.2% of the population.

Although the gannet is not regarded as a "sensitive" species in the Moray Firth (Table 10.16), the estimated additional mortality through collision reflects concerns expressed in earlier appraisals of the effects of offshore wind farms on certain long-lived species with relatively low rates of productivity (*BirdLife International* 2003). At a 95% avoidance rate, the WTGs might cause an additional 12 fatalities each year, equivalent to about 0.4% of the population present at Troup Head. Gannet numbers were seen to rise significantly in the later part of the year, and this was probably a reflection of the fact that adults and juveniles were leaving nesting sites and foraging more widely. Gannets travel more widely after the breeding period, and it is therefore very likely that the individuals seen around the Demonstrator site in the late summer and autumn originated from a number of sites, not just Troup Head. For example, it is likely that gannets from colonies in Shetland will be found foraging in the Moray Firth after the breeding season.

The collision risk mortality for gannets from the two WTGs can, therefore, be put in context by considering the larger gannet population of northern Britain. Table 10.18 lists selected gannet colonies of northern Scotland and the North Sea, with estimates of their population size (Mitchell *et al.*, 2004).

Table 10.18 Sizes of selected gannet colonies of northern Scotland (Mavor et al., 2004) (Numbers derived by doubling the number of apparently occuped nests or sites).

COLONY	ESTIMATED POPULATION SIZE 2003-2004
1. Hermaness	31,266
2. Noss	17,304
3. Foula	1,836
4. Fair Isle	3,750
5. Sule Stack	9,236
9. Troup Head	3,094
Total	**66,486**

If Hermaness is excluded (the largest and most distant of this group) the total population of this group is approximately 35,000, which represents about 8% of the total population of Great Britain and Ireland. If the population exposed to the potential additional mortality from the presence of the WTGs is some 32,000, its natural morality rate would be about 2,450 individuals each year. In the context of this wider population, the estimated additional mortality caused by collisions with the WTGs would thus equate to an increase in natural morality of about 0.5%.

10.6 CONCLUSION

The effects of the Demonstrator Project on birds, and in particular bird species which are the qualifying interests of adjacent SPAs in the Moray Firth, are likely to be small. The WTGs will occupy a small area of the Smith Bank in which birds are seen flying, "loafing" and occasionally feeding. The WTGs will not present a major barrier to migrating birds, nor will they exclude or displace individuals from important feeding areas.

The additional mortality that may result from collisions with the WTGs has been estimated using a standard model, conservative assumptions regarding avoidance rates, and average values for bird density. With the exception of great black-backed gulls, the annual mortality from collisions is estimated to equate to less than a 1% increase in the natural mortality of the local population of that species (i.e. the population at sites around the Moray Firth). This conclusion holds for all the species which are qualifying interests in any of the SPAs in the Moray Firth. The gannet is not a qualifying interest nor is it on the UKBAP. Although the estimated mortality rate for gannets is high in relation to the local breeding population at Troup Head, the data from the Demonstrator site indicate that greater numbers of gannet are seen in the area after the end of the breeding season, and there is evidence to suggest that gannets from other colonies in the North of Scotland will be visiting the general area of the Moray Firth, including the Demonstrator site. The total population of the north east of Scotland, excluding Hermaness, is approximately 35,000, and in terms of this wider population the additional mortality from the WTGs would equate to an increase in the natural rate of mortality of about 0.5%.

A review of the potential effects of the Demonstrator Project on SACs, SPAs and other sites is given in Section 13.

10.7 MITIGATION AND MONITORING PROPOSED

The two WTGs will be sited more than 25km from land, and from all SPAs UKBAP sites, Ramsar Sites, IBA sites, and estuaries. They do not appear to be located in a particularly important feeding ground for any species of sea bird, or in an area that is frequented by large numbers of either flying or moulting birds.

No mitigation can be proposed for short-term disturbance effects on birds during construction, except to complete the activities in a timely manner. During their operational life, the WTGs will bear navigation lights, and the lower parts of the towers will be painted to make them more visible to shipping (Section 3.1.11). The rest of the tower, and the blades, will be painted grey so as to reduce their overall visual impact.

Inspection and maintenance will be carried out periodically, using the fast rescue craft deployed from the nearby Beatrice platform. Given the present existence of vessel activity around the Beatrice field, and the fact that few birds have been observed at the Demonstrator site on the water surface or feeding, the localised disturbance caused by maintenance visits is likely to be localised and not significant.

10.8 FURTHER RESEARCH PROPOSED

The University of Aberdeen will conduct field surveys of the feeding and resting behaviour of marine birds in and around the site of the Demonstrator Project. This work will probably use boat transect and may also use radar observations of seabird movements before and after the installation of the WTGs. Work is continuing to optimise the bird data that can be obtained using offshore radar.

11 Landscape and Seascape Visual Impact Assessment

11 LANDSCAPE AND SEASCAPE VISUAL IMPACT ASSESSMENT

11.1 INTRODUCTION

This section presents a summary of the Landscape and Visual Impact Assessment (LVIA) of the proposed Demonstrator Project. The full LVIA report, with tables, maps, wireline diagrams and photomontages, is presented in Appendix 4.

The LVIA includes:

- *an assessment of the existing landscape and visual resource, and the effects of the proposed development on them*
- *an assessment of the existing seascape and visual resource, and the effects of the proposed development on them*
- *an assessment of cumulative effects with other onshore wind farm developments*
- *an assessment of sequential impacts assessment along specific routes.*

11.2 ASSESSMENT METHODOLOGY

11.2.1 SOURCES OF INFORMATION, GUIDANCE DOCUMENTS AND POLICY CONTEXT

The visual impact assessment for the Beatrice Demonstrator Project was undertaken with reference to a wide range of documentation and sources of information relating to policy and planning advice, legislation, guidance on methods for assessing both landscape and seascape visual impacts, and background material on the region (Table 11.1).

With the continuing development of onshore wind farms, and new initiatives to develop offshore wind farms, further work is in hand to provide guidance and best-practice advice to developers on how to plan and undertake assessment of visual impacts. Some of these studies will provide further advice and guidelines that may be particularly applicable to the development of offshore wind farms located close to the coast, where there is the potential for effects on both the landscape and seascape, and cumulative effects between the offshore wind farm and existing or planned onshore wind farms.

One such study "Guidance on the assessment of the impact of offshore wind farms: seascape and visual impact report", by the DTI in association with the Countryside Agency, the Countryside Council for Wales and Scottish Natural Heritage, was published in November 2005, after the LVIA for the Beatrice Demonstrator was completed. Although this study was not available to be utilised in Talisman's assessment, given the wealth of existing material that has been drawn upon to complete this LVIA, and the experience of the landscape architects who undertook the work, Talisman believes that the methods, approach and assessment techniques used for the Demonstrator LVIA will be in broad agreement with any future developments in best practice that may be available later in 2006.

11.2.2 CONSULTATION

The Highland Council and Scottish Natural Heritage were consulted on the key issues to be addressed by the Environmental Impact Assessment in addition to recommended viewpoints for the Visual Impact Assessment.

11.2.3 DEFINITION OF STUDY AREA

The study area on which the LVIA and seascape assessment focuses, extends to a radius of 35km from the proposed development. This radius has been chosen on the basis of Good Practice Guidelines and in order to include all viewpoints from which significant visual effects (as defined by EIA Regulations) are most likely to occur.

Nevertheless, for the Demonstrator Project, it was acknowledged that there are certain conditions when the proposed WTGs may be clearly visible from beyond 35km. This is mainly because of the isolation of the WTGs in contrast to open suroundings and the high clarity of visibility that can occur when looking over the sea during exceptional weather conditions, especially in a northwards direction when the sun is at a low angle from behind. For these reasons, visibility of the proposed development was considered beyond this radius, extending to approximately 65km from the centre of the site. This is to confirm that significant visual impacts will not occur at these far distances.

Table 11.1 Sources of information used for the LVIA and Seascape assessment

LEGISLATION AND POLICY

- The Highland Structure Plan, The Highland Council, 2001
- The Moray Structure Plan, 1999
- The Moray Local Plan, 2000
- The Caithness Local Plan, 2002
- The South and East Sutherland Local Plan, 2000
- 'National Planning Policy Guideline (NPPG 6): Renewable Energy', The Scottish Office Environment Department, Revised 2000
- 'National Planning Policy Guideline (NPPG 14): Natural Heritage', The Scottish Office Development Department,1999
- SNH Policy Statement 04/01, Marine renewable energy and the natural heritage – an overview and policy statement

GUIDANCE AND ADVICE

- 'Guidance for Landscape and Visual Impact Assessment', The Landscape Institute and the Institute of Environmental Assessment second edition 2002
- 'Guide to Best Practice in Seascape Assessment', The Countryside Council for Wales, Brady Shipman Martin and University College Dublin, 2001
- 'Landscape Character Assessment for England and Scotland', Scottish Natural Heritage (SNH) and The Countryside Agency, 2002
- 'Guidelines on the Environmental Impacts of Wind Farms and Small Scale Hydroelectric Schemes', SNH, 2001
- 'Policy Statement No 02/03 – Wilderness in Scotland's Countryside', SNH, 2002
- 'Planning Advice Note (PAN 45) Renewable Energy Technologies', Scottish Office Environment Department, Revised 2002
- 'A Handbook on Environmental Impact Assessment', SNH, 2002
- 'University of Newcastle (2002) Visual assessment of wind farms: Best Practice', SNH Commissioned report F01AA303A, 2002
- A review of possible marine renewable energy development projects and their natural heritage impacts from a Scottish perspective, SNH commissioned report F02AA414, 2003
- Visual and landscape effect of WTG units: The CCW Contract Science Report No. 631 'Studies to inform advice on offshore renewable energy developments: visual perception versus photomontage', Symonds Group Ltd

BACKGROUND

- Caithness and Sutherland Landscape Character Assessment, SNH 1998
- Ross and Cromarty Landscape Character Assessment, SNH 1999
- Inverness District Landscape Character Assessment, SNH 1999
- Inner Moray Firth Landscape Character Assessment, SNH 1997
- OS 1: 50,000 map sheets 11, 12, 17, 21, 26, 27 and 28
- 'Scotland's Scenic Heritage', Countryside Commission for Scotland, 1978
- 'Inventory of Gardens and Designed Landscapes – Volume 3': Highland, Orkney and Grampian Countryside Commission for Scotland and Historic Scotland, 1987
- 'An Inventory of Gardens and Designed Landscapes – Supplementary Volume 2': Highlands and Islands, SNH and Scotland and Historic Scotland, 1998

11.2.4 METHODS USED FOR LVIA

The methodology employed is based on the 'Guidelines for Landscape and Visual Assessment' (Second Edition), produced by the Landscape Institute and Institute of Environmental Management and Assessment (2002). It has had to be modified, however, to incorporate elements of seascape assessment as recommended within the Guide to Best Practice in Seascape Assessment, produced by the Countryside Council for Wales, Brady Shipman Martin and University College Dublin (2001), in addition to other guidance as listed within Table 11.1.

Seascape assessment is concerned with the interaction of the sea, coast and land and how a proposed development relates to this combination. For some projects this includes an element of assessment from the sea to the land. However, this tends to be for schemes where the turbines will be close to the coast and/or commonly seen from the open sea looking towards the land; for example where there is a key ferry route passing by the outside of the turbines. Neither of these scenarios apply to the proposed Beatrice Demonstrator Project, and it was judged that there would be insufficient distinction of seascape units from distances offshore at which the proposed Beatrice WTGs would have significant seascape and visual impacts. The seascape assessment for the Demonstrator Project is therefore mainly concerned with how the WTGs will affect distinct character and views as experienced from land and coastal areas.

The initial stages of assessment defined the study area and identified landscape character, landscape designations and relevant government policy, to determine the general extent of visibility and to identify a representative range of potential viewpoints from which to carry out the Visual Impact Assessment (LVIA). These viewpoints are largely concentrated within publicly accessible areas along roads and public footpaths, in residential locations and in areas popular for outdoor recreation.

Maps showing Zones of Theoretical Visibility (ZTV) were generated to identify the potential extent of visibility of the WTGs over a 60km radius from the centre of the site. The ZTVs were modelled using a computer-based visibility analysis package compiled using Ordnance Survey Digital Terrain Model data at 10m interval resolution. This ZTV represents a "bare ground" scenario, based on landform only, and takes no account of the screening effects of local hills, urban areas, buildings, structures or vegetation.

The ZTVs identified a number of potential viewpoints that would represent the potential range of views to the WTGs that could have significant visual impacts. These were visited, photographed and assessed by a number of Chartered Landscape Architects between June 2005 and November 2005 in order to confirm the value of the viewpoints to the assessment process (for example whether they were truly representative of views in the area and whether the proposed development would actually be screened by local features). Some of these viewpoints also represent potential cumulative visual impacts of other wind farms proposed within the study area.

The provisional list of viewpoints was sent to Scottish Natural Heritage (SNH) and The Highland Council (Appendix 4). SNH and The Highland Council subsequently responded with subsequent recommendations, all of which were subject to further assessment and, where appropriate, additional figures were included.

The assessment of potential visual impacts from viewpoints was aided by the use of computer generated wireline images, illustrating the likely scale and positioning of the proposed WTGs and the position of the existing oil platforms. Photographs of the existing baseline conditions were also taken, using a 35mm single lens reflex (SLR) camera with a 50mm and/or 70mm lens.

The panoramic photographs from each viewpoint were formed by splicing together single frames. They, together with the wirelines and photomontages, must be viewed at a specific viewing distance (indicated upon each sheet) and image size (as noted upon the sheets and as printed within the ES) in order to obtain an accurate representation of the scale of elements within the photograph. The turbine blades have been shown facing the same direction and, in some instances, colour balancing has occurred to make the image appear more realistic.

It should be noted that wireline images are not intended to represent the actual appearance of the proposed Demonstrator WTGs, but have been used as a tool to aid prediction of the likely scale, form and positioning of WTGs in comparison with the existing view seen on site.

Photomontages were produced for some of the viewpoints in addition to wireline images. The LVIA was based on a prediction of impacts, based upon views on-site in combination with the wireline images only. In addition, however, photomontages are produced to inform others impression of the likely images of the proposed WTGs (as it would be seen within photographs). The choice of viewpoints to be illustrated using photomontages is determined by whether the proposed WTGs would be able to be clearly shown upon a photomontage and a prediction of likely significant visual effect. Conventionally this means that photomontages are not usually produced for viewpoints over 15km away, due to the technical difficulty of representing wind turbines in photos over this distance (either existing or montaged). For this project photomontages were required to cover a greater distance, because the proposed development is located approximately 22km from the shore.

11.2.5 ASSESSMENT PROCESS, CRITERIA AND DEFINITIONS

The aim of this assessment is to identify, predict and evaluate potential key impacts on particular elements of the environment: effects on the landscape, seascape and visual resource of the study area; and the resulting overall significance of these effects arising from the proposed WTGs.

Throughout this Section, the term "landscape" is used to include elements of both the landscape and seascape – considering inland areas, the coastal edge, and marine areas and how these combine together.

Landscape resource is defined here as: "The combination and distribution of physical components that contribute to landscape context and character and how this is experienced and valued."

Visual resource is defined here as: "The quality of a particular area or view in terms of its visual components that create a visual setting."

Assessment of sensitivity of existing baseline conditions and prediction of magnitude of change leads to assessment of residual landscape and visual impacts on particular elements and the overall landscape and visual effects on the study area. The significance of these impacts and effects can be defined.

In order to provide a level of consistency to the assessment, these assessments have been based on pre-defined criteria described fully in Appendix 3.

11.2.6 ASSESSING SIGNIFICANCE

The significance of impacts and effects was judged using two principal criteria – the magnitude of the change and the sensitivity of the location or person affected by the change (receptors). Measures of significance must, however, be defined in relation to the specific circumstances of an individual development and landscape.

To determine the significance of the development on landscape resource, the following factors were considered (The Landscape Institute and Institute of Environmental Management and Assessment 2002):

- *the sensitivity of the landscape to the type of change proposed*
- *the nature of the effect (i.e. whether the key characteristics of the existing landscape resource of the study area, and their consistency throughout that area, are reinforced or weakened as a result of the changes in landscape character brought about by the introduction of the proposed development)*

- *the quality of the landscape characteristics affected and the potential for enhancement*
- *the value of landscape elements, feature or characteristics and the recognition of this by designation at various levels, such as local, regional, national and international and the affect of the change on the integrity of the designated area*
- *the magnitude of the effect and whether the change would be positive, adverse, temporary or permanent*
- *the type and rate of other changes that are likely to occur in the landscape resource of the study area in the future.*

To determine the significance of the development on the visual resource, the following factors are considered:

- *the nature of the effect (i.e. whether the scenic qualities of the view are strengthened or weakened as a result of the changes to visual amenity brought about by the introduction of the proposed development)*
- *the magnitude of the effect*
- *the sensitivity of the visual resource and receptors*
- *the number of people affected by the change (although changes affecting large number of people are generally more significant, this is not necessarily the case in sensitive landscape, for example areas of wild land)*
- *the type and rate of other changes that are likely to occur on the visual amenity of the study area in the future.*

For individual impacts, significance is measured in a scale of 'none', 'negligible', 'slight', 'moderate', and 'substantial'. For the overall landscape effect and visual effect of the proposed development within the study area, a determination is made as to whether the likely affect would be 'significant' or 'not significant'.

Wherever possible, identified effects are quantified, but the nature of landscape and visual assessment requires interpretation informed by professional judgement.

11.2.7 SEQUENTIAL IMPACTS

Sequential impacts occur when the observer moves along a linear route, as a series or continuum of points. Views from these routes may include other developments.

11.2.8 CUMULATIVE LANDSCAPE AND VISUAL IMPACTS

An assessment of the cumulative landscape and visual impacts of other wind farms in addition to the proposed WTGs has been undertaken. This considers changes that result in conjunction with other existing or reasonably foreseeable proposals. The scope of this assessment was discussed with SNH and The Highland Council.

All existing planning or Section 36 applications and consents for wind farms and single wind turbines within the study area that were identified before October 2005 as having potential significant cumulative impacts have been included in the Cumulative Landscape and Visual Impact Assessment (Table 11.2).

Table 11.2 Wind farms considered by the cumulative assessment in addition to the Demonstrator Project.

Wind farm	No of wind turbines	Distance from Beatrice (centre to centre) (km)	Status
Causeymire	24 (21 current)	30	Existing
Buolfruich	16	23	In Construction
Dunbeath	23	30	Submitted
Gordonbush	35	50	Submitted
Kilbraur	19	58	Submitted

As Causeymire and Buolfruich wind farms already exist, seven cumulative scenarios were considered by this study as follows:

1 The proposed Dunbeath wind farm plus the Beatrice Demonstrator Project (including the existing Causeymire and Buolfruich wind farms);

2 The proposed Kilbraur wind farm plus the Beatrice Demonstrator Project (including the existing Causeymire and Buolfruich wind farms);

3 The proposed Gordonbush wind farm plus the Beatrice Demonstrator Project (including the existing Causeymire and Buolfruich wind farms);

4 The proposed Dunbeath and Kilbraur wind farms plus the Beatrice Demonstrator Project (including the existing Causeymire and Buolfruich wind farms);

5 The proposed Dunbeath and Gordonbush wind farms the Beatrice Demonstrator Project (including the existing Causeymire and Buolfruich wind farms);

6 The proposed Dunbeath, Gordonbush and Kilbraur wind farms plus the Beatrice Demonstrator Project (including the existing Causeymire and Buolfruich wind farms); and

7 The proposed Gordonbush and Kilbraur wind farms plus the Beatrice Demonstrator Project (including the existing Causeymire and Buolfruich wind farms).

11.3 SUMMARY OF RESULTS

11.3.1 THE PROPOSED BEATRICE DEMONSTRATOR WIND TURBINE GENERATORS

The proposed WTGs have been sited according to two major factors as follows:

- *the presence of existing oil and gas infrastructure on the seabed around Beatrice*
- *the topography and depth of the seabed.*

No adjustments to the proposed siting were recommended on landscape and visual grounds. This was for two reasons: firstly it was provisionally assessed that the proposed WTGs were sited in an arrangement that related well to the surrounding land and seascape resource; and, secondly, no scope for amendment was considered feasible on account of technical and practical factors.

The proposed design for the Demonstrator WTGs was selected for its technical specification and energy output. Once again, no adjustments to this were recommended on landscape and visual grounds for the same reasons as described above with regards to siting.

11.3.2 LANDSCAPE IMPACTS OF THE DEMONSTRATOR WIND TURBINE GENERATORS

Various combinations of landscape character types as identified within the Caithness and Sutherland Landscape Character Assessment (SNH, 1998) were divided into five separate local landscape character areas. Generally, the proposed WTGs would relate strongly to many of the key characteristics of these landscape areas, specifically their large scale, sense of exposure, existing patchy composition of features and existing presence of human-made elements. Most importantly, the WTGs at the Demonstrator site would seem closely associated with the existing oil platforms – appearing to complement the energy generation function and focal qualities of these features.

For all local landscape areas, landscape impacts were judged to be of low magnitude. On account of the mainly low sensitivity of these areas, most of the impacts identified were judged as being of slight significance, with moderate significance only occurring within the “Interior hills” area, reflecting its medium sensitivity. No substantial adverse impacts were identified.

11.3.3 VISUAL IMPACTS OF THE DEMONSTRATOR WIND TURBINE GENERATORS

From most viewpoints the proposed development would be seen as a single cohesive feature within the landscape, of similar prominence to existing foci within the onshore landscape such as telecom masts and distinctive low hills, as well as the existing oil platforms seen offshore. Given its distance from the coast, it would appear clearly separated from the onshore landscape and part of the open sea, and the movement of wind turbine blades would rarely be discernible from the mainland. In addition, although the vertical line of the WTGs would contrast to the existing platforms and the surrounding horizontal emphasis of the sea, this disparity would appear as a “clean” contrast of line and form on account of the simple composition of elements.

The proposed WTGs would appear most prominent from those coastal areas that have a simple foreground pattern, and thus fewer distracting features, especially when such views are directed towards the proposed development. Visibility would mainly occur from southern directions and at high elevations.

Although 11 viewpoints have been assessed as part of the LVIA process, five were chosen mainly to illustrate the nature of visibility rather than for predicted significant visual impacts, as they are located outside the 35km study area. For all the viewpoints, impacts were judged to be of only negligible or low magnitude of visual impact, strongly affected by the fact that all the viewpoints are over 25km from the proposed development (which itself is 22km from the coast). These viewpoints are all of only low or medium sensitivity to the type of development being proposed, mainly reflecting their location within open areas that contain many other built elements. No substantial visual impacts were found.

11.3.4 SEQUENTIAL IMPACTS OF THE DEMONSTRATOR WIND TURBINE GENERATORS

The potential sequential impacts of the WTGs when viewed in either direction along two routes were assessed. Generally, however, because of the distance of the proposed development, as previously discussed, most of the views from these routes would result in no or negligible impact, although low magnitude of impacts would occur along some sections. This would result in none, negligible or slight significance of impacts along all sections of the roads apart from one section travelling south between Wick and Latheron and one section travelling north between Navidale and Dunbeath. From these sections, which equate to 51km of a total sequential assessment of 313km, there would be moderate sequential visual impacts. No substantial sequential impacts were found.

11.3.5 IMPACTS OF THE DEMONSTRATOR WIND TURBINE GENERATORS ON AREAS OF LANDSCAPE AND SCENIC VALUE

The proposed development would have low or negligible magnitude of impact on areas of recognised landscape and scenic value. It would have no significant impact on any NSA. However, it would result in moderate adverse impacts on one proposed AGLV and two Garden and Designed Landscapes, which reflects their medium sensitivity. No substantial significant impacts have been identified on areas of landscape and scenic value.

11.3.6 CUMULATIVE LANDSCAPE AND VISUAL IMPACTS OF THE DEMONSTRATOR WIND TURBINE GENERATORS WITH OTHER WIND FARMS

Consideration of cumulative impacts of the proposed Demonstrator WTGs with the existing Causeymire and Buolfruich wind farms formed part of the baseline conditions. The cumulative LVIA also considered the combined landscape and visual impacts of the Demonstrator WTGs with the proposed Dunbeath, Kilbraur and Gordonbush wind farms.

Generally, the Demonstrator WTGs would appear as a separate isolated feature from these wind farms, seen within a different setting and when looking in a different direction from key viewpoints, e.g. Scaraben. In this way, they would seem more closely associated with the existing offshore oil platforms than other wind farms within the vicinity of viewpoints. A few exceptions to this occur in places: firstly where existing and proposed wind farms would cumulatively dominate the landscape, and thus views to the Demonstrator WTGs at the edge of these areas could tentatively seem to increase its extent, almost as an outlier; and, secondly, where the existing and proposed WTGs are viewed from elevated locations as a loosely linked arc of developments and the Demonstrator WTGs would appear between two other developments, seeming to reinforce the linkage.

Within the local landscape character areas, only none, negligible or slight significance of impacts were identified; no moderate or substantial impacts were found. This is mainly because the proposed WTGs would largely seem to relate to the character of the surrounding land and seascape, particularly on account of their close association with the existing oil platforms.

For the 11 viewpoints, only none or negligible cumulative significance of impacts have been identified apart from one viewpoint, Scaraben, where moderate cumulative visual impacts could result if both the proposed Gordonbush and Dunbeath wind farms were developed in addition to the existing Causeymire and Buolfruich wind farms.

For the sequential impacts along the two routes assessed in both directions, the cumulative LVIA found that mainly none or negligible cumulative impacts would occur. The only exceptions would be: a slight significance of cumulative landscape impacts when travelling from Navidale to Dunbeath and Wick to Latheron if the proposed Dunbeath and Kilbraur wind farms were built; a slight significance of cumulative visual impact between Latheron and Dunbeath if the proposed Dunbeath wind farm was built; and a moderate significance of visual impact between Navidale and Dunbeath if the proposed Dunbeath wind farm was built.

11.3.7 OVERALL EFFECT OF THE DEMONSTRATOR WIND TURBINE GENERATORS

The LVIA has established that the proposed Demonstrator Project at Beatrice would change the landscape and visual baseline conditions during its construction and operational phases. The proposed WTGs would introduce two new elements into the landscape and seascape. The construction phase would be relatively short (Section 3), and would have only temporary adverse effects on the landscape and visual resource of the study area.

The design of the Demonstrator WTGs has been mainly determined by technical and practical factors. The resulting design would appear concentrated from all viewpoints, forming a simple feature that would seem to relate to the character of the surrounding landscape and seascape and the existing oil platforms. In this way, the proposed WTGs would satisfy good practice guidance.

The application site is not subject to any statutory or local designations for landscape or scenic interest. The proposed Demonstrator Project would also not be visible from any major settlement.

Overall, during construction and operational phases, it was judged that direct impacts would have a slight adverse effect on the landscape resource. This is considered to be a non-significant effect.

Overall, during construction and operational phases, it was judged that direct impacts would have slight adverse effect on the visual resource. This is considered to be a non-significant effect.

11.3.8 OVERALL CUMULATIVE EFFECT OF DEMONSTRATOR WIND TURBINE GENERATORS

Assessment of the proposed Demonstrator WTGs in addition to the proposed Dunbeath, Kilbraur and Gordonbush wind farms identified that they would appear as a distinct feature within the landscape and seascape. Although the Demonstrator WTGs would seem to complement the function of the onshore developments, they would seem clearly separate from these within the wide open sea, more closely associated to the existing oil platforms than the nearest land mass.

Given the various effects described above, it was judged that direct cumulative impacts during construction and operational phases would have a negligible adverse effect on the landscape and visual resource. This is considered to be a non-significant effect.

12 Effects On Other Users of the Marine Environment

12 EFFECTS ON OTHER USERS OF THE MARINE ENVIRONMENT

12.1 EFFECTS ON SHIPPING AND NAVIGATION

This section assesses the risk of two types of collision, a collision with a ship under power, and a collision with a drifting vessel.

12.1.1 METHOD USED TO ESTIMATE COLLISION RISK AND IMPACT

The Anatec UK database "ShipRoutes" was used to provide data on the numbers, types and sizes of vessels passing in close proximity to the Demonstrator site. The database uses two types of data:

- *an analysis of ship movements per year on routes passing through UK waters, estimated by analysing ship callings, data at ports in the UK and Western Europe (ships greater than 100 GT). The ShipRoutes database excludes the movements of "non-route-based" traffic such as fishing vessels, naval vessels, tugs, dredgers, yachts and offshore service vessels to mobile drilling installations*

- *an analysis of the routes taken by ships between ports.*

This information was combined to create the ShipRoutes database containing all the shipping routes passing through UK waters, with each route having a detailed distribution of shipping characteristics.

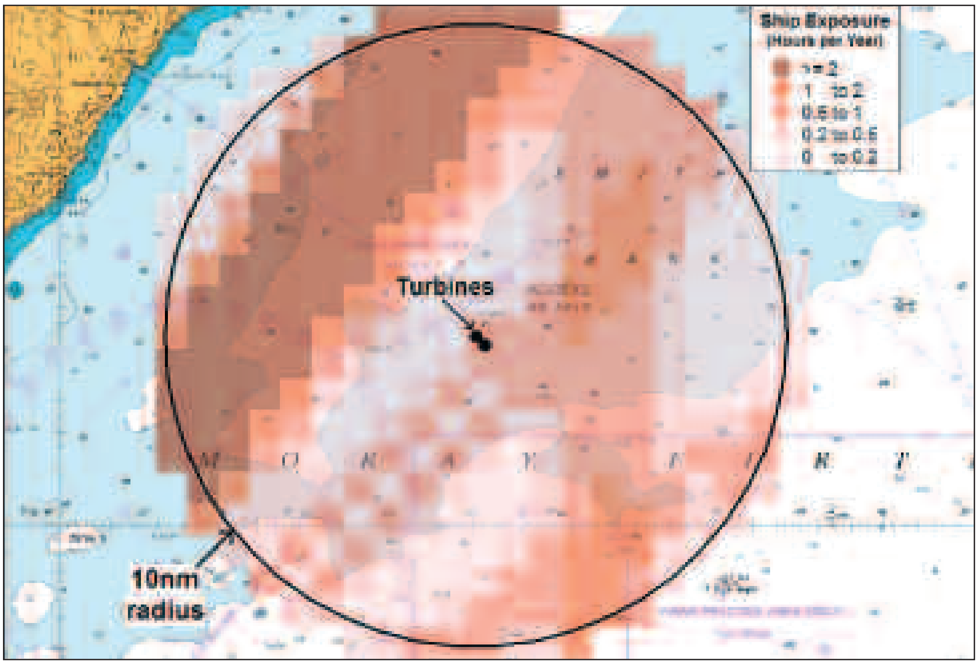
The Anatec COLLRISK model was used for both scenarios. This model is based on the premise that the collision frequency is proportional to the volume of traffic interacting with the structures. Historical data show that ship watch-keeping failure tends to be the chief cause of passing vessel collisions with offshore structures (HSE, 2003), and hence that the size of the structure is indicative of the probability of the structure being hit by errant powered traffic on any particular route.

The drifting collision model is based on the premise that the engine(s) on a vessel must fail before a vessel will drift. The model takes account of the likelihood of vessels having multiple engines; for example, passenger ferries in the UK generally have at least two engines.

Using this information it is possible to estimate the overall rate of breakdown in proximity to the turbines. The probability of a vessel drifting towards a turbine and the drift speed are estimated using the wind and wave rose for the area. Finally, the probability of a ship being repaired before reaching the turbines is estimated based on the time available. Ships that are not repaired within the time to reach the turbines are assumed to collide.

For modelling the risk of passing ships losing power and drifting into the Beatrice wind turbines a shipping exposure grid was generated (Figure 12.1). The grid covers a 10nm radius around the turbines to take into account the fact that vessels from several miles away that lost power could present a collision risk.

Figure 12.1 Ship Exposure grid around Beatrice Wind Turbines (Anatec, 2005).



Neither assessment considers or takes account of the potential mitigating effects of potential collision risk management measures, such as use of a guard vessel or a radar warning system. Nor do they take account of actions that the crew of a vessel might be able to take; for example, it may be possible for a drifting vessel to deploy its anchor successfully in the water depth around the Demonstrator site.

The collision frequency model has recently been calibrated based on a review of historical collision data on the UKCS (HSE, 2003), taking into account:

- *number of collisions*
- *UK installation details (operational years, status and dimensions)*
- *vessel type (note: infield and fishing vessels were excluded).*

The model uses location-specific data to take into account the effect of the following influencing factors on collision frequency based on HSE research (HSE, 1999):

- *shipping data (traffic density, type and size)*
- *installation dimensions and orientation*
- *wave height*
- *visibility*
- *vessel speed distribution*
- *guard vessel coverage and specification, e.g. radar type (where applicable).*

Using this information it is possible to generate a site-specific impact energy distribution for the structure being considered. It should be noted the impact energies calculated by COLLRISK are total energies based on the estimated kinetic energy of the impacting ship and do not take into account the proportion of energy likely to be absorbed by the structure.

12.1.2 DATA ON SHIPPING ACTIVITY

Six shipping routes pass within 10nm of the proposed turbine locations, with an estimated 232 vessels using them each year (Anatec, 2005) (Figure 12.2 and Table 12.1). The majority of vessel traffic is associated with the ports of Cromarty, Invergordon, and Inverness, and the Nigg terminal.

Figure 12.2 Shipping route positions within 10nm of the proposed turbines (Anatec, 2005).

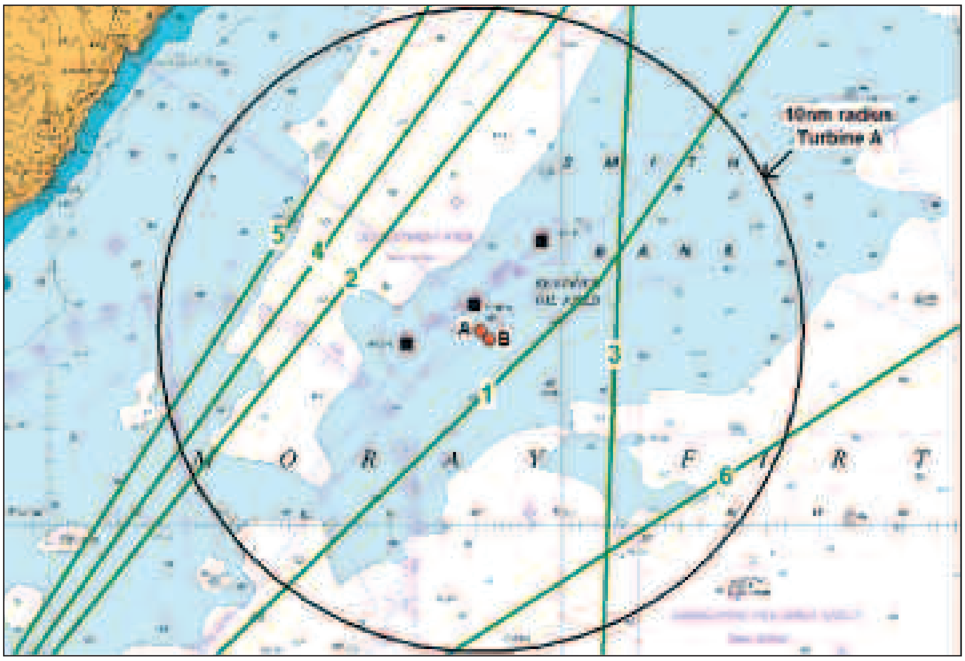


Table 12.1 Ship routes passing within 10nm of the turbines (Source: Anatec, 2005).

Route No	Description	WTG 1		WTG 2		Ships Per Year
		CPA	Brg	CPA	Brg	
1	Moray Firth-N Norway/Russia E	1.5	136	1.1	136	12
2	Moray Firth-N Norway/Russia W	4.1	308	4.5	308	12
3	Belfast-Buckie	4.2	92	3.9	92	24
4	Moray Firth-Lerwick	5.4	306	5.8	306	64
5	Moray Firth-Scalloway	6.7	303	7.1	303	104
6	Leadon-Moray Firth	8.0	147	7.6	147	16
Total number of ships passing each year						**232**

CPA = *Closest Point of Approach, in nautical miles*
Brg = *Bearing of CPA from the turbine, degrees magnetic*

Route Number 1 is the only route identified to pass within 2nm of the turbines. This is a relatively minor route which is used infrequently by ships travelling between the Moray Firth and northern Norway/Russia. This route passes to the south-east of both proposed turbines at mean distances of 1.5nm (WTG 1) and 1.1nm (WTG 2).

The majority of the vessels passing within a 10nm radius of the turbines are cargo vessels; 52% of all vessels are in the size category 0-1,500 Dead Weight Tonnage (DWT), and 38% in the 1,500-5,000 DWT category. Vessels over 40,000 DWT account for 10% of the total vessel traffic passing within 10nm of the turbines, and the majority of these are tankers. Overall, cargo vessels and tankers constitute 84% and 16% respectively of the total vessel traffic within 10nm of the turbines.

Vessel type/size distributions

The composition of the traffic on each route distributed by vessel type and size (deadweight tonnage) is presented in Tables 12.2 and 12.3.

Table 12.2 Cargo vessel size distribution (Anatec, 2005).

Route No	Size Distribution (DWT)					Ships Per Year
	< 1,500	1,500-5,000	5,000-15,000	15,000-40,000	≥ >40,000	
1	17%	83%	0%	0%	0%	12
2	17%	83%	0%	0%	0%	12
3	17%	83%	0%	0%	0%	24
4	67%	33%	0%	0%	0%	60
5	77%	23%	0%	0%	0%	88
Total	**59%**	**41%**	**0%**	**0%**	**0%**	**196**

Table 12.3 Tanker vessel size distribution (Anatec, 2005).

Route No	Size Distribution (DWT)					Ships Per Year
	< 1,500	1,500-5,000	5,000-15,000	15,000-40,000	≥ >40,000	
4	0%	100%	0%	0%	0%	4
5	25%	25%	0%	0%	50%	16
6	0%	0%	0%	0%	100%	16
Total	**11%**	**22%**	**0%**	**0%**	**67%**	**36**

Discussion of routeing pattern

There are six shipping routes passing within 10nm of WTG 1, used by an estimated 232 ships per year. This corresponds to an average of less than one vessel per day. The majority of the traffic is associated with ports in the Moray Firth such as Cromarty, Invergordon, Inverness and the Nigg terminal. The overall breakdown of traffic by vessel type and size is presented in Figure 12.3 and Figure 12.4, respectively.

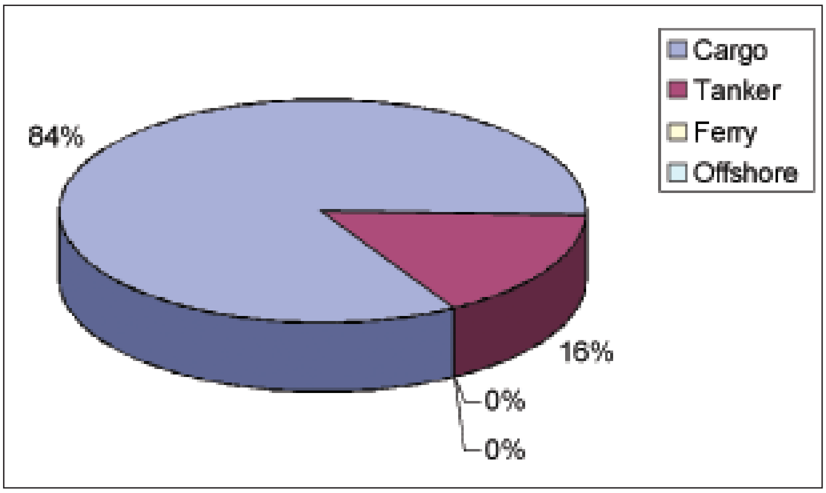


Figure 12.3 Vessel type distribution within 10nm of Beatrice WTGs (Anatec, 2005).

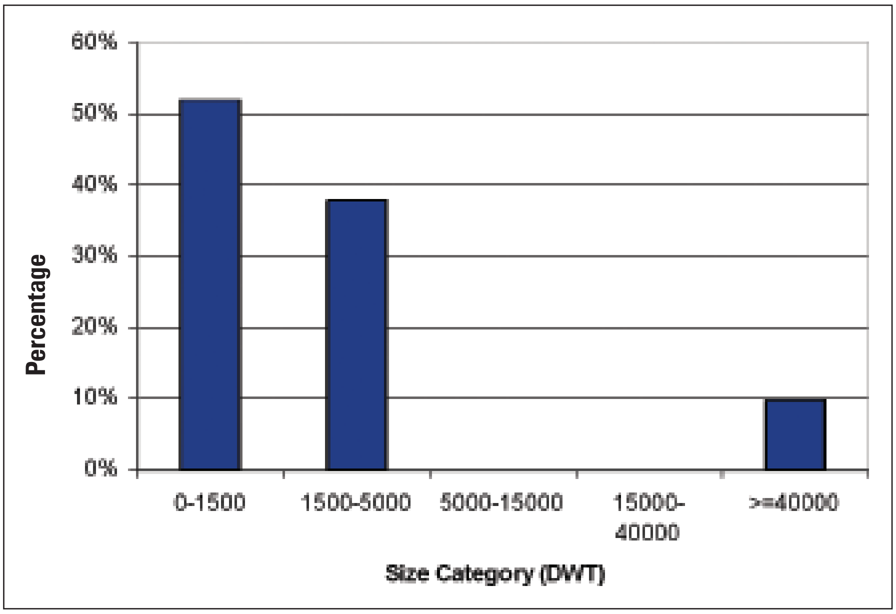


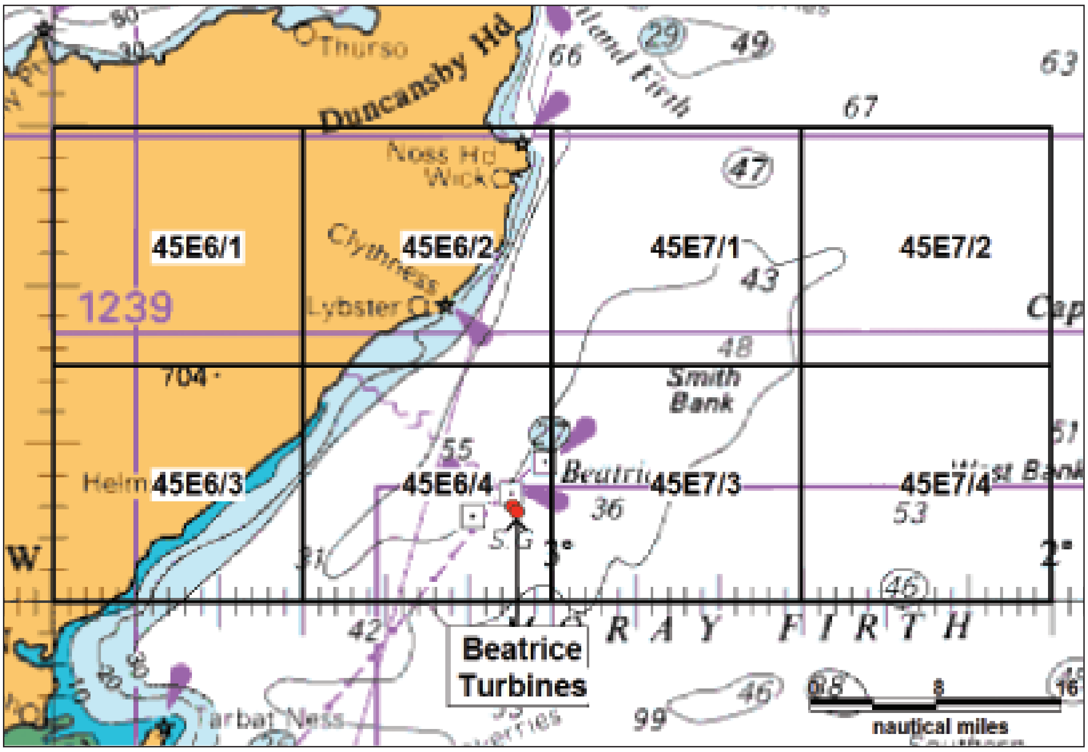
Figure 12.4 Vessel size distribution within 10nm of Beatrice WTGs (Anatec, 2005).

12.1.3 DATA ON FISHING VESSELS

Activity

Data on fishing vessel activity were obtained from FRS for each ICES statistical rectangles. Surveillance data for the North Sea may be further divided into ICES subsquares, with each subsquare representing one-quarter of an ICES rectangle. The Beatrice Wind Farm Demonstrator Project is within ICES rectangle 45E6 subsquare 4.

Figure 12.5 ICES statistical rectangles encompassing the Beatrice location.



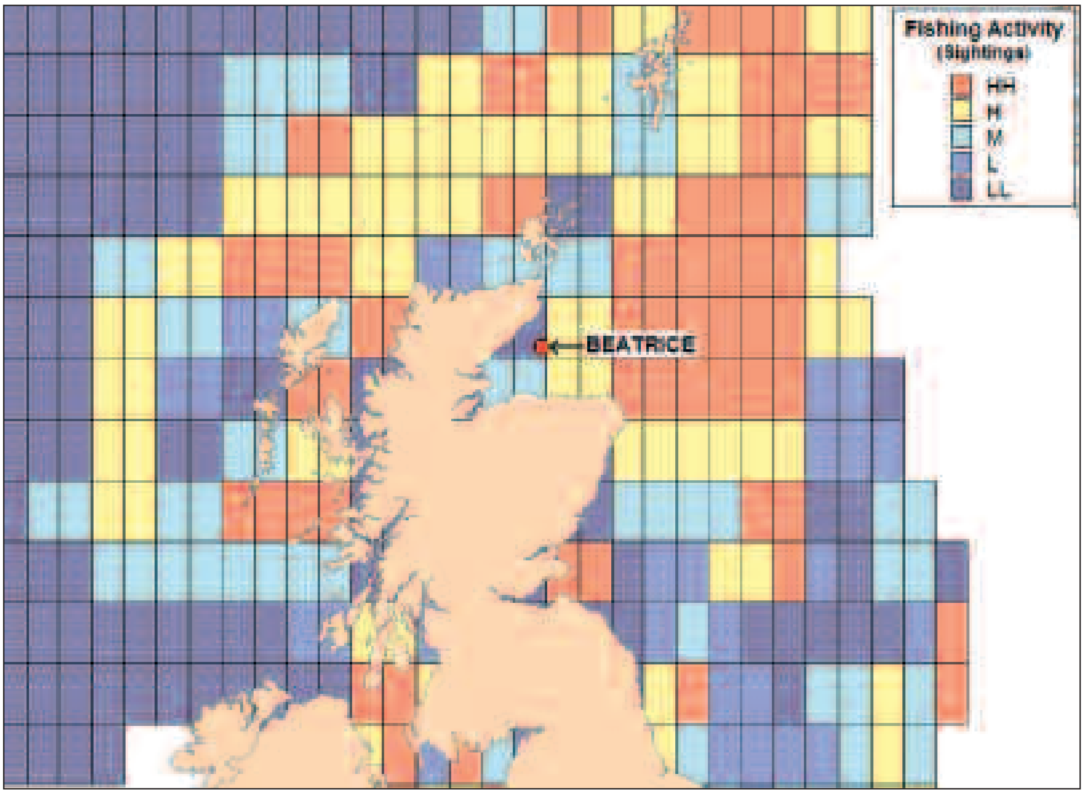
Data has been analysed for ICES rectangle 45E6 and the adjacent rectangle 45E7. The area of each ICES rectangle is approximately 950nm^2, but approximately 60% of this rectangle is on land.

Data on fishing vessel sightings in the vicinity of Beatrice have been obtained from the Scottish Fisheries Protection Agency (SFPA) for the years 2002-04. The SFPA monitor the fishing industry's compliance with UK, EU and international fisheries laws through the deployment of patrol vessels, surveillance aircraft and the Sea Fisheries Inspectorate. This data source provides information on all fishing vessels sighted within each ICES rectangle per patrol, including vessel position, activity, gear type, nationality and tonnage.

Fishing vessel satellite tracking data has been obtained for fishing vessels within ICES rectangles 45E6 and 45E7 for the years 2002-04. The data obtained mainly covers all vessels above 24m and has limited coverage of vessels between 15-24m fitted during 2004. The data cover all EC countries within British Fisheries Limits and certain third countries, e.g. Norway and Faroes. Vessels used exclusively for aquaculture and operating exclusively within baselines are exempt.

To put the fishing activity at Beatrice in context, Figure 12.6 presents a colour-coded plot of the average fishing vessel densities observed during patrols in the UK sector of the North Sea in 1999. The Beatrice Demonstrator site is located in a low density cell, which indicates the fishing vessel activity in the area is below average for the UK.

Figure 12.6 Density of fishing vessels in the UK for 1999 (Anatec, 2005).



The number of sightings and surveillance patrols in rectangles 45E6 and 45E7 in the years 2002-04 are presented in Tables 12.4 and 12.5. The numbers of patrols varied between the rectangles, with 45E7 being surveyed more than twice as much as 45E6, and this is taken into account within the weighted sightings per patrol presented in the tables.

The sightings data were imported into a GIS for mapping and analysis. A plot of the locations of all fishing vessels sighted in the ICES rectangle during patrols between 2002 and 2004 is presented in Figure 12.7. When viewing this figure and the proceeding figures it should be borne in mind that there were a higher number of surveillance patrols in rectangle 45E7 (303 versus 119 over the three-year period).

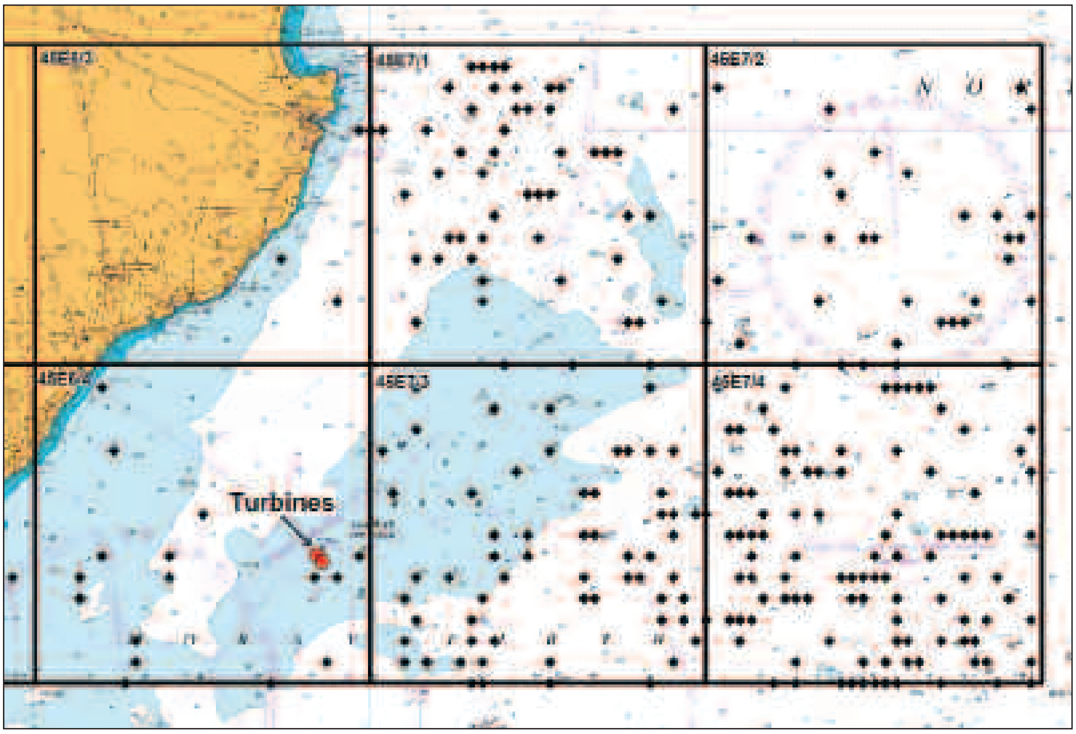
Table 12.4 Surveillance data for 45E6 (SFPA 2002-04).

Year	Vessel Sightings	Patrols	Sightings per Patrol
2002	3	23	0.1
2003	9	40	0.2
2004	11	56	0.2
Total	**23**	**119**	**0.2**

Table 12.5 Surveillance data for 45E7 (SFPA 2002-04).

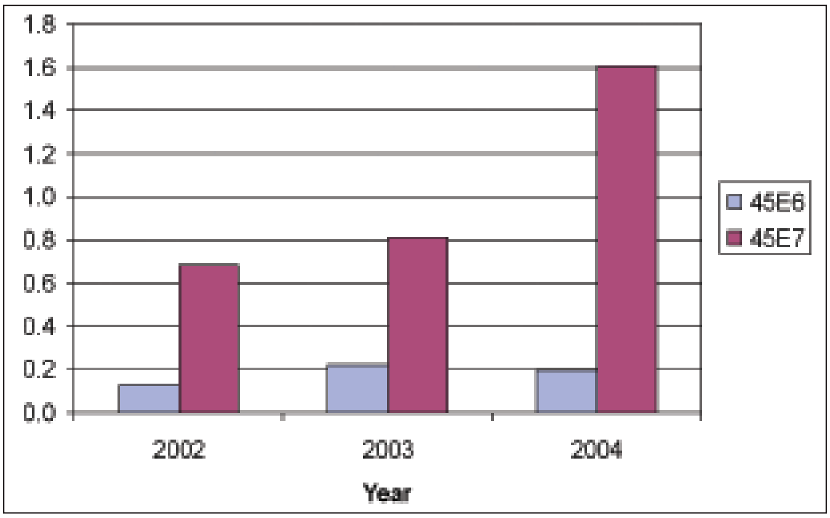
Year	Vessel Sightings	Patrols	Sightings per Patrol
2002	71	104	0.7
2003	102	126	0.8
2004	117	73	1.5
Total	**290**	**303**	**1.0**

Figure 12.7 Locations of fishing vessels sighted by the SFPA between 2002 and 2004.



The average sightings per patrol per year are illustrated in Figure 12.8.

Figure 12.8 Fishing vessel sightings per patrol per year.



The vessel density in rectangle 45E7 is significantly higher than 45E6. The average vessel density in rectangle 45E6 over the period 2002-04 was 0.2 vessels per patrol, i.e., an average of one fishing vessel spotted per five patrols. This compares to an average of one vessel per patrol in rectangle 45E7. However, it should also be noted that approximately 60% of rectangle 45E6 is on land.

Figure 12.9 Fishing vessel activities (SFPA 2002-04) (colour coded by activity).

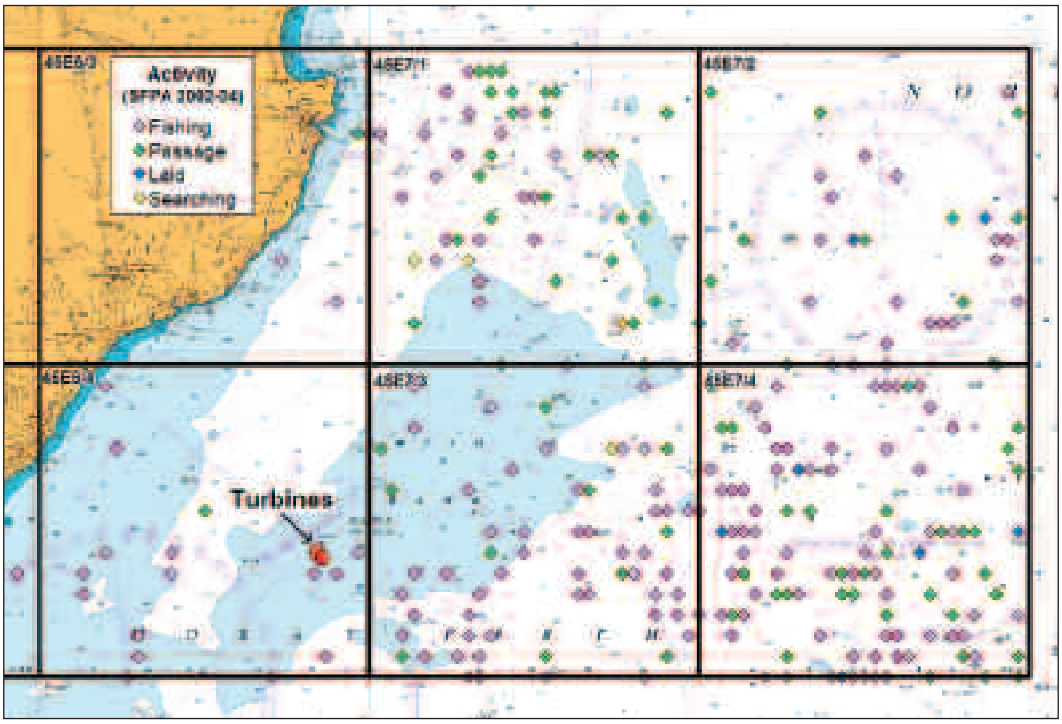
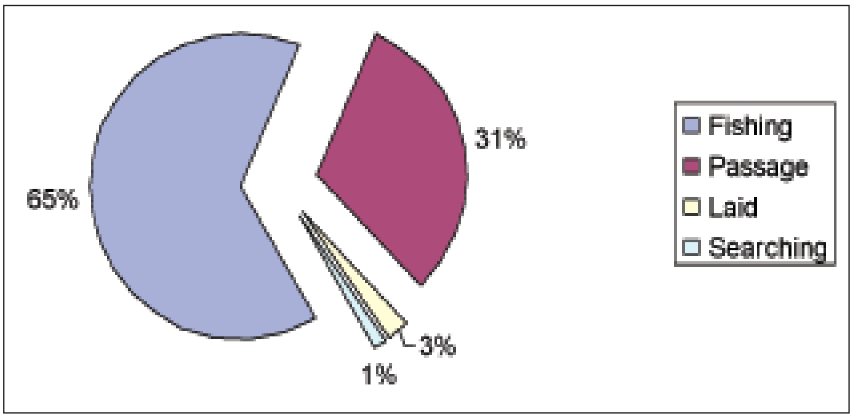


Figure 12.10 Fishing vessel activity distribution.



From observations made by the Scottish Fisheries Protection Agency (SFPA) over the period 2002-04, 65% of fishing vessels recorded within ICES rectangles 45E6 and 45E7 were engaged in fishing activity (i.e. gear deployed); 31% were on passage to and from fishing grounds; 3% were at anchor or on standby; and 1% were searching for shoals of fish. Fishing activity is the predominant activity for fishing vessels within the vicinity of the WTGs at Beatrice (Figure 12.10).

Fishing vessel tonnage distribution

The fishing vessel sightings colour-coded by Gross Registered Tonnage (GRT) are presented in Figure 12.11. The majority of vessels sighted were below 300 tonnes, as shown in Figure 12.12. Five vessels exceeded 1,000 tonnes.

Figure 12.11 Fishing vessel tonnages (SFPA 2002-04).

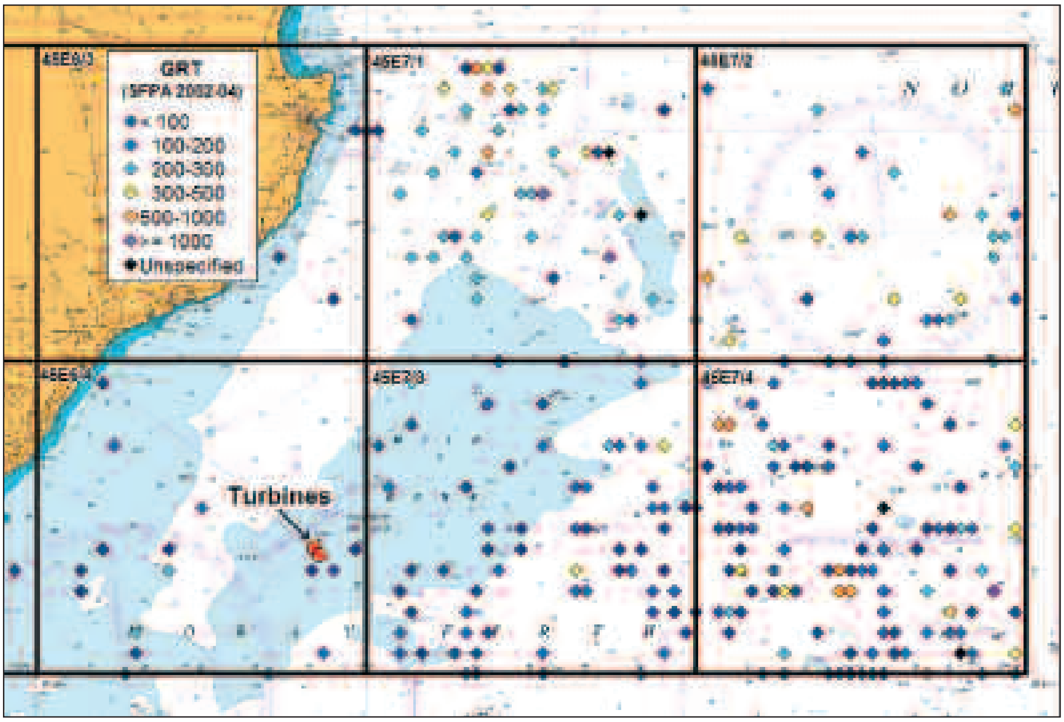
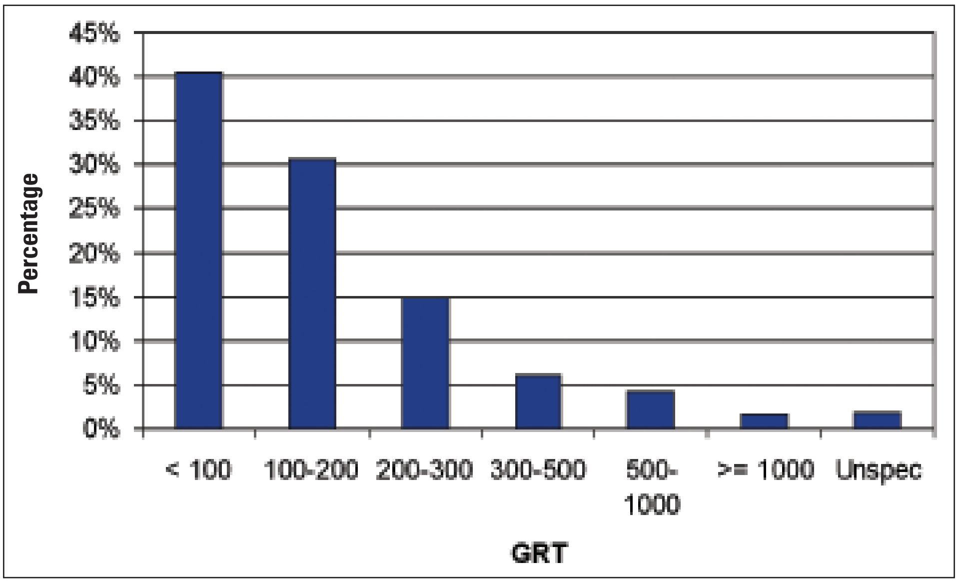


Figure 12.12 Tonnage distribution (SFPA 2002-04).



Vessel length distribution

The fishing vessel sightings colour-coded by overall length are presented in Figure 12.13. The majority of vessels identified were in the 15-30 metre length category, as confirmed by Figure 12.14. Eight vessels exceeded 50m in length.

Figure 12.13 Fishing vessel lengths (SFPA 2002-04).

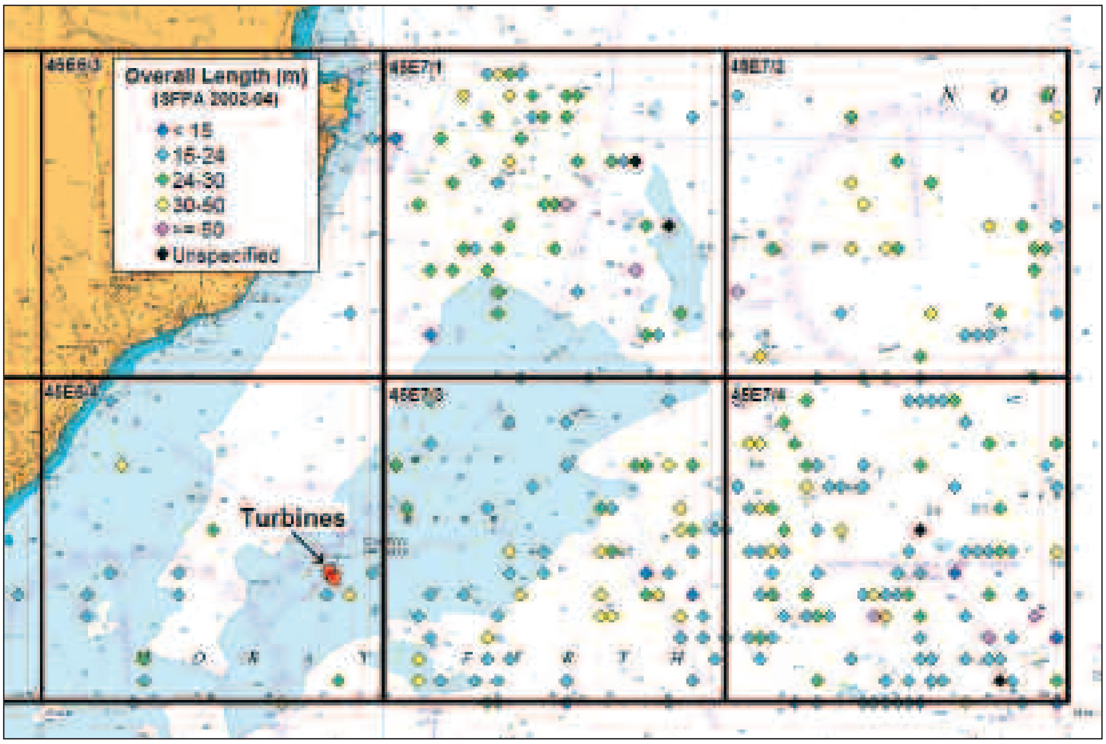
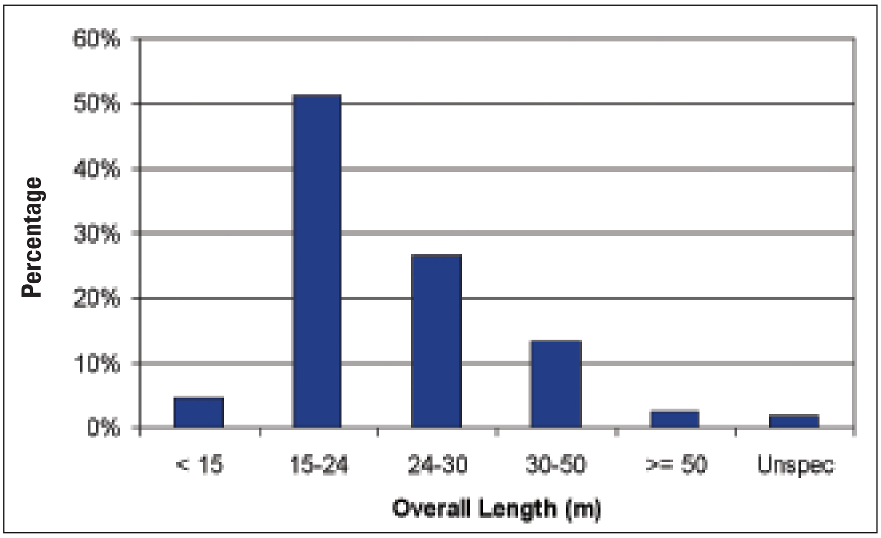


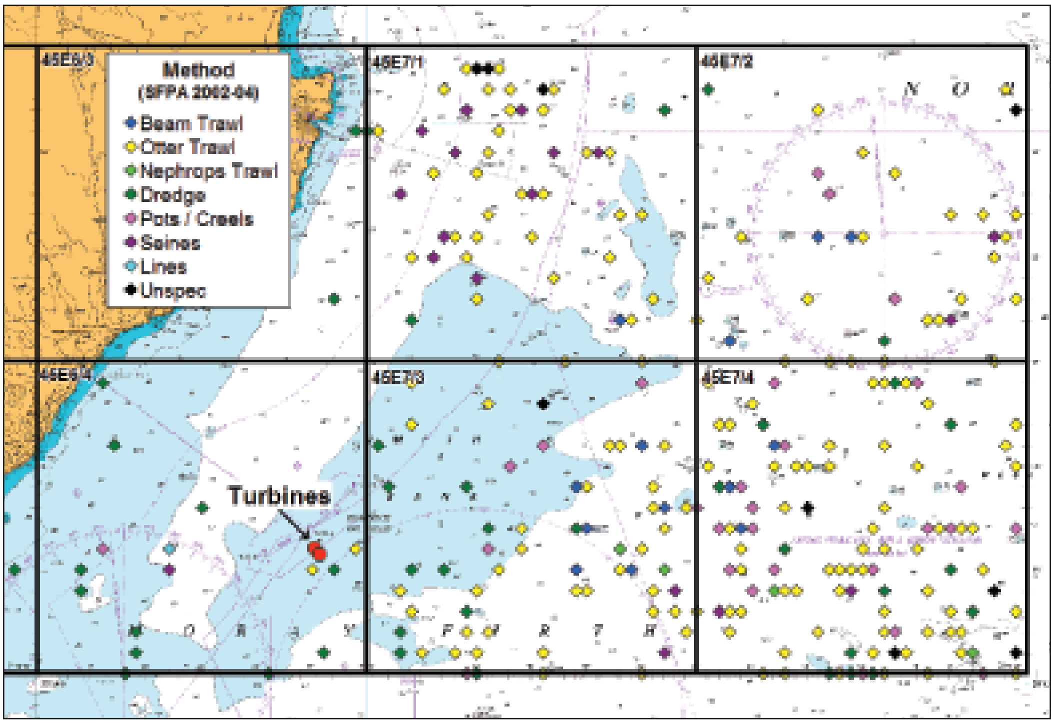
Figure 12.14 Fishing vessel length distribution.



Fishing gear

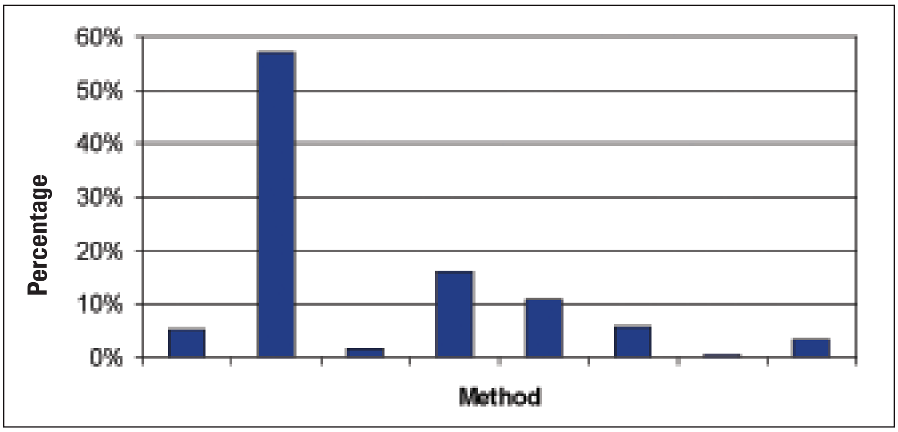
According to the SFPA the predominant fishing gears used within rectangles 45E6 and 45E7 are otter trawls, followed by dredges and creels. The Scottish fishing fleet is the most active nationality in the area, representing 92% of all sightings in rectangles 45E6 and 45E7 between 2002 and 2004. The fishing vessel sightings colour-coded by method (gear type) are presented in Figure 12.15.

Figure 12.15 Fishing vessel methods (SFPA 2002-04).



The method distribution is summarised in Figure 12.16, which shows that the main gears used are otter trawls followed by dredges and covered pots (creels).

Figure 12.16 Fishing vessel method distribution.



Fishing vessel activity at the Demonstrator site

The locations of fishing vessels sighted within 5nm of the proposed WTGs are presented in Figure 12.17. A total of seven fishing vessels were sighted within 5nm. Details of these vessels are presented in Table 12.6.

Figure 12.17 Locations of fishing vessel sighted within 5nm of Beatrice.

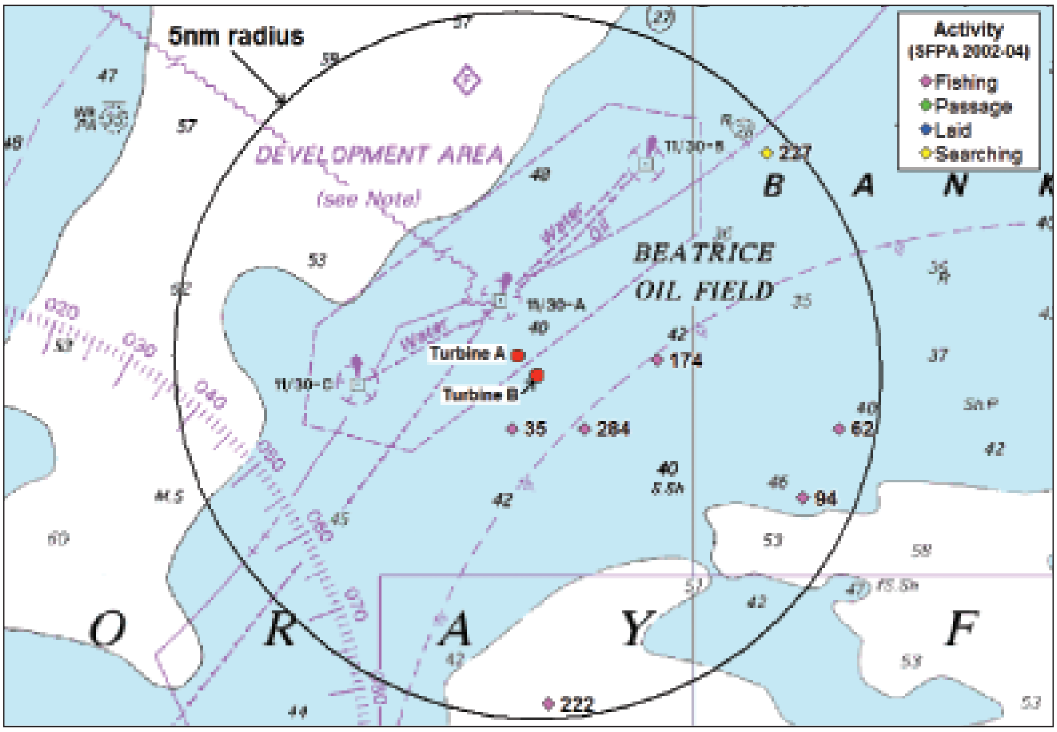


Table 12.6 Fishing vessels sighted within 5nm of Beatrice.

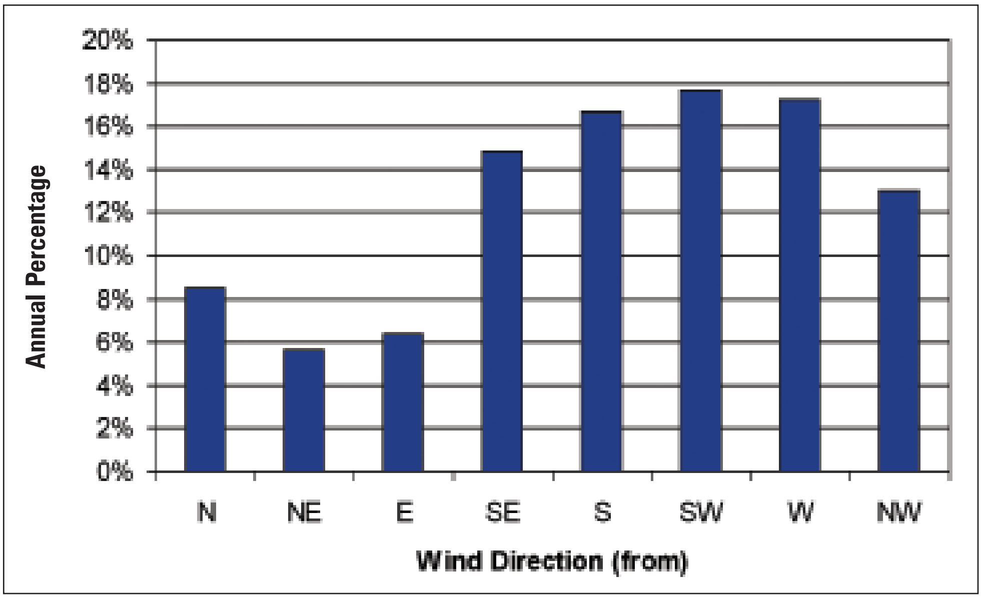
ID	Year	Month	Method	Nationality	Activity	Length	GRT	kW
35	2004	11	Otter Trawl	Scotland	Fishing	17m	65	201
62	2003	5	Dredge	Scotland	Fishing	17m	56	242
94	2002	7	Otter Trawl	Scotland	Fishing	20m	70	312
174	2003	9	Otter Trawl	Scotland	Fishing	18m	63	441
222	2004	12	Dredge	England + Wales	Fishing	24m	105	540
227	2003	10	Dredge	England + Wales	Passage	24m	105	540
284	2004	12	Dredge	Scotland	Fishing	30m	180	745

The data show that all the fishing vessels identified within 5nm of the proposed Beatrice turbine locations were bottom otter trawlers or dredgers. All the vessels were registered at UK ports, with the majority being Scottish.

12.1.4 DATA ON METEOROLOGICAL PARAMETERS

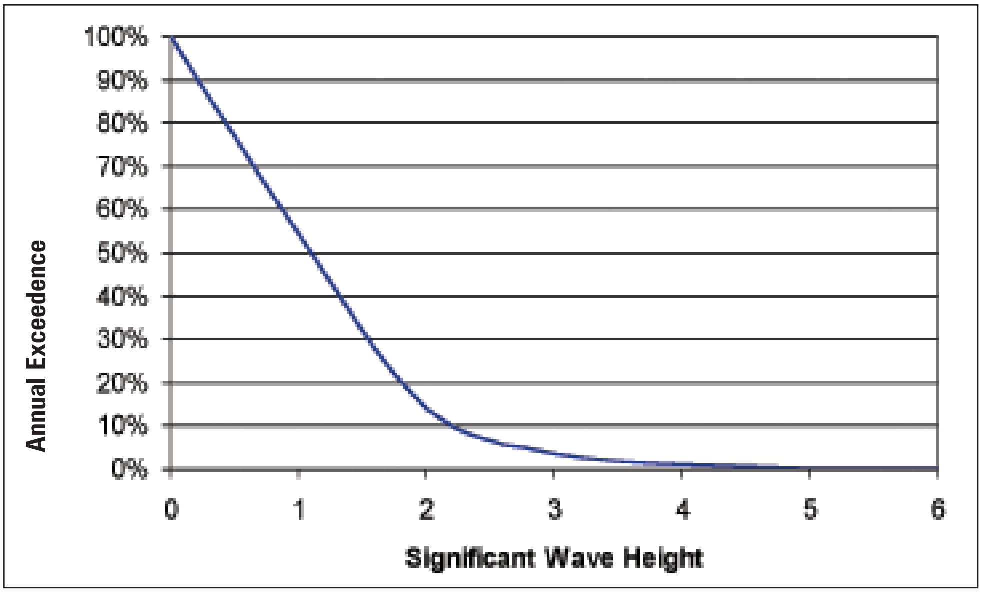
Wind

Figure 12.18 Annual wind direction distribution for Beatrice area (Ref i).



The percentage exceedence distribution of significant wave height for the Beatrice area is shown in Figure 12.19. The frequency of severe sea states (significant wave height exceeding 5m) is approximately 0.1% per year.

Figure 12.19 Annual wave height exceedence curve for the Beatrice area (Ref i).



Visibility

Historically, visibility has been shown to have a major influence on the risk of ship collision. The annual probability of visibility less than 1km for the UK North Sea is approximately 0.03, i.e., 3% of the year.

12.1.5 RESULTS FOR SHIPPING COLLISION RISK

Table 12.8 presents the annual ship/installation collision frequencies distributed by impact energy for WTG 1 and WTG 2. The results show that the annual passing powered ship collision frequency for WTG 1 is estimated to be 1.5 x 10^{-5}, corresponding to a collision return period of 66,900 years. For WTG 2 the annual passing powered ship collision frequency is estimated to be 3.2 x 10^{-5}, corresponding to a collision return period of 31,700 years.

Table 12.8 Estimated frequency of powered ship/installation collisions

Impact Energy (MJ)	Annual Collision Frequency	
	WTG 1	WTG 2
0-20	3.0E-06	5.6E-06
21-50	5.0E-06	1.1E-05
51-100	4.2E-06	9.2E-06
101-200	2.8E-06	6.2E-06
>200	Negligible	Negligible
Total	**1.5E-05**	**3.2E-05**

Table 12.9 presents the annual ship/installation collision frequencies distributed by impact energy for WTG 1 and WTG 2. The results show that the annual passing drifting ship collision frequency for WTG 1 is 3.1 x 10^{-7}, corresponding to a collision return period of approximately 320, and for WTG 2 the collision frequency is 2.9 x 10^{-7}, corresponding to a collision return period of approximately 348,000 years.

Table 12.9 Estimated frequency of drifting ship/installation collisions

Impact Energy (MJ)	Annual Collision Frequency	
	WTG 1	WTG 2
0-20	3.1E-07	2.9E-07
21-50	Negligible	Negligible
51-100	Negligible	Negligible
101-200	Negligible	Negligible
>200	Negligible	Negligible
Total	**3.1E-07**	**2.9E-07**

12.1.6 RESULTS FOR FISHING VESSEL COLLISION RISK

Fishing vessel activity around Beatrice

This section presents an analysis of the latest satellite data provided by SFPA for the sea area around Beatrice. This mainly covers vessels of 24m overall length and above, but includes a proportion of vessels between 15-24m. From the sightings data, 43% of vessels were over 24m in length and 95% were over 15m in length.

The following three figures (12.20 to 12.22) show the fishing vessel satellite tracks recorded in the ICES rectangles encompassing the area of the Demonstrator site. The consecutive positions reported by vessels have been joined to aid interpretation of fishing vessel movements in the area, but the lines should not be considered as continuous due to the time gap between position reports (typically one to two hours). Figure 12.23 shows the fishing vessel activity on a grid density basis for 2002-2004.

Figure 12.20 Fishing satellite tracking data (SFPA 2002).

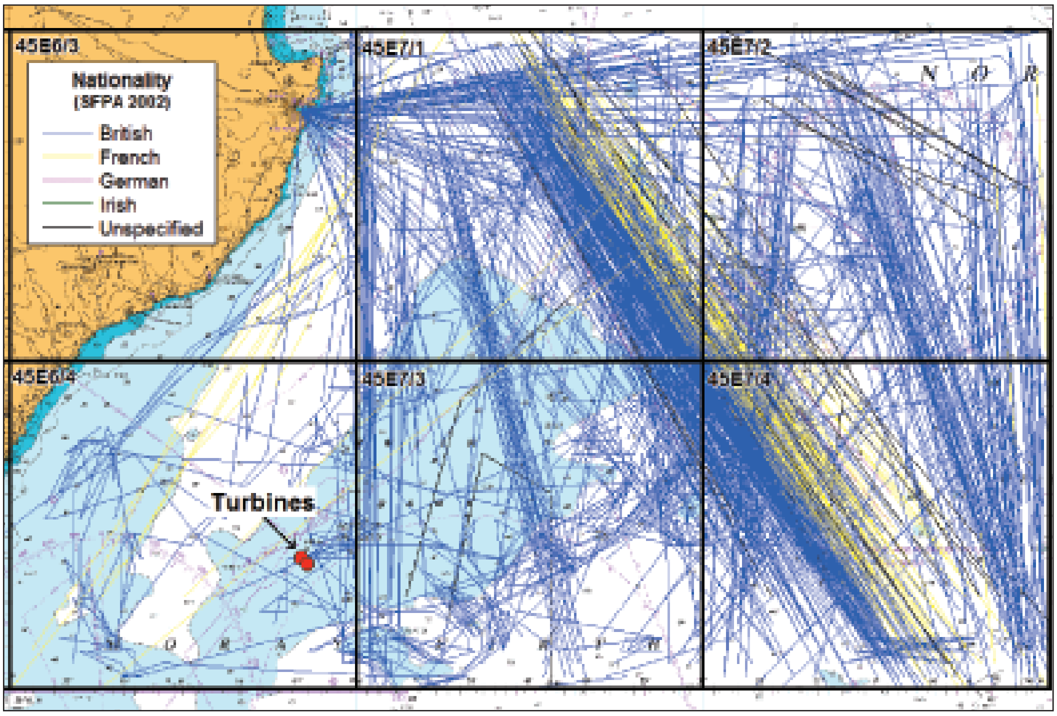


Figure 12.21 Fishing satellite tracking data (SFPA 2003).

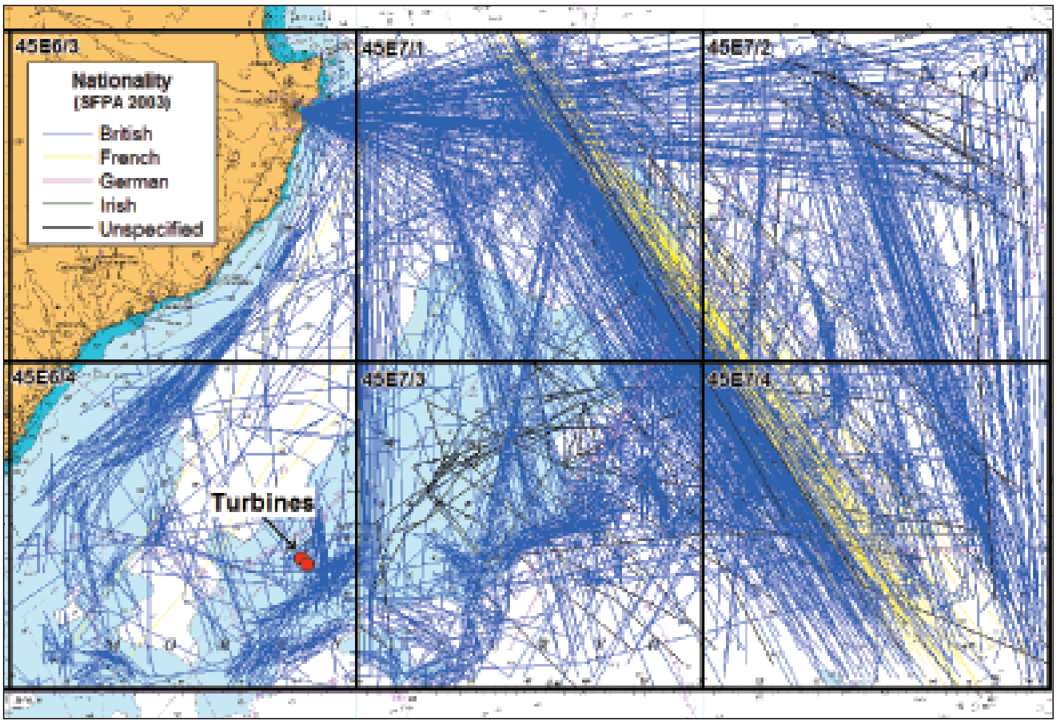


Figure 12.22 Fishing satellite tracking data (SFPA 2004).

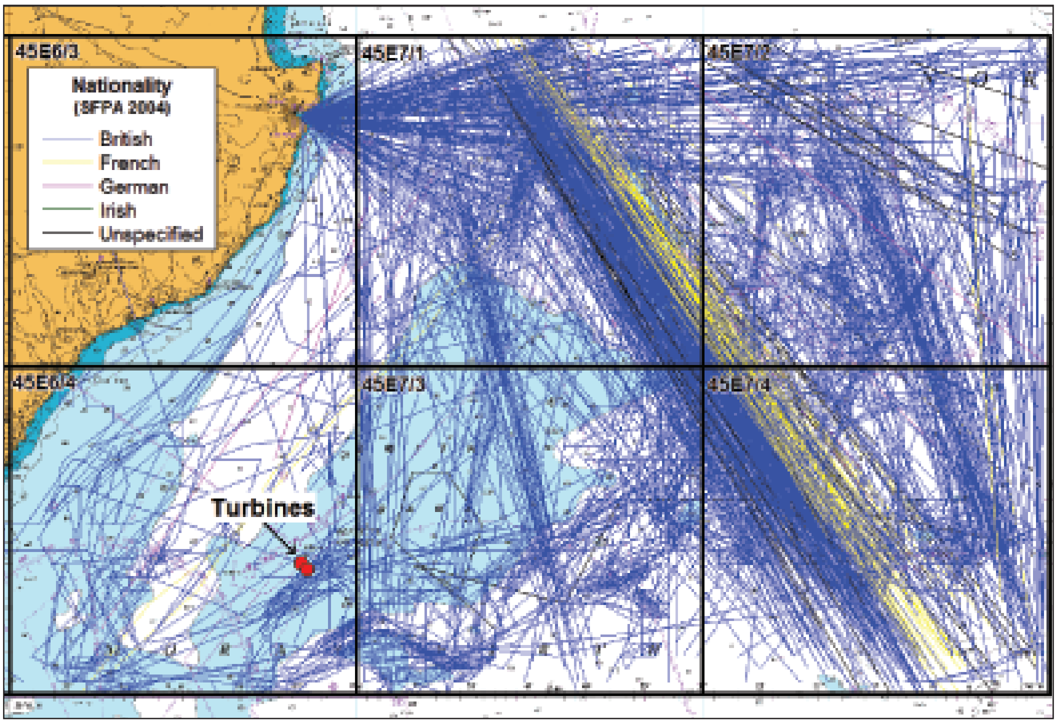
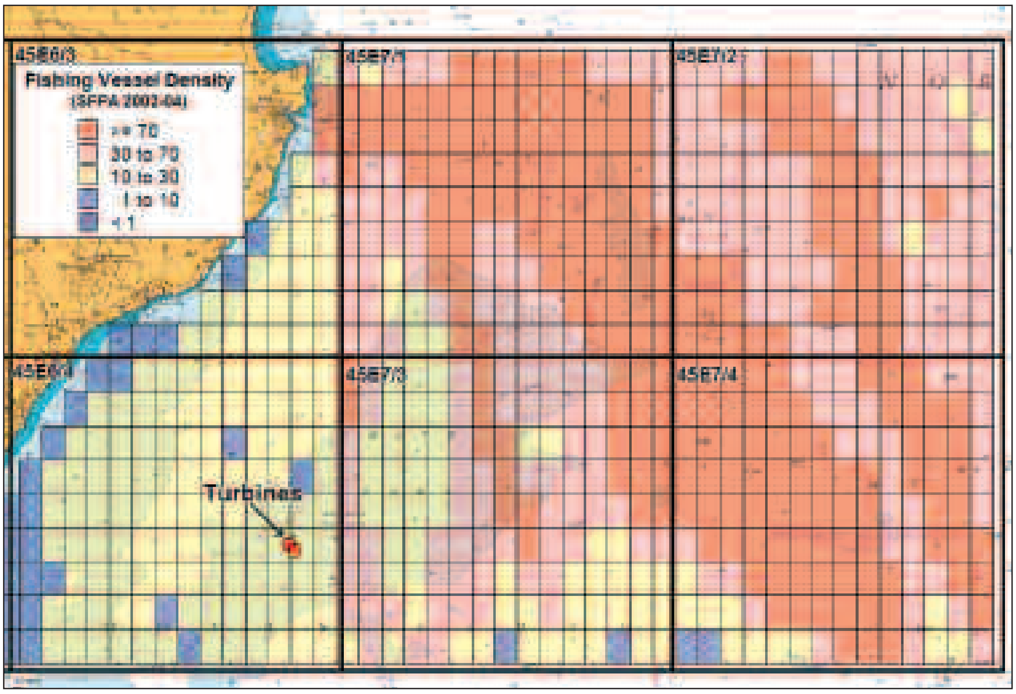


Figure 12.23 Fishing vessel density (SFPA 2002-04).



The majority of fishing activity in the area tends to be well to the north and east of the Demonstrator site. There is a marked band of activity heading in a north-west/south-east direction off the north-east coast of Scotland, which is likely to be associated with vessels heading out into the Atlantic via the Pentland Firth. There is also a high density area associated with vessels heading to and from Wick.

Figure 12.24 Detailed view of fishing tracks around Beatrice (SFPA 2002-04).

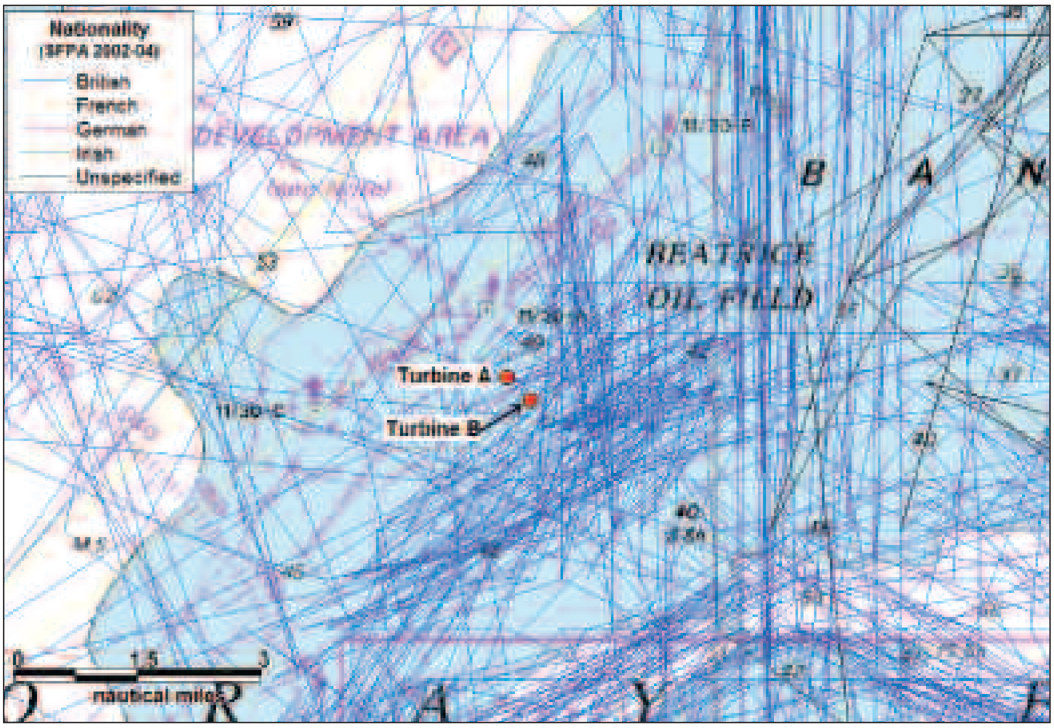


Figure 12.24 shows a more detailed view of the fishing tracks in the vicinity of the proposed WTGs. Several vessel tracks have been recorded in the vicinity of the proposed WTGs over the three-year period, and the vast majority of these being from British vessels.

Fishing vessel collision frequency assessment

The fishing vessel collision frequency was estimated using Anatec's COLLRISK model for fishing vessels. This is a density-based model, calibrated directly with historical data, taking into account the following factors:

- *collision data between fishing vessels and UKCS offshore installations*
- *fishing activity data for the UKCS*
- *fishing activity in proximity to the Beatrice turbines*
- *turbine dimensions*
- *fishing vessel tonnage distribution*
- *fishing vessel activity distribution.*

Fishing vessel density

The density of fishing vessels in ICES rectangles 45E6 and 45E7 varies significantly, and to ensure the collision risk assessment is site-specific, the fishing vessel density within a 5nm radius of the Beatrice turbines was estimated. Based on the sightings data, and taking into account the number of patrols in the respective ICES rectangles, the density of fishing vessels within a 5nm radius of the Beatrice turbines was estimated to be 5.3 x 10^{-4} vessels per nm^2. This density applies to both turbine locations.

Fishing vessel collision frequency

The annual frequency of fishing vessel collisions with each turbine was estimated by entering data on fishing vessel density and turbine dimensions into the COLLRISK fishing model. The results are presented in Table 12.10, and it should be noted that the results are the same for each turbine because the data on structure dimensions and fishing vessel densities are the same for both WTGs.

Table 12.10 Estimated annual collision frequency for fishing vessels with a WTG at the proposed Demonstrator site (applies to each WTG).

Impact Energy	Annual Collision Frequency
0-20	4.5E-05
21-50	2.3E-07
51-100	Negligible
101-200	Negligible
>200	Negligible
Total	**4.5E-05**

The frequency of fishing vessel collisions for each of the WTGs is estimated to be 4.5 x 10^{-5} per year, which corresponds to an average collision return period of 22,000 years for each turbine.

12.1.7 SITE-SPECIFIC DATA ON VESSEL MOVEMENTS IN BEATRICE AREA

Talisman commissioned a report (SML 2005) which examined the level of vessel activity within 10nm of the Beatrice field, using data from radar surveillance from the Beatrice platform. A very large amount of raw data were made available, and the results of this study are illustrated in Figures 12.25 and 12.26.

Figure 12.25 shows for each month of 2004, the total numbers of approaches by all vessels, and the numbers of approaches by fishing vessels, to within 10nm, 5nm, 2nm and 1nm of WTG 1 (labelled WTG A on the graph). Figure 12.26 shows similar data for WTG 2 (WTG B) in 2994.

These data confirm that the WTG sites are not used or crossed at present by a large number of vessels. This underscores the overall assessment that collisions risk is low, and also that the presence of the WTGs and the 500m safety zone around them, will not result in a significant inconvenience to commercial fishing operations.

Figure 12.25 Approaches by all vessels and fishing vessels to within 10nm, 5nm, 2nm and 1nm of the site of WTG 1, in each month of 2004.

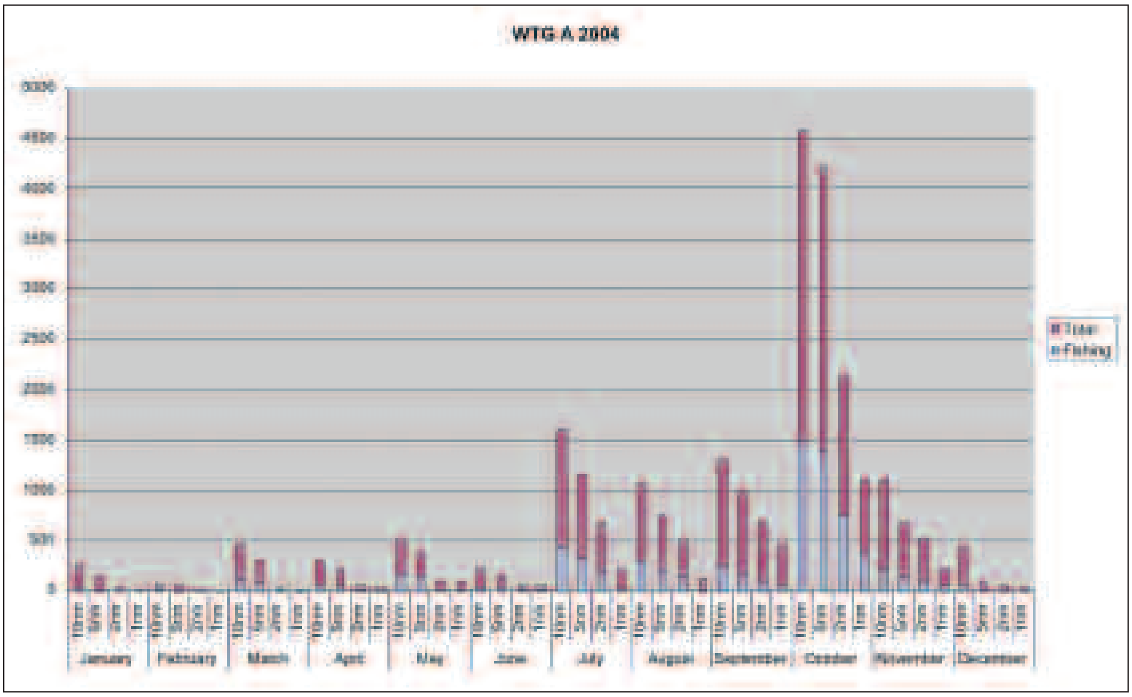
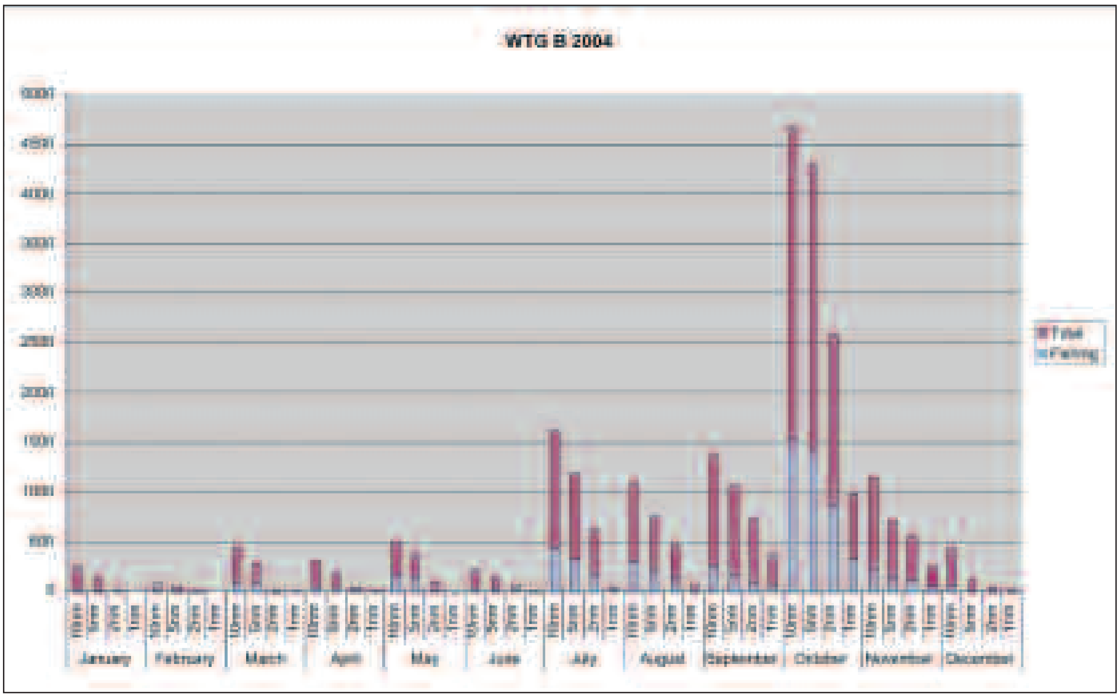


Figure 12.26 Approaches by all vessels and fishing vessels to within 10nm, 5nm, 2nm and 1nm of the site of WTG 2, in each month of 2004.



12.1.8 SUMMARY OF ALL COLLISION RISKS

A summary of the collision results for each WTG is presented in Table 12.11 and Table 12.12, distributed by scenario and total impact energy.

Table 12.11 Estimated annual collision frequencies for WTG 1.

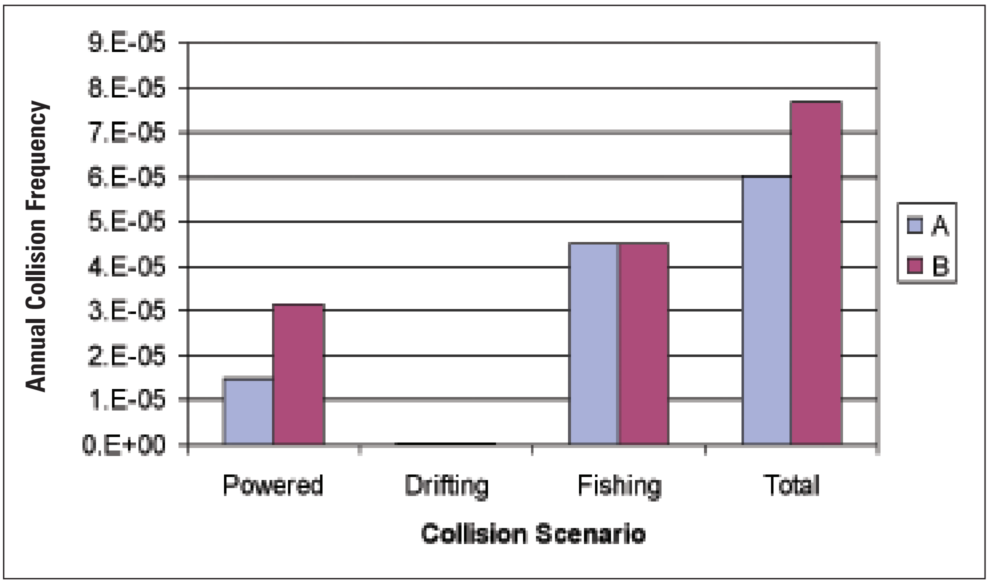
Impact Energy (MJ)	Annual Collision Frequency			
	Powered Ship	Drifting Ship	Fishing	Total
0-20	3.0E-06	3.1E-07	4.5E-05	4.8E-05
21-50	5.0E-06	Negligible	2.3E-07	5.2E-06
51-100	4.2E-06	Negligible	Negligible	4.2E-06
101-200	2.8E-06	Negligible	Negligible	2.8E-06
>200	Negligible	Negligible	Negligible	Negligible
Total	**1.5E-05**	**3.1E-07**	**4.5E-05**	**6.0E-05**

Table 12.12 Estimated annual collision frequencies for WTG 2.

Impact Energy (MJ)	Annual Collision Frequency			
	Powered Ship	Drifting Ship	Fishing	Total
0-20	5.6E-06	2.9E-07	4.5E-05	5.1E-05
21-50	1.1E-05	Negligible	2.3E-07	1.1E-05
51-100	9.2E-06	Negligible	Negligible	9.2E-06
101-200	6.2E-06	Negligible	Negligible	6.2E-06
>200	Negligible	Negligible	Negligible	Negligible
Total	**3.2E-05**	**2.9E-07**	**4.5E-05**	**7.7E-05**

A comparison of the results per turbine is presented in Figure 12.27.

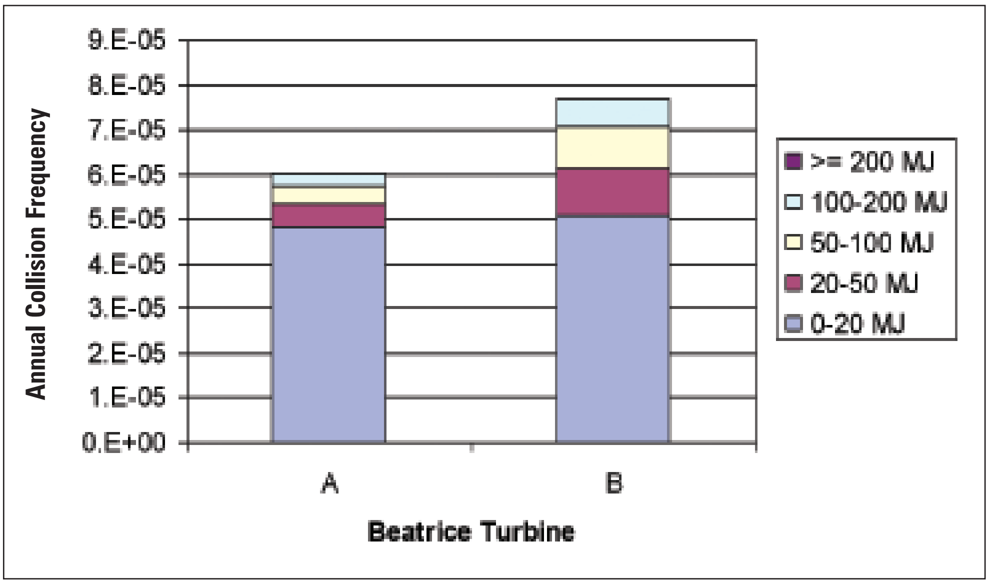
Figure 12.27 Summary of collision results per scenario for Beatrice WTGs.



The overall collision risk for WTG 2 is slightly higher than for WTG 1 (a return period of 13,010 years versus 16,585 years). This is mainly due to the higher frequency of passing powered ship collisions. Overall, the collision risks for both turbines are assessed to be low, based on the relatively low shipping and fishing vessel activity identified in the Beatrice area.

In terms of impact energies, the overall categorisation for each WTG is presented in Figure 12.28. The majority of collisions are expected to generate total impact energies below 20 MJ.

Figure 12.28 Summary of collision results per impact energy for Beatrice WTGs.



12.1.9 MITIGATION FOR COLLISION RISKS

The offshore activities associated with the installation of the facilities, and the locations of the WTG units will be notified in Admiralty "Notices to Mariners". The WTG units will be painted and lit in accordance with International Association of Marine Aids to Navigation and Lighthouse Authorities guidelines, and will be visible on ships' radar.

12.2 EFFECTS ON COMMERCIAL FISHING

12.2.1 INTRODUCTION

It is possible that the operations to install the two WTG units and subsea umbilicals, and their physical presence for the duration of the Demonstrator Project, will represent a source of interference to commercial fishing operations in the area. The potential impacts are:

- *interference with fishing during the deployment of the WTG units and the associated electrical cable link between the WTG units and Beatrice AP platform*
- *the potential interactions between the WTG units and fishing vessels*
- *the potential interactions between the umbilical cable and fishing gear.*

The potential impacts in this section generally concentrate on those which may affect the ability of fishermen to conduct commercial fishing activities. Possible effects of the Demonstrator Project on the size or viability of fish and shellfish populations, which may indirectly affect commercial fishing activities, are addressed in Section 8.3, and potential collision risks for vessels are discussed in Section 12.1.

12.2.2 STATUS OF THE SITE

The commercial fishing value for ICES rectangle 45E6 is "high" (Section 4.4), but the level of fishing activity is low in comparison with many other areas of the North Sea. Only a small number of fishing vessels were sighted in the immediate vicinity of the site of the proposed Demonstrator Project over the period 2002-04 (Section 4.4).

12.2.3 MAGNITUDE OF POTENTIAL EFFECTS ON COMMERCIAL FISHING

Interference with fishing during construction

During the period of construction, vessels will be operating at the two WTG sites and along the cable routes from WTG 1 to WTG 2 and from WTG 1 to Beatrice AP see project schedule (Section 3). These activities will be advertised in "Notices to Mariners", but there are no plans to establish any safety exclusion zones around any of these sites during the installation activities. Commercial fishing vessels will, therefore, be able to continue their activities around the sites, with due regard to safety and good seamanship.

The operations to install the WTGs and the subsea cables will, therefore, not have any significant effect on commercial fisheries in the area of the Demonstrator Project.

Interference with fishing during operational life

The two WTGs will become "supplementary units" as defined in the Offshore Installations and Pipeline Works (Management and Administration) Regulations 1995. In this respect they will become effectively part of the Beatrice installation. They will therefore attract an automatic 500m safety zone as per Section 21of the Petroleum Act 1987. This will exclude fishing vessels from a very small area of the seabed around the structures, but since fishing activity in the immediate area of the WTGs is low (Section 12.1) Talisman do not believe that this will be significant.

The subsea umbilical from WTG 1 to WTG 2 will be buried and it will be possible to continue fishing operations over and along this route. Most of the umbilical from WTG 1 to Beatrice AP will also be buried, so this will not impose any restrictions on fishing. The umbilical will emerge onto the surface of the seabed before it crosses the 16" oil export pipeline, but this short exposed section will lie completely within the existing 500m safety zone around Beatrice AP and so will not represent a constraint on fishing activity.

The presence of the WTGs and buried umbilical will, therefore, not have any effect on commercial fisheries in the area of the Demonstrator Project.

12.2.4 MITIGATION FOR POTENTIAL EFFECTS ON COMMERCIAL FISHING

The offshore activities associated with the installation of the facilities, and the locations of the WTG units will be notified in Admiralty "Notices to Mariners". The WTG units will be painted and lit in accordance with International Association of Marine Aids to Navigation and Lighthouse Authorities guidelines, and will be visible on ships' radar.

Where the subsea electric cables are buried, they will be buried to a depth of at least 0.6m to ensure that they would not be affected by bottom-towed fishing gear. Where they are not buried, they will be protected by concrete mattresses. The longest length of mattressed cable will be from the crossing over the 16" oil export line to Beatrice AP, a distance of about 200m, and all of this will lie within the existing 500m safety zone around the Beatrice platform. Periodic monitoring of the cable routes will be undertaken to ensure that the cables remain buried to the required depth.

12.2.5 FURTHER STUDIES PROPOSED

No field studies of this aspect are planned for the Demonstrator Project. In the event that the Demonstrator Project is successful and a decision is made to move to future commercial development, the impacts on fishing, and associated consultation, will be examined again in detail.

12.3 INTERFERENCE WITH TELECOMMUNICATIONS AND AVIATION

12.3.1 INTRODUCTION

The presence of the WTG units may affect fixed radio links, maritime radio systems, civil and military radars, and aeronautical radio navigation aids. Wind turbines can, for example, interfere with signals or create blind areas on radar coverage. The magnitude of potential effects depends on the size, extent and location of the wind turbines in relation to the affected instruments. Telecommunications and aviation may be affected by large-scale wind farm developments. Although it is unlikely that the effects of the two WTGs in the Beatrice Wind Farm Demonstrator Project would be significant, the issue was raised during consultation and this section presents an assessment of the potential effects.

12.3.2 METHODS USED TO ASSESS POTENTIAL IMPACT

A review was made of the nature, location and use of all radar and telecommunication facilities within a 30km radius of the WTGs. Discussions were held with the operators/owners of these facilities to determine the detailed operating parameters of each system, to evaluate whether they would be likely to be affected by the presence of the WTGs. These discussions included the examination of possible mitigation measures. This information was then drawn together by an independent expert to provide a comprehensive assessment of the potential for the WTGs at the Demonstrator site to affect telecommunications or aviation (Spaven, 2005).

12.3.3 ASSESSMENT OF THE POTENTIAL EFFECTS OF THE BEATRICE WIND FARM DEMONSTRATOR PROJECT

Effects on telecommunications

Consultation with Ofcom confirmed that there are no known civil fixed radio links in the vicinity of the Demonstrator Project. Of the 18 telecommunications operators consulted, 17 responded and they all confirmed either that they did not have facilities in the area, or that the proposed Demonstrator Project would not have any effect on their facilities.

The nearest telecommunications facility to the Demonstrator site is a microwave link routing up the north coast of the Moray Firth Figure 12.29. This will not be affected by the Demonstrator Project.

Television reception

The only television subscribers whose service might be affected by the development are personnel working on the Beatrice platforms. Any terrestrial television signals to the Beatrice platforms will be received from the Rumster Forest transmitter, 29km to the north-west and in clear line of sight. Since the WTGs are located south of the Beatrice Alpha platform they will not interrupt the signal path between Rumster Forest and Beatrice, and television reception would not be affected.

The BBC online wind farm assessment tool (http://windfarms.kw.bbc.co.uk/cgi-bin/rd/windfarms/windfarm.cgi) was used to confirm the prediction that there will be no impact on television reception. The results confirmed that there would not be any homes whose television reception could be affected.

Aviation

The Civil Aviation Authority Directorate of Airspace Policy (DAP) has been consulted and has indicated that it has no comments on the proposal, other than those relating to potential vertical obstruction issues associated with helicopter instrument approach procedures for the existing Beatrice platforms.

Talisman has discussed potential impacts on instrument approach procedures for helicopters operating to the Beatrice Platforms with its helicopter contractors – currently Bristow Helicopters. The existence of vertical obstacles in the vicinity of the helidecks of offshore platforms is not new and there are many examples in the North Sea of multi-platform fields where instrument approaches to platforms are constrained in height and/or direction by other platforms and facilities in this vicinity.

Details of the proposed Beatrice Wind Farm Demonstrator Project were forwarded by DAP to National Air Traffic Services (NATS) for comment. Current NATS policy is not to respond to pre-planning consultations on wind farm proposals, but to refer developers to a web-based self-assessment tool to determine whether the proposal is in an area which could interfere with the radar and radio navigation facilities of NATS En Route Ltd (NERL).

Consequently, the NATS assessment tool (www.bwea/com/aviation) was used to ascertain the location of the Beatrice turbines in relation to NATS radar coverage. Figure 12.30 is an excerpt from the NATS map of radar coverage of locations at 140m above sea or ground level, annotated to show the locations of the two WTGs. This shows that both turbines are in the yellow zone, within which “there remains a potential to interfere” with the NERL operational infrastructure, and are just outside the blue area where wind farm developments are “likely to interfere with the operational infrastructure of NERL”. The facility whose coverage is depicted on the map is the NERL radar at Allanshill, near New Aberdour in Aberdeenshire. The boundary of this radar’s coverage, shown immediately to the north-east of the WTGs, is caused by intervening high ground 5-6km north-west of the radar station.

The potential for the NATS Allanshill radar to be able to detect the Beatrice WTGs has been independently assessed using a software tool developed by ATDI Ltd (http://www.atdi.co.uk). This assessment shows that WTG 1 will not be visible because of the intervening terrain referred to above, but that the blade tips of WTG 2 may be visible Figures 12.31 and 12.32. This is counter-intuitive since the path to WTG 2 crosses higher terrain than the path to WTG 1. The results can, however, be regarded as a confirmation of the NATS model which indicates that the WTGs are in an area of marginal visibility from the Allanshill radar.

Formal assessment by NATS of the potential impact of the WTGs on their Allanshill radar will be initiated following submission of the planning application for the Beatrice Demonstrator Wind Farm. This assessment will take account not only of radar visibility but also of the operational significance of any unwanted radar returns in that area, given NATS radar responsibilities for the provision of air traffic radar services in the area.

Pending receipt of a formal assessment by NATS, an independent analysis was undertaken of the likely operational significance of the WTGs being visible on the Allanshill radar. This has concluded that the only aircraft in that area likely to be receiving a service from Aberdeen or Scottish Area Control Centre (ScACC) controllers using the Allanshill radar are helicopters routing between the Beatrice Alpha platform and Aberdeen. The normal practice is for these aircraft to receive a service from RAF Lossiemouth until coasting in at Banff, then to transfer to Aberdeen radar. Aberdeen or ScACC controllers would not, therefore, be providing a service to these aircraft when in the vicinity of the Beatrice WTGs. In addition, the Beatrice WTGs will be located more than five nautical miles from air routes W4D and HMR X-ray, on which radar services are provided by ScACC using the Allanshill radar. This is sufficiently far away to eliminate any effects on radar services

Figure 12.30 NATS wind farm safeguarding in the Moray Firth.

The Demonstrator site is well beyond the 10km radius safeguarding consultation zones around any NATS radio navigation facilities in the region (shown on Figure 12.30 as blue circles around Inverness and Wick airports).

There are currently no other air traffic control radars in the area with the potential to be affected by the Beatrice Wind Farm Demonstrator Project. Highlands and Islands Airports Limited (HIAL), operators of Inverness Airport, are expected to install a new radar near Inverness Airport in the next few years. The commissioning of this radar is likely to post-date the construction of the Beatrice WTGs and although any new radar may be capable of detecting the WTGs, controllers at Inverness are unlikely to be providing radar services to traffic in this area. Consequently, any radar visibility is unlikely to be of operational significance.

Figure 12.31 Radar path profile from NATS Allanshill radar to blade tips of Beatrice Demonstrator WTG 1.

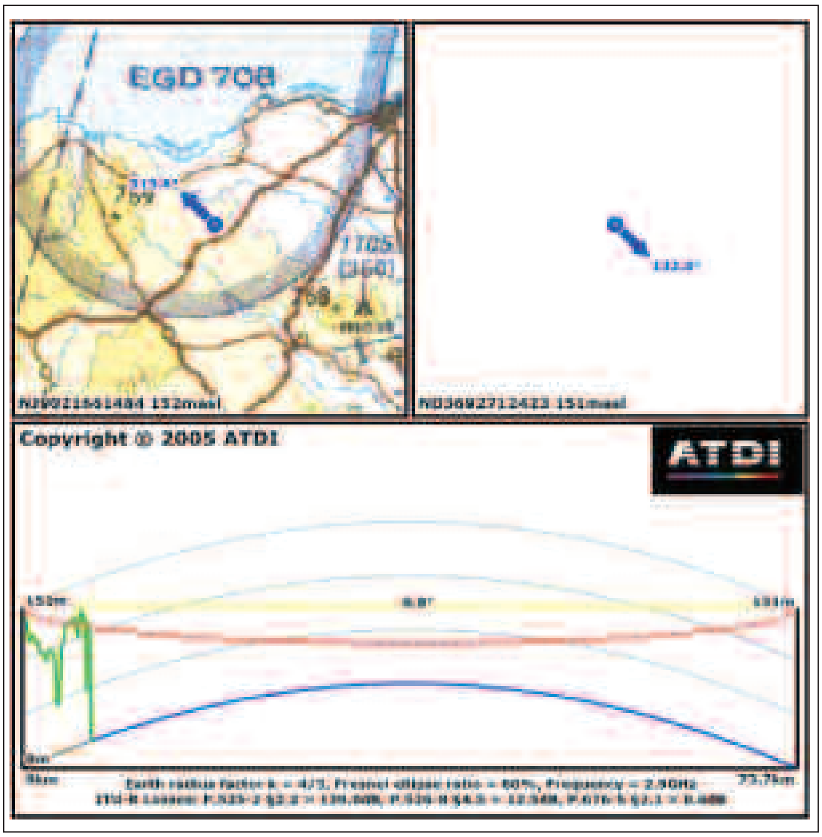
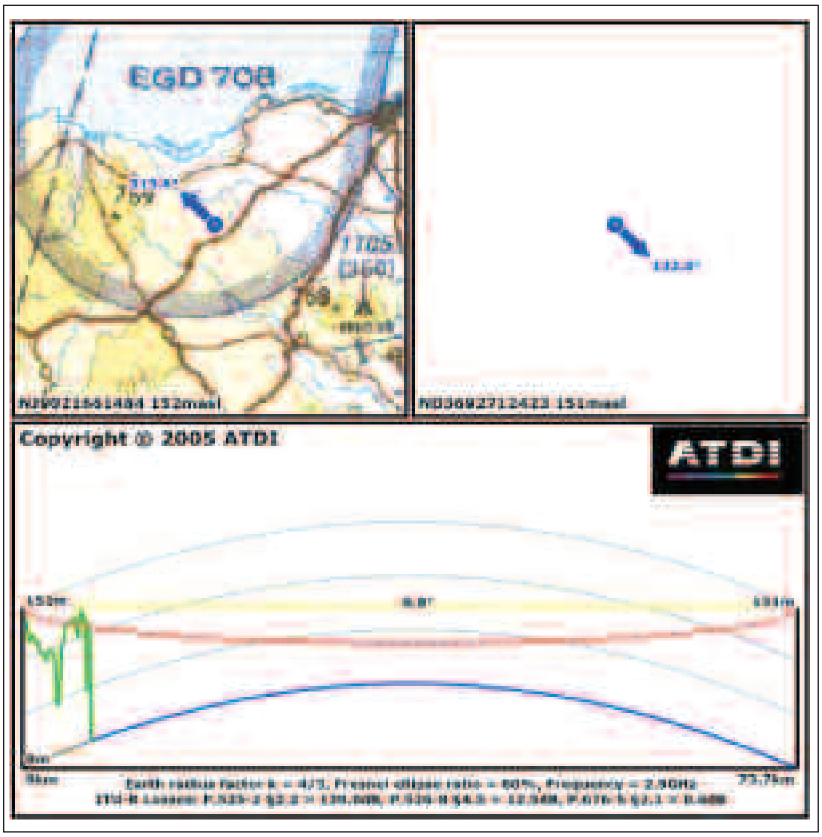


Figure 12.32 Radar path profile from NATS Allanshill radar to blade tips of Beatrice Demonstrator WTG 2.



12.3.4 SUMMARY AND CONCLUSIONS

There are no known telecommunications facilities with the potential to be affected by the development, and television reception will not be affected.

No potential impacts on aviation have been identified other than possible restrictions on existing instrument approach procedures for helicopters to the Beatrice platforms. The WTGs may be marginally visible from the NATS Allanshill radar, but this is not expected to be of any operational significance. A new radar planned for Inverness Airport may be able to detect the Beatrice WTGs, but this is not expected to be of operational significance.

12.3.5 MITIGATION PROPOSED

In view of the results of the assessment for potential effects on telecommunications and aviation, Talisman do not propose to undertake any additional mitigation measures. The provisions for lighting the WTGs is described in Section 3.

12.3.6 FURTHER STUDIES DURING THE DEMONSTRATOR PHASE

No further studies on potential effects on telecommunications and aviation are planned.

12.4 EFFECTS ON OFFSHORE OIL AND GAS ACTIVITIES

The activities to install the WTGs and umbilicals, and the operation of the WTGs within the Beatrice field, will have no effect on the operations of any other oil or gas development in the Moray Firth or central North Sea.

12.5 EFFECTS ON MOD ACTIVITIES

Sites of interest to the MOD were shown in Section 4.12.2. The Demonstrator site does not lie within any active site. The activities to install the WTGs and umbilicals, and the operation of the WTGs within the Beatrice field, will have no effect on MOD sites or activities. Indeed, Talisman has an active working relationship with the MOD regarding the use of Beatrice facilities both now, and at future stages of the possible decommissioning programme for Beatrice.

12.6 EFFECTS ON ARCHAEOLOGICAL SITES

There are no known sites of archaeological interest in the area of the Demonstrator Project.

12.7 EFFECTS ON TOURISM AND LEISURE

The Demonstrator site is 24km from the coast, and is little used at present for tourism or recreation.

Onshore activities at the assembly site may well be of interest to locals and visitors alike, but once the WTGs are located at the Demonstrator site, where they will appear as very small objects on the far horizon, it is likely that they will stimulate little long-term interest from those onshore. Conversely, their visual impact in the Moray Firth will be so small that they are extremely unlikely to be considered to be detrimental to the overall beauty and wildness of the Firth, and its landscapes and seascapes.

The Demonstrator Project is, therefore, unlikely to have any effects, positive or negative, on tourism or leisure.

13 Effects on Special Areas of Conservation and Special Protection Areas

13 EFFECTS ON SPECIAL AREAS OF CONSERVATION AND SPECIAL PROTECTION AREAS

13.1 INTRODUCTION

To comply with the Habitats Directive (Article 6.2) it is the obligation of Member States to ensure within Natura sites (SPA and SAC) that appropriate steps are taken to avoid deterioration of habitats, and habitats of species, as well as significant disturbance of species. As part of this process, new plans and projects require to be assessed with respect to a Natura site's conservation objectives, to determine if it might adversely affect the integrity of the site. Article 2.2 of the Habitats Directive requires that measures taken should be designed to maintain or restore natural habitats and species at Favourable Conservation Status (FCS). Article 3.1 indicates that the network of Natura sites should enable FCS to be maintained or restored. Achieving the obligations of Article 6.2 an individual site will thus contribute to the fulfilment of the wider aims of Articles 2.2 and 3.1 to achieve FCS for Annex I Habitats and Annex II Species (SNH guidance Document, 2000).

The consideration as to whether a proposed project or development may affect a Natura 2000 site has two important stages. The first is an appraisal as to whether the proposal is "likely to have a significant effect on the site", and the second is a consideration as to whether the proposal will adversely affect the integrity of the site. Guidance notes (SNH, 2000) define a likely significant effect as "any effect that may reasonably be predicted as a consequence of a proposal that may affect the qualifying interests, but excluding trivial or inconsequential effects". This test of significance is a coarse filter intended to identify which proposed plans and projects require further assessment, and it is distinct from the subsequent appropriate assessment of adverse effects on the integrity of a site. Guidance notes stress that the importance of the international conservation interest of the site should be at the forefront of decision-making.

The environmental assessment has indicated that some of the activities associated with the installation and operation of the WTGs at the Demonstrator site might affect some of the qualifying features of SACs and SPAs in the Moray Firth, and thus their integrity. The proposed Demonstrator Project is therefore likely to have a significant effect on one or more of these sites. Drawing on information and assessments presented in other parts of the ES, this section, therefore, concentrates on the second stage described above, and examines whether the proposed project might affect the conservation objectives of any of these sites.

The section is laid out as follows:

- *a summary of the method and definitions used to assess the implications of the Demonstrator Project on the integrity of each site*
- *a table listing the SACs and SPAs in the Moray Firth, indicating which of the activities or operations associated with the Demonstrator site might give rise to significant effects, and indicating which of the qualifying interest(s) of the site might be affected*
- *an assessment of whether the potential effects of the Demonstrator Project on the qualifying interest(s) for each site might result in an adverse effect on the integrity of the site.*

13.2 METHOD AND DEFINITIONS USED TO ASSESS IMPLICATIONS FOR EACH SITE'S INTEGRITY

13.2.1 DEFINITIONS OF KEY TERMS

The conservation objectives of a site are defined as "the reasons for which the site was classified", and the integrity of a site is "the coherence of its ecological structure and function, across its whole area, which enables it to sustain the habitat, complex of habitats and/or levels of populations of species for which it was classified" (SE Circular 6/95, as amended). The integrity of the site only applies to the qualifying features, and is directly linked to the conservation objectives for the site. This means that there is also a direct link to the obligation in Article 6.2 to avoid deterioration to natural habitats and significant disturbance of species. If the conservation objectives are met, then the integrity of the site will be maintained and deterioration of habitat or habitat of species or significant disturbance of species avoided (SNH Guidance document, 2000).

13.2.2 METHOD

From the above guidance it is clear that if the conservation objectives for which a Natura site was classified can be met, then the integrity of the site will not be adversely affected. Talisman has, therefore, undertaken a review of the conservation objectives of each of the Natura sites in the Moray Firth that could reasonably be expected to be potentially exposed to adverse effects from the Demonstrator Project, in order to determine if the integrity of any site might be affected.

SNH Guidance (2000) offers checklists with which to consider potential impacts on the integrity of a site, and these are summarised in Table 13.1.

Table 13.1 Checklist of elements for construction of conservation objectives and consideration of impact upon integrity (SNH, 2000).

Annex I Habitats Conservation Objectives: To avoid deterioration of the qualifying habitat(s) thus ensuring the integrity of the site is maintained and the site makes an appropriate contribution to achieving FCS for each of the qualifying features.

To ensure for the qualifying habitat(s) that the following are maintained in the long term:

- *extent of the habitat on site*
- *distribution of the habitat within the site*
- *structure and function of the habitat*
- *processes supporting the habitat*
- *distribution of typical species of the habitat*
- *viability of typical species as components of the habitat*
- *no significant disturbance of typical species of the habitat*

Annex II Species Conservation Objectives: To avoid deterioration of the qualifying habitat(s) thus ensuring the integrity of the site is maintained and the site makes an appropriate contribution to achieving FCS for each of the qualifying features.

To ensure for the qualifying habitat(s) that the following are maintained in the long term:

- *population of the species (including range of genetic types where relevant) as a viable component of the site*
- *distribution of species within site*
- *distribution and extent of habitats supporting the species*
- *structure, function and supporting process of habitats supporting the species*
- *no significant disturbance of species distribution and viability of species' host species (where relevant)*
- *structure, function and supporting processes of habitats supporting the species' host species (where relevant)*

Bird Species Conservation Objectives: To avoid deterioration of the habitats of the qualifying species or significant disturbance to the qualifying species, thus ensuring that the integrity of the site is maintained.

To ensure for the qualifying species that the following are maintained in the long term:

- *population of the species as a viable component of the site*
- *distribution of the species within the site*
- *distribution and extent of habitats supporting the species*
- *structure, function and supporting process of habitats supporting the species*
- *no significant disturbance of the species*

The potential effects of the Demonstrator Project on the qualifying features of SACs and SPAs in the Moray Firth were assessed in light of this guidance. The results of this assessment are presented in a series of tables, one for each SAC and SPA. For each SAC and SPA Talisman has:

- *prepared a table identifying if the project would affect any of the measures by which the integrity of the species or feature is judged*
- *highlighted any aspect of the project that might cause such an effect*
- *summarised the mitigation measures that would be put in place.*

13.3 OVERALL CONCLUSION

On the basis of the quantitative assessments of potential impact presented in Sections 7-12 of the environmental statement, and bearing in mind the range of mitigation measures that will be enacted by Talisman, Talisman conclude that the installation and operation of the propose WTGs at the Demonstrator site in the Beatrice field will not affect the viability or integrity of any SAC or SPA in the Moray Firth.

Assessment of potential impacts on conservation objectives of Moray Firth SAC, with regards to effects on integrity of Annex II species

Conservation objective of site: To maintain and protect the Moray Firth to ensure that conditions for a healthy dolphin population are in place. The management of activities or developments in the area is paramount and must consider the well-being of the dolphins and the condition of their habitat when they carry out work (summary from http://www.anglersnet.co.uk/sacn/release04.htm;
http://www.jncc.gov.uk/protectedsites/sacselection/sac.asp?EUCode=UK0019808)

1. Overview

	Potential effects on measures used to judge implications for integrity of the species				
Qualifying species	**On viability of species**	**On distribution of species**	**On supporting habitats**	**On supporting processes**	**Disturbance of species**
Primary qualifying species					
Bottlenose dolphin	None	None	None	None	Very localised and temporary
Other qualifying species present					
There are no Annex II qualifying species present that are not a primary reason for site selection					

2. Potential effect

Underwater noise from piling (two hours per pile, eight piles) may disturb any bottlenose dolphins within about 2km of the site (Section 9). Levels that might cause temporary changes to hearing ability would only be found within 1km of site.

3. Mitigation measures

Talisman is investigating physical means to reduce piling source noise. Talisman will adhere to JNCC guidance for underwater noise from seismic operations (Section 9), including use of MMOs, soft-starts, and passive acoustic monitoring.

4. Conclusion

The viability and integrity of the bottlenose dolphin in the Moray Firth will not be adversely affected by the proposed piling operations, which will be of very short duration. Significantly elevated noise levels will not reach the boundary of the Moray Firth SAC. From best available information, the numbers of individual bottlenose dolphin frequenting the area of the Demonstrator Project, and that might thus be exposed to noise levels that cause an avoidance reaction (swimming away) will be low (Section 4).

Assessment of potential impacts on conservation objectives of Moray Firth SAC, with regards to effects on integrity of Annex I habitats

Conservation objective of site: To protect the habitat structure, function and biological components of the sublittoral sandbanks in the Moray Firth.

1. Overview

	Potential effects on measures used to judge implications for integrity of the species						
Qualifying habitats	**On extent of site**	**On distribution of habitats**	**On structure and function of habitat**	**On supporting processes**	**Distribution of typical species**	**Viability of typical species as components of habitat**	**Disturbance of species**
Primary							
There are no Annex I habitats that are a primary reason for selection of this site							
Other qualifying habitats present							
Sandbanks	None	None	None	None	None	None	None

2. Potential effect

The Demonstrator Project may cause some very localised and temporary disturbance to clean sandy sediments at the Demonstrator site, but any affected benthic communities will quickly recover.

3. Mitigation measures

No additional mitigation measures are required.

4. Conclusion

The Demonstrator Project will not affect nearshore sandbanks in the Moray Firth.

Assessment of potential impacts on conservation objectives of Dornoch Firth and Morrich More SAC, with regards to effects on integrity of Annex II species

Conservation objective of site: To protect the only east coast estuarine population of otters and the common seal population. The Dornoch Firth is the most northerly large estuary in Britain and supports a significant proportion of the Inner Moray Firth population of the common seal.

1. Overview

	Potential effects on measures used to judge implications for integrity of the species				
Qualifying species	**On viability of species**	**On distribution of species**	**On supporting habitats**	**On supporting processes**	**Disturbance of species**
Primary					
Otter Common seal	None None	None None	None None	None None	None Very localised and temporary
Other qualifying species present					
There are no Annex II qualifying species present that are not a primary reason for site selection					

2. Potential effect

Underwater noise from piling may disturb some individual seals within 7km of the site and result in an avoidance reaction. Piling operations will be of short duration (two to eight hours per pile, eight piles in total).

3. Mitigation measures

Talisman will adopt JNCC guidelines for minimising effects of noise. Measures to reduce source noise level are being investigated. Marine mammal observers will be present through operations. Visual and passive acoustic monitoring will be used to detect presence of cetaceans and seals. Soft-start techniques will be used. Piling will only start during daylight hours.

4. Conclusion

The viability and integrity of the common seal population in the Moray Firth will not be adversely affected by the proposed piling operations, which will be of very short duration. Significantly elevated noise levels will not reach the boundary of the Moray Firth SAC. From best available information, the numbers of individual common seal frequenting the area of the Demonstrator Project, and that might thus be exposed to noise levels that cause an avoidance reaction (swimming away) will be low (Section 4).

Assessment of potential impacts on conservation objectives of Dornoch Firth and Morrich More SAC, with regards to effects on integrity of Annex I habitats

Conservation objective of site: To protect and sustain the habitat structure, function and biological components of the habitats identified in the table below. The Dornoch Firth is a complex estuarine system, encompassing extensive sandflats and mudflats. The adjacent Morrich More contains an extensive range of dune ecosystems.

1. Overview

	Potential effects on measures used to judge implications for integrity of the species						
Qualifying habitats	**On extent of site**	**On distribution of habitats**	**On structure and function of habitat**	**On supporting processes**	**Distribution of typical species**	**Viability of typical species as components of habitat**	**Disturbance of species**
Primary							
Estuaries	None	None	None	None	None	None	None
Mudflats and sandflats	None	None	None	None	None	None	None
Salicornia and other colonising annuals	None	None	None	None	None	None	None
Atlantic salt meadows	None	None	None	None	None	None	None
Embryonic shifting dunes	None	None	None	None	None	None	None
White dunes	None	None	None	None	None	None	None
Grey dunes	None	None	None	None	None	None	None
Decalcified fixed dunes	None	None	None	None	None	None	None
Atlantic decalcified fixed dunes	None	None	None	None	None	None	None
Humid dune slacks	None	None	None	None	None	None	None
Coastal dunes with *Juniperus spp.*	None	None	None	None	None	None	None
Other qualifying habitats present							
Sandbanks	None	None	None	None	None	None	None
Reefs	None	None	None	None	None	None	None

2. Potential effect

The Demonstrator Project may cause some very localised and temporary disturbance to clean sandy sediments at the Demonstrator site, but any affected benthic communities will quickly recover. The Demonstrator Project will not affect nearshore or coastal sandbanks in the Moray Firth.

3. Mitigation measures

No additional mitigation measures are required.

4. Conclusion

The integrity of the SAC will not be affected. The project will not affect any of these coastal habitats. There are no reefs of *Modiolus modiolus* at the site (Section 4).

Assessment of potential impacts on conservation objectives of Berriedale and Langley Waters SAC, with regards to effects on integrity of Annex II species

Conservation objective of site: To protect and sustain the small, but high-quality salmon *Salmo salar* populations. The rivers have two separate catchments, but share a short length of river just before they meet the sea. Both rivers are oligotrophic, draining the southern edge of the Caithness and Sutherland peatlands, and show only limited ecological variation along their length. Whilst they are comparatively small rivers and support only a small proportion of the Scottish salmon resource, their long history of low management intervention means that they score highly for naturalness. Recent records indicate that the full range of Atlantic salmon life-history types return to the river, with grilse, spring and summer salmon all being caught.

1. Overview

	Potential effects on measures used to judge implications for integrity of the species				
Qualifying species	**On viability of species**	**On distribution of species**	**On supporting habitats**	**On supporting processes**	**Disturbance of species**
Primary					
Atlantic salmon	None	None	None	None	None
Other qualifying species present					
There are no Annex II qualifying species present that are not a primary reason for site selection					

2. Potential effect

Underwater noise from piling may cause localised disturbance to salmon within about 2km of the site but this will be temporary.

3. Mitigation measures

Talisman is investigating physical measures that could be used to further reduce the source noise level from piling operations.

4. Conclusion

The integrity of the SAC will not be affected.

Assessment of potential impacts on conservation objectives of River Spey SAC, with regards to effects on integrity of Annex II species

Conservation objective of site: To protect the river system from pollution and other adverse impact on the river ecosystem to safeguard the populations of important species. The River Spey supports an outstanding freshwater pearl mussel population. In parts of the River Spey, extremely dense mussel colonies are supported, and the total population is estimated at several million. The population also shows evidence of recent recruitment and a high proportion of juveniles, and therefore the population is considered to be of great international significance. Due to its good water quality, clean gravels and marginal silts and unhindered migration route to the sea the River Spey also supports the sea lamprey *Petromyzon marinus.* The River Spey also supports one of the largest Atlantic salmon *Salmo salar* populations in Scotland, with little evidence of modification by non-native stocks in addition to one of the most important otter *Lutra lutra* sites in Scotland.

1. Overview

	Potential effects on measures used to judge implications for integrity of the species				
Qualifying species	**On viability of species**	**On distribution of species**	**On supporting habitats**	**On supporting processes**	**Disturbance of species**
Primary					
Freshwater pearl mussel	None	None	None	None	None
Sea lamprey	None	None	None	None	None
Atlantic salmon	None	None	None	None	None
Otter	None	None	None	None	None
Other qualifying species present					
There are no Annex II qualifying species present that are not a primary reason for site selection					

2. Potential effect

Underwater noise from piling may cause localised disturbance to salmon within about 2km of the site but this will be temporary.

3. Mitigation measures

Talisman is investigating physical measures that could be used to further reduce the source noise level from piling operations.

4. Conclusion

The integrity of the SAC will not be affected.

Assessment of potential impacts on conservation objectives of River Oykel SAC, with regards to effects on integrity of Annex II species

Conservation objective of site: To protect the river system from pollution and other adverse impact on the river ecosystem to safeguard the populations of freshwater pearl mussel and Atlantic salmon. The Oykel River supports an excellent, high-quality freshwater pearl mussel population with high densities recorded at some locations, including a bed numbering several thousand individuals. Surveys have also recorded high percentages of juveniles within the population, indicating that there has been recent successful recruitment. There is also evidence of unsurveyed pearl mussel populations in deep water that may increase the conservation importance of the river.

1. Overview

	Potential effects on measures used to judge implications for integrity of the species				
Qualifying species	**On viability of species**	**On distribution of species**	**On supporting habitats**	**On supporting processes**	**Disturbance of species**
Primary					
Freshwater pearl mussel	None	None	None	None	None
Other qualifying species present					
Atlantic salmon	None	None	None	None	None

2. Potential effect

Underwater noise from piling may cause localised disturbance to salmon within about 2km of the site but this will be temporary.

3. Mitigation measures

Talisman is investigating physical measures that could be used to further reduce the source noise level from piling operations.

4. Conclusion

The integrity of the SAC will not be affected.

Assessment of potential impacts on conservation objectives of River Moriston SAC, with regards to effects on integrity of Annex II species

Conservation objective of site: To protect the river system from pollution and other adverse impact on the river ecosystem to safeguard the populations of freshwater pearl mussel and Atlantic salmon. The River Moriston supports a functional freshwater pearl mussel population. Pearl mussels are present from downstream of a hydro-electric dam to the confluence with Loch Ness. Due to illegal pearl-fishing the population is not abundant but survey results show that 40% of the population is composed of juveniles. This is the highest percentage recorded in any Scottish pearl mussel population and indicates that recent successful recruitment has taken place.

1. Overview

	Potential effects on measures used to judge implications for integrity of the species				
Qualifying species	**On viability of species**	**On distribution of species**	**On supporting habitats**	**On supporting processes**	**Disturbance of species**
Primary					
Freshwater pearl mussel	None	None	None	None	None
Other qualifying species present					
Atlantic salmon	None	None	None	None	None

2. Potential effect

Underwater noise from piling may cause localised disturbance to salmon within about 2km of the site but this will be temporary.

3. Mitigation measures

Talisman is investigating physical measures that could be used to further reduce the source noise level from piling operations.

4. Conclusion

The integrity of the SAC will not be affected.

Assessment of potential impacts on conservation objectives of East Caithness Cliffs SPA, with regards to effects on integrity of bird species

Conservation objective of site: To protect the supporting populations of bird species of European importance listed on Annex I of the Bird Directive:

1. Overview

	Potential effects on measures used to judge implications for integrity of the species				
Qualifying bird species (numbers of birds)	**On viability of species**	**On distribution of species**	**On supporting habitats**	**On supporting processes**	**Disturbance of species**
Primary qualification					
Peregrine falcon (6 pairs)	None	None	None	None	None
Guillemot (71,509 pairs)	None	None	None	None	None
Herring gull (9,370 pairs)	None	None	None	None	None
Kittiwake (31,930 pairs)	None	None	None	None	None
Razorbill (9,259 pairs)	None	None	None	None	None
Shag (2,345 pairs)	None	None	None	None	None
Assemblage qualification: a seabird assemblage of international importance including, in addition to the above species					
Fulmar (15,000)	None	None	None	None	None
Great black-backed gull (850)	None	None	None	None	None
Cormorant (144)	None	None	None	None	None
Puffin (1,750)	None	None	None	None	None

2. Potential effect

The WTGs may present a collision risk for some species that are observed at the Demonstrator site (Section 4). Collision risk has been assessed (Section 10) using conservation assumptions. With the exception of great black-backed gulls, additional mortality from the WTGs using a value of 95% avoidance would result in a $<1\%$ increase in the level of natural mortality. The estimated potential increase in mortality for great black-backed gulls (about 2.5% of natural levels of mortality) may be elevated due to the presence in November and December of birds that were not from the local population. Great black-backed gulls are widely dispersed in the North Sea and Moray Firth, and individuals observed at the Demonstrator site will almost certainly have come from other sites, as well as from East Caithness cliffs.

3. Mitigation measures

There are no additional mitigation measures that can be enacted.

4. Conclusion

The integrity of the SPA will not be affected by the siting and operation of the WTGs at the Demonstrator site.

Assessment of potential impacts on conservation objectives of Dornoch Firth and Loch Fleet SPA, with regards to effects on integrity of bird species

Conservation objective of site: To protect the supporting populations of bird species of European importance listed on Annex I of the Bird Directive:

1. Overview

	Potential effects on measures used to judge implications for integrity of the species				
Qualifying bird species (numbers of birds)	**On viability of species**	**On distribution of species**	**On supporting habitats**	**On supporting processes**	**Disturbance of species**
Primary qualification					
Osprey (10 pairs)	None	None	None	None	None
Bar-tailed godwit (1,300)	None	None	None	None	None
Greylag goose (2,079)	None	None	None	None	None
Wigeon (15,304)	None	None	None	None	None
Assemblage qualification: a wetland of international importance including, in addition to the above species					
Curlew (1,368)	None	None	None	None	None
Dunlin (4,462)	None	None	None	None	None
Oystercatcher (3,270)	None	None	None	None	None
Teal (1,462)	None	None	None	None	None

2. Potential effect

Only low numbers of greylag goose, dunlin and teal were observed at the Demonstrator site, but they were not observed flying at the height of the blades. The risk of additional mortalities from collision for all these species is therefore very small. All the other species were not observed at the Demonstrator site during a year-long monitoring programme in 2005.

3. Mitigation measures

There are no additional mitigation measures that can be enacted.

4. Conclusion

The integrity of the SPA will not be affected by the siting and operation of the WTGs at the Demonstrator site.

Assessment of potential impacts on conservation objectives of Loch Eye SPA, with regards to effects on integrity of bird species

Conservation objective of site: To protect the supporting populations of bird species of European importance listed on Annex I of the Bird Directive:

1. Overview

	Potential effects on measures used to judge implications for integrity of the species				
Qualifying bird species (numbers of birds)	**On viability of species**	**On distribution of species**	**On supporting habitats**	**On supporting processes**	**Disturbance of species**
Primary qualification					
Whooper swan (213)	None	None	None	None	None
Greylag goose (11,321)	None	None	None	None	None
Assemblage qualification: No assemblage qualification					

2. Potential effect

Low numbers of greylag goose and whooper swan were observed at the Demonstrator site, but they were not observed flying at the height of the blades. The risk of additional mortalities from collision for both these species is therefore very small.

3. Mitigation measures

There is no additional mitigation measures that can be enacted.

4. Conclusion

The integrity of the SPA will not be affected by the siting and operation of the WTGs at the Demonstrator site.

Assessment of potential impacts on conservation objectives of Cromarty Firth SPA, with regards to effects on integrity of bird species

Conservation objective of site: To protect the supporting populations of bird species of European importance listed on Annex I of the Bird Directive:

1. Overview

	Potential effects on measures used to judge implications for integrity of the species				
Qualifying bird species (numbers of birds)	**On viability of species**	**On distribution of species**	**On supporting habitats**	**On supporting processes**	**Disturbance of species**
Primary qualification					
Common tern (294 pairs)	None	None	None	None	None
Osprey (1 pair)	None	None	None	None	None
Bar-tailed godwit (1,420)	None	None	None	None	None
Whooper swan (55)	None	None	None	None	None
Greylag goose (1,777)	None	None	None	None	None
Assemblage qualification: a wetland of international importance including, in addition to the above species					
Wigeon (10,476)	None	None	None	None	None
Redshank (1,324)	None	None	None	None	None
Red breasted merganser (194)	None	None	None	None	None
Scaup (302)	None	None	None	None	None
Curlew (1,475)	None	None	None	None	None
Dunlin (3,384)	None	None	None	None	None
Knot (3,078)	None	None	None	None	None
Oystercatcher (2,509)	None	None	None	None	None
Pintail (226)	None	None	None	None	None

2. Potential effect

Tern sp., whooper swan, greylag goose, and dunlin were observed in low or very low numbers at the Demonstrator site, but none was observed flying at the height of the blades. The additional mortalities from collisions for tern sp. is estimated to represent about 0.7% of natural mortality rates (Section 10). The risk to other species from collision will be very small.

3. Mitigation measures

There are no additional mitigation measures that can be enacted.

4. Conclusion

The integrity of the SPA will not be affected by the siting and operation of the WTGs at the Demonstrator site.

Assessment of potential impacts on conservation objectives of Inner Moray Firth SPA, with regards to effects on integrity of bird species

<u>Conservation objective of site:</u> To protect the supporting populations of bird species of European importance listed on Annex I of the Bird Directive:

1. Overview

	Potential effects on measures used to judge implications for integrity of the species				
Qualifying bird species (numbers of birds)	**On viability of species**	**On distribution of species**	**On supporting habitats**	**On supporting processes**	**Disturbance of species**
Primary qualification					
Common tern (310 pairs)	None	None	None	None	None
Osprey (4 pair)	None	None	None	None	None
Bar-tailed godwit (1,155)	None	None	None	None	None
Greylag goose (1,731)	None	None	None	None	None
Red breasted merganser (1,731)	None	None	None	None	None
Redshank (1,811)	None	None	None	None	None
Scaup (97)	None	None	None	None	None
Assemblage qualification: a wetland of international importance including, in addition to the above species					
Wigeon (6,800)	None	None	None	None	None
Oystercatcher (3,063)	None	None	None	None	None
Curlew (1,337)	None	None	None	None	None
Teal (1,849)	None	None	None	None	None
Goosander (397)	None	None	None	None	None
Goldeneye (199)	None	None	None	None	None
Cormorant (418)	None	None	None	None	None

2. Potential effect

Tern sp., greylag goose, teal, and cormorant were observed in low or very low numbers at the Demonstrator site, but only teal was observed flying at the height of the blades. The additional mortalities from collisions for tern sp. is estimated to represent about 0.7% of natural mortality rates (Section 10). The risk to other species from collision will be very small.

3. Mitigation measures

There are no additional mitigation measures that can be enacted.

4. Conclusion

The integrity of the SPA will not be affected by the siting and operation of the WTGs at the Demonstrator site.

Assessment of potential impacts on conservation objectives of Moray and Nairn Coast SPA, with regards to effects on integrity of bird species

Conservation objective of site: To protect the supporting populations of bird species of European importance listed on Annex I of the Bird Directive:

1. Overview

	Potential effects on measures used to judge implications for integrity of the species				
Qualifying bird species (numbers of birds)	**On viability of species**	**On distribution of species**	**On supporting habitats**	**On supporting processes**	**Disturbance of species**
Primary qualification					
Osprey (7 pairs)	None	None	None	None	None
Bar-tailed godwit (1,156)	None	None	None	None	None
Greylag goose (2,679)	None	None	None	None	None
Pink-footed goose (139)	None	None	None	None	None
Redshank (1,690)	None	None	None	None	None
Assemblage qualification: a wetland of international importance including, in addition to the above species					
Wigeon (2,600)	None	None	None	None	None
Red-breasted merganser (216)	None	None	None	None	None
Oystercatcher (2,171)	None	None	None	None	None
Dunlin (2,689)	None	None	None	None	None
Velvet scoter (133)	None	None	None	None	None
Common scoter (531)	None	None	None	None	None
Long-tailed duck (277)	None	None	None	None	None

2. Potential effect

Greylag goose and dunlin were observed in very low numbers at the Demonstrator site, but they were not observed flying at the height of the blades. The risk to these species from collision will be very small.

3. Mitigation measures

There are no additional mitigation measures that can be enacted.

4. Conclusion

The integrity of the SPA will not be affected by the siting and operation of the WTGs at the Demonstrator site.

Assessment of potential impacts on conservation objectives of Loch Spynie SPA, with regards to effects on integrity of bird species

Conservation objective of site: To protect the supporting populations of bird species of European importance listed on Annex I of the Bird Directive:

1. Overview

	Potential effects on measures used to judge implications for integrity of the species				
Qualifying bird species (numbers of birds)	**On viability of species**	**On distribution of species**	**On supporting habitats**	**On supporting processes**	**Disturbance of species**
Primary qualification					
Greylag goose (3,360)	None	None	None	None	None
Assemblage qualification: No assemblage qualification					

2. Potential effect

Very low numbers of greylag goose were observed at the Demonstrator site, and individuals were not observed flying at the height of the blades. The potential for additional mortalities due to collision will therefore be very small.

3. Mitigation measures

There is no additional mitigation measures that can be enacted.

4. Conclusion

The integrity of the SPA will not be affected by the siting and operation of the WTGs at the Demonstrator site.

Assessment of potential impacts on conservation objectives of Troup, Pennan and Lion's Head SPA, with regards to effects on integrity of bird species

Conservation objective of site: To protect the supporting populations of bird species of European importance listed on Annex I of the Bird Directive:

1. Overview

	Potential effects on measures used to judge implications for integrity of the species				
Qualifying bird species (numbers of birds)	**On viability of species**	**On distribution of species**	**On supporting habitats**	**On supporting processes**	**Disturbance of species**
Primary qualification					
Kittiwake (31,660)	None	None	None	None	None
Fulmar (4,400)	None	None	None	None	None
Guillemot (29,902)	None	None	None	None	None
Herring gull (4,200)	None	None	None	None	None
Razorbill (3,216)	None	None	None	None	None
Assemblage qualification: a seabird assemblage of international importance including all the above species					

2. Potential effect

With the exception of razorbill and guillemot, all these species were observed at the Demonstrator site. However, only herring gull and kittiwake were observed flying at the height of the blades. It was estimated that the additional mortality for herring gull from collisions would be about 0.3% of the natural mortality (Section 10). Herring gulls are widely dispersed in the North Sea and Moray Firth, and individuals observed at the Demonstrator site will almost certainly have come from other sites, as well as from Troup, Pennan and Lion's Head. The additional mortality for kittiwake from collisions would be about 0.2% of the natural mortality rate (Section 10). For the other species, the potential for additional mortalities due to collision will be very small.

3. Mitigation measures

There are no additional mitigation measures that can be enacted.

4. Conclusion

The integrity of the SPA will not be affected by the siting and operation of the WTGs at the Demonstrator site.

14 Environmental Management

14 ENVIRONMENTAL MANAGEMENT

14.1 INTRODUCTION

The installation of the Beatrice Demonstrator WTGs, and their operation, would be managed within the context of Talisman's existing environmental policy and management system.

This section:

- *summarises the important elements of this policy and system*
- *outlines some of the measures that will be incorporated in the project-specific environmental management plan*
- *identifies some of the ongoing monitoring and survey programmes that will be conducted during the installation and operational periods.*

14.2 TALISMAN COMPANY POLICY

A copy of Talisman's Safety, Health and Environmental Policy is provided in Appendix 1, which underlines Talisman's commitment to protect the environment by working to minimise the impact of its activities. The company aims for continuous improvement in environmental performance through effective project planning and implementation, emission reduction, waste minimisation, waste management, and energy conservation.

The key aims of Talisman's Safety, Health and Environmental Policy are to:

- *provide the necessary training*
- *follow the relevant standards*
- *conduct hazard and risk assessments to identify and manage any present or future risks in company operations*
- *develop systems of work which are safe and free from risks to the environment and comply with regulations*
- *ensure compliance through audits and inspections*
- *manage emissions and discharges, and eliminate unnecessary waste.*

14.3 POLICY IMPLEMENTATION AND ENVIRONMENTAL MANAGEMENT SYSTEMS

The Board of Talisman Energy Inc sets the overall Policy, which applies to all the company's activities worldwide and to the whole workforce. The Vice President of Talisman Energy (UK) Limited and the Executive Vice-President, International Operations, are responsible for ensuring that this Policy is properly implemented and resourced in the UK. Line management have the primary responsibility for complying with this Policy and to communicate it to their workforce. The responsibilities of key staff are laid out in the Talisman Energy (UK) Policy on SH&E (Talisman, 2002). Talisman's environmental management system is an integral part of the Safety, Health and Environment Management System is based around 12 key elements (Figure 14.1).

Figure 14.1 Talisman's SH&E management system and principles.

Principle 12, which covers Environmental Management, highlights:

- *who is involved in environmental management*
- *key controls, such as auditing, environmental reviews and action tracking*
- *key processes, such as environmental impact assessments and monitoring*
- *relevant documents, such as Talisman's SH&E Policy, audit reports and Environmental Statements*
- *typical performance measures, such as the number of audits carried out, the number of new measures introduced to minimise environmental impact and the number of actions to support local community organisations.*

For each of the key elements, there is a series of given SH&E practices supported by platform- or rig-specific practices and procedures as appropriate.

Responsibility for implementation of Talisman's environmental policy in the North Sea lies principally with the Environmental Officer. Each offshore operation reports chemical usage, oil-in-water returns, flaring, cuttings and other drilling discharges to the appropriate staff, who in turn submit relevant reports to the DTI and Scopec. It is the Environmental Officer's responsibility to ensure that this is carried out collectively and in a timely manner.

14.4 PROJECT-SPECIFIC ENVIRONMENTAL MANAGEMENT

The ES will be used as a management tool throughout the project implementation stage of the Beatrice Demonstrator Project to ensure good environmental performance. Careful tracking of any issues raised will be carried out through the use of an action-tracking database.

Project-specific procedures will be in place for a number of operations during the installation phase. This project environmental management plan is currently being developed, and as indicated in several sections of this ES it will include the following safeguards:

- *liaison with fishing organisations and fishermen, to ensure that they are aware of pending offshore operations*
- *publication of proposed WTG positions and pending operations, in "Notices to mariners"*
- *written, agreed protocols for reducing the possible exposure of marine mammals to loud noise from piling operations*
- *the provision of marine mammal observers throughout piling operations*
- *the use of passive acoustic monitoring (PAM) prior to piling operations, to help confirm the absence of marine mammals in immediate area before operations begin*
- *a code of conduct for the use of small craft during installation and subsequent maintenance and monitoring excursions, to minimise potential harm to marine mammals in the area, and those that might visit the WTGs once in place*
- *an amendment to the existing Beatrice oil spill contingency plan, to cover the installation operations for the WTGs*
- *providing or ensuring that all offshore personnel involved in the offshore installation operations have an appropriate level of environmental awareness training*
- *ensuring that vessels chartered for offshore operations meet Talisman's required environmental standards, and in particular have the necessary on-board equipment for identifying, segregating, storing and handling refuse and waste, and for dealing with small spills of hydrocarbons.*

14.5 INTERFACE WITH CONTRACTORS

For the purposes of managing the potential environmental effects of the offshore operations to install and commission the WTGs and umbilicals, Talisman will put in place "bridging documents" with each of the prime contractors. These essentially ensure that the environmental performance of the contractors meets the level and standard required by Talisman; they help to align the contractors' environmental management systems with Talisman's. The bridging documents will lay out the management structure and division of responsibilities, the methodology for execution of the work programme, and the emergency response procedures. The contractors' management systems are the primary management control on-board the vessels and other contractors' safety management systems will be consistent with that control.

14.6 SUMMARY OF ONGOING MONITORING PROGRAMME

14.6.1 INTRODUCTION

Talisman is committed to the continuing monitoring and investigation of the Moray Firth and the Beatrice area. Discussions have been ongoing with the University of Aberdeen Lighthouse Research Station to design a research programme for 2006. The studies currently under consideration are summarised below.

14.6.2 BIRD RADAR

The auto-tracking system in the present system installed on Beatrice Alpha is limiting data collection, and has had some problems tracking birds as they are too small for the standard shipping software tracking system to register them. Although this has resulted in some limitations to the useful data produced from the present system, there are options for improvement: The favoured option is a software package that will help reduce the amount of "clutter" within the readings and enable tracking of very small targets. It is hoped to trial this software over the installation period.

14.6.3 PLATFORM-BASED ORNITHOLOGICAL SURVEYS

Talisman is committed to continuing the ornithological surveys from the existing Beatrice AP platform. Plans are being developed to enhance the information obtained from the surveys, including undertaking transect surveys by boat through the site after the WTGs have been installed. This would provide data on bird density, behaviour and flight height in relation to the operating WTGs.

14.6.4 BOAT-BASED ORNITHOLOGICAL AND MARINE BIOLOGICAL SURVEYS

Boat-based surveys are being planned for 2006, and are likely to take place in the period April to June. Discussions are continuing to finalise the structure of these offshore programmes in order to make the most of the time spent at sea. At present, it is suggested that the programme includes:

- *gathering data on bird use of the site (as described above) by running transects through the Demonstrator site and a control site. This should help overcome the patchiness of the data in terms of area and time*
- *visiting the locations of the TPODS, to check their status and also undertake corresponding visual confirmations of the species in the area to aid distinguishing the vocal trains recorded by the TPODS*
- *deploying CTD to examine the oceanographic environment on a smaller scale*
- *undertaking underwater video sampling, to obtain data on the presence and density of fish.*

These plans would be able to produce both point sampling and transect data for cetaceans, birds, underwater noise and oceanographic data.

Glossary and Abbreviations

GLOSSARY AND ABBREVIATIONS

GLOSSARY

TERM	DEFINITION
AD platform	Beatrice Alpha Drilling platform
Anadromous	Species of fish that migrate from the sea to freshwater to spawn, e.g. salmon
Anode	See sacrificial anode
AP platform	Beatrice Alpha Production platform
B platform	Beatrice Bravo platform
Benthos	The communities of plants and animals living on and in the seabed
Bivavle	The common name for the group of molluscs with two hinged shells (e.g. the mussel)
Cathodic protection	Electro-chemical techniques used to protect steel structures against corrosion
Cephalopod	Marine mollusc characterised by well-developed head and eyes and sucker-bearing tentacles, e.g. octopus and cuttlefish
Cetaceans	The collective name for all whales, dolphins and porpoises
Cuttings	The small fragments of rock produced when wells are drilled
Determination Boundary	The boundary of the licence area within which the Beatrice field is located
Diadromous	Species of fish that spend part of their lives in freshwater, and part in seawater
Epifauna	The collective name for all animals living on the surface of the seabed
Elasmobranchs	Fish with a skeleton made of cartilage, rather than bone
Eulittoral	The shore between the high and low tide levels
Fauna	The collective name for all animals
Hydroids	Types of colonial animals that grow attached to hard surfaces on the seabed

TERM	DEFINITION
ICES Rectangle	Sea area of 30 minutes latitude by one-degree (60 minutes) longitude used in the UK and internationally to record fisheries statistics such as catch and effort
Infauna	The collective name for all animals living in the sediments of the seabed
Jacket	The supporting structure fixed to the seabed which carries the topsides of oil and gas platforms
Macrobenthos	The collective name for large animals living on or in the seabed
Mariculture	The commercial growing of marine organisms (fish and shellfish) in the sea
Mattresses	Flexible mats made out of 10-30 concrete “tiles” linked by strong rope or steel wire. Each mattress measures about 6m x 3m x 0.15m. They are used to anchor and protect pipelines and other seabed facilities
Molluscs	Invertebrate having a soft unsegmented body usually enclosed in a shell
Mudmats	Large flat horizontal steel plates, which help to spread the load of the jacket onto the seabed and also provide temporary stability prior to piling
Mysticetes	The baleen whales
Nacelle	The part of the WTG located on top of the tower that houses the turbine for generating electricity from the rotation of the blades
Odontocetes	The toothed whales
Oil based mud	A type of fluid used to lubricate the drill bit and help return cuttings to the platform
Patrol	An SFPA patrol within a specific ICES Rectangle where details on all fishing vessels within the Rectangle at that time are logged by surveillance aeroplane and/or patrol vessel
Phytoplankton	The collective name for all the microscopic plants that float in the water column
Piling	The process of driving the steel piles into the seabed to fix the substructure in place

TERM	DEFINITION
Pile sleeve	Strong steel tubes fixed to the outside of the jacket at the base of each leg. They guide and hold the piles, and provide a link between the piles and the jacket so that it can be fixed firmly to the seabed
Pinnipeds	Collective name for all seals and walrus
Plankton	Plankton consists of plants (phytoplankton) and animals (zooplankton) which live freely in the water column and drift with the currents. The plankton forms the basis of the marine ecosystem, representing a fundamental part of the food web which ultimately supports larger organisms such as fish, birds and sea mammals
Polychaete	The collective name for the group of marine worms with segmented bodies
Sacrificial Anodes	Anodes made of aluminium and zinc that provide protection from corrosion to steel structures in the sea
Sighting	Vessel logged within a specific ICES Rectangle during an SFPA surveillance patrol. Each vessel is identified by name and registration (confidential information not released), and its activity and position (latitude and longitude to one hundredth of a minute) are recorded
Sublittoral	The coast or seabed from the low tide level down to the edge of the continental shelf (in UK at about 200m depth)
Subsquare	One quarter of an ICES Rectangle
Substructure	The steel structure of legs and tubular braces that will support the tower and nacelle
Support tower	The tower fixed to the top of the substructure, that carries the nacelle
Swaging	A mechanical process that deforms the pile inside the pile sleeve and locks the two together, thus securing the jacket to the seabed
Swarf	Small pieces of metal debris created when metal is cut or ground
Taxa	The collective name for all of the categories used to classify organisms

TERM	DEFINITION
Thermocline/Temperature Stratification	A marked discontinuity between warm surface water, and colder deep water, that occurs during summer when surface waters are warmed
Transition piece	Part of the WTG that links the substructure to the support tower
Trenching operations	Activities to bury a cable or pipe by excavating a narrow trench in the seabed
Umbilical	Subsea cable linking the WTGs and Beatrice AP, that contains the electrical cable, and other cables for monitoring and control of the WTGs
Uraduct	A strong plastic outer sheath used to protect pipelines or umibilicals laid on the surface of the seabed
Zooplankton	The collective name for all the microscopic animals that float in the water column

GLOSSARY AND ABBREVIATIONS

ABBREVIATIONS

ABBREVIATION	FULL MEANING
AGDS	Acoustic Ground Discrimination System
AGLV	Area of Great Landscape Value
ALAT	Approximate Lowest Astronomical Tide
AOD	Above Ordnance Datum
AONB	Area of Outstanding Natural Beauty
AoSP	Area of Special Protection
B Field	Magnetic Field
BAP Species	UK British Action Plan
BOD	Biological Oxygen Demand
CAPEX	Capital Expenditure
COLLRISK	Collision Risk
COP	Cessation of Production
COWRIE	Collaborative Offshore Wind Energy Research Into the Environment
CPA	Closest Point of Approach
DAP	Directorate of Airspace Policy
dB	Decibel – a measure of noise
DP	Dynamic Positioning
DOWNVInD	Distant Offshore Wind farms with No Visual Impact in Deepwater
DSFB	District Salmon Fishery Boards
DTI	Department of Trade and Industry
DTM	Digital Terrain Model
DWT	Dead Weight Tonnes

ABBREVIATION	FULL MEANING
E Field	Electrical Field
EA	Environmental Assessment
EEC	European Economic Community
EEMS	Environmental Emissions Monitoring System
EIA	Environmental Impact Assessment
EMS	Environmental Management System
ERIC	Emergency Rapid Intervention Craft
ES	Environmental Statement
EU	European Union
FEED	Front End Engineering Design
G&DL	Garden and Designed Landscapes
GC	Gas Chromatography
GCR	Geological Conservation Review
GRT	Gross Registered Tonnes
GT	Gross Tonnes
GW	Gigawatt – 109 watts
HLV	Heavy Lift Crane Vehicle
HSE	Health and Safety Executive
HS&E	Health, Safety and Environment
HV	High Voltage
Hz	Hertz
IBA Site	Important Bird Area
ICES	International Council for the Exploration of the Sea
iE Field	Induced Electrical Field
JIF	Jacket Interface Frame
JNCC	Joint Nature Conservation Committee

ABBREVIATION	FULL MEANING
kN	Kilo Newton – a thousand Newtons
kW	Kilo watt
LAT	Lowest Astronomical Tide
LCT	Landscape Character Type
LLD	Local Landscape Designation
LNR	Local Nature Reserve
LVIA	Landscape and Visual Impact Assessment
m^3	Cubic metres
MARPOL	International Convention for the Prevention of Pollution from Ships, 1973, as modified by the Protocol of 1978 relating thereto
MCA	Maritime and Coastguard Agency
MFP	Moray Firth Partnership
MOD	Ministry of Defence
ms^{-1}	Metres per second
MSL	Mean Sea Level
MW	Megawatt – 1 million watts
NATS	National Air Traffic Services
nm	Nautical mile
NNR	National Nature Reserve
NPPG	National Planning Policy Guidelines
NPV	Net present value
NSA	National Scenic Area
OPEX	Operating expenditure
O & M	Operations and Maintenance
OJQ	OWEC Jacket Quadropod – the type of substructure used in the Demonstrator

ABBREVIATION	FULL MEANING
OSPAR	Oslo and Paris Commission
OSRL	Oil Spill Response Limited
Pa	Pascal – a measure of pressure
pAGLV	Proposed Area of Great Landscape Value
PAH	Poly Aromatic Hydrocarbon
PAM	Passive Acoustic Monitoring
PCZ	Preferred Conservation Zones
Ramsar	Wetlands of International Importance
RLD	Regional Landscape Designation
ROV	Remotely Operated Vehicle
RSPB	Royal Society for the Protection of Birds
SAC	Special Area of Conservation
SAST	Seabirds at Sea Team
SAWL	Search Areas for Wild Land
SCOPEC	See EEMS
SEPA	Scottish Environment Protection Agency
SFF	Scottish Fishermen's Federation
SFPA	Scottish Fisheries Protection Agency
SL	Source Level
SLR	Single Lens Reflex
SNH	Scottish Natural Heritage
SPA	Special Protection Area
SPL	Sound Pressure Level
SSE	Scottish and Southern Energy
SSSI	Site of Special Scientific Interest
THC	Total Hydrocarbon Concentration

ABBREVIATION	FULL MEANING
TIF	Tower Interface Frame
TL	Transmission Loss
TPOD	Timed Porpoise Detector
TTS	Temporary Threshold Shift
UKCS	United Kingdom Continental Shelf
UKDMAP	UK Digital Map
UKHO	United Kingdom Hydrographic Office
UKOOA	United Kingdom Offshore Operators Association
UCM	Unresolved Complex Mixture
UPS	Uninterruptible Power Supply
WCA	Wildlife and Countryside Act
WeBS	Wetland Bird Surveys
WROV	Work Remotely Operated Vehicle
WTG	Wind Turbine Generator
ZTV	Zone of Theoretical Visibility

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Appendices

APPENDIX 1

SAFETY, HEALTH & ENVIRONMENTAL POLICY

Talisman strives to create a workplace where accidents do not occur and where no one is exposed to health hazards. Talisman endeavours to cause no harm to the environment by minimising the impact of its activities.

We achieve this by:

> Providing the right number of competent people and other resources to do the job.

> Setting realistic, but challenging, individual and company targets for everyone.

> Providing and maintaining safe and healthy workplaces.

> Clearly stating and achieving our standards and expectations whilst meeting statutory requirements.

> Assessing risks and taking appropriate actions as part of our normal business.

> Managers and supervisors leading by example.

> Everyone being accountable for the actions they take to ensure their own safety and the safety of others around them.

> Ensuring everyone is accountable for minimising the environmental impact of their activities.

> Finding ways to continuously improve our performance.

> Regularly checking that our Management Systems are working effectively and making changes where appropriate.

> Investigating unplanned events, learning lessons and taking appropriate actions.

> Openly communicating and consulting throughout the company and with interested parties to ensure information is shared and issues are addressed.

“ I am determined that we succeed in making all Talisman sites safe, healthy places to work and that our activities do not cause environmental harm. But I believe this can only be achieved by everyone becoming personally involved and committing themselves to these objectives.”

Paul Blakeley | Vice President
Talisman Energy (UK) Limited July 2004

TALISMAN
ENERGY

APPENDIX 2

ENVIRONMENTAL LEGISLATION PERTAINING TO OIL AND GAS DEVELOPMENTS ON THE UKCS

This table lists some of the environmental regulations relating to offshore oil and gas activities in the UKCS that will be applicable to the proposed demonstrator project. The table gives an indication of the regulatory context within which the project will be executed, and the issues which inform Talisman Energy UK's planning and management of the project. Further information on this legislation may be found at http://www.ukooaenvironmentallegislation.co.uk

ACTIVITY	LEGISLATION / GUIDANCE
Environmental Impact Assessment	**Offshore Petroleum Production and Pipelines (Assessment of Environmental Effects) Regulations 1999, (EIA)**
Transboundary Environmental Impact	**Convention on Environmental Impact Assessment in a Transboundary Context (The ESPOO Convention)**
Licences – *fixed mobile installations*	Section 34 of **Coast Protection Act 1949**, as extended by the **Continental Shelf Act 1964** **Petroleum Act (1998)** **Food and Environment Protection Act 1985**
Licences – *pipelines*	Section 34 of **Coast Protection Act 1949**, as extended by the **Continental Shelf Act 1964** **Petroleum Act (1998)** **Food and Environment Protection Act 1985**
Discharge of oily water (drainage water)	**Convention on the Protection of the Marine Environment of the North East Atlantic 1992 (OSPAR Convention)** **Merchant Shipping (Prevention of Oil Pollution) Regulations 1996**
Discharge of oily water (drainage water)	**Offshore Petroleum Activities (Oil Pollution, Prevention and Control) Regulations 2005**
Selection, use and discharge of chemicals – all aqueous discharges except reservoir hydrocarbons	**Offshore Chemicals Regulations (OCR) 2002 (under the Pollution Prevention and Control Act, 1999)**

ACTIVITY	LEGISLATION / GUIDANCE
Cooling water	**The Food and Environment Protection Act (FEPA) 1985 – Deposits in Sea Exemption Order 1985** **Convention on the Protection of the Marine Environment of the North East Atlantic 1992 (OSPAR Convention)**
Accumulation and disposal of radioactive waste i.e. LSA scale	**Radioactive Substances Act 1993** **Radioactive Substances and (Phosphatic Substances, Rare Earths, etc) Exemption Order 1962** **Radioactive Substances (Substances of Low Activity) Exemption Order 1986 (as amended)** **Offshore Petroleum Activities (Oil Pollution Prevention and Control) Regulations 2005**
Discharge of galley/food waste	**Merchant Shipping (Prevention of Pollution by Garbage) Regulations 1998**
Discharge of sewage	**FEPA 1985 – Deposits in the Sea (Exemption) Order 1985** **MARPOL Annex IV Regulations for the Prevention of Pollution by Sewage from Ships)**
Discharge of non-oily materials	**FEPA 1985 – Deposits in Sea (Exemption) Order 1985** **The Merchant Shipping (Dangerous or Noxious Liquid Substances in Bulk) Regulations 1996** consolidating and repealing previous pieces of legislation and enacting **MARPOL 73/78 Annex II**
Loss of containment in pipeline by corrosion and rupture, fracturing or as a result of a dropped object	**Pipeline Safety Regulations 1996 and Offshore Installations (Safety Case) Regulations 1992**
Movement of pipelines by natural or third party forces, e.g. fishing gear & scour	**Pipeline Safety Regulations 1996 and Offshore Installations (Safety Case) Regulations 1992**
Oil Spill Contingency Planning	**Merchant Shipping (Oil Pollution Preparedness and Response Convention) Regulations 1998** **The Offshore Installations (Emergency Pollution Control) Regulations 2002.** **Offshore Petroleum Activities (Oil Pollution, Prevention and Control) Regulations 2005**

ACTIVITY	LEGISLATION / GUIDANCE
Oil Spill Contingency Planning *(cont)*	**International Convention on Oil Pollution Preparedness, Response and Co-operation (OPRC Convention)** **Merchant Shipping (Salvage and Pollution) Act 1994**
Emergency procedures for installations	**Offshore Installations (Prevention of Fire and Explosion and Emergency Response) Regulations 1995 PFEER**
Disposal of garbage and operational waste	**Merchant Shipping (Prevention of Pollution by Garbage) Regulations 1998** **Environmental Protection Act 1990 and Special Waste Regulations 1996**
Discharges of rig bilge tanks	**MARPOL 73/78 (93 Amended)**
Dropped objects (e.g. equipment, chemical drums, drill pipe or casings)	**FEPA 1985 – Deposits in the Sea (Exemption) Order 1985**
Carriage of dangerous substances at sea	**MARPOL Annex III – International Marine Dangerous Goods Code (IMDG)** **Merchant Shipping (Dangerous Goods and Marine Pollutants) Regulations 1997** **Chemical (Hazard Information and Packaging) Regulations 2002** **Merchant Shipping Notice 1741 Reporting Requirements for Ships Carrying Dangerous or Polluting Goods**
General	**Air Quality Regulations (2000)** **Global Warming Treaty and the Convention on Long-Range Transboundary Air Pollution** **UNECE Convention and Protocol on Transboundary Air Pollution and UN Framework Convention on Climate Change**
Turbine and other exhaust emissions from plant	**The Offshore Combustion Installations (Prevention and Control of Pollution) Regulations 2001 (PPC)**
Waste management and transfer of waste from the platform to the supply base	**International Convention for the Prevention of Pollution from Ships (MARPOL) 1973, as amended** **Petroleum Operations Notice 2** **Environmental Protection Act 1990 and Environmental Protection (Duty of Care) Regulations 1991**

ACTIVITY	LEGISLATION / GUIDANCE
Waste management and transfer of waste from the platform to the supply base	***Controlled Waste Regulations 1992 (as amended)*** ***Special Waste Regulations 1996*** **Merchant Shipping and Maritime Security Act 1997**
Special waste	**Environment Protection Act 1990 as amended** **Environment Protection (Duty of Care) Regulations 1991** **Controlled Waste Regulations 1992 (as amended)** **Special Waste Regulations 1996 (as amended)** **The Special Waste (Amendment) Regulations 2001** **The Control of Pollution (Special Waste) Regulations 1996 and amendment regulations 1996**
Transfer of oily residues and mixtures to shore	**Prevention of Oil Pollution (Reception Facilities) Order 1994**
Conservation of habitats	**Offshore Petroleum Activities (Conservation of Habitats) Regulations 2001** ***Habitats Directive 92/43/EC*** ***Wild Birds Directive 79/409/EEC*** **The Conservation (Natural Habitats, etc.) Regulations 1994 and the Conservation (Natural Habitats, etc.) Regulations Northern Ireland 1995**
Access to information	**EC Directive 2003/4/EC on public access to information** **Environmental Information Regulations 2004 (SI 2004/3391)** **Environmental Information (Scotland) Regulations 2004 (SSI 2004/520)**
Environmental management systems (EMS)	**OSPAR Recommendation 2003/5 to promote the use and implementation of Environmental Management Systems by the Offshore Industry** **BS EN ISO14001: 2004 Environmental Management Systems** **European Eco-Management and Audit Scheme (EMAS)**

ACTIVITY	LEGISLATION / GUIDANCE
DECOMMISSIONING	
Fixed Installations	**Petroleum Act 1998** **Offshore Chemicals Regulations 2002** **Offshore Petroleum Activities (Conservation of Habitats) Regulations 2001** **OSPAR Decision 98/3** **Environmental Protection 1990 (EPA) Part 2 Duty of Care** **Food and Environment Protection Act 1985** **Radioactive Substances Act 1993** **Prevention of Oil Pollution Act 1971 (currently being replaced**
Pipelines	**Petroleum Act 1998** **Offshore Chemicals Regulations 2002** **Offshore Petroleum Activities (Conservation of Habitats) Regulations 2001** **OSPAR Decision 98/3** **Environmental Protection 1990 (EPA) Part 2 Duty of Care** **Food and Environment Protection Act 1985** **Radioactive Substances Act 1993** **Prevention of Oil Pollution Act 1971 (currently being replaced**

APPENDIX 3

ORGANISATIONS CONTACTED

Alphabetical list of all the organisations contacted during the consultation programme:

- *Aberchirder and Mardoch Community Council*
- *Aberdeen and Grampian Tourist Board*
- *Aberdeenshire Council*
- *Aberdour and Tyrie Community Council*
- *Alness Community Council*
- *Alvah and Forglen Community Council*
- *Ardersier and Petty Community Council*
- *Ardross Community Council*
- *Association of District Salmon Fishery Boards*
- *Association of Salmon Fishery Boards*
- *Auldearn Community Council*
- *Avoch and Killen Community Council*
- *BAA Aberdeen*
- *Ballifeary Community Council*
- *Balloch Community Council*
- *Banff and Macduff Community Council*
- *Banff Sailing Club*
- *Beauly District Salmon Fishery Board*
- *Beauly Community Council*
- *Berriedale and Dunbeath Community Council*
- *Bremner Fishing Co Ltd*
- *British Telecom*
- *British Trust for Ornithology*
- *British Wind Energy Association*
- *Brora Community Council*
- *Buckie Community Council*
- *Buckie Inshore Fishselling Company Ltd*
- *Burghead and Cummingston Community Council*
- *Caithness and Sutherland Enterprise*
- *Caithness District Salmon Fishery Board*
- *Chanonry Sailing Club*
- *Civil Aviation Authority*
- *Conon and Nairn District Salmon Fishery Boards*
- *Conon Bridge Community Council*
- *Conon District Salmon Fishery Board*
- *Conservative Party*
- *Contin Community Council*
- *Cornhill and Ordiquhell Community Council*
- *Cromarty and District Community Council*
- *Cromarty Boat Club*
- *Cromarty Firth Port Authority*
- *Crown Community Council*
- *Croy and Culloden Community Council*
- *Culcabrook and Drakies Community Council*
- *Dalneigh and Columba Community Council*
- *Department of Environment, Food and Rural Affairs*
- *Deveron Bogie and Isla Rivers Trust*
- *Deveron District Salmon Fishery Board*
- *Dingwall Community Council*
- *Dores and Essich Community Council*
- *Dornoch Area Community Council*
- *Dyke Landward Community Council*
- *East Nairnshire Community Council*
- *Edderton Community Council*
- *Elgin Community Council*
- *Fearn, Balintore and Hilton Community Council*
- *Ferintosh Community Council*
- *Findhorn District Salmon Fishery Board*
- *Findhorn and Kinloss Community Council*
- *Findochty Community Council*

- *Findochty Water Sports Club*
- *Fisheries Research Service*
- *Fishermen's Association Ltd*
- *Fordyce and Sandend Community Council*
- *Forres Community Council*
- *Fortrose and Rosemarkie Community Council*
- *Fraserburgh Community Council*
- *Friends of the Earth*
- *Friends of the Moray Firth Dolphins*
- *George Downey (Fish Merchants)*
- *Golspie Community Council*
- *Grampian Special Sailing Association*
- *Grampian Splash Association*
- *Green Party*
- *Health and Safety Executive*
- *Heldon Community Council*
- *Helmsdale Community Council*
- *Helmsdale District Salmon Fishery Board*
- *Helmsdale Harbour*
- *Highland Council*
- *Highland Federation of Tenants and Residents Associations*
- *Highlands and Islands Airports Ltd*
- *Highlands and Islands Enterprise*
- *Highlands of Scotland Tourist Board*
- *Hilton and Milton and Castle Heather Community Council*
- *Historic Scotland*
- *Holm Community Council*
- *Inver Community Council*
- *Invergordon Boating Club*
- *Inverness and Nairn Enterprise*
- *Inverness Freshwater Fisheries Consultancy*
- *Inverness Harbour Trust*
- *Inverness West Community Council*
- *Jack Scalloping Ltd*
- *Joint Nature Conservation Committee*
- *Killearnan Community Council*
- *Kilmorack Community Council*
- *Kilmuir and Logie Easter Community Council*
- *Kiltarlity Community Council*
- *Kiltearn Community Council*
- *King Edward and Gamrie Community Council*
- *Kirkhill Bunchrew Community Council*
- *Knockbain Community Council*
- *Kyle District Salmon Fishery Board*
- *Labour Party*
- *Latheron, Lybster and Clyth Community Council*
- *Lennox Community Council*
- *Liberal Democrat Party*
- *Lossie District Salmon Fishery Board*
- *Lossiemouth Community Council*
- *Lossiemouth Cruising Club*
- *Lossiemouth Sailing Club*
- *Marine Conservation Society*
- *Maritime and Coastguard Agency*
- *Marybank, Scatwell and Strathconon Community Council*
- *Maryburgh Community Council*
- *Merkinch Community Council*
- *Ministry of Defence*
- *Moray, Badenoch and Strathspey Enterprise*
- *Moray Council*
- *Muir of Ord Community Council*
- *Muirtown Community Council*
- *Nairn District Salmon Fishery Board*
- *Nairn River Community Council*
- *Nairn Sailing Club*
- *National Air Traffic Services*
- *Ness District Fishery Board*
- *Newburgh Sailing Club*
- *Nigg and Shandwick Community Council*

- *North of Scotland Industries Group*
- *North of Scotland Yachting Association*
- *North of Scotland Youth Sailors*
- *OFCOM*
- *Offshore Solutions UK Ltd*
- *Park Community Council*
- *Peterhead Sailing Club*
- *Portknockie Community Council*
- *Portsoy and District Community Council*
- *Rathven and Arradoul Community Council*
- *Resolis Community Council*
- *Rosehearty Community Council*
- *Ross and Cromarty Enterprise*
- *Royal Findhorn Yacht Club*
- *Royal Fine Art Commission for Scotland*
- *Royal Society for the Protection of Birds Scotland*
- *Salmon Farm Protest Group*
- *Salmon Net Fishing Association*
- *Saltburn and Westwood Community Council*
- *Scottish Environment Protection Agency*
- *Scottish Fishermen's Federation*
- *Scottish Natural Heritage*
- *Scottish Renewables Forum*
- *Scottish Sailing Institute Ltd*
- *Scottish White Fish Producers Association*
- *Scottish Wildlife Trust*
- *Sea Mammal Research Unit*
- *Seafish Industry Authority*
- *Sinclair Bay District Community Council*
- *Smithton and Culloden Community Council*
- *SOAFED – Aberdeen*
- *Spey District Salmon Fishery Board*
- *Spey Fishery Board*
- *Strathdearn Community Council*
- *Strathisla Community Council*
- *Strathnairn Community Council*
- *Strathpeffer Community Council*
- *Sutherland Estates Office*
- *Sutherland Schools Sailing Association*
- *Tain Community Council*
- *Tarbat Community Council*
- *The Crown Estate*
- *The Department of Trade and Industry*
- *The Fishermen's Association Ltd*
- *The Marine Connection*
- *The Ministry of Defence*
- *The Moray Council*
- *The Moray Firth Partnership Fisheries Advisory Group*
- *The National Air Traffic Service*
- *The Scottish Executive*
- *The Scottish White Fish Producers Association Ltd*
- *University of Aberdeen*
- *VisitScotland*
- *West Nairnshire Community Council*
- *Westhill Community Council*
- *Whale and Dolphin Conservation Society*
- *Whitehills and District Community Council*
- *Wick Community Council*
- *World Wildlife Fund for Scotland*

APPENDIX 4

horner + maclennan
landscape architects

BEATRICE DEMONSTRATOR WIND TURBINES

LANDSCAPE AND VISUAL IMPACT ASSESSMENT

Final report by

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For

Talisman Energy

22 December 2005

CONTENTS

TABLES

FIGURES

1 INTRODUCTION

This part of the ES presents a Landscape and Visual Impact Assessment (LVIA) of the proposed Beatrice wind turbines. Given the proposed development is located offshore, this includes Seascape Assessment.

The LVIA and Seascape Assessment include assessment of the existing landscape, seascape and visual resource and the effects of the proposed development on this. This includes assessment of other onshore wind farm developments and sequential assessment along specific routes.

2 ASSESSMENT METHODOLOGY

2.1 SOURCES OF INFORMATION

A number of information sources were used within the course of the assessment as listed in Table 1.

2.2 CONSULTATION

The Highland Council and Scottish Natural Heritage were consulted on the key issues to be addressed by the Environmental Impact Assessment in addition to recommended viewpoints for the Visual Impact Assessment.

2.3 DEFINITION OF STUDY AREA

The study area on which the LVIA and seascape assessment focuses, extends to a radius of 35km from the proposed development. This radius has been chosen on the basis of Good Practice Guidelines and to include all viewpoints from which significant visual effects (as defined by EIA Regulations) are most likely to occur.

Nevertheless, for this particular proposal, it was acknowledged that there are certain conditions when the proposed WTGs may be clearly visible from beyond 35km. This is mainly because of the isolation of the WTGs in contrast to open suroundings and the high clarity of visibility that can occur when looking over the sea during exceptional weather conditions, especially in a northwards direction when the sun is at a low angle from behind. For these reasons, visibility of the proposed development was considered beyond this radius, extending to approximately 65km from the centre of the site. This is not because it is predicted that signigficant visual impacts are likely to occur from these far distances, but nevertheless to confirm this situation and enable an assessment of the likely visibility of the proposed development from far distances.

Table 1 Sources of information used for the LVIA and Seascape assessment

LEGISLATION AND POLICY

- The Highland Structure Plan, The Highland Council, 2001
- The Moray Structure Plan, 1999
- The Moray Local Plan, 2000
- The Caithness Local Plan, 2002
- The South and East Sutherland Local Plan, 2000
- 'National Planning Policy Guideline (NPPG 6): Renewable Energy', The Scottish Office Environment Department, Revised 2000
- 'National Planning Policy Guideline (NPPG 14): Natural Heritage', The Scottish Office Development Department,1999
- SNH Policy Statement 04/01, Marine renewable energy and the natural heritage – an overview and policy statement.

GUIDANCE AND ADVICE

- 'Guidance for Landscape and Visual Impact Assessment', The Landscape Institute and the Institute of Environmental Assessment second edition 2002
- 'Guide to Best Practice in Seascape Assessment', The Countryside Council for Wales, Brady Shipman Martin and University College Dublin, 2001
- 'Landscape Character Assessment for England and Scotland', Scottish Natural Heritage (SNH) and The Countryside Agency, 2002
- 'Guidelines on the Environmental Impacts of Wind Farms and Small Scale Hydroelectric Schemes', SNH, 2001
- 'Policy Statement No 02/03 – Wilderness in Scotland's Countryside', SNH, 2002
- 'Planning Advice Note (PAN 45) Renewable Energy Technologies', Scottish Office Environment Department, Revised 2002
- 'A Handbook on Environmental Impact Assessment', SNH, 2002
- 'University of Newcastle (2002) Visual assessment of wind farms: Best Practice', SNH Commissioned report F01AA303A, 2002
- A review of possible marine renewable energy development projects and their natural heritage impacts from a Scottish perspective, SNH commissioned report F02AA414, 2003
- Visual and landscape effect of WTG units: The CCW Contract Science Report No. 631 'Studies to inform advice on offshore renewable energy developments: visual perception versus photomontage', Symonds Group Ltd.

BACKGROUND

- Caithness and Sutherland Landscape Character Assessment, SNH 1998
- Ross and Cromarty Landscape Character Assessment, SNH 1999
- Inverness District Landscape Character Assessment, SNH 1999
- Inner Moray Firth Landscape Character Assessment, SNH 1997
- OS 1: 50000 map sheets 11, 12, 17, 21, 26, 27 and 28
- 'Scotland's Scenic Heritage', Countryside Commission for Scotland, 1978
- 'Inventory of Gardens and Designed Landscapes – Volume 3': Highland, Orkney and Grampian Countryside Commission for Scotland and Historic Scotland, 1987
- 'An Inventory of Gardens and Designed Landscapes – Supplementary Volume 2': Highlands and Islands, SNH and Scotland and Historic Scotland, 1998.

2.4 METHODS USED FOR LVIA

The methodology employed is based on the 'Guidelines for Landscape and Visual Assessment' (Second Edition), produced by the Landscape Institute and Institute of Environmental Management and Assessment (2002). It has had to be modified, however, to incorporate elements of Seascape Assessment as recommended within the Guide to Best Practice in Seascape Assessment, produced by the Countryside Council for Wales, Brady Shipman Martin and University College Dublin (2001), in addition to other guidance as listed within Table 1.

Seascape assessment is concerned with the interaction of the sea, coast and land and how a proposed development relates to this combination. For some projects this includes an element of assessment from the sea to the land. However, this tends to be for schemes where the turbines will be close to the coast and/or commonly seen from the open sea looking towards the land; for example where there is a key ferry route passing by the outside of the turbines. Neither of these scenarios apply to the proposed Beatrice Demonstrator Project, and it was judged that there would be insufficient distinction of seascape units from distances offshore at which the proposed Beatrice WTGs would have significant seascape and visual impacts. The seascape assessment for the Demonstrator Project is therefore mainly concerned with how the WTGs will affect distinct character and views as experienced from land and coastal areas.

The initial stages of assessment defined the study area and identified landscape character, landscape designations and relevant government policy, to determine the general extent of visibility and to identify a representative range of potential viewpoints from which to carry out the Visual Impact Assessment (LVIA). These viewpoints are largely concentrated within publicly accessible areas along roads and public footpaths, in residential locations and in areas popular for outdoor recreation.

Maps showing Zones of Theoretical Visibility (ZTV) were generated to identify the potential extent of visibility of the WTGs over a 60km radius from the centre of the site. The ZTVs were modelled using a computer based visibility analysis package compiled using Ordnance Survey Digital Terrain Model data at 10m interval resolution. This ZTV represents a "bare ground" scenario, based on landform only, and takes no account of the screening effects of local hills, urban areas, buildings, structures or vegetation.

The ZTVs identified a number of potential viewpoints that would represent the potential range of views to the WTGs that could have significant visual impacts. These were visited, photographed and assessed by a number of Chartered Landscape Architects between June 2005 and November 2005 in order to confirm the value of the viewpoints to the assessment process (for example whether they were truly representative of views in the area and whether the proposed development would actually be screened by local features). Some of these viewpoints also represent potential cumulative visual impacts of other wind farms proposed within the study area.

The provisional list of viewpoints was sent to Scottish Natural Heritage (SNH) and The Highland Council (THC) (Table 23). SNH and The Highland Council responded with subsequent recommendations, all of which were subject to further assessment and, where appropriate, additional figures were included.

The assessment of potential visual impacts from viewpoints was aided by the use of computer generated wireline images, illustrating the likely scale and positioning of the proposed WTGs and the position of the existing oil platforms. Photographs of the existing baseline conditions were also taken, using a 35mm single lens reflex (SLR) camera with a 50mm and/or 70mm lens.

The panoramic photographs from each viewpoint were formed by splicing together single frames. They, together with the wirelines and photomontages, must be viewed at a specific viewing distance (indicated upon each sheet) and image size (as noted upon the sheets and as printed within the ES) in order to obtain an accurate representation of the scale of elements within the photograph. The turbine blades have been shown facing the same direction and, in some instances, colour balancing has occurred to make the image appear more realistic.

It should be noted that wireline images are not intended to represent the actual appearance of the proposed Demonstrator WTGs, but have been used as a tool to aid prediction of the likely scale, form and positioning of WTGs in comparison with the existing view seen on site.

Photomontages were produced for some of the viewpoints in addition to wireline images. The LVIA was based on a prediction of impacts based upon views on-site in combination with the wireline images only. In addition, however, photomontages are produced to inform the impression of others of the likely images of the proposed WTGs (as it would be seen within photographs). The choice of viewpoints to be illustrated using photomontages is determined by whether the proposed WTGs would be able to be clearly shown upon a photomontage and a prediction of likely significant visual effect. Conventionally this means that photomontages are not usually produced for viewpoints over 15km away, due to the technical difficulty of representing wind turbines in photos over this distance (either existing or montaged). For this project photomontages were required to cover a greater distance, because the proposed development is located approximately 22km from the shore.

2.5 ASSESSMENT PROCESS, CRITERIA AND DEFINITIONS

The aim of this assessment is to identify, predict and evaluate potential key impacts on particular elements of the environment, effects on the landscape, seascape and visual resource of the study area and the resulting overall significance of these effects arising from the proposed WTGs.

Throughout this Section, the term "landscape" is used to include elements of both the land and seascape – considering inland areas, the coastal edge, and marine areas and how these combine together.

Landscape resource is defined here as: "The combination and distribution of physical components that contribute to landscape context and character and how this is experienced and valued."

Visual resource is defined here as: "The quality of a particular area or view in terms of its visual components that create a visual setting."

Assessment of sensitivity of existing baseline conditions and prediction of magnitude of change leads to assessment of residual landscape and visual impacts on particular elements and the overall landscape and visual effects on the study area. The significance of these impacts and effects can be defined.

In order to provide a level of consistency to the assessment, these assessments have been based on pre-defined criteria.

2.5.1 Sensitivity to change

The sensitivity of the landscape resource to changes associated with the proposed development can be defined as high, medium or low based on professional judgement of a combination of parameters, as follows:

- *landscape character – scale, enclosure, openness, land cover, texture and form*
- *landscape value – local, regional or national landscape statutory designations and non-statutory designated areas*
- *distribution of receptors*
- *scope for mitigation.*

Usually an area would not fit every criterion within just one category; but, rather, it would be categorised based on best fitting more of the criteria, or the most important of the criteria, within one category.

Table 2 Definition of landscape sensitivity.

High	Key characteristics and features that are very sensitive to the location of a wind farm, such as simple or indistinct pattern, few existing foci, sense of intimacy and shelter, and sense of wildness or wild land, and these contribute significantly to the distinctiveness of the landscape character type.
	The distinctive characteristics of the landscape are widely experienced and contribute significantly to the value of the landscape at a local, regional and national level. Designated landscapes, e.g. National Scenic Area (NSA) and Area of Great Landscape Value (AGLV) and those identified as having landscape value, for example within Search Areas for Wild Land (SAWL).
Medium	Key characteristics and features that are sensitive to the location of a wind farm, but with which the wind farm may also integrate, such as a landscape with a distinct pattern, with occasional prominent foci, large scale structures, a sense of enclosure and a landform to which wind turbines could fit. A landscape where the wind farm would not affect the key characteristics that contribute to the distinctiveness and/or value of the landscape. The distinctive characteristics of the landscape are only locally experienced and/or only contribute to the value of the landscape at a regional level. Locally valued landscapes that are not designated. Landscapes in which it is possible to site and design a wind farm to have minimal impacts within the landscape
Low	A landscape where the wind farm would not affect the key characteristics that contribute to the distinctiveness and/or value of the landscape. Landscape characteristics and features that do not make a significant contribution to landscape character or distinctiveness locally, or which are untypical or uncharacteristic of the landscape type. Areas where a wind farm would fit the key characteristics of the existing landscape and/or where this can easily accommodate landscape change subject to careful design. The distinctive characteristics of the landscape are only experienced locally. Landscapes in which it is possible to site and design a wind farm to have minimal impacts within the landscape.

The sensitivity of the visual resource to changes associated with the proposed development is defined as high, medium or low based on professional interpretation of a combination of parameters, as follows:

- *location and nature of the view*
- *direction and extent of the view*
- *value/importance of the view*
- *scope for mitigation (including ability of the view to absorb development)*
- *activity of the receptor and expectations, frequency and duration of the view.*

Usually, a view would not fit every criterion within just one category; but, rather, it would be categorised based on fitting more of the criteria, or the most important criteria, within one allocation than another.

Table 3 Definition of receptor sensitivity.

High	Focused view or panoramic view in which a wind farm would form the dominant focus, distracting from existing elements or features. Existing view includes important landscape features with physical, cultural or historic attributes. Principal view from prominent buildings, "beauty spots" or popular viewpoints. Area designated for scenic value, or en route or in a location valued for its visual amenity. Wind farm difficult to integrate within visual composition, for example very complex pattern of elements, or these are of very different prominence or scale to wind turbines. Users of outdoor recreational facilities including those on footpaths, cycle routes or rights of way and popular hill or mountain tops, and key vehicular access routes from which viewers' attention is directed to the landscape.
Medium	Open, but unfocussed view in which a wind farm would be seen as one of several foci. Existing view includes some important landscape features with physical, cultural or historic attributes. Forms marginal part of view from prominent buildings, "beauty spots" or popular viewpoints. View within area of some scenic value, although not designated. Or visible along route or in location that is valued as having scenic value. Wind farm able to be accommodated within visual composition, for example in relation to linear features or pattern of point features, although this would result in some change to the pattern and/or nature of this composition. Wind turbines would be of similar prominence to existing visual features. Users of outdoor recreational facilities including local footpaths, cycle routes or rights of way, en route to locally popular hill or mountain tops whose attention may be focused on the landscape. Local access routes.
Low	Unfocused and/or partially screened view in which a wind farm would be seen as a minor element of the view. Existing view does not include important landscape features with physical, cultural or historic attributes. Site not clearly visible from prominent buildings, "beauty spots" or popular viewpoints. View not within area of recognised scenic value and not designated. Not visible from routes, or in location, which are valued for their visual amenity. Wind farm able to be accommodated within visual composition, for example in relation to linear features or pattern of point features without significant change to the pattern and/or nature of this composition. Wind turbines would be of similar or lesser prominence to existing visual features. Local users whose attention is likely to be focused on work or activity rather than the wider landscape, for example using local access routes to travel to/from work or working within an industrial or commercial centre.

2.5.2 Magnitude of change

The magnitude of change to the landscape resource arising from the proposed development at any particular point is described as high, medium, low, negligible or none based on the interpretation of a combination of largely quantifiable parameters as follows:

- *the scale of the change*
- *whether the change would affect key landscape characteristics on which the distinctive qualities of the landscape character type rely and/or for which it is valued, and thus result in a loss of landscape resource*
- *the nature of the change in relation to landscape characteristics and whether this is beneficial or adverse*
- *the duration of the change and whether this is temporary or permanent.*

The magnitude of change to the visual resource arising from the proposed development at any particular viewpoint is described as high, medium, low, negligible or none based on the interpretation of a combination of largely quantifiable parameters as follows:

- *scale of change in the view*
- *degree of contrast with the existing visual components, including extent of other built and vertical development visible*
- *distance of the viewpoint from the development*
- *duration and nature of effect*
- *angle of view in relation to main receptor activity*
- *proportion of the field of view occupied by the development*
- *background to the development*
- *extent over which changes would occur.*

Table 4 Definition of magnitude of change.

High	Fundamental change to the characteristics of the landscape or visual resource
Medium	Considerable change to the characteristics of the landscape or visual resource
Low	Noticeable change to the characteristics of the landscape or visual resource
Negligible	Discernable change, but only in exceptional conditions
No change	No change

2.5.3 Adverse and beneficial

When assessing impacts on the landscape and visual resource, the following categorisation has been used:

- *Adverse – the key characteristics of the landscape and visual resource are compromised*
- *No impact – the key characteristics of the landscape and visual resource are not affected*
- *Beneficial – key characteristics of the landscape and visual resource are reinforced.*

2.5.4 Impacts and effects

The following terms are used in this assessment as defined below:

Impact is used to refer to changes to an individual element or characteristic of the environment. The degree of change affecting an element by the proposed development can be described factually.

Effect is a broader-based view of the accumulation of one or more impacts that involves not only a degree of professional judgement, but also some extrapolation and generalisation, both of which also involve professional judgement.

2.6 ASSESSING SIGNIFICANCE

The significance of impacts and effects are based on two principal criteria – the magnitude of the change and the sensitivity of the location or person affected by the change (receptors). However, measures of significance require to be defined in relation to the specific circumstances of an individual development and landscape.

To determine the significance of the development on landscape resource, the following factors were considered (The Landscape Institute and Institute of Environmental Management and Assessment 2002):

- *the sensitivity of the landscape to the type of change proposed*
- *the nature of the effect (i.e. whether the key characteristics of the existing landscape resource of the study area, and their consistency throughout that area, are reinforced or weakened as a result of the changes in landscape character brought about by the introduction of the proposed development)*
- *the quality of the landscape characteristics affected and the potential for enhancement*
- *the value of landscape elements, feature or characteristics and the recognition of this by designation at various levels, such as local, regional, national and international and the affect of the change on the integrity of the designated area*
- *the magnitude of the effect and whether the change would be positive, adverse, temporary or permanent*
- *the type and rate of other changes that is likely to occur in the landscape resource of the study area in the future.*

To determine the significance of the development on the visual resource, the following factors are considered:

- *the nature of the effect (i.e. whether the scenic qualities of the view are strengthened or weakened as a result of the changes to visual amenity brought about by the introduction of the proposed development*
- *the magnitude of the effect*
- *the sensitivity of the visual resource and receptors*
- *the number of people affected by the change (although, changes affecting large number of people are generally more significant, this is not necessarily the case in sensitive landscape, for example areas of wild land)*
- *the type and rate of other changes that are likely to occur on the visual amenity of the study area in the future.*

For individual impacts, significance is measured in a scale of none, negligible, slight, moderate, and substantial. For the overall landscape effect and visual effect of the proposed development within the study area, a determination is made to whether the likely affect would be significant or not significant.

Wherever possible, identified effects are quantified, but the nature of landscape and visual assessment requires interpretation informed by professional judgement.

2.7 SEQUENTIAL IMPACTS

Sequential impacts occur when the observer moves along a linear route, as a series or continuum of points. Views from these routes may include other developments.

2.8 CUMULATIVE LANDSCAPE AND VISUAL IMPACTS

An assessment of the cumulative landscape and visual impacts of other wind farms in addition to the proposed WTGs has been undertaken. This considers changes that result in conjunction with other existing or reasonably foreseeable proposals. The scope of this assessment was discussed with SNH and The Highland Council.

All existing planning or Section 36 applications and consents for wind farms and single wind turbines within the study area that were identified before October 2005 as having potential significant cumulative impacts have been included in the Cumulative Landscape and Visual Impact Assessment (Table 5).

Table 5 Wind farms considered by the cumulative assessment in addition to the Demonstrator Project.

Wind farm	No of wind turbines	Distance from Beatrice (centre to centre) (km))	Status
Causeymire	24 (21 current)	30	Existing
Buolfruich	16	23	In Construction
Dunbeath	23	30	Submitted
Gordonbush	35	50	Submitted
Kilbraur	19	58	Submitted

As Causeymire and Buolfruich wind farms already exist, seven cumulative scenarios were considered by this study as follows:

1 The proposed Dunbeath wind farm plus the Beatrice Demonstrator Project (including the existing Causeymire and Buolfruich wind farms);

2 The proposed Kilbraur wind farm plus the Beatrice Demonstrator Project (including the existing Causeymire and Buolfruich wind farms);

3 The proposed Gordonbush wind farm plus the Beatrice Demonstrator Project (including the existing Causeymire and Buolfruich wind farms);

4 The proposed Dunbeath and Kilbraur wind farms plus the Beatrice Demonstrator Project (including the existing Causeymire and Buolfruich wind farms);

5 The proposed Dunbeath and Gordonbush wind farms the Beatrice Demonstrator Project (including the existing Causeymire and Buolfruich wind farms);

6 The proposed Dunbeath, Gordonbush and Kilbraur wind farms plus the Beatrice Demonstrator Project (including the existing Causeymire and Buolfruich wind farms); and

7 The proposed Gordonbush and Kilbraur wind farms plus the Beatrice Demonstrator Project (including the existing Causeymire and Buolfruich wind farms).

3 BASELINE DESCRIPTION

3.1 THE PROPOSAL

The proposed development is described in detail within Section 3 of the ES. However, to summarise, it would comprise two wind turbine generators (WTG) located 1.6km and 2.3km from the existing AP Beatrice oil platform, approximately 22km offshore. Each WTG would comprise a substructure fixed to the seabed, a support tower with a transition piece and a turbine. It is predicted that the turbine tower would be 88 metres high above mean sea level (MSL) and the blades would be 63m long. The blades would operate between wind speeds of 3.5 m/s to 25 m/s, at a rotational speed of seven to 12 revolutions per minute. The two WTGs and the existing Beatrice AP platform would be linked by a subsea umbilical.

Two red flashing aeronautical obstruction lights would be mounted upon the nacelle of each turbine. The visibility of these would depend on environmental conditions, such as the level of light and the position of the observer. However, assuming an observer is at the same elevation as the lights and is looking at them at night and in good visibility, they should be visible to a distance from the turbines of 10.8 nautical miles (20km) (taking into account a dirt factor of 0.74 in Europe). Two yellow flashing lanterns would also be positioned on the main deck at opposite corners, visible to a distance of 6.7 nautical miles (12.4km) and thus not be visible from onshore areas. In addition, five flood lights would light the stair access way and five fluorescent lights would illuminate the lay-down area. These would be inward facing and only visible within the immediate locality.

There would be no new onshore development associated with the proposed wind turbines.

The proposed wind turbines have been sited according to two major factors as follows:

- *the location of shipping routes*
- *the topography and depth of the seabed.*

3.2 POLICY CONTEXT

3.2.1 Policies

The Beatrice Wind Farm Demonstrator Project will be consented under the Petroleum Act (1987). However the Environmental Statement will be submitted under the Offshore Petroleum Production and Pipelines (Assessment of Environmental Effects) Regulations 1999. Most of the policy and guidance documents relevant to the landscape and visual resource and wind farm impacts are listed within Table 1. However, it is useful to highlight a number of planning policies of direct relevance to landscape and visual impacts below:

Highland Council Structure Plan, adopted in 2001

Policy E2

"Wind energy proposals would be supported provided that impacts are not shown to be significantly detrimental. In addition to the General Strategic Policies, wind energy would be assessed in respect of ... visual impact."

Policy L2

"The Council recommends to the Government the implementation of the advice from Scottish Natural Heritage contained within the review of National Scenic Areas so that it will … set out clear support for National Scenic Areas and establish a new basis in statute."

Policy L3

"Local Plans will identify Areas of Great Landscape Value in general accordance with the areas indicatively identified in Figure 12. Existing Areas of Great Landscape Value and other designations will be reviewed by the Council and brought forward for inclusion in the Structure Plan."

Policy L4

"The Council will have regard to the desirability of maintaining and enhancing present landscape character in the consideration of development proposals, including offshore developments."

Policy BC4

"The Council will seek to preserve historic gardens and designed landscapes identified in the published inventory and in any additions to it. Local Plans will contain policies for their protection."

Policy T6

"The Highland Council will protect important scenic views enjoyed from tourist routes and viewpoints, particularly those specifically identified in Local Plans."

Wild Land

"The qualities of wild land are a material consideration in evaluating development proposals on or affecting it. NPPG 14 Natural Heritage defines wild land as 'uninhabited and often relatively inaccessible countryside where the influence of human activity on the character and quality of the environment has been minimal'."

3.2.2 National Planning Policy Guidelines

NPPG14: Natural Heritage, issued in 1999 3.2

The following is stated at paragraph 23:

Development, which would affect a designated area of national importance, should only be permitted where:

- *the objectives of the designation and the overall integrity of the area will not be compromised*
- *any significant adverse effects on the qualities for which the area has been designated are clearly outweighed by social or economic benefits of national importance.*

NPPG6: Renewable Energy Developments, revised in 2000

The following is stated at paragraph 36:

"Visual Impact – the size and scale of the development and its relationship to the characteristics of the locality and landform in which it is to be built would be a relevant consideration. The visibility of a wind farm may in some circumstances raise concerns, although distance as well as landscape and topography would affect its prominence. Additionally the cumulative impact of neighbouring wind developments may in some circumstances be relevant."

"Landscape – the character of the landscape and its ability to accept this type of development, including the associated infrastructure, would be an important consideration. SNH has prepared a comprehensive programme of landscape character assessments and where appropriate local authorities should provide a local interpretation. A cautious approach should be adopted in relation to particular landscapes that are valued, such as National Scenic Areas or National Parks or sites in the inventory of designed landscapes. Such concerns may also extend to regionally important landscapes such as regional parks, and parts of approved green belts may be valued for their contribution to the landscape setting or nearby towns."

3.2.3 Caithness Local Plan

Policy PP3

"The Council will seek to identify and safeguard scenic views from unsympathetic development. Views from public roads to open water are particularly important for amenity and tourism. To aid appreciation of scenic views the Council will favour improved lay-by parking, visitor interpretation and view point features, notably on the A9, A99 and A836."

3.2.4 South and East Sutherland Local Plan

Local Plans General Policies Annex

"Development which would affect a designated area of international, national, or local importance, referred to in policies ENV-ENV4, will be assessed under the following criteria:

- *Sites of national importance – development must not compromise the objectives of designation and the overall integrity of sites of the area. Exceptions to this will only be made if any significant adverse effects in respect of the above are clearly outweighed by economic or social benefits of national importance*
- *Sites of local importance – developments will be assessed for effects on the interests of sites of local heritage importance and will be resisted where these are judged to be unreasonably detrimental.*

Generally, development proposals must:

- *be of an appropriate design in relation to:*
  - *Site placement*
  - *Size and form*
  - *Density, layout and orientation*
  - *Use of materials and colours*
- *meet appropriate standards of access and servicing*
- *ensure established building lines and significant trees are maintained*
- *ensure no adverse effects on amenity or heritage features*
- *provide appropriate landscaping."*

3.3 REGIONAL CONTEXT

The proposed WTGs will be located approximately 22km south-east of the coast of east Sutherland and Caithness.

3.4 LANDFORM

Within the study area, the landform divides into three separate areas: rounded hills in the south; leading to flat peatland within the central area; and gently undulating slopes in the north. The entire area is edged by the coast.

The high rounded hills in the south have smooth convex slopes that descend to the sea. The scale and shape of these hills seems massive and their form is influenced by glens and watercourses. The northern edge of these hills is marked by the distinctive peak of Scaraben, which is one of a cluster of lone mountains that extend into the peatland interior, including Morven and Maiden Pap.

The central area encompasses the south-eastern part of peatland known as the Flow Country. Overall, this area is almost flat and thus contains mainly lochans and boggy areas. It also offers extensive and panoramic views.

The northern part of the study area is predominantly gently undulating with an overall horizontal emphasis, although there are some low distinctive hills such as Ben-a-chielt. There is also a small local area of intimately and deeply undulating land around Hill of Yarrows. Within this area views are limited by the landform.

3.5 POPULATION DISTRIBUTION

The population in and around the study area is predominantly located along the coast, traditionally taking advantage of the preferable access and agricultural conditions. Wick is the largest town servicing the northern part of the study area (although located just outside the boundary), while Helmsdale is the largest settlement servicing the southern part. However there is a fairly even frequency of small villages along the entire coast in between. Most of these settlements are concentrated around bridging points or harbours and tend to be oriented perpendicular to the coast. They also tend to be strongly linked to the main A9 and A99 roads.

3.6 COMMUNICATION PATTERN

Serving the population distribution described above, the main roads through the study area, the A9 and A99, run close and parallel to the coast. From this, branch roads tend to pass into the interior via straths and glens that are less restricted within the northern part of the study area due to a gentler landform.

There are numerous tracks that extend into the interior moorland areas, mainly providing access for forestry or shooting estates. The routes of these tend to be restricted by ground conditions that largely comprise peatland and bog within the interior. Many of these tracks are used as footpaths as well as for 4x4 vehicular access. Within coastal areas, there are, however, several dedicated footpaths enabling access up and along the coastal hills as well as to the sea edge.

The main Inverness to Thurso railway line passes through the south-western edge of the study area, travelling through Helmsdale and along Strath Ullie. Outside the study area, this route passes through the distinct peatland area known as the Flow Country between Forsinard and Georgemas Junction, travelling through a distinctive area not publicly accessible by vehicle.

3.7 LAND USE AND LAND COVER

Land use within the study area varies considerably between coastal and interior areas. Along the coast, land use is predominantly small-scale farming and crofting combined with settlement and infrastructure. Within the interior areas, land is generally only extensively managed – mainly for deer and forestry. Within the study area as a whole, the nature of land use is significantly affected by two key factors: northern climatic conditions and exposure, and the peripheral location of the area from the large population centres to the south.

3.8 HUMAN-MADE FEATURES

The proposed wind turbines would be located near to existing Beatrice oil platforms located off the coast of east Caithness and Sutherland. These platforms currently form key focal features within offshore views, indicating human activity that is complemented by also seeing boats out to sea.

Within the study area on land, human activity is very obvious within coastal areas, particularly within settlements and crofting/farming areas, with roads, powerlines, telecom masts and forest plantations all creating obvious human-made features. However, within the interior areas, particularly within the peatland and bog areas where access is very restricted, there is a sense of wildness.

3.9 RECREATION

Footpaths upon local hills, within woodland near to residences and along the coast tend to be very popular with the resident population of the study area. However, although used by some for active recreation, such as walking and climbing, the study area does not tend to attract the high numbers of visitors that target the western Highlands. This may be partly because of the absence of very high mountains, the Munros, less publicity for the north-east within tourist literature, and also because of the far distance to the population centres further south. Instead, more people seem to tour the area by vehicle, stopping off at attractions for short durations en route. The coast and beaches, in addition to historical and archaeological features, tend to attract people in this way.

3.10 LANDSCAPE STATUTORY DESIGNATIONS AND NON-STATUTORY DESIGNATIONS

Figure 1 shows the location of statutory and non-statutory designations within the study area.

The study area includes one proposed Area of Great Landscape Value (pAGLV). This area extends from Berriedale on the coast into the peatland interior containing the Flow Country and the distinctive hills of Morven and Scaraben. A 'Search Area for Wild Land', identified by SNH, also extends near to the study area boundary. This covers the interior peatland area of the Flow Country, similar in extents to the pAGLV.

Two Gardens and Designed Landscapes are included within the study area – Dunbeath Castle and Langwell Lodge.

3.11 LANDSCAPE AND SEASCAPE RESOURCE

Landscape character types

The Caithness and Sutherland Landscape Character Assessment (SNH 1997) describes the landscape character within the study area and provides guidance on accommodating change within these landscapes. The distribution of these landscape character types is shown in Figure 2.

Within the study area, 14 landscape character types have been identified. Through the LVIA, it was judged that the proposed development would have most effect on six of these landscape character types (LCTs) and that the key characteristics of these would be most significantly affected by the proposed WTGs, in both adverse and beneficial ways. The key characteristics of these LCTs most relevant to wind farm development and design are as follows:

Table 6 Key characteristics of landscape character types relevant to wind farm development.

Landscape character type	Key characteristics sensitive to wind farm development
1. Moorland slopes and hills	• sloping open moorland • convex character of slopes tend to limit distant visibility and views of hill tops from their base • variable slope of landform • landscape remains overwhelmingly open • rocky crags and outcrops occur in some places, especially on hill tops and glen sides • similar height of hilltops create numerous minor foci • from the high points, aerial views reveal the interlocking arrangement of the moorland landform • the hills are of massive proportions • the interior of the landscape remains largely uninhabited • fragments of broadleaf woodland exist • coniferous plantations form a key landscape characteristic within some areas of moorland slopes.
2. Coastal shelf	• distinct linear space, semi-enclosed with seaward views on one side • an elevated platform • the pattern of land-use largely relates to the linear space of this landscape • some of the glens which intersect this landscape are very narrow and steep, and these tend to carve very deep crevices through to the sea and are often lined with woodland. Others are broader and sometimes open out to form a wide, fan shaped plain • settlements within this landscape tend to be located within the broader glens • the main land-use is agriculture • this landscape encompasses both land and sea environments. Its experience is dominated by the character of both, and the balance between these.

Table 6 (cont) Key characteristics of landscape character types relevant to wind farm development.

Landscape character type	Key characteristics sensitive to wind farm development
3. Small farms and crofts	• occupation and activity of people dominate the character of this landscape • a complex variety of different land-use characteristics • extent of visibility tends to be limited • scale of spaces are fairly small and views are directed towards foreground details • a complex visual composition of different spaces • land-use is mainly agricultural • some areas contain small fragments of broadleaf woodland, mainly located within the steep glens along the coast
3a Dispersed small farms	• very dispersed layout of buildings • the land adopts a more unified character as it tends to be managed on a larger scale • landscape appears more open.
3b Fringe crofting and historic features	• sparse habitation • a proliferation of croft ruins and ancient structures, often occupying prominent and slightly raised sites • ancient and ruined structures are highlighted by the open space and dominance of sky.
6. Sweeping moorland	• wide open space which affords extensive visibility • fairly flat or gently sloping or undulating landform • a largely uninhabited landscape that, in addition to the visual simplicity, tends to direct attention towards foreground details as well as the non-visual experiential characteristics • ribbons of broadleaf woodland occasionally run along the water courses and loch edges within the landscape • service elements pass through some parts of the landscape. These tend to be highly visible due to the visual simplicity and openness of the surroundings • coniferous plantations form a dominant characteristic within some areas of this landscape type • the landscape sometimes forms a raised shelf or plateau near to the sea. In such locations, the coastline is not visible from inland areas.

3.12 POTENTIAL FUTURE CHANGE TO LANDSCAPE CHARACTER

The study area generally seems to be at low pressure for change, its main land uses being infrastructure, rough grazing for sheep and deer and some areas of coniferous plantation. Recent and current developments include the up-grading of the A9 road north of Helmsdale, forest restructuring, individual house developments and numerous telecommunication masts near the main roads.

It is possible that a number of wind farms proposed within and just outside the study area will be built as part of increasing renewable energy development in the north of Scotland, and national grid connections may be upgraded to accommodate this production.

3.13 LOCAL LANDSCAPE CHARACTER AREAS

The sensitivity of the landscape character types described above depends on their key landscape characteristics, whether a proposed development would be seen or not, and how the landscape character types combine and are typically experienced together. Given that these characteristics will also vary at the local level, that their sensitivity will depend on the type of development being proposed, and landscape character types are rarely experienced in isolation, a number of distinct local landscape areas containing different landscape character types have been identified as listed in Table 7 and shown on Figure 2.

Table 7 Wind farms considered by the cumulative assessment in addition to the Demonstrator Project.

Local landscape area no	**Description of area**	**Main landscape character type(s)**	**Reference to viewpoint number**
1	Navidale Coastal Shelf	• coastal shelf • high cliffs and sheltered bays • coniferous woodland • moorland slopes and hills • strath • broadleaf or mixed woodland • dispersed small farms and crofts	6
2	Interior hills	• moorland slopes and hills • strath • broadleaf or mixed woodland • lone mountains • sweeping moorland	4
3	Interior moorland and marginal crofting	• moorland slopes and hills • broadleaf or mixed woodland • lone mountains • sweeping moorland • small farms and crofts • coniferous woodland • flat peatland • dispersed small farms and crofts • fringe crofting and historic features	
4	South east Caithness coastal edge	• moorland slopes and hills • broadleaf or mixed woodland • sweeping moorland • small farms and crofts • small farms and crofts with local facilities • small farms and crofts with new housing • dispersed small farms and crofts • fringe crofting and historic features • mixed agriculture and settlement • open intensive farmland	5, 3, 1, 11
5	Yarrows cnocs	• dispersed small farms and crofts • fringe crofting and historic features	

The following section describes the typical key landscape characteristics within these areas that either relate to, or would be sensitive to, wind farm development.

3.13.1 Landscape area 1 – Navidale coastal shelf

The landscape composition tends to be simple within these areas, mainly comprising the coastal edge, smooth convex hills and simple vegetation. The shape and elevation of the landform creates an alternating sense of exposure and open views upon the high points and a strong sense of shelter, enclosure and focused views within the glens, with very steep slopes marking the distinction in between. As roads wind around the landform, views are thrown back and forth between the hill interior and the coast. However, the predominant emphasis of the area is the coast to the east. Settlement tends to be limited to the gentler slopes upon elevated shelves or at bridging points.

3.13.2 Landscape area 2 – Interior hills

This area comprises moorland and hills that are simple in pattern and largely rolling in form with an overriding horizontal emphasis, apart from the distinct isolated peak of Scaraben that rises sharply from its surroundings. The area is intersected by the glens of the Langwell Water and Berriedale Water, which provide local shelter and harbour patches of woodland and residences. Otherwise the area is large in scale and predominantly open with a sense of exposure and wildness. The landform limits views of the sea to the highest slopes, so that the area largely seems isolated and strongly linked to the interior areas of peatland to the north and west.

3.13.3 Landscape area 3 – Interior moorland and marginal crofting

This area seems transitional in character, lying between the coast and interior peatland and containing a mixed composition of features characteristic of both environments – marginal croft land, moorland, infrastructure and dispersed settlement. As such, its pattern of elements often seems complex and unclear, with no obvious focus or hierarchy. This is exacerbated by the fairly gentle landform that does not limit development to distinct areas. The presence of many abandoned and ruined buildings, in addition to prominent utilitarian built features, also conveys a sense of negative value for the underlying landscape qualities within this area.

3.13.4 Landscape area 4 – South east Caithness coastal edge

Within this area, landscape pattern and land use tend to appear as the key characteristics of the landscape, arranged in direct relation to the coast. The majority of the area is occupied by dispersed settlement and unintensive agriculture/crofting, with concentrated villages occurring at fairly regular intervals along the coast, often coinciding with bridging points of straths. Otherwise there is a mixed and complex composition of landscape elements against which the sea appears as a simple backcloth. In this way, the existing oil platforms appear as key foci within the area, indicating direction and position in a landscape in which it is otherwise often difficult to orient. Throughout the area, coastal views dominate the experience of the landscape in addition to the overriding horizontal emphasis of the landform and consequent “wide skies” and sense of exposure.

3.13.5 Landscape area 5 Yarrow cnocs

The landscape character of this small area contrasts greatly to its surroundings by possessing an intricate and irregular undulating landform. This forms small scale cnocs and creates a local sense of enclosure and inward focus. In addition, the area contains a high number of historic and archaeological features that convey a sense of history within the landscape. The lower ground tends to be extensively managed for grazing, while the higher and steeper slopes largely comprise moorland.

The key landscape characteristics of each landscape area described above determines the sensitivity of the landscape resource to the proposed development, as listed in Table 8.

Table 8 Summary of sensitivity of landscape resource.

Landscape assessment area number	Description of area	Sensitivity of landscape resource to proposed wind turbine development
1	Navidale coastal shelf	Low
2	Interior hills	Medium
3	Interior moorland and marginal crafting	Low
4	South east Caithness coastal edge	Low
5	Yarrows cnocs	Low

3.14 SEASCAPE ASSESSMENT REGIONAL UNITS

The Guide to Best Practice in Seascape Assessment (2001) recommends the assessment of seascape for wind farms at a regional scale. Because this assessment needs to be combined with the Landscape and Visual Impact Assessment, the two coastal local landscape areas within the study area – the Navidale coastal shelf and south east Caithness coastal shelf – have been split into separate regional seascape units.

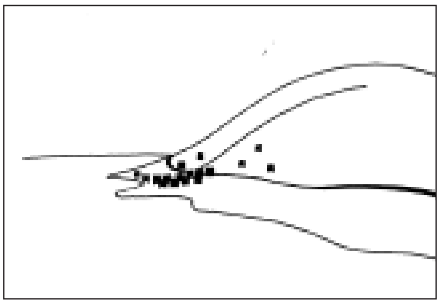
These regional units have three distinct components; the coastal dimension, the marine component and the hinterland component. As recommended within The Guide to Best Practice in Seascape Assessment, these units are distinguished by the following factors:

- *physical/natural factors*
- *human activity*
- *visual characteristics.*

The characteristics of these regional seascape units are described below.

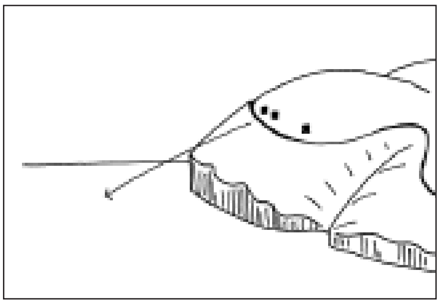
3.14.1 Navidale Coastal Shelf

A Helmsdale



This unit included the village of Helmsdale that forms a small concentrated settlement at the intersection of the glen of the River Helmsdale and the coast. It has a marine emphasis that is highlighted by its distinct architecture, including old merchant premises and fisherman cottages, although the fishing industry is now a shadow of its former self. The existing harbour still creates a focus within the village and is the home to a few local boats. The hills to the north-west and north of the settlement create a simple backdrop to the settlement and emphasise its concentrated form and simple pattern. Apart from the inner harbour area, the coastline is fairly open and unindented in character.

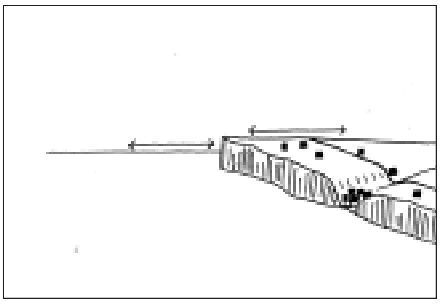
B Navidale – Berriedale



This section of the coast is largely uninhabited, apart from some developments along the lower beach shelves at the edge of Helmsdale, Navidale and Berriedale, and a few upland crofts. Historically, there were also additional coastal settlements, for example at Badbea. Most of the coast is characterised by steep cliffs that rise up from a rocky coast, before extending into very steep hill slopes that ascend to gradually curve over an elevated hill plateau. The landscape is simple in composition, while views vary considerably but discretely with the subtle changes in slope. Commonly, most people experience this coastal area via views from the A9 and Navidale settlements; these reveal the simple hill foreground against a simple sea and sky background.

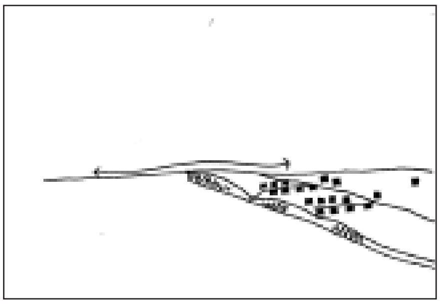
3.14.2 South east Caithness coastal edge

A Berriedale - Latheronwheel



This section of the coast is characterised by a rocky coastline and steep cliffs, up to 100m high in places, which form a clear vertical edge to the elevated but almost flat open land above. The steepness and height of these cliffs mean that access to the coast from inland areas is mainly limited to those locations where there is an intersection of burns or rivers, for example at Dunbeath Bay. Otherwise, there is a sharp division of the coastal and inland environment, marked spectacularly by the focal landmark of Dunbeath Castle. This feature is very prominent from the harbour at Dunbeath, where a small facility is all that remains of the once historic focus of the settlement. The character and experience of this area is, however, now dominated by the scale of the large-scale road overpass that crosses the river, and by the noise and activity of traffic upon this structure.

B Latheronwheel – Helman Head



This section of the coast mainly possesses a rocky coastline with cliffs between 25m and 50m high, breached by intersecting rivers and burns. As such, there is a marked coastal edge dividing terrestrial and marine areas, but it is easily penetrated and the horizontal emphasis and openness of the land and seascape evident within local views seems to extend smoothly between the two areas. This linkage is reinforced further by the fact that many of the roads and lines of houses run perpendicular to the coast, rather than parallel to it which would emphasise its line and edge. Generally this coast is fairly continuous in line, with only local and small scale indentations and inlets. As such, offshore views tend to pass directly and distantly outwards from the coast rather than being focused locally within bays.

Table 9 Summary of sensitivity of regional seascape units.

Landscape character area	Unit number	Unit name/ description	Sensitivity to type of proposed development
Navidale	A	Helmsdale	Low
Coastal Shelf	B	Navidale – Berriedale	Low
South east Caithness coastal edge	A	Berriedale – Latheronwheel	Low
	B	Latheronwheel – Sarclet Head	Low

3.15 VISUAL RESOURCE

3.15.1 Visibility

The Zone of Theoretical Visibility (ZTV) for the proposed Beatrice wind turbines is illustrated within the following Figures:

Figure 3 Zone of Theoretical Visibility (ZTV) to 60km – Strategic Overview

Figure 4 Zone of Theoretical Visibility (ZTV) to blade tip – Overview with viewpoint locations

Figure 5 Zone of Theoretical Visibility (ZTV) to hub height – Overview with viewpoint locations

Figure 6a Zone of Theoretical Visibility (ZTV) to blade tip – detail 1 of 4

Figure 6b Zone of Theoretical Visibility (ZTV) to blade tip – detail 2 of 4

Figure 6c Zone of Theoretical Visibility (ZTV) to blade tip – detail 3 of 4

Figure 6d Zone of Theoretical Visibility (ZTV) to blade tip – detail 4 of 4

The LVIA has largely been based on blade tip ZTVs which means that they indicate all parts of the study area where some part of one or more WTG may be visible. ZTVs to hub height have also been produced, however, as listed above, and a comparison between these and the blade tip ZTVs enables assessment of where only wind turbine blades will be visible. Visibility has been separated into bands of numbers of WTGs visible, 1 or 2.

The potential extent of cumulative visibility of the proposed Demonstrator WTGs together with Causeymire wind farm (existing) and Buolfruich (under construction) is illustrated in Figure 8; cumulative visibility with the proposed Dunbeath wind farm is shown in Figure 9, and with Gordonbush and Kilbraur wind farms in Figure 10.

ZTV maps give a good indication of the broad areas from which the wind farms and wind turbines may be seen and are useful as a tool for assessment. It should be noted, however, that they do have a number of limitations, as listed below:

- *a ZTV can only indicate potential theoretical visibility*
- *a ZTV's accuracy is limited by the data available and used to create it. Most importantly, the accuracy of the ZTV is limited by Digital Terrain Model (DTM) data, which cannot distinguish below a certain level of detail, and by the need for software to "interpolate" between the heights at survey points*
- *a ZTV cannot indicate potential visual impacts, or their significance.*

3.15.2 Distribution of visibility

Although the WTGs will be located within open sea and thus clearly visible from the nearest coast, their visibility from other areas of the mainland is limited – mainly by the coastal hills and the convex nature of their slopes in addition to local screening by buildings and woodland. The WTGs would thus be mainly visible along the coast, from sea-facing slopes and from distant high hills.

The proposed WTGs would not be visible from the centres of most of the major villages in the study area as these tend to be tucked into low sheltered harbour areas. The WTGs at the Demonstrator site would not be visible from any towns or cities.

The ZTV maps clearly show that in most locations where the Demonstrator site would be visible, two wind turbines would be seen. In only a few very small areas, would foreground features screen one or other of the two proposed WTGs.

The different distribution of visibility of the proposed wind turbines up to their blade tips and hubs can be seen by directly comparing the ZTVs shown in Figures 4 and 5. This clearly shows that, where the wind turbines would be visible, the top of the towers, in addition to all of their rotor blades, would usually be seen.

3.15.3 Cumulative visibility

Figure 8 shows the areas from where the proposed WTGs would be seen within the study area together with the existing Causeymire and Buolfruich wind farms, both individually and collectively.

The ZTV indicates that the main areas from where the Beatrice wind turbines and Buolfruich wind farm could theoretically be seen together are short sections of the A9 around Newport, Dunbeath, Latheronwheel, Burrigill and Clyth. They would also be seen together along the road between Dunbeath and Braemore, although they would be seen when looking in different directions.

Within the study area, Figure 8 indicates that there are only a few small areas from where the proposed development would theoretically be seen with just the Causeymire wind farm. This includes the top of the low ridge that runs from Cnoc Vigas to Cnoc an Earrannaiche to the Hill of Yarrows, running roughly parallel to the coast 4-7km inland.

Figure 8 reveals that combined visibility of the Causeymire and Buolfruich wind farms in combination with the proposed Demonstrator WTGs would be mainly restricted to the highest interior hills within the Beatrice study area, including Scaraben, Meall na Caorach, Cnoc na Feadaige, Wag Hill and Bouilag Hill, in addition to the elevated moorland around Buoltach and Den Moss.

Figure 9 shows the areas from where the WTGs would theoretically be seen together with the proposed Dunbeath wind farm. This indicates that the main areas from where these wind farms would be seen together include short sections along the A9 around Ramscraigs, north-eastern Dunbeath and Knockinnon, east Latheron, Burrigill, Swiney, Lybster, Clyth and Braehungie. In addition, they would also be seen together in sections along the minor road between Dunbeath and Braemore. Otherwise, combined visibility would mainly occur within areas of elevated peatland to the north-west of Dunbeath.

Figure 10 reveals that within the study area there would not be any cumulative visibility with the proposed Kilbraur wind farm, and there would only be a small area of potential cumulative visibility with the proposed Gordonbush wind farm upon the southern slopes of Scaraben and upon Creag Thoraraidh to the south.

3.16 VIEWPOINTS

Ten viewpoints were originally identified to represent those locations from where there would be potential for significant visual impacts, as listed within Appendix I and recommended to SNH and THC. This list was then amended to incorporate recommendations by THC. All of these viewpoints were assessed as part of the LVIA process, but some were later dismissed due to a lack of site visibility or because of similarity of impacts with another viewpoint. Finally ten viewpoints were chosen to represent likely significant visual impacts; these are listed in Table 10 and are shown in Figures 11-21.

It should be highlighted that viewpoint assessment is not the only source of data that informs the LVIA of the proposed development within the study area.

Table 10 List of viewpoints.

Viewpoint nr.	Location	Main users (receptors)	Grid Ref	Approx Altitude (m)	Approx distance from edge of wind farm (km)	Direction to centre of wind farm	Other wind farms theoretically visible
1	Lybster	Local residents and visitors (also similar to views from A9)	324884, 935060	51	26	SSE	B D K > 35km G > 35km
2	Latheron	Motorists and local residents	319809 933137	72	28	NE	K > 35km G > 35km
3	Dunbeath Heritage Centre	Local residents, visitors and motorists	315943, 929538	55	26	SE	B D K > 35km
4	Scaraben	Hill walkers and stalkers	308074, 927326	626	32	SE	C B G D
5	A9/Berriedale Borgue area	Motorists and local residents	313171, 924717	135	26	SE	D K > 35km
6	A9 Navidale	Motorists and local residents	303767, 916153	79	33	ESE	B > 35km C > 35km
7	Creag Riasgain	Local walkers	295746, 912661	415	41	E	B > 35km C > 35km K G
8	Brora Golf Course/Car Park	Golfers, local residents, visitors	291004, 903966	10	46	ENE	B > 35km C > 35km D > 35km K
9	Tarbat Ness	Local residents and tourists	294821, 887641	10	49	SSE	B > 35km C > 35km D > 35km K
10	Lossiemouth	Local residents	323321, 871291 or 323317, 871285	3	44	NNE	C > 35km B> 35km G> 35km K> 35km D> 35km
11	Durn Hill	Local residents and visitors	357100, 863842	195	53	NNW	C > 35km B> 35km G> 35km K> 35km D> 35km

C=Causeymire, B=Buolfruich, D=Dunbeath, K=Kilbraur, G=Gordonbush >35km=outside the study area of the wind farm and thus visibility data not provided

Photographs taken from these viewpoints, recording the baseline visual resource, are presented in Figures 11-21.

3.16.1 Viewpoint 1 – Lybster

This viewpoint is located at the southern end of the village of Lybster, at the end of the main road that runs through the village and is oriented roughly perpendicular to the coast. It represents views from the coastal settlements to the north-west of the proposed development, around 26km away. The viewpoint would be mainly experienced by local residents and local motorists.

The viewpoint does not lie within any designated landscapes.

From this viewpoint, views are directed over the simple foreground slopes towards the sea, lined up to focus towards the existing oil platforms. Within the foreground, there is a simple pattern of agricultural fields marked by fences. The line of the slope runs parallel to the coast so that there is a horizontal emphasis of components. Due to the slight convexity of the coastal slopes, it is not possible to see the coastal edge from this viewpoint. Although, at the time of this assessment, construction machinery and earthworks are visible within the foreground due to the construction of a new waste water treatment works, these are temporary features and thus not a permanent part of the visual baseline conditions.

Despite the pattern of the landscape within the foreground, there is an overwhelming sense of openness and the visual composition is dominated by the visible vast expanse of the sea together with "wide skies" that often reveal a dynamic quality to the landscape in terms of revealing changing weather conditions.

Within the surrounding area, there is a mixed composition of elements, including houses, patches of trees, field boundaries and telecommunication masts. Apart from the formal arrangement of the main settlements themselves, which tend to form linear patterns, elements seem to be fairly scattered within the landscape, largely unrestricted by the landform and ground conditions.

From this viewpoint, four platforms are clearly visible (including the two existing Beatrice platforms) in combination with the built setting of the foreground; these tend to convey a fairly urban/industrial character to the landscape.

Views from this location towards the proposed development tend to be highlighted during the evening hours in summer, when the sun is directed from behind the viewer from the north-west. At other times, visibility is often limited due to offshore cloud, fog or haze or because of looking towards the sun.

3.16.2 Viewpoint 2 – Latheron

This viewpoint is located at Latheron, on the coast between Latheronwheel and Lybster. It represents views from the north-west of the proposed development, approximately 28km away. The viewpoint lies at the entrance to a field, next to a lay-by on the A9, as you enter Latheron, and is mainly experienced by motorists and local residents.

The viewpoint does not lie within any designated landscapes.

From this location there is a panoramic view of the sea that dominates the vista. This is seen beyond a foreground pattern of fields and drystone walls. The existing oil platforms are visible and form key foci on the horizon.

Views from this location towards the proposed development tend to be highlighted during the evening hours in summer, when the sun is directed from behind the viewer from the north-west. At other times, visibility is often limited due to offshore cloud, fog or haze or because of looking towards the sun.

3.16.3 Viewpoint 3 – Dunbeath Heritage Centre

This viewpoint is located upon the southern edge of Dunbeath, at the edge of the car park serving the Dunbeath Heritage Centre. It represents views to the proposed development from the north-east, approximately 26km away.

The viewpoint does not lie within any designated sites, although it is located approximately 750 metres north-east of the edge of the Dunbeath Castle Garden and Designed Landscape.

The viewpoint lies on the southern side of the river and deep glen that runs through Dunbeath and is crossed by the main road overpass. Key views tend to be across this glen and along it, out to sea. The flattish elevated ground surrounding Dunbeath seems to be at a similar height as the sea horizon from this viewpoint, so there is an overriding horizontal emphasis to the landscape.

Within the landscape extending inland from Dunbeath, there is a complex pattern of elements – pylons, houses, fields, patches of woodland and the main road, many of which stand out on account of their vertical form in contrast to their surroundings. These elements seem to cumulatively dominate the underlying natural characteristics of the landscape, compounded by the activity and noise of traffic travelling along the main road. Although views to the sea are distracted by the complexity and confusion of these elements within the visual composition, it also provides a valued simple backdrop to these.

Buolfruich wind farm, currently being constructed, is not visible from this viewpoint, although it can be seen from higher locations around Dunbeath. The existing oil platforms are clearly visible out to sea and seem similar in form to point foci onshore.

Views from this location towards the proposed development tend to be highlighted during the evening hours in summer, when the sun is directed from behind the viewer from the north-west. At other times, visibility is often limited due to offshore cloud, fog or haze or because of looking towards the sun.

3.16.4 Viewpoint 4 – Scaraben

This viewpoint is located on the summit of East Scaraben, which is one part of a range of isolated hills that rise up sharply from the peatlands within southern Caithness that also include Morven and Maiden Pap. It represents views from these hills and the interior peatland area, to the north-west of the proposed development, about 32km away. The viewpoint is mainly visited by hillwalkers, that often visit it as part of a loop that includes Morven. The area is also used by local stalkers.

The viewpoint lies within a proposed AGLV that extends from Berriedale on the coast into the interior that includes the peatlands known as the Flow Country. It also lies just outside a Search Area for Wild Land that has similar extents to the proposed AGLV within the interior peatlands and hills.

From this area, the experience of the visual resource is dominated by panoramic views that include both the interior moorland and hills and the sea. There is an overwhelming sense of openness and simplicity of visual composition. Because of the great width and horizontal emphasis of the view, the eye tends to keep moving around the view, intermittently focusing on isolated features, rather than just resting in one direction and/or on one feature.

The visual composition to the west mainly comprises the wide expanse of moorland, with occasional lochs and tracks under a wide expanse of sky. The existing Causeymire wind farm can be seen in this direction, its position highlighted by the movement of turbine blades and the pattern and colour of turbines that contrast to the simple and dark coloured moorland backcloth. Buolfruich wind farm also appears incongruous in the same way, but is more prominent due to its closer proximity. Both developments seem marginal to the open moorland surrounding

Scaraben, in addition to other features such as the telecommunication masts upon Ben-a-Chielt; however, they create prominent features that contrast to the simple surroundings and distract from coastal views.

To the east of the proposed development, views tend to focus either to the north-east or south-east. To the north-east, the coastline leads the eye past Dunbeath and along the cliffs and upon the agricultural pattern of distant crofting areas. To the south-east, views are led along the incised gorge of Berriedale Water and towards the sea horizon. To the south, the hills appear more curvaceous. These create an image of overlapping hill horizons, fairly simple in form and texture, apart from occasional masts, tracks, moorland drains and forest plantations. The sun tends to be shinning from this direction, however, so views tend to be directed away from this area.

Because of the strong contrast of height and steepness of Scaraben with the surrounding moorland, there is a confusing effect of visual foreshortening whereby the flat landform below often seems sloped towards the viewer.

The view looking towards the proposed development site tends to be most clearly emphasised when the sun is behind the viewer in the afternoon. However, visibility offshore is often impeded by either offshore haar, cloud or haziness over the sea.

3.16.5 Viewpoint 5 – A9 Berriedale/Borgue area

This viewpoint is located between Berriedale and Borgue, near the small settlement of Newport. It is positioned adjacent to the A9 main road, backed by a dispersed pattern of houses and overlooking open agricultural land towards the sea. It represents views from the coastal crofting area to the north-east of the proposed development, about 26km away. The viewpoint adjoins the main A9 road and, as such, would be mainly experienced by motorists along the road in addition to local residents.

The viewpoint does not lie within any designated landscapes, although it is positioned just outside a proposed AGLV that extends from Berriedale into the moorland interior that includes the peatlands known as the Flow Country and the distinctive hills of Scaraben and Morven.

From this viewpoint, views are directed over the foreground slopes towards the sea. Within the foreground, there is a simple pattern of fields, marked by fences. The line of the slope runs parallel to the coast so that there is a horizontal emphasis of components, with views spread within a wide arc from the north to the east. Due to the convex nature of the coastal slopes, it is not possible to see the coastal edge from this viewpoint.

Within the surrounding area, there is a mixed composition of elements – houses, patches of trees, pylons and telecommunication masts. The pattern of these elements becomes less strongly influenced by the coast and hill slopes to the west and north so that the visual composition appears more mixed and scattered. For this reason, views often seem to be directed towards the sea when searching for simple qualities.

Within this composition, the existing oil platforms are clearly visible, seen as two separate and distinct features. They appear as point elements that contrast to the overriding horizontal and linear emphasis of the coastal view; however, their small size means that they do not appear as dominant foci. Generally they are very difficult to scale without any other features of known size close by and they seem dwarfed by the vast expanse of sea surrounding them.

Views from this location towards the proposed development tend to be highlighted during the evening hours in summer, when the sun is directed from behind the viewer from the north-west. At other times, visibility is often limited due to offshore cloud, fog or haze or because of looking towards the direction of the sun during morning hours.

3.16.6 Viewpoint 6 – A9 Navidale

This viewpoint is located between East Helmsdale and the Navidale braes, near to the entrance to the western track to Navidale Farm. To the south-east is the Navidale House Hotel which, in combination with its surrounding trees, forms a focus within the local landscape. This viewpoint represents views from the coastal shelf that runs along the east coast of Sutherland, to the west of the proposed development, around 33km away. The viewpoint adjoins the main A9 road and, as such, would be mainly experienced by motorists along the road in addition to a number of local residences.

The viewpoint does not lie within any designated landscapes, although it is located approximately 3km and 4.5km from two proposed AGLVs to the south and north-west respectively, that encompass the coastal hills.

From this area, the visual composition appears simple – dominated by the smoothness of the vegetation that overlies the rounded and convex slopes of the coastal hills that offer elevated views to the sea and create simple midground horizons that conceal the coastline below. Within this composition, the interior hills provide a simple backcloth to views that, in addition to the horizontal emphasis of the visual composition, tend to be thrown out to sea. Within the foreground, however, the main road and the associated movement of cars, form a dominant feature. In addition, telecommunication masts upon Creag Thoraraidh, powerlines and forest plantations all appear as incongruous human elements within the landscape.

The experience of views within the area is strongly influenced by the aspect of slopes and particularly the bends in the roads around the braes, as these currently slow down movement through the landscape, focusing views within the area and emphasising the distinctive character of the place. This experience is expected to change significantly in the future however, with the planned re-routing of the A9 within this area, whereby earthworks would screen many of the existing views from the A9 to the sea, in addition to reducing the distinctiveness of the braes area.

The existing Beatrice oil platforms can currently be seen as very distant minor elements upon the sea horizon. Their form, seen as point features, contrasts to the overriding horizontal and linear emphasis of the coastal view; however, they are seen as so very small as to only register as very minor features.

The view looking towards the proposed development site tends to be most clearly emphasised when the sun is behind the viewer in the afternoon. However, even then, visibility is often impeded by offshore cloud, haar or haziness seen over the sea.

3.16.7 Viewpoint 7 – Creag Riasgain

This viewpoint is located upon the hills at the coastal edge north of Lothbeg Point. It represents views from the hills to the west of the site around 41km away. The viewpoint lies at the summit of Creag Riasgain. This is not served by any formal pathway; however, it is understood that this hill top is popular with local residents for recreation.

The viewpoint lies within a proposed AGLV (numbered 1 on Figure 1), extending from the coast around Berriedale into the moorland interior which includes the peatlands known as the Flow Country and the distinctive hills of Scaraben and Morven.

From the top of the hill, views are panoramic. Looking towards the sea to the east and south, the visual composition is simple, comprising a smooth texture of grass, heather and pools of water in the foreground moulded over a curvaceous convex landform, and the sea meeting the horizon in the distance. To the south-east and south, the outline of Moray forms a silhouette beyond the sea.

Looking north-east and south-west along the coast, the composition becomes more complex with the changing shapes of the landform rising from the sea and different shapes and features formed by human influence such as fields, housing, powerlines and coniferous plantations.

The view looking to the west and inland consists of simple visual layers – a subtle mosaic of grasses, heathers and pools of water within the foreground, leading beyond to a composition of undulating and smooth rounded hills flowing into sharper, higher peaks. Within this view a road, some fencing and a small mast is visible; however, otherwise there is a sense of remoteness.

Although the focus of views tends to be towards the sea, visibility in this direction is often poor due to coastal cloud, fog or haze. As a consequence, views are often redirected along the coastal edge. Within this area, the movement of weather systems often seems to create a dynamic image due to the intermittent "spotlighting" and obscuring of the curvaceous hill forms.

3.16.8 Viewpoint 8 – Brora golf course car park

This viewpoint is located at the north eastern edge of Brora, next to the sand dunes, links and beach that run along the coast. It represents views along the east coast of Sutherland, to the south-west of the proposed development, around 46km away. The viewpoint lies at the edge of the car park that serves those using the golf course and accessing the beach, and thus is frequently visited by both residents and visitors.

The viewpoint does not lie within any designated landscapes, although it possesses views to a proposed AGLV to the north, encompassing the coastal hills beyond Brora and above Loth.

From this area, the experience of the visual resource is dominated by views along the coast and out to sea, within an arc extending broadly north-east to south-east. The visual composition is simple, dominated by the horizontal expanse of the sea and the distant horizon, framed between the distant coastal hills to the north-east, the foreground undulations and vegetation of the links together with the settlement edge of Brora, and the very distant landform silhouette of Moray in the far distance. The horizontal emphasis of the view tends to encourage one to constantly move their attention around the panorama or, alternatively, to focus on foreground details as there are no dominant foci within the distant view. Although the visual composition is predominantly simple, some of the curves created by the links landform create dynamic lines and shapes within the foreground. No major vertical features tend to feature within this composition.

The view looking towards the proposed development site tends to be most clearly emphasised when the sun is behind the viewer in the afternoon. However, visibility offshore is sometimes impeded by offshore haar or, even in clear weather, a haze seen over the sea.

3.16.9 Viewpoint 9 – Tarbat Ness

This viewpoint is located at the far north eastern tip of the peninsular of land between the Dornoch and Cromarty firths, protruding into the Moray Firth. The viewpoint is located upon the footpath that travels from the lighthouse down to the sea edge. It represents views from coastal areas to the south-west of the proposed development, around 49km away. The site is serviced by a small car park and viewpoint that would be mainly experienced by those walking to the sea edge for recreation, likely to be both local people and visitors to the area.

The viewpoint does not lie within any designated landscapes.

The experience of this viewpoint is dominated by the wide panorama of views and openness resulting from the exposed position upon a promontory in the sea. The visual composition is simple, dominated by the wide expanse of sea and sky, and the horizon separating them, but also consisting of a simple moorland foreground and the distant shapes of the east Sutherland hills. Views tend to follow the shape of the landform, leading towards the point.

On account of the openness, exposure and coastal position of the viewpoint, its experience is strongly affected by weather conditions. The wide expanse of the sea and sky tends to contribute a dynamic quality to views in terms of revealing changing weather conditions.

Within the surrounding area, there is a mixed composition of elements, including houses, patches of trees and field boundaries. Generally, the pattern seems fairly ordered and active land management results in a simple smooth vegetation texture that contrasts strongly to vertical features such as stone walls. Within this composition, the lighthouse creates a very prominent landmark within both the local and regional landscape.

From this viewpoint, the existing platforms are theoretically visible; however, even on a clear day it is often not possible to see these due to their distance and the effects of either offshore cloud or haze. Views from this location towards the proposed development tend to be highlighted during the afternoon hours, when the sun is directed from behind the viewer from the south-west.

3.16.10 Viewpoint 10 – Lossiemouth

This viewpoint lies on the coastal edge of Lossiemouth, on the point to the west of Spey Bay. It is a small area of unmanaged land used by local dog-walkers, located in front of a residential area and to the west of an industrial area. This viewpoint represents views of the proposed development from Moray to the south, approximately 44km away.

The viewpoint does not lie within any designated landscape.

From this location, there is a panoramic sea view and it is extremely open and exposed. The overall visual composition is simple, comprising of mostly horizontal lines dividing the textured vegetation and rubble in the foreground from the sea in the distance, loosely contained by distant headlands at either side of the visible horizon. Tarbat Ness Point is a prominent landform to the north-west. In addition, the Sutherland hills are just about visible beyond this, seen in silhouette on the distant horizon. Lighthouses form a vertical element within this composition.

Looking away from the sea, the land behind accommodates housing, gently rising in elevation. To the west, between the houses and the sea are industrial buildings and piles of rubble. The middle ground of this composition is made complex by the different levels, orientation, shapes and fabric of the houses, interspersed with street lighting, signs, walls, fences and vegetation. The street lights form very prominent vertical elements.

Visibility out to sea varies depending upon the weather conditions, often impeded by coastal haze or cloud.

3.16.11 Viewpoint 11 – Durn Hill

This viewpoint occurs upon the top of Durn Hill that is located to the south-west of the coastal settlement of Portsoy. It represents views from the very distant south-east of the proposed development, around 57km away. The viewpoint lies at the summit of the hill. It is not served by any formal pathway, but attracts some local walkers, mainly for its provision of views over the surrounding landscape and coast, which is otherwise difficult to view at lower elevations; it is also marked by evidence of a hill-top fort and a cross erected to the north of the summit.

The viewpoint does not lie within a designated landscape.

From the top of the hill, views are panoramic; however, they focus towards the north and the sea and coastal area, specifically the concentrated coastal settlements of Cullen and Portsoy and the distinctive steep isolated hills such as Bin of Cullen. These foci sit within a fairly simple landscape pattern marked by field boundaries and contrasting vegetation in addition to woodland plantations. The convex form of the hill tends to result in foreground screening and a horizontal emphasis of the visual composition – foreground vegetation, the coastal strip, the sea and the sky.

The landscape appears actively managed and human elements form key features within the visual composition, including industrial structures, coniferous tree plantations, intensive agriculture and traffic along the surrounding roads. Boats, too, can be seen out to sea. Hills such as Durn Hill, provide a key vantage point from which this pattern of features and activity can be seen while separated from it within an isolated and tranquil environment.

Although views from this location tend to be directed towards the sea, especially when highlighted by a southerly sun from behind, visibility in this direction is often poor due to coastal cloud, fog or haze. This has the effect of redirecting attention towards the intricate features of the coast, the composition of which are highlighted against the contrasting plain sea backcloth.

Given the visual resource of the viewpoints described above, their sensitivity to the proposed development is judged as the following:

Table 11 Viewpoint sensitivity.

Viewpoint number	**Viewpoint location**	**Sensitivity to type of proposed development**
1	Lybster	Low
2	Latheron	Low
3	Dunbeath Heritage Centre	Low
4	Scaraben	Medium
5	A9 Berriedale/Borgue area	Low
6	A9 Navidale	Medium
7	Creag Riasgain	Low
8	Brora golf course car park	Low
9	Tarbat Ness	Low
10	Lossiemouth	Low
11	Durn Hill	Low

3.17 SEQUENTIAL ASSESSMENT

The experience of the landscape as one moves through an area, detected visually and via other senses, is an important element of the landscape and visual resource. For most people, this change is experienced whilst moving either along roads, footpaths or a railway. After considering the visibility of the proposed Beatrice wind turbines as discussed previously, it was considered that there were two main access routes that represented typical sequential changes in landscape experience as listed below and shown in Figure 22.

1 *A9 The Mound – Thurso*

2 *A99 Latheronwheel – John o' Groats*

Each of these routes was assessed for their landscape and visual characteristics, while considering that visibility is strongly affected by the following:

- *angle of the view to the site in relation to the direction of travel*
- *roadside vegetation*
- *local landform*
- *frequency of use*
- *nature of user.*

3.17.1 Route 1 A9 The Mound – Thurso

A The Mound – Brora

From The Mound, views are at first contained by woodland along the coast. They are, nevertheless directed eastwards by the interior hills and the attraction of the bright coastal light. Generally the coastal shelf, sandwiched between the sea and the interior hills, creates a linear landscape with a sense of being upon an edge. The road runs along the interior edge of this landscape, providing views over the simple pattern of the shelf, mainly comprising smooth slopes and a pattern of fields and stone walls.

As the A9 approaches Golspie, the road is more elevated, providing more open views to the sea and revealing the land mass to the south-east and the landmark of Tarbat Ness. Key views are directed towards the north-east.

Through Golspie, views are restricted by buildings. However, from Dunrobin, the road becomes more elevated again and views are directed towards the sea, attracted by coastal features such as historical structures, e.g. Carn Liath. The main road acts as a prominent linear feature within the landscape; however, this form is also reinforced by the railway that seems to impede views to the coast along some stretches.

Near to Doll, the landform becomes more variable which, in combination with the random pattern of houses, intermittently screens views. There is a short stretch of open ground south of Brora, where views are directed towards the sea, before village buildings again screen views from the A9.

B Brora – Navidale

Leaving Brora, views tend to be focused towards the coastal hills rather than offshore; however, as the hills become closer to the coast again and the A9 becomes more elevated, views are again directed towards the sea. Linear groups of houses occur at fairly regular intervals along this section of the coast, creating a rhythmic pattern and reinforcing the linearity of the landscape.

Around Crakaig, the existing oil platforms become more noticeable. These appear as isolated distant features, related to other isolated foci along the coastal shelf such as occasional large houses or churches. They do not compromise the simplicity and overriding horizontality of the coastal views.

Proceeding further north towards Helmsdale, the existing oil platforms are seen more to the side of the main views so that they appear less noticeable. Then the road descends closer to sea level and views are focused upon the settlement of Helmsdale itself, while coastal views are distracted by the railway line that runs between the main road and the coast.

Rising out of Helmsdale, there are a multitude of features near to the road before, at Navidale, views open out over the coastal shelf to the sea, directed outwards by the coastal hills. Here, the landscape pattern is simpler and less distracting.

Between Achrimsdale and Gartymore, the A9 passes through a proposed AGLV.

C Navidale – Dunbeath

From Navidale, the A9 bends around the braes towards the north-west so that views are directed towards the inland slopes, before it curves back out towards the east. Along this latter stretch, views are directed towards the existing platforms before the route passes onto a recently upgraded stretch of road. This is edged on the coastal side by gently rising verges which limit views to the sea until the A9 reaches the Ord of Caithness. As you pass this point, views open up and there is an increasing prominence of the adjacent large scale rounded hill forms. Within this area, the simplicity of landform and heather vegetation cover generally creates a simple visual composition, although this is compromised by the incongruous features of coniferous plantations and powerlines. Along this stretch of the A9, the existing platforms are visible, but they tend to be seen as just one part of a very wide horizon, so they do not appear prominent.

At Berriedale, views tend to be focused upon the road and in front on account of the road terrain. Within this field of view, Langwell House and its wind turbine, in addition to Berriedale Water and neighbouring houses, tend to be seen as foci. However, above Berriedale braes to the north, there is a marked change in experience as the landscape and views open up to reveal a broad and mixed composition of houses. These tend to form an informal linear pattern, but seem loosely related to the coastline and thus direct views towards the sea.

Proceeding further north towards Dunbeath, the views open up even further and are led along the coast northwards. There is an overriding horizontal emphasis whereby the land and sea horizon seem to be at a similar level and views pass smoothly between them. Looking to the north, there is a mixed patchwork of vegetation colours and texture in addition to a scattering of houses and lines of pylons. Within this composition, the hill form and masts of Ben-a-chielt appear as a distinctive landmark.

Between Ousdale and Berriedale, the A9 passes through a proposed AGLV.

D Dunbeath – Latheron

Entering Dunbeath, mature trees near to the road, that form part of the Dunbeath Castle Garden and Designed Landscape, act as a gateway feature. Then, as the road curves and descends towards the village, views are briefly directed towards the Buolfruich wind farm, whose vertical form, movement and formality of pattern attracts attention by its incongruity before views focus upon the main road overpass. The scale of this structure seems to dominate and overshadow the underlying character of the village below. It also forms a dominant linear feature within views, despite a multitude of other elements within the surrounding landscape such as houses, field boundaries and powerlines.

Rising above Dunbeath, the horizontal emphasis of views is regained, with a scattering of built features within the foreground, leading down towards the coast. The pattern of the landscape is difficult to discern within this area, as the coast acts as the only obvious feature to which elements relate. Regular foci do occur however, mainly at bridging points that are emphasised by a descent and curve of the A9 to pass over the watercourse and usually a focus of buildings and/or road intersection.

North of Dunbeath, the existing oil platforms are less prominent within coastal views as they appear to the side of the key views towards the north-east, rather than within the driver's cone of vision.

E Latheron – Thurso

From Latheron, the A9 ascends up through an area that seems transitional in character, away from the settled landscape along the coast, but not yet within the open moorland area to the north. This is characterised by marginal land uses such as infrastructure developments and marked by the telecommunication masts upon Ben-a-chielt.

Passing the crofts of Ben-a-chielt, views are directed over the wide expanse of peatland to the north-west. Within these views, the existing wind farm of Causeymire acts a dominant focus, prominent mainly on account of its vertical form, movement of blades, contrast of colour with the vegetation backdrop and contrasting pattern with the otherwise simple open peatland. As the A9 passes the wind farm, views alternatively focus upon other human elements in the view, such as the plantations, powerlines, and quarries. Within this composition, the distinctive form of Spittal Hill is seen as a local focus.

As the A9 passes Spittal, views intermittently pass to other small hills within the surrounding landscape, such as Sordale and Sour, in addition to gently defined river straths. However, generally, there is a mixed composition of elements, for which a pattern is difficult to distinguish, that results in a difficulty to orient.

Approaching Thurso, the landscape becomes more actively managed and simple in pattern, often emphasised by Caithness Flag boundary walls. In this direction, the northern coastal light also becomes an increasingly dominant characteristic in addition to distant sea views.

3.17.2 Route 1a Thurso – The Mound

A Thurso – Latheron

From Thurso, the A9 rises up to the south, passing through a landscape that is largely agricultural in character, although views down to the River Thurso and surrounding hill tops, reveal local areas of less intensive land management. Generally, views are limited through this area by foreground features, such as field boundaries and buildings. The Georgemas road junction is also marked by a railway loading yard. From here, views are directed over the undulating open ground to the south-west and away from the rising slopes of Spittal Hill. These views reveal an open landscape and mixed composition of woodland, fields and houses, in addition to power lines.

At Mybster, views suddenly open up to the south-west across the open peatlands that form the eastern edge of the Flow Country. These views are dominated by the Causeymire wind farm, which is seen from this area as accommodating a marginal area of plantations, marginal croftland, powerlines and quarrying.

Once past the Causeymire wind farm, views are directed over the simple peatlands towards the distant and prominent hill range that includes Scaraben, Morven and Maiden Pap. These views are undistracted by the powerlines which, south of El Sub Station, run along the eastern side of the A9. To the south-west, the visual composition appears very simple – comprising a foreground and midground of simple peatland vegetation that extends far into the distance under wide open skies.

Travelling further south, Buolfruich wind farm becomes increasingly prominent to the south-west, compromising views to Scaraben and Morven. It appears to contrast to the horizontal emphasis and simplicity of the surrounding landscape with its vertical lines and formality of pattern. In addition, the hill form of Ben-a-chielt and its telecom masts become an increasingly prominent feature that marks the approach to Latheron.

B Latheron – Dunbeath

At Latheron, the junction of the A9 and A99 marks a changing emphasis of views to the coastline from the open moorland to the north. From this area, views are directed down the coastal slopes out to sea and towards the existing oil platforms. Along this stretch of road, the buildings and bridging point of Latheronwheel mark a distinctive focus; otherwise elements seem informally arranged along the coastal landscape.

C Dunbeath – Navidale

Dunbeath is notable for the road overpass of the river and village, which sweeps around in a curve, directing the eye outwards and to the scattering of crofts to the north and west of the settlement. From Dunbeath, the road ascends towards the Mains, during which views tend to be directed along the road and limited by the landform either side. From Ramscraigs, views are once again more open and elevated and directed towards the sea. Within this area, there is a distribution of residences that broadly relates to the linear form of the coast; however their variation of spacing, detailed orientation and style conveys a lack of clear pattern or cohesion. Exacerbated by mixed land use that includes powerlines, tracks and telecommunication masts, this creates a fairly confusing composition of elements.

As the road descends towards Berriedale, views become more contained by the landform and focused upon the route in front and the cluster of buildings around the river bridging point. This focus of views towards foreground details is complemented by a marked sense of enclosure and shelter that continues up towards Croc na Croiche. From here, the landscape seems markedly simple in composition, mainly comprising the forest plantations, the main road, pylons and simple moorland slopes. Views to the sea are largely screened by the convex nature of the coastal landform. This character of landscape largely continues as far as Navidale although, further to the west, the landscape opens up as the road winds around and over a series of ridges and glens, and views intermittently directed between the interior hill moorland and out to sea over elevated slopes.

D Navidale – Brora

From Navidale, the main road descends into the concentrated settlement of Helmsdale that is focused around a harbour and bridging point and where the historic importance of the sea is clearly evident in the distinct architecture of old merchant and fisherman residences. South of Helmsdale, the road seems pinned along the coastal edge, edged by interior hill slopes on one side and the railway and coast upon the other. However, beyond Portgower, the road runs along the interior edge of a distinct coastal shelf. This area comprises a marked composition of simple, interior moorland hills above a linear raised platform with a formal field pattern and occasional built foci, running down to the railway and coastal edge. Through this area, views from the road tend to be directed either to the south or east over the platform, with the sea forming a simple backcloth to the fore and midground pattern of elements. Approaching Brora, the coastal hills retreat to reveal a coastal plain fanning out either side of the river. This area accommodates a mixed pattern of residences and agriculture, with an interior emphasis of views.

E Brora – The Mound

South of Brora, the A9 runs along a brief section of coastal shelf again, although the contrast of landform profile is less distinct along this stretch and greater enclosure is created by adjacent woodland. Along this section, Dunrobin Castle forms the most prominent focal point, seen as a distinct point feature rising above the woodland and overlooking the sea to the east.

From Dunrobin, views to the sea become largely screened by woodland or built features, instead focusing within the settlement itself and the overshadowing presence of Beinn a' Bhragaidh behind with its distinct profile, simple texture, dark vegetation colour and landmark feature – the Duke of Sutherland monument. South of Golspie, there is again a section of coastal shelf, with views being directed south by interior steep slopes and passing across a formal landscape pattern of agricultural fields. This pattern is emphasised along this stretch of the A9 by distinctive stone walls and hedgerow trees. Approaching The Mound, views are directed over the Balblair plantations before being screened by road cuttings and adjacent trees before focusing upon Loch Fleet.

3.17.3 Route 2 Latheron – John o' Groats

A Latheron – Wick

From Latheron, the A99 broadly runs parallel to the coast over a fairly open and gently sloping landscape. Views within the foreground tend to be intermittently screened by buildings and roadside features so that views to the sea are only fleeting. Generally there is an informal scattering of houses throughout the landscape, with no obvious landscape pattern or limiting physical features; however, some concentrated settlements occur such as Lybster. There is an overriding horizontal emphasis of visual composition within this area, so that the sea horizon seems to extend fairly seamlessly from the onshore skyline.

North-east of Clyth, the landform changes markedly, becoming intricately undulating. This results in a containment of views within the area, focused towards the tops of small scale knolls such as the Hill of Yarrows and Warehouse Hill – the vertical form of which is emphasised by a number of small lochs and lochans. Within this area, there is a high number of archaeological features which create a distinct sense of history. Views to the sea tend to be limited to the hill tops.

The landform is again simple and gently sloping between Thrumster and Wick. Along this stretch of the A99, views mainly focus within the immediate setting, including on the masts at Thrumster and Loch Hempriggs. Views only tend to be directed towards the sea in the distance, as the sloping landform screens direct views towards the coast within the foreground.

B Wick – John o' Groats

North of Wick, the landscape is overwhelmingly open and horizontal in emphasis, with wide open views passing over a largely agricultural landscape. It is often difficult to discern the landscape pattern within this area, despite formal lines of fields and roads, due to it being overlain over almost flat ground. This means it is also often difficult to orient within the landscape. As such, distinct features such as the Reiss Lodge or Ackergill beach create valuable landmarks within the area.

North of Reiss, views pass across Sinclair's Bay. The A99 then follows a route closer to the sea, running roughly parallel to the coast. Along this stretch, there is a fairly informal scattering of residences; however, the pattern of these generally cannot be clearly discerned unless seen directly against a land backdrop such as at Skirza. Within this area, the emphasis of the landscape and visual composition remains horizontal, with a dominant sense of exposure beneath wide skies and an intense clarity of light. In this landscape, any vertical element stands out, e.g. Auckengill Tower, particularly at times when the sun is at a low angle in the sky.

Further north, the moorland surrounding Warth Hill creates a simple buffer to complex patterned crofting settlements to the north and south, and links the area back into the interior. However, at John o' Groats, the emphasis is back towards the sea and specifically the northern coastal edge, marked in places by high and dramatic sea cliffs. From this area, there is an overwhelming dominance of the sea – from the sense of exposure, sound of waves, coastal light and experience of changing weather conditions, to views along the coast to offshore islands and boats out to sea, and a distinct flora and fauna.

3.17.4 Route 2a John o' Groats – Latheron

A John o' Groats – Wick

Travelling south from John o' Groats, there is a mixed pattern of buildings, fences and fields visible within an overwhelmingly open and horizontal landscape. The presence of the coast nearby is evident by the distinctive light, habitat and vegetation conditions; however views to the coastal edge tend to be screened by the slope of the landform; views along the road are often unclear also, because of looking towards the prevalent direction of the sun.

The open moorland surrounding Warth Hill marks a change in emphasis, from the north to the east coast, and the main A99 starts to follow parallel to the coastline. Glimpse views are directed towards the interior moorland to one side, and the sea to the other; however these are interrupted by the presence of crofting settlements and residences that occur at fairly regular intervals along this route.

Proceeding towards Keiss, views are directed across Sinclair's Bay and the prominent linear feature of the Ackengill beach and links and the point foci of Castle Sinclair and Noss Head. The main road pivots around parallel to the bay, passing through an open and very exposed landscape. Within this composition, large industrial pipes are often seen around the Keiss coastal works, creating prominent human-made features.

From Reiss, views pass over the agricultural land around Aukergill towards the runway areas of Wick Airport and the east coast. The landscape pattern is formal and large scale in pattern so that point features stand out. The northern edge of Wick is fairly abrupt in contrast to this openness, with a mixture of commercial, industrial and residential buildings forming the entrance to the town.

B Wick – Latheron

Exiting Wick, the main A99 road is very straight and views tend to be directed straight along it towards the prominent masts at Thrumster, with coastal views screened by landform slopes. The landscape is overriding horizontal in emphasis. It is also very open and is agricultural in character with dispersed residences and farm building clusters. Travelling past Whiterow, views temporarily focus upon Hempriggs and the small hills beyond, before ascending to the focus of Thrumster. Further south, the road enters an area of small scale undulating hills and lochs and lochans around Yarrows. It is upon some of these local undulations that views are again directed out to sea, albeit intermittently screened by foreground features and slopes. Along some stretches, the line of these views focus directly upon the existing Beatrice oil platforms in the distance which act as a key focal feature within the open sea.

From Clyth, views alternate further depending on the elevation of the road, steepness of slopes either side and foreground features and landscape pattern. However along elevated and open stretches, views tend to be directed towards the sea to the south west and the distant silhouette of the Scaraben and Morven mountain range towards the west. Both these areas provide a valuable simple backdrop to the complex pattern of the landscape within the foreground.

Given the nature of the landscape and visual resource described above, the following table lists the sensitivity of separate sections of the sequential routes.

Table 12 Sensitivity of sequential landscape and visual resource to the proposed development type.

Route number	Route location	Section number	Section location	Landscape sensitivity	Visual sensitivity
1	The Mound – Thurso	A	The Mound – Brora	Low	Low
		B	Brora – Navidale	Low	Low
		C	Navidale – Dunbeath	Low	Medium
		D	Dunbeath – Latheron	Low	Low
		E	Latheron – Thurso	Medium	Medium
1a	Thurso – The Mound	A	Thurso –Latheron	Medium	Medium
		B	Latheron – Dunbeath	Low	Low
		C	Dunbeath – Navidale	Medium	Medium
		D	Navidale – Brora	Medium	Low
		E	Brora – The Mound	Low	Low
2	Latheron – John o' Groats	A	Latheron – Wick	Low	Low
		B	Wick – John o' Groats	Low	Medium
2a	John o' Groats – Latheron	A	John o' Groats – Wick	Low	Medium
		B	Wick – Latheron	Low	Medium

3.18 LANDSCAPE AND SCENIC VALUE

Landscape and scenic designations within the study area are shown in Figure 1. References to these designations, as they affect the sensitivity of the landscape and visual resource, are included within the descriptions of baseline conditions for these aspects. However a description of these designations is included below.

3.18.1 National Scenic Areas (NSAs)

NSAs are areas that are nationally important for their scenic quality, established by Order of the Secretary of State in 1981. Their sensitivity to change would usually be high. There are no NSAs within the study area.

3.18.2 Proposed Areas of Great Landscape Value (AGLVs)

Within the Highlands, AGLVs were selected mainly in the past to protect small local areas of scenic and recreational value. However, within the Highland Council Structure Plan (2001), a number of large proposed AGLVs were identified. These are generally areas that are seen as complementing the existing suite of NSAs. Confirmation of these proposed AGLVs will occur through the process of updating and replacing Local Plans within the Highlands. Given the regional or local importance of proposed AGLVs, these will usually be judged as having at least medium sensitivity to change.

There is one proposed AGLV lying within the study area as listed below and shown within Figure 1:

AGLV 1 – East Caithness hills and the Flow Country, extending to the Berriedale coast

However, an additional AGLV 2 lies just outside the eastern edge of the study area, extending from the Lothmore coast west across the coastal hills to Loch Fleet.

3.18.3 Inventory of gardens and designed landscapes

Sites listed in the Inventory of Gardens and Designed Landscapes are not statutory designations, but are protected through policies within the Structure Plan and are thus considered to usually have at least medium sensitivity to change. Gardens and Designed Landscapes included in the Inventory which lie within the study area are listed below.

Table 13 Inventory sites of garden and designed landscapes.

Entry	Grid reference	Assessment of Visual Significance
1 Langwell Lodge	ND 114 228	Scenic: Outstanding
2 Dunbeath Castle	ND 158 282	Scenic: Outstanding

3.18.4 Wild land and wildness

Wild land can be described as extensive areas where wildness (the quality) is best expressed . Within NPPG 14 wild land is defined as "uninhabited and often relatively inaccessible countryside where the influence of human activity on the character and quality of the environment has been minimal". SNH states[1] that its policy aim is that "there are parts of Scotland where the wild character of the landscape, its related recreational value and potential for nature are such that these areas should be safeguarded against inappropriate development or land-use change." The policy identifies a "preliminary search map for areas of wild land". It states that the purpose of this is not to "delimit wild land, but to act as a starting point for review of where the main resource of wild land is most likely to be found".

Search Areas for Wild Land (SAWL) are not a designation. However, planning authorities are required to take great care to safeguard areas of wild land character including assessment of development outwith these areas that might adversely affect them (NPPG14). Wild land, by its nature of openness and lack of development, tends to have a high sensitivity to change.

No SAWLs occur within the study area. However one SAWL is located upon the boundary of the north western edge of the study area. This area encompasses a wide area of interior peatland, known commonly as the Flow Country, in addition to the distinctive hills of Morven, Scaraben and Ben Alisky.

[1] *SNH policy statement Wildness in Scotland's Countryside 2002.*

4 POTENTIAL LANDSCAPE AND VISUAL IMPACTS

The proposed development would potentially have the following key impacts:

Landscape impacts:

- *introduction of a human-made element which forms a feature within the land and seascape and may reinforce the industrial character of existing features within the local area*
- *introduction of moving elements that would relate to the sense of exposure within the landscape, although movement of the WTG blades would rarely be discernible from the shore due to their far distance*
- *introduction of a feature that relates in its function to existing energy features within the landscape*
- *introduction of a feature that will act as a size indicator within the seascape whose scale and distance is otherwise difficult to discern*
- *the reinforcement of an existing landmark within the area.*

Visual impacts:

- *the introduction of a focal point within the land and seascape*
- *introduction of large scale vertical elements (wind turbines) within the landscape*
- *the creation of pattern in the relative arrangement of the wind turbines to each other and the existing platforms, changing the sense of simplicity of the visual composition*
- *introduction of a feature that will contrast in colour and texture to the surrounding seascape*
- *the introduction of lights within the seascape, although these will not be visible from the mainland.*

During construction, these impacts will, in the short term, be supplemented by additional impacts as listed below:

- *movement and presence of construction vessels to and on site*
- *erection of the wind turbines.*

5 MITIGATION

The proposed wind turbines have been sited according to two major factors as follows:

- *the presence of existing oil and gas infrastructure on the seabed around Beatrice*
- *the topography and depth of the seabed.*

No adjustments were recommended on landscape and visual grounds to the proposed siting. This was for two reasons: firstly it was provisionally assessed that the proposed wind turbines were sited in an arrangement that related well to the local landscape, seascape and visual resource; and, secondly, no scope for amendment was considered feasible on account of technical and practical limitations. The proposed wind turbine design was selected for its technical specification and energy output. Once again, no adjustments to this were recommended on landscape and visual grounds for the same reasons as described above with regards to turbine siting.

6 RESIDUAL IMPACTS

This section describes the residual landscape, seascape and visual impacts arising from the proposed wind farm development.

6.1 LANDSCAPE AND SEASCAPE RESOURCE

6.1.1 Local landscape character areas

This section describes the predicted landscape impacts upon distinct areas of combined landscape character types as listed in Table 6.

Landscape area 1 – Navidale Coastal Shelf

The proposed wind farm would be visible from most east facing slopes within this area, apart from around Ousdale and Borgue Langwell. However, as the hill landform is convex and curvaceous, views would be intermittently obscured and revealed as one moves through the landscape. Where visible, the wind turbines would be seen as two very distant elements located quite close to the existing platforms. They would appear as very small and minor features and not directly associated with the character of landscape onshore. As such they would not appear to greatly affect the existing sense of remoteness or rural character. Collectively the wind turbines would also appear as a single feature from this area that relates to the simplicity of land cover.

The movement of the wind turbine blades would be unlikely to be discernible from this area due to their far distance away. The red flashing lights upon the proposed turbines would not be visible from this area (visibility up to 20km from the turbines).

These impacts would not vary greatly during the proposed construction phase, although there may be increased activity in the form of boat movements, and a greater complexity of image due to construction machinery.

The existing Causeymire and the proposed Kilbraur wind farms would not be visible from within this area. However the existing Buolfruich and proposed Dunbeath and Gordonbush wind farms would be visible from the top of some of the coastal hills such as Creag Thoraraidh and Cnoc Bad Asgaraidh. These would appear as very minor and distant elements within the landscape, isolated with large areas of open landscape in between. They would obviously relate to each other and the proposed Beatrice wind turbines in function. However they would seem as separate and isolated foci and the proposed Beatrice wind turbines would appear more closely related to the existing oil platforms out to sea than the other onshore wind developments.

Landscape area 2 – Interior Hills

The proposed wind turbines would be visible from just the highest east facing slopes within this area. As such, they would only be visible when there is a wide panorama of view in many different directions and containing many different elements. Where and when visible, the wind turbines would be seen as two very distant elements located quite close to the existing oil platforms, but quite distant from the coast and thus would not seem to impinge upon the hill area itself. They would be seen beyond a midground coastal landscape that contains many human features, and thus not appear incongruous in character, nor seem to affect the existing sense of remoteness evident within the hill area. Collectively the wind turbines would appear as a single feature from this area and would not seem to compromise the simplicity of the pattern within this landscape.

The movement of the wind turbine blades would be unlikely to be discernible from this area due to their far distance away. In addition, the red flashing lights upon the proposed turbines would not be visible from this area (visibility up to 20km from the turbines).

These impacts would not vary greatly during the proposed construction phase, although there may be increased activity in the form of boat movements and a greater complexity of image due to construction machinery.

All of the existing and proposed wind farms considered by this assessment would be visible from some of the tops of the high hills within this area, apart from Kilbraur. Cumulative visibility would be particularly significant, however, from the area around the Scaraben ridge. Visibility of different wind farms from Scaraben are described within the viewpoint assessment for this location, viewpoint 4 and cumulative visibility is shown within the cumulative wireline, Figure 23. Although the proposed Beatrice wind turbines would seem to reinforce a line of developments that would appear to form a loose arc around this area, from the north to the east to the south-east, it would appear as only a tentative link between the other developments by comprising of only two turbines and being separated from the other developments by wide areas of open space.

Landscape area 3 – Interior Moorland and Marginal Crofting

The proposed wind turbines would theoretically be visible from most east facing slopes within this area. However, within many of these locations, views would be screened by foreground features such as forest plantations and buildings. In addition, where visible, the prominence of the turbines would often be diminished by the distracting influence of elements within the landscape pattern such as buildings, fencelines and telecom masts.

From this area, the proposed turbines would appear as very small and minor features within the open sea, most obviously associated with the adjacent platforms rather than onshore elements. Collectively with the platforms, the proposed turbines would seem to form a simple, concentrated and isolated feature that does not further exacerbate the confused pattern of elements on shore. As such, they would have a positive effect.

The movement of the wind turbine blades would be unlikely to be discernible from this area due to their far distance away. In addition, the red flashing lights upon the proposed turbines would not be visible from this area (visibility up to 20km from the turbines).

These impacts would not vary greatly during the proposed construction phase, although there may be increased activity in the form of boat movements and a greater complexity of image due to construction machinery.

The Buolfruich, Dunbeath and/or Causeymire wind farms are visible from much of the interior moorland and hills within this area, with more visibility of Buolfruich and Dunbeath in the south-west and more of Causeymire in the north-east, with small areas of overlap in between. In contrast, the proposed Kilbraur and Gordonbush wind farms would either be over 35km away or not visible. From within this area, dominant landscape characteristics relate to the interior moorland character and, as such, the proposed Beatrice wind turbines would seem removed from this, more closely associated with the existing offshore oil platforms rather than onshore developments. However, there would be some association of function by which the proposed Beatrice wind turbines may seem to extend the effect of the interior wind farms further to the south-east.

Landscape area 4 – South East Caithness Coastal Shelf

The proposed wind turbines theoretically would be visible from most coastal parts of this area, although visibility would often be limited a small way inland by the coastal landform. As the emphasis of views within this area is towards the sea, the wind turbines would appear as a key feature within offshore views. They would appear as very small and minor elements within the distance, forming part of an existing cluster that includes the existing platforms, rather than being directly associated with onshore features. As such, they would not exacerbate the existing complexity of pattern within the landscape and, rather, would distract attention from this by emphasising the focus offshore.

Although, by reinforcing the existing point feature of the platforms, the proposed turbines would contrast to the characteristic horizontal emphasis of the land and seascape, their small size within views would mean that they would not appear to compromise this quality, nor the overwhelming sense of openness and simplicity, of coastal views.

The movement of the wind turbine blades would be unlikely to be discernible from this area due to their far distance away. In addition, the red flashing lights upon the proposed turbines would not be visible from this area (visibility up to 20km from the turbines).

These impacts would not vary greatly during the proposed construction phase, although there may be increased activity in the form of boat movements and a greater complexity of image due to construction machinery.

The existing Causeymire wind farm and proposed Kilbraur and Gordonbush wind farms would not be visible from this area. The existing Buolfruich and proposed Dunbeath wind farms would potentially be visible from some elevated parts near to the coast as shown on Figures 8 and 9, although local screening may occur by foreground features. From this landscape area, characteristics tend to directly relate to the coast. This means that, if the separate wind energy developments would be seen in the directions of both coastal and inland areas, this balance would change, with the focus of attention split. This would have the effect of seeming to reduce the distinction between these areas.

Landscape area 5 – Yarrow Cnocs

The proposed wind turbines would theoretically be visible mainly from the southern part of this landscape area. However, even from here, visibility would be patchy on account of local screening by the undulating landform and foreground features. As views from this area do not particularly focus towards the sea, apart from the highest hill tops, the proposed wind turbines would not typically appear prominent from within this area.

From this area, where visible, the proposed turbines would appear as very small and minor features within the open sea, most obviously associated with the adjacent oil platforms, to create a collective minor focus. As such, they would not seem to impinge upon the remote and semi-enclosed character of this area and would, rather, reinforce the foreground landscape pattern that also comprises a patchy composition of point features.

The movement of the wind turbine blades would be unlikely to be discernible from this area due to their far distance away. In addition, the red flashing lights upon the proposed turbines would not be visible from this area (visibility up to 20km from the turbines).

These impacts would not vary greatly during the proposed construction phase, although there may be increased activity in the form of boat movements and a greater complexity of image due to construction machinery.

The existing Causeymire and Buolfruich wind farms are not visible within this area and the proposed Kilbraur and Gordonbush wind farms lie over 35km away and thus would not likely result in significant impacts. However the proposed Dunbeath wind farm would be visible from one small part of this landscape area, near to Warehouse Hill. From here the two developments would be seen in different directions and of very different character; Dunbeath seen in the distance within a mixed composition of hills and built elements, and Beatrice seen within the open sea as an isolated feature. As such, the proposed Beatrice wind turbines would not appear closely associated to the Dunbeath development.

A summary of the predicted landscape impacts of the proposed development on the local landscape character areas as described above is provided below:

Table 14 Summary of landscape impacts of Beatrice wind turbines on local landscape character areas.

			Construction*		Operation*	
Number	**Description/name**	**Sensitivity**	**Magnitude**	**Significance**	**Magnitude**	**Significance**
1	Navidale Coastal Shelf	Low	Low	Slight	Low	Slight
2	Interior Hills	Medium	Low	Moderate	Low	Moderate
3	Interior Moorland and Marginal Crofting	Low	Low +ve and -ve	Slight +ve and -ve	Low	Slight
4	South East Caithness Coastal Edge	Low	Low +ve and -ve	Slight +ve and -ve	Low	Slight
5	Yarrows Cnocs	Low	Low +ve and -ve	Slight +ve and -ve	Low	Slight

Table 15 Summary of cumulative landscape impacts of the Beatrice wind turbines on local landscape character areas.

		Dunbeath & Beatrice		Kilbraur & Beatrice		Gordonbush & Beatrice		Dunbeath, Kilbraur & Beatrice		Dunbeath, Gordonbush & Beatrice		Dunbeath, Gordonbush, Kilbraur & Beatrice	
Landscape area	**Sensitivity**	**Magnitude***	**Significance***	**Magnitude***	**Significance***	**Magnitude***	**Significance***	**Magnitude***	**Significance***	**Magnitude***	**Significance***	**Magnitude***	**Significance***
1	L	Ne	Ne	No	No	Ne	Ne	L	S	Ne	Ne	L	S
2	M	Ne	Ne	No	No	Ne	Ne	Ne	Ne	L	S	L	S
3	L	L	S	No	No	No	No	L	S	L	S	L	S
4	L	L	S	No	No	No	No	L	S	L	S	L	S
5	L	Ne	Ne	No	No	No	No	Ne	Ne	Ne	Ne	Ne	Ne

+ve = beneficial, -ve = adverse
** All impacts are adverse unless noted or outwith the study area, over 35km away*
Sensitivity and Magnitude: No=None, Ne=Negligible, L=Low, M=Medium, H=High
Significance: No=None, Ne=Negligible, S=Slight, Mo=Moderate, Sub=Substantial

6.1.2 Regional seascape units

Navidale Coastal Shelf

A Helmsdale

The proposed development would be visible from some parts of this seascape unit; however, it would not be prominent as views tend to focus in an alternative direction to the south-east. The proposed turbines would seem closely associated with the existing oil platforms and thus also seem to relate to the historic emphasis of the village on the marine environment. However, it would appear as a very distant, isolated feature from this distance and thus would not notably change the existing composition of elements within the land/seascape.

B Navidale – Berriedale

The proposed wind turbines would be visible from most coast facing slopes within this seascape unit, apart from around Ouscale and Borgue Langwell. From these areas, framing by hill slopes and a contrast of shape, positioning and colour to the simple fore and midground visual composition would result in the turbines being seen as a prominent feature that would increase the focus of views upon the sea environment from within this unit. These views, however, tend to occur only intermittently as one moves through the landscape and already focus on the proposed development site on account of the existing oil platforms.

South East Caithness Coastal Edge

A Berriedale – Latheronwheel

The proposed development would be visible along the coastal area of much of this unit. From these areas, the proposed turbines would be seen as a single isolated feature within an overriding horizontal visual composition of land, sea and sky. In this way, they would reinforce the focal qualities and character of the existing oil platforms. They would, however, not be highly prominent on account of the fact that the coastal landscape already contains numerous point foci which distract from these offshore features. In addition, they would also not significantly change the balance of attention between the land and seascape because of the very small proportion of offshore view that they would occupy.

B Latheronwheel – Helman Head

Within this unit, the similar horizontal emphasis of the on and offshore landscape means that the proposed development is unlikely to appear highly prominent as an isolated point feature out to sea, relating as it would to similar point features upon land. The existing focus of views towards the oil platforms would, however, be amplified, increasing the link between the on and offshore environments and reducing the contrasts of texture and pattern between them. This effect would mainly occur from the main A99 road when travelling south and from the ends of settlement access roads at the coast as most buildings are arranged perpendicular to the shoreline.

Table 16 Summary of impacts on the seascape characteristics of the proposed Beatrice wind turbines.

Landscape character area	Unit number	Unit name/ description	Sensitivity of receptors	Magnitude of impact*	Significance of impact*
Navidale Coastal Shelf	A	Helmsdale	Low	Negligible	Negligible
	B	Navidale – Berriedale	Low	Medium +ve and -ve	Moderate +ve and -ve
South east Caithness coastal edge	A	Berriedale – Latheronwheel	Low	Negligible	Negligible
	B	Latheronwheel – Sarclet Head	Low	Low +ve and -ve	Slight

+ve=beneficial, -ve=adverse
** All impacts are adverse unless noted*

6.2 VISUAL RESOURCE

6.2.1 Viewpoint 1 – Lybster

Predicted view during operation

The two proposed wind turbines would be clearly seen from this viewpoint in good visibility conditions, appearing in the main line of views from the end of the public road; however they would be seen as only minor elements due to the small proportion of the visible expanse of sea that they would occupy. These turbines would be seen closely associated with the existing oil platforms, that are clearly visible, and would collectively appear as a simple and isolated focal feature within the far distance, so that they do not compromise the simplicity of the foreground composition. The existing oil platforms and turbines would be seen to collectively form two, slightly separate, couples.

The proposed wind turbines would appear as a distinctly offshore feature, clearly separated from the nearest land mass by a large visible extent of sea. Nevertheless, they would relate to the local landscape character which includes many prominent built features along this part of the coast.

The complete turbine tower and blades would be visible from this viewpoint, appearing upon the sea horizon. However the movement of the blades would not be clearly discernible at this distance. In addition, the red flashing lights upon the proposed turbines would not be visible from this viewpoint (visible up to 20km from the turbines).

Predicted view during construction

During construction, the main operations that would be clearly visible would be the erection of the wind turbines using cranes in addition to the movement of boats accessing the site. Although visibility of cranes and boats at their base would confuse the distinctive image of the wind turbines' form, it is unlikely that this would have significant impacts given the short timescale of construction and the distance of the viewpoint from the proposed development (26km).

Cumulative impact

The ZTVs te that the existing Buolfruich wind farm and proposed Dunbeath wind farm could theoretically be visible from this location. However, the existing Buolfruich wind farm could not be seen while on site due to screening from adjacent buildings and it is predicted that the proposed Dunbeath wind farm would also not be visible for the same reason. Consequently the proposed Beatrice wind turbines would have no cumulative impact on the visual resource from this viewpoint.

6.2.2 Viewpoint 2 – Latheron

Predicted view during operation

The two proposed wind turbines would be clearly seen from this viewpoint in good visibility conditions, appearing prominent in offshore views. The proposed turbines would be seen in close association with the existing oil platforms and appear in a similar arrangement to them, as a closely spaced couple, as shown in detail within Appendix II. The prominence of these features results mainly from their isolation within a wide expanse of open sea, the direction of views towards them by the sloping landform and a lack of competing foci. Nevertheless the proposed wind turbines would appear as only small elements within the view and would collectively appear as a simple and isolated focal feature in the far distance, sufficiently separated from the coast that they do not seem to confuse the simplicity of the foreground visual composition.

Movement of the proposed wind turbine blades would not be clearly discernible at this distance (28km). In addition, the red flashing lights upon the proposed turbines would not be visible from this viewpoint (visible up to 20km from the turbines).

Predicted view during construction

During construction, the main operations that would be clearly visible would be the erection of the wind turbines using cranes in addition to the movement of boats accessing the site. Although visibility of cranes and boats at their base would confuse the distinctive image of the wind turbines' form, it is unlikely that this would have significant impacts given the short timescale of construction and the distance of the viewpoint from the proposed development.

Cumulative impact

The ZTVs in Figures 8-9 indicated that neither the existing Buolfruich and Causeymire wind farms, nor the proposed Dunbeath wind farm, would be visible from this viewpoint. The proposed Kilbraur and Gordonbush wind farms are located over 35km from this location and thus are unlikely to result in significant impacts. Consequently the proposed Beatrice wind turbines would have no or negligible cumulative impact on the visual resource from this viewpoint.

6.2.3 Viewpoint 3 – Dunbeath Heritage Centre

Predicted view during operation

The two proposed wind turbines would be visible from this viewpoint in good visibility conditions. When visible, these would appear as two very minor elements upon the sea horizon – as a couple of turbines slightly separated from a couple of platforms. As such, the turbines would appear closely associated with the platforms, rather than with the nearest land mass, although they would loosely relate to a number of vertical features within the foreground landscape such as pylons and telecommunication masts and the Buolfruich wind turbines which, although not visible from this viewpoint, can be seen from higher vantage points nearby.

When visible, the turbines would not appear within the centre of the view, but would rather be seen within the southern part of the expanse of sea visible. All of the turbines' tower and blades would be visible, although movement is unlikely to be discernible at this far distance from the viewpoint and the turbines would appear as only isolated minor features due to the small proportion of the visible expanse of sea that they would occupy.

The red flashing lights upon the proposed turbines would not be visible from this viewpoint (visible up to 20km from the turbines).

Predicted view during construction

During construction, it is likely that the only operations that would be clearly visible would be the erection of the wind turbines using cranes as well as additional boat movements. Although visibility of these would confuse the distinctive image of the wind turbines' form, it is unlikely that this would have significant impacts given the short timescale of construction and distance of the viewpoint from the proposed development (26km).

Cumulative impact

Neither the existing Buolfruich nor Causeymire wind farms are visible from this location, although Buolfruich is visible higher up the hill to the south-west. The cumulative ZTVs in Figures 9-10 indicate that the proposed Dunbeath wind farm would be visible from this location while the proposed Gordonbush wind farm would not. The proposed Kilbraur wind farm is located over 35km from the viewpoint and thus is unlikely to result in significant impacts.

From this location, the proposed Dunbeath wind farm would appear upon the skyline to the west. This would appear as a prominent feature, adding to the complex mixed composition of elements within the view. The proposed Beatrice wind turbines would be seen as contrasting to this feature in appearance and setting – seen looking in the opposite direction and as a very distant, isolated and simple feature within the open sea. As such, the Beatrice wind turbines would appear more closely linked in character to the existing oil platforms than the Dunbeath development, although there would be an obvious similarity in their function.

6.2.4 Viewpoint 4 – Scaraben

Predicted view during operation

The two proposed wind turbines would be visible from this viewpoint in good visibility conditions. When visible, these would appear as two very small elements of the view seen near to the existing oil platforms, occupying only a very small proportion of the visible expanse of sea. As such, they would be seen as a minor feature within the panorama that contains many other foci such as the existing Causeymire and Buolfruich wind farms, Ben-a-chielt, the ridge of Scaraben and peaks of Maiden Pap and Morven, and rivers, woodland patches and buildings. Consequently they would appear relatively insignificant as these other features appear more prominent, mainly on account of their shape, pattern, scale or proximity.

All of the wind turbine towers and blades would be seen from this viewpoint, lying below the skyline. They would appear as a couple, similar to the platforms nearby. Due to their isolated position upon the sea, it would require concentrated effort to focus upon these elements from this viewpoint.

The movement of the blades would not be clearly discernible at this distance. In addition, the red flashing lights upon the proposed turbines would not be visible from this viewpoint (visible up to 20km from the turbines).

Predicted view during construction

During construction, it is likely that the only operations that would be clearly visible would be the erection of the wind turbines using cranes. Although visibility of these would confuse the distinctive image of the wind turbines' form, it is unlikely that this would have significant impacts given the short timescale of construction and distance of the viewpoint from the proposed development (32km).

Cumulative impact

The existing Buolfruich and Causeymire wind farms are clearly visible from this viewpoint. The proposed Dunbeath wind farm would also be clearly visible from this viewpoint. It would be seen within part of the view that lies between the foreground horizon of the top of Scaraben and the existing Buolfruich wind farm (as shown in Figures 16j and 17d of the Dunbeath Wind Farm ES) and would appear as a very prominent feature that would dominate the view due to its proximity; this would also result in the wind farm seeming to impinge upon the character and experience of the area despite its obvious separation from the peak itself by its lower elevation. As an addition to this effect, the Beatrice wind turbines would appear as a very minor feature outside the main focus of views towards the proposed Dunbeath wind farm. Given its incomparable positioning, size and pattern within the view, it would seem more closely associated with the existing offshore oil platforms rather than the onshore wind farms, resulting in negligible cumulative impacts in addition to Dunbeath.

The cumulative ZTV presented in Figure 10 indicates that the proposed Kilbraur wind farm would not be visible from this viewpoint. However the proposed Gordonbush wind farm could be seen. Given the distance that this would be from the viewpoint (34km) and the fact that it lies in the direction most commonly facing the sun, it would not be prominent. Rather, it would appear as a very distant isolated element within a broad and mixed composition of hills. In addition to this, the proposed Beatrice wind turbines would appear as a similarly minor and isolated feature, although located within a very different setting and thus appearing to contrast in visual effect.

The key cumulative impact of the Beatrice wind turbines in addition to Buolfruich, Causeymire, Gordonbush and Dunbeath wind farms would be in appearing as a single element to the south-east that links a loose chain of wind farm developments from the south-west–north-west–north-east as shown in the cumulative wireline in Figure 23. However this would appear as a very tentative link due to the very contrasting visual character visible in these different directions and their apparent wide spacing apart.

6.2.5 Viewpoint 5 – A9 Berriedale/Borgue area

Predicted view during operation

The two proposed wind turbines would be seen from this viewpoint in good visibility conditions. When visible, these would appear as two very small elements of the view on account of their far distance, so that they do not diminish the simple composition of the foreground of coastal views. They would be seen near to the existing platforms, collectively the turbines and platforms forming two, slightly separated, couples. They would appear as a distinctly offshore feature, clearly separated from the nearest land mass.

When visible, the wind turbines would be seen to the east, within the main arc of views, although not in the dominant line of views when travelling along the A9 which is to the north-east or south-east.

All of the turbines' towers and blades would be visible from this viewpoint, appearing to extend below the visible sea horizon. However the movement of the blades would not be clearly discernible at this distance and the wind turbines would appear as isolated minor features due to the small proportion of the visible expanse of sea that they would occupy.

The red flashing lights upon the proposed turbines would not be visible from this viewpoint (visible up to 20km from the turbines).

Predicted view during construction

During construction, the main operations that would be clearly visible would be the erection of the wind turbines using cranes in addition to the movement of boats accessing the site. Although visibility of cranes and boats at their base would confuse the distinctive image of the wind turbines' form, it is unlikely that this would have significant impacts given the short timescale of construction and the distance of the viewpoint from the proposed development (26km).

Cumulative impact

The existing Buolfruich and Causeymire wind farms are not visible from this viewpoint. In addition, the ZTVs presented in Figures 9-10 indicate that the proposed Gordonbush wind farm would not be visible from this viewpoint, while the proposed Kilbraur wind farm lies over 35km from this viewpoint and thus would be unlikely to result in significant impacts. The ZTV reveals that only the proposed Dunbeath wind farm could be visible from this location.

From here, the proposed Dunbeath wind farm would be seen behind the viewpoint and, if visible, would be seen skylining above the existing complex pattern of built elements on the western side of the A9. As such, it would not appear closely associated with the proposed Beatrice wind turbines that would be seen when looking out to sea to the south-east of the viewpoint. As a consequence, the proposed Beatrice wind turbines would have only negligible cumulative visual impacts in combination with Dunbeath wind farm – contrasting greatly in its appearance on account of its greater distance from the viewpoint, its offshore setting and its clear visibility as a single feature within an open setting.

6.2.6 Viewpoint 6 – A9 Navidale

Predicted view during operation

The two proposed wind turbines would be visible from this viewpoint in good visibility conditions. When seen, these would appear as two very small elements of the view on account of their far distance. They would be seen near to the existing platforms, and thus associated with these rather than the nearest land mass. When visible, they would be seen within the main arc of views to the east. However, due to their isolated position upon the sea horizon on which there are no other features nearby, it would require concentrated effort to focus upon these elements, and they would seem as isolated minor features due to the small proportion of the visible expanse of sea that they would occupy.

All of the turbines' towers and blades would be visible from this viewpoint, skylining upon the horizon. However the movement of the blades would not be clearly discernible at this distance. In addition, the red flashing lights upon the proposed turbines would not be visible from this viewpoint (visible up to 20km from the turbines).

Predicted view during construction

During construction, it is likely that the only operations that would be clearly visible would be the erection of the wind turbines using cranes. Although visibility of these would confuse the distinctive image of the wind turbines' form, it is unlikely that this would have significant impacts given the short timescale of construction and distance of the viewpoint from the proposed development (33km).

Cumulative impact

Neither the existing Buolfruich or Causeymire wind farms are visible from this location, nor would be the proposed Dunbeath wind farm. Both the proposed Kilbraur and Gordonbush wind farms lie over 35km from this viewpoint and thus would be unlikely to result in significant impacts. Consequently the proposed Beatrice wind turbines would have no or negligible cumulative impact on the visual resource from this viewpoint.

6.2.7 Viewpoint 7 – Creag Riasgain

Predicted view during operation

The two proposed wind turbines would be visible from this viewpoint in good visibility conditions. When visible, these would appear as two very small elements of the view seen near to the existing oil platforms. These would appear below the sea horizon, close to where the hill landform to the north-east screens views to the sea. As such, the proposed turbines would not appear as prominent elements within the main focus of views towards the surrounding hill peaks or directly out to sea to the east.

Although the proposed turbines would appear as single point features when visible, and thus contrast to the characteristic simplicity of pattern and visual composition within this landscape, they would appear as only a very minor feature, occupying only a tiny proportion of the visible expanse of sea. They would also seem most closely associated with the existing offshore platforms rather than onshore characteristics, and would appear relatively insignificant in contrast to the more prominent foci within the landscape such as the peaks of Beinn Mhealaich, Ben uarie, Beinn Dhorain and Druim Deag.

All of the proposed wind turbines' towers and blades would be seen from this viewpoint, lying below the skyline. They would appear as a couple, similar to the platforms nearby.

The movement of the blades would not be clearly discernible at this distance. In addition, the red flashing lights upon the proposed turbines would not be visible from this viewpoint (visible up to 20km from the turbines).

Predicted view during construction

During construction, it is likely that the only operations that would be clearly visible would be the erection of the wind turbines using cranes in addition to additional boat movements. Although visibility of these activities would confuse the distinctive image of the wind turbines' form, it is unlikely that this would have significant impacts given the short timescale of construction and distance of the viewpoint from the proposed development (41km).

Cumulative impact

The existing Buolfruich and Causeymire wind farms are located over 35km from this viewpoint and thus would be unlikely to result in significant impacts. ZTVs also indicate that the proposed Dunbeath wind farm would not be visible from this viewpoint. However the proposed Kilbraur and Gordonbush wind farms would be visible to the south-east. The proposed Gordonbush wind farm would be approximately 16km away and the proposed Kilbraur wind farm would be approximately 31km away, so that they would appear as only small features upon the skyline beyond the foreground hills. In this way, the proposed Beatrice wind turbines would relate to these as a minor, distant isolated feature. However it would be seen in an alternative direction and within a very different setting of the open sea, more closely related to the existing oil platforms than the interior mixed hill composition in which Gordonbush and Kilbraur would be seen.

6.2.8 Viewpoint 8 – Brora golf course car park

Predicted view during operation

The proposed wind turbines would be visible from this viewpoint in only very good visibility conditions. When visible, these would appear as two very small elements of the view on account of their far distance and would occupy only a very small proportion of the panorama visible from this viewpoint. When visible, they would be seen within the main arc of views, to the east. However, due to their isolated position upon the sea horizon on which there are no other features nearby, it would require concentrated effort to focus upon these elements.

Only the blades and tower tops of the proposed turbines would be visible, skylining upon the horizon; however the distinction of these separate elements would not be clearly discernible at this distance and the turbines may actually be mistaken as different elements from this distance, such as boats.

The red flashing lights upon the proposed turbines would not be visible from this viewpoint (visible up to 20km from the turbines).

Predicted view during construction

During construction, it is likely that the only operations that would be clearly visible would be the erection of the wind turbine blades using cranes. Given the distance of the viewpoint from the proposed development (46km), it is unlikely that this would have any significant difference from views of the wind farm when operational as described above.

Cumulative impact

From this viewpoint the existing Buolfruich and Causeymire wind farms and the proposed Dunbeath wind farms are located over 35km and thus would be unlikely to result in significant impacts, while ZTVs indicate that the proposed Gordonbush wind farm would not be visible. ZTVs also reveal that the proposed Kilbraur wind farm would potentially be visible from this location; however site assessment has shown that the proposed development would not be seen within this area due to foreground screening by buildings. As a consequence, the proposed Beatrice wind turbines would not have any cumulative visual impacts from this viewpoint.

6.2.9 Viewpoint 9 – Tarbat Ness

Predicted view during operation

The two proposed wind turbines would be visible from this viewpoint in exceptionally good visibility conditions, appearing in the main line of views along the path towards the coast. However they would be seen as only very small minor elements due to their far distance away (49km) and the small proportion of sea expanse that they would occupy. In addition, only the proposed wind turbine blades would be visible upon the skyline – the proposed towers would be screened (as illustrated in detail within Appendix II). The existing oil platforms are not visible from this location.

The proposed turbines would be seen in the vicinity of the hill backdrop of east Sutherland that appears to protrude above the distant skyline. Given their clear separation from the viewpoint by a wide expanse of sea, this would result in them appearing most closely related to the distant visual composition, as a distinct offshore feature that does not compromise the simplicity of the visual composition within the foreground.

The red flashing lights upon the proposed turbines would not be visible from this viewpoint (visible up to 20km from the turbines).

Predicted view during construction

On account of the far distance of the proposed development and thus its small image size within views from this viewpoint, there would not be any discernible variation of the impacts described above during the construction phase.

Cumulative impact

The existing Buolfruich and Causeymire wind farms and the proposed Dunbeath wind farm are located over 35km from this viewpoint and thus would be unlikely to result in significant cumulative impacts. ZTVs reveal that the proposed Gordonbush wind farm would not be visible from this viewpoint, although the proposed Kilbraur wind farm could. This would be located approximately 24km away and would appear as a very minor element upon the distant hills. The proposed Beatrice wind turbines would not seem closely associated with this wind farm due to their further distance (49km) and location within a very different visual setting within the open sea. As such, they would only result in negligible cumulative visual impacts.

6.2.10 Viewpoint 10 – Lossiemouth

Predicted view during operation

The two proposed wind turbines would only be seen from this viewpoint during exceptionally good visibility conditions, appearing within the open sea. When visible, they would be seen as very small elements within the view due to their distance (44km) and isolated position within a wide expanse of sea.

Only the proposed turbine blades and hubs would be visible above the skyline; the towers would be screened. The existing oil platforms are also not visible from this viewpoint. The turbines would collectively appear as a simple and isolated feature within the far distance, clearly separated from the nearest land mass by a wide extent of sea and thus not compromising the simplicity of the foreground composition. In this way, they would appear as a distinctly offshore feature, most closely associated with boats seen on the sea, and may even be mistaken as being one of these. Movement of the wind turbine blades would not be discernible at this distance.

The proposed turbines would not appear incongruous to the character of the landscape in which this viewpoint occurs, as this includes many other built developments, including those associated with marine activities.

The red flashing lights upon the proposed turbines would not be visible from this viewpoint (visible up to 20km from the turbines).

Predicted view during construction

On account of the far distance of the proposed development and thus its small image size within views from this viewpoint, there would not be any discernible variation of the impacts described above during the construction phase.

Cumulative impact

All the other existing, approved or proposed wind farms assessed by this study occur over 35km from this viewpoint. Consequently it is judged that the proposed wind turbines would have none/negligible cumulative impact on the visual resource from this viewpoint.

6.2.11 Viewpoint 11 – Durn Hill

Predicted view during operation

The two proposed wind turbines would only be visible from this viewpoint during exceptionally good visibility conditions. When visible, these would be seen against the very distant landform backdrop of east Caithness and Sutherland (as shown in Appendix II). The two turbines would appear as two very small elements of the view on account of their far distance (53km), with one platform lining up to be seen between the two turbines and one seen to the east. The movement of the wind turbine blades would not be discernible at this distance.

When visible, the proposed wind turbines would be seen beyond views towards Sandend and Garron Point, rather than in the main focus of view to the north. Given the visible separation of the turbines from the Moray coast, they would seem more closely associated with the sea and distant Caithness and Sutherland coast than the immediate area surrounding the viewpoint. As such, they would not seem to affect the visual composition of this area.

The red flashing lights upon the proposed turbines would not be visible from this viewpoint (visible up to 20km from the turbines).

Predicted view during construction

On account of the far distance of the proposed development and thus its small image size within views from this viewpoint, there would not be any discernible variation of the impacts described above during the construction phase.

Cumulative impact

All of the other existing, approved or proposed wind farms assessed by this study occur over 35km from this viewpoint. Consequently it is judged that the proposed wind turbines would have none/negligible cumulative impact on the visual resource from this viewpoint.

Table 17 Summary of visual impacts of the Beatrice wind turbines.

			Construction*		Operation*	
View-point number	**Location**	**Sensitivity to proposed development**	**Magnitude**	**Significance**	**Magnitude**	**Significance**
1	Lybster	Low	Low	Slight	Low	Slight
2	Latheron	Low	Low	Slight	Low	Slight
3	Dunbeath Heritage Centre	Low	Low	Slight	Low	Slight
4	Scaraben	Medium	Low	Moderate	Low	Moderate
5	A9 Berriedale/ Borgue area	Low	Low	Slight	Low	Slight
6	A9 Navidale	Medium	Low	Moderate	Low	Moderate
7	Creag Riasgain	Low	Low	Slight	Low	Slight
8	Brora golf course car park	Low	Negligible	Negligible	Negligible	Negligible
9	Tarbat Ness	Low	Negligible	Negligible	Negligible	Negligible
10	Lossiemouth	Low	Negligible	Negligible	Negligible	Negligible
11	Durn Hill	Low	Negligible	Negligible	Negligible	Negligible

+ve=beneficial, -ve=adverse
** All impacts are adverse unless noted*

Table 18 Summary of cumulative visual impacts of the Beatrice wind turbines.

		Dunbeath & Beatrice		Kilbraur & Beatrice		Gordonbush & Beatrice		Dunbeath, Kilbraur & Beatrice		Dunbeath, Gordonbush & Beatrice		Dunbeath, Gordonbush, Kilbraur & Beatrice	
Viewpoint no.	**Sensitivity**	**Magnitude**	**Significance**	**Magnitude**	**Significance**	**Magnitude**	**Significance**	**Magnitude**	**Significance**	**Magnitude**	**Significance**	**Magnitude**	**Significance**
1	L	No	No	No/Ne	No/Ne	No/Ne	No/Ne	No	No	No	No	No	No
2	L	No/Ne	No/Ne	No/Ne	No/Ne	No/Ne	No/Ne	No/Ne	No/Ne	No/Ne	No/Ne	No/Ne	No/Ne
3	L	Ne	Ne	No/Ne	No/Ne	No	No	Ne	Ne	Ne	Ne	Ne	Ne
4	M	Ne	Ne	No	No	Ne	Ne	Ne	Ne	L	Mo	L	Mo
5	L	Ne	Ne	No/Ne	No/Ne	No/Ne	No/Ne	Ne	Ne	Ne	Ne	Ne	Ne
6	M	No	No	No/Ne	No/Ne	No/Ne	No/Ne	No/Ne	No/Ne	No/Ne	No/Ne	No/Ne	No/Ne
7	L	No/Ne	No/Ne	No	No	No	No	No/Ne	No/Ne	No/Ne	No/Ne	No/Ne	No/Ne
8	L	No/Ne	No/Ne	Ne	Ne	No	No	Ne	Ne	No/Ne	No/Ne	Ne	Ne
9	L	Ne/No	Ne/No	Ne	Ne	No	No	No/Ne	No/Ne	No/Ne	No/Ne	No/Ne	No/Ne
10	L	No/Ne	No/Ne	No/Ne	No/Ne	No/Ne	No/Ne	No/Ne	No/Ne	No/Ne	No/Ne	No/Ne	No/Ne
11	L	No/Ne	No/Ne	No/Ne	No/Ne	No/Ne	No/Ne	No/Ne	No/Ne	No/Ne	No/Ne	No/Ne	No/Ne

+ve = beneficial, -ve = adverse
** All impacts are adverse unless noted*
Sensitivity and Magnitude: No=None, Ne=Negligible, L=Low, M=Medium, H=High
Significance: No=None, Ne=Negligible, S=Slight, Mo=Moderate, Sub=Substantial

6.3 SEQUENTIAL LANDSCAPE AND VISUAL IMPACTS

Figure 22 shows the sections of the A9 and A99 that would have visibility to the proposed Beatrice wind turbines between The Mound to Thurso and to John o' Groats. Figures 8-10 show from where there would also be visibility to either the existing Causeymire and Buolfruich wind farms or the proposed Kilbraur, Gordonbush and Dunbeath wind farms. These maps have been used as a tool to assess the sequential impacts of the Beatrice wind turbines in combination with the other wind farms being addressed by this assessment. These impacts are described within the following section.

6.3.1 Route 1 A9 The Mound – Thurso

A The Mound – Brora

From The Mound, the proposed development could theoretically be visible to the north-east, with the two turbines appearing upon the skyline. However this would only be possible where at raised elevations, as visibility of the proposed development within this area at sea level would be prevented by the curvature of the earth. Where visible, only the turbine blades would be seen and the existing oil platforms are out of sight; this visibility however would not occur in the dominant direction of views to the south-east.

Potential visibility shown upon Figure 3, north of Golspie, would be prevented by surrounding woodland and so the proposed wind turbines would not again be potentially visible until the stretch of road between Doll and Brora. Within this area, however, as described within the baseline conditions, the variable nature of the local landform intermittently screens coastal views as well as these being deflected by the route of the railway (and its associated fencing). Where visible, potential views are represented by viewpoint 8, Brora golf course car park, where only the blades of the proposed turbines would be visible.

From the Mound to Brora, the existing Causeymire and Buolfruich wind farms and the proposed Dunbeath wind farm are located over 35km distant and thus are/would be unlikely to result in significant impacts, while ZTVs reveal that the proposed Gordonbush wind farm would not be visible. Although ZTVs also indicate that the proposed Kilbraur wind farm would theoretically be visible around the Golspie Burn and on the approach to Brora, views from the former area are screened by trees within the foreground and views from the latter would be behind the viewer, to the west.

B Brora – Navidale

North of Brora, although the proposed wind turbines would theoretically be visible, these would not occur within the main focus of views towards the coastal hills as described within the baseline conditions. However, from Crakaig, views are directed towards the existing oil platforms and would too focus upon the proposed wind turbines. Along this stretch the proposed development would appear closely associated with the existing platforms, reinforcing the presence of these as an offshore feature that seems isolated by its location out to sea, but would otherwise relate to other minor foci within the foreground landscape. As such, although the proposed development would be visible, it would not appear to change the intrinsic character of the coastal shelf.

Proceeding further north towards Helmsdale, the proposed development, like the existing oil platforms, would appear less prominent as they are seen to the side of the main views before becoming focused upon the settlement of Helmsdale itself.

Between Brora and Navidale, the existing Buolfruich wind farm and the proposed Dunbeath, Kilbraur and Gordonbush wind farms would not be visible. The Causeymire wind farm is located over 35km away and thus would be unlikely to result in significant impacts.

C Navidale – Dunbeath

North of Helmsdale, travelling around the Navidale Braes, views would again be directed towards the proposed wind turbines – from here creating a simpler and fairly prominent feature against a simple foreground land and seascape composition. However, along this stretch, the development would only be visible intermittently as the road winds back and forth around the landform and only occasionally is in line to face the proposed wind turbines. Views within this area are represented by viewpoint 6. As can be seen in Figures 16a and 16b, the proposed wind turbines would be seen as two separate elements closely associated with the couple of oil platforms close by. They would collectively appear as a very small isolated feature within the sea.

Over the Ord, the proposed wind turbines would be visible near to the existing oil platforms. However, within these views, they would tend to be seen as just a very small part of the very wide horizon visible and thus would not appear prominent. From here, views would then be screened by the landform, apart from a short stretch north of Ousdale (although, even here, views may be screened by foreground features).

At Berriedale, views to the proposed development would, in the main, be screened by the landform; and, even where theoretically visible, they would not tend to focus on the proposed development as views within this area tend to be directed towards the road and foreground landscape. However, above Berriedale braes, travelling north, the proposed wind turbines would theoretically become visible along most of the A9 as the landscape and coastal views open up. Within this area, the proposed wind turbines would be clearly visible, as represented by viewpoint 5 and shown in Figures 15a and 15b. However, importantly, they would appear to the side of the main focus of views when travelling along the road. As such, they would be seen within brief glimpses away from the road, rather than as a sustained view focused in their direction. Where visible, the turbines would appear partially below the visible horizon and as two distinct elements, closely associated with the existing oil platforms by their proximity and similar pair arrangement.

The study areas of the proposed Kilbraur and Gordonbush wind farms extend only as far as Berriedale and Latheronwheel respectively, so visibility beyond these points is unlikely to result in significant impacts and would thus not be discussed further for this route.

Between Navidale and Dunbeath, the Causeymire wind farm would not be visible. The proposed Dunbeath wind farm would be visible along the A9 south of Berriedale and around Borgue. It would also be visible on the approach to Dunbeath, as too is the existing Buolfruich wind farm. Along this stretch, where the proposed Beatrice wind turbines would also be visible, the Dunbeath and Buolfruich wind farms would appear upon the hills above Dunbeath, their pattern increasing the complexity of the visual composition. In contrast, the proposed Beatrice wind turbines would appear as a simple, single isolated focus within the open sea, more closely associated with the existing offshore oil platforms than the onshore developments.

D Dunbeath – Latheron

Entering Dunbeath, views towards the proposed development would mainly be screened or distracted by existing prominent features within the fore and midground landscape composition. However glimpse views to the proposed wind turbines, as represented by viewpoint 3, may be seen. From here, the proposed wind turbines would appear closely associated with the existing platforms and collectively form an isolated feature that relates to other vertical structures within the foreground landscape, including the Buolfruich wind farm and telecommunication masts upon Ben-a-chielt.

North of Dunbeath, the proposed wind turbines, similar to the existing oil platforms, would become less obvious within coastal views as these would appear to the side of the key direction of view towards the north-east and thus outside the motorist's main cone of vision. Views to the proposed development would also be distracted by the confusing pattern of elements that often occurs within the foreground of this area. However, where visible, as represented by viewpoint 2, the proposed turbines would be seen to form two closely spaced vertical features.

The arrangement of these would appear to relate closely to the existing oil platforms and they would collectively appear as isolated pairs within the open sea.

Between Dunbeath and Latheron, the ZTV in Figure 8 reveals that there would be no visibility of the Causeymire wind farm. However there would be potential visibility of the existing Buolfruich wind farm along this stretch of the road around Latheronwheel, although this is likely to be partially screened by structures and vegetation in the foreground and would be in a direction slightly behind the viewer. There would also be potential visibility of the proposed Dunbeath wind farm around Knockinnon, although this too would require viewing slightly behind the viewer. As a consequence, the proposed Beatrice wind turbines would not result in significant cumulative impacts along this stretch of the A9.

E Latheron – Thurso

From Latheron, the proposed wind turbines would not be visible in views travelling north. Although they could still potentially affect the experience of the landscape as a sequential feature, and specifically the cumulative effect of the Dunbeath, Buolfruich and Causeymire wind farms, it is predicted that this would not occur on account of the fact that previous views to the proposed Beatrice wind turbines along this route would have been seen from a very different character of land and seascape. As such, this would not seem associated or linked to the landscape experience between Latheron and Thurso.

6.3.2 Route 1a Thurso – The Mound

A Thurso – Latheron

The proposed wind turbines would not be visible between Thurso and upper Latheron. When seen near to Latheron however, their form would be more clearly recognisable on account of the fact that the Causeymire and Buolfruich wind farms would have just been passed along this route. Although descending towards Latheron, the proposed wind turbines would be visible, as represented by viewpoint 2, coastal views are not focused straight in this direction and are also distracted by a multitude of foreground elements of the landscape and visual resource.

The proposed Dunbeath wind farm would also be visible along the route between Spittal and Latheron. This development would be seen in the same direction as the Causeymire and Buolfruich wind farms. Cumulatively it would be likely to change the character of this area as a landscape dominated by wind energy. As such, when the Beatrice wind turbines would be visible, approaching Latheron, they could appear to tentatively extend this character area further southwards offshore, almost as a remote outlier.

B Latheron – Dunbeath

From Latheron, travelling south, the proposed wind turbines would be clearly visible from most stretches of the road and attention would be directed towards them by the slope of the land down to sea. However, the proposed turbines, alike the existing oil platforms, would be seen to the side of the main focus of views which is towards the south-west and, as a consequence, would be most likely experienced within brief glimpses as one moves through the landscape. Where visible, as represented by viewpoint 2, the proposed wind turbines would be seen as a distinct pair of vertical elements, closely associated with the existing platforms, but otherwise seen as a small isolated feature upon the horizon.

The proposed Dunbeath wind farm would be visible approaching Latheronwheel and Dunbeath as represented by viewpoint 15 within the Dunbeath ES. From this stretch of road, it can be seen that the proposed Dunbeath wind farm would have significant visual impacts. This means that, if the proposed Dunbeath wind farm was built, it would become the dominant focus of views in this area and thus would distract views away from the proposed Beatrice wind turbines.

C Dunbeath – Navidale

From Dunbeath, travelling south, the proposed wind turbines would be seen out of the main line of view. However they would be visible to the side as represented by viewpoint 5 from the Berriedale/Borgue area; indeed, views may be particularly steered in this direction at times when trying to avoid looking directly into the sun when it is shinning from the south-west. When visible, the proposed development would appear as a distinct isolated pair of elements within the open sea, directly associated with the existing oil platforms nearby.

Between Dunbeath and Navidale the existing Causeymire and Buolfruich wind farms and the proposed Dunbeath wind farm are located behind the viewer travelling south. As such, the proposed Beatrice wind turbines would not result in significant cumulative impacts with them. As a consequence, these wind farms are not considered further within this assessment travelling south.

D Navidale – Brora

E Brora – The Mound

From Navidale to The Mound, the proposed Beatrice wind turbines would be seen behind the main direction of views. Although previous visibility can affect the experience of a landscape and visual resource further along a route, it is predicted that this would not be the case along the A9 for the proposed development. This is mainly on account of the fact that, where previously visible, the proposed development would have appeared as a single isolated feature within the open sea that did not change the character of the landscape from which it was viewed. Consequently, it would not seem to change the wider occurrence of that landscape character type if encountered further along the route.

Between Navidale and Brora, ZTVs reveal that neither the proposed Kilbraur nor Gordonbush wind farms would be visible. In addition the Gordonbush wind farm would also not be visible between Brora and The Mound. However the Kilbraur wind farm would potentially be visible when travelling out from Brora and through Doll, seen to the west. Although sequential cumulative impacts can extend along a route even with intermittent visibility, the proposed Beatrice wind turbines would have been last seen approximately 11 miles earlier. Given this distance and the change in landscape character that occurs south of Brora, it is considered that the previous visibility of the Beatrice wind turbines would not result in significant cumulative impacts when Kilbraur is seen within this area.

6.3.3 Route 2 Latheron – John o' Groats

A Latheron – Wick

Around Latheron, as discussed for route 1 above, the proposed wind turbines would be seen outside the main direction of views towards the north-east. However, where visible to the side of the key views, the proposed wind turbines, as represented by viewpoint 2, would be seen as two small isolated elements upon the skyline, directly associated with the existing oil platforms. Given their visual separation from land, they would not appear to confuse the pattern of landscape elements within the foreground, but would rather relate to other vertical features onshore such as telecommunication masts and pylons (their disparity of scale unimportant due to their distance apart and lack of key scale indicators upon the sea).

Travelling north, Figure 22 indicates that the proposed development would not be visible along the A99 between Thrumster and Wick.

Between Latheron and Wick, the existing Causeymire and Buolfruich wind farms and proposed Dunbeath wind farm would be behind the viewer and thus not be notable within views.

B Wick – John o' Groats

North of Wick, Figure 22 indicates that the proposed development would not be visible from most areas between Wick and John o' Groats. There are, however, a few locations from where it would theoretically be visible around Nybster, Hill of Harley and Warth Hill, although, even in these locations, the proposed development would be behind the main line of views towards the north. As such the proposed turbines would not be prominent, exacerbated also by the fact that they would be located over 50km away.

Even when behind the viewer, previous visibility of a feature can affect the experience of the landscape and visual resource further along a route. However it is predicted that this would not be the case along the A99, travelling towards John o' Groats. This is mainly because, where previously visible, this would have been part of an experience of the landscape that would have been distinctly different in character, with more emphasis to the east than the north; consequently the impacts of the development associated would be restricted to an area to south. In addition, the proposed development would have seemed to relate to the existing character of the onshore landscape and visual resource by appearing as a single isolated feature, for example comparable to other point features such as the tower at Reiss. As such they would not have seemed to change it in any way that would alter the experience of that resource further on.

Between Wick and John o' Groats, the existing Causeymire and Buolfruich wind farms and proposed Dunbeath wind farm would be behind the viewer and thus not be notable within views.

6.3.4 Route 2a John o' Groats – Latheron

A John o' Groats – Wick

Travelling south from John o' Groats to Wick, Figure 22 indicates that the proposed development would theoretically only be visible within three short stretches at Nybster, Hill of Harley and Warth Hill. All of these locations however are over 50km from the proposed development and thus visibility of the proposed turbines would be limited due to partial screening by earth curvature. Consequently the proposed turbines would only be visible in exceptional visibility and weather conditions and, when visible, would appear as two very distant elements within the open sea expanse.

Between John o' Groats and Wick, the proposed Dunbeath wind farm would be visible within the Keiss area, as too would be the existing Buolfruich and Causeymire wind farms. Within this area, these would be seen broadly within the same cone of vision when travelling south. They would however appear very different from the proposed Beatrice wind turbines that would have been seen previously as described above. In contrast they would appear as part of a complex and overlapping pattern of elements within the distant interior view, rather than as an isolated and concentrated feature within the open sea.

B Wick – Latheron

Figure 22 indicates that the proposed wind turbines would not be visible between Wick and Thrumster. Between Thrumster and Latheron, travelling south, there would be repeated glimpse views to the proposed wind turbines and existing oil platforms, intermittently screened in between by foreground structures and the coastal landform. Views from within this area are represented by viewpoint 2, Latheron. Views would focus upon the existing platforms and wind turbines when in line with them. From here, they would collectively appear as quite a prominent feature within the open sea, although still appearing small within the visual composition at over 25km away.

Between Wick and Latheron, the existing and proposed onshore wind farms assessed as part of this cumulative study would largely not be visible. However, between Clyth and Latheron, Buolfruich wind farm is visible in patches, while the proposed Dunbeath wind farm would be visible along much of this stretch of the A9, apart from where screened by foreground elements. In combination with these, the Beatrice wind turbines would be seen in the opposite direction to the south-east and would appear very different in character, as a single isolated and distant feature within the open sea. However they would appear similar in function and, in this way, the proposed Beatrice turbines could seem to weakly extend the impact of the onshore wind farms across the area into the offshore environment.

Measures for the potential sequential landscape and visual impacts described above are summarised within the following table.

Table 19 Summary of sequential landscape and visual impacts of the Beatrice wind turbines.

		landscape resource			visual resource		
Route	**Section**	**Sensitivity**	**Magnitude***	**Significance***	**Sensitivity**	**Magnitude***	**Significance***
1	A	Low	Negligible	Negligible	Low	Negligible	Negligible
	B	Low	Negligible	Negligible	Low	Low	Slight
	C	Low	Low	Slight	Medium	Low	Moderate
	D	Low	Negligible	Negligible	Low	Negligible	Negligible
	E	Medium	None	None	Medium	None	None
1a	A	Medium	Negligible	Negligible	Medium	Negligible	Negligible
	B	Low	Low	Slight	Low	Low	Slight
	C	Medium	Negligible	Negligible	Medium	Negligible	Negligible
	D	Medium	None	None	Low	None	None
	E	Low	None	None	Low	None	None
2	A	Low	Negligible	Negligible	Low	Negligible	Negligible
	B	Low	Negligible	Negligible	Medium	Negligible	Negligible
2a	A	Low	Negligible	Negligible	Medium	Negligible	Negligible
	B	Low	Low	Slight	Medium	Low	Moderate

** All impacts are adverse unless noted*

Table 20 Summary of cumulative sequential landscape impacts of the Beatrice wind turbines.

		Dunbeath & Beatrice		Kilbraur & Beatrice		Gordonbush & Beatrice		Dunbeath, Kilbraur & Beatrice		Dunbeath, Gordonbush & Beatrice		Dunbeath, Gordonbush, Kilbraur & Beatrice	
Section	**Sensitivity**	**Magnitude**	**Significance**	**Magnitude**	**Significance**	**Magnitude**	**Significance**	**Magnitude**	**Significance**	**Magnitude**	**Significance**	**Magnitude**	**Significance**
1a	L	No/Ne	No/Ne	Ne	Ne	No	No	No/Ne	No/Ne	No/Ne	No/Ne	No/Ne	No/Ne
1b	L	No	No	No	No	No	No	No	No	No	No	No	No
1c	L	L	S	No	No	No	No	L	S	L	S	L	S
1d	L	Ne	Ne	No	No	No	No	Ne	Ne	Ne	Ne	Ne	Ne
1e	M	Ne	Ne	No	No	No	No	Ne	Ne	Ne	Ne	Ne	Ne
1aa	M	L	Mo	No	No	No	No	L	Mo	L	Mo	L	Mo
1ab	L	Ne	Ne	No	No	No	No	Ne	Ne	Ne	Ne	Ne	Ne
1ac	M	Ne	Ne	No	No	No	No	Ne/No	Ne/No	Ne/No	Ne/No	Ne/No	Ne/No
1ad	M	Ne/No	Ne/No	Ne	Ne	No	No	Ne/No	Ne/No	Ne/No	Ne/No	Ne/No	Ne/No
1ae	L	Ne/No	Ne/No	Ne	Ne	No	No	Ne/No	Ne/No	Ne/No	Ne/No	Ne/No	Ne/No
2a	L	Ne	Ne	Ne/No	Ne/No	Ne/No	Ne/No	Ne	Ne	Ne	Ne	Ne	Ne
2b	L	Ne	Ne	Ne/No	Ne/No	Ne/No	Ne/No	Ne	Ne	Ne	Ne	Ne	Ne
2aa	L	Ne	Ne	Ne/No	Ne/No	Ne/No	Ne/No	Ne	Ne	Ne	Ne	Ne	Ne
2ab	L	L	S	Ne/No	Ne/No	Ne/No	Ne/No	L	S	L	S	L	S

Table 21 Summary of cumulative sequential visual impacts of the Beatrice wind turbines.

		Dunbeath & Beatrice		Kilbraur & Beatrice		Gordonbush & Beatrice		Dunbeath, Kilbraur & Beatrice		Dunbeath, Gordonbush & Beatrice		Dunbeath, Gordonbush, Kilbraur & Beatrice	
Route and section	Sensitivity	Magnitude	Significance	Magnitude	Significance	Magnitude	Significance	Magnitude	Significance	Magnitude	Significance	Magnitude	Significance
1a	L	Ne/No	Ne/No	Ne	Ne	No	No	Ne/No	Ne/No	Ne/No	Ne/No	Ne/No	Ne/No
1b	L	No	No	No	No	No	No	No	No	No	No	No	No
1c	M	L	M	No	No	No	No	L	M	L	M	L	M
1d	L	Ne	Ne	No	No	No	No	Ne	Ne	Ne	Ne	Ne	Ne
1e	M	Ne	Ne	No	No	No	No	Ne	Ne	Ne	Ne	Ne	Ne
1aa	M	Ne	Ne	No	No	No	No	Ne	Ne	Ne	Ne	Ne	Ne
1ab	L	L	S	No	No	No	No	L	S	L	S	L	S
1ac	M	Ne	Ne	No	No	No	No	Ne/No	Ne/No	Ne/No	Ne/No	Ne/No	Ne/No
1ad	L	Ne/No	Ne/No	Ne	Ne	No	No	Ne/No	Ne/No	Ne/No	Ne/No	Ne/No	Ne/No
1ae	L	Ne/No	Ne/No	Ne	Ne	No	No	Ne/No	Ne/No	Ne/No	Ne/No	Ne/No	Ne/No
2a	L	Ne	Ne	Ne/No	Ne/No	Ne/No	Ne/No	Ne	Ne	Ne	Ne	Ne	Ne
2b	M	Ne	Ne	Ne/No	Ne/No	Ne/No	Ne/No	Ne	Ne	Ne	Ne	Ne	Ne
2aa	M	L	Ne	Ne	Ne/No	Ne/No	Ne/No	Ne/No	Ne	Ne	Ne	Ne	Ne
2ab	M	Ne	Ne	Ne/No	Ne/No	Ne/No	Ne/No	Ne	Ne	Ne	Ne	Ne	Ne

+ve=beneficial, -ve=adverse
** All impacts are adverse unless noted*
Sensitivity and Magnitude: No=None, Ne=Negligible, L=Low, M=Medium, H=High
Significance: No=None, Ne=Negligible, S=Slight, Mo=Moderate, Sub=Substantial

6.4 LANDSCAPE AND SCENIC VALUE

The proposed development is not located within any designated landscapes and, as such, would result in no direct impacts upon these. However it would indirectly impact upon a number of designated areas as described below.

6.4.1 Proposed Areas of Great Landscape Value (pAGLV)

The proposed development would be visible from parts of one pAGLV (labelled 1 on Figure 1) within the study area that extends across the east Caithness hills and Flow Country to the Berriedale coast. This area extends along the coastal edge of the pAGLV, along the ridge behind Langwell House and along the eastern side of the Scaraben ridge. This forms just a small part of the entire pAGLV and the proposed development would only be visible along short stretches of the A9 – the access route from which most people experience the area, as shown in Figure 6a. It would however be visible from some parts of the coastal footpaths to Badbea and Croc na Croiche.

Where visible from within the pAGLV, the proposed wind turbines would mainly be seen as a very distant isolated feature, as represented by viewpoints 4 and 5 described above. As such, the proposed development would appear as a distinct offshore element, associated with the existing oil platforms, rather than seeming to impinge upon the qualities of the pAGLV onshore. In addition, the proposed turbines would relate to existing vertical features within the coastal parts of the pAGLV such as the existing electricity pylons and a wind turbine at Langwell.

The proposed development would also be visible from the far north eastern part of a pAGLV that extends from the Lothmore coast west across the coastal hills to Loch Fleet. This lies just outside the study area; however visual impacts are represented by viewpoint 7, Creag Riasgain.

6.4.2 Garden and Designed Landscapes (G&DL)

Within the study area, the proposed development would be visible from only two Garden and Designed Landscapes, Langwell Lodge and Dunbeath Castle, as shown in Figure 1. The characteristics and qualities of these landscapes are described within 'An Inventory of Gardens and Designed Landscapes in Scotland, Volume 3: Highland, Orkney and Grampian' (1987) and 'An Inventory of Gardens and Designed Landscapes, Supplementary Volume 2, Highlands and Islands'.

Dunbeath Castle

The Inventory shows that this G&DL is very small and forms a narrow strip running from the A9 to the coast. The ZTV (Figure 6b) demonstrates that, theoretically, the proposed development would be visible across the entire site. However, views to the development would be limited mainly to the coastal edge and the castle itself due to the screening of views by trees and built features.

Viewpoint 3 represents the nature of views to the proposed development from the area (Figure 13a), while Figure 24 shows a wireline from the G&DL itself. This reveals that the proposed wind turbines would be visible upon the skyline within the centre of the view. They would be seen as very small elements, closely associated with the existing oil platforms, and forming a similar couple arrangement. As such, they would appear as an extension to the existing offshore feature, reinforcing the existing focus of views to the south-east, rather than distracting from the existing direction of attention. The movement of the turbine blades would not be clearly discernible at this distance (approximately 27km).

During construction, it is likely that the only operations that would be clearly visible would be the erection of the wind turbines using cranes as well as additional boat movements. It is unlikely that this would have significant impacts different from the operational impacts described above given the short timescale of construction and distance of the viewpoint from the proposed development.

Langwell Lodge

The Inventory indicates that this G&DL extends from Berriedale along the slopes of the Langwell water. The ZTV (Figure 6a) shows that the proposed development would only be visible from the open parts of the site immediately around the house. From here, views are represented by viewpoint 5 (Figures 15a and 15b), while Figure 24 shows a wireline diagram from the G&DL itself.

The proposed development would appear within the central focus of views that are framed by the glen slopes through which the Berriedale and Langwell waters pass out to the sea. The turbines would be seen closely associated with the existing oil platforms, and seen to take a similar arrangement as a distinct couple. They would appear as two very small elements upon the skyline on account of their far distance (approximately 28km) and the movement of the turbine blades would not be clearly discernible.

During construction, it is likely that the only operations that would be clearly visible would be the erection of the wind turbines using cranes as well as additional boat movements. It is unlikely that this would have significant impacts different from the operational impacts described above given the short timescale of construction and distance of the viewpoint from the proposed development.

6.4.3 Search Area for Wild Land (SAWL)

A proposed SAWL lies near the boundary of the study area for the proposed Beatrice wind turbines. This area encompasses a wide area of interior peatland, known commonly as the Flow Country, in addition to the distinctive hills of Morven, Scaraben and Ben Alisky. Impacts from this area are represented by viewpoint 4 (Scaraben) and local landscape areas 2 and 3, Interior Hills and Interior Moorland and Marginal Crofting respectively.

From the edge of this SAWL, the proposed wind turbines would be visible upon the east facing slopes. However, as represented by viewpoint 4, they would be visible as only very small minor elements within offshore views and seen as only one minor feature within a wide panorama that includes much more prominent foci. In addition, the proposed wind turbines would be seen closely linked to the existing oil platforms, and thus appear as an extension to existing structures, rather than as a new feature.

Given the reasons described above, in addition to the distance of the proposed wind turbines from the SAWL (approximately 36km), the distinct separation of them from this area by a wide open expanse of sea, and the fact that other human elements are obvious within the area in between, the proposed wind turbines would not seem to impinge upon the wildness characteristics and qualities of the SAWL.

As a consequence of the impacts described above, it is judged that the following impacts would occur on areas of landscape and scenic value:

Table 22 Summary of landscape and visual impacts on landscape and scenic value.

		Landscape and visual resource		
Designated Area	**Individual area**	**Sensitivity**	**Magnitude***	**Significance**
Proposed Area of Great Landscape Value (pAGLV)	pAGLV 1	Medium	Low	Moderate
Garden and Designed Landscape (G&DL)	Langwell Lodge	Medium	Low	Moderate
	Dunbeath Castle	Medium	Low	Moderate
SAWL (SAWL)	Flow Country and Caithness hills	High	Negligible	Negligible

** All impacts are adverse unless noted*

Given the strategic scale of these designations, it is judged that these impacts would not vary to any significant degree between construction and operation phases of the proposed development.

7 CONCLUSIONS

7.1 THE PROPOSED BEATRICE WIND TURBINES

The proposed wind turbines have been sited according to two major factors as follows:

- *the presence of existing oil and gas infrastructure on the seabed around Beatrice*
- *the topography and depth of the seabed.*

No adjustments were recommended on landscape and visual grounds to the proposed siting. This was for two reasons: firstly it was provisionally assessed that the proposed wind turbines were sited in an arrangement that related well to the surrounding land and seascape resource; and, secondly, no scope for amendment was considered feasible on account of technical and practical factors.

The proposed wind turbine design was selected for its technical specification and energy output. Once again, no adjustments to this were recommended on landscape and visual grounds for the same reasons as described above with regards to siting.

7.2 LANDSCAPE IMPACTS OF THE BEATRICE WIND TURBINES

Various combinations of landscape character types as identified within the Caithness and Sutherland Landscape Character Assessment (SNH 1998) were divided into five separate local landscape character areas. Generally the proposed wind turbines would relate strongly to many of the key characteristics of these landscape areas, specifically their large scale, sense of exposure, existing patchy composition of features and existing presence of human-made elements. Most importantly, it would seem closely associated with the existing oil platforms – appearing to complement the energy generation function and focal qualities of these features.

For all local landscape areas, landscape impacts are judged to be of low magnitude. On account of the mainly low sensitivity of these areas, most of the impacts identified are judged as being of slight significance, with moderate significance only occurring within the Interior hills area, reflecting its medium sensitivity. No substantial adverse impacts are identified.

7.3 VISUAL IMPACTS OF THE BEATRICE WIND TURBINES

The proposed development, from most viewpoints, would be seen as a single cohesive feature within the landscape, of similar prominence to existing foci within the onshore landscape such as telecom masts and distinctive low hills, as well as the existing oil platforms seen offshore. Given its distance from the coast, it would appear clearly separated from the onshore landscape and, alternatively, part of the open sea, and the movement of wind turbine blades would rarely be discernible from the mainland. In addition, although the vertical line of the turbines would contrast to the existing platforms and the surrounding horizontal emphasis of the sea, this disparity would appear as a "clean" contrast of line and form on account of the simple composition of elements.

The proposed wind turbines would appear most prominent from the coastal areas that have a simple foreground pattern, and thus less distracting features, especially when which views are directed towards the proposed development. Visibility would mainly occur from southern directions and at high elevations.

Although 11 viewpoints have been assessed as part of the LVIA process, five were chosen mainly to illustrate the nature of visibility rather than for predicted significant visual impacts, as they are located outwith the 35km study area. Of all the viewpoints, impacts have been judged to be of only negligible or low magnitude of visual impact, strongly affected by the fact that all the viewpoints are over 25km from the proposed development (which itself is 22km from the coast). These viewpoints are all of only low or medium sensitivity to the type of development being proposed, mainly reflecting their location within open areas that contain many other built elements.

For the 11 viewpoints, the proposed development would mainly result in only negligible or slight significance of visual impacts, with only two viewpoints resulting in moderate significance of visual impact, reflecting their higher sensitivity. No substantial visual impacts have been assessed.

7.4 SEQUENTIAL IMPACTS OF THE BEATRICE WIND TURBINES

Two sequential routes were assessed in both directions for the proposed Beatrice wind turbines. Generally, however, because of the distance of the proposed development, as previously discussed, most of these would result in no or negligible magnitude of impact, although low magnitude of impacts would occur along some sections. This would result in none, negligible or slight significance of impacts along all sections of the roads apart from one section travelling south between Wick and Latheron and one section travelling north between Navidale and Dunbeath. From these sections, which equate to 51km of a total sequential assessment of 313km, there would be moderate sequential visual impacts. No substantial sequential impacts have been assessed.

7.5 IMPACTS OF THE BEATRICE WIND TURBINES ON AREAS OF LANDSCAPE AND SCENIC VALUE

The proposed development would have low or negligible magnitude of impact on areas of recognised landscape and scenic value. It would have no significant impact on any NSA. However, it would result in moderate adverse impacts on one proposed AGLV and two Garden and Designed Landscapes, which reflects their medium sensitivity. No substantial significant impacts have been identified on areas of landscape and scenic value.

7.6 CUMULATIVE LANDSCAPE AND VISUAL IMPACTS OF THE BEATRICE WIND TURBINES WITH OTHER WIND FARMS

Consideration of cumulative impacts of the proposed Beatrice wind turbines with the existing Causeymire and Buolfruich wind farms formed part of the baseline conditions. The cumulative LVIA however also considered the combined landscape and visual impacts of the Beatrice wind turbines with the proposed Dunbeath, Kilbraur and Gordonbush wind farms.

Generally the Beatrice wind turbines would appear as a separate isolated feature from these wind farms, seen within a different setting and when looking in a different direction from key viewpoints, e.g. Scaraben. In this way, it would seem more closely associated with the existing offshore oil platforms than other wind farms within the vicinity of viewpoints. A few exceptions to this occur in places: firstly where existing and proposed wind farms would cumulatively dominate the landscape and thus views to the Beatrice wind turbines at the edge of these areas could tentatively seem to increase its extent, almost as an outlier; and, secondly, where the existing and proposed wind turbines are viewed from elevated locations as a loosely linked arc of developments and the Beatrice wind turbines would appear between two other developments, seeming to reinforce the linkage.

Within the local landscape character areas, only none, negligible or slight significance of impacts were identified – no moderate or substantial. This is mainly because the proposed wind turbines would largely seem to relate to the character of the surrounding land and seascape, particularly on account of their close association with the existing oil platforms.

For the 11 viewpoints, only none or negligible cumulative significance of impacts have been identified apart from one viewpoint, Scaraben, where moderate cumulative visual impacts could result if both the proposed Gordonbush and Dunbeath wind farms were developed in addition to the existing Causeymire and Buolfruich wind farms.

Sequentially, of the two routes assessed in both directions, the cumulative LVIA assessed that mainly none or negligible cumulative impacts would occur. The only exceptions would be: a slight significance of cumulative landscape impacts when travelling from Navidale to Dunbeath and Wick to Latheron if the proposed Dunbeath and Kilbraur wind farms were built; a slight significance of cumulative visual impact between Latheron and Dunbeath if the proposed Dunbeath wind farm was built; and a moderate significance of visual impact between Navidale and Dunbeath also if the proposed Dunbeath wind farm was built.

7.7 OVERALL EFFECT OF THE BEATRICE WIND TURBINES

The LVIA has established that the proposed wind turbine development at Beatrice would change the landscape and visual baseline conditions during its construction and operational phases. The proposed wind turbines would introduce two new elements into the land and seascape. The construction phase would be relatively short as detailed in Section 3 of the ES, and would have only temporary adverse effects on the landscape and visual resource of the study area.

The design of the Beatrice wind turbines has been mainly determined by technical and practical factors. The resulting design would appear concentrated from all viewpoints, forming a simple feature that would seem to relate to the character of the surrounding land and seascape and the existing oil platforms. In this way, the proposed wind turbines would satisfy good practice guidance.

The application site is not subject to any statutory or local designations for landscape or scenic interest. The proposed wind farm would also not be visible from any major settlement.

Overall, during construction and operational phases, it is judged that direct impacts would have a slight adverse effect on the landscape resource. This is considered to be a non-significant effect.

Overall, during construction and operational phases, it is judged that direct impacts would have slight adverse effect on the visual resource. This is considered to be a non-significant effect.

7.8 OVERALL CUMULATIVE EFFECT OF BEATRICE WIND TURBINES

Assessment of the proposed Beatrice wind turbines in addition to the proposed Dunbeath, Kilbraur and Gordonbush wind farms identified that they would appear as a distinct feature within the land and seascape. Although the Beatrice turbines would seem to complement the function of the onshore developments, they would seem clearly separate from these within the wide open sea, more closely associated to the existing oil platforms than the nearest land mass.

Given the various effects described above, it is judged that direct cumulative impacts during construction and operational phases would have a negligible adverse effect on the landscape and visual resource. This is considered to be a non-significant effect.

Table 23 Original identification of viewpoints for the proposed Beatrice wind turbines LVIA.

No	Location	Reason for selection	Grid reference	Approx elevation
1	Brora golf course /car park	WSW viewpoint at low elevation. Approx. 44km distant. Local residents, visitors.	291004, 903966	59m/24m
2	A9 Navidale	W viewpoint at moderate elevation. Approx. 32km distant. Local residents, road users travelling on A9.	303767, 916153	91m/85m
3	A9/Berriedale Borgue area	WNW viewpoint at moderate elevation. Approx 25km distant. Local residents, road users travelling on A9.	313171, 924717	142m/140m
4	Dunbeath Heritage Centre	NW viewpoint at moderate elevation. Approx 24km distant. Local residents, visitors – also representative of views from A9.	315943, 929538	56m/58m
5	Lybster	NNW viewpoint at moderate elevation. Approx 24km distant. Local residents, visitors – also representative of views from A9.	324884, 935060	59m
6a	Scaraben	WNW viewpoint at high elevation. Approx. 32km distant. Hill walkers. Either or 6b	308074, 927326	626m
6b	Creag Riasgain	Suggested by local people during Talisman consultation exercise. Either of 6a	295746, 912661	415m
7a	Lossiemouth	SSW viewpoint at low elevation. Approx. 43km. Local residents, visitors. Either or 7b	323321, 871291 or 323317, 871285	5m
7b	Durn Hill	SSE viewpoint at medium-high elevation (with landform backdrop). Approx. 50km. Recreational walkers. Either or 7a	357100, 863842	199m
8	Burgie Hill	SSW viewpoint at medium-high elevation. Approx 61km. Minor road users – representative of views from Moray Hills. Explore other locations in Moray Hills within 60km radius as substitute.	310157, 857068	213m/210m

Note: Viewpoints 6a and 6b and 7a and 7b were intended as alternatives, with a final selection to be made on the basis of wirelines. It was subsequently determined that both 6a and 6b should be retained, and that 7a and 8 were selected as they gave a better representation than using either 7a or 7b together with 8.

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