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The Scottish Marine Protected Area Project – Developing the Evidence Base for Impact Assessments and the Sustainability Appraisal

Final Report

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The Scottish Marine Protected Area Project – Developing the Evidence Base for Impact Assessments and the Sustainability Appraisal

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Summary

Introduction

The Marine (Scotland) Act and the UK Marine and Coastal Access Act contain provisions for the designation of a network of Marine Protected Areas (MPAs) in Scottish territorial and offshore waters in order to protect marine biodiversity and geodiversity and contribute to a UK and international network of MPAs. New Nature Conservation MPAs, along with existing protected sites in Scotland's marine environment, will contribute to achieving Good Environmental Status (GES) under the Marine Strategy Framework Directive (MSFD) and deliver Scotland's contribution to the ecologically coherent network of MPAs under the OSPAR convention on the protection of the marine environment in the North East Atlantic.

Proposed sites for Nature Conservation MPAs have been identified, following Scottish Natural Heritage (SNH) and the Joint Nature Conservation Committee's (JNCC's) application of the Guidelines on the Selection of MPAs and Development of the MPA Network to MPA search locations in Scotland's territorial and offshore waters respectively. Scottish Ministers reported to Parliament on progress towards developing the Scottish MPA network in December 2012, with their report including up to 33 potential areas for Nature Conservation MPAs (NC MPAs). A formal public consultation on proposals for designation of specific MPAs will be undertaken in 2013. Following this public consultation, Scottish Ministers will decide on whether to designate specific sites as MPAs.

The identification and selection of MPA sites is primarily a 'science-led' process. However, socio-economic evidence can be considered in Ministers' decisions as to whether to designate specific sites, particularly where several different alternatives may make a similar ecological contribution to the MPA network. Socio-economic evidence can also be taken into account in determining the management approaches adopted for individual MPAs.

The study aims to assess the potential economic and social effects of the proposed suite of NC MPAs in Scottish offshore and territorial waters. The assessment investigates the potential cumulative economic benefits and costs, and associated potential social impacts, of designating each individual proposed NC MPA. It also considers the potential economic benefits and costs, and associated potential social impacts of designating the suite of MPA proposals as a whole.

The assessment provides Marine Scotland with evidence on economic and social effects to inform a Business and Regulatory Impact Assessment (BRIA) for each NC MPA, and a Sustainability Appraisal for the suite of proposals as a whole.

Methodology

The study has sought to estimate the effects of designation of the 33 proposed NC MPAs both at site level and for the network as a whole in terms of:

- The potential costs to activities:
- A distributional analysis and consequent social impacts;
- The potential costs to the public sector; and
- The potential benefits to activities and wider society.

Within the study, three scenarios (**lower, intermediate and upper**) were developed and applied to provide an indication on the following and where necessary seek to reflect uncertainties relating to:

- The precise management measures that might be required to support achievement of conservation objectives for individual features within each site;
- The spatial area over which management measures might need to apply, reflecting uncertainties in the underlying spatial extent of the features proposed for designation within individual sites; and
- The extent to which features might already be protected under existing policies.

The potential cost to activities have been assessed for each scenario in relation to the following interests, based on draft management options provided by SNH and JNCC:

- Aggregates;
- Aquaculture – finfish;
- Aquaculture – shellfish;
- Aviation;
- Carbon Capture and Storage;
- Coast Protection and Flood Defence;
- Commercial Fisheries (including salmon and sea trout);
- Energy Generation;
- Military Interests;
- Oil and Gas (including exploration, production, interconnectors, gas storage);
- Ports and Harbours (including dredge material disposal);
- Power Interconnectors and Transmission Lines;
- Recreational Boating;
- Shipping;
- Telecom Cables;
- Tourism; and
- Water Sports (including recreational angling, surfing, windsurfing, sea kayaking, small sail boat activities (such as dinghy sailing) and scuba diving).

For each sector, potential cost estimates were estimated where appropriate and feasible in terms of additional expenditure that would be incurred and presented as Present Values (PV) over the lifetime of the assessment period (2014 to 2033). It was not possible to quantify costs associated with some management measures for other sectors or in relation to potential consenting delays or reductions in investor confidence associated with stricter environmental regulation.

For the commercial fisheries sector, potential cost impacts were estimated in terms of impacts to Gross Value Added (GVA) as the management options for some MPAs may give rise to a reduction in output. This provides a better representation of the true economic cost to the commercial fisheries sector. These impacts were reported as both annual average and PV values.

A distributional analysis was undertaken focusing exclusively on the commercial fishing sector (and the fish processing sector) as this is the only sector where it was been possible to quantify the potential economic costs of designation (on output, GVA and employment). The focus of the distributional analysis was predominantly on groups in Scotland, as this is where the majority of impacts are expected to occur. This has included impacts on specific locations (including regions, districts and ports) and on specific groups within Scotland's population (including, for example, different age groups, genders, minority groups, and parts of Scotland's income distribution).

A social impact analysis has been prepared to identify the key areas of social impact that could potentially be affected by the potential economic costs (quantified and non-quantified) generated by designation and assesses the potential significance of these impacts. This approach is consistent with that put forward by the Government Economic Service (GES) / Government Social Research (GSR) Social Impacts Taskforce, which is based on the 'capitals approach' of ensuring that stocks of social capital are maintained over time. It was not possible to estimate the social impacts associated with those that would benefit from the designations so any cost estimates should be treated as gross rather than net. The key areas of social impact identified by the Task Force include:

- Access to services;
- Crime;
- Culture and Heritage;
- Education;
- Employment;
- Environment; and
- Health.

Public sector costs were estimated for the following broad areas based on discussions with Marine Scotland, SNH and JNCC:

- Preparation of Marine Management Schemes;
- Preparation of Statutory Instruments;
- Development of voluntary measures;
- Site monitoring;
- Compliance and enforcement;
- Promotion of public understanding; and
- Regulatory and advisory costs associated with licensing decisions.

It is possible that public bodies such as The Crown Estate (TCE) could also experience impacts on its revenues from seabed leases should some development projects not proceed as a result of MPA designation or should some existing TCE moorings require relocation. However, it has not been possible to estimate such potential impacts within this assessment. In addition, Scottish Water may also incur some additional costs, although the assumption used for this assessment is that any management measures required to support the achievement of MPA objectives would already be required under the Water Framework Directive.

The potential benefits of MPA designation to activities and wider society have been assessed using an ecosystem services framework. This has largely been undertaken as a qualitative assessment owing to a lack of applicable quantitative evidence.

The combined impact of designating the NC MPAs has been assessed taking account of potential options identified by SNH and JNCC. The combined assessment has largely adopted an additive approach (i.e. it assumes that the combined impact is equivalent to the sum of the individual impacts within each site), although additional commentary has been provided where the combined impacts on specific sectors are potentially significant.

Detailed assessments for each proposed NC MPA are presented in Appendix E with an assessment of the combined impact presented in the main report (section 7).

Findings

Impacts to Activities

Potential cost impacts were identified for 9 different human activities within one or more proposed NC MPAs. The costs should be treated as partial as it was not possible to estimate cost impacts for all potential management measures, for potential costs associated with delays or for impacts on investor confidence. For commercial fisheries, the values presented represent the estimated GVA associated with the value of landings that could be affected by the draft management measures and will be overestimates if some of the effort that could be displaced continues to fish elsewhere. Given the uncertainties, confidence in the cost estimates is low, although the ranges presented across the scenarios are, for most sectors, considered to adequately capture the uncertainty. The cost estimates for the intermediate scenario are considered to represent the best estimate of impact as they reflect JNCC's current best view on potential management requirements.

Table S1 summarises cost estimates by activity and by scenario. The ranges presented within scenarios reflect the possible range of quantified costs depending on which particular site options are selected. The range in cost between scenarios reflects data limitations, insufficient details on some development plans and projects, the uncertainty in the choice of management measures, the spatial area over which such measures might be required and the extent to which existing policy commitments may already deliver some of the management requirements. The main sectors that are likely to experience additional cost impacts, particularly under the intermediate and upper scenarios are commercial fisheries, energy generation (offshore renewables) and oil and gas.

Table S1. Present value (PV) in £ millions for quantified national cost impacts to human activities (costs discounted over assessment period, 2012 prices) (except for commercial fisheries, expressed as impact to direct GVA)

Human Activity	Scenarios		
	Lower	Intermediate	Upper
Aquaculture - finfish	0.36	0.61	0.61
Aquaculture - shellfish	0.14	0.19	0.19
Commercial fisheries (direct GVA)	0.64	24.03 – 38.92	50.70 – 73.53
Energy generation	0.13 – 0.20	2.59 - 2.66	3.90 - 47.34
Military activities	0.19	0.19	0.19
Oil and gas	1.38 – 1.49	3.63 – 8.15	122.67 – 123.20
Port and harbours	0.14	0.14	0.16
Recreational boating	Not quantified	Not quantified	Not quantified
Telecom cables	0.01	0.01	0.75

The combined impact of the designation of proposed MPAs on activities is largely considered to be additive, given the relatively low levels of impact associated with the draft management options assessed within this study. For the energy generation and oil and gas sectors, it is possible that the combined impacts could be more significant, should some of the planned investment be deterred as a result of the additional costs of development. However, this remains uncertain. For the commercial fisheries sector, certain fleet segments may be significantly affected by the designation of several proposed MPAs in a region. This is particularly the case for over-15m and under-15m nephrops trawls in the West inshore and North-west inshore regions, and to a lesser extent for over-15m dredges and whitefish trawls. The displacement of these vessels from their fishing grounds may cause conflict among them and with other vessels in the grounds they are displaced to. There may be other costs associated with moving to new fishing grounds, changing target species or fishing method, and a number of vessels may leave the sector, with resulting employment and social impacts.

Distribution of Economic Costs and Consequent Social Impacts

Commercial Fishing Sector and Fish Processing Sector

A number of challenges have been encountered in seeking to assess the potential socio-economic consequences of designation of proposed MPAs on the commercial fishing sector (and hence the fish processing sector) as, ultimately, this will depend on the extent to which the fleet can access alternative fishing grounds, and that is unknown. The quantitative estimates presented for this sector, therefore, assume there is no redistribution of fishing effort - all affected landings are lost - and hence represent worst-case estimates.

The analysis suggests:

- Designation of ten of the possible MPAs would not require any restrictions on fishing activities and hence would not generate any economic or social costs;
- Under the lower scenario, the economic and social impacts of designation of the other sites would be minimal;
- While designation of the suite of MPAs would have negative impacts on GVA and employment, the impact at the Scottish economy level would not be significant;
- While designation of the suite of MPAs would have negative impacts on the sector's GVA and employment under the intermediate and upper scenarios, these impacts would be relatively small and possible benefits to industry have not so far been quantified. Under the worst-case scenario, there would be a 2% reduction in the sector's GVA and employment;
- The North-east, North-west and West regions, however, would bear a disproportionate share of these costs with the most significant employment impacts likely to be felt in Fraserburgh, Peterhead, Mallaig and Ayr. Designation of the suite of MPAs could put jobs at risk in these and other areas (under the intermediate and upper scenarios) and this could generate significant economic and social costs for the individuals affected (and their families) if the fishing grounds are lost and it wasn't possible to fish alternative grounds;
- It is anticipated that designation of the suite of proposed MPAs would have a negative, but fairly minimal impact, on the Scottish fish processing sector as a whole. Affected landings account for a relatively low proportion of total landings at landing ports (typically 0–3%, and 7% worst case at Mallaig) and it is likely that fish processors will react to reductions in local supplies of fish by importing greater quantities of raw material from other locations. The impacts could be more significant for smaller-scale processors which are more heavily reliant on locally-caught demersal species and shellfish. Designation is not expected to have any impact on the pelagic sector; and
- If the impact of designation on the Scottish fleet was a displacement of fishing activity, the economic and social costs would be smaller than those estimated. These may, however, be partly offset by other economic and social costs associated with displacement such as increased fuel costs and a loss of social cohesion among fleets, as a result of increased tensions among vessels from having to share fishing grounds. Displacement issues are likely to be greater in the West and North-west inshore regions, particularly for nephrops trawlers (<15m and >15m) and dredges.

Energy Generation

It has not been possible to fully quantify the potential costs associated with possible mitigation measures in the energy generation (offshore renewables) sector but these are potentially significant, particularly under the upper scenario. and could render some future development projects unviable. Further, it has not been possible to estimate the costs associated with potential delays or the impact of designation on investment decisions which could be significant under the upper scenario. If designation rendered projects unviable or restricted or deterred investment in development projects (existing, planned or future), this would have potentially more significant socio-economic impacts; not only would it reduce the contribution these sectors make to future levels of GVA and employment but it could have indirect effects on their supply chains and the wider Scottish economy. However it should be noted that SNH and JNCC's current advice is that the intermediate scenario represents their best view on potential management requirements.

Oil and Gas

It has not been possible to fully quantify the potential costs associated with possible mitigation measures in the oil and gas sector but these are potentially significant, particularly under the upper scenario, and could render some future development projects unviable. Further, it has not been possible to estimate the costs associated with potential delays or the impact of designation on investment decisions which could be significant under the upper scenario. If designation rendered projects unviable or restricted or deterred investment in development projects (existing, planned or future), this would have potentially more significant socio-economic impacts; not only would it reduce the contribution these sectors make to future levels of GVA and employment but it could have indirect effects on their supply chains and the wider Scottish economy. However it should be noted that JNCC's current advice is that the intermediate scenario represents their best view on potential management requirements.

Public Sector Costs

Table S2 presents a summary of estimated cost impacts to the public sector. The main potential costs are assessed as relating to future site monitoring

Table S2. Present value (PV) in £ millions for public sector costs (costs discounted over assessment period, 2012 prices)

Activity	Scenarios		
	Lower	Intermediate	Upper
Marine Management Schemes	0.14	0.14	0.14
Statutory Instruments – Inshore Measures	0.02	0.04	0.05
Statutory Instruments – Offshore Measures	0.03	0.05	0.05
Voluntary Measures	-	-	-
Site Monitoring – Inshore	4.63	4.63	4.63
Site Monitoring - Offshore	18.62 to 19.99	18.62 to 19.99	18.62 to 19.99
Compliance and Enforcement	-	-	0.20
Promoting Public Understanding	0.05	0.05	0.05
Regulatory and Advisory Costs			
▪ Planning applications – aquaculture	0.04	0.04	0.04
▪ CAR licences – finfish aquaculture	0.01	0.01	0.01
▪ Oil & gas licensing	0.14 to 0.15	0.14 to 0.15	0.14 to 0.15
▪ Marine licensing	0.03 to 0.04	0.04	0.04 to 0.05
Total	**23.71 to 25.10**	**23.76 to 25.14**	**23.97 to 25.36**

There are a number of uncertainties surrounding the estimates of costs to the public sector, in particular, the frequency with which offshore biological surveys will be carried out, the requirement for and costs of compliance and enforcement of any inshore fisheries management measures and the costs associated with securing CFP measures.

Benefits to Activities and Wider Society

The review of evidence on benefits has demonstrated that relevant quantified evidence is extremely limited. It is particularly hampered by difficulties in, and a lack of research to, apply available economic techniques to the marine environment, the lack of knowledge of the baseline condition of many features in the MPAs, and of the impact of management measures on features and ecosystem services from sites.

The available evidence to value the benefits of the designation and management of the proposed MPAs is very limited. A range of potential benefits to different ecosystem services can be identified for the proposed sites, and from the network of sites. However, weaknesses in the evidence, including uncertainty in the baseline condition and the impact of management measures on features and ecosystem services from sites, mean that this only provides a partial understanding of the benefits to society.

A recent UK study of the non-use value of protecting marine biodiversity through site designations (McVittie and Moran, 2008) has been translated to value the proposed MPAs in accordance with UK Government value transfer guidelines[1] The non-use value of Scottish households, with allowance for the scale of Scottish marine waters

[1] http://archive.defra.gov.uk/environment/policy/natural-environ/using/valuation/

and a possible time-lag in the benefits from designation, are estimated at between £239 million and £583 million, at 2012 prices discounted over 20 years, from 2014.

Abbreviations

ABPmer	ABP Marine Environmental Research Ltd
BRIA	Business and Regulatory Impact Assessments
Cefas	Centre for the Environment, Fisheries and Aquaculture Science
CFP	Common Fisheries Policy
DECC	Department of Energy and Climate Change
Defra	Department for the environment, Food and Rural Affairs
EIA	Environmental Impact Assessment
ES	Ecosystem Service
GeMs	Geodatabase of Marine features in Scotland
GES	Good Environmental Status
GIS	Geographic Information System
GP	General Practitioner
GSR	Government Social Research
GVA	Gross Value Added
IA	Impact Assessment
ICES	International Council for the Exploration of the Seas
JNCC	Joint Nature Conservation Committee
MarLIN	Marine Life Information Network
MCZ	Marine Conservation Zone
MPA	Marine Protected Area
MSFD	Marine Strategy Framework Directive
NC MPA	Nature Conservation MPA
NE	Natural England
NEA	National Ecosystem Assessment
NGO	Non-Governmental Organisation
OSPAR	Oslo and Paris Commission
PAG	Project Advisory Group
PSG	Project Steering Group
SAC	Special Area of Conservation
SIC	Standard Industrial Classification
SNCB	Statutory Nature Conservation Body (SNH or JNCC)
SNH	Scottish Natural Heritage
spp.	Species
TTWA	Travel To Work Area
UK	United Kingdom
UNEP-WCMC	United Nations Environment Programme – World Conservation Monitoring Centre
VMS	Vessel Monitoring System
VNN	Valuing Nature Network

The Scottish Marine Protected Area Project – Developing the Evidence Base for Impact Assessments and the Sustainability Appraisal:

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1. Introduction

1.1 Background

The Marine (Scotland) Act and the UK Marine and Coastal Access Act contained provisions for the designation of a network of Marine Protected Areas (MPAs) in Scottish territorial and offshore waters in order to protect marine biodiversity and geodiversity and contribute to a UK and international network of MPAs. New Nature Conservation MPAs, along with existing protected sites in Scotland's marine environment, will contribute to achieving Good Environmental Status (GES) under the Marine Strategy Framework Directive (MSFD) and deliver Scotland's contribution to the ecologically coherent network of MPAs under the OSPAR convention on the protection of the marine environment in the North East Atlantic.

Proposed sites for Nature Conservation MPAs have been identified, following Scottish Natural Heritage (SNH) and the Joint Nature Conservation Committee's (JNCC's) application of the Guidelines on the Selection of MPAs and Development of the MPA Network to MPA search locations in Scotland's territorial and offshore waters respectively. Scottish Ministers reported to Parliament on progress towards developing the Scottish MPA network in December 2012, with their report including up to 33 potential areas for Nature Conservation MPAs (NC MPAs), together with four MPA Search Locations, primarily for mobile features (Image 1). One proposed MPA (Central Fladen) contains a 'core' area and an additional area that represents an option to take forward protection of seapens and burrowing megafauna. A formal public consultation on proposals for designation of specific MPAs will be undertaken in 2013. Following this public consultation, Scottish Ministers will decide on whether to designate specific sites as MPAs. A list of the names and codes of the proposed MPAs is provided in Table 1.

The identification and selection of MPA sites is primarily a 'science-led' process. However, socio-economic evidence can be considered in Ministers' decisions as to whether to designate specific sites, particularly where several different alternatives may make a similar ecological contribution to the MPA network. Socio-economic evidence can also be taken into account in determining the management approaches adopted for individual MPAs.

The study aims to assess the potential economic and social effects of the proposed suite of NC MPAs in Scottish offshore and territorial waters. The four Search Locations are not assessed. The assessment investigates the potential cumulative economic benefits and costs, and associated potential social impacts, of designating each individual proposed NC MPA. It also considers the potential economic benefits and costs, and associated potential social impacts of designating the suite of MPA proposals as a whole.

The assessment will provide Marine Scotland with evidence on economic and social effects to inform a Business and Regulatory Impact Assessment (BRIA) for each NC MPA, and a Sustainability Appraisal for the suite of proposals as a whole.

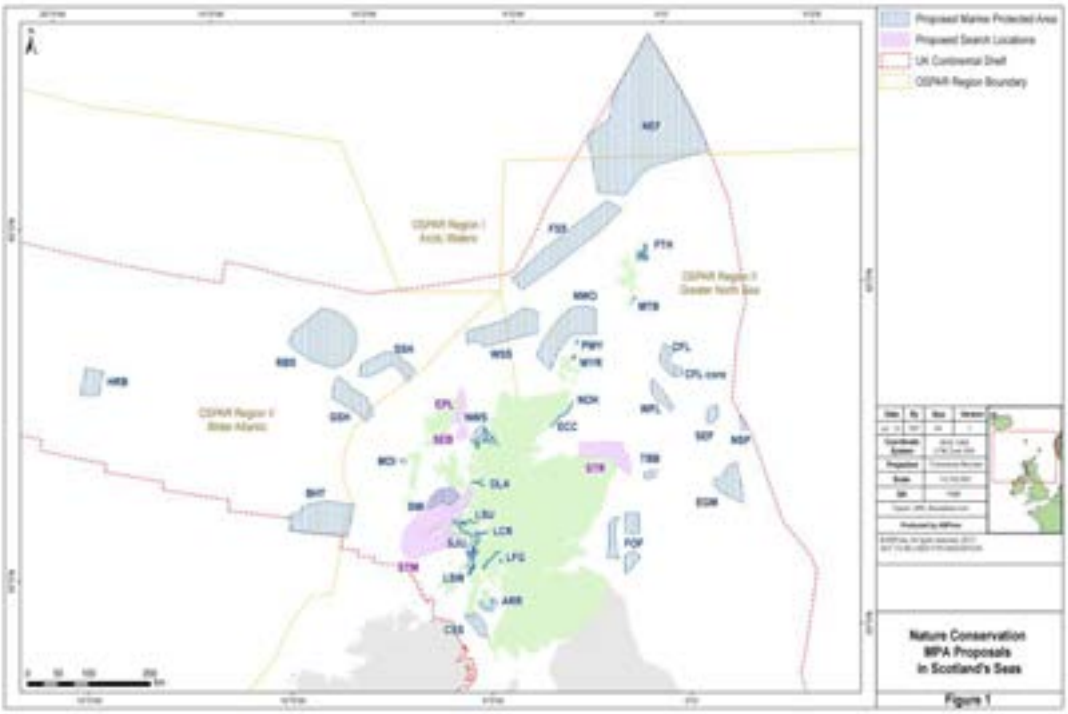

Image 1. NC MPA Proposals in Scotland's Seas

Table 1. List of proposed MPAs

Inshore Sites	Code	Offshore Sites	Code
Clyde Sea Sill	CSS	The Barra Fan & Hebrides Terrace Seamount	BHT
East Caithness Cliffs	ECC	Central Fladen	CFL
Fetlar to Haroldswick	FTH	Central Fladen (core)	CFL (core)
Loch Creran	LCR	East of Gannet & Montrose Fields	EGM
Loch Sunart	LSU	Faroe-Shetland Sponge Belt	FSS
Loch Sunart to the Sound of Jura	SJU	Firth of Forth Banks Complex	FOF
Loch Sween	LSW	Geikie Slide & Hebridean Slope	GSH
Lochs Duich, Long and Aish	DLA	Hatton-Rockall Basin	HRB
Monach Isles	MOI	North-east Faroe-Shetland Channel	NEF
Mousa to Boddam	MTB	Norwegian Boundary Sediment Plain	NSP
North-west Sea Lochs & Summer Isles	NWS	North-west Orkney	NWO
Noss Head	NOH	Rosemary Bank Seamount	RBS

Inshore Sites	Code	Offshore Sites	Code
Papa Westray	PWY	South-east Fladen	SEF
Small Isles	SMI	South-west Sula Sgeir & Hebridean Slope	SSH
South Arran	ARR	Turbot Bank	TBB
Upper Loch Fyne & Loch Goil	LFG	West Shetland Shelf	WSS
Wyre and Rousay Sounds	WYR	Western Fladen	WFL

1.2 Aims and Objectives

The aim of this contract is to generate evidence on the potential economic costs and benefits and social impacts[2] of designating the individual NC MPA site proposals, and of designating the proposed suite of NC MPAs as a whole.

Up to 33 potential areas[3] for MPAs have been identified by SNH and JNCC. Of these 33 proposals, SNH and JNCC advise that at least 29 are needed to adequately represent search features in the network. Some of the 33 site proposals are science-based alternatives to the features of recommended MPA proposals, whilst other proposals are of equivalent ecological value for the same combinations of features (see Box 1). As it is not possible to pre-judge the outcome of Ministers' decisions on which sites to consult on, this study takes the assumption that 33 potential areas will require impact assessments and site-based assessments will be completed for all 33.

A further four MPA Search Locations will not be fully assessed against the Guidelines on the Selection of MPAs and Development of the MPA Network prior to public consultation in 2013. These Search Locations (which primarily relate to mobile features) are viewed by SNH and JNCC as being likely to yield sites that would be integral parts of the MPA Network. However, the available scientific evidence is currently insufficient to allow them to be assessed against the guidelines.

2 In the context of this project, 'social impacts' are defined as distributional impacts – the impact of the sets of plan options on different groups. This will be UK-based but is expected to focus predominantly on Scotland. This includes impacts on specific locations (including individual settlements, where feasible within the scope of the project and data availability) and on specific groups within Scotland's population (including but not limited to different age groups, genders, minority groups, and parts of Scotland's income distribution).

3 Treating CFL and CFL(core) as a single site.

Box 1. Alternative Options for MPAs

South-West Sula Sgeir and Hebridean Slope vs. Geikie Slide and Hebridean Slope

- The proposed protected features within the South-west Sula Sgeir and Hebridean slope MPA proposal, and the Geikie Slide Hebridean slope MPA proposal, are considered to offer an equivalent contribution to the MPA network. This means that JNCC would recommend only one of these two proposals needs to be designated to meet the MPA Selection Guidelines.

Central, Western and South-east Fladen

- JNCC have identified science-based alternatives to the representation of one component of burrowed mud (seapens and burrowing megafauna) within the Central Fladen MPA proposal. These are Western and South-east Fladen. JNCC recommend that the southern part of the Central Fladen MPA proposal would need to be designated (CFL (core)) as it represents a different component of burrowed mud (the tall sea pen). However, there are options around the representation of seapens and burrowing megafauna and this could come from including the rest of Central Fladen OR Western Fladen OR South-east Fladen.
- Central Fladen (core) would be designated under all options - the alternatives relate to the designation of the additional CFL area, which does not incorporate CFL (core) in this assessment.

Firth of Forth Banks Complex, Turbot Bank and Norwegian Boundary Sediment Plain

- JNCC have identified science-based alternatives to the representation of the ocean quahog within Firth of Forth Banks Complex (Norwegian Boundary Sediment Plain) and sands and gravels and shelf banks and mounds within Firth of Forth Banks Complex (Turbot Bank). Turbot Bank is also identified in its own right for sandeels. There are therefore several scenarios:
    - If Firth of Forth Banks Complex is not designated, then sands and gravels and shelf banks and mounds will need to be added to Turbot Bank as well as sandeels and Norwegian boundary sediment plain will also need to be designated for ocean quahog;
    - If Firth of Forth Banks Complex is designated, then Turbot Bank will be recommended for sandeels only and Norwegian boundary sediment plain will not be required to be designated.

The study has involved an analysis for each individual site, plus analysis for the suite of sites overall. In order to achieve this aim, the study has been taken forward to deliver the following objectives for assessments of each individual MPA site proposal:

- Building on evidence gathered by SNH and JNCC, identify the activities[4] taking place in proposed MPA sites;
- Building on draft conservation objectives and feature management analysis developed by SNH and JNCC for the features contained within proposed sites for designation and using the Scottish MPA Project sensitivity matrix, identify the activities that could be affected by designation of each proposed site as an MPA, and how they may be affected;
- Identify and estimate the costs, where possible, to potentially-affected activities arising from designation proposals, specifically from potential management requirements arising from conservation objectives proposed for each individual site;
- Identify, describe and quantify, where possible, the potential benefits to marine activities, associated with designation of each individual site as an MPA;
- Identify any communities and social groups that may be adversely or positively affected by designation proposals, and quantify the scale and costs of such impacts where possible;
- Estimate the costs to Government associated with designation of sites as MPAs, including (but not limited to) additional management, monitoring and enforcement requirements, along with potential benefits; and
- Identify, describe and quantify the potential costs and benefits to society as a whole associated with designation of each individual site as an MPA.

The contract has also sought to deliver against the following objectives for the assessment of the suite of NC MPA proposals as a whole:

- Based on the individual MPA impact assessments, estimate the aggregate costs of designation of the suite of MPA proposals to potentially-affected marine activities, communities, social groups and Government;

4 For the purposes of this study, 'Activities' are defined as being those that take place in marine waters, or on the immediate foreshore. For practical purposes, they should be consistent with activities examined in the Productive Seas sections of Charting Progress 2, Scotland's Marine Atlas, and in the Socio-Economic Baseline Review for Offshore Renewables in Scottish Waters. They should therefore include coastal and marine tourism.

- Assess the extent to which aggregate negative impacts and costs may be increased or offset as a result of cumulative factors (e.g. displacement of fisheries activities; economies of scale in monitoring and enforcement);

- Based on the individual MPA impact assessments, identify, describe and quantify the potential aggregate benefits from designation of the suite of MPA proposals to marine activities, communities, social groups and society; and
- Assess the extent to which aggregate positive impacts are increased or offset as a result of cumulative factors, and the extent to which additional benefits are generated through designation of the suite of MPA proposals.

This contract has been concerned solely with analysis of the economic and social effects of proposals for designating NC MPAs. Analysis of other forms of MPA envisaged by the Marine (Scotland) Act, such as Historic MPAs, is beyond the scope of this project. Similarly, analysis of existing types of MPAs (e.g. Special Areas of Conservation) or the overall effects of the 'complete' MPA network (i.e. the NC MPAs, plus pre-existing MPAs) is also considered out of scope. Environmental or ecological assessment of sites is also beyond the scope.

Analysis has been based on existing and available evidence, and quantified as far as possible. New primary data collection or primary research is considered out of scope. This means that gathering new statistical evidence for values of sectoral activities is beyond the scope of this contract, along with gathering new evidence on the ecosystem services associated with features protected through NC MPAs. Undertaking new valuation studies of non-market goods and services (e.g. through use of contingent valuation or choice experiment methodologies) is also beyond the scope of this project.

1.3 Project Oversight

The contract has been managed by the Scottish Government. A Project Steering Group (PSG) was established, comprising members of Marine Scotland, JNCC, SNH, and the Scottish Government SEA team. The purpose of this group has been to advise the project team, facilitate access to required data and evidence, comment and sign off on project outputs. In addition, a Project Advisory Group (PAG) was convened, which included national representatives of potentially affected marine industries, environmental NGOs, and other national and strategic stakeholders.

While the study has been taken forward working closely with Scottish Government, the views expressed aren't necessarily those of Scottish Ministers.

1.4 Structure of Report

The report is structured as follows:

- Section 1: Introduction – this section;
- Section 2: Methodology;
- Section 3: Cost Impacts to Human Activities;
- Section 4: Costs to Public Sector;
- Section 5: Distribution of Economic Costs and Consequent Social Impacts;
- Section 6: Benefits;
- Section 7: Assessment of Combined Impacts; and
- Section 8: Discussion and Conclusions.

In addition, a series of Appendices present background information on the analysis, and the site-specific assessment results by MPA, as follows:

- Appendix A: Reporting template for MPA site assessments;
- Appendix B: Assumptions used to define feature extents under lower, intermediate and upper scenarios;
- Appendix C: Sector-specific descriptions and methodologies;
- Appendix D: Matrix of ecosystem services for MPA features;
- Appendix E: MPA site reports;
- Appendix F: List of stakeholders contacted.

2. Methodology

2.1 Introduction

The proposed methodology builds on previous marine socio-economic assessments undertaken in Scotland and the assessment undertaken for Marine Conservation Zones (MCZs) in England (Defra, 2012). It also takes account of Better Regulation Executive guidance on impact assessment[5], the Green Book methodology for economic assessment (HM Treasury, 2011) and Scottish Government guidance on Business and Regulatory Impact Assessment (BRIA).

The methodology covers:

- Establishing a baseline against which impacts can be assessed;
- Approach to quantification of impacts; and
- Estimating costs and benefits in terms of Gross Value added (GVA) and employment.

Development of the methodology was taken forward through consultation with the Project Steering Group on an Inception Report and consultation with the Project Steering Group and Project Advisory Group on a Data and Methods Paper. Comments received from the Project Steering Group and Project Advisory Group were taken into account where possible in the final methodology for the assessment reported here.

A 'Reporting Template' was prepared (Appendix A), which was used to record results of the analysis for individual MPA sites (Appendix E). Comments received from the Project Steering Group (PSG) and Project Advisory Group (PAG) on the draft Reporting Template were taken into account where possible in developing the final site reporting template.

2.1.1 General Project Assumptions

A number of key assumptions were developed in consultation with the Project Steering Group which have particularly informed the progression of the study:

- It has been assumed that should designation proceed, all sites are designated in 2014, which provides the base year for the assessment. It has been assumed that where management measures are required to be implemented for unlicensed or non-spatially licensed activity (e.g. fishing licences), these are implemented between 2014 and 2016. Where management measures are required for spatially-licensed activities, these will be implemented at the time licences are applied for;

5 http://www.bis.gov.uk/assets/biscore/better-regulation/docs/i/11-1112-impact-assessment-toolkit.doc

- An assessment period of 20 years following designation has been selected as providing a reasonable time period within which the main impacts are likely to occur. The assessment period therefore runs from 2014 to 2033;
- Lower, intermediate and upper scenarios have been developed to assess the potential range of impacts on sectors, which reflect uncertainty in the extent of proposed protected features, and a range of possible management options that may be applied (see Section 2.3.1). The management options have been developed for the purposes of the assessment, based on advice from JNCC and SNH, but are the judgement of the study team and do not anticipate JNCC or SNH's final advice on management measures, nor do they reflect the management measures that may be adopted by the Scottish Government for individual features or sites. The actual management measures that may be applied in the future will be developed through a process of consultation with stakeholders.
- Marine Scotland has indicated that its policy presumption is that there will be no review of existing spatially-based consents and licences on the basis that the impacts of such activities are already manifest in the condition of the sites being proposed for designation. This assumption is subject to future monitoring by the Statutory Nature Conservation Bodies (SNCBs) confirming that such activities are not giving rise to new impacts within sites. As a result, no cost impacts have been identified for existing activities with spatially-based consents or licences, except where such activities are expected to apply for new consents or licences within the assessment period;
- For mobile features, no 'additional protection' will be offered outside of an MPA even if the species is directly linked to the population protected within the MPA. On this basis no cost impacts have been identified for management measures to protect features outside of the site boundaries; and
- Disposal of liquid wastes from coastal point source discharges has been scoped out of the assessment on the basis that the EC Water Framework Directive (2000/60/EC) requires that measures are implemented to achieve Good Status for waters out to 3nm from the territorial baseline by 2015 (subject to time-limited derogations). It has been assumed that no additional management measures will be required of operators of point source discharges beyond those necessary to achieve Good Status and therefore there will be no significant cost impacts (see Box 2)

Box 2: Possible Costs to Scottish Water

As with the approach taken in England & Wales; the disposal of liquid wastes from coastal point sources has been scoped out of the Impact Assessment (IA) on the basis that good status will be achieved by Water Framework Directive (WFD) measures required to be taken by 2015. Therefore any requirements that may be subsequently placed on Scottish Water over and above those required to meet WFD standards are not captured within the report.

In addition Scottish Water, unlike water companies in E&W, is a Public Body and any costs incurred are not captured under section 4 Costs to the Public Sector or section 7 Assessment of Combined Impacts.

Scottish Water considers it likely that additional costs may arise through development of management schemes or voluntary measures, compliance and regulatory costs associated with licensing applications & decisions.

Scottish Water's approach to investment to meet legislative drivers, within the context of defined investment periods, is to ensure that the environmental impacts and needs are fully understood before promoting investment in our assets. This is carried out through a process of studies and, depending on the outcome of the studies, delivering the most appropriate cost effective solution.

Scottish Water (SW) has identified some areas where it considers it likely that cost will be incurred:

- Requirement to undertake revision of CAR licence standards for discharges near or within MPA (through SNH advice to SEPA);
- New SW projects near or within MPA likely be scrutinised to current standard for SAC;
- Compliance with current licence conditions may come under closer scrutiny where they are within the vicinity of an MPA;
- Staff resources may be required for input to management of sites;
- Other sectors, that are captured within the scope of IA, may require developments that consequently impact on SW activities e.g. WWTW capacity, investment required or rendered unnecessary due to displacement of other activities such as aquaculture and fish processing (farmed and wild stock);
- MPAs will be incorporated into Site Condition Monitoring to determine Conservation Status as applied to European and National designated sites. The information will feed into National Performance Indicator (NPI) 37. Cost for SW may arise through remedies to maintain or attain Favourable Condition of certain features; and
- More detailed assessments/surveys may be required for new development projects likely to impact on MPAs, with associated costs.

2.2 Collation and Preparation of Baseline Information

Baseline information is required to inform the ‘do nothing’ scenario against which one or more intervention options can be compared. Requirements for the baseline include:

- Information on the current spatial distribution of activities in the marine environment and their intensity and economic value (turnover, employment);
- Information on how the spatial distribution of activities in the marine environment and their intensity and economic value may change over the time period of the assessment (in the absence of the intervention), in response to existing drivers including current policy drivers; and
- Information on ecosystem service values associated with the marine environment and how these may change over time (in the absence of the intervention);
- Information on pre-existing site designations and management (eg. SACs, SSSIs, SPAs).

In addition, a range of other information has been used with the assessment, for example, information on the costs of management measures for specific human activities. These have been derived from other sources e.g. the Impact Assessment undertaken for English Marine Conservation Zones (Finding Sanctuary *et al*, 2012) and through discussions with the various sectors. Full details are provided in Appendix C.

2.2.1 Socio-economic Information on Activities

The following marine activity categories have been used in this study (which are broadly consistent with Charting Progress 2 (UKMMAS, 2010) and Scotland’s Marine Atlas (Scottish Government, 2011) and take account of the need to include activities on coastal land:

- Aggregates;
- Aquaculture – finfish;
- Aquaculture – shellfish;
- Aviation;
- Carbon Capture and Storage;
- Coast Protection and Flood Defence;
- Commercial Fisheries (including salmon and sea trout);
- Energy Generation;
- Military Interests;
- Oil and Gas (including exploration, production, interconnectors, gas storage);
- Ports and Harbours (including dredge material disposal);
- Power Interconnectors and Transmission Lines;
- Recreational Boating;

- Shipping;
- Telecom Cables;
- Tourism; and
- Water Sports (including recreational angling, surfing, windsurfing, sea kayaking, small sail boat activities (such as dinghy sailing) and scuba diving).

Much of the required baseline information on activities has been compiled from previous studies, including:

- Scotland's Marine Atlas (largely incorporated in the offshore renewables baseline);
- Data held by SNH and JNCC as part of the NC MPAs project including the Geodatabase of Marine features in Scotland (GeMS) and various socio-economic data (for example data used to identify Least Damaged/Most Natural Areas (Chaniotis et al, 2011)); and
- The socio-economic baseline data collated to inform offshore renewables assessments (ABPmer & RPA, 2012) – this data source is particularly useful as it includes detailed descriptions of socio-economic activities at national and regional levels that can be used to construct baseline information for the impact assessments. It also includes information on projections of future activity.

In addition, the study acquired further baseline data in the following areas:

- Processed Vessel Monitoring System (VMS) data for fishing vessels >15m in length showing spatial distribution of the value of landings, by gear type (provided by Marine Scotland);
- Provisional ScotMap data for fishing vessels <15m in length (provided by Marine Scotland);
- VMS ping data for non-UK vessels for 2011 and 2012, by nationality (Marine Scotland);
- Information on fishing activity by French vessels in certain MPA proposals in 2008 and 2011 (CRPMEM Nord); and
- Information on the location of recreational anchorages (provided by SNH).

National baseline information is presented in Appendix C for each activity listed above. Assumptions on future activity are also provided which take account of the key drivers of change where relevant. For example, the energy generation sector (Appendix C8) identifies the projected expansion of offshore renewables in response to Government policies to increase the proportion of electricity generated from renewable sources. The potential consequential impacts of offshore renewables expansion on other activities (such as commercial fishing, commercial shipping and recreation) are also identified where relevant for particular sectors in Appendix C.

2.2.2 Ecosystem Services Valuation Data

There are limited valuation data for marine ecosystem services provided by MPA features. The National Ecosystem Assessment (NEA) included a synthesis of data available up to 2010 (Austen *et al*, 2011). Much of this data is aggregated and valuation data for specific features are largely lacking, although some habitats (such as saltmarsh and intertidal mudflat) are relatively well-studied. Additional work has also been undertaken under the NEA follow-on project and Valuing Nature Network (VNN) and drafts of this work have been used to inform our analysis. The data limitations impose significant constraints on the extent to which changes in ecosystem service (ES) provision can be quantified.

In addition there is a requirement to collate information on the ES provided by individual MPA features. Bournemouth University and ABPmer (2010) collated information for many benthic habitat and benthic species MCZ features. This has been extended by work under the Valuing Nature Network (VNN) project to include most Scottish MPA ecological features, which has been used as the basis for assessing potential ecological benefits from the proposed NC MPAs.

2.2.3 Other Information Requirements

In addition to baseline data, a range of additional data and information has been collated to inform the assessment. Information on licensing costs and the cost impacts of potential management measures has been obtained to estimate cost impacts for activities, together with information on enforcement, surveillance and monitoring costs to estimate impacts on the public sector. Relevant information has been drawn from the MCZ IA and for IAs that have accompanied the UK Marine & Coastal Access Act and Marine (Scotland) Act, which are included in the sector scenario summaries in Appendix C. Additional information was obtained through consultation with Marine Scotland, JNCC, SNH and wider stakeholders.

2.2.4 Information Management

All incoming data was checked for validity and accuracy prior to acceptance within the project in accordance with internal quality procedures. Available spatial data has been held and managed within a project-specific spatial database (ArcGIS).

2.3 Quantification of Potential Impacts (Costs and Benefits)

2.3.1 Development of Scenarios

There are a number of key uncertainties associated with the designation of MPAs that influence the scale of potential impacts, including:

- The location and extent of MPA features within MPA proposals;
- The location and scale of some new development activities over the assessment period (for example offshore renewables and carbon capture and storage (CCS) infrastructure) and the extent to which these new developments might interact with MPA features;
- The nature and scale of management measures that might be required to support achievement of conservation objectives for MPA features; and
- The extent to which MPA features are already protected by existing policy commitments.

For the purposes of this study, to address the uncertainties identified above, three scenarios were developed, which were used to inform the range of possible costs and benefits at site level for each proposed MPA. The scenarios have not taken account of potential differences in the location and scale of new development activity as this would introduce an inconsistency into the future baseline between scenarios. The three scenarios have therefore focused on the following key factors:

- A **'lower'** scenario where:
  - Requirements for management measures are at the lower end of a possible range of measures aimed at achieving MPA feature conservation objectives;
  - The spatial extent of the feature requiring protection is towards the lower end of the estimated range; and
  - It is assumed that no additional management measures are required for OSPAR/BAP features for activities with spatially-based licences.
- An **'intermediate'** scenario where:
  - Requirements for management measures are based on SNH/JNCC's current best view on management options required to address the risks to features;
  - The spatial extent of the feature requiring protection is towards the middle of the estimated range; and
  - It is assumed that additional management measures are required for non-OSPAR/BAP features and different conditions on management for some OSPAR/BAP features for activities with spatially-based licences over and above current practice.
- A **'higher'** scenario, where:
  - Requirements for management measures are at the upper end of a possible range of measures aimed at achieving MPA feature conservation objectives;
  - The spatial extent of the feature requiring protection is towards the upper end of the estimated range; and
  - It is assumed that additional management measures are required for non-OSPAR/BAP features and different conditions

on management for some OSPAR/BAP features for activities with spatially-based licences over and above current practice.

There is an acknowledged uncertainty concerning the extent to which impacts to OSPAR/BAP features might already be fully addressed through existing licensing processes for spatially based activities. On a precautionary basis, this assessment has taken the view that all future licence applications that have the potential to affect MPA features (irrespective of whether they are or are not OSPAR/BAP features) will incur additional costs in preparing an assessment of impacts in relation to the conservation objectives for these features. In addition, the assessment has also included costs for additional monitoring and mitigation measures for certain OSPAR/BAP features[6] where, in the view of the study team, those features may not currently be afforded the same level of protection that is likely to be provided by the MPA designations.

The nature and type of management measures required will vary by sector. Appendix C therefore sets out a series of assumptions that have been used to identify management measures for the scenarios for each sector/activity. The precise management measures used in the scenarios have been determined based on initial work undertaken by SNH and JNCC to develop management options for each site. The initial management options have been developed based on SNH and JNCC's assessment of risk to MPA features from activities and the draft conservation objectives proposed for each feature. The study team has sought to translate the initial management options into management measures for the three scenarios as indicated above. Necessarily, options with less stringent management measures will pose a greater risk that the conservation objectives will not be met. However, even under the lower scenario, the study team has sought to ensure that the management measures could be compatible with achievement of the conservation objectives.

2.3.2 Approach to Assessments

The designation of NC MPAs will give rise to a range of potential costs and benefits:

- Impacts to activities:
  - Loss or displacement of current (or future) economic activity;
  - Increased operating costs of economic activity (additional costs of applying for licences, implementing *in situ* management measures); and
  - Benefits to activities (e.g. from enhanced user experience).

6 Some OSPAR/BAP features are already effectively afforded protection from activities with spatially-based licences; however, the following features are considered by the study team not to be given full protection: burrowed mud, inshore deep mud with burrowing heart urchins, offshore deep sea muds, offshore subtidal sands and gravels, shallow tide-swept coarse sands with burrowing bivalves and ocean quahog aggregations.

- Social impacts:
  - Social impacts arising as a result of cost impacts on economic activities, assessed through a distributional analysis which considers the distribution of the key quantified economic costs and identifies the social impacts that could be generated as a result.
- Costs to the public sector:
  - Preparation of Marine Management Schemes;
  - Preparation of Statutory Instruments;
  - Development of voluntary measures;
  - Site monitoring;
  - Compliance and enforcement;
  - Promotion of public understanding; and
  - Regulatory and advisory costs associated with licensing decisions.
- Benefits:
  - The contribution to the benefits of an ecologically-coherent network of MPAs (see section 2.3.3 for details of combined assessment);
  - The beneficial impacts of MPAs on the condition of the features that they have been designated to protect; and
  - The provision of ecosystem services (including benefits to activities and to wider society).

The cost impacts to human activities that have been assessed are estimates of the potential costs that may arise. Actual cost impacts may be higher or lower than the estimates derived in this study, depending on the precise management measures required. For example, the cost impacts on the fisheries sector quantify the value of landings affected by the management options, assuming all affected landings are lost, as a worst-case estimate. In reality, a proportion of fishing activity may be displaced to other areas or to other gear types. This would have its own associated costs and benefits, but would result in overall cost impacts which are lower than the worst-case estimates presented. Furthermore, in all cases, quantification (valuation) of both costs and benefits has been carried out where the evidence allows, other impacts are identified qualitatively.

Site impacts have been assessed in the following categories:

- Impacts to activities;
- Social impacts;
- Economic costs to the public sector; and
- Benefits:
  - Benefits to MPA features and the MPA network;
  - Benefits to ecosystem services (including any benefits to activities and social benefits identified in impacts to activities and social impacts above).

The assessment of benefits draws together a range of different benefits and presents them within an overall ecosystem services framework to avoid the risk of double counting. The benefits to MPA features and the MPA network are described separately as these are important reasons for designation in their own right.

An outline of the methods used for each of these categories is provided below. Image 2 provides a schematic of the assessment process.

Process for economic analysis

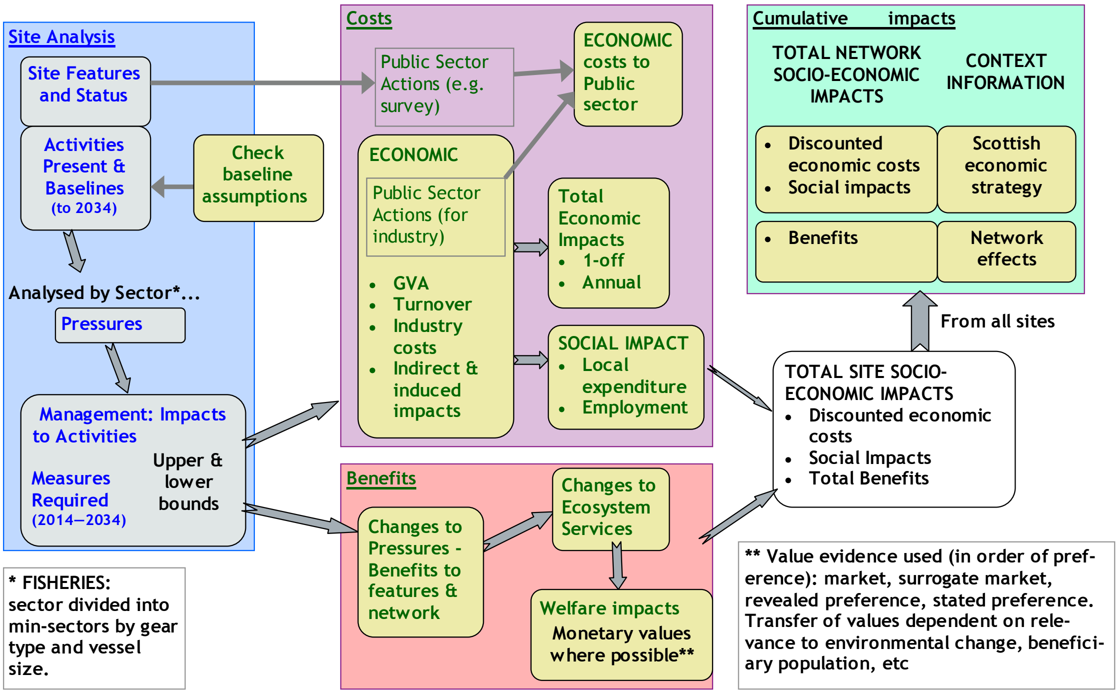

Image 2. Illustration of Socio-economic Assessment Process

Most of the assessments have been undertaken at the level of individual sites. However, for some activities, it was only possible to provide national estimates of impacts:

- Finfish and shellfish aquaculture – estimates of future development activity not available at site level;
- Military activities – estimates of impacts not available at site level; and
- Oil and gas – estimates of future oil and gas decommissioning not available at site level.

2.3.2.1 Impacts to activities

The main areas in which impacts might be experienced are listed below, however it should be noted that not all of these impacts will be experienced at each site:

- Costs of management measures[7]:
  - Increased operating costs of economic activity (additional costs of applying for licences, undertaking additional monitoring, implementing *in situ* management measures); and
  - Loss or displacement of current (or future) economic activity.
- Indirect cost impacts:
  - Impact of project delays;
  - Impact on investor confidence; and
  - Consequential impacts to regional and local economies as a result of impacts on economic activities (this will be assessed as part of the distributional analysis for social impacts (see below).
- Benefits to activities arising from management measures implemented by other sectors.

The extent to which cost impacts might be incurred by economic interests depends on the nature and scale of the potential interaction with MPA features and judgements on possible requirements for management measures. The assessment has been progressed through a number of steps, described below.

Step 1 - Assessment of spatial overlap between MPA features and activities

A spatial analysis has been undertaken in GIS to identify, for each activity identified in Section 2.2.1, the extent of spatial overlap with features proposed for designation within possible MPAs. For a number of MPA features there is some uncertainty concerning their spatial extent within MPAs. Different possible extents of features within each MPA were therefore estimated based on various assumptions (see Appendix B) and used within the scenarios to take account of the uncertainty.

The analysis has also included a suitable buffer area around each feature extent to take account of possible indirect effects. Buffers[8] have been used in two ways in the analysis:

- To estimate costs to activities as a result of additional assessments required to assess potential risks to MPA features to inform licensing decisions for regulated activities within the buffer zone (for example, when considering risks to protected features within Natura 2000 sites, it is common practice to consider risks arising from licensed activities located outside, but within the vicinity of the designated sites); and

[7] The term ‘management measures’ is used here to denote any additional actions that might be required of activities, including requirements for specific assessments, monitoring requirements and mitigation measures).

[8] For information on the buffers applied to specific human activities, see relevant sections of Appendix C.

- To estimate costs to activities as a result of management measures to address indirect impacts to features within an NC MPA, from activities occurring outside the NC MPA, for example, in relation to physical process changes, sediment plumes or underwater noise from piling activities.

Based on an initial analysis of the location of MPA proposals relative to human activity categories and the potential vulnerability of MPA features to certain categories of human activity, the following sectors have been scoped out of the analysis:

- Marine aggregates – there are two existing licensed sites for marine aggregate extraction within Scottish waters (although neither is currently in production). These sites are located around 60km from the nearest MPA proposal and there are no impact pathways by which designated features could be affected by activities in these areas. While there may be potential for marine aggregate extraction to be licensed in other areas of Scottish waters in the future, based on the geological distribution of marine sand and gravel resources, there is currently little demand for marine aggregate in Scotland and it is considered that significant future expansion to support traditional markets (general construction aggregate) is unlikely. On this basis no cost impacts to the sector are anticipated. There is the potential for new markets for marine aggregate to emerge in the future in support of coastal development (reclamation), coastal protection (beach nourishment) and renewable energy development (gravity base foundations), however there is no clarity on where these demands may arise geographically or when. Therefore, the cost impacts arising from areas of potential future resource interest are unable to be considered; and
- Shipping – the only impact pathway identified by which shipping activity might impact on features proposed for designation with the current list of MPA proposals is through damage to seabed habitats and associated species from anchoring. The pressure associated with formal and informal anchorage areas for commercial shipping is assessed under Ports and Harbours. On this basis, shipping is scoped out of the assessment. Should additional MPA proposals be brought forward that include marine mammal features, it may be necessary to consider collision risk with shipping traffic as an additional pressure, for which management measures may need to be considered.

Step 2 - Assessment of potential vulnerability of MPA features within MPA proposals to pressures associated with activities screened in on the basis of Step 1

The initial SNH and JNCC advice on management options takes account of the potential risk to MPA features associated with current and possible future activity within MPA proposals. This information has been used to inform assessments of potential vulnerability in this study. Where information on the initial management options was incomplete, additional assessments were undertaken by the study team, making use of the Scottish MPA sensitivity matrix to identify potential vulnerability of features to pressures from relevant activities.

Step 3 – Assessment of implications for activities giving rise to a potential vulnerability

Where a potential vulnerability was identified, consideration was given to the requirement for management measures based on the sector-specific scenarios presented in Appendix C. For activities occurring outside of MPA proposals which have the potential to affect MPA features within site boundaries, the requirement for management measures has been determined on a site-specific basis, having regard to the sensitivity of the features to the relevant human pressures and the likely magnitude of the pressure.

Step 4: Estimating the costs arising from management measures

The information on impacts has been translated into a format suitable for use within an IA in accordance with Better Regulation Executive guidance on impact assessment[9], the Green Book methodology for economic assessment (HM Treasury, 2011) and Scottish Government guidance on Business and Regulatory Impact Assessment (BRIA). The assessment has been undertaken for a period of 20 years (2014–2033), assuming designation of all sites in 2014.

The costs and benefits associated with the impacts have been estimated for the relevant intervention option scenarios compared to the 'do nothing' option both for individual sites and for the network as a whole. Monetisation of the costs and benefits has been undertaken where this is possible and where potentially significant impacts have been identified.

Where appropriate, impacts to activities have been estimated in terms of changes to:

- Costs faced by industries (e.g. increased costs of EIA, additional survey costs, costs of mitigation measures, costs of delays and impacts on investor confidence);
- Gross Value Added[10] (GVA) and employment as a result of restrictions on their activities (e.g. changes to fishing grounds or development locations); and

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9 http://www.bis.gov.uk/policies/better-regulation/policy/scrutinising-new-regulations/preparing-impact-assessments

10 Gross Value Added is an income measure and measures the contribution which each producer, industry or sector makes to the economy.

- The distribution of economic activity in affected communities.

Quantification of the potential increased operating costs of designation on activities

For most activities the potential costs of designation reflect potential increases in operating costs (e.g. additional costs of applying for licences, additional survey costs or additional mitigation costs). Unit costs for these elements have been derived from existing published sources or through consultation with the relevant sector.

Full details on the methods used to assess these costs are presented in Appendix C.

Where a potential requirement for management measures was identified, consideration was also given to the potential for additional cost impacts to arise as a result of project delays or as a result of impacts on investor confidence.

It is not possible to quantify the costs associated with potential delays during the consenting, licensing or permitting process or the impact of designation on investment decisions, although during consultation, some industries have flagged these as significant concerns.

Quantification of potential costs of designation on GVA and employment

For some activities, the potential cost of designation is a loss or displacement of current (and future) economic activity. For commercial fisheries, for example, the potential cost of designation is a loss or displacement of current (and future) output, caused by spatial or temporal restrictions on fishing activities.

If there is a decrease in output, then all else being equal, GVA in the fishing sector will fall (this is the direct effect). If the decrease in output reduces this sector's demand on their suppliers, there will also be knock-on effects on their suppliers and so on down the supply chain (this is the indirect effect). This includes all the supporting industries that supply commercial fishing vessels (e.g. diesel suppliers, equipment suppliers, boat manufacturers and repairers and transport providers).

The potential costs on the commercial fisheries sector and its downstream supply chain have therefore been estimated in terms of:

- value of potential landings foregone - assessed on a gear-specific and feature-by-feature basis;

- reduction in direct GVA (i.e. reduction in GVA generated by the commercial fishing sector) - estimated by applying fleet segment-specific ratios (GVA divided by fishing income) to the value of landings affected;
- reduction in direct and indirect GVA (i.e. reduction in GVA generated by the sector and its supply chain) - estimated by applying the Type I GVA multiplier for sea fishing from the recently revised Scottish Government's Input-Output Tables and Multipliers (2009); and
- reductions in direct and indirect employment - estimated by applying the Type I employment effect for sea fishing from the Scottish Input-Output Tables and Multipliers.

Another supply chain that is highly relevant to commercial fishing vessels is that which the vessels supply, that is, the supply of fish to processing facilities and to the wholesale and retail trades. The potential cost of designation on the fish processing industry has been estimated in terms of the value of potential landings foregone, by port of landing. Again, these have been assessed on a gear-specific and feature-by-feature basis. The potential impacts on GVA and employment in the processing sector have not been assessed as estimating the reduction in this sector would also estimate the reduction in the commercial fisheries sector as an indirect effect and hence would result in double counting.

Full details on the methodology used to estimate the costs for commercial fisheries and the wider economy are set out in Appendix C (C7.7).

It is appropriate to use multipliers for the commercial fisheries sector given that there is a potential reduction in output, which can be assumed to be similar to a fall in Final Demand (which is what the multipliers relate to). It is also possible to apply the multipliers as specific multipliers and effects are available for fishing (Marine water and Freshwater Fishing) and estimates of the direct impacts upon the industry are available in monetary terms (i.e. value of landings forgone).

Multipliers have not been applied to other sectors because designation is not expected to generate a change in output or Final Demand. Rather, in most of the other sectors, designation is expected to change the input structure, that is, the same output is produced but more inputs (e.g. additional licence costs etc.) are needed to produce this output.

It is recognised, however, that for some activities (i.e. energy generation and oil and gas), the additional costs and delays arising from management measures could potentially render some projects economically unviable and/or lead to a loss in investor confidence particularly in the upper scenario. If the additional costs or loss of confidence generated by management measures, restricted developments (current, planned, or future), or, meant that developments did not proceed, there would be a loss of future GVA and employment in the sectors affected, and knock-on effects on their supply chains and the wider Scottish economy.

Although it is highly uncertain whether designation of the proposed MPAs would affect future economic activity in these sectors, where there is a potential risk that these impacts might be generated, they are highlighted. The potential socio-economic impacts that could be generated as a result are also identified as part of the social impact analysis.

The units of measurement used to assess the costs have been clearly described in presenting information within the Site Reports. Estimates of costs derived from previous years have been uprated to 2012 values using GDP deflators. Estimates of monetary costs have been discounted in line with the Treasury Green Book guidance at 3.5%, providing all financial data in 2012 costs.

The assessments are presented in a series of MPA site reports (Appendix E), which include the qualitative and quantitative information that underlie the calculations for each site (and the combined assessment), along with any assumptions that have been made.

2.3.2.2 Distributional analysis and consequent social impacts

The social impacts generated by the designation of possible MPAs will be strongly connected to the nature, scale and distribution of the economic impacts. Any change in employment, for example, generated as a result of designation can have significant social impacts (e.g. on health, crime).

Economic and social impacts have been assessed through a distributional analysis in line with the requirements of the specification.

The distributional analysis has focused exclusively on the commercial fishing sector (and the fish processing sector) as this is the only sector where it has been possible to quantify the potential economic costs of designation (on output, GVA and employment). The focus of the distributional analysis was predominantly on groups in Scotland, as this is where the majority of impacts are expected to occur. This has included impacts on specific locations (including regions, districts and ports) and on specific groups within Scotland's population (including, for example, different age groups, genders, minority groups, and parts of Scotland's income distribution). Table 2 summarises the list of groups that have been considered in the distributional analysis.

The social impact analysis identifies the key areas of social impact that could potentially be affected by the potential economic costs (quantified and non-quantified) generated by designation and assesses the potential significance of these impacts. This approach is consistent with that put forward by the

Government Economic Service (GES) / Government Social Research (GSR) Social Impacts Taskforce, which is based on the 'capitals approach' of ensuring that stocks of social capital are maintained over time. The key areas of social impact identified by the Task Force include:

- Access to services;
- Crime;
- Culture and Heritage;
- Education;
- Employment;
- Environment; and
- Health.

In order to assess the impacts of interactions with the sectors the assessment clearly defines what is (and is not) covered under each of the areas of social impact.

Table 2. Groups who may be affected by designation

Location	Groups Distinguished By					
	Age	Gender	Fishing Group	Income	Minority	Other
▪ Region ▪ Port ▪ Rural/ urban/ coastal or island	▪ Children ▪ Working age ▪ Pensionable age	▪ Male ▪ Female	▪ Gear type ▪ Vessels type ▪ Species type	▪ 10% most deprived ▪ 10% most affluent ▪ Remaining 80%	▪ Crofters ▪ 10% most deprived ▪ 10% most affluent ▪ Ethnic minorities ▪ Religion ▪ Sexual orientation	▪ With disability or long-term sick Groups

Table 3 provides an indication of the definitions used for each area. The definitions provided in Table 3 are, to the extent possible, related to the need to ensure that stocks of capital (produced, human, social and natural) are maintained so that the potential for wellbeing is non-declining over time (Defra, 2011).

Table 3. Definition of areas of social impact

Key Area	Access	Experience
Access to services	Change in opportunity to use services or time to access services	Change in quality of service provided or received
Crime	Change in opportunity for criminal activities	Change in level of crime (perceived or actual)
Culture and heritage	Change in opportunity to access culture and heritage Change in existence of culture/heritage, or knowledge of it (especially loss) Change in number of visits to cultural/heritage sites	Change in quality of cultural or heritage through change in context, quality of visits
Education	Change in opportunity to access education services	Change in quality of education services
Employ-ment	Change in employment opportunities	Change in quality of employment opportunities
Environ-ment	Change in opportunity to access environment Change in existence of environment, or knowledge of it (especially change in habitats) Change in number of visits to environmental sites	Change in quality of environment through change in quality of habitats, species supported or change in quality of visits
Health	Change in level of disease or symptoms (physical and mental health)	Change in self-assessed quality of health

2.3.2.3 Economic costs to the public sector

Table 7 of the Final Regulatory Impact Assessment for the Marine (Scotland) Bill (Scottish Government, 2009) identified various costs to the public sector associated with the designation of NC MPAs. Some of these costs have already been incurred or will have been incurred at the point at which decisions to designate individual sites are made (for example, site selection, survey costs, work to develop management options and consultation on site proposals). These are therefore ‘sunk’ costs and do not need to be considered in this assessment. Additional costs that will be incurred as part of the designation process include the development and implementation of Marine Management Schemes and the preparation of Statutory Instruments (Marine Conservation Orders or national or European (for sites beyond 12nm or sites between 6 to 12nm with historic rights for non-UK vessels) fisheries management measures) for sites for which these are required. It is also possible that some costs could be associated with the development of guidance on voluntary measures for some sites.

Following designation, additional costs will be incurred in relation to on going monitoring of the condition of features within designated sites and in enforcing management measures. Some costs may also be incurred in promoting public understanding of nature conservation MPAs.

Separately, regulatory bodies and their statutory advisors may incur additional costs associated with reviewing developer assessments of potential impacts to nature conservation features within MPAs as part of the licensing process (analogous to the effort currently required to review Appropriate Assessment signposting documents for developments likely to affect Natura 2000 sites).

In addition, it is possible that public bodies such as The Crown Estate (TCE) could also experience impacts on its revenues from seabed leases should some development projects not proceed as a result of MPA designation or should some existing TCE moorings require relocation (see section 3.12). However, it has not been possible to estimate such potential impacts within this assessment. Scottish Water may also incur some additional costs, although the assumption used for this assessment is that any management measures required to support the achievement of MPA objectives would already be required under the Water Framework Directive.

Estimates of the cost impacts to the public sector have been based on information contained within the Final Regulatory Impact Assessment for the Marine (Scotland) Bill (Scottish Government, 2009), information within the MCZ IA (Finding Sanctuary et al, 2012) and informal discussions with Marine Scotland, SNH and JNCC.

2.3.2.4 Benefits

Benefits to MPA Features

The benefits to MPA features and to the MPA network as a whole are discussed below. The benefits have been identified based on information contained in the SNH and JNCC Assessment of potential adequacy reports (SNH & JNCC, 2012a). These reports provide an assessment of the contribution of different sites and features to an ecologically-coherent network of MPAs, in terms of the representation, replication, geographic range and variation, resilience and equivalent ecological value of proposed protected features and sites.

Ecosystem Services Benefits (Including Benefits to Activities and Wider Society)

The biodiversity features of an MPA contribute to the delivery of a range of ecosystem services. Designation of the MPA and its subsequent management may improve the quantity and quality of the beneficial services provided, which may, inturn increase the value (contribution to economic welfare) of them. Impacts on the value of ecosystem services may occur as a result of the designation, management and/or achievement of the conservation objectives of the MPA.

The ecosystem services analysis has provided a qualitative description of the potential changes in ES provision associated with the implementation of management measures to support the achievement of conservation objectives for individual features. This draws on the work of Bournemouth University and ABPmer (2010) and work to extend that analysis to all relevant Scottish MPA features (Valuing Nature Network (Potts *et al*, 2013)). The list of final ecosystem services that have been considered is provided in Table 4.

Table 4. List of final ES to be considered in the assessment

General Ecosystem Service Categorisation	Final Ecosystem Services to be Used
Provisioning	Provision of fish and shellfish for human and non-human consumption
Cultural	Recreation
	Research and education
	Non-use
Regulating	Natural hazard protection
	Environmental resilience
	Gas and climate regulation
	Regulation of pollution

In applying economic valuation evidence we have sought to clearly link management measures under different management scenarios (‘lower’ to ‘upper’) to changes in ecosystem services and the economic value of these. The analysis has been summarised in an assessment table (Table 8 in Appendix A), similar to that used in the IAs of inshore MPAs for Natural England and JNCC. This approach was approved in Defra’s peer review of these IAs as a sound application of ecosystem services methodology.

In addition to the summary of anticipated ES benefits under the lower, intermediate and upper scenarios, the summary includes four columns of information to clarify our understanding of the qualitative changes in ecosystem services arising from (non-) designation (see Table 8 in the Reporting Template (Appendix A)):

Relevance: Relating to the amount of ecosystem good or function arising from site;

Value weighting: Categorisation of how valuable the amount of ecosystem good or function from the site is in providing benefits to human population;

Scale of benefits: Consideration of actual potential to deliver benefits (for example considering leakage, delivery to human population, etc);

Confidence: Level of confidence in our current knowledge of all other categories (in other words, scale of benefit, level of improvement, etc.).

Based on the above categories, an overall level of each ecosystem service has been defined with its own confidence level. Following, an overall level of total benefits has also been defined.

The parameters have been assigned a level for each service from a menu, defined as:

Nil:	Not present/none;
Minimal:	Present at a very low level, unlikely to be large enough to make a noticeable impact on ecosystem services;
Low:	Present/detectable, may have a small noticeable impact on ecosystem services, but unlikely to cause a meaningful change to site's condition;
Moderate:	Present/detectable, noticeable incremental change to site's condition;
High:	Present/detectable order of magnitude impact on sites condition.

The approach provides a qualitative summary of the expected ecosystem services benefits to ensure all relevant impacts are captured in the analysis.

2.3.3 Approach to Assessing Combined Impacts

The combined assessment considers the costs and benefits of different combinations of proposed MPAs where there are science-based alternatives to the features of recommended MPA proposals, or where alternative proposals are of equivalent ecological value for the same combinations of features. It also explores whether the combined impacts associated with groups of sites at regional or national levels may be larger or smaller than the sum of the individual impacts.

Specific methods have been applied in assessing the combined cost impacts to activities, public sector costs, social impacts and benefits, described below.

2.3.3.1 Impacts to activities

The starting point for assessing the cumulative impacts on activities has been to add together the impacts identified for each individual MPA proposal, taking account of potential alternative sites. In areas where there are concentrations of sites affecting a particular activity (as identified by the distributional analysis), further consideration has been given to the potential combined impact to describe qualitatively whether the combined impact might be larger or smaller than the sum of the individual impacts.

The scale of the sectors affected in Scotland has been used as the context for assessing the significance of combined impacts to activities. Information on key sectors has been drawn (where available) from the Scottish

Government's Economic Strategy, or from industry data. The significance of combined impacts will depend on the scale of the impacts incurred by different sectors and the relative importance of each sector to the Scottish economy (now and in the future).

2.3.3.2 Impacts to the public sector

The assessment of impacts to the public sector has adopted a national approach. The national costs therefore represent the cumulative impact on the public sector.

2.3.3.3 Distribution of economic impacts and consequent social impacts

The combined analysis assesses the likely distribution of the potential economic impacts (and hence associated social impacts) which are expected to be generated from designating the suite of MPA proposals as a whole. The approach to estimating the combined distributional impacts differs across the six different aspects that are assessed as part of the distributional analysis:

- Location;
- Age groups;
- Gender groups;
- Fishing groups;
- Income group; and
- Social groups.

For some of the location aspects (i.e. distribution across regions and ports) and Fishing groups) the distribution of costs has been assessed quantitatively. For others (i.e. age, gender, income and social groups), the analysis indicates whether designation of the suite of MPA proposals is likely to impact on these groups, and, if so, whether the impact is anticipated to be minimal, negative, or significantly negative.

The approach to estimating the combined social impacts has been based on assigning a significance rating to the social impacts identified for each relevant sector.

2.3.3.4 Benefits

Part of the rationale for an ecologically-coherent network of MPAs is the concept that the value of the network is greater than the sum of its parts. However, scientific understanding of the relationships between individual sites and the network is limited and it is likely to be difficult to provide any quantification of the combined benefits.

The selection of potential MPAs has been based on the Scottish MPA Selection Guidelines (Marine Scotland *et al*, 2011) (Box 3). These guidelines include a number of elements that relate to the wider benefits of a network, for example, replication supports resilience and connectivity supports linkages between marine ecosystems.

Box 3: Scottish MPA Selection Guidelines (Marine Scotland *et al*, 2011)

Representation: To support the sustainable use, protection and conservation of marine biological diversity and ecosystems, areas which best represent the range of species, habitats and ecological processes (for which MPAs are a suitable measure) should be considered for inclusion.

Replication: Replication of features in separate MPAs in each biogeographic area is desirable where it is possible in order to contribute to resilience and the aims of the network.

Size of site: The appropriate size of a site should be determined by the purpose of the site and be sufficiently large to maintain the integrity of the feature for which it is selected.

Adequacy: The MPA network should be of adequate size to deliver its ecological objectives.

Connectivity: The MPA network should take into account the linkages between marine ecosystems and the dependence of species and habitats on processes that occur outside the MPA concerned.

The Site Reporting Template (Appendix A) has been used to capture information on the contribution that each site makes to an ecologically-coherent network in relation to the Scottish MPA Selection Guidelines, based on information contained in SNH and JNCC Stage 5 Reports[11].

As part of the assessment the scope for monetising the benefits assessments has also been explored. This has made use of market value data where available and investigated value transfer to develop monetary values for the ES changes that cannot be valued directly through market prices. Value transfer has been considered in line with the best practice guidelines developed by eftec (2010)[12].

These guidelines (eftec, 2010) give guidance on how to assess the robustness of value evidence transfer. This takes into account the relevance of the evidence in terms of the geography, the scale and timing of environmental change, the numbers and socio-economic groups of beneficiaries, and the decision-making context. The better the match of valuation evidence to the issues being analysed, the more robust the value

11 http://www.scotland.gov.uk/Topics/marine/marine-environment/mpanetwork/engagement/270612/Stage5Examples

12 http://archive.defra.gov.uk/environment/policy/natural-environ/using/valuation/index.htm

transfer. Ideally data are adjusted based on statistical evidence (e.g. in proportion to the differences in beneficiary populations, or scale of environmental change). However, expert judgement is often necessary, and has been laid out transparently. The different sources of uncertainty inherent in this approach have resulted in a range of values.

Most marine ecosystem services valuation studies have focused on developing methodologies and there are limited studies that value the benefits. However there are some studies available (e.g. The transfer of values in a study for SE LINK, and recent work by eftec (in prep) for the Dutch Government valuing the recreational impacts of marine litter. Value transfer results are limited by the extent of this evidence base and uncertainty over ecosystem services impacts from MPAs. Limited quantitative data are available on marine ecosystem services changes. The assessment has therefore largely adopted a qualitative approach to assessing the potential benefits from designation of MPAs. On this basis, the combined ecosystem services benefits have been assessed by collating information from individual sites.

2.4 Reporting

Individual Site Assessments are presented in a series of MPA Site Reports (Appendix E). Figures indicating the location of human activities in each MPA and fisheries over-15m VMS ping data, are also provided in Appendix E. An overview of impacts to activities, the public sector, social impacts and benefits together with an assessment of combined impacts is presented in subsequent sections of this report.

2.5 Communication

The study has been undertaken to a very tight timetable. Advice and guidance has been provided through the Project Steering Group and a wider Project Advisory Group including key socio-economic interests and environmental stakeholders. Wider consultation has also been undertaken with stakeholders identified as attending previous Scottish MPA workshops plus some additional consultees (hereafter ‘wider stakeholders’; see list at Appendix F), to seek to clarify methods and assumptions and to obtain additional information as time permitted.

3. Impacts to Human Activities

Estimated potential impacts on human activities from individual MPA proposals are presented in Tables 4 to 6 of the MPA Site Reports (Appendix E). This section provides an overview of the potential impacts by human activity type (sector).

The following activities were scoped out of the assessment on the basis that there would be no significant interaction between the activity and features proposed for protection within any of the current MPA proposals:

- Marine Aggregates – the closest current licensed marine aggregate sites are around 60km from the nearest NC MPA proposals; and
- Shipping – the only impact pathway identified by which shipping activity might impact features proposed for designation within existing NC MPA proposals is through damage to seabed habitats and associated species from anchoring. The pressure associated with formal and informal anchorage areas for commercial shipping is assessed under Ports and Harbours.

3.1 Aquaculture – Finfish

There are 9 inshore proposed MPAs that have existing finfish farm sites within the proposed site boundary or within 1km of the site boundary. Most proposed MPAs only overlap with a very small number of finfish farm sites, although Fetlar to Haroldswick and Loch Sunart to the Sound of Jura overlap with larger numbers of sites (Fetlar to Haroldswick – 21 sites within proposed MPA boundary and one site within 1km of the boundary; Loch Sunart to the Sound of Jura – 21 sites within the proposed MPA boundary and three sites within 1km of the boundary).

Cost impacts to the finfish aquaculture sector may arise due to:

- Additional assessment and survey costs associated with planning applications or CAR licence applications;
- Additional mitigation measures for new developments to support achievement of site conservation objectives;
- Costs associated with delays during the consenting process; and
- Loss of investor confidence (developments do not proceed).

In the absence of public information on the location of potential future finfish aquaculture developments, it has not been possible to assess the cost impacts of new development at site level, nor to quantify the costs of mitigation measures. It is not possible to quantify the costs associated with potential delays during the consenting process or the impact of designation on investment decisions, although during consultation, the industry has flagged these issues as concerns.

Table 5 presents an estimate of the quantified costs impacts to the finfish aquaculture sector which takes account of potential additional assessment and survey costs associated with future CAR licence applications for proposed MPAs, together with a national assessment of the potential additional assessment and survey costs associated with future planning applications for new or extended finfish aquaculture installations. The total quantified costs range from £0.36 million (PV) in the lower scenario to £0.61 million in the upper scenario. The intermediate (best) estimate has been assessed as the same as the upper scenario.

Table 5. Present value (PV) in £ millions for quantified costs to finfish aquaculture (costs discounted over assessment period, 2012 prices)

NC MPA Proposal	Scenarios		
	Lower	Intermediate	Upper
Fetlar to Haroldswick	0.02	0.07	0.07
Loch Creran	0.01	0.01	0.01
Loch Sunart	<0.01	0.01	0.01
Loch Sunart to the Sound of Jura	0.02	0.08	0.08
Lochs Duich, Long and Aish	<0.01	0.01	0.01
North-west Sea Lochs & Summer Isles	0.01	0.02	0.02
South Arran	<0.01	<0.01	<0.01
Upper Loch Fyne & Loch Goil	<0.01	0.02	0.02
Wyre & Rousay Sounds	<0.01	0.01	0.01
Total for Inshore Sites	**0.060**	**0.22**	**0.22**
National Costs for Future Development	**0.30**	**0.39**	**0.39**
Total Quantified Costs	**0.36**	**0.61**	**0.61**

While it has not been possible to estimate the costs of mitigation measures, the costs of such measures, where required, are likely to be larger than the costs associated with additional assessments and surveys to inform licensing decisions. The quantified cost estimates presented in Table 5 may therefore underestimate the total cost impact to the finfish aquaculture sector.

There are significant uncertainties surrounding the assessment. In particular, the number and location of future finfish farm applications is uncertain and the assessment is sensitive to assumptions on future development activity. The requirements for mitigation measures are also uncertain and will vary at site level. Overall confidence in the quantified estimates is assessed as low.

3.2 Aquaculture – Shellfish

There are 7 inshore proposed MPAs that have existing shellfish aquaculture sites within the proposed site boundary or within 1km of the site boundary. Most proposed MPAs only overlap with a very small number of shellfish aquaculture sites, although Fetlar to Haroldswick and Loch Sunart to the

Sound of Jura overlap with larger numbers of sites (Fetlar to Haroldswick – 10 sites within proposed MPA boundary and one site within 1km of the boundary; Loch Sunart to the Sound of Jura – 21 sites within the proposed MPA boundary and three sites within 1km of the boundary).

Cost impacts to the shellfish aquaculture sector may arise due to:

- Additional assessment and survey costs associated with planning applications;
- Additional mitigation measures for new developments to support achievement of site conservation objectives;
- Costs associated with delays during the consenting process; and
- Loss of investor confidence (developments do not proceed).

In the absence of public information on the location of potential future shellfish aquaculture developments, it has not been possible to assess the cost impacts of new development at site level, nor to quantify the costs of mitigation measures. It is not possible to quantify the costs associated with potential delays during the consenting process or the impact of designation on investment decisions, although during consultation, the industry has flagged these issues as concerns.

Table 6 presents a national assessment of the potential additional assessment and survey costs associated with future planning applications for new or extended shellfish aquaculture installations. The total quantified costs range from £0.14 million (PV) in the lower scenario to £0.19 million in the upper scenario. The intermediate (best) estimate has been assessed as the same as the upper scenario.

Table 6. Present value (PV) in £ millions for quantified costs to shellfish aquaculture (costs discounted over assessment period, 2012 prices)

NC MPA Proposal	Scenarios		
	Lower	Intermediate	Upper
National Costs for Future Development	0.14	0.19	0.19

While it has not been possible to estimate the costs of mitigation measures, the costs of such measures, where required, are likely to be larger than the costs associated with additional assessments and surveys to inform licensing decisions. The quantified cost estimates presented in Table 6 may therefore underestimate the total cost impact to the shellfish aquaculture sector.

There are significant uncertainties surrounding the assessment. In particular, the number and location of future shellfish farm planning applications is uncertain and the assessment is sensitive to assumptions on future development activity. The requirements for mitigation measures are also uncertain and will vary at site level. Overall confidence in the quantified estimates is assessed as low.

3.3 Aviation

The main potential interaction between aviation and features proposed for designation within NC MPA proposals relates to the potential for disturbance to black guillemot by low flying aircraft or helicopters. A number of MPA proposals are located in close proximity to local airfields, for example, the airport at Westray is in close proximity to the Papa Westray proposed MPA. SNH advice is that they do not consider that the potential disturbance from low flying aircraft or helicopters in normal operation poses a significant risk to black guillemot. On this basis, SNH draft management options for NC MPA proposals supporting black guillemot features do not include any management measures in relation to aviation. For the purposes of this assessment, it has therefore been assumed that there will be no cost impacts to the aviation sector under any of the impact scenarios.

3.4 Carbon Capture and Storage

There are currently no operational CCS projects in Scottish waters. However, there is potential for future development. A study into the opportunities for CO_2 storage around Scotland (Scottish Centre for Carbon Storage (SCCS), 2009) showed that within the Scottish Renewable Energy Zone study area, 29 hydrocarbon fields and 10 saline aquifers had apparent potential for CO_2 storage, all of which lie in offshore waters within the Central and Northern North Sea. Specific CCS development is proposed, centred on the Goldeneye field, approximately 100km north-east of St Fergus utilising an existing pipeline. It is possible that further pipelines will be constructed within the assessment period, running from the Firth of Forth and the Tees to the Goldeneye field.

None of the currently envisaged infrastructure will significantly interact with the MPA proposals. Four MPA proposals overlap with possible hydrocarbon fields and saline aquifers identified as having future CCS potential (East of Gannet and Montrose Fields: 2 saline aquifers; Faroe-Shetland Sponge Belt – 1 hydrocarbon field; South East Fladen – 1 hydrocarbon field; Western Fladen – 1 hydrocarbon field). However, none of these fields are anticipated to be developed for CCS within the assessment period (Scottish Enterprise, no date). On this basis, no cost impacts are anticipated to the CCS sector.

3.5 Coast Protection and Flood Defence

There are a number of coast protection and flood defence structures around the Scottish coast. Most of these are located within the major estuaries Forth, Tay and Clyde and low lying coastal areas e.g. East Lothian, Clyde Sea and Moray Firth. None of these coast protection and flood defence structures are in the vicinity of proposed MPAs. A short length of coast protection is located along the coastline of the Loch Sunart to Sound of Jura proposed MPA, but this feature will not interact with the Common Skate feature for which this MPA is proposed. A number of proposed MPAs have 'developed beaches' (beaches with some form of development at the top of the beach (e.g. walls and other structures)) but these structures will not significantly interact with MPA features. On this basis, no significant cost impacts are anticipated.

3.6 Commercial Fisheries

Commercial fishing takes place throughout Scottish waters by UK-flagged vessels, as well as vessels from other EU Member States and non-EU countries. In 2010, the Scottish fleet was responsible for landing 61% of the total UK value and volume of fish with Scottish vessels landing 367,000 tonnes of fish worth £435 million (Marine Scotland, 2011); in 2011 the value of landings increased to £501 million (Marine Scotland, 2012). In the inshore areas, fishing activity is predominantly by Scottish vessels, and close to the coast is mainly by smaller vessels (under-15m). Further offshore, there is more activity by other countries, and by larger vessels.

3.6.1 Potential Costs on the Commercial Fishing Sector

The potential costs of designation on the commercial fisheries sector are different in nature from those faced by most other sectors. For most sectors the potential costs of designation reflect potential increases in operating costs (e.g. additional costs of applying for licences, additional survey costs). For commercial fisheries, however, the potential cost of designation is a loss or displacement of current (and future) output, caused by spatial or temporal restrictions on fishing activities required to protect vulnerable and sensitive MPA features.

Any decrease in output will, all else being equal, reduce the GVA generated by the commercial fishing sector; this is the direct effect. If the decrease in output reduces this sector's demand on suppliers, there will be knock-on effects on those industries that support commercial fishing vessels (e.g. diesel suppliers, equipment suppliers, boat manufacturers and repairers and transport providers); this is the indirect effect.

The potential costs on the commercial fisheries sector and its downstream supply chain have been estimated in terms of:

- Value of potential landings foregone - assessed on a gear-specific and feature-by-feature basis;
- Reduction in direct GVA (i.e. reduction in GVA generated by the commercial fishing sector) - estimated by applying fleet segment-specific ratios (GVA divided by fishing income) to the value of landings affected;

- Reduction in direct and indirect GVA (i.e. reduction in GVA generated by the sector and its supply chain) - estimated by applying the Type I GVA multiplier for sea fishing from the recently revised Scottish Government's Input-Output Tables and Multipliers (2009); and
- Reductions in direct and indirect employment - estimated by applying the Type I employment effect for sea fishing from the Scottish Input-Output Tables and Multipliers.

Another supply chain that is relevant in assessing the potential economic impact of designation is the supply of fish by commercial fishing vessels to fish processing facilities, hotels/restaurants and the wholesale and retail trades. Management measures that restrict commercial fishing activity have the potential to reduce the quantity of fish and shellfish landed locally at Scottish landing ports and hence to reduce the supply of locally-landed catch to these industries.

The potential costs of designation on the fish processing industry have therefore been estimated in terms of the value of potential landings foregone by port of landing. Again, these have been assessed on a gear-specific and feature-by feature basis. The potential impacts on GVA and employment have not been assessed, as estimating the reduction in GVA and employment in this sector would also estimate the reduction in the commercial fisheries sector as an indirect effect, and hence would result in double counting.

Full details on the methodology used to estimate the costs for commercial fisheries and the wider economy are set out in Appendix C (C7.7).

3.6.1.1 Potential Loss in Value of Landings by MPA (assuming zero displacement of fishing activity)

The cost impacts on commercial fisheries in terms of the value of landings affected, by proposed MPA are presented in Table 7. . A number of proposed MPAs will not have any cost impacts on the landings of UK fisheries. These are East Caithness Cliffs, Loch Creran, Monach Isles, Mousa to Boddam, and Papa Westray (inshore sites) and Hatton-Rockall Basin, North-west Orkney and West Shetland Shelf (offshore).

Table 7 shows that the proposed MPAs with the greatest impacts on the value of landings are:

- Small Isles (impacts predominantly on over-15m, and to a lesser extent, under-15m, nephrops and whitefish trawls);
- North-west Sea Lochs and Summer Isles (impacts predominantly on over-15m, and to a lesser extent under-15m, nephrops trawls);
- South Arran (impacts predominantly on over-15m nephrops trawls);
- Central Fladen (impacts predominantly on over-15m whitefish and nephrops trawls);

- Geikie Slide and Hebridean Slope (impacts predominantly on over-15m whitefish trawls and 'other gear' and under-15m whitefish trawls (although the cost impact on the under-15m sector may be an over-estimate));
- South-west Sula Sgeir and Hebridean Slope (impacts predominantly on over- and under-15m whitefish trawls (although the cost impact on the under-15m sector may be an over-estimate));
- Western Fladen (impacts predominantly on over-15m nephrops trawls); and
- Faroe-Shetland Sponge Belt (impacts predominantly on over-15m whitefish trawls).

Taken together, these MPAs account for around 60–75% of total affected landings under each scenario.

The total annual average value of landings lost each year for those sites for which it is reported is estimated to range between £0.1 million and £10.1 million under the different scenarios - depending on the management measures assessed and the feature extents to which they are applied. No values are presented for Barra Fan and Hebrides Terrace Seamount, North-east Faroe Shetland Channel or Rosemary Bank Seamount proposed MPAs because the annual average values for over-15m vessels would be disclosive (fewer than 5 vessels). Subsequent estimates of GVA impacts for these sites are provided as this information is considered not to be disclosive.

The total impact in terms of landings values represents a very small percentage (approximately 0–2%) of the estimated total value of landings in 2011. It is noted that as a result of the proposed Firth of Forth offshore wind farm development, which partially overlaps with the Firth of Forth Banks Complex proposed MPA, it is possible that some fishing effort may be displaced from the MPA as a result of such development. However, it is unlikely that any physical development will have occurred at the point of designation. For the purposes of this assessment, the impacts have therefore been estimated based on current levels of fishing activity.

It is also important to highlight that these estimates, particularly the upper scenario, represent a worst case and may overestimate the potential costs at some sites. The estimates are based on the assumption that all activity is lost, that is, there is no adaption or displacement of fishing activity. In reality, vessel owners are likely to try and adapt within the site (e.g. by changing gear type or target species) if that is possible, or, search for alternative fishing grounds, in an attempt to maintain profitability. Vessels have switched fleet segments from one year to the next in the North Sea and West of Scotland demersal and nephrops segments in response to changing fish opportunities, fish prices and management measures (SeaFish, 2013a). It is difficult, however, to forecast the scale and nature of adaption or displacement of fishing activity that is likely to occur and hence the extent to which this will offset the reduced value of landings generated by MPA designation.

It is also recognised that there are costs associated with adaption and displacement (such as the costs of developing new gear types and changing gears, increased fuel costs from longer steaming times, changes in costs and earnings patterns of individual vessels, possible additional quota and days at sea costs) and that in some cases there may be a lack of suitable alternative fishing grounds. Displacement can also generate conflict between vessels displaced to a new site and vessels previously fishing in that site (or indeed reduce conflict if some gears are prohibited); as well as causing environmental impacts through targeting of new areas. In light of the difficulties involved in assessing the scale of adaption/displacement of fishing activity and the associated costs, the costs presented for commercial fisheries assume that total value of landings affected is forgone, every year, over the 20-year period. The loss in the value of landings (and indeed the GVA and employment estimates) presented below, therefore, represent worst case estimates.

Table 7. Average annual loss in value of landings, assuming zero displacement of fishing activity, in £ millions for commercial fisheries (2012 prices)

NC MPA Proposal	Scenarios		
	Lower	**Intermediate**	**Upper**
Inshore Sites			
Clyde Sea Sill	0.00	0.23	0.45
Fetlar to Haroldswick	0.00	0.00	0.00
Loch Sunart	0.00	0.00	0.01
Loch Sunart to the Sound of Jura	0.00	0.23	0.46
Loch Sween	0.00	0.01	0.02
Lochs Duich, Long and Aish	0.00	0.01	0.03
North-west Sea Lochs & Summer Isles	0.00	0.26	0.51
Noss Head	0.00	0.00	0.00
Small Isles	0.00	0.29	1.01
South Arran	0.00	0.25	0.79
Upper Loch Fyne & Loch Goil	0.00	0.01	0.02
Wyre & Rousay Sounds	0.00	0.00	0.00
Offshore Sites			
The Barra Fan & Hebrides Terrace Seamount	*	*	*
Central Fladen	0.00	0.56	1.12
Central Fladen (core)	0.00	0.12	0.21
East of Gannet & Montrose Fields	0.00	0.05	0.22
Faroe-Shetland Sponge Belt	0.06	0.36	0.87
Firth of Forth Banks Complex	0.00	0.52	0.62
Geikie Slide & Hebridean Slope	0.00	0.78	1.09
North-east Faroe-Shetland Channel	*	*	*
Norwegian Boundary Sediment Plain	0.00	0.00	0.00
Rosemary Bank Seamount	*	*	*
South-east Fladen	0.00	0.34	0.67

NC MPA Proposal	Scenarios		
	Lower	Intermediate	Upper
South-west Sula Sgeir & Hebridean Slope	0.00	0.80	1.00
Turbot Bank	0.00	0.00 - 0.07+	0.00-0.14+
Western Fladen	0.00	0.43	0.85
Total	**0.07**	**5.55**	**10.65**
* Annual average loss of landings not shown as they would be disclosive (less than 5 vessels) + Range in value reflects whether Turbot Bank is designated for sandeel only or also for subtidal sands and gravels			

3.6.2 Potential Economic Impact of MPA Designation

The economic impact of the proposed MPAs in Scotland depends on:

- The contribution (current and potential) of the Scottish fishing industry to the Scottish Economy in terms of GVA and employment, and the extent to which that will be affected by the proposed designations; and
- The level of dependence of the Scottish fishing industry (and businesses and wider communities associated with the industry) on the landings that will affected by the proposals.

3.6.2.1 Economic importance of the commercial fishing sector to the Scottish economy and sustainable economic growth

Scotland's sea-fishing industry is estimated to contribute approximately 0.2%[13] to total Scottish GDP and 0.4% of GDP when the indirect and induced effects throughout the Scottish economy are added. Total employment in the sea-fishing industry was 4,400 in 2010 (Scottish Government, 2012b), which is 0.2% of the labour force in Scotland. The total effect on employment (taking account of indirect and induced effects) is estimated to be 6,424 full time equivalent (FTE) jobs which is 0.3% of the labour force in Scotland. The most recent Scottish Sea Fisheries Statistics published (Scottish Government, 2012a) show that in 2011, the number of fishermen employed in the Scottish fishing sector decreased by four percent compared to 2010 and is the now at lowest number ever recorded.

Although the commercial fishing sector makes a relatively low contribution to total Scottish GDP and employment, the Government Economic Strategy (2011), which sets out the Scottish Government's approach to establishing the foundations for long-term sustainable economic growth, identifies fisheries (as part of the Food and Drink sector) as one of six Growth Sectors[14] of the Scottish economy. These are sectors where Scotland has a real international comparative advantage, distinctive capabilities and businesses with the

13 Estimated using GVA estimates for the industry and for Scotland presented in the Scottish Input-Output Tables (2007).

14 The others are: Energy (including renewables, Sustainable Tourism, Creative Industries (including digital), Life Sciences and Financial and Business Services). The Food and Drink sector includes agriculture and fisheries.

potential to be internationally successful in areas of global demand. The Scottish Government is prioritising these sectors, to ensure they grow, maximise value added and create high quality and sustainable jobs.

The Strategy recognises that securing faster, more sustainable growth will require increased performance across the economy and from of all areas of Scotland. The fact that most of the fish catching industry in Scotland is concentrated in coastal areas and islands means it has important role to play in ensuring that these parts of Scotland contribute to, and share in, future economic growth.

The latest Scottish Annual Business Statistics (August 2012) presents data on turnover, GVA and employment for the Growth Sectors. In 2010, GVA in the fishing sector in Scotland amounted to £195 million, up 38% on 2008. GVA in 2010 was also above the 2009 level of £150 million (Scottish Government, 2012b). The fishing industry has delivered these increases at a time when the majority of industry divisions in Scotland have experienced a decline in GVA due to the global downturn in 2008 and 2009 and recession.

The most recent sea fisheries statistics show that the value of fish landed by Scottish vessels increased by 13% in real terms in 2011 to reach the highest level in the century (Scottish Government, 2012a). The figures show that 359,000 tonnes of fish were landed by Scottish vessels with a value of £501 million. A key factor contributing to this was a 40% increase in real terms in the value of pelagic landings, to £184 million in 2011 and a 5% increase in real terms in the value of shellfish to £164 million. This record value of landings was achieved from 359,000 tonnes of fish, the lowest volume landed in the decade.

The commercial fishing sector, therefore, has an important contribution to make to increasing Scotland's growth and ensuring that all parts of Scotland share in that growth. In 2010, although Scotland had only 8.6% of the UK population, it landed 61% of the total value of fish caught in the UK. The industry is therefore of much greater economic (and social and cultural) importance to Scotland than to the rest of the UK.

3.6.2.2 Impact of Loss of Landings on GVA and Employment (assuming zero displacement of fishing activity)

Table 8 presents the impact which the management measures (under lower, intermediate and upper scenarios) could have on the GVA generated by the fishing sector in Scotland and GVA generated by the fishing sector and its downstream supply chain, under the assumption of zero displacement. Full details on the methods used to calculate the GVA estimates are presented in Appendix C (C7.7). These estimates are based on the sum of values across all proposed MPAs and therefore represent overestimates, as not all site options will be required to complete the network (see section 7 for more information on the combined impact of the network).

Table 8 shows the potential direct impact is an annual reduction in GVA of between £0.03 million (lower scenario) and £3.76 million per year (upper scenario). That represents approximately 0%–2% of the sector's GVA. Over the 20-year timeframe of the analysis, the estimated total reduction in sectoral GVA ranges from £0.64 million (lower scenario) up to £73.5 million (upper scenario).

Table 8. Impact on GVA for the commercial fishing sector (direct impact and direct plus indirect impact) assuming zero displacement of fishing activity, £ million

GVA Impact	Scenarios		
	Lower	Intermediate	Upper
Direct Impact:			
Average annual reduction in GVA, £m/yr (PV)	0.03	2.02	3.76
Total reduction in GVA (2014-2033), £m(PV)	0.64	38.92	73.53
Direct plus Indirect Impact:			
Average annual reduction in GVA, £m/yr (PV)	0.05	2.61	4.97
Total reduction in GVA (2014-2033), £m(PV)	0.96	52.25	99.53

The total direct and indirect impact on GVA is an annual reduction in GVA of between £0.05 million and £4.97 million, across the scenarios. The total reduction over the 20-year time frame, is estimated to range between £0.96 million and £99.53 million, across the scenarios.

Table 9. Average (mean) number of direct and indirect jobs affected assuming zero displacement of fishing activity, year-on-year over 2014–2033, FTEs

Reduction in Employment	Scenarios		
	Lower	Intermediate	Upper
Direct and Indirect:			
Average (mean) number of jobs affected[1] (year on year over 2014-2033)	1	69	131
Notes: The total impact on employment has been estimated as the average (mean) number of jobs affected, (rather than the sum of jobs affected), over the 20 year period. This is because it is likely that it would be the same jobs that are affected, year-on year and hence summing the jobs would provide a misleading total.			

As indicated in Table 9, under the assumption of zero displacement, the designation of all proposed MPAs is estimated to lead to between 1 and 131 full-time equivalent jobs being lost directly and indirectly throughout the Scottish Economy, across the scenarios. This represents between 0–2% of total full-time equivalent jobs created directly and indirectly by the Scottish fishing industry.

These estimates suggest that, under the lower scenario, the economic impact of designation would be minimal. While the estimated loss of GVA under the intermediate and upper scenarios would clearly have a negative impact, the impact at the Scottish economy and sectoral level, is relatively small. Even under the upper scenario, the impact represents less than 2% of the sector's GVA and employment. Furthermore, these estimates are considered to overestimate the likely impacts as they assume that all fishing effort and associated landings is lost rather than being displaced (even although some displacement is likely).

The employment impacts also assume that reductions in GVA will automatically translate into job losses. In reality, vessels are likely to be able to absorb some small reductions in turnover and hence profit without that having any impact on employment. Further, even where the reductions in GVA are significant enough to affect employment, vessel owners have a number of alternative options before having to make fishermen redundant (e.g. reduction in wages, reduction in hours).

The point at which reductions in profits start to impact on employment issues will be different for the owners of different vessels. Rather than apply an arbitrary estimate of the threshold below which businesses would be able to absorb costs, it has been assumed that all losses in GVA translate directly into lost employment. The estimates presented above, therefore, are considered likely to over-estimate the economic impacts generated by the proposals.

Although the GVA and employment impacts are relatively small at the Scottish economy and sectoral level, they could have more significant economic and social consequences for the specific locations, individuals and communities that are affected. The scale and significance of the impacts will depend on who bears the costs and the relatively vulnerability of the local economies, fishing sectors and social groups upon which they fall. A detailed distributional analysis has therefore been undertaken for the commercial fisheries sector (and the fish processing sector) and is presented in Section 5.

3.6.2.3 Impact of Affected Landings on GVA and Employment, by MPA (assuming zero displacement of fishing activity)

Tables 10 and 11 present the potential annual average reduction in GVA and the potential total reduction in GVA over the period of analysis, by MPA, respectively. Both tables present the direct effects on the sector and the combined effects on the sector (i.e. direct effect) and its supply chain (i.e. indirect effect). Table 12 presents the potential impact of designation on employment.

Table 10. Average annual reduction in GVA (direct effect and the combined direct and indirect effect), assuming zero displacement of fishing activity, £ millions (2012 prices)

NC MPA Proposal	Scenarios					
	Lower		Intermediate		Upper	
	PV Direct Effect	Direct and Indirect	PV Direct Effect	Direct and Indirect	PV Direct Effect	Direct and Indirect
Inshore Sites						
Clyde Sea Sill	0	0	0.081	0.121	0.162	0.242
East Caithness Cliffs	0	0	0	0	0	0
Fetlar to Haroldswick	0	0	0	0	0.001	0.002
Loch Creran	0	0	0	0	0	0
Loch Sunart	< 0.001	< 0.001	< 0.001	0.001	0.001	0.002
Loch Sunart to the Sound of Jura	0	0	0.072	0.109	0.172	0.258
Loch Sween	0.001	0.001	0.003	0.004	0.006	0.009
Lochs Duich, Long and Aish	0	0	0.003	0.004	0.009	0.013
Monach Isles	0	0	0	0	0	0
Mousa to Boddam	0	0	0	0	0	0
North-west Sea Lochs & Summer Isles	0	0	0.078	0.117	0.156	0.234
Noss Head	< 0.001	< 0.001	< 0.001	< 0.001	0.001	0.001
Papa Westray	0	0	0	0	0	0
Small Isles	0	0	0.084	0.126	0.308	0.462
South Arran	< 0.001	0.001	0.084	0.126	0.242	0.363
Upper Loch Fyne & Loch Goil	0	0	0.004	0.006	0.006	0.009
Wyre and Rousay Sounds	< 0.001	< 0.001	< 0.001	< 0.001	0.002	0.003
Offshore Sites	0	0	0	0	0	0
The Barra Fan & Hebrides Terrace Seamount	0.002	0.003	0.144	0.187	0.184	0.239
Central Fladen	0	0	0.151	0.197	0.301	0.391
Central Fladen (core)	0	0	0.033	0.043	0.059	0.076
East of Gannet & Montrose Fields	0	0	0.013	0.017	0.061	0.080
Faroe-Shetland Sponge Belt	0.023	0.034	0.087	0.112	0.280	0.364
Firth of Forth Banks Complex	0	0	0.284	0.271	0.327	0.296
Geikie Slide & Hebridean Slope	0	0	0.247	0.321	0.353	0.459
Hatton-Rockall Basin	0	0	0	0	0	0
North-east Faroe-Shetland Channel	0.002	0.003	0.083	0.108	0.215	0.280
Norwegian Boundary Sediment Plain	0	0	0	0	0.001	0.001
North-west Orkney	0	0	0	0	0	0
Rosemary Bank Seamount	0.004	0.005	0.071	0.092	0.130	0.169
South-east Fladen	0	0	0.096	0.124	0.191	0.249
South-west Sula Sgeir & Hebridean Slope	0	0	0.264	0.343	0.325	0.422
Turbot Bank	0	0	0.020	0.026	0.028	0.036
West Shetland Shelf	0	0	0	0	0	0
Western Fladen	0	0	0.121	0.158	0.243	0.316
Total	**0.032**	**0.048**	**2.021**	**2.612**	**3.763**	**4.974**

Table 11. Present value (PV) reduction in GVA (direct effect and the combined direct and indirect), assuming zero displacement of fishing activity, £millions (costs discounted over assessment period, 2012 prices)

NC MPA Proposal	Scenarios					
	Lower		Intermediate		Upper	
	Direct Effect	Direct and Indirect	Direct Effect	Direct and Indirect	Direct Effect	Direct and Indirect
Inshore Sites						
Clyde Sea Sill	0	0	1.62	2.42	3.23	4.85
Fetlar to Haroldswick	0	0	0	0	0.03	0.04
Loch Creran	0	0	0	0	< 0.01	< 0.01
Loch Sunart	<0.01	< 0.01	0.01	0.01	0.03	0.04
Loch Sunart to the Sound of Jura	0	0	1.45	2.17	3.44	5.16
Loch Sween	0.02	0.03	0.05	0.08	0.13	0.19
Lochs Duich, Long and Aish	0	0	0.05	0.08	0.18	0.27
North-west Sea Lochs & Summer Isles	0	0	1.56	2.34	3.12	4.67
Noss Head	<0.01	<0.01	<0.01	<0.01	0.01	0.02
Small Isles	0	0	1.68	2.53	6.15	9.23
South Arran	0.01	0.01	1.67	2.51	4.84	7.26
Upper Loch Fyne & Loch Goil	0	0	0.08	0.12	0.12	0.18
Wyre and Rousay Sounds	<0.01	<0.01	<0.01	<0.01	0.04	0.05
Offshore Sites						
The Barra Fan & Hebrides Terrace Seamount	0.04	0.06	2.88	3.75	3.68	4.78
Central Fladen	0	0	3.03	3.93	6.02	7.83
Central Fladen (core)	0	0	0.67	0.87	1.18	1.53
East of Gannet & Montrose Fields	0	0	0.25	0.33	1.23	1.59
Faroe-Shetland Sponge Belt	0.45	0.68	1.73	2.25	5.60	7.28
Firth of Forth Banks Complex	0	0	4.17	5.43	4.80	5.93
Geikie Slide & Hebridean Slope	0	0	4.94	6.42	7.06	9.18
North-east Faroe-Shetland Channel	0.05	0.07	1.66	2.16	4.30	5.59
Norwegian Boundary Sediment Plain	0	0	0	0	0.01	0.01
Rosemary Bank Seamount	0.07	0.11	1.42	1.84	2.60	3.37
South-east Fladen	0	0	1.91	2.49	3.83	4.98
South-west Sula Sgeir & Hebridean Slope	0	0	5.28	6.87	6.49	8.44
Turbot Bank	<0.01	<0.01	0.39	0.51	0.56	0.72
Western Fladen	0	0	2.43	3.16	4.86	6.31
Total	**0.64**	**0.96**	**38.92**	**52.25**	**73.53**	**99.53**

Table 12. Average (Mean) number of direct and indirect jobs affected assuming zero displacement of fishing activity (year on year, 2014–2033), by MPA, FTEs

MPA Proposal	Scenarios		
	Lower	Intermediate	Upper
	Direct and Indirect	Direct and Indirect	Direct and Indirect
Inshore Sites			
Clyde Sea Sill	0.00	2.58	5.16
East Caithness Cliffs			
Fetlar to Haroldswick			
Loch Creran			
Loch Sunart	0.00	0.02	0.07
Loch Sunart to the Sound of Jura	0.00	2.65	5.30
Loch Sween	0.04	0.08	0.20
Lochs Duich, Long and Aish	0.00	0.08	0.14
Monach Isles			
Mousa to Boddam			
North-west Sea Lochs & Summer Isles	0.00	2.93	5.86
Noss Head			
Papa Westray			
Small Isles	0.00	3.25	11.50
South Arran	0.02	2.87	8.67
Upper Loch Fyne & Loch Goil	0.00	0.13	0.21
Wyre and Rousay Sounds	0.00	0.00	0.05
Offshore Sites			
The Barra Fan & Hebrides Terrace Seamount	0.06	4.36	5.71
Central Fladen	0.00	6.37	12.74
Central Fladen (core)	0.00	1.34	2.34
East of Gannet & Montrose Fields	0.00	0.53	2.56
Faroe-Shetland Sponge Belt	0.70	4.14	9.93
Firth of Forth Banks Complex	0.00	5.94	7.08
Geikie Slide & Hebridean Slope	0.00	8.91	12.43
Hatton-Rockall Basin			
North-east Faroe-Shetland Channel	0.08	2.61	6.42
Norwegian Boundary Sediment Plain	0.00		0.02
North-west Orkney			
Rosemary Bank Seamount	0.10	2.00	4.14
South-east Fladen	0.00	3.85	7.70
South-west Sula Sgeir & Hebridean Slope	0.00	9.09	11.43
Turbot Bank	0.00	0.79	1.57
West Shetland Shelf	0.00	0.00	0.00
Western Fladen	0.00	4.86	9.71
Total	**1.0**	**69.3**	**130.9**

Notes: The total impact on employment has been estimated as the average (mean) number of jobs affected, (rather than the sum of jobs affected), over the 20 year period. This is because it is likely that it would be the same jobs that are affected, year-on year and hence summing the jobs would provide a misleading total.

It is clear from Table 10 that there is a significant level of variation in the impact of designating different proposed MPAs on GVA in the commercial fishing sector (and its associated supply chains). The reduction in annual average GVA ranges between £0- £0.34m under the intermediate scenario (with management measures at South-west Sula Sgier & Hebridean Slope responsible for the greatest potential reduction) and £0 - £0.46m under the upper scenario (with management measures at Faroe-Shetland Sponge Belt generating the greatest potential reduction).

Similarly, Table 12 shows that the potential employment losses associated with designating different proposed MPAs, ranges from 0 to approximately 9 FTEs under the intermediate scenario (with management measures at South-west Sula Sgier & Hebridean Slope generating the greatest losses), and 0 to approximately 13 FTEs under the upper scenario (with management measures at Central Fladen, Geikie Slide & Hebridean Slope and Sula Sgier & Hebridean Slope generating the greatest potential losses).

It is important to highlight that for the reasons set out in sub-section 3.6.1 above, the estimates presented in Tables 10, 11 and 12 represent worst case estimates of the potential impact of designation on GVA and employment.

3.6.3 Impacts on Other Countries

In 2012 a number of foreign vessels were recorded fishing in Scottish Waters and 591 overlapped with the MPA areas. Of this number the main country which will be potentially affected include Norway where 78 vessels fished in the North-East Faroe-Shetland Channel proposed MPA, 32 vessels in Barra Fan and Hebrides Terrace Seamount, and 28 vessels fished in Faroe-Shetland Sponge Belt and Geikie Slide and Hebridean Slope. However, as the gear type used by these vessels is not known, the number of vessels that would actually be impacted by the proposed management measures is similarly unknown. Beyond Norway the other countries whose fleets are potentially affected include France, Denmark and the Netherlands, with smaller numbers of vessels affected from Germany, the Faroe Islands, Greenland, Ireland, Spain and Sweden. The numbers of vessels potentially affected in each case are identified in the MPA site reports in Appendix E.

3.7 Energy Generation

The energy generation sector includes coastal power stations, offshore renewables (offshore wind, wave and tidal energy) and marine biofuel production. However, the assessment focuses on offshore renewables as none of the four coastal power stations will be affected by currently proposed MPAs and the marine biofuel industry is very much in its infancy and there is insufficient information to undertake a meaningful assessment

There are eight inshore and two offshore proposed MPAs that have existing, planned or potential future offshore renewables development within the proposed site boundary or within 5km of the site boundary. One site, Wyre and Rousay Sound, overlaps with a Draft Plan Option[15] area for tidal energy development being considered for inclusion in the Scottish Government's Tidal Energy Plan. North West Orkney overlaps with similar Draft Plan Options for offshore wind and wave energy development. The Firth of Forth Banks Complex overlaps with the Firth of Forth Round 3 offshore wind lease area for which two applications for offshore wind development were submitted in 2012 and for which further applications are planned. Other proposed MPAs overlap with or are in close proximity to proposed or possible export cable routes for planned or possible future offshore wind, wave or tidal development.

Cost impacts to the offshore renewables sector may arise due to:

- Additional assessment and survey costs associated with consent applications;
- Additional mitigation measures for new developments to support achievement of site conservation objectives;
- Costs associated with delays during the consenting process; and
- Loss of investor confidence (developments do not proceed).

It is not possible to quantify the costs associated with potential delays during the consenting process or the impact of designation on investment decisions, although during consultation, the industry has flagged these issues as significant concerns, particularly in relation to the Firth of Forth Round 3 development.

Table 13 presents a national assessment of the potential additional assessment and survey costs associated with future consent applications for new offshore renewables arrays and export cables. It also includes the cost of mitigation measures, where these are considered to be required. The total quantified costs range from £0.2m (PV) in the lower scenario to over £47m (PV) in the upper scenario. The intermediate (best) estimate cost is approximately £2.7m (PV).

Under the lower scenario, minor additional costs would be associated with the need to undertake additional assessments of potential impacts to MPA features as part of development applications for offshore renewables developments. For the intermediate scenario, which is based on SNH's advice on the most likely management requirements, it is possible that additional costs might be incurred associated with re-routeing of a potential export cable from a Draft Plan Option area for wave energy within North-west Sea Lochs & Summer Isles proposed MPA. However, this is an indicative

15 The Scottish Government has identified a number of Draft Plan Option areas for future offshore wind, wave and tidal development on which it will be undertaking a public consultation in summer 2013.

cable route from a Draft Plan Option area which will be subject to public consultation and it is therefore uncertain whether the development might proceed in the future.

Table 13. Present value (PV) in £ millions for quantified costs to energy generation (costs discounted over assessment period, 2012 prices)

NC MPA Proposal	Scenarios		
	Lower	Intermediate	Upper
Inshore Sites			
Clyde Sea Sill	0.01	0.02	0.02
Loch Sunart to the Sound of Jura	0.04	0.23	0.23
Moussa to Boddam	0.01	0.01	0.04
North-west Sea Lochs & Summer Isles	0.01	2.17	2.31
Noss Head	0.01	0.02	0.02
Papa Westray	0.01	0.01	0.11
South Arran	0.01	0.04	1.05
Wyre & Rousay Sounds	0.01	0.02	0.07
Offshore Sites			
Firth of Forth Banks Complex	0.07	0.07	43.44
North West Orkney	0.03	0.06	0.06
Total Quantified Costs	**0.20**	**2.66**	**47.34**

Under the upper scenario, a number of additional potential cost impacts have been identified. These include potential costs associated with a possible requirement to re-route a potential export cable from a Draft Plan Option area for tidal energy within South Arran proposed MPA and for additional management measures for proposed offshore wind development within the Firth of Forth Banks Complex proposed MPA.

For South Arran proposed MPA, this is an indicative cable route from a Draft Plan Option area which will be subject to public consultation and it is therefore uncertain whether the development might proceed in the future.

For the Firth of Forth Banks Complex proposed MPA, significant cost impacts may be incurred under the upper scenario due to the cost associated with the potential requirement to use graded scour protection. Seagreen Wind Energy Limited has indicated that the scale of these costs could render planned future development unviable. However, it should be noted that JNCC's current advice is that the intermediate scenario represents their best view on potential management requirements.

For the purposes of the assessment, it has been assumed that consent will be obtained for the two Phase 1 offshore windfarms within the Round 3 zone (Project Alpha and Project Bravo, Seagreen Wind Energy Limited) before designation of the MPA (assumed 2014) . However, should consent not be obtained before 2014 and should additional management measures be required, additional costs could be incurred, particularly under the upper scenario. For example, applying the assessment methodology to the Phase 1 sites, the additional costs associated with graded scour protection are estimated to be £14.8m PV.

Scottish Renewables expressed concern that if the additional costs arising from management measures under the upper scenario restricted developments (current, planned, or future) or meant that developers did not proceed with projects, there could be impacts on future GVA and employment in this sector with knock-on effects on this sector's supply chains and the wider Scottish economy. Although it is highly uncertain whether designation of the proposed MPAs would affect future economic activity in this sector under the upper scenario, in light of the potential risks, the socio-economic impacts that could be generated as a result are assessed as part of the social impact analysis (sub-section 5.2).

There are significant uncertainties surrounding the assessment. In particular, the number and location of future offshore renewables developments is uncertain and the assessment is sensitive to assumptions on future development activity and cable routes. The requirements for mitigation measures are also uncertain and will vary at site level. Overall confidence in the quantified estimates is assessed as low.

3.8 Military Activities

Military activities and exercises occur in three offshore and 12 inshore proposed MPAs. A wide range of different activities occur within individual areas including general practice areas, submarine exercise areas, live firing, acoustic trials, mine laying and air combat practice.

It has not been possible to identify potential cost impacts to the military defence sector at site level. A cost estimate has been made at national level drawing on information provided by MOD to the MCZ IA (Finding Sanctuary et al, 2012).

As a public authority and operator, MoD is required under the Marine (Scotland) Act 2010 and the Marine and Coastal Access Act 2009 to carry out its functions and activities in a way that will further, or least hinder, the conservation objectives of MPAs. The Secretary of State for Defence's Safety, Health, Environmental Protection and Sustainable Development in Defence policy statement directs MoD to introduce management arrangements which, so far as is practicable, ensure that outcomes are at least as good as those required by the European Union's Environmental Impact Assessment Directive, from which military activities are exempt (JNCC and Natural England, 2011). To assist in meeting its environmental obligations, MoD has developed a Maritime Environmental Sustainability Appraisal Tool (MESAT).

This will include operational guidance to reduce significant impacts of military activities on MPAs.

For the purposes of this assessment, it has been assumed that MoD will incur additional costs under all three scenarios in adjusting MESAT and other MoD environmental assessment tools in order to consider whether its activities will impact on the conservation objectives of MPAs. It will also incur additional costs in adjusting electronic charts to consider MPAs. In line with the MCZ IA (Finding Sanctuary et al, 2012), it has been assumed that there will be a one-off cost of £25,000 in 2014 (at 2012 prices) to update MESAT with an annual cost of £5000 p.a. (at 2012 prices) from 2015 onwards to maintain MESAT.

It has also been assumed that MoD will mitigate the impact of military activity on MPA features through additional planning consideration during operations and training (as provided through the revisions to MESAT) and during coastal military activities covered by Integrated Rural Management Plans. The costs of these mitigation measures have been assumed to be £10,000 p.a. (at 2012 prices) in the first four years of the IA period, reducing to £5,000 p.a. from year 5 onwards in line with the assumptions used in the MCZ IA (Annex H10 of Finding Sanctuary et al, 2012).

On this basis, it is estimated that the PV cost (2012 prices, discounted at 3.5% over the assessment period) would be £0.19m for all three scenarios (Table 14). No potential benefits have been identified to the military defence sector.

Table 14. Present value (PV) in £ millions for quantified costs to military activities (costs discounted over assessment period, 2012 prices)

NC MPA Proposal	Scenarios		
	Lower	Intermediate	Upper
National Total	0.19	0.19	0.19

3.9 Oil and Gas

There are eleven offshore proposed MPAs that have existing or planned exploration and/or development activity. A number of other sites have historic exploration activity such as the presence of abandoned wells, but there is no current or planned exploration or development activity for these sites.

The Faroe-Shetland Sponge Belt proposed MPA encompasses five major fields West of Shetland including Schiehallion, Foinaven and Loyal which are currently in production and Laggan and Tormore which are currently under development. The East of Gannet and Montrose Fields MPA proposal encompasses 18 known hydrocarbon fields and four oil and gas platforms (Nordic Apollo FPSO; 21/25 GANNET A; 22/17 B and 22/17 A).

A large number of 26th and 27th licensing round awards have been made for oil and gas licensing blocks that are within or which overlap proposed MPAs, including:

- Faroe-Shetland Sponge Belt – 52 awards;
- North-East Faroe-Shetland Channel – 50 awards; and
- East of Gannet and Montrose Fields – 21 awards.

It is estimated that around 15 oil and gas fields that intersect with proposed MPAs will bring forward decommissioning plans over the assessment period (DECC, pers. comm., 2013). The locations of these fields cannot be disclosed for reasons of commercial confidentiality.

Cost impacts to the oil and gas sector may arise due to:

- Additional assessment and survey costs associated with licence and permit applications for new exploration development and decommissioning;
- Additional mitigation measures for new developments or decommissioning activities to support achievement of site conservation objectives;
- Costs associated with delays during the licensing and permitting process; and
- Loss of investor confidence (developments do not proceed).

It is not possible to quantify the costs associated with potential delays during the consenting process or the impact of designation on investment decisions, although during consultation, the industry has flagged these issues as significant concerns, particularly in relation to development within the West of Shetland fields.

Table 15 presents a national assessment of the potential additional assessment costs associated with future licence and permit applications for oil and gas exploration and development, as well as additional survey and mitigation costs. It also includes a national assessment of potential additional assessment costs associated with oil & gas decommissioning.

Under the lower scenario, minor additional costs would be associated with the need to undertake additional assessments of potential impacts to MPA features as part of development applications for oil and gas developments. Further potential costs might be incurred under the intermediate scenario primarily associated with the need for micrositing of oil and gas infrastructure to avoid sensitive habitats (areas of high density for tall sea pens).
Greater potential cost impacts are identified under the upper scenario, associated with additional survey and mitigation measures, including requirements to microsite infrastructure to avoid damaging a wider range of

sensitive habitats and a requirement to skip and ship drill cuttings to avoid damaging sensitive habitats. These mitigation measures would particular affect potential cost impacts for the East of Gannet and Montrose Fileds, Faroe-Shetland Sponge Belt and North-east Faroe-Shetland Channel proposed MPAs, reflecting the high levels of likely future development in these areas and requirements for extensive micrositing and skip and ship of drill cuttings. Oil & Gas UK have expressed concerns that the scale of potential cost impacts could render some proposed developments unviable. However, it should be noted that JNCC's current advice is that the intermediate scenario represents their best view on potential management requirements.

Table 15. Present value (PV) in £ millions for quantified costs to oil and gas (costs discounted over assessment period, 2012 prices)

NC MPA Proposal	Scenarios		
	Lower	Intermediate	Upper
Offshore Sites			
The Barra Fan & Hebrides Terrace Seamount	0.07	1.56	5.79
Central Fladen	0.03	0.60	2.22
Central Fladen (core)	0.03	0.78	2.90
East of Gannet & Montrose Fields	0.23	0.23	35.02
Faroe-Shetland Sponge Belt	0.49	0.49	27.93
North-east Faroe-Shetland Channel	0.44	0.44	37.62
Norwegian Boundary Sediment Plain	0.02	0.02	1.15
North West Orkney	0.07	0.07	0.07
Turbot Bank*	0.01	0.01	0.01 - 0.54
West Shetland Shelf	0.02	0.02	2.17
Western Fladen	0.06	3.91	7.77
Decommissioning Costs	0.02	0.02	0.02
Total	**1.49**	**8.15**	**122.67 - 123.20**

* Range of quantified total costs (present value) due to alterative options for the designation of MPA features. The lower estimate relates to designation of sandeels only.

Oil & Gas UK has expressed concern that if the additional costs arising from management measures under the upper scenario restricted developments (current, planned, or future) or meant that developers did not proceed with projects, there could be impacts on future GVA and employment in this sector. The exploitation of significant discoveries generally involves multi-billion pound investments. Should significant discoveries be identified but not exploited, this could have substantial knock-on effects on this sector's supply chains and the wider Scottish economy. Although it is highly uncertain whether designation of the proposed MPAs would affect future economic activity in this sector under the upper scenario, in light of the potential risks, the socio-economic impacts that could be generated as a result are assessed as part of the social impact analysis (sub-section 5.2).

There are significant uncertainties surrounding the assessment. In particular, the number and location of future oil and gas developments (including decommissioning) is uncertain, particularly in the longer term. The requirements for mitigation measures are also uncertain and will vary at site level. Overall confidence in the quantified estimates is therefore assessed as low.

3.10 Ports and Harbours

There are ten inshore proposed MPAs within which minor ports are present or adjacent to the site boundaries. No major ports are located within or adjacent to proposed MPAs. One open disposal site is located within the North West Sea Lochs and Summer Isles proposed MPA. There is no overlap between proposed MPAs and Chamber of Shipping anchorage areas. Seven proposed MPAs have one or more anchorages or mooring areas[16] within them (South Arran, Lochs Duich, Long and Aish, Fetlar to Haroldswick, Upper Loch Fyne & Loch Goil, Loch Sween, North West Sea Lochs and Summer Isles and Loch Sunart to the Sound of Jura), which may come under the jurisdiction of harbour authorities.

Cost impacts to the ports and harbours sector may arise due to:

- Additional assessment and survey costs associated with consent applications for new developments or dredge material disposals;
- Additional mitigation measures for new developments, dredge material disposal activities or commercial anchorages to support achievement of site conservation objectives;
- Loss of income associated with loss of trade;
- Costs associated with delays during the consenting process; and
- Loss of investor confidence (developments do not proceed).

It has not been possible to quantify the potential loss of income associated with loss of trade. There is a concern within the ports sector about the consequential loss of income that may arise as a result of reductions in fishing activity, particularly at those ports that are dependent on income from harbour dues from commercial fishing vessels (Ullapool Harbour Trust, pers. comm., 2013).

It has not been possible to quantify the costs associated with potential delays during the consenting process or the impact of designation on investment decisions, although this is considered unlikely to be a substantial issue for minor port developments. Some additional costs could be associated with mitigation measures for relocation of anchorages that come under the jurisidiction of harbour authorities, should such measures be required, for

16 Identified from Seazone hydrospatial dataset.

example, to relocate to less sensitive habitat areas. However, these costs have not been quantified.

Table 16 presents a national assessment of the potential additional assessment costs associated with future consent applications for new developments or dredge material disposal licences. No additional costs have been identified related to requirements for additional surveys to support consent applications or for mitigation measures as part of consent applications. The total quantified costs range from £0.14m (PV) in the lower scenario to around £0.16m in the upper scenario. The intermediate (best) estimate cost is around £0.14m (PV).

Table 16. Present value (PV) in £ millions for quantified costs to ports and harbours (costs discounted over assessment period, 2012 prices)

NC MPA Proposal	Scenarios		
	Lower	**Intermediate**	**Upper**
Inshore Sites			
Clyde Sea Sill	0	0	0.01
East Caithness Cliffs	0.02	0.02	0.02
Fetlar to Haroldswick	0.01	0.01	0.01
Loch Sunart	0	0	0.01
Loch Sunart to the Sound of Jura	0.05	0.05	0.05
Loch Sween	0	0	0.01
Lochs Duich, Long and Aish	0.01	0.01	0.01
North-west Sea Lochs & Summer Isles	0.03	0.03	0.03
Small Isles	0.01	0.01	0.01
Upper Loch Fyne & Loch Goil	0.01	0.01	0.01
Total	**0.14**	**0.14**	**0.16**

There are significant uncertainties surrounding the assessment. In particular, the number and location of future port developments is uncertain and the assessment is sensitive to assumptions on future development activity. The requirements for mitigation measures are also uncertain. Overall confidence in the quantified estimates is assessed as low.

3.11 Power Interconnectors and Transmission Lines

There are 11 inshore and three offshore proposed MPAs that have existing or planned (consented) interconnectors transiting the site or within 1km of the site boundary. Most proposed MPAs only overlap with a single power interconnector, although Loch Sunart to the Sound of Jura is intersected by 11 existing power interconnectors and transmission lines.

Given the assumption that there will be no review of existing consents or licences, no significant cost impacts are anticipated to arise in relation to existing power interconnectors and transmission lines. Should marine licences be required for maintenance work on specific sections of cable within MPAs in the future (for example, to rebury cables that have become exposed), the cable operators would be required to undertake additional assessments to take account of potential impacts to MPA features. It is possible that additional mitigation measures could be required for such works. However, the number and location of such works cannot be predicted. No significant cost impacts to the power cable sector have been identified in the assessment under any of the scenarios.

There are significant uncertainties surrounding the assessment. While the planning of power interconnectors and transmission lines is undertaken centrally by Government and there is reasonable information on the forward programme over the next decade, there is significant uncertainty surrounding the development of the offshore grid, which will be driven by development plans for offshore renewables which are themselves uncertain. It is possible that additional proposals for new interconnectors which interact with MPA features could be brought forward and implemented within the period of the assessment. The requirements for mitigation measures are uncertain and will vary at site level. Overall confidence in the quantified estimates is assessed as medium.

3.12 Recreational Boating

Scottish coastal waters are important for recreational boating activity. A large number of sailing and cruising routes are present in inshore waters with some transits through offshore waters. There are also a large number of recreational anchorages and moorings within sea lochs and sheltered coastal waters. The transit of vessels along cruising and sailing routes is not considered to pose significant risks to the features proposed for designation within current proposed MPAs. However, recreational anchoring and moorings have the potential to cause damage to sensitive seabed habitats and species.

Cost impacts may arise to the recreational boating sector if existing anchorages or moorings are closed or relocated. Potentially adverse interactions between recreational anchorages or moorings and MPA features have been identified within eight proposed MPAs:

- South Arran;
- Lochs Duich, Long and Aish;
- Upper Loch Fyne & Loch GoilLoch Sunart;
- Loch Sween;
- North-west Sea Lochs and Summer Isles
- Loch Sunart to the Sound of Jura;
- Small Isles; and
- Wyre and Rousay Sounds.

Under the lower and intermediate scenarios, SNH has identified 5 proposed MPAs where a small number of anchorages may require relocation (South Arran, Loch Sunart, Loch Sween, North-west Sea Lochs and Summer Isles and Wyre and Rousay Sounds) and 2 proposed MPAs where individual moorings may require relocation (Loch Sunart and North-west Sea Lochs and Summer Isles). Under the upper scenario, a larger number of anchorages and moorings may require relocation, taking account of current uncertainties in the spatial extent of MPA features and their sensitivity to anchor/mooring damage.

It has not been possible to quantify the cost impact of possible closure or relocation of recreational anchorages or moorings as more detailed site specific discussions are required on whether management measures were needed for individual anchorages or moorings. However, given the small number of anchorages and moorings likely to be affected, the cost impact is considered to be at worst minor.

3.13 Telecom Cables

There are two inshore (South Arran and Clyde Sea Sill) and seven offshore (Central Fladen, Central Fladen Core, North-east Faroe-Shetland Channel, Faroe-Shetland Sponge Belt, Hatton-Rockall Basin, North West Orkney, West Shetland Shelf) proposed MPAs that have existing telecom cables transiting the site. In addition one existing cable is within 1km of an inshore site (Moussa to Boddam). There is no information on potential future telecom cables. It is likely that most new development will comprise replacement of existing cables along existing routes. The asset life of a telecom cable is notionally 25 years. It is possible that some telecom cables will therefore require replacement within the assessment period. No licensing is required for cables beyond 12nm. For the purposes of the assessment it has been assumed that one cable transiting the South Arran and Clyde Sea Sill proposed MPAs will require replacement during the assessment period.

Cost impacts to the telecom cable sector may arise due to:

- Additional assessment and survey costs associated with licence applications within the 12nm limit;
- Additional mitigation measures for new developments to support achievement of site conservation objectives;
- Costs associated with delays during the consenting process; and
- Loss of investor confidence (developments do not proceed).

It is not possible to quantify the costs associated with potential delays during the consenting process or the impact of designation on investment decisions.

Table 17 presents a national assessment of the potential additional assessment and survey costs associated with future marine licence applications for new telecom cables within 12nm. The total quantified costs range from £0.014m (PV) in the lower scenario to £0.046m in the upper scenario. The intermediate (best) estimate has been assessed as the same as the lower scenario.

Table 17. Present value (PV) in £ millions for quantified costs to telecom cables (costs discounted over assessment period, 2012 prices)

NC MPA Proposal	Scenarios		
	Lower	Intermediate	Upper
Inshore Sites			
Arran	0.01	0.01	0.74
Clyde Sea Sill	0.01	0.01	0.01
Total	**0.01**	**0.01**	**0.75**

The costs largely relate to undertaking additional assessments of the potential impacts of laying a new cable on the features within the MPA. Within the upper scenario for South Arran, it has been assumed that additional survey would be required to support route planning and that an additional 1km of telecom cable is required to re-route around the burrowed mud feature.

There are significant uncertainties surrounding the assessment. In particular, the number and location of future telecom cables is uncertain and the assessment is sensitive to assumptions on future development activity. The requirements for mitigation measures are also uncertain and will vary at site level. Overall confidence in the quantified estimates is assessed as low.

3.14 Tourism

Tourism is an important and widespread economic activity within Scotland and tourism will interact with all of the proposed inshore MPAs with a coastal location. However, tourism is assessed as having relatively minor potential impacts on features within the proposed MPAs and no significant direct cost impacts are anticipated.

Given the close relationship between coastal tourism, recreational boating and water sports, impacts to the recreational boating and water sports sectors could potentially have indirect impacts on the tourism sector. While some potential impacts to the recreational boating sector have been identified (see section 3.12) in relation to possible requirements to relocate anchorages, these are not considered likely to have a significant impact on recreational boating activity. No potentially significant impacts of proposed MPAs on water sports have been identified (see section 3.15). On this basis, no significant indirect impacts on the tourism sector are anticipated.

The tourism sector may benefit directly from the designation of NC MPAs with a coastal component (with the MPA providing an added attraction to a destination). Indirect benefits may also accrue as a result of benefits to other sectors. For example, some benefits to the water sports sector have been identified associated with potential improvements in the ecological value of NC MPAs stemming from management measures applied to other sectors (see section 3.15). Potential benefits to the tourism sector are discussed in more detail within the benefits assessment (Section 6).

3.15 Water Sports

A wide range of water sports activities take place in Scottish waters including recreational angling, surfing, windsurfing, sea kayaking, small sail boat activities (such as dinghy sailing) and scuba diving (BMF et al., 2009). Recreational boating activity in larger vessels such as yachts is covered separately (see section 3.12). Water sports activities will interact with all of the proposed inshore MPAs with a coastal location. Some activities such as diving will also interact with some sites further offshore, for example, there are four dive sites within the Firth of Forth Banks Complex proposed MPA. However, all water sports are assessed as having relatively minor potential impacts on features within the proposed MPAs and no significant direct cost impacts are anticipated.

Some benefits to the water sports sector have been identified associated with potential improvements in the ecological value of NC MPAs stemming from management measures applied to other sectors. For example, recreational fishing may benefit from improved fish resources (more and larger fish) and recreational diving may benefit from the increased abundance and size of fish and conspicuous epiflora/fauna. Potential benefits to the water sports sector are discussed in more detail within the benefits assessment (Section 6).

4. Costs to the Public Sector

Following a decision to designate individual sites, costs will be incurred by the public sector in the following broad areas, it should however be noted that not all measures listsed will be needed at all sites, i.e. these requirements will be site specific:

- Preparation of Marine Management Schemes;
- Preparation of Statutory Instruments;
- Development of voluntary measures;
- Site monitoring;
- Compliance and enforcement;
- Promotion of public understanding; and
- Regulatory and advisory costs associated with licensing decisions.

It is possible that public bodies such as The Crown Estate (TCE) could also experience impacts on its revenues from seabed leases should some development projects not proceed as a result of MPA designation or should some existing TCE moorings require relocation (see section 3.12). However, it has not been possible to estimate such potential impacts within this assessment. In addition, Scottish Water may also incur some additional costs, although the assumption used for this assessment is that any management measures required to support the achievement of MPA objectives would already be required under the Water Framework Directive.

Most of the potential costs identified have been assessed at the level of individual MPA sites, except for inshore site monitoring, compliance and enforcement, promotion of public understanding and an element of regulatory and advisory costs which have been assessed at national level.

4.1 Marine Management Schemes

As part of the process of designation, management plans will be developed for each potential nature conservation MPA, setting out the preferred management option and how it will be delivered. These management plans represent a sunk cost as the work will largely be completed ahead of the decision to designate individual sites. For many sites, particularly offshore sites where the only significant human activity is likely to be commercial fishing, the management plan is likely to provide a sufficient basis for coordinating management efforts. However, for inshore sites where a large number of activities may be occurring, it may be necessary to develop a more formal Marine Management Scheme which sets out the roles and responsibilities of different public authorities so that there is clarity concerning how these authorities will be delivering their statutory functions to support achievement of the conservation objectives for protected features within the MPAs. These management schemes will be considerably more detailed than the management plans, similar in nature to the Schemes of Management that have been established for some European Marine Sites.

For the purposes of this assessment, it has been assumed that a management scheme will be required for certain inshore sites within 6nm where there are multiple activities taking place over a significant proportion of the site. This includes sea lochs, where there is a significant community of interest. SNH has advised that sites for which black guillemot is the only feature will not require a Management Scheme. On this basis 6 sites have been tentatively identified as potentially requiring Management Schemes:

- North West Sea Lochs and Summer Isles;
- Lochs Duich, Long and Alsh;
- Upper Loch Fyne and Loch Goil;
- Loch Sunart;
- Loch Sunart to the Sound of Jura; and
- South Arran.

The cost associated with preparing a Management Scheme has been assumed to be £24,500 (at 2012 prices) per site based on the estimate of £23,000 at 2009 prices provided in Scottish Government (2009). It is assumed that that these Schemes are developed in 2014 and 2015 with the costs split equally across these 2 years. On this basis the one-off PV cost (2012 prices discounted at 3.5% over the assessment period) for these Schemes is £0.144 million.

4.2 Statutory Instruments

A number of different mechanisms may be used to restrict or regulate works or activities potentially affecting nature conservation MPAs:

- Marine Conservation Orders (under the Marine (Scotland) Act 2010);
- Fisheries management measures within 12nm under the Inshore Fishing (Scotland) Act 1984; and
- Fisheries management measures beyond 12nm under the Common Fisheries Policy.

4.2.1 Marine Conservation Orders

Marine Conservation Orders (MCOs) may be required to regulate activities that take place within a designated MPA where and when required. MCOs are provided for under the Marine (Scotland) Act and are therefore applicable only to inshore sites. They might be required to prohibit or restrict certain activities such as entry into a site, anchoring vessels, killing, taking etc animals or plants, depositing material or damaging the seabed. The cost associated with the making of such Orders has been assumed to be £3,500 (at 2009 prices), being the mid-range of the estimate provided in Scottish Government (2009).

The initial management options papers developed by SNH have not identified any specific requirements for MCOs at this stage. Given the uncertainty surrounding the future requirement for MCOs , no specific costs have been identified to the public sector within this assessment.

4.2.2 Inshore Fisheries Management Measures

Should fisheries management measures be required in inshore waters, it is likely that these will be pursued under fisheries legislation rather than through MCOs. The Inshore Fishing (Scotland) Act enables Ministers to establish spatial management measures within 6nm through Orders which may prohibit certain gear or vessel types, the targeting of particular species and the time periods for which such prohibitions apply. Separately, s197 of the Marine and Coastal Access Act 2009 as read with s158 of the Marine (Scotland) Act 2010 gives Scottish Ministers the power to amend the conditions of fishing licences to protect the marine environment within territorial waters (0-12nm). These can be used to apply similar restrictions to those applicable using the Inshore Fishing (Scotland) Act 1984. As this Act only applies in the 0-6nm zone, conditions on fishing licences will be used as a method used to provide fisheries management when measures are required in NC MPAs located within the 6-12nm zone where the UK has exclusive access.

For the purposes of this assessment, it has been assumed that an Order will be required for each MPA which is wholly or partially within 6nm for which new fisheries management restrictions may be required under one or more of the assessment scenarios. The cost associated with the making of such Orders (or modifying existing Orders) has been assumed to be £3,500 (at 2009 prices), being the mid-range of the estimate provided in Scottish Government (2009).

Based on the assumptions on management options used in the site specific assessments, it is estimated that five to twelve sites will require new or modified fisheries Orders to support achievement of the conservation objectives, depending on the scenario. It is assumed that these Orders and amendments to fisheries licences will be made in 2014, representing a one-off cost of between £0.019 million and £0.045 million (Present Value, 2012 prices discounted at 3.5% over the assessment period). It is noted that on going work to ensure that commercial fisheries activities comply with the requirements of Article 6 of the Habitats Directive may also lead to a requirement for Fisheries Orders in some potential MPA locations. Assuming that a single Order can be made to establish the management measures required both for potential nature conservation MPAs and compliance with Article 6 of the Habitats Directive, this would reduce the costs to the public sector in making these Orders.

For sites wholly or partly between 6 to 12nm where UK vessels have exclusive access , it has been assumed that any required fisheries management measures will be implemented through amendments to licence conditions for individual vessels. Marine Scotland (Marine Scotland, pers. comm., 2013) has indicated that modifications to fishing licences is a minor administrative task (all fishing licences could be amended within 3 days by a single member of staff) and the costs of amending a proportion of fishing licences would therefore be absorbed within existing activity. It is assumed that amendments to fisheries licences will be made in 2014, but will not represent a significant additional cost to the public sector.

For sites wholly or partly between 6 to 12nm where non-UK vessels have historic fishing rights, measures to manage non-UK vessels would need to be pursued under the CFP. Based on current information, it is not anticipated that any specific CFP measures would be required for sites partly or wholly between 6 to 12nm. Where sites overlap the 12nm boundary, CFP measures would necessarily be required if fishing activity was to be restricted.

4.2.3 Offshore Fisheries Management Measures

Should fisheries management measures be required in offshore waters, these would need to be pursued through the CFP in consultation with the European Commission. These measures, if approved, would control the activities of all fishing vessels. The measures could introduce spatial restrictions on gear types, the targeting of particular species and the time periods for which such prohibitions would apply.

For the purposes of this assessment, it has been assumed that CFP measures will be required for each MPA which is wholly or partially beyond 12nm for which new fisheries management restrictions may be required under one or more of the assessment scenarios. The cost associated with negotiating such measures has been assumed to be £5,000 per site (at 2012 prices) (Marine Scotland, pers. comm., 2013), although there is no available evidence on which to base this estimate.

Under the lower scenario, CFP measures could be required at 5 offshore sites, rising to 10 to 11 sites under the intermediate and high scenarios depending on choices about alternative site options.. Assuming these measures are developed during 2015 and 2016 with the cost spread evenly over these 2 years, the one-off PV cost (2012 prices discounted at 3.5% over the assessment period) for these measures ranges from £0.025 million (lower scenario) to £0.047 million to £0.052 million (intermediate and upper scenarios).

4.3 Voluntary Measures

For some sites, it may be appropriate for public bodies to develop voluntary measures to manage certain types of recreational activity. This may be particularly appropriate for remote coastal sites where the scale of impact is unlikely to be severe and where there is little possibility of cost-effective enforcement. The cost associated with developing and publicising voluntary measures is uncertain, but considered likely to be similar to the costs of preparing Orders (assumed to be £3,500 (at 2009 prices), being the mid-range of the estimate provided in Scottish Government (2009)). Given the uncertainty surrounding the future requirement for voluntary measures, no specific costs to the public sector have been identified within this assessment.

4.4 Site Monitoring

The costs of site surveys to characterise potential nature conservation MPAs in advance of designation have been treated as sunk costs because the expenditure has already occurred or has been budgeted.

Following designation, there will be an ongoing requirement to undertake monitoring within nature conservation MPAs, both to improve understanding of the distribution of features and to monitor the condition of features to assess achievement of the feature-specific conservation objectives. It is assumed that sites will be monitored based on a 6-year reporting cycle. Effort will be targeted towards those features considered to be most at risk. The approach to site-based monitoring following designation will be set out in a detailed monitoring strategy that will be developed by SNH and JNCC as part of a UK-wide marine monitoring strategy that is being coordinated by JNCC in collaboration with the statutory nature conservation bodies.

The costs of monitoring individual MPAs will vary depending on their location, with higher costs likely to be associated with surveys for offshore sites, owing to the requirement for larger vessels. For the purposes of this assessment, the following assumptions have been applied:

- Inshore sites with seabed habitat features (sites mainly within 12nm) - current levels of expenditure on benthic habitat and species surveys for inshore sites will continue (approximately £300k p.a. at 2012 prices, SNH pers. comm.);
- Inshore sites with only black guillemot feature (Monach Isles, Papa Westray, East Caithness Cliffs) – assume total cost of £30k (2012 prices) every 6 years; and
- Offshore sites (sites mainly beyond 12nm) (based on JNCC, pers. comm.):
  - Fladen survey work undertaken simultaneously;
  - Shallow water sites at a cost of £272 per sq km (based on MCZ IA costings report);
  - Deep water sites at a cost of £25,000 per day = £350,000 per survey (assuming average 14 day survey) as deeper and more expensive than relatively shallower sites; and
  - Cost of North-east Faroe-Shetland Channel survey doubled due to size to £700,000.

The expenditure on inshore sites equates to around £1.83m per 6 year reporting cycle, or approximately £110,000 per site. This compares to an estimated average value of £150,000 per site (covering both inshore and offshore sites) presented in Table 7 of the Final Regulatory Impact Assessment for the Marine (Scotland) Bill (Scottish Government, 2009).

For the offshore sites, Table 18 presents estimated survey costs for individual sites. Depending on the alternative options selected, there may be between 12 and 13 offshore sites. Assuming monitoring is undertaken on a 6 year cycle, this would equate to a total annual cost of £0.92 million to £1.01 million, although it is possible that a lower frequency of monitoring could be applied to offshore sites (JNCC, pers. comm.).

Table 18. Estimated survey costs – offshore sites

Name	Site Type	Sq km Area	Cost Per Survey (£m)
Turbot Bank	Shallow	233.45	0.06
Fladen Group	Shallow	723.33 (upper value)	0.20
East of Gannet and Montrose Fields	Shallow	1837.76	0.50
Firth of Forth Banks Complex	Shallow	2130.06	0.58
West Shetland Shelf	Shallow	4047.30	1.10
North-west Orkney	Shallow	4388.46	1.19
Norwegian Boundary Sediment Plain	Shallow	160.79	0.04
Faroe-Shetland Sponge Belt	Deep	6378.74	0.35
Hatton-Rockall Basin	Deep	1264.64	0.35
South-west Sula Sgeir and the Hebridean Slope	Deep	2093.45	0.35
Geikie Slide and Hebridean Slope	Deep	2269.04	0.35
Rosemary Bank Seamount	Deep	7413.13	0.35
The Barra Fan and Hebrides Terrace Seamount	Deep	4700.83	0.35
North-east Faroe-Shetland Channel	Deep	26,967.71	0.70

The estimated PV cost (2012 prices discounted at 3.5% over the assessment period) for the suggested level of future monitoring required is £18.6 million to £20.0 million.

4.5 Compliance and Enforcement

Where management measures are necessary to support the achievement of conservation objectives for individual features within MPAs, a level of compliance and enforcement activity will be required. For licensable activities, this is likely to primarily entail scrutiny of monitoring returns provided by operators in fulfilment of conditions in their licences and in most cases is likely to impose only a minimal administrative burden on regulators.

For unlicensed activity, some additional site based monitoring could be required. For commercial fishing activity, particularly in offshore sites which are exclusively used by over 12m vessels, Vessel Monitoring System (VMS) data will provide a good source of information on compliance with any spatial closures. However, where management measures restrict gear types, some additional site based inspection activity may also be required, although in the future, remote sensing technologies or high frequency VMS technologies may be able to be used to indicate gear types being deployed. Marine Scotland Compliance have three Marine Protection Vessels (MPV) that are deployed on fisheries enforcement activities in Scottish inshore and offshore waters. Marine Scotland Compliance (Marine Scotland, pers. comm., 2013) has indicated that potential additional inspection requirements for NC MPAs will be prioritised within existing resources and will not therefore lead to any significant increase in existing costs.

For inshore sites, where spatial management measures are required for commercial fishing activities, it will also be possible to measure compliance by >12m vessels with any spatial closures using VMS data. For vessels <12m, it may be necessary to establish alternative compliance mechanisms, for example, using local VMS systems based on mobile phone technology, which have successfully been used to monitor compliance with spatial closures in Lyme Bay. Detailed information on the total costs of implementing the local VMS pilot system for Lyme Bay is not available although the cost of acquiring and installing a monitoring terminal was around £1k (Neil Wellum, MMO pers. comm.). This terminal permits users to download information in near-real time. Should such systems be considered necessary for inshore NC MPAs, it is unlikely that the total cost of implementing, monitoring and enforcing such systems would exceed £5k per site p.a. It has been assumed that three such systems are established from 2016 (high scenario only). The estimated PV cost (2012 prices discounted at 3.5% over the assessment period) is £0.199m.

For other types of unlicensed activity, it is unlikely that formal compliance monitoring will be required unless specific local issues arise. For inshore sites, additional information on compliance is likely to be provided by members of the public.

4.6 Promoting Public Understanding

Once designated, a level of promotion of the MPAs and their management plans will be undertaken. This may take a variety of forms including provision of information via the internet, including within Marine Scotland Interactive, and for inshore sites, local public education activity and possibly the provision of signage at key access points. The costs associated with these activities are generally considered to be part of normal corporate activity for Marine Scotland, SNH and JNCC and for the purposes of this assessment it has therefore been assumed that no additional costs will be incurred. Marine Scotland (Marine Scotland, pers. comm., 2013) has indicated that there could be a maximum one-off cost of £50,000 associated with developing public information on the internet, assumed to be incurred in 2014.

4.7 Regulatory and Advisory Costs Associated with Licensing Decisions

Where licensed development is proposed in the vicinity of features protected within nature conservation MPAs, developers may be required to provide an assessment of the potential impacts of the development on those features as part of their overall development application. Under the Marine (Scotland) Act 2010 and Marine and Coastal Access Act 2009, where it is concluded that a proposed development is capable of affecting other than insignificantly a protected feature of an NC MPA, a more detailed assessment of the potential impact is required. This main assessment stage focuses on determining whether the potential development might pose a significant risk of hindering the conservation objectives. Where additional assessment effort is required of developers, this will necessarily entail additional review effort by regulators and their advisors. Based on information contained in the draft Regulatory Impact Assessment for the Scottish Marine Bill, the cost to regulators of reviewing developer submissions is approximately 10% of the cost to the developer of preparing those submissions (Scottish Government, 2009). Additional regulatory and advisory costs associated with reviewing additional assessments have therefore been calculated on this basis.

The main areas identified where additional costs may be incurred in reviewing licensing and consent applications include:

- Planning applications for new or extended finfish and shellfish aquaculture installations (local authorities, particularly Western Isles, Argyll & Bute, Highland and Shetland Councils) - £0.044 million PV (all scenarios);
- CAR licences for use of chemical therapeutants in finfish aquaculture installations (SEPA) - £0.006 million (all scenarios) PV;
- Oil and gas licences and permits for new oil & gas exploration and development (DECC) - £0.138 million to £0.146 million (PV) (all scenarios), depending on offshore options chosen; and
- Marine licences for new development activity (multiple sectors) (Marine Scotland) - £0.029 million to £0.036 million PV (lower scenario) to £0.040 million to £0.047 million PV (upper scenario), depending on combination of alternative sites selected.

The cost impacts identified above will fall on the lead regulators for the relevant licensing regimes but also on SNH and JNCC, the statutory nature conservation bodies.

4.8 Summary of Estimated Costs to the Public Sector

Table 19 summaries the estimated potential costs to the public sector. Information on site specific costs is also provided in the relevant Site Reporting Templates (Appendix E) where costs could be allocated to individual sites.

Table 19. Present value (PV) in £ millions for public sector costs (costs discounted over assessment period, 2012 prices)

Activity	Scenarios		
	Lower	Intermediate	Upper
Marine Management Schemes	0.14	0.14	0.14
Statutory Instruments – Inshore Measures	0.02	0.04	0.05
Statutory Instruments – Offshore Measures	0.03	0.05	0.05
Voluntary Measures	-	-	-
Site Monitoring – Inshore	4.63	4.63	4.63
Site Monitoring - Offshore	18.62 to 19.99	18.62 to 19.99	18.62 to 19.99
Compliance and Enforcement	-	-	0.20
Promoting Public Understanding	0.05	0.05	0.05
Regulatory and Advisory Costs			
▪ Planning applications – aquaculture	0.04	0.04	0.04
▪ CAR licences – finfish aquaculture	0.01	0.01	0.01
▪ Oil & gas licensing	0.14 to 0.15	0.14 to 0.15	0.14 to 0.15
▪ Marine licensing	0.03 to 0.04	0.04	0.04 to 0.05
Total	**23.71 to 25.10**	**23.76 to 25.14**	**23.97 to 25.36**

There are a number of uncertainties surrounding the estimates of costs to the public sector, in particular, the frequency with which offshore biological surveys will be carried out, the requirement for and costs of compliance and enforcement of any inshore fisheries management measures and the costs associated with securing CFP measures.

5. Distribution of Economic Costs and Consequent Social Impacts

The analysis presented in Section 3 has demonstrated that designation of the proposed MPAs, under the intermediate and/or upper scenarios, could generate potentially significant socio-economic impacts on the following sectors and/or the businesses, communities or individuals that depend on them:

- Commercial fisheries;
- Energy generation; and
- Oil and gas.

For commercial fisheries, implementation of the management measures required to protect the features of some MPAs (under the intermediate and upper scenarios), would result in a reduction or displacement of current and future output. It has been possible to quantify the potential loss of output and the associated impacts on GVA and employment for the sector and the economy as a whole. Although the GVA and employment impacts are relatively small at the Scottish economy and sectoral level, they could have potentially significant economic and, hence, social consequences depending on the specific regions/ports, individuals and communities that are affected.

The social impacts generated by the proposed NC MPAs will be strongly connected to the nature, scale and distribution of the economic impacts. This section is therefore presented in three parts:

- Sub-section 5.1 - presents a distributional analysis of the key quantified economic costs;
- Sub-section 5.2 - identifies the areas of social impact that could potentially be affected by potential designation of the proposed MPAs and assesses the significance of these impacts; and
- Sub-section 5.3 - presents the key conclusions.

Sub-section 5.1 focuses exclusively on the commercial fishing sector (and the consequent impacts on the fish processing sector) as this is the only sector where quantitative estimates of the economic costs (on output, GVA and employment) are available.

For energy generation and oil and gas, the potential increases in operating costs and some mitigation measures associated with designation have been quantified but it has not been possible to quantify the additional costs of some mitigation measures for new developments, decommissioning activities (in the case of oil and gas), or the costs associated with the potential delays or the impact of designation on future decisions. It is recognised that if the additional costs and delays potentially generated by management measures had a negative impact on investment decisions and meant that developments did not proceed (or were restricted), there would be a loss of future GVA and employment in these sectors. There would also be knock-on effects on their supply chains and the wider Scottish economy.

Sub-section 5.2, therefore, not only identifies the types of social impacts that are likely to be connected with the key quantified economic costs for the commercial fisheries sector, but also considers the social impacts likely to be associated with the non-quantified economic impacts for all three sectors. In the case of commercial fisheries, this involves identifying the social costs that are likely arise if those that own the affected vessels make some effort to offset the loss in output by fishing other grounds as well as those that can be anticipated assuming no redistribution of effort.

It should be noted that this section focuses on the potential socio-economic costs arising from designation of the proposed MPAs. It is evident that there are also potential economic and social benefits that would be generated from the environmental benefits of designating the possible MPAs. These are presented in Section 6.3 and should be considered against the socio-economic costs presented in this section.

5.1 The Distribution of Key Quantified Economic Costs: Commercial Fishing Sector and Fish Processing Sector

The designation of the entire suite of proposed NC MPAs is estimated to:

- reduce the average annual value of output landed by the commercial fisheries sector by between £0.1m and £11.5m;
- reduce average annual GVA (direct and indirect) by £0.05m to £5.0m; and
- reduce the average (mean) number of jobs (direct, indirect and induced) by between 1 and 131 FTEs.

with the ranges reflecting the different management options assessed across the scenarios.

These are worst-case estimates based on the assumption that all economic activity is lost rather than being displaced to alternative fishing grounds. Since it is likely that some displacement of effort would occur, the economic costs are likely to be lower than those estimated. This may, however, be partly offset by other economic and social costs associated with displacement (set out in Table 29, sub-section 5.2 below) such as increased fuel costs and a loss of social cohesion among fleets.

In addition to the impact on the commercial fisheries sector, reductions in the quantity of seafish landed locally at Scottish landing ports, would reduce the supply of locally-landed catch to fish processing facilities and the hotel/restaurant, retail and wholesale trades. The distributional analysis therefore considers how the impacts on both sectors (commercial fisheries and fish processing) are likely to be distributed across different areas of Scotland and specific groups of people, and assesses the likely significance of these impacts.

The distributional analysis presented in this section considers the distribution of the potential economic (and hence social) costs of designating the entire suite of MPA proposals. A distribution analysis has also been conducted for each relevant individual proposed NC MPA and is presented in the Site Reports in Appendix E.

Six different aspects are assessed as part of the distributional analysis:

- Location;
- Age groups;
- Gender groups;
- Fishing groups;
- Income group; and
- Social groups.

The key results of the distributional analysis are summarised in Tables 20 and 21. For some aspects, the distribution of costs (e.g. across different Scottish regions and ports, categories of vessel and species type) has been assessed quantitatively. For others (i.e. age, gender, income and social groups), the analysis indicates whether designation of the possible MPAs is likely to impact on these groups, and, if so, whether the impact is anticipated to be minimal, negative, or significantly negative.

Table 20. Distribution of quantified economic costs for commercial fisheries and fish processors (assuming zero displacement of fishing activity) - location, age, gender

Sector/Impact	Location			Age			Gender	
	Regions	Port (s)	Rural, Urban, Coastal or Island	Children	Working Age	Pensionable Age	Male	Female
Commercial Fisheries Reduction in landed value, GVA and employment	Share of total costs for vessels >15 m under Intermediate and Upper Scenario: North-east: over 50% West: 20% . North-west: 12-14% North: 4% East:1%	Largest employment impacts in: Fraserburgh: 18-32 FTE job losses Peterhead: 5-9 FTE job losses Mallaig: 3-8 FTE job losses Ayr: 4-6 FTE job losses Campbeltown: 2-7 job losses Largest relative impact on total landings to port: Buckie: 6- 14% of total landings affected	xx Impacts concentrated in coastal areas; urban in North-East, rural in West and North-west	xxx Potentially significant negative effect if parent loses job/becomes unemployed	xxx	xx Potential negative effect if retirees own affected vessels or live in households affected by unemployment	xxx 1-131 FTE job losses	xxx Potentially significant negative effect if member of household loses job/becomes unemployed.
Fish Processors Reduction in local landings at landing ports	x North-east and North-west regions most significantly affected	In most ports affected landings represent a very low proportion (0–3%) of total landings: x Mallaig: xx affected landings represent 2–7% of total landings to the port; Kinlochbervie: xx affected landings represent 3–5% of total landings to the port, under intermediate and upper scenarios	x Impacts concentrated in coastal areas; urban in North-East, rural in North-west	x	x	0	x 60% of processors male	x 40% of processors female
Impacts: xxx : xx : x: 0:	significant negative effect; possible negative effects; minimal negative effect, if any; no noticeable effect expected.							

Table 21. Distribution of quantified economic costs for commercial fisheries and fish processors (assuming zero displacement of fishing activity) - Fishing groups, income groups and social groups

Sector/Impact	Fishing Groups		Income Group			Social Groups		
	Vessel Category <15m >15m	**Gear Types/Sector**	**10% Most Deprived**	**Middle 80%**	**10% Most Affluent**	**Crofters**	**Ethnic Minorities**	**With Disability or Long-Term Sick**
Commercial fisheries Reduction in landed value, GVA and employment	Under lower scenario – main impact on <15m vessels Under intermediate and upper scenarios – main impact on >15m vessels	Main gear types affected for vessels <15m are nephrops trawlers Main gear types affected for vessels >15m are whitefish and nephrops trawls followed by dredges No impact on pelagic vessels	xx Possible negative impact on 10% most deprived	xx Possible negative impact on middle income group	x Information only available on average incomes, not the distribution of income. Not clear, therefore, whether this group will be affected	0	No breakdown of fisherman employment by social group	0 No employment data but unlikely to be employed in fisheries
Fish Processors Reduction in local landings at landing ports		Impacts on species type: Lower scenario – approx. 80% of affected landings are demersal and 20% shellfish Intermediate and upper scenarios – almost 60% of affected landings are shellfish and the remainder demersal Impact on different types of processing units: Shellfish & demersal fish processing units that cannot offset reductions in local landings with imported fish: xx Shellfish & demersal fish processing units that can offset reductions in local landings with imported fish: x	x	x	0	0	No breadown of fish processing employment data available by social group	No breakdown of fish processing employment data available by social group
Impacts: xxx : significant negative effect; xx : possible negative effects; x: minimal negative effect, if any; 0: no noticeable effect expected								

5.1.1 Commercial Fishing Sector

5.1.1.1 Distribution of economic costs by location (assuming zero displacement of fishing activity)

Table 22 presents the annual loss of landings affected by region and home port, for vessels greater than 15m. It is not possible to present the analysis for the total annual loss of landings as data on landings affected by home port are not available for smaller vessels (i.e. less than 15m).

As indicated in Table 24 below, however, over 65% of the landings affected under the intermediate and upper scenarios are lost by larger vessels. The analysis presented below therefore captures a high proportion of the landings affected, although it is recognised that the distribution of impacts across ports may be different between the larger-scale and smaller-scale vessels.

It is clear from Table 22 that:

- The costs of designating the entire suite of proposed MPAs would fall disproportionately on the North-east region. It is estimated that over 50% of the total cost of the proposals for larger vessels (56% under the intermediate scenario and 53% under the upper scenario), would fall on vessels operating from ports in this region. The most significant impacts would be felt in Fraserburgh which alone accounts for 40% of total costs under the intermediate scenario and 36% under the upper scenario;
- The West and the North-west regions would also bear a relatively high proportion of the costs under the intermediate and upper scenarios – 20% and 12-14%, respectively. In the West, the costs are shared across Campbeltown, Oban and Ayr while in the North-West, the impacts fall disproportionately on Mallaig which bears 7–9% of the total costs under the intermediate and upper scenarios; and
- The North and the East bear a relatively small share of the costs – 4% and 1%, respectively.

In order to assess the significance of the potential impacts on specific Scottish districts/ports, Table 23 presents data on two key indicators for all Scottish districts/ports:

- The value of landings affected (from over-15m vessels) as a percentage of the total value of landings to ports; and
- The potential number of jobs lost as a percentage of the total number of fishermen employed at each district/port.

Table 22. Annual average value (£ million) and percentage of landings affected by region and home port, for >15m vessels, assuming zero displacement of fishing activity (costs discounted over the assessment period) 2012 prices

Region/District/Port	Scenarios					
	Lower		Intermediate		Upper	
	Total value of landings affected at port	As % of total value of landings affected across all ports	Total value of landings affected at port	As % of total value of landings affected across all ports	Total value of landings affected at port	As % of total value of landings affected across all ports*
NORTH EAST:						
Fraserburgh	0.00	18	1.17	40	2.07	36
Buckie	0.00	0	0.15	5	0.32	6
Aberdeen	0.00	0	0.01	0	0.02	0
Peterhead	0.00	26	0.32	11	0.61	11
North East Total	0.00	44	1.65	56	3.02	53
NORTH:						
Kirkwall	0.00	32	0.10	3	0.16	3
Scrabster	0.00	0	0.01	1	0.02	0
Lerwick	0.00	0	0.01	0	0.01	0
North Total	0.00	32	0.12	4	0.20	4
WEST:						
Campbeltown	0.00	19	0.15	5	0.43	8
Oban	0.00	0	0.18	6	0.35	6
Ayr	0.00	0	0.26	9	0.39	7
West Total	0.00	19	0.59	20	1.16	20
NORTH WEST:						
Stornoway	0.00	0	0.03	1	0.08	1
Lochinver	0.00	0	0.05	2	0.06	1
Portree	0.00	0	0.00	0	0.01	0
Mallaig	0.00	0	0.19	7	0.49	9
Ullapool	0.00	0	0.07	2	0.16	3
Kinlochbervie	0.00	0	0.01	0	0.02	0
North West Total	0.00	0	0.35	12	0.83	14
EAST						
Eyemouth	0.00	0	0.01	0	0.02	0
Pittenweem	0.00	0	0.01	0	0.01	0
East Total	0.00	0	0.02	1	0.04	1
TOTAL	**0.01**		**2.73**		**5.25**	

* The value of total landings affected (i.e. across all ports) is different under the three scenarios. The value of landings affected at one port as a percentage of the total value of landings across all ports, therefore, can be lower under the upper scenario than it is under the intermediate scenario.

Table 23. Landings affected (assuming zero displacement of fishing activity) as a percentage of total landings and job losses as a percentage of the total number of fishermen employed, by district/port

Scottish Region/Port	Scenarios								
	Lower			Intermediate			Upper		
	Affected landings as % of total landings to port	Estimated reduction in employment	In employment as % of total employed in fishing	Affected landings as % of total landings to port	Estimated reduction in employment	In employment as % of total employed in fishing	Affected landings as % of total landings to port	Estimated reduction in employment	In employment as % of total employed in fishing
Aberdeen	0	0	0.0	0.2	0	0.3	0.4	0	0.5
Buckie	0	0	0.0	6.4	2	1.4	13.6	5	2.9
Eyemouth	0	0	0.0	0.2	0	0.1	0.5	0	0.3
Fraserburgh	0	0	0.0	3.1	18	2.8	5.5	32	4.9
Peterhead	0	0	0.0	0.3	5	1.3	0.7	9	2.6
Pittenweem	0	0	0.0	0.2	0	0.1	0.4	0	0.2
Scrabster	0	0	0.0	0.1	0	0.1	0.1	0	0.2
Orkney	0	0	0.0	-	-	-	-	-	-
Shetland	0	0	0.0	-	-	-	-	-	-
Stornoway	0	0	0.0	0.4	0	0.0	1.0	0	0.0
Ayr	0	0	0.0	3.2	4	0.8	4.6	6	1.2
Campbeltown	0	0	0.0	1.5	2	0.8	4.2	7	2.5
Kinlochbervie	0	0	0.0	0.1	0	0.4	0.3	0	0.9
Lochinver	0	0	0.0	0.2	1	4.0	0.3	1	5.3
Mallaig	0	0	0.0	2.8	3	2.9	7.0	8	7.2
Oban	0	0	0.0	3.0	3	1.1	5.9	5	2.2
Portree	0	0	0.0	0.0	0	0.0	0.1	0	0.0
Ullapool	0	0	0.0	0.6	1	0.5	1.4	3	1.2

It is clear from Table 23 that the value of landings lost as a result of designating the suite of proposed MPAs represents a very small proportion of total landings for the large majority of Scotland's districts and ports. At most districts/ports, the affected landings represent less than 1% of total landings under the intermediate and upper scenarios, respectively. At some ports - Fraserburgh, Ayr, Campbeltown, Mallaig and Oban - affected landings account for a higher proportion (ranging between 1.5% and 5.5%) of the value of total landings, but are still relatively low.

The largest job losses are expected in Fraserburgh. Under the intermediate and upper scenarios, it is estimated that the proposals could put between 18 and 32 jobs at risk; this represents a 3–5% reduction in the number of fishermen employed on vessels based in Fraserburgh. Fraserburgh employs the greatest number of fishermen in Scotland and over half of the employment in the Fraserburgh TTWA is dependent on the fishing industry. Even taking account of the fact that the job losses will be lower than that estimated, therefore, the proposals could have significant economic and social impacts on some individuals in this area.

Although the scale of the job losses are smaller in Mallaig (3 to 8 jobs at risk under the intermediate and upper scenarios), they represent a more significant proportional reduction in the number of fishermen employed locally in the sector. In Mallaig, the proposals could (at worst) lead to a 7.2% reduction in the local fishing workforce.

It is worth highlighting again that the information presented in Table 23 is based on home port information for vessels greater than 15m. The distribution of affected landings and employment may be different for vessels smaller than 15m.

5.1.1.2 Distribution of Economic Costs - Age and Gender

Under the assumption that all affected activity is lost, designation has the potential to put between 1 and 131 FTE jobs at risk in the commercial fishing sector and its downstream supply chain. This could generate significant economic and social costs for the individuals concerned and for their families.

In reality, some displacement of fishing activity is likely to occur and hence the impacts on employment are likely to be lower than those estimated.

5.1.1.3 Distribution of Economic Costs - Fishing Groups (vessel category)

Table 24 presents the annual average loss of the value of landings by gear type and vessel length, by region. Under the lower scenario, the majority of impacts are on the under-15m sector, in the north region, however this is predominantly due to the impact on under-15m gears in the FSS proposed MPA, which may be an over-estimate due to the ICES rectangle landings data 'under-15m' vessel length category including cases where vessel length and/or administrative port information was missing from landings returns.

Under the intermediate and upper scenarios the majority of value of landings affected is from over-15m vessels. Whitefish trawls and nephrops trawls are particularly affected, followed by dredges. Nephrops trawls are most affected in the North-East region, particularly across the Fladen sites (CFL, WFL and SEF). Since these sites represent options and only one site would be put forward for designation, the actual impact on nephrops trawls in this region is likely to be less (approximately one third). Over-15m nephrops trawls are also impacted in the West and North-west inshore regions, and dredges in the West inshore region. This might lead to conflict over diminishing fishing grounds for these gear types in the West and North-west inshore regions. Over-15m whitefish trawls are affected across a wider area than nephrops trawls, but to a lesser extent in each region - impacts are greatest in the North-west offshore, North-east and North regions. In the North-west offshore region, only one of GSH and SSH proposed MPAs would be put forward for designation, therefore the actual impact in this region is likely to be less.

Under the intermediate and upper scenarios, of the under-15m vessels, nephrops trawls are the most affected, and predominantly in the West inshore region. This is likely to further compound any displacement issues and conflicts over fishing grounds identified above for the over-15m sector in this region, in particular given that the under-15m vessels have a smaller operating range. Under-15m whitefish trawls appear to be heavily impacted in the North-west offshore region, and the gear category 'all affected gears' (where it has not been possible to identify individual gear types by site, for confidentiality reasions) in the North region, however, these may be over-estimates of actual impact, due to the ICES rectangle landings data 'under 15m' vessel length category including cases where vessel length and/or administrative port information was missing from landings returns.

Table 24. Annual average loss of landings (assuming zero displacement of fishing activity) by gear type and vessel length, by region, £ million

	Lower Scenario							Intermediate Scenario							Upper Scenario						
	Total by Region						Sum	Total by Region						Sum	Total by Region						Sum
	W(in)	NW (in)	NW (off)	N	NE	E	All MPAs	W(in)	NW (in)	NW (off)	N	NE	E	All MPAs	W(in)	NW (in)	NW (off)	N	NE	E	All MPAs
Over-15m vessels																					
Whitefish Trawls	0.00	0.00	0.00	0.01	0.00	0.00	0.01	0.00	0.07	0.43	0.21	0.36	0.00	1.08	0.00	0.21	0.60	0.43	0.77	0.00	2.00
Whitefish Seines	-	-	-	-	-	-	-	0.00	0.00	0.00	0.00	0.02	0.00	0.02	0.00	0.00	0.00	0.00	0.03	0.00	0.03
Nephrops Trawls	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.22	0.31	0.00	0.00	1.11	0.00	1.65	0.63	0.78	0.00	0.00	2.29	0.00	3.70
Other Trawls	-	-	-	-	-	-	-	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Dredges	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.25	0.04	0.00	0.00	0.01	0.41	0.72	0.52	0.12	0.00	0.00	0.03	0.41	1.08
Other Gears	-	-	-	-	-	-	-	0.01	0.00	0.20	0.00	0.00	0.04	0.24	0.01	0.00	0.20	0.00	0.00	0.07	0.29
'Other Affected Gears'	-	-	-	-	-	-	-	0.00	0.00	0.00	0.02	0.00	0.00	0.03	0.00	0.00	0.00	0.10	0.01	0.00	0.11
'All Affected Gears'	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.11	0.14	0.00	0.00	0.26	0.00	0.00	0.16	0.34	0.00	0.00	0.50
TOTAL >15m	**0.00**	**0.00**	**0.00**	**0.01**	**0.00**	**0.00**	**0.01**	**0.49**	**0.43**	**0.75**	**0.38**	**1.51**	**0.45**	**3.99**	**1.17**	**1.11**	**0.96**	**0.87**	**3.12**	**0.48**	**7.71**
Under-15m vessels																					
Whitefish Trawls	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.93	0.00	0.00	0.00	0.93	0.00	0.00	1.28	0.00	0.00	0.00	1.28
Nephrops Trawls	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.20	0.07	0.00	0.00	0.04	0.00	0.31	0.51	0.14	0.00	0.00	0.09	0.00	0.73
Other Trawl	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Dredge	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.04	0.00	0.00	0.00	0.00	0.00	0.04	0.07	0.02	0.00	0.00	0.00	0.00	0.09
Nets	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Pots	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Whitefish & Nephrops Trawls	-	-	-	-	-	-	-	0.00	0.05	0.00	0.00	0.00	0.00	0.05	0.00	0.28	0.00	0.00	0.00	0.00	0.28
'Other Affected Gears'	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.00	0.00	0.00	0.01	0.00	0.00	0.01	0.01	0.01	0.00	0.03
'All Affected Gears'	0.00	0.00	0.02	0.06	0.00	0.00	0.08	0.00	0.00	0.44	0.22	0.00	0.07	0.73	0.00	0.00	0.71	0.57	0.00	0.14	1.41
TOTAL <15m	**0.00**	**0.00**	**0.02**	**0.06**	**0.00**	**0.00**	**0.08**	**0.25**	**0.12**	**1.38**	**0.22**	**0.05**	**0.07**	**2.09**	**0.58**	**0.44**	**2.00**	**0.58**	**0.09**	**0.14**	**3.82**
TOTAL	**0.00**	**0.00**	**0.02**	**0.07**	**0.00**	**0.00**	**0.09**	**0.73**	**0.55**	**2.13**	**0.59**	**1.55**	**0.52**	**6.08**	**1.75**	**1.55**	**2.96**	**1.44**	**3.22**	**0.62**	**11.53**

W(in) = West, inshore: ARR, CSS, LSW, LFG, LCR, LSU, SJU; NW(in) = North-west, inshore: DLA, MOI, NWS, SMI; NW(off) = North-west, offshore: BHT, GSH, HRB, RBS, SSH; N = North (inshore & offshore): WSS, NOW, WYR, PWY, MTB, FSS, FTH, NEF; NE = North-East (inshore &offshore): CFL, CFL (core), WFL, NOH, ECC, SEF, NSP, TBB, EGM; E = East (inshore & offshore): FOF

5.1.1.4 Distribution of economic costs - income group

In 2010/11, the median gross annual full time earnings in Scotland were £25,205 and the lowest-paid 10% of workers received an average of £15,565 a year.

Table 25 presents information on the gross wages and salaries of employees in the Scottish fishing sector.

Table 25. Gross wages and salaries per employee in the Scottish fishing industry, 2008–2010

Scottish Fishing (SIC 03.1)	2008	2009	2010
Gross Wages & Salaries per employee (£)	18,167	33,716	16,716

(Source: Scottish Annual Business Statistics, 2010)

Table 25 shows that the gross earnings of those employed in the Scottish fishing industry, varies considerably from year to year. In 2007, for example, the gross salary was £18,167 which was below average earnings in Scotland in 2008. In 2009, however, average earnings increased to £33,716 and hence were well above average earnings in the rest of Scotland that year.

While the gross wages and salaries of fisherman are, on average, above those earnt by the lowest-paid 10%, it is likely that there will considerable variation in gross earnings across fleets. It is possible, therefore, that designation of the possible MPAs could impact on income groups falling into lowest paid 10% and the middle 80% of workers.

5.1.1.5 Distribution of economic costs by social group - crofters, ethnic minorities and long-term sick

In addition to regular and part-time fishermen, Scotland has a small number of crofters that engage in commercial fishing. A crofter is a person who occupies and works a small land-holding known as a croft and operates a system of small-scale subsistence farming. There were 52 crofters engaged in commercial fishing in Scotland in 2011; that represents no change compared to 2010. In 2011, 33 of these crofters were employed at Portree, 17 at Stornoway, 1 at Kinlochbervie and 1 at Lochinver. Given that the value of affected landings at Portree, Kinlochbervie and Lochiver as a percentage of total landings, is less than 1% and in the case of Stornoway less 2%, designation of the entire suite of possible MPAs is not anticipated to have any noticeable impact on crofters.

There is no information to our knowledge that provides information on the ethnic origin of fishermen employed on Scottish-based vessels. It is not anticipated, however, that there would be any significant impacts on this group.

Likewise, we are not aware of any information on people employed in the industry with disabilities. Given the nature of the work, however, it is considered unlikely that people with disabilities or the long-term sick would be employed in fisheries and hence the proposals are not anticipated to have any noticeable effects on this social group.

5.1.2 Fish Processing Industry

In the Scottish fish processing industry there are 119 businesses processing sea fish[17] (SeaFish, 2013a). It is clear from Table 26 that processing activity is concentrated in the North East of Scotland (Grampian) with more modest levels of processing activity in "Other Scotland" and in the Highlands and Islands (where processing is on a smaller scale). Over 50% of processing units are located in Grampian and together they account for over 70% of total employment in the fish processing industry in Scotland.

Table 26. Number of sea fish processing units in Scotland and industry employment, 2012

Location	Sea Fish Processing Units	Industry FTE Employment
North East (Grampian)	63	3,448
Other Scotland	37	1,088
Highland and Islands	19	373
Total	**119**	**4,909**

Source: SeaFish, 2013a.

There are also 39 salmon processing units in Scotland which in 2012 accounted for 2,859 FTE jobs. No management measures are anticipated for wild salmon and sea trout fisheries as a result of the establishment of proposed MPAs in Scottish waters, and these processing units would predominantly be processing farmed salmon. No impacts are expected, therefore, on the Scottish salmon processing industry.

Management measures are, however, anticipated to restrict commercial fishing activity, and have the potential to reduce the quantity of seafish landed locally at Scottish landing ports and hence reduce the supply of locally-landed catch to fish processing facilities and the hotel/restaurant, retail and wholesale trades.

The fish processing industry has already been badly affected by a reduction in landings. Since 1995, for example, Grampian has experienced a 10% decline

17 All marine fish including shellfish (excludes salmon and trout).

in the number of units, principally in companies with 25 or fewer employees. The decline in landings has had a particular impact on primary processors where there has been a shift away from primary processing towards secondary or mixed processing units. Landings of pelagic and demersal species have continued to decrease over the last decade, therefore, there is a lower volume of these species available to the processing industry (Brown, 2009). By contrast there is a larger volume of shellfish available to processors.

Further reductions in landings, therefore, would impact on the fish processing industry. The significance of the economic impact will depend upon various factors, including:

- the extent to which the landings of different species are affected (i.e. pelagic, demersal shellfish) and the dependency of different processing units on these species;
- the distribution of affected landings across landing ports/regions and the dependency of landing ports on the affected landings; and
- the dependency of fish processing units in these regions/ports on processing locally landed catch and their ability to offset reductions in local landings with imported fish.

5.1.2.1 Distribution of economic cost assuming zero displacement of fishing activity - across target species groups

An analysis of the value of landings (for vessels over 15m) that would affected by the designation of the suite of proposed MPAs, by species type, shows that under the lower scenario, almost 80% of the landings affected are in the demersal sector and approximately 20% in the shellfish sector. Under the intermediate and upper scenarios, it is the shellfish sector that is predominantly affected, accounting for almost 60% of the total reduction in the value in landings.

The pelagic sector is not expected to be affected by management measures in possible MPAs. This is significant because:

- landings of pelagic species have been decreasing over the last decade,
- pelagic landings, which in Scotland are dominated by mackerel, saw a 40% increase in value in real terms in 2011. This has resulted in record value of landings in 2011 despite a record low in the total volume of fish landed.

The potential economic impact of designating the suite of proposed MPAs (both on the commercial fisheries sector and the fish processing sector), therefore, is lower than it would have been if the management measures affected landings from the pelagic sector.

Information on the different species groups processed by fish processing facilities is not available for Scotland. However, the latest survey by the UK Seafood Processing Industry (SeaFish, 2013a) shows that units processing mixed species (mix of demersal, shellfish and pelagic) account for the majority (52%) of processing units in the UK. Units processing only demersal, shellfish or pelagic species, account for 21%, 20% and 8% of processing units, respectively.

This analysis suggests that designation of possible MPAs that impose restrictions on commercial fisheries vessels would:

- have no impact on fish processing units that only process pelagic species;
- have the largest impacts on fish processors that only process either demersal or shellfish (and particularly the latter under the intermediate and upper scenarios); and
- impact on mixed fish processing units with the scale of the impact depending on the relative shares of pelagic, demersal and shellfish processing to total processing.

5.1.2.2 Distribution of economic costs assuming zero displacement of fishing activity - across regions/ports

Table 27 shows the expected distribution of total affected landings across landing ports in Scotland. Figures are presented showing the total value of landings potentially affected at each port, and the total value of affected landings as a percentage of total landings at each port, under each scenario. The former provides an indication of the potential scale of the impact and the latter provides an indication of likely significance of the estimated reduction in local landings for each port. As explained above, the analysis is limited by the fact that data on the value of affected landings at ports are only available for vessels greater than 15m in length.

Table 27 suggests that the reduction in local landings would be distributed unevenly across the landing ports. The North-east region would bear the brunt of the costs with Fraserburgh alone accounting for 24%–25% of the total value of landings lost under the intermediate and upper scenarios, and Peterhead bearing over 20% of the total value of landings lost under the intermediate and upper scenarios.

However, as a proportion of total landings at each port, however, the loss is relatively small (typically 0–3%). This is within the range of normal inter-annual vaiability in landings and therefore it is considered unlikely that designating the suite of proposed MPAs would have a significant impact on the fish processing sector. The largest impacts under the intermediate scenario are felt by Aberdeen (North-east), where affected landings represent

4% of total landings to the port. Under the upper scenario, 7% of landings are affected at Mallaig (North-west), and 5% at Kinlochbervie (North-West) and Aberdeen (North-east).

Table 27. Landings affected (assuming zero displacement of fishing activity) as a percentage of total affected landings and as a percentage of total landings at each landing port

Landing Port	Lower		Intermediate		Upper	
	% total affected landings	% of total landings to port	% total affected landings	% of total landings to port	% total affected landings	% of total landings to port
Fraserburgh			24%	2%	25%	4%
Peterhead	9%	0%	22%	1%	21%	1%
Mallaig			6%	2%	9%	7%
Kinlochbervie	15%	0%	9%	3%	8%	5%
Campbeltown	15%	0%	4%	1%	6%	3%
Scrabster	36%	0%	5%	1%	5%	1%
Aberdeen			8%	4%	4%	5%
Ullapool	17%	0%	4%	1%	3%	2%
Lochinver			4%	0%	3%	1%
Oban	0%	0%	3%	1%	3%	3%
Troon and Saltcoats			1%		1%	
Montrose			1%		1%	
Crinan			1%		1%	
Troon			1%		1%	
Carradale					1%	
Tarbert			0%		1%	
Lerwick			1%		1%	
West Loch Tarbert	3%					
Wick	2%					
Tayvallich	1%					
Tayinloan	1%					

The significance of the impact for individual fish processing units will depend on various factors, including the extent to which they can offset the reduction in locally-landed fish with imported fish. It is expected that the reductions in landings caused by designation would have little impact on the larger fish processing facilities and those that are engaged in secondary processes that already use a significant proportion of imported fish (e.g. processors in the North-East such as Peterhead and Fraserburgh which are expected to bear the brunt of the costs associated with designation of proposed MPAs) as they are already geared up for obtaining supplies via direct routes and from overseas. It can be assumed that these processors will be able to counterbalance a reduction in local landings with increased use of imported raw material and hence that designation would have a minimal negative impact, if any, on the processors.

The impacts could be greater:

- for smaller-scale fish processors which are more reliant on processing catch from Scottish waters. Designation could have a potentially negative impact on these processors though the impact is not expected to be significant given the scale of affected landings; and
- for those supplying hotels/restaurants and retail and wholesale trade where the demand is specifically for fish caught locally from Scottish waters. Again, however, the impact is not expected to be significant given the scale of affected landings.

It is important to note that as the information presented in Table 28 is based on landing port information for vessels greater than 15m, the distribution of affected landings may be different for vessels smaller than 15m.

5.1.2.3 Distribution of economic costs - age and gender

Designation of proposed MPAs has the potential to have a negative impact on some fish processing units that cannot easily offset the reduction in locally caught fish with imported fish. The impact, however, is not expected to be significant given the scale of the landings affected. The impact on employment is expected to be minimal if any.

Although there is no male/female split of employment information for the Scottish fish processing sector, the gender split at the UK level is approximately 60:40 men to women. Any job losses in the fish processing sector that did occur as a result of MPA designation could therefore impact on the male and female labour markets of the coastal communities affected.
If job losses did occur then the impacts of designation would be felt on the working age population and their families.

5.1.2.4 Distribution of economic costs - income group

In 2010/11, median gross annual full time earnings in Scotland were £25,205 and the lowest-paid 10% of workers received an average of £15,565 a year.

Table 28 presents information on the gross wages and salaries of employees in Scotland for processing and preserving fish, crustaceans and molluscs.

Table 28 shows that the gross earnings of those employed in the fish processing and preserving industry are around £16,000 -18,000 a year. This is well below median annual earnings in Scotland (£ 25,205) and fairly close to the average annual earnings of the lowest paid workers (£15,565). It is likely that beneath the averages, there will be variations in earnings across different types of processing units and across regions.

If designation did result in job losses in the fish processing sector, therefore, impacts could be felt by the lowest paid 10% and the middle 80% of workers.

Table 28. Gross wages and salaries per employee for the processing and preserving of fish, crustaceans and molluscs, 2008–2010

Scotland: Processing and Preserving Fish, Crustaceans and Molluscs (SIC 10.2)	2008	2009	2010
Gross Wages & Salaries per employee (£)	16,507	18,384	18,332

(Source: Scottish Annual Business Statistics, 2010).

5.1.3 Distribution of Economic Costs by Social Group - Crofters, Ethnic minorities and Long-term sick

Designation of the entire suite of possible MPAs is not anticipated to have any noticeable impact on crofters (see Section 5.1.1.5 above).

There is no information to our knowledge that provides information on the ethnic origin of people employed in fish processing units (either in Scotland or the UK). Likewise, we are not aware of any information on people employed in the industry with disabilities or long-term sick. It is not anticipated, however, that the designation of possible MPAs would have any significant impacts on these social groups.

5.2 Social Impacts

The social impacts generated by the designation of MPAs will be strongly connected to the nature, scale and distribution of the economic impacts. Table 29 identifies the areas of social impact that are likely to be affected by the quantified and non-quantified economic costs identified for the commercial fisheries, energy generation, and oil and gas, sectors in Section 3 and assesses their potential significance.

Table 29. Social impacts associated with quantified and non-quantified economic impacts

Sector	Potential Economic Impacts	Economic Costs	Area of Social Impact Affected	Mitigation	Significance of Social Impact
Commercial Fishing	Loss of traditional fishing grounds with consequent loss in landings, value of landings and hence GVA	Annual average loss in value of landings, assuming zero displacement of fishing activity: £0.1m–£10.1m Annual average reduction in GVA (direct plus indirect) assuming zero displacement of fishing activity: £0.05 – £5.0m	▪ Culture and heritage – impact on traditions from loss of fishing grounds.		xx
	If the loss in GVA significant enough, risk of job losses (direct plus indirect)	Job losses, assuming zero displacement of fishing activity: ▪ Direct and indirect: 1–131 FTE jobs	A reduction in employment can generate a wide range of social impacts: ▪ **Health** (increase in illness, mental stress, loss of self esteem and risk of depression); ▪ Increase in **crime;** ▪ Reduction in **future employment** prospects/future earnings. Which, in turn, can generate a range of short and long term costs for wider society and the public purse.	Support to retrain those affected and for the promotion of new small businesses in fisheries dependent areas	xxx
	Displacement Effects	Not quantified	Quantified impact on jobs assume worst case scenario (i.e. no redistribution of effort). In reality displacement effects likely to occur with socio-economic consequences: ▪ **Employment** – reduced employment due to changes in costs and earnings profile of vessels (e.g. increased fuel costs, gear development and adaption costs, additional quota costs).		xx

Sector	Potential Economic Impacts	Economic Costs	Area of Social Impact Affected	Mitigation	Significance of Social Impact
			▪ **Conflict/Loss of social cohesion** – diminishing fishing grounds may increase conflict with other vessels/gear types, increase social tensions within fishing communities and lead to a loss of social cohesion among fleets. Could also lead to increased operating costs as a result of lost or damaged gear. Equally, gear conflict could reduce where gears are restricted/prohibited. ▪ **Health** - increased risks to the safety of fishers and vessels and increased stress due to moving to lesser known areas. ▪ **Environmental** – increased impact in targeting new areas, longer streaming times and increased fuel consumption. ▪ **Culture and heritage** – change in traditional fishing patterns/ activities.		
Energy Generation	Additional mitigation measures for new developments to support achievement of site conservation objectives	Quantified Cost Impact: Total PV cost: £0m – £47m	▪ **Future employment opportunities** – if increased operational costs associated with management measures render projects unviable or restrict project size there will be a negative impact on economic activity and job creation in this sector.		xxx (under upper scenarios)

Sector	Potential Economic Impacts	Economic Costs	Area of Social Impact Affected	Mitigation	Significance of Social Impact
	Costs associated with delays during the consenting process. Loss of investor confidence (developments do not proceed).	Not quantified	▪ **Future employment opportunities** – if the delays deter investments there will be a negative impact on economic activity and future job creation in this sector. ▪ **Environment** – possible negative impact in relation to climate change and the ability of the Scottish Government to		xxx (under upper scenarios)
Oil and Gas	Additional mitigation measures for new developments or decommissioning activities to support achievement of site conservation objectives	Total PV cost: £0m - £120m	▪ **Future employment opportunities** – reduced future employment opportunities if costs significant and render development projects unviable.		xxx (under upper scenarios)
	Costs associated with delays during the licensing and permitting process. Loss of investor confidence (developments do not proceed).	Not Quantified	▪ **Employment** – reduced future employment opportunities if delays deter investments		xxx (under upper scenarios)

Notes: The likely areas of social impact are based on the key areas identified by the GES/GSR Social Impacts Taskforce

Ratings:
x x x : significant negative effect;
x x : possible negative effect;
x: minimal negative effect, if any;
0: no noticeable effect expected

5.2.1 Commercial Fishing Sector - Social Impacts if Fishing Activity is Lost

If the value of fishing activity is lost (i.e. not replaced by fishing alternative grounds) and jobs are lost as a result, this could generate a wide range of social impacts. The nature and scale of the social impacts, however, depends on what happens to those who lose their jobs. If those affected can find alternative employment then this may result in a change in, for example:

- the type, quantity or quality of employment;
- working patterns;
- household income;
- working conditions; and
- location - if those affected have to move to find employment.

These changes could be negative or positive.

If, however, those affected cannot find alternative employment, the ‘lost’ jobs could go into unemployment, or, in some cases, (early) retirement. Each scenario will set in train an array of further economic and social impacts, not only for the individuals concerned, but also for their families and dependents, for fishing communities, wider society and the public purse.

The social impacts of employment are well documented. There is a vast literature, for example, looking at the link between unemployment and ill health and the psychological, social and biological pathways by which this happens (e.g. the role of relative poverty, social isolation, loss of self-esteem, including that associated with losing access/membership of certain types of sub-culture which is likely to be particularly important in fishing communities). A significant amount of analysis has also been conducted on the impact of unemployment on families. The emotional distress arising from jobs losses and the financial hardship affects both the job loser and other family members and directly affects family relationships. A significant body of research also shows that unemployment induces increases in crime and that a period of unemployment (particularly youth unemployment) can reduce future employment prospects and hence future earnings.

The extent to which the designation of proposed MPAs will trigger any of these social impacts depends on whether and how quickly those who lose their jobs find alternative employment and the quality of that employment. This, in turn, will depend on: where the job losses occur, the number of jobs affected in each area and the prospects for alternative employment. A particularly important feature highlighted by the distribution analysis in sub-section 5.1 above is that the potential employment impacts of designating the suite of MPAs will be concentrated in coastal areas in the North-east, North-west and West. The communities in these areas are highly dependent on the fishing industry and have few prospects of alternative employment.The economic and social impacts of job losses in these areas, therefore, can be expected to be greater than job losses generated in areas which offer more diverse employment opportunities.

5.2.2 Commercial Fishing Sector - Social Impacts if Fishing Activity is Displaced to Other Grounds

In reality, it is likely that some commercial fishing activity will be displaced to other grounds. The extent to which revenues could be replaced from fishing elsewhere in the short term and the longer term, is difficult to estimate, even qualitatively, as that will depend on an array of different factors, for example:

- the availability of alternative fishing grounds;
- whether vessels change gear type and target species;
- the relative catch rates and associated profitability of the new fishing grounds; and
- the effect on other vessels fishing in these grounds.

There may be less scope for smaller vessels to offset affected landings as they have a more restricted range and hence there may be fewer alternative fishing grounds available. If so, this group would experience a greater impact from the designation of proposed MPAs. Given that costs will be incurred in displacing fishing effort to other grounds and/or switching gear types, and that vessels are constrained by spatial restrictions on quota and limits on days at sea, it is considered unlikely that the total amount of revenues lost due to MPAs could be fully replaced by fishing elsewhere.

Table 29 identifies and describes a range of social consequences that could arise from displacement, including negative impacts on:

- employment - from increased costs (e.g. fuel costs) and hence reduced profits;
- health (e.g. increased stress) and safety (of fisherman and vessels) - from fishing in unfamiliar grounds;
- social cohesion – from increased tensions among fleets from competing ports having to share grounds thus breaking the bonds that normally bring individual fleets together;
- the environment - from increased emissions if vessels are forced to move further afield and impact to benthic habitats that may have been previously unaffected by fishing; and
- culture and heritage - from a change in traditional fishing patterns.

The scale and significance of these impacts will depend on a number of inter-related factors, for example:

- the extent of displacement that occurs;
- the impact on revenues (employment, social cohesion);
- the size/quality of stock and additional pressures on existing grounds that remain open and which will inevitably be fished harder (social cohesion);
- whether there is a need to ban gears that have fished the area in question for decades (cultural and heritage).

5.2.3 Energy Generation – Potential Future Socio-Economic Impacts

In light of the considerable uncertainties that exist, it is not possible to determine whether designation of the proposed MPAs would reduce the potential level of future economic activity generated by this sector. It is recognised, however, that if the additional operating costs or delays associated with management measures restricted or deterred investment in offshore renewables projects, there could be potentially significant socio-economic impacts, in terms of a loss of future economic activity and job creation opportunities under the upper scenarios. However, it should be noted that SNH and JNCC's current advice is that the intermediate scenario represents their best view on potential management requirements.

In addition, there would be potential indirect impacts on this industry's supply chains and the wider Scottish economy. The successful future development of a strong supply chain requires a critical mass of projects in Scottish waters and development beyond current projects. If the management measures associated with the proposed MPAs restricted current or future developments this could have potentially significant socio-economic consequences by restricting the supply chain opportunities.

The potential value of this sector and its supply chain is fully acknowledged in the Scottish Government's Economic Strategy, the government's overarching Strategy for delivering long-term sustainable economic growth. The Strategy identifies Energy (including renewables) as one of six sectors in Scotland which have the potential to be international successful in areas of global demand and to which priority is being given to ensure these sectors grow, maximise added value and create high quality and sustainable jobs.

5.2.4 Oil and Gas – Social Impacts

In the absence of information on the location of future developments within individual proposed MPAs, it has not been possible to estimate the costs associated with possible mitigation measures. These costs are potentially very significant under the upper scenarios and, as with the Energy sector, if they rendered development projects unviable, there would be potentially significant socio-economic impacts, in terms of a loss of future economic activity and job creation opportunities, not only in the sector and its supply chains but in the wider Scottish economy. However, it should be noted that JNCC's current advice is that the intermediate scenario represents their best view on potential management requirements.

5.3 Conclusions

This section, together with Section 3, has assessed the scale and significance of the potential socio-economic impacts that could be generated by the proposed designation of MPAs on the commercial fishing sector, the energy sector and the oil and gas sector.

The analysis has shown that there is a significant level of variation in the scale of potential socio-economic costs that are likely to be generated by designation of alternative proposed MPAs under alternative management scenarios. In other words, some of the possible MPAs are currently or potentially significantly more valuable in economic terms than others. Given the Scottish Government's policy to deliver habitat protection based on specific objectives while minimising the resulting economic and social impacts, this has important implications for the possible MPAs that are included in the designation and the management scenarios that are adopted.

5.3.1 Commercial Fishing Sector and Fish Processing Sector

It is difficult to assess the potential socio-economic consequences of designation of possible MPAs on the commercial fishing sector (and hence the fish processing sector) as, ultimately, this will depend on the extent to which the fleet can source alternative fishing grounds, and that is unknown. The quantitative estimates presented for this sector, therefore, assume there is no redistribution of fishing effort and hence represent worst-case estimates.

The analysis suggests:

- designation of ten of the possible MPAs would not require any restrictions on fishing activities and hence would not generate any economic or social costs;
- under the lower scenario, the economic and social impacts of designation would be minimal;
- while designation of the suite of MPAs would have negative impacts on GVA and employment, the impact at the Scottish economy level would not be significant;
- while designation of the suite of MPAs would have negative impacts on the sector's GVA and employment under the intermediate and upper scenarios, these impacts would be relatively small. Under the worst-case scenario, there would be a 2% reduction in the sector's GVA and employment;
- the North-east, North-west and West regions, however, would bear a disproportionate share of these costs with the most significant

employment impacts being felt in Fraseburgh, Peterhead, Mallaig and Ayr. Designation of the suite of MPAs could put jobs at risk in these and other areas (under the intermediate and upper scenarios) and this could generate significant economic and social costs for the individuals affected (and their families) if they do not find alternative employment;

- it is anticipated that designation of the suite of proposed MPAs would have a negative, but fairly minimal impact, on the Scottish fish processing sector as a whole. Affected landings account for a relatively low proportion of total landings at landing ports (typically 0-3% and 7% worst case at Mallaig) and it is likely that fish processors will react to reductions in local supplies of fish by importing greater quantities of raw material. The impacts could be more significant for smaller-scale processors which are heavily reliant on locally-caught demersal species and shellfish. Designation is not expected to have any impact on the pelagic sector; and
- if the impact of designation on the Scottish fleet was a displacement of fishing activity, the economic and social costs would be smaller than those estimated. These may, however, be partly offset by other economic and social costs associated with displacement such as increased fuel costs and a loss of social cohesion among fleets, as a result of increased tensions among vessels from having to share fishing grounds.

5.3.2 Energy Generation

The analysis for the energy generation sector indicates:

- ten of the possible MPAs have existing, planned or potential future offshore renewable development within the relevant boundaries;
- potentially very high cost impacts have been identified for the Firth of Forth Banks complex and South Arran under the upper scenario and for North-west Sea Lochs and Summer Isles under the intermediate and upper scenarios;
- it has not been possible to quantify the costs associated with potential delays or the impact of designation on investment decisions. If designation restricted or deterred investment in existing, planned or future offshore renewables projects, there could be potentially significant socio-economic impacts, in terms of a loss of future economic activity and job creation opportunities;
- the successful future development of a strong supply chain requires a critical mass of projects in Scottish waters and development beyond current projects. If the management measures associated with the possible MPAs restricted current or future developments this could have potentially significant socio-economic consequences by restricting the supply chain opportunities.

5.3.3 Oil and Gas

The analysis for the oil and gas sector indicates:

- Eleven of the proposed MPAs have existing or planned exploration and/or development activity;
- It has not been possible to quantify the costs associated with possible mitigation measures but these are potentially very significant and may render projects unviable;
- If designation renders projects unviable or deters investment, this could have significant socio-economic consequences in terms of reduced levels of future economic activity and job creation in the sector, with knock-on effects for its supply chain and the wider Scottish economy.

This section has focused on the socio-economic costs of designation of the proposed MPAs; these need to be set against the benefits (environmental, economic and social) that would potentially be generated by their designation.

6. Benefits

6.1 Benefits of Scottish MPA Designations

This Section considers the range of benefits that could arise from the proposed designation of MPAs. These benefits are assessed based on the implementation of the potential management measures used to consider the likely costs in previous Sections. As with the costs, a range of management scenarios (lower, intermediate, upper) is used to reflect the range of likely future management approaches.

This analysis of benefits adopts an ecosystem services approach. It is important to note that it assesses the expected changes in ecosystem services as a result of designation and management – it is not an assessment of the total ecosystem services arising from the proposed sites. The change in ecosystem services is assessed relative to the baseline of the expected condition of the sites in the absence of designation and management. This is a source of considerable uncertainty, as the extent and condition of the features of the proposed sites, and their response to management measures, are not well understood.

A qualitative approach has been adopted to assess the potential benefits within each site (see methods described in Section 2.3.2.4 and individual Site Reports presented in Table 9 of Appendix E). It is important to remember that the analysis in this Table assesses the changes to ecosystem services as a result of designation and management, not the overall importance of the site for ecosystem services.

This section firstly considers the evidence on changes in ecosystem services likely to be realised from designation and management of individual MPAs. It then considers evidence on the values of these changes. In both cases, the available evidence on changes that are relevant to an impact assessment (i.e. increases in welfare in Scotland) is limited. Therefore, much of the discussion in on general changes, with more specific observations (e.g. identifying where sites are known to play a specific role in commercial fish species lifecycles) is presented in Table 9 of Appendix E). It then discusses the overall benefits of the proposed set of designated sites, and any synergies (or network effects) arising from their collective designation. This discussion informs the analysis of cumulative benefits in Section 7.5.

6.2 Ecosystem Services from Marine Protected Areas

A healthy marine environment provides a large number of benefits to human populations. The benefits and the beneficiaries are not uniform and cover a wide range of ecosystem functions and interdependencies. The concept of ‘ecosystem services’ is used to capture the benefits provided. Ecosystem services are the outcomes from ecosystems that directly lead to good(s) that are valued by people (NCC, 2013)

The ecosystem service concept provides a framework to identify the range and type of benefits provided by an ecosystem. This Section uses the terminology from the UK Nation Ecosystem Assessment (2010, first used in the Millennium Ecosystem Assessment, 2005) which splits the benefits provided by UK environments into the following services:

- Provisioning Services – the tangible goods and associated benefits produced by an ecosystem.
- Regulating Services – the benefits from the regulation of ecosystem processes.
- Cultural Services – the non-tangible ecosystem benefits either from experience of the ecosystem or knowledge of its existence.
- Supporting Services – those services whose function underlie all other ecosystem service provision.

6.2.1 Ecosystem Services from Proposed Scottish MPAs

MPAs are focused on protecting particular features of interest in the marine environment. Those features can be geological, habitats or species. They are identified on conservation grounds, and therefore are subject to moral and philosophical arguments about the appropriateness and benefits of their protection. This analysis focuses on the economic arguments for their protection, which are regarded as separate, but not superior to, moral or other arguments.

The assessment of ecosystem services benefits is a gross assessment of the impacts of designating an individual site. This approach mirrors that in the costs assessment, where costs to activities (e.g. fishing, are gross assessments of the costs of management measures). A more realistic analysis of impacts of both costs and benefits would be a net assessment of likely changes. In particular this would take into account displacement of fishing effort, which could both reduce the costs of designation in terms of reduced fishing landings, and reduce the benefits by displacing damage caused by some fishing gears to other areas, (albeit ones probably with less exemplary marine biodiversity features).

Current work for the Valuing Nature Network (VNN - D Burdon, pers. comm.) identifies a number of ecosystem services associated with habitats and species in UK waters. The features in the proposed Scottish MPAs were linked to these habitats and species to produce an overview of the number of features in each proposed site associated with different ecosystem services (see Appendix D). It must be recognised that this information is only a guide to the levels of ecosystem services that may be provided by the proposed MPAs. It needs to be combined with understanding of the status and threats to these features, and the extent to which these may be addressed by management measures for the designated area, in order to predict possible changes in ecosystem services associated with designation. The timing of ecosystem service benefits is also uncertain. Experiences in temperate marine ecosystems indicate that recovery of seabed habitats following impacts from human pressures can occur over a range of time scales from less than one year to many years, depending on the features affected. Recovery of fish populations has also been observed over a range of time scales, depending on the scale of impact and the life cycles of the species affected.

This information set is subject to considerable uncertainty. Firstly the VNN data is known to reflect a variable and substantially incomplete literature on whether, and at what level, different marine features provide different ecosystem services. Secondly, the physical extent and baseline condition of many of the features in the proposed MPAs is poorly understood, as reflected in the site designation information. The lack of baseline information is particularly crucial as an assessment of benefits is based on expected changes from designation relative to a baseline scenario of 'no designation'. However, there is evidence (Friedrich et al. 2013) at both global and UK levels, underpinning the assumption of a deteriorating ecological baseline. It identifies evidence that human pressures have led to the depletion of marine species and populations, to the destruction of marine habitats, and has prompted changes to the composition of marine communities in UK seas. This has detrimental impacts on their ability to provide regulating, supporting and provisioning ecosystem services essential for human wellbeing. Thirdly, the speed and extent to which protection of features will result in increases in ecosystem services is poorly understood. Fourthly, the benefits analysis is mainly based on consideration of ecosystem services from protected features (due to the available information). In reality, MPAs are likely to contain marine biodiversity that are not designated features but which give higher levels of ecosystem services as a result of protection under site management measures.

As a result of these uncertainties, a key part of the ecosystem services analysis for each site is that the level of confidence in each assessment is explicitly recorded. In general, confidence is only moderate or high for ecosystem services which are not expected to change significantly at a site. For most potential positive impacts at individual sites, the analysis of ecosystem services changes has low confidence. This issue is discussed further in Section 7.5.

Some key issues in the assessment of levels of different ecosystem services in the site assessments are discussed here.

6.2.1.1 Provisioning services

The potential management measures for the proposed MPAs could increase the level of several provisioning services. Gubbay (2006) found some evidence of positive species community effects such as greater complexity of food webs and increase primary and secondary productivity in MPAs as a consequence of protection. This study considered habitats relevant to the proposed MPAs: Seagrass beds; Kelp forests; Mussel beds; Maerl beds; and Sediment communities.

The most significant provisioning service is of fish (and shellfish) for human consumption. While the status of commercial fish stocks in UK waters are variable and not fully known, the assessment is based on the fact that UK populations of several important commercial species are at suboptimal levels. It is assumed that protected areas can potentially help with stock recovery. This can result from reduction of fishing pressures, and in particular from protection of key stages (e.g. spawning, nursery grounds) in species life cycles. Providing spatial or species protection, has been shown to boost populations, which potentially can have a benefit on fishery yields. As expected there is more evidence for shellfish in this regard: In Lundy it has been shown that there is the potential for spillover benefits from no-take zones into the surrounding lobster population. On Skomer the scallop population has increased four to eight fold over 20 years of protected area designation according to anecdotal evidence. In the Lyme Bay statutory fishing closure the increased densities of scallops have spilled over into surrounding areas.

For mobile fish species spillover benefits are more complex, and the benefits of the proposed MPAs will depend on other factors, in particular the implementation of recent CFP reforms. However, it is noted that the proposed MPAs include sites which are known to be spawning grounds for commercial species (e.g. Arran) and habitats that are known to provide nursery habitats for commercial species (e.g. Maerl beds). Therefore it is reasonable to assume that such benefits will arise at least at some sites, even though they cannot be quantified.

The actual impact of protected areas on fish stocks is complex and controversial, and is known to depend on many factors including the size of the MPA, its position in an MPA network, the size of that network, the mobility of the species, the distribution of fishing effort and so on. Detailed modelling of these issues is beyond the scope of this work.

6.2.1.2 Regulating services

Three regulating services are considered in the analysis. No benefits are identified in terms of hazard protection, as the proposed network is assessed not to have any interaction with coastal defences. Carbon sequestration is more significant where there is primary productivity from benthic vegetation in a site.

Waste assimilation services are provided by protected features within some sites' (e.g. Maerl beds) but to be a valuable service there needs to be a source of waste that is affecting water quality. Actions under the Water Framework Directive (WFD) are assumed to be dealing with any significant impacts on coastal water quality, any so benefits of designations in improving water quality in excess of WFD requirements are assumed to be very low. However, a healthy inshore environment could enhance waste assimilation functions and so contribute to water quality in excess of WFD standards, which could have benefits (e.g. to recreational visitors).

The regulating services assessed are not considered significant for any offshore sites. They are relevant to some inshore sites, but in general the available evidence does not enable identification of any sites where they are expected to increase significantly as a result of designation. It is not possible to quantify any of the potential benefits effects accurately, and so they are not considered further in this analysis.

6.2.1.3 Cultural services

Cultural services are the least-well understood group of final ecosystem services from the marine environment. The significance of the proposed MPAs has been assessed for research and education, recreation activities, and non–use benefits. It can be argued that the proposed sites produce a range of other cultural values. These include direct use values such as the maintenance of traditional fishing communities. The literature also describes more indirect values such as meaningful places or socially valued landscapes, symbolic benefits (aesthetic, heritage, spiritual), and philosophical, inspiration values. However, there is little conclusive evidence on these issues.

Most of the inshore sites have some recreational activities (e.g. scuba diving, angling, recreational boating routes and anchorages), and the value of these activities may be enhanced by designation is users of sites will encounter higher levels of biodiversity and environmental quality.

The value of non-use benefits is considered further under the valuation evidence below.

6.2.1.4 Supporting services

MPAs provide a significant number of supporting services. These services are the foundation for all other ecosystem services. Perhaps most significantly is the support that these services provide for provisioning services such as the protection of features which provide habitats for larval and juvenile life stages of marine species.

A series of ecosystem services associated with MPAs are show in Table 30.

Table 30. Supporting ecosystem services provided by MPAs

Ecosystem Service	Feature that Ecosystem Services are Relevant to
Larval gamete supply	European spiny lobster, mud habitats in deep water, high energy intertidal rock, intertidal mud, sandbanks
Secondary production	Mud habitats in deep water, intertidal mud, seagrass, sandbanks
Food web dynamics	Mud habitats in deep water, high energy intertidal rock, moderate energy intertidal rock, seagrass, sandbanks, bottlenose dolphin
Nutrient cycling	Mud habitats in deep water, seagrass, sandbanks
Formation of species habitat	Mud habitats in deep water, high energy shallow water rock, moderate energy shallow water rock, high energy intertidal rock, moderate energy intertidal rock, intertidal sand and muddy sand, tide swept channels, reef, intertidal sand and muddy sand, seagrass, *Ostrea Edulis (*European Flat Oyster), sandbank
Primary Production	High energy intertidal rock, seagrass
Species diversity	High energy shallow water rock, moderate energy shallow water rock, high energy intertidal rock, moderate energy intertidal rock, subtidal coarse sediment, tide swept channels, reef, intertidal sand and muddy sand, sea grass, sandbanks
Formation of physical barriers	High energy shallow water rock, moderate energy shallow water rock, high energy intertidal rock, moderate energy intertidal rock, reef

6.3 Values of Benefits from MPAs

The ecosystem services changes expected from the proposed designation and potential management measures of Scottish MPAs produce a variety of benefits to people. An attempt can be made to identify the economic value of these benefits. However, much of the valuation evidence available is uncertain, and the evidence base has very significant gaps. When combined with the uncertainties over the levels of ecosystem services changes, this makes accurate valuation of the benefits of the MPAs very difficult. The timing of realisation of benefits is also uncertain.

In order to gauge the ecosystem services accruing from marine protected areas relevant valuation literature has been assessed including a recent unpublished review prepared as part of the NEA Follow On project (Prof Kerry Turner, University of East Anglia pers. comm.). This section considers additional values from individual MPAs. The cumulative value of the network is discussed in Section 7.5.

6.3.1 Provisioning Services

By their very nature provisioning services are those services closest tied to the market economy. Goods (fish, shellfish, oil, gas) from marine ecosystems are sold in existing markets and so have a market value: the total value of Scottish fish landings was £501m in 2011 (Scottish Government, 2012a).

Such market values do not include the externalities of extracting the good from the ecosystem.

In four MCZ case studies considered by Fletcher *et al.* (2012), it was predicted that there would be potential additional benefits associated with the delivery of ecosystem services. The only exception was certain commercial fisheries which could potentially experience initial short term disadvantage followed by longer term benefit.

6.3.2 Regulating Services

Marine regulating ecosystem services provide some essential functions. For example, carbon sequestration and storage in the marine environment helps regulate the global climate. Marine regulating services are generally difficult to quantify in scientific terms and therefore are difficult to value in monetary terms. For example, while the proposed sites have features known to be important for carbon sequestration, the expected change in carbon sequestration as a result of site designation and management cannot be reliably quantified in most cases.

With the exception of carbon (which has a price in a regulated market), marine regulating services are generally external to markets and so do not have market values. For these reasons the benefits of MPAs for regulating services have not been valued.

6.3.3 Cultural Services

The majority of cultural services from the marine environment are dependent on the quality of the marine environment, which is likely to be enhanced (or at least is less likely to be degraded) in marine protected areas. However, the extent of this improvement due to designation is very hard to predict.

Cultural services and non-use values are classified in different ways in different marine ecosystem services studies. The main evidence available relates to non-use value for biodiversity (see below) and use values for recreation, therefore the analysis looks at these two areas in detail. Other cultural services, such as the value of research and education, are hard to quantify or value either in total or in terms of the expected changes from Scottish MPAs.

6.3.3.1 Recreation and tourism

The marine environment provides a location for recreational activities and tourism, with many if not all activities inherently linked to the quality of the marine environment. Much ‘marine’ recreation activity relates to beaches, and therefore is not always relevant to the expected impacts of MPA designation. However, some valuation evidence for marine recreation and tourism is available. This data is estimated from the expenditure of individuals on a particular marine recreation activity (Prof Kerry Turner, University of East Anglia, pers. comm.). Only one study, by Lawrence (2005) has a value of a change in the condition of the marine environment which might reflect the changes expected from MPAs. The other studies estimate the total expenditures on activities, and therefore only give an indication of the scale of the values which might change due to the impacts of MPA designation. The IA process looks for Scottish-level benefits, and evidence of national benefits from individual sites is hard to obtain, due to difficulties in assessing potential displacement effects. Therefore it is important to note that there is a lack of evidence, not evidence of zero benefits.

There are social benefits associated with recreation and tourism activities, and therefore the proposed designation and management of MPAs could improve social welfare through access to a healthier marine environment. This is most likely under the intermediate scenario. This is because it has more significant management measures than the lower scenario, so more significant improvements in the quality of the environment are likely, but does not have restrictions on recreational activities that are part of the upper scenario management measures for some sites.

As stated above, there is a more extensive literature on beach recreation values, but beach quality is less directly associated with MPA designation. A recent review by eftec for the Dutch Government (in prep) reviewed economic literature on the recreational value of clean beaches. It recommends a range of €0.60 to €1.60 (£0.51 - £1.36) per trip for the value of moving from partly littered to fully clean beaches on the North Sea coast. While MPA designation will contribute to improved quality of the marine environment, including beaches, it will not result in 'fully clean beaches', and so these values are not directly transferable to MPAs.

The lack of published valuation studies showing the effects of MPAs on marine nature-based recreational activities found in the UK (or similar locations) is a limitation in understanding what impacts NC MPAs will have on recreational users. This in turn restricts the ability to identify socio-economic benefits from increased recreation activity as a result of designation and management of the proposed sites. Work is on going under the UK National Ecosystem Assessment follow-on project to value marine ecosystem services (UNEP-WCMC, in press)[18]. It provides new evidence indicating that designation of MPAs will increase use and non-use values to anglers and divers, including through securing the quality of the marine resources they use (i.e. protection against degradation). Once published, the evidence will be looked into further to see if it can provide monetary estimates of these values that can be used in the final impact assessment.

[18] Jasper Kentner, pers. comm..

It should be noted that any socio-economic benefits associated with recreation and tourism will occur in coastal, often remote communities. These communities may be the same as those where many of the costs identified in Section 5 occur.

6.3.4 Supporting Services

Supporting services are perhaps the most critical set of services provided by features in MPAs. Supporting services underpin all other ecosystem services, and therefore few studies are able to extract the contribution and therefore value of each ecosystem process. Valuing supporting ecosystem services brings a significant risk of double-counting, and they support the provisioning, regulating and cultural services from MPA sites discussed above. However, not valuing supporting services also brings a risk of under-valuing benefits: if MPA designations increase supporting services that give rise to final ecosystem services outside the boundaries of MPAs, and these values are not captured because the available evidence is applied only to changes in final services inside the boundaries of MPAs.

6.3.5 Total Economic Value

As well as limited evidence on the value of different ecosystem services, there are studies that attempt to estimate the total value of the marine environment. A study by Gubbay (2006) reviewed the evidence for benefits of MPAs set up for the conservation of marine biodiversity. They found some direct evidence that MPAs can protect and enhance ES comes from situation where habitats and species protected by MPAs are known to provide specific ES. They concluded that highly protected MPAs lead to overwhelming positive effects on biodiversity (i.e. higher densities, biomass, size and diversity of certain species or groups of species). There is some evidence of positive species community effects such as greater complexity of food webs and increase primary and secondary productivity in MPAs as a consequence of protection. There report considered habitats that are present in the proposed Scottish MPAs (Seagrass beds, Kelp forests, Mussel beds, Maerl beds, Sediment communities).

McVittie & Moran (2008) derived a primary estimate of benefits from the implementation of the nature conservation measures in the draft Marine Bill, specifically, marine conservation zones (MCZs). They identified UK households’ aggregate willingness to pay (WTP) of £487 million to £698 million per year. This figure represents a total economic valuation for the MCZ provisions, as described in the CV scenario. Due to the nature of the MCZ outcomes, it is suggested that a high proportion of this value will be non-use value. However, the data did not allow the study to categorically isolate this component.

A median value for halting the loss of marine biodiversity (which includes, but is a wider objective than MCZ provisions) had an aggregate UK value of £1,170.7 million per year. This value is based on median estimates, and is recommended as it avoids the influence of extreme values and represents the amount that 50% of respondents would be willing to pay.

The values generated within this research were based on the best *ex ante* assessment of the anticipated environmental gains from the UK Marine Bill Marine Nature Conservation Zones, using a hypothetical network scenario. Because of uncertainty, there is potential for disparity between the policy benefits scenarios presented here and what is actually realised as the policy is implemented. It is also important to note that no assumption has been made for the timescale over which these benefits arise. One interpretation is that the values represent preferences for implementation of the Marine Bill, and that these benefits arise immediately from policy implementation. For IA reporting, it is feasible to assume alternative benefits timescales as part of any sensitivity analysis. For example, time lags of 2, 5 and 7 years could reasonably be used to represent the potential delay of returns in line with biological uncertainty about the trajectory of marine biodiversity benefits. This analysis is not conducted in this report.

While the proposed MPAs would be expected to contribute to halting the loss of marine biodiversity (the change considered by McVittie and Moran), the extent of this contribution is unclear due to uncertainty in the current extent, condition and trends in designated features. Therefore it is concluded that the non-use value of the improvements to marine biodiversity from the MPAs cannot be accurately valued.

It is interesting to note that the average values per household for halting loss of, or increasing, marine biodiversity in the McVittie and Moran (2008) study were lower in Scotland than in England or Wales. Nevertheless the average household values in Scotland were significant and positive. Also these values relate to average country household values for all UK waters, implying that English and Welsh households will value improvements in biodiversity in Scottish waters.

The extent to which the non-use values identified in the McVittie and Moran study are relevant to the proposed MPAs is limited due to the uncertainty over the contribution that the MPAs will make to halting marine biodiversity loss: the MPAs are focussed on specific biodiversity features, whose current status and response to management measures is often unclear. As a result, the site ecosystem services assessments mainly identify moderate non-use values for the MPAs, with a low-moderate level of confidence.

The ambiguity and uncertainty associated with the quantification of ecosystem services, as reflected in the evidence reviewed above, reinforces the necessity for a largely qualitative approach to the assessments of benefits at a site level. The approach taken is described in Section 2.3.2.4.

6.3.5.1 Value transfer studies

The range of valuation evidence reviewed above gives indications of which ecosystem services from MPA designation may be valuable to society. Consideration of different groups of services does not produce any valuation data that can be used with confidence to value the changes expected from MPAs.

In a large part of this conclusion is due to the uncertainties in how ecosystem services will change with respect to potential MPA management measures. More detailed analysis of these changes is possible, and has been carried out in a study for Scottish Environment Link (INDUROT, 2012), which is based on a value transfer (eftec, 2010). It identifies benefits of the proposed MPAs of £4bn to £10bn over 20 years (range including sensitivity analysis of assumptions).

This work is regarded as the best available approach to value transfer given the evidence and resources available. However, it remains subject to enormous uncertainties. Firstly, the economic evidence on values of ecosystem services changes is, as discussed above, very patchy. INDUROT have had to use evidence that cannot be reliably transferred to the UK (e.g. evidence from a Constanza et al (1997) study used in Beaumont et al. (2006). Secondly, the modelling is necessarily reliant on large scientific assumptions:

- The model distributes national ecosystem services (ES) values within Scottish seas based on assumptions about the relative contribution of landscapes (broad scale habitats) to particular ES, based on expert judgement. The evidence base used to inform these assumptions is not presented;
- The model estimates the potential benefit to individual ES associated with the implementation of management measures using expert. This is done in a number of steps:
    - Firstly, the sensitivity of the landscape (BSH) features to ‘human pressure’ has been assessed. The model does not appear to have distinguished between different types of human pressure. As has been demonstrated by the MCZ sensitivity matrix (Tillin et al, 2010), the sensitivity of BSH features varies greatly (depending on the particular habitat within a BSH group affected). It also varies greatly depending on the type of pressure.
    - The model then makes assumptions about the benefit derived from management measures (as a percentage increase in service provision). No evidence for the potential scale of benefits is presented. The largest ES values relate to food, nutrient

cycling and gas and climate regulation. It is debatable whether significant benefits would occur to these services. Significant changes in nutrient cycling and gas and climate regulation have not been identified in the site ES assessments. For food, while human pressures may change species composition, this may simply result in substitution by species that provide similar services (for example, evidence that benthic productivity may increase under increased fishing pressure through increases in short-lived fast growing species with higher productivity).
  - The model then assumes that the pressure is present across the whole of the feature and that the benefit occurs over whole extent of the feature. However, pressures will not be uniformly distributed across the seabed or necessarily across the entirety of MPA features.
- The model doesn't take account of loss of ES provision offsite (i.e. it provides a gross benefit). This is consistent with the ES assessments and estimated costs (e.g. to fishing activity) for the individual sites. However, while it is true for some features that MPAs protect areas of higher biodiversity and better examples of that biodiversity that may contribute higher levels of ES, this is not universally the case. For example, a number of features such as ocean quahog, subtidal sand and gravels, are fairly uniform and the network is really just protecting representative examples of these habitats. If activity is simply displaced elsewhere, the net benefit may be significantly reduced.

These considerations are major uncertainties in the model used, and mean there is low confidence in the results arrived at by INDUROT. The complexities of this value transfer also serve to illustrate why it is not possible to produce reliable monetary values for the changes in ecosystem services resulting from MPA designation and management.

6.3.6 Conclusion

The assessment of benefits has focussed on the changes to ecosystem services that are expected to result from MPA designation and management. While the proposed MPAs undoubtedly support a considerable range and value of ecosystem services, evidence on the baseline condition of the site features, and on the expected nature of these changes in scientific or economic terms, is extremely sparse. As a result the assessment of changes in ecosystem services at individual sites (see Table 9 in Site Reports, Appendix E) is highly uncertain.

7. Assessment of Combined Impacts

This section provides an assessment of the combined impacts of designation of NC MPA proposals. This takes account both of alternative options for designation (where there are choices concerning which sites could be designated) and the combined impact of designating multiple sites at regional and national scales.

The starting point for each assessment has been to sum the estimated impacts for each NC MPA proposal, taking account of possible alternative sites. For most sectors, the potential cost impacts are minor such that the combined impacts are likely to be additive. However, for sectors for which more substantial cost impacts have been identified, consideration has been given to the extent to which combined impacts may be more or less than the summed estimates and a qualitative description of the potential combined impacts is provided.

Some of the 33 site proposals are science-based alternatives to the features of recommended MPA proposals, whilst other proposals are of equivalent ecological value for the same combinations of features. It will therefore not be necessary to designate all of the sites for which assessments have been prepared and the total costs and benefits of designating the suite of NC MPAs will be less than the sum of the total for all sites. The impact of designating different combinations of site options is therefore also explored.

7.1 Combined Cost Impacts by Site

Table 31 presents a summary of potential quantified cost impacts for non-fisheries activities within inshore sites, together with estimated additional costs for finfish and shellfish aquaculture planning application costs which could only be estimated at national level. The scale of estimated quantified costs is generally very low for all proposed MPAs except for North-west Sea Lochs and Summer Isles under the intermediate and upper scenarios and for South Arran under the upper scenario. For these proposed sites/scenarios, higher levels of cost impact were identified associated with a potential requirement to re-route export power cables from Draft Plan Option Areas currently being considered for possible future offshore energy generation. There is therefore a high level of uncertainty concerning whether such costs might need to be incurred. More detailed information on the combined impact on activities/sectors is presented in section 7.2.

Table 32 presents a summary of potential quantified impacts on direct GVA for commercial fisheries within inshore sites. No cost impacts are estimated for five inshore sites and very low costs are estimated for all sites under the lower scenario. Relatively minor cost impacts are estimated for five sites under the intermediate and upper scenarios. More substantial cost impacts are estimated for Clyde Sea Sill, Loch Sunart to the Sound of Jura, North-west Sea Lochs and Summer Isles, Small Isles and South Arran under the intermediate and upper scenarios. Total cost impacts for the inshore sites under the intermediate and upper scenarios are estimated to be £8.17m and £21.31m (direct GVA, discounted over assessment period) respectively.

Table 31. Present value (PV) in £ millions for cost impacts to non-fisheries activities for inshore sites (costs discounted over assessment period, 2012 prices)

NC MPA Proposal	Scenarios		
	Lower	Intermediate	Upper
Clyde Sea Sill	0.01	0.02	0.03
East Caithness Cliffs	0.02	0.02	0.02
Fetlar to Haroldswick	0.03	0.08	0.08
Loch Creran	0.01	0.01	0.02
Loch Sunart	0.00	0.01	0.01
Loch Sunart to the Sound of Jura	0.11	0.36	0.36
Loch Sween	0.00	0.00	0.00
Lochs Duich, Long and Aish	0.01	0.02	0.02
Monach Isles	0.00	0.00	0.00
Mousa to Boddam	0.01	0.01	0.04
North-west Sea Lochs & Summer Isles	0.05	2.23	2.36
Noss Head	0.01	0.02	0.02
Papa Westray	0.01	0.01	0.11
Small Isles	0.00	0.00	0.00
South Arran	0.02	0.05	1.76
Upper Loch Fyne & Loch Goil	0.01	0.03	0.03
Wyre & Rousay Sounds	0.01	0.03	0.08
National costs (finfish and shellfish aquaculture planning application costs)	0.44	0.58	0.58
Total	**0.76**	**3.48**	**5.50**

Table 32. Impacts to GVA in £ millions for commercial fisheries for inshore sites (costs discounted over assessment period, 2012 prices)

NC MPA Proposal	Scenarios		
	Lower	Intermediate	Upper
Inshore Sites			
Clyde Sea Sill	-	1.62	3.23
East Caithness Cliffs	-	-	-
Fetlar to Haroldswick	-	-	0.03
Loch Creran	-	-	<0.01
Loch Sunart	<0.01	0.01	0.03
Loch Sunart to the Sound of Jura	-	1.45	3.44
Loch Sween	0.02	0.05	0.13
Lochs Duich, Long and Aish	-	0.05	0.18
Monach Isles	-	-	-
Mousa to Boddam	-	-	-
North-west Sea Lochs & Summer Isles	-	1.56	3.12
Noss Head	<0.01	<0.01	0.01
Papa Westray	-	-	-
Small Isles	-	1.68	6.15

NC MPA Proposal	Scenarios		
	Lower	Intermediate	Upper
South Arran	0.01	1.67	4.84
Upper Loch Fyne & Loch Goil	-	0.08	0.12
Wyre & Rousay Sounds	<0.01	<0.01	0.04
Total	**0.03**	**8.17**	**21.31**

Table 33 presents a summary of potential quantified cost impacts for non-fisheries activities within offshore sites, together with estimated quantified costs associated with oil & gas decommissioning and military activities which could only be estimated at national level. The scale of estimated quantified costs in the lower and intermediate scenarios is generally very low for all proposed MPAs except for The Barra Fan & Hebrides Terrace Seamount and Western Fladen in the intermediate scenario where higher estimated costs arise as a result of additional management measures for new oil & gas exploration and development activity. In the upper scenario, a number of additional sites could potentially experience significant additional costs as a result of additional management measures for new oil & gas exploration and development activity. Additional costs could be experienced by the offshore renewables sector associated with management measures for the Firth of Forth Banks Complex proposed MPA. More detailed information on the combined impact on activities/sectors is presented in section 7.2.

Table 33. Present value (PV) in £ millions for quantified cost impacts to non-fisheries activities for offshore sites (costs discounted over assessment period, 2012 prices)

NC MPA Proposal	Scenarios		
	Lower	Intermediate	Upper
Offshore Sites			
The Barra Fan & Hebrides Terrace Seamount	0.07	1.56	5.79
Central Fladen	0.03	0.60	2.22
Central Fladen (core)	0.03	0.78	2.90
East of Gannet & Montrose Fields	0.23	0.23	35.02
Faroe-Shetland Sponge Belt	0.49	0.49	27.93
Firth of Forth Banks Complex	0.07	0.07	43.44
Geikie Slide & Hebridean Slope	0.00	0.00	0.00
Hatton-Rockall Basin	0.00	0.00	0.00
North-east Faroe-Shetland Channel	0.44	0.44	37.62
North-west Orkney	0.10	0.13	0.13
Norwegian Boundary Sediment Plain	0.02	0.02	1.15
Rosemary Bank Seamount	0.00	0.00	0.00
South-east Fladen	0.00	0.00	0.00
South-west Sula Sgeir & Hebridean Slope	0.00	0.00	0.00
Turbot Bank	0.01	0.01	0.01 – 0.54*
West Shetland Shelf	0.02	0.02	2.17
Western Fladen	0.06	3.91	7.77
National costs (oil & gas decommissioning)	0.02	0.02	0.02
National costs (military activities)	0.19	0.19	0.19

NC MPA Proposal	Scenarios		
	Lower	Intermediate	Upper
* depending on whether Turbot Bank is designated for sandeel or also for subtidal sand and gravel habitats			

Table 34 presents a summary of potential quantified impacts on direct GVA for commercial fisheries within offshore sites. No or very limited cost impacts are estimated for four offshore sites – Hatton Rockall Basin, Norwegian Boundary Sediment Plain, North West Orkney and West Shetland Shelf under all of the scenarios reflecting the lack of fishing activity in the first two sites and no requirement for additional fisheries management measures for the latter two sites. Very low cost impacts are estimated for all sites under the lower scenario, except Faroe-Shetland Sponge Belt, reflecting the assumed low requirement for management measures in this scenario. For the remaining sites, impacts to direct GVA in the intermediate and upper scenarios range from £0 to £0.6m (Turbot Bank – depending on the features for which the site may be designated) respectively, up to £4.9 to £7.1m (Geikie Slide and Hebridean Slope) (discounted over assessment period) respectively.

Table 34. Impacts to direct GVA in £ millions for quantified impacts to commercial fisheries for offshore sites (costs discounted over assessment period, 2012 prices)

NC MPA Proposal	Scenarios		
	Lower	Intermediate	Upper
Offshore Sites			
The Barra Fan & Hebrides Terrace Seamount	0.04	2.88	3.68
Central Fladen	-	3.03	6.02
Central Fladen (core)	-	0.67	1.18
East of Gannet & Montrose Fields	-	0.25	1.23
Faroe-Shetland Sponge Belt	0.45	1.73	5.60
Firth of Forth Banks Complex	-	4.17	4.80
Geikie Slide & Hebridean Slope	-	4.94	7.06
Hatton-Rockall Basin	-	-	-
North-east Faroe-Shetland Channel	0.05	1.66	4.30
North-west Orkney	-	-	-
Norwegian Boundary Sediment Plain	-	-	0.01
Rosemary Bank Seamount	0.07	1.42	2.60
South-east Fladen	-	1.91	3.83
South-west Sula Sgeir & Hebridean Slope	-	5.28	6.49
Turbot Bank	-	0 - 0.39	0 - 0.56
West Shetland Shelf	-	-	-
Western Fladen	-	2.43	4.86

Table 35 presents a summary of the potential combined quantified cost impacts for non-fisheries activities within inshore and offshore sites, including costs assessed at national level and taking account of alternative options for some of the offshore sites:

- South-west Sula Sgeir and Hebridean Slope (SSH) vs. Geikie Slide and Hebridean Slope (GSH);
- Central (CFL), Western (WFL) and South-east Fladen (SEF) (Central Fladen (core) would be designated under all options - the alternatives relate to the designation of the additional CFL area, which does not incorporate CFL (core) in this assessment); and
- Firth of Forth Banks Complex (FOF), Turbot Bank (TBB) (addition of subtidal sands and gravels feature if FOF not designated) and Norwegian Boundary Sediment Plain (NSP).

In total, based on these alternatives, there are 12 possible combinations of options.

For the lower scenario, the quantified cost estimates for non-fisheries activities are broadly comparable across the 12 options. For the intermediate scenario, the estimated costs for options involving Western Fladen are around 50% higher than for other options, reflecting the potential requirement for micrositing of new oil and gas infrastructure in this proposed MPA. For the upper scenario, options which include the Firth of Forth Banks Complex proposed MPA are significantly more costly, owing to the potential cost impact of mitigation measures for proposed offshore wind energy development. No potential non-fisheries costs have been identified for South-west Sula Sgeir and Hebridean Slope (SSH) or Geikie Slide and Hebridean Slope (GSH). Therefore, there is no difference in the cost estimates for these alternatives.

Table 35. Present value (PV) in £ millions for quantified cost impacts to non-fisheries activities for combinations of sites (costs discounted over assessment period, 2012 prices)

Combination of MPA Options	Scenarios		
	Lower	Intermediate	Upper
GSH plus FOF plus CFL	2.45	8.03	162.95
GSH plus FOF plus SEF	2.42	7.43	160.73
GSH plus FOF plus WFL	2.49	11.34	168.50
GSH plus TBB feature and NSP plus CFL	2.40	7.98	121.19
GSH plus TBB feature and NSP plus SEF	2.37	7.38	118.97
GSH plus TBB feature and NSP plus WFL	2.43	11.28	126.74
SSH plus FOF plus CFL	2.45	8.03	162.95
SSH plus FOF plus SEF	2.42	7.43	160.73
SSH plus FOF plus WFL	2.49	11.34	168.50
SSH plus TBB feature and NSP plus CFL	2.40	7.98	121.19
SSH plus TBB feature and NSP plus SEF	2.37	7.38	118.97
SSH plus TBB feature and NSP plus WFL	2.43	11.28	126.74

Table 36 presents a summary of potential impacts to direct GVA for fisheries activities within inshore and offshore sites. The cost impacts range from £0.6m in the lower scenario to around £24m to £29m in the intermediate scenario and £51m to £58m in the upper scenario. The differences are largely accounted for by differences between the impacts associated with the Fladen options (estimated impact to direct GVA ranges between £2–3m and £4–6m under the intermediate and upper scenarios, respectively, with the highest cost impacts relating to CFL) and inclusion of the Firth of Forth Banks Complex (estimated impact around £5m greater than alternative option).

Table 36. Impacts to GVA in £ millions for quantified cost impacts to commercial fisheries for combinations of sites (costs discounted over assessment period, 2012 prices)

Combination of MPA Options	Scenarios		
	Lower	Intermediate	Upper
GSH plus FOF plus CFL	0.64	28.93	57.69
GSH plus FOF plus SEF	0.64	27.82	55.50
GSH plus FOF plus WFL	0.64	28.33	56.52
GSH plus TBB feature and NSP plus CFL	0.64	25.14	53.46
GSH plus TBB feature and NSP plus SEF	0.64	24.03	51.26
GSH plus TBB feature and NSP plus WFL	0.64	24.55	52.29
SSH plus FOF plus CFL	0.64	29.27	57.13
SSH plus FOF plus SEF	0.64	28.16	54.93
SSH plus FOF plus WFL	0.64	28.67	55.96
SSH plus TBB feature and NSP plus CFL	0.64	25.49	52.89
SSH plus TBB feature and NSP plus SEF	0.64	24.38	50.70
SSH plus TBB feature and NSP plus WFL	0.64	24.89	51.73

7.2 Combined Cost Impacts by Activity

This section presents information for those human activities for which cost impacts were identified for one or more sites or for which costs were identified at national level. Potential quantified and unquantified costs have been identified for nine activities/sectors (Table 37). The ranges represent the possible variation in cost impact depending on which options might be selected. The most significant potential costs may be incurred by the oil and gas sector, the commercial fisheries sector (note costs are expressed in terms of impacts to direct GVA, based on the estimated value of landings affected), and the energy generation sector.

For many of the activities and sectors affected – finfish and shellfish aquaculture, military activities, ports and harbours, recreational boating and telecom cables - both the site-level and combined impacts are likely to be very small therefore no significant combined impacts are expected.

For commercial fisheries, significant cost impacts are identified for most of the offshore sites and some inshore sites under the intermediate and upper scenarios, reflecting the impact of the management measures applied. Impacts are expected to be greatest in the North-east region (predominantly on over-15m nephrops and whitefish trawls) and West and North-west inshore regions (predominantly on over-15m and under-15m nephrops trawls, and over-15m dredges and whitefish trawls).

Table 37. Present value (PV) in £ millions for quantified national cost impacts to human activities (costs discounted over assessment period, 2012 prices) (except for commercial fisheries, expressed as impact to direct GVA).

Human Activity	Scenarios		
	Lower	Intermediate	Upper
Aquaculture - finfish	0.36	0.61	0.61
Aquaculture - shellfish	0.14	0.19	0.19
Commercial fisheries (direct GVA)	0.64	24.03 – 38.92	50.70 – 73.53
Energy generation	0.13 – 0.20	2.59 - 2.66	3.90 - 47.34
Military activities	0.19	0.19	0.19
Oil and gas	1.38 – 1.49	3.63 – 8.15	122.67 – 123.20
Port and harbours	0.14	0.14	0.16
Recreational boating	Not quantified	Not quantified	Not quantified
Telecom cables	0.01	0.01	0.75

For the energy generation sector, the majority of cost impact under the upper scenario relates to proposed development within the Firth of Forth R3 Offshore Wind Zone which overlaps with the Firth of Forth Banks Complex proposed MPA. On this basis the combined impact is unlikely to be any greater than the sum of the impacts on individual developments. However, should the additional costs deter some of the investment in the Firth of Forth R3 Offshore Wind Zone, it is possible that this could affect investment decisions in the wider offshore wind supply chain. However, such impacts are unlikely because JNCC’s current advice is that the intermediate scenario represents their best view on potential management requirements.

For oil and gas, significant cost impacts are identified under the intermediate and upper scenarios, based on the draft management measures proposed by JNCC. In the intermediate scenario, significant costs could be associated with required management measures to microsite infrastructure to avoid sensitive features for The Barra Fan & Hebrides Terrace Seamount and Western Fladen proposed MPAs. Under the upper scenario, a number of further proposed MPAs could also experience cost impacts, particularly associated with the requirement to microsite new infrastructure and to skip and ship drill cuttings. While the scale of the potential impacts is large, the overall scale of investment in oil and gas projects is also large. The extent to which such additional costs might compromise individual investments under the upper scenario is currently unclear. This is likely to vary on a site by site basis depending on the scale of the potential oil and gas resource and the overall costs of its exploitation. Should a number of potential developments be deferred or cancelled, this could have the potential to give rise to more significant combined impact on the oil and gas sector as a whole. However, such impacts are unlikely because JNCC's current advice is that the intermediate scenario represents their best view on potential management requirements.

7.3 Combined Costs to Public Sector

The estimated costs to the public sector presented in section 4.8 have been derived from a national assessment. The combined costs are therefore estimated to be the same as those presented in Table 19.

7.4 Combined Analysis of Distribution of Economic Costs and Consequent Social Impacts

The main social costs that could potentially be generated by designating the proposed NC MPAs are likely to arise as a consequence of reduced employment generated as a result of lost (or displaced) economic activity (current and future). The combined social impacts that could potentially be generated by designating the suite of proposed NC MPAs are summarised in Table 29 in Section 5.

A distributional analysis of the economic (and hence social) costs that could be generated from designating the entire suite of NC MPAs has also been undertaken for the commercial fisheries sector. This shows how the economic (and hence social) costs generated by designating the entire suite of possible MPAs would be likely to be distributed across different areas of Scotland and specific groups of people and assesses the likely significance of these impacts. The results of the distributional analysis are summarised in Tables 20 and 21 in Section 5.

The key conclusions from the combined analysis of social costs and the distributional analysis are set out in Section 5.3.

7.5 Combined Benefits

Treating marine protected areas as a collection of individual and separate features providing separate ecosystem services potentially ignores any network effects that could occur from a set of continuous set of marine protected areas. The network effect is best described with telephone networks. The additional of one telephone to a network, will privately benefit the owner of that telephone because they are now connected all other users of the network, but it will also have a positive externality on the rest of network because there is now one extra person to call. In marine conservation a number of adjacent marine reserves may demonstrate network effects, i.e. the benefit from the networks may be greater (or less) than the sum of the benefits from the individual MPAs. These effects are potentially of great importance in marine protected areas because of the lack of barriers and mobility of species.

Little literature exist which examines this effect. But care should be taken in using values for ecosystem services which ignore this effect. A collection of protected features, or significant differences in areas of MPAs could exhibit network effects and therefore any valuations undertaken must take into account these potentially synergistic properties. Fletcher et al. (2012), assessed the benefits available from the designation of a network of MCZs. They concluded that the ecological connectivity of the network is likely to have an instrumental role in supporting the delivery of beneficial ecosystem services and their associated socio-economic value at various scales. Benefits may be experienced both within and outside an individual MPA due to connectivity with the wider marine environment, not only other MPAs. The designation of a network is therefore more likely to secure the current and future benefits available from MPAs than would a small number of isolated sites. A precautionary approach to securing the actual and potential benefits available from an MPA network would be to maximise potential connectivity through the designation of an extensive network.

Network effects are considered highly relevant to identifying the benefits of the MPAs, but cannot be quantified. An overview of the ecosystem services provided by the features in the MPAs has been compiled based on recent analysis by the VNN (see Section 3). It is shown in Appendix D, and simply presents the number of features in each site associated with each ecosystem service. It does not considered the level of ecosystem services from different features, or the strength of the scientific evidence identifying these links, both of which are variable.

The table in Appendix D reflects the generally lower numbers of features in offshore sites, with the exception of BHT. For inshore sites, there is more variability in the numbers of features associated with ecosystem services in different sites. The highest numbers of features are associate with supporting services, the numbers of features associated with cultural and regulating services are lower than for supporting services, while the lowest number relate to provisioning services (especially other than fish). There are numerous sites with multiple features associated with supporting services, and this illustrates the potential collective contribution of the MPAs to network values and resilience.

The information in Appendix D has been used to inform the individual site ecosystem services assessment (Table 9 in the Site Reports, Appendix E) and also informs the summary of the cumulative ecosystem services impacts of the proposed sites shown in Table 38.

In addition to these final ecosystem services from the proposed sites, the network of sites could cumulatively have an effect on supporting services. Including the value of the services can in some cases double-count the final services they support. However, they should be considered because they can have additional value through supporting final services from outside the network of sites (and so would not be reflected in Table 38) and through their contribution to the resilience of marine ecosystems and levels of marine ecosystem services.

Table 38. Cumulative view of final ES considered in the assessment

General Ecosystem Service Categorisation	Final Ecosystem Services to be Used	Observations from Site Analysis
Provisioning	Provision of fish and shellfish for human and non-human consumption	High uncertainty in response of fish and shellfish populations to protection of benthic habitats. Changes to primary productivity are complex and interactions between species uncertain. Furthermore, the designation may enhance levels of commercial and non-commercial species, but simultaneously make them less accessible to commercial fishing activities.
Cultural	Recreation	Most inshore sites have some recreational activities (e.g. angling, diving, boating routes and anchorages), and these are likely to be enhanced if participants can encounter increased levels of biodiversity, and/or if they feel the quality of the marine environment is less likely to be degraded.
	Research and education	The value of individual sites for research is not well understood. Research and education opportunities are enhanced through protection of healthy marine ecosystems, but the value of this is uncertain at individual sites due to the availability of substitutes. The value of the network in this respect is greater, as there is no substitute for the proposed network.
	Non-use	Non-use values are potentially very substantial over the 20 year assessment period, but also uncertain. See discussion in Section 6.
Regulating	Natural hazard protection	No benefits are identified in terms of hazard protection, as the proposed network is assessed not to have any interaction with coastal defences.
	Environmental resilience	This service was not considered for individual sites as it is regarded as something that operates at a larger scale (i.e. the network level). The MPA network will contribute to increased resilience of marine ecosystems through protection of marine biodiversity. Worm (2006) identified that more ecologically diverse marine ecosystems were more resilient to external pressures and disturbances.
	Gas and climate regulation	Carbon sequestration within marine environments is more significant where there is primary productivity from benthic vegetation. Relevant habitats are present in some proposed MPAs, but they are an extensive feature of the proposed network, and some are already subject to protection. Therefore the additional value of the network in this respect is considered low.

	Regulation of pollution	Waste assimilation services are provided by some sites' protected features (e.g. Maerl beds), but actions under the Water Framework Directive (WFD) are assumed to be dealing with any significant impacts on coastal water quality, any so benefits of designations in to improve water quality in excess of WFD requirements are assumed to be very low.

The analysis in Appendix D shows that many features in the proposed sites are associated with a wide range of supporting marine ecosystem services. Therefore, it is reasonable to assume that designating the proposed network of sites will make a contribution to the resilience of ecosystem services from the Scottish marine environment. However, currently available evidence does not allow any quantification of this benefit.

7.5.1 Value Transfer for Non-User Benefits of MPA Network

This section details a value transfer to measure the non-use value of designating a network of Marine Protect Areas in Scotland. It aims to present the steps and assumptions leading to a value or a range of plausible values which are reflective of the value placed on Scottish waters by Scottish households.

Value transfer is a process by which readily-available economic valuation evidence is applied in a new context for which valuation is required. It is a quicker and lower cost approach to generating economic valuation evidence compared to commissioning a specifically-designed primary valuation study. This advantage of value transfer makes it a practical tool for analysis given the time and resource constraints that decision-making regularly faces.

The methods and process involved are described in more detail in UK Government guidelines[19]. The process of value transfer is rarely perfect: some adjustment of the available evidence (the 'source study') is needed to apply it to another context. This adjustment introduces uncertainties into the valuation evidence produced, and these are reflected in the range of values obtained.

The source study for this value transfer is McVittie and Moran (2008). This is considered a suitable, and the most relevant, study for value transfer due to the similarity of the following factors in this study and in the proposed Scottish MPA designations:

- The good considered: a non-market good based on government action;
- The change: designation of a national scale network of marine protected areas (MPAs) subject to management measures that protect biodiversity;

[19] http://archive.defra.gov.uk/environment/policy/natural-environ/using/valuation/

- The population: the national population (a Scottish subsample is identified);
- The context: new marine protection legislation; and
- Timing: although economic conditions have changed, the data is relatively recent.

The source study estimates benefits derived from the implementation of the nature conservation measures in the draft Marine Bill, specifically, MCZs in the UK. MCZs are the term used for designating MPAs under the Marine Bill, so MCZs and MPAs are considered to have the same meaning in this context.

It quantifies total economic valuation for the MCZ provisions. However, due to the nature of the MCZ outcomes (being largely to species and seabed habitats not regularly encountered by members of the public), it is suggested that a high proportion of this value will be non-use value (i.e. associated with benefits derived simply from the knowledge that the natural environment is maintained) even though the data from this study do not allow the study to clearly isolate this component.

The study uses stated preference valuation methods with a sample size of 828 individuals across different regions of the UK (England, Wales, Scotland, and Northern Ireland). Individuals were asked about their willingness to pay (WTP) for marine conservation through the designation of a network of MCZs. The contingent valuation survey in McVittie and Moran (2008) that generated the unit value used in this analysis stated:

> *Without the introduction of Marine Conservation Zones it is possible that the deterioration of the marine environment will continue and that some of the damage may be irreversible. The only way of ensuring the conservation of the marine environment would be through an increase in annual tax paid by all households including yours.*

The analysis emphasises non-use values of the environmental benefits arising from designations of MCZs. This is a good match for the current policy context in which MPAs are being introduced in Scotland – the policy aims to conserve the condition of the marine environment and is undertaken by Government, funded through annual taxation.

7.5.1.1 Adjusted unit value transfer

Unit value

McVittie and Moran (2008) find a mean WTP per Scottish household for marine conservation (as defined above) in the UK of £14.97 for the year 2008.

Adjustments

Adjustments to transferred values are based on empirical evidence and control for the differences between the study site and the policy site that cause the unit value to differ between the two contexts (eftec, 2010).

Updating the WTP estimate to 2014

The value transferred from McVittie and Moran (2008) and used in this study is for the year 2008. It is therefore updated to 2012 prices using the GDP deflator from The Treasury from 2008 to 2012[20] (a factor of 1.080)). WTP by Scottish households for marine conservation in the UK is then £16.18 per Scottish household in 2014. With 2.37 million households in Scotland, according to the General Register Office for Scotland[21], this amounts to a non-use value for 2014 of £38.34 million by all Scottish households for marine conservation in the UK.

Size of the marine environment affected

McVittie and Moran (2008) value marine conservation in UK waters. To make the unit value used in their study relevant to Scottish waters only, the total non-use value of marine conservation in UK waters by Scottish households has been scaled down by a factor reflecting the proportion of Scottish sea area in the UK. It is estimated that 60.9% of UK waters are Scottish[22],[23],[24]. Therefore the UK value is scaled down by 60.9% to give an estimated value to Scottish households of marine conservation of Scottish waters only of £24.32 million.

Using the Scottish sea area as a proportion of UK sea area is consistent with the way McVittie and Moran (2008) define the good that they value: the McVittie and Moran (2008) study considers the territorial waters (out to 12 nautical miles) of England and the three devolved administrations as well as the UK continental shelf.

Aggregating WTP over time

Discounting

The value transfer detailed in this section includes discounting using the recommended discount rate of 3.5% in The Green Book. The discount rate is employed over the time horizon of 20 years considered in the study. This is done to convert all benefits to 'present values' so that they can be compared

20 https://www.gov.uk/government/publications/gdp-deflators-at-market-prices-and-money-gdp-march-2013.

21 http://www.gro-scotland.gov.uk/press/news2012/number-of-households.html.

22 UK sea area is assumed to be 770,000 km^2 according to a report by the MEFEP (Making the European Fisheries Ecosystem Plan Operational), available online at: http://www.liv.ac.uk/media/livacuk/mefepo/pdf/NWW-ATLAS-FINAL_wc.pdf.

23 Scottish sea area is assumed to be 469,000 km^2 according to Scotland's Environment Web: http://www.environment.scotland.gov.uk/our_environment/water/scotlands_seas.aspx.

24 Sea areas considered in this adjustment do not include the extended continental shelf within which the HRB site is located. Given that there are no management measures proposed for this site, and no existing activities, the results of the adjustment made in this section are not considered sensitive to this exclusion.

to present value costs. This process is based on the principle that people prefer to receive goods and services now rather than later, a concept referred to as ‘time preference’.

The discounted total value of marine conservation in UK waters by Scottish households is £583 million in 2012 prices compared to an undiscounted value of £805 million. Adjusted to Scottish water (as above) the total value for marine conservation in Scotland by Scottish households is £355 million over for the period 2014–2034.

Benefits time lag

In aggregating WTP over time, a final adjustment is made to the non-use value of marine conservation of Scottish waters by Scottish households to account for the time lag of benefits. This lag exists because the benefits of MPA designation do not all occur immediately. In reality, it takes many years for habitats to recover from degradation before the flow of ecosystem services (ES) can resume.

In this context, it is assumed that the benefits for the first year after MPA designation are nil and grow at a rate of 10% over 10 years after which the benefits reach and remain at full value until 2034.

McVittie and Moran (2008) are explicit in stating that they do not make such an adjustment. In effect, the values generated within their research are based on the best ex-ante assessment of the anticipated environmental gains from marine conservation, using a scenario of a hypothetical network of MCZs. One interpretation of this fact is that the benefits of marine conservation in their study represent preferences for implementation of the Marine Bill and arise immediately from policy implementation.

Either assumption is possible as benefits can arise immediately because people know marine biodiversity is being protected, or with a lag after that protection has had a positive effect on the conservation of biodiversity.

7.5.1.2 Results

The value transfer produces a range for the non-use value of the designation of a network of MPAs in Scotland. The ranges are spread across the series of adjustments made to transfer the unit value from the source study to the policy study.

The first part of the range is identified by scaling total non-use value expressed by Scottish households for all UK marine waters down, to only account for Scottish waters. The value over 20 years goes from £583 million to £355 million in 2012 prices. Both values can be thought to represent the non-use value of Scottish waters by Scottish households. The former value assumes that households in Scotland only value marine conservation in

Scottish waters whilst the latter assumes that they value marine conservation evenly across UK waters.

A second part of the range of plausible values is then identified by adjusting for the possibility of a lag in the benefits of marine conservation. The value over 20 years goes from £583 million, assuming the benefits are realised immediately, to £392 million in 2014 prices assuming they are realised with a lag. The range of the non-use value of Scottish marine conservation by Scottish households over the 20-year time horizon goes from £355 million, assuming the benefits are realised immediately, to £239 million assuming they are realised with a lag. Both assumptions are plausible.

Table 39 summarises the range[25] of values that the adjustments in this value transfer lead to.

Table 39. Range of non-use values of Scottish waters by Scottish households

Adjustment	Estimated Value (2012 prices)
Scottish Households value for UK MPAs	£583 million
Adjusted for size of the Scottish marine environment	£355 million
Adjusted for benefits time lag	£392 million
Adjusted for benefits time lag AND size of the Scottish marine environment	£239 million

It is worth noting that the adjustment to Scottish sea area assumes that Scottish households value MCZs evenly across UK waters. Alternatively, the original value of Scottish households for UK waters could also be used assuming Scottish households only value MCZs in Scotland. This study, however, assumes that the real value of marine conservation in Scottish waters by Scottish households will lie within the range of £239–583 million, underpinned by different plausible assumptions.

The adoption of a range is in line with the argument that, in reality, Scottish households value marine conservation in all UK waters, but value it in Scotland more than at the broader UK level. A wide range also reflects the high level of scientific uncertainty within the area this study is concerned with. The analysis does not take into account any possible effects of economic conditions since 2008, when the McVittie and Moran study was carried out, on Scottish households' willingness to pay for marine conservation.

[25] The ranges presented in this table are the product of sensitivity analysis not statistical analysis.

8. Discussion and Conclusions

8.1 Cost Impacts to Activities

Based on the assessments undertaken, it is estimated that there will be no significant cost impacts associated with designation of the proposed MPAs under any of the scenarios for the following activities: aviation, carbon capture and storage, coast protection and flood defence, power interconnectors and transmission lines, tourism and water sports.

It is estimated that relatively minor cost impacts will be experienced by the following activities with greater cost impacts under the intermediate and upper scenarios: finfish and shellfish aquaculture, military activities, ports and harbours, recreational boating and telecom cables. However, there is some uncertainty surrounding the potential scale of impacts to finfish and shellfish aquaculture, as it has not been possible to estimate the potential costs of mitigation measures and actual cost impacts could therefore be greater. It has not been possible to derive monetary estimates for the potential impacts to the recreational boating sector, but based on the limited number of anchorages and moorings likely to be affected, the cost impacts are expected to be minor.

Potentially more significant cost impacts could be experienced by the commercial fisheries, energy generation and oil & gas sectors, particularly under the intermediate and/or upper scenarios. For commercial fisheries, potential impacts on GVA (discounted over assessment period) range from £0.6m (lower scenario), £24m to £30m (intermediate scenario) and £52m to £60m (upper scenario) depending on the offshore site options included. The differences are largely accounted for by differences between the impacts associated with the Fladen options (estimated impact to GVA ranges between £3m to £7m) and inclusion of the Firth of Forth Banks Complex (estimated impact around £5m greater than alternative option).

For energy generation potential PV costs range from £0.1m to £0.2m (lower scenario), £2.6 to £2.7m) (intermediate scenario) and £3.9m to £47.3m (upper scenario) depending on the offshore site options included. The costs are particularly affected by the inclusion of the Firth of Forth Banks Complex in the upper scenario owing to the potential requirement to provide graded scour protection around each installation.

For the oil and gas sector potential PV costs range from £1.4m – £1.5m (lower scenario), £3.6m – £7.6m (intermediate scenario) and £111m – £121m (upper scenario) depending on the offshore site options included. In the lower scenario, the costs relate solely to potential additional assessment costs associated with new oil and gas exploration and development. In the intermediate scenario, some additional survey and mitigation measure costs potentially arise in relation to micrositing oil and gas infrastructure to avoid areas of high density for tall sea pens, particularly in Central Fladen (core) and Western Fladen proposed MPAs. In the upper scenario, potentially much larger costs could be incurred associated with more widespread micrositing of infrastrue and skip and ship of drill cuttings.

The combined impact of the designation of proposed MPAs on activities is largely considered to be additive, given the relatively low levels of impact associated with the draft management options assessed within this study. For the energy generation and oil and gas sectors, it is possible that the combined impacts could be more significant in the upper scenario, should some of the planned investment be deterred as a result of the additional costs of development. However, this remains uncertain and JNCC's current advice is that the intermediate scenario represents their best view on management requirements.

For the commercial fisheries sector, certain fleet segments may be significantly affected by the designation of several proposed MPAs in a region under the intermediate and upper scenarios. This is particularly the case for over-15m and under-15m nephrops trawls in the West inshore and North-west inshore regions, and to a lesser extent for over-15m dredges and whitefish trawls. The displacement of these vessels from their fishing grounds may cause conflict among them and with other vessels in the grounds they are displaced to. There may be additional costs associated with moving to new fishing grounds, changing target species or fishing method, and a number of vessels may leave the sector, with resulting employment and social impacts.

It is recognised that accurate quantification of potential cost impacts is very challenging and confidence in the quantified assessments is generally low. It has not been possible to quantify a number of the potential cost impacts, for example mitigation costs for some sectors, or costs of delays in consenting or deterrent to investment. The quantified cost impacts therefore provide only a partial picture of the potential cost impacts of the draft management options. In addition, some cost impacts have only been quantified at national level. The Site Reporting Templates (Appendix E) therefore do not provide a complete picture of all quantified costs and this should be taken into account when considering the estimated costs for each site.

8.2 Costs to the Public Sector

The main public sector costs relate to the costs of biological surveys to assess the condition of features within sites once designated (PV around £23m to £25m, depending on the offshore site options included in the network). Other public sector costs associated with Marine Management Schemes, Statutory Instruments to implement fisheries management measures, compliance and enforcement activities, proportion of public understanding and regulatory and advisory costs are estimated to be relatively minor (PV around £0.5m for all options).

There are some uncertainties surrounding the estimates of costs to the public sector, in particular, the requirements for and costs of enforcement of inshore fisheries management measures and the costs associated with securing CFP measures. However, such costs are likely to remain only a minor component of overall public sector costs. The potential for cost impacts to Scottish Water is also uncertain.

8.3 Distribution of Economic Costs and Consequent Social Impacts

8.3.1 Commercial Fishing Sector and Fish Processing Sector

It is difficult to assess the potential socio-economic consequences of designation of proposed MPAs on the commercial fishing sector (and hence the fish processing sector) as, ultimately, this will depend on the extent to which the fleet can access alternative fishing grounds, and that is unknown. The quantitative estimates presented for this sector, therefore, assume there is no redistribution of fishing effort - all affected landings are lost - and hence represent worst-case estimates.

The analysis suggests:

- Designation of ten of the possible MPAs would not require any restrictions on fishing activities and hence would not generate any economic or social costs;
- Under the lower scenario, the economic and social impacts of designation would be minimal;
- While designation of the suite of MPAs would have negative impacts on GVA and employment, the impact at the Scottish economy level would not be significant;
- While designation of the suite of MPAs would have negative impacts on the sector's GVA and employment under the intermediate and upper scenarios, these impacts would be relatively small. Under the worst-case scenario, there would be a 2% reduction in the sector's GVA and employment;
- The North-east, North-west and West regions, however, would bear a disproportionate share of these costs with the most significant employment impacts being felt in Fraseburgh, Peterhead, Mallaig and Ayr. Designation of the suite of MPAs could put jobs at risk in these and other areas (under the intermediate and upper scenarios) and this could generate significant economic and social costs for the individuals affected (and their families) if they do not find alternative employment;
- It is anticipated that designation of the suite of proposed MPAs would have a negative, but fairly minimal impact, on the Scottish fish processing sector as a whole. Affected landings account for a relatively low proportion of total landings at landing ports (typically 0–3%, and

7% worst case at Mallaig) and it is likely that fish processors will react to reductions in local supplies of fish by importing greater quantities of raw material. The impacts could be more significant for smaller-scale processors which are more heavily reliant on locally-caught demersal species and shellfish. Designation is not expected to have any impact on the pelagic sector; and

- If the impact of designation on the Scottish fleet was a displacement of fishing activity, the economic and social costs would be smaller than those estimated. These may, however, be partly offset by other economic and social costs associated with displacement such as increased fuel costs and a loss of social cohesion among fleets, as a result of increased tensions among vessels from having to share fishing grounds. Displacement issues are likely to be most pronounced in the West and North-west inshore regions, particularly for nephrops trawlers (under-15m and over-15m) and dredges.

8.3.2 Energy Generation and Oil and Gas

It has not been possible to quantify the costs associated with all of the possible mitigation measures in the energy generation or oil and gas sectors but these are potentially significant, particularly under the upper scenario. Further, it has not been possible to estimate the costs associated with potential delays or the impact of designation on investment decisions. If designation rendered projects unviable or restricted or deterred investment in development projects (existing, planned or future), this would have potentially very significant socio-economic impacts; not only would it reduce the contribution these sectors make to future levels of GVA and employment but it would have indirect effects on their supply chains and the wider Scottish economy. However, such impacts are unlikely because JNCC's current advice is that the intermediate scenario represents their best view on potential management requirements.

8.4 Benefits

Section 6 reviewed evidence on expected changes in ecosystem services and on the value of those changes. The evidence is extremely limited. It is particularly hampered by the lack of knowledge of the baseline condition of many features in the MPAs, and the impact of management measures on features and ecosystem services from sites.

The available evidence suggests that people do value protection of marine biodiversity and will benefit from increased ecosystem services as a result of MPA designation and management. These changes in ecosystem services are however poorly understood and very difficult to quantify. The conclusion is therefore that the scale of the benefits of designating the MPAs remains unproven, but this should not be interpreted as meaning that these benefits are low.

The same limitations hamper assessment of the cumulative benefits of the proposed MPAs. However, at this scale additional evidence on the network value of MPAs is relevant. The sites can cumulatively contribute to the resilience of marine ecosystem services in a way that is greater than the sum of their parts.

At the network level, economic studies on the value of UK MPAs and halting the loss of marine biodiversity in the UK, discussed in Section 6.3.5, are more relevant. The basis for reliably transferring most of this evidence to the proposed MPAs is uncertain.

A recent UK study of the non-use value of protecting marine biodiversity through site designations (McVittie and Moran, 2008) has been translated to value the proposed MPAs in accordance with UK Government value transfer guidelines. The non-use value of Scottish households, with assumptions made on the scale of Scottish marine waters and a possible time-lag in the benefits from designation, are estimated at between £239 million and £583 million, at 2012 prices discounted over 20 years, from 2014.

8.5 Limitations and Uncertainties

A number of significant limitations and uncertainties have been identified through the course of the study. The development of the scenarios has sought to encompass some of these uncertainties, in particular:

- Where the spatial extent of MPA features for which management measures might be required is uncertain (and thus the spatial area over which management measures might need to be applied (and over which costs and benefits might accrue) is uncertain) the scenarios have used different estimates of the spatial extent of those features;
- Different assumptions have been used concerning the requirements for management measures within the scenarios to take account of uncertainty in the management requirements. This influences the scale of costs and benefits across the scenarios;
- Different assumptions have been used within the scenarios concerning the extent to which management measures might already be necessary to deliver OSPAR/BAP requirements. This also influences the scale of costs and benefits across the scenarios.

As a result of incorporating these uncertainties within the scenarios, significant variations in the range of potential costs and benefits have been identified, with estimates of costs typically varying by around two orders of magnitude between the lower and upper scenarios. These differences are particularly driven by assumptions on management measure requirements , but in some instances cost estimates are also sensitive to assumptions about whether management measures might already be necessary to meet

OSPAR/BAP requirements.Further refinement of the management options through the consultation process on the MPA proposals could help to reduce this uncertainty.

Uncertainties in the location and nature of future activity in the marine environment also introduce an uncertainty in the estimation of costs and benefits. For example, some of the estimated offshore renewables impacts are based on the location of Draft Plan Options and indicative export cable routes, which will be the subject of separate public consultation. Similar uncertainties relate to future trends in ongoing activities such as commercial fishing (assumed landings values remain constant over the assessment period). Such assessments are therefore based on a significant degree of speculation about future levels of activity and are thus inherently uncertain.

As identified in section 8.1 above, it has not been possible to provide quantified estimates of cost impacts for a number of potential management measures owing to a lack of data on the location of future activity or a lack of information on the costs of management measures. In addition, it has not been possible to estimate the cost of potential consequential impacts associated with designation, for example the costs of delays to consenting processes or costs associated with reduced investor confidence.

For commercial fisheries, the cost impacts have been based on GVA estimates of the value of potential landings foregone. These values will overestimate impacts to the commercial fisheries sector as they assume that all of the displaced effort will be lost, although in practice a proportion of the displaced effort will relocate and continue fishing in other areas. There is also an inherent uncertainty in the multipliers used to estimate GVA, which are not site specific. Further information on displacement effects could usefully be gathered through the consultation process on the MPA proposals.

The main potential social impacts identified within the assessment relate to impacts on the commercial fishing sector. Given the uncertainties relating to commercial fishing impacts identified above, the social consequences of these impacts are also similarly uncertain.

The assessment of benefits has largely been limited to a qualitative assessment owing to the very limited evidence on expected changes in ecosystem services and on the value of those changes. The assessment has also been hampered by the lack of knowledge of the baseline condition of many features in the MPAs, and the impact of management measures on features and ecosystem services within those sites. However, a significant amount of additional research is in progress, for example under the auspices of the National Ecosystem Assessment Follow-on project and it may be possible to incorporate additional informationduring and following the public consultation on the MPA proposals.

The combined assessment poses particular challenges owing to the complexity of such assessments and the limited scientific understanding of impacts. Within this study, combined effects have generally been assessed as the sum of the individual impacts of on individual sites, but the potential for combined cost impacts has been recognised, particularly in relation to commercial fisheries and possibly also for offshore renewables and oil and gas under the upper scenario. The assessment of combined benefits is subject to the same limitations as those identified for the site assessments. However, at this scale, additional evidence on the network value of MPAs is relevant. For example, the sites can cumulatively contribute to the resilience of marine ecosystem services in a way that is greater than the sum of their parts, but there is little if any quantified evidence available to support this.

9 References

ABPmer & RPA, 2012. Socio-economic Baseline Reviews for Offshore Renewables in Scottish Waters. ABP Marine Environmental Research Ltd, Report No. R.1905 to Marine Scotland .

ABPmer & eftec, 2012. Designing Business as Usual Projections of the Marine Environment to Inform the UK Implementation of the Marine Strategy Framework Directive

ABPmer & RPA, in progress. Developing the Socio-Economic Evidence Base for Offshore Renewable Sectoral Marine Plans in Scottish Territorial Waters.

Austen, M., Malcolm, S., Frost, M., Hattam, C., Mangi, S., Stentiford, G., 2011. Marine. In: The UK National Ecosystem Assessment Technical Report. UK National Ecosystem Assessment. Cambridge: UNEP-WCMC.

Beaumont, N., Townsend, M., Mangi, S. and Austen, M.C., 2006. Marine biodiversity: An economic valuation. Final Report to DEFRA.

Bournemouth University & ABPmer, 2010. Description of the ecosystem services provided by broad-scale habitats and features of conservation importance that are likely to be protected by Marine Protected Areas in the Marine Conservation Zone Project area. Final Report, October, 2010.

British Marine Federation *et al*. 2009. Water sports and Leisure Participation Survey 2009. Available online: http://www.britishmarine.co.uk/upload_pub/WatersportsandLeisureOmnibus2009finalpublic.pdf

Brooks, A.J. Kenyon, N.H. Leslie, A., Long, D. and Gordon, J.E. (2012). Characterising Scotland's marine environment to define search locations for new Marine Protected Areas. Part 2: The identification of key geodiversity areas in Scottish waters (2nd interim report). *Scottish Natural Heritage Commissioned Report No.431*. Available from http://www.snh.org.uk/pdfs/publications/commissioned_reports/431.pdf

Cefas, 2010. Development of an additional datalayer of UK and non-UK fishing effort for use in the planning of marine protected area networks. Report No 4. Final. August 2010.

Chaniotis, P.D., Crawford-Avis, O.T., Cunningham, S., Gillham, K., Tobin, D., Linwood, M., 2011. Least damaged/more natural locations in Scotland's seas technical annex. Technical Annex produced by the Joint Nature Conservation Committee, Scottish Natural Heritage and Marine Scotland for the Scottish Marine Protected Areas Project. Available from http://www.scotland.gov.uk/Resource/Doc/295194/0121829.pdf.

Constanza, R., d'Arge, R., de Groot, R., Farber, S., Grasso, M., Hannon, B., Limburg, K., Naeem, S., O'Neill, R., Paruelo, J., Raskin, R., Sutton, P. and Van den Belt, M., 1997. The value of the world's ecosystem services and natural capital. Nature, 387: 253-260.

Defra, 2012. Designation of Marine Conservation Zones in English Inshore Waters and English and Welsh Offshore Waters. Impact Assessment. IA No: Defra 1475. December 2012.

Defra, 2011. A framework for understanding the social impacts of policy and their effects on wellbeing, paper for the Social Impacts Taskforce, Defra evidence and analysis series Paper 3, April 2011, available at: http://www.defra.gov.uk/publications/files/pb13467-social-impacts-wellbeing-110403.pdf.

Eftec, 2010. Valuing environmental impacts: Practical guidelines for the use of value transfer in policy and project appraisal. Report to Defra.

Finding Sanctuary, Irish Seas Conservation Zones, Net Gain and Balanced Seas. 2012. Impact Assessment materials in support of the Regional Marine Conservation Zone Projects' Recommendations.

Fletcher, S., Rees, S., Gall, S. Jackson, E., Friedrich, L., and Rodwell, L., 2012. A report to The Wildlife Trusts by the Centre for Marine and Coastal Policy Research. Plymouth University.

Friedrich L, Fletcher S, Gall S & Rees S (2013) Securing the benefits of the Marine Conservation Zone Network: Evidence for a declining ecological baseline. February 2013. Centre for Marine and Coastal Policy Research. Plymouth University

Gubbay, S., 2006. Marine Protected Areas. A review of their use for delivering marine biodiversity benefits. English Nature Research Reports, No 688.

HM Treasury (2011). *The Green Book: Appraisal and evaluation in Central Government.* Treasury Guidance.

INDUROT, 2012. Valuing the Benefits of Designating a Network of Scottish MPAs in Territorial and Offshore Waters. A report to Scottish Environment Link, November, 2012.

Joint Nature Conservation Committee, 2012a. Scottish MPA Project – Data Confidence Assessment: Central Fladen MPA proposal v1.3. Available online at: http://jncc.defra.gov.uk/page-6352.

Joint Nature Conservation Committee, 2012b. Scottish MPA Project – Data Confidence Assessment: East of Gannet and Montrose Fields MPA proposal v1.2. Available online at: http://jncc.defra.gov.uk/page-6352.

Joint Nature Conservation Committee, 2012c. Scottish MPA Project – Data Confidence Assessment: Faroe-Shetland Sponge Belt MPA proposal v1.4. Available online at: http://jncc.defra.gov.uk/page-6352.

Joint Nature Conservation Committee, 2012d. Scottish MPA Project – Data Confidence Assessment: Firth of Forth Banks Complex MPA proposal v1.2. Available online at: http://jncc.defra.gov.uk/page-6352.

Joint Nature Conservation Committee, 2012e. Scottish MPA Project – Data Confidence Assessment: Geikie Slide and Hebridean Slope MPA proposal v1.31. Available online at: http://jncc.defra.gov.uk/page-6352.

Joint Nature Conservation Committee, 2012f. Scottish MPA Project – Data Confidence Assessment: Hatton-Rockall Basin MPA proposal v1.2. Available online at: http://jncc.defra.gov.uk/page-6352.

Joint Nature Conservation Committee, 2012g. Scottish MPA Project – Data Confidence Assessment: North-west Orkney MPA proposal v1.7. Available online at: http://jncc.defra.gov.uk/page-6352.

Joint Nature Conservation Committee, 2012h. Scottish MPA Project – Data Confidence Assessment: Norwegian Boundary Sediment Plain MPA proposal v1.2. Available online at: http://jncc.defra.gov.uk/page-6352.

Joint Nature Conservation Committee, 2012i. Scottish MPA Project – Data Confidence Assessment: Rosemary Bank Seamount MPA proposal v1.2. Available online at: http://jncc.defra.gov.uk/page-6352.

Joint Nature Conservation Committee, 2012j. Scottish MPA Project – Data Confidence Assessment: South-east Fladen MPA proposal v1.2. Available online at: http://jncc.defra.gov.uk/page-6352.

Joint Nature Conservation Committee, 2012k. Scottish MPA Project – Data Confidence Assessment: South-west Sula Sgeir and Hebridean Slope MPA proposal v1.2. Available online at: http://jncc.defra.gov.uk/page-6352.

Joint Nature Conservation Committee, 2012l. Scottish MPA Project – Data Confidence Assessment: Turbot Bank MPA proposal v1.2. Available online at: http://jncc.defra.gov.uk/page-6352.

Joint Nature Conservation Committee, 2012m. Scottish MPA Project – Data Confidence Assessment: West Shetland Shelf MPA proposal v1.3. Available online at: http://jncc.defra.gov.uk/page-6352.

Joint Nature Conservation Committee, 2012n. Scottish MPA Project – Data Confidence Assessment: Western Fladen MPA proposal v1.2. Available online at: http://jncc.defra.gov.uk/page-6352.

Joint Nature Conservation Committee and Natural England, 2011. General advice on assessing potential impacts of and mitigation for human activities on MCZ features, using existing regulation and legislation. Advice from the Joint Nature Conservation Committee and Natural England to the Regional MCZ Projects. June 2011. 107pp

Lawrence, K.S. (2005) Assessing the value of recreational sea angling in South West England. Fisheries Management and Ecology 12: 369–375.

Marine Management Organisation, 2011. UK Sea Fisheries Statistics 2010 - Tables. [online] Available at: http://www.marinemanagement.org.uk/fisheries/statistics/annual2011.htm [Accessed: 14 May 2013].

Marine Scotland, 2011. Scottish Sea Fisheries Statistics 2010. Published by Marine Scotland, The Scottish Government, September 2011 DPPAS11957 (08/11). 92 pages.

Marine Scotland, JNCC and SNH, 2011. Marine Protected Areas in Scotland's Seas. Guidelines on the selection of MPAs. February, 2011.

McVittie, A., & Moran, D., 2008. Determining monetary values for use and non-use goods and services: Marine Biodiversity–primary valuation. Final Report to Defra.

Natural England and Joint Nature Conservation Committee, 2010. Ecological Network Guidance.

National Capital Committee, 2013, State of Natural Capital Report. Natural Capital Committee, Defra.

Potts, T., Jackson, E., Burdon, D., Saunders, J., Atkins, J., Hastings, E. and Langmead, O., .2013. Marine Protected Areas and Ecosystem Services – Linking Conservation and Human Welfare?. VNN Coastal Topic Report.

Scottish Centre for Carbon Storage, 2009. Opportunities for CO2 storage around Scotland: An integrated strategic research study. Report for the Scottish Government. April, 2009.

Scottish Enterprise, no date. Carbon Capture and Storage: CO_2 Transport Options for Scotland.

Scottish Government, 2009. Final Regulatory Imp[act Assesement for the Marine (Scotland) Bill.

Scottish Government, 2011. Scotland's Marine Atlas: Information for the national marine plan. Marine Scotland, Edinburgh.

Scottish Government, 2012a. Scottish Sea Fisheries Statistics 2011. Available at http://www.scotland.gov.uk/Publications/2012/09/1840

Scottish Government, 2012b. Scottish Annual Business Statistics 2010. Available at http://www.scotland.gov.uk/ Topics/Statistics/Browse/Business/SABS.

Scottish Natural Heritage, 2012a. Scottish MPA Project – Data Confidence Assessment: Clyde Sea Sill MPA Proposal v7. Available online at: http://www.snh.gov.uk/protecting-scotlands-nature/protected-areas/national-designations/marine-protected-areas/mpa-protected-data-assessment/

Scottish Natural Heritage, 2012b. Scottish MPA Project – Data Confidence Assessment: East Caithness Cliffs MPA Proposal v8. Available online at: http://www.snh.gov.uk/protecting-scotlands-nature/protected-areas/national-designations/marine-protected-areas/mpa-protected-data-assessment/

Scottish Natural Heritage, 2012c. Scottish MPA Project – Data Confidence Assessment: Fetlar to Haroldswick MPA Proposal v7. Available online at: http://www.snh.gov.uk/protecting-scotlands-nature/protected-areas/national-designations/marine-protected-areas/mpa-protected-data-assessment/

Scottish Natural Heritage, 2012d. Scottish MPA Project – Data Confidence Assessment: Loch Creran MPA Proposal v7. Available online at: http://www.snh.gov.uk/protecting-scotlands-nature/protected-areas/national-designations/marine-protected-areas/mpa-protected-data-assessment/

Scottish Natural Heritage, 2012e. Scottish MPA Project – Data Confidence Assessment: Lochs Duich, Long and Alsh MPA Proposal v7. Available online at: http://www.snh.gov.uk/protecting-scotlands-nature/protected-areas/national-designations/marine-protected-areas/mpa-protected-data-assessment/

Scottish Natural Heritage, 2012f. Scottish MPA Project – Data Confidence Assessment: Loch Sunart MPA Proposal v8. Available online at: http://www.snh.gov.uk/protecting-scotlands-nature/protected-areas/national-designations/marine-protected-areas/mpa-protected-data-assessment/

Scottish Natural Heritage, 2012g. Scottish MPA Project – Data Confidence Assessment: Loch Sunart to the Sound of Jura MPA Proposal v7. Available online at: http://www.snh.gov.uk/protecting-scotlands-nature/protected-areas/national-designations/marine-protected-areas/mpa-protected-data-assessment/

Scottish Natural Heritage, 2012h. Scottish MPA Project – Data Confidence Assessment: Loch Sween MPA Proposal v7. Available online at: http://www.snh.gov.uk/protecting-scotlands-nature/protected-areas/national-designations/marine-protected-areas/mpa-protected-data-assessment/

Scottish Natural Heritage, 2012i. Scottish MPA Project – Data Confidence Assessment: Monach Isles MPA Proposal v7. Available online at: http://www.snh.gov.uk/protecting-scotlands-nature/protected-areas/national-designations/marine-protected-areas/mpa-protected-data-assessment/

Scottish Natural Heritage, 2012j. Scottish MPA Project – Data Confidence Assessment: North-west sea lochs and Summer Isles MPA Proposal v7. Available online at: http://www.snh.gov.uk/protecting-scotlands-nature/protected-areas/national-designations/marine-protected-areas/mpa-protected-data-assessment/

Scottish Natural Heritage, 2012k. Scottish MPA Project – Data Confidence Assessment: Mousa to Boddam MPA Proposal v7. Available online at: http://www.snh.gov.uk/protecting-scotlands-nature/protected-areas/national-designations/marine-protected-areas/mpa-protected-data-assessment/

Scottish Natural Heritage, 2012l. Scottish MPA Project – Data Confidence Assessment: Noss Head MPA Proposal v7. Available online at: http://www.snh.gov.uk/protecting-scotlands-nature/protected-areas/national-designations/marine-protected-areas/mpa-protected-data-assessment/

Scottish Natural Heritage, 2012m. Scottish MPA Project – Data Confidence Assessment: Papa Westray MPA Proposal v7. Available online at: http://www.snh.gov.uk/protecting-scotlands-nature/protected-areas/national-designations/marine-protected-areas/mpa-protected-data-assessment/

Scottish Natural Heritage, 2012n. Scottish MPA Project – Data Confidence Assessment: Small Isles MPA Proposal v9. Available online at: http://www.snh.gov.uk/protecting-scotlands-nature/protected-areas/national-designations/marine-protected-areas/mpa-protected-data-assessment/

Scottish Natural Heritage, 2012o. Scottish MPA Project – Data Confidence Assessment: South Arran MPA Proposal v7. Available online at: http://www.snh.gov.uk/protecting-scotlands-nature/protected-areas/national-designations/marine-protected-areas/mpa-protected-data-assessment/

Scottish Natural Heritage, 2012p. Scottish MPA Project – Data Confidence Assessment: Upper Loch Fyne and Loch Goil MPA Proposal v7. Available online at: http://www.snh.gov.uk/protecting-scotlands-nature/protected-areas/national-designations/marine-protected-areas/mpa-protected-data-assessment/

Scottish Natural Heritage, 2012q. Scottish MPA Project – Data Confidence Assessment: Wyre and Rousay Sounds MPA Proposal v7. Available online at: http://www.snh.gov.uk/protecting-scotlands-nature/protected-areas/national-designations/marine-protected-areas/mpa-protected-data-assessment/

SeaFish, 2013a. 2012 Survey of the UK Seafood Processing Industry. Sea Fish Industry Authority.

SeaFish, 2013. Seafish Multi-Year Fleet Economic Performance Dataset. Sea Fish Industry Authority.

SNH & JNCC, 2012a. Assessment of the potential adequacy of the Scottish MPA network for MPA search features: summary of the application of the stage 5 selection guidelines. Available online from: http://www.scotland.gov.uk/Topics/marine/marine-environment/mpanetwork/engagement/270612.

SNH & JNCC, 2012b. Advice to the Scottish Government on the selection of Nature Conservation Marine Protected Areas (MPAs) for the development of the Scottish MPA network. Scottish Natural Heritage Commissioned Report No. 547. Scottish Natural Heritage and the Joint Nature Conservation Committee.

UKMAS, 2010. Charting Progress 2.

UNEP-WCMC, in press. The value of potential Marine Protected Areas in the UK to divers and sea anglers.

Worm B, et al., 2006. Impacts of biodiversity loss on ocean ecosystem services. Science 314: 787–790.

Websites

Defra Environment Policy:
http://archive.defra.gov.uk/environment/policy/natural-environ/using/valuation/index.htm

UK Standard Industrial Classification of Economic Activities 2007:
http://www.ons.gov.uk/ons/ guide-method/classifications/current-standard-classifications/standard-industrial-classification/sic2007---explanatory-notes.pdf.

Appendices

Appendix A

Reporting Template for Sites

Appendix A. Reporting Template for Sites

[Site Name (site 3-letter code)] Site Area (km^2): [ ]

Site Summary

Table 1. Summary of Proposed Protected Features, Data Confidence and Conservation Objectives					[Site Code]
Proposed protected features					
[Description of biodiversity and geodiversity features that would be protected]					
Summary of confidence in presence, extent and condition of proposed protected features and conservation objectives					
Proposed Protected Feature	**Estimated Area of Feature (by scenario) (km^2)**	**Confidence in Feature Presence**	**Confidence in Feature Extent**	**Confidence in Feature Condition**	**Conservation Objective and Risk**
Biodiversity Features					
e.g. Black guillemot	*				
Geodiversity Features					
e.g. Marine Geomorphology of the Scottish Shelf Seabed - sand wave field					
Key: * Estimated area based on best available data References: Area of Features: Confidence in biodiversity feature presence and extent: Confidence in biodiversity feature condition: Confidence in geodiversity feature presence and extent: Confidence in geodiversity feature condition:					

Summary of Costs and Benefits

Table 2a. Site-Specific Economic Costs on Human Activities arising from the Designation and Management of the Site as an MPA (over 2014 to 2033 inclusive)			**[Site Code]**
Human Activity	**Cost Impact on Activity**		
	Lower Estimate (£k)	**Intermediate Estimate (£k)**	**Upper Estimate (£k)**
Quantified Economic Costs (Discounted)			
e.g. Aquaculture			
Total Quantified Economic Costs			
Non-Quantified Economic Costs			
[Identify non-quantified costs here]	Describe costs e.g. loss of confidence to invest	Describe costs	Describe costs
Note: For detailed information on economic cost impacts on activities, see Table 4.			

Table 2b. Site-Specific Public Sector Costs arising from the Designation and Management of the Site as an MPA (over 2014 to 2033 inclusive)			**[Site Code]**
Description	**Public Sector Costs**		
	Lower Estimate (£k)	**Intermediate Estimate (£k)**	**Upper Estimate (£k)**
Quantified Public Sector Costs (Discounted)			
Preparation of Marine Management Schemes			
Preparation of Statutory Instruments			
Development of voluntary measures			
Site monitoring			
Compliance and enforcement			
Promotion of public understanding			
Regulatory and advisory costs associated with licensing decisions			
Total Quantified Public Sector Costs			
Non-Quantified Public Sector Costs			
[Identify non-quantified costs here]	Describe costs	Describe costs	Describe costs

Table 2c. Summary of Social Impacts and Distribution of Quantified Impacts arising from the Designation and Management of the Site as an MPA (over 2014 to 2033 inclusive) **[Site Code]**

Key Areas of Social Impact	Description	Scale of Expected Impact across Scenarios, Average (mean no. of jobs affected)	Distributional Analysis							
			Location			Fishing Groups Predominantly Affected		Social Groups Affected		
			Region	Port	Rural/ Urban/ Island	Gear Types Most Affected	Vessels most affected	Crofters	Ethnic minorities	With disability or long term sick
e.g. Employment with consequent impacts on: Health, Crime, Environment, and Culture and Heritage	e.g. Commercial Fisheries									

Note: For detailed information on socio-economic impacts by sector, see Table 7a. For more detailed information on distributional impacts of quantified costs by sector see Tables 7b and 7c.

Table 2d. Site-Specific Benefits arising from the Designation and Management of the Site as an MPA (over 2014 to 2033 inclusive) **[Site Code]**

Benefit	Description	
Ecosystem Services Benefits (Moderate and High Benefits)	**Relevance**	**Scale of Benefits**
e.g. Food provisioning		
Other Benefits		
[Identify other benefits here e.g. contribution to ecologically-coherent network; activities that would benefit, regulatory certainty]	Describe benefits	

Note: For detailed information on ecosystem services benefits, see Tables 9 and 10. For detailed information on other benefits, see Table 5 (activities that would benefit) and Table 8 (contribution to ecologically-coherent network).

Summary of Overlaps and Interactions between Proposed Designated Features and Human Activities

Table 3. Overlaps and Potential Interactions between Features and Activities under different Scenarios, indicating need for Assessment of Cost Impacts on Human Activities from Designation of the Site as an MPA **[Site Code]**

	Aggregates	Aquaculture (Finfish)	Aquaculture (Shellfish)	Aviation	Carbon Capture & Storage	Coastal Protection	Commercial Fisheries	Energy Generation	Military Activities	Oil & Gas	Ports & Harbours	Power Interconnectors	Recreational Boating	Shipping	Telecom Cables	Tourism	Water Sports
Biodiversity Features																	
e.g. Black guillemot																	
Geodiversity Features																	
e.g. Marine Geomorphology of the Scottish Shelf Seabed - sand wave field																	

Note: L = Lower Scenario; I = Intermediate Scenario; U = Upper Scenario. Normal font indicates that there is an overlap between the activity and proposed designated feature under that scenario, **bold** indicates that the overlap results in a potential interaction between the activity and proposed designated feature that has resulted in cost impacts under that scenario.
For detail of management measures assessed under each scenario for each activity, and results of the cost estimates, see Table 4.

Human Activity Summaries

Human activities that would be impacted by designation of the site as an MPA

Table 4a. e.g. Aquaculture (Finfish)			**[Site Code]**
[Summary description of activity and risks to features]			
Economic Costs on the Activity of Designation of the Site as an MPA			
	Lower Estimate	**Intermediate Estimate**	**Upper Estimate**
Assumptions for cost impacts	▪ [Summary description of management measures, additional costs (licensing, monitoring) inc. feature extent to which applied]	▪ [Summary description of management measures, additional costs (licensing, monitoring) inc. feature extent to which applied]	▪ [Summary description of management measures, additional costs (licensing, monitoring) inc. feature extent to which applied]
Description of one-off costs	▪ [Description and unit value, year in which incurred]	▪	▪
Description of recurring costs	▪ [Description and unit value, periodicity of recurrence]	▪	▪
Description of non-quantified costs	▪ [Description]	▪	▪
Quantified Costs on the Activity of Designation of the Site as an MPA			
Total costs (2014–2033)	[Value]		
Average annual costs	[Value]		
Present value of total costs (2014–2033)	[Value]		
Economic Impacts			
Total change in GVA (2014–2033)	[Value]		
Average annual change to GVA	[Value]		
Present value of total change in GVA (2014–2033)	[Value]		
Direct and Indirect reduction in employment	[full time equivalent jobs]		

Total costs = Sum of one-off costs and recurring costs for the site summed over the 20 year period.
Average annual costs = Total costs divided by the total number of years under analysis (i.e. 20).
Present value of total costs = Total costs discounted to their current value, using a discount rate of 3.5%.
Total change in GVA (2014–2033) = The change in direct GVA in the sector for the site summed over the 20 year period.
Average annual change to GVA = Total change in direct GVA in the sector for the site divided by the total number of years under analysis (i.e. 20).
Present value of total change in GVA (2014–2033) = Total change in direct GVA in the sector for the site discounted to current value, using a discount rate of 3.5%.
Direct and Indirect reduction in Employment = The average (mean) reduction in direct employment in the sector plus the indirect reduction in employment on the sector's suppliers.

Human activities that would benefit from designation of the site as an MPA

Table 5. Human Activities that would Benefit from Designation of the Site as an MPA				**[Site Code]**
Activity	**Description**	**Lower Estimate**	**Intermediate Estimate**	**Upper Estimate**
List activities that would benefit from designation, or note 'None'.	Description of activity..	Text summary of benefits	Summarise benefits	Summarise benefits

Human activities that would be unaffected by designation of the site as an MPA

Table 6. Human Activities that are Present but which would be Unaffected by Designation of the Site as an MPA	**[Site Code]**
Activity	**Description**
List activities that are unaffected, or note 'None'	Describe why the activity is unaffected (e.g. does not occur within MPA or buffer, and not expected to occur in future; or overlaps, but feature not sensitive, no management measures or additional costs anticipated under any scenario)

Social and Distributional Analysis of Impacts from Designation of the Site as an MPA

Table 7a. Social Impacts Associated with Quantified and Non-Quantified Economic Costs **[Site Code]**

Sector	Potential Economic Impacts	Economic Costs and GVA, (PV)	Area of Social Impact Affected	Mitigation	Significance of Social Impact

Impacts: xxx – significant negative effect; xx – possible negative effects; x – minimal negative effect, if any; 0 – no noticeable effect expected.
* These estimates assume zero displacement of fishing activity and hence are likely to overestimate the costs.

Table 7b. Distribution of Quantified Economic Costs for Commercial Fisheries and Fish Processors (assuming zero displacement of fishing activity) – Location, Age and Gender **[Site Code]**

Sector/Impact	Location			Age			Gender	
	Region	Ports*	Rural, Urban, Coastal or Island	Children	Working age	Pensionable Age	Male	Female

Impacts: xxx – significant negative effect; xx – possible negative effects; x – minimal negative effect, if any; 0 – no noticeable effect expected.
* Based on value of landings by home port affected under intermediate scenario.

Table 7c. Distribution of Quantified Economic Costs for Commercial Fisheries and Fish Processors (assuming zero displacement of fishing activity) – Fishing Groups, Income Groups and Social Groups **[Site Code]**

Sector/Impact	Fishing Groups		Income Groups			Social groups		
	Vessel category <15m >15m	Gear Types	10% most deprived	Middle 80%	10% most affluent	Crofters	Ethnic minorities	With disability or long-term sick

Impacts: xxx – significant negative effect; xx – possible negative effects; x – minimal negative effect, if any; 0 – no noticeable effect expected.
* Based on costs to gear types/sectors and vessel categories affected under the intermediate scenario.

Potential Contribution of the Site to an Ecologically-Coherent Network

Table 8. Overview of Features Proposed for Designation and how these contribute to an Ecologically Coherent Network of MPAs					**[Site Code]**
Feature Name	**Representation**	**Replication**	**Linkages**	**Geographic Range and Variation**	**Resilience**
		Contributes one of xx replicates within Scottish seas			
References					

Anticipated Benefits to Ecosystem Services

Table 9. Summary of Ecosystem Services Benefits arising from Designation of the Site as an MPA								**[Site Code]**
Services	**Relevance to Site**	**Baseline Level**	**Estimated Impacts of Designation**			**Value Weighting**	**Scale of Benefits**	**Confidence**
			Lower	**Intermediate**	**Upper**			
Fish for human consumption								
Fish for non-human consumption								
Gas and climate regulation								
Natural hazard protection								
Regulation of pollution								
Non-use value of natural environment								
Recreation								
Research and Education								
Total value of changes in ecosystem services								

Appendix B

Assumptions on MPA Feature Extents

Appendix B. Assumptions on MPA Feature Extents

Feature extents for inshore Nature Conservation MPA proposals

MPA proposal	Feature	Available data types and comments	Method on creation of lower extent for IA and management purposes	Method on creation of intermediate extent for IA and management purposes	Method on creation of upper extent for IA and management purposes
East Caithness Cliffs	Black guillemot	▪ ProF database (GeMS point data).	The MPA is only designated for Black guillemot therefore full MPA boundary extent.	The MPA is only designated for Black guillemot therefore full MPA boundary extent.	The MPA is only designated for Black guillemot therefore full MPA boundary extent.
Fetlar to Haroldswick	Kelp and seaweed sublittoral communities on sublittoral mixed sediment. (i.e. not on annex I reef)	▪ ProF (GeMS and 2012 Fetlar survey). ▪ UKSeaMap	Distinct cluster of points, polygon created using points to determine the extent.	Distinct cluster of points, polygon created using points to determine the extent.	Distinct cluster of points, polygon created using points to determine the extent.
	Horse mussel beds	▪ ProF (GeMS and 2012 Fetlar survey).	Distinct cluster of points, polygon created using points to determine the extent.	Distinct cluster of points, polygon created using points to determine the extent.	Distinct cluster of points, polygon created using points to determine the extent.
	Maerl beds	▪ ProF (GeMS and 2012 Fetlar survey).	Distinct cluster of points, polygon created using points to determine the extent.	Distinct cluster of points, polygon created using points to determine the extent.	Distinct cluster of points, polygon created using points to determine the extent.
	Black guillemot	▪ ProF (GeMS point data).	The coastline was buffered to 2km and this area within the MPA boundary created the extent.	The coastline was buffered to 2km and this area within the MPA boundary created the extent.	The coastline was buffered to 2km and this area within the MPA boundary created the extent.
	Tide-swept coarse sands with burrowing bivalves	▪ ProF (GeMS and 2012 Fetlar survey). ▪ UkSeaMap polygon data.	Cluster of points, polygons created using points to determine the extent.	Cluster of points, polygons created using points to determine the extent.	Polygon extent of 'Infralittoral coarse sediment' (A5.12) encompassing polygons created from the intermediate scenario.
	Circalittoral sand and coarse sediment communities	▪ ProF points (GeMS, 2012 Fetlar survey and marine recorder extract). ▪ UkSeaMap polygon data.	Cluster of points, polygons created using points to determine the extent. **.	Polygon extent of UKSeaMap for 'circalittoral sand and coarse sediment' encompassing polygons created from the lower scenario.	Polygon extent of UKSeaMap for 'circalittoral sand and coarse sediment' encompassing polygons created from the intermediate scenario.
	Marine geomorphology of scottish shelf seabed (components to be confirmed)	▪ GeMS - geodiversity layers	Geodiversity feature polygons which fall within the MPA boundary.	Geodiversity feature polygons which fall within the MPA boundary.	Geodiversity feature polygons which fall within the MPA boundary.
Mousa to Boddam	Sandeels	▪ ProF – Marine Scotland Science data sets including polygon data.	Polygons created by Marine Science Scotland of 'Scottish coastal sandeel grounds'.	Polygons created by Marine Science Scotland of 'Scottish coastal sandeel grounds'.	Full MPA boundary extent.

MPA proposal	Feature	Available data types and comments	Method on creation of lower extent for IA and management purposes	Method on creation of intermediate extent for IA and management purposes	Method on creation of upper extent for IA and management purposes
	Marine geomorphology of scottish shelf seabed (components to be confirmed)	▪ GeMS - geodiversity layers.	Geodiversity feature polygons which fall within the MPA boundary.	Geodiversity feature polygons which fall within the MPA boundary.	Geodiversity feature polygons which fall within the MPA boundary.
Noss Head	Horse mussel beds	▪ ProF – GeMS and Noss Head 2011 survey.	Polygon was created using the extent of the feature point data.	Polygon was created using the extent of the feature point data.	The MPA is only proposed for 'Horse mussel beds' therefore full MPA boundary extent.
Papa Westray	Black guillemot	▪ ProF (GeMS point data).	The coastline was buffered to 2km and this area within the MPA boundary determined the extent.	The coastline was buffered to 2km and this area within the MPA boundary determined the extent.	The coastline was buffered to 2km and this area within the MPA boundary determined the extent.
	Sand wave field	▪ GeMS - geodiversity layers.	Geodiversity feature polygons which fall within the MPA boundary.	Geodiversity feature polygons which fall within the MPA boundary.	Geodiversity feature polygons which fall within the MPA boundary.
Wyre and Rousay Sounds	Kelp and seaweed sublittoral communities	▪ ProF – GeMS and 2011 Orkney survey. ▪ UKSeaMap	Cluster of points, polygons were created using points to determine the extent..	The whole MPA site is Infralittoral therefore the full MPA boundary was used to create feature polygon.	The whole MPA site is Infralittoral therefore the full MPA boundary was used to create feature polygon.
	Maerl beds	▪ ProF – GeMS and 2011 Orkney survey. ▪ UKSeaMap.	Cluster of points, polygons were created using points to determine the extent.	Cluster of points, polygons were created using points to determine the extent.	UKSeaMap 'Infralittoral coarse sediment' polygons and the intermediate extent polygons create the feature extent.
	Marine geomorphology of scottish shelf seabed (components to be confirmed)	▪ GeMS – geodiversity layers	Geodiversity feature polygons which fall within the MPA boundary.	Geodiversity feature polygons which fall within the MPA boundary.	Geodiversity feature polygons which fall within the MPA boundary.
Clyde Sea Sill	Black guillemot	▪ ProF (GeMS point data).	The coastline was buffered to 2km and this area within the MPA boundary determined the extent.	The coastline was buffered to 2km and this area within the MPA boundary determined the extent.	The coastline was buffered to 2km and this area within the MPA boundary determined the extent.
	Fronts	▪ GeMS – raster data.	Full MPA boundary extent.	Full MPA boundary extent.	Full MPA boundary extent.
	Circalittoral sand and coarse sediment communities	▪ ProF – 2012 Clyde surveys, point data. ▪ UKSeaMap polygon data.	UKSeaMap polygon extents for 'Circalittoral coarse sediment', 'Deep circalittoral coarse sediment', 'Circalittoral fine sand' and 'deep circalittoral sand'.	UKSeaMap polygon extents for 'Circalittoral coarse sediment', 'Deep circalittoral coarse sediment', 'Circalittoral fine sand' and 'deep circalittoral sand'.	UKSeaMap polygon extents for 'Circalittoral coarse sediment', 'Deep circalittoral coarse sediment', 'Circalittoral fine sand' and 'deep circalittoral sand'.
	Sand banks	▪ GeMS – geodiversity layers	Geodiversity feature polygons which fall within the MPA boundary.	Geodiversity feature polygons which fall within the MPA boundary.	Geodiversity feature polygons which fall within the MPA boundary.

MPA proposal	Feature	Available data types and comments	Method on creation of lower extent for IA and management purposes	Method on creation of intermediate extent for IA and management purposes	Method on creation of upper extent for IA and management purposes
	Sand ribbon fields	▪ GeMS – geodiversity layers	Geodiversity feature polygons which fall within the MPA boundary.	Geodiversity feature polygons which fall within the MPA boundary.	Geodiversity feature polygons which fall within the MPA boundary.
	Sand wave fields	▪ GeMS – geodiversity layers	Geodiversity feature polygons which fall within the MPA boundary.	Geodiversity feature polygons which fall within the MPA boundary.	Geodiversity feature polygons which fall within the MPA boundary.
Loch Creran	Flame shell beds	▪ ProF – GeMS and 2012 survey . ▪ SNH Polygon available	SNH polygon extended slightly to encompass the point data.	SNH polygon extended slightly to encompass the point data.	SNH polygon extended slightly to encompass the point data.
	Quaternary of scotland (components to be confirmed)	▪ GeMS – geodiversity layers	Geodiversity feature polygons which fall within the MPA boundary.	Geodiversity feature polygons which fall within the MPA boundary.	Geodiversity feature polygons which fall within the MPA boundary.
Lochs Duich, Long and Alsh	Burrowed mud	▪ GeMS – point data ▪ UKSeaMap polygon data covers some of the MPA. ▪ UKSeaMap combined EUNIS habitats.	A5.3 polygon extents from 'combinedEUNISHabiat' layer extend to encompass feature point data.	A5.3 polygon extents from 'combinedEUNISHabiat' layer extend to encompass feature point data.	Full MPA boundary extent.
	Flame shell beds	▪ ProF – GeMS point data. ▪ UKSeaMap combined EUNIS habitats. ▪ SNH Polygon.	Extent polygon provided by SNH.	Extent polygon provided by SNH.	Extent polygon provided by SNH.
Loch Sunart	Flame shell beds	▪ ProF – GeMS point data. ▪ SNH polygons.	Extent polygon provided by SNH.	Extent polygon provided by SNH extended to encompass outlying data points.	Extent is 50% of the MPA boundary area incorporating the intermediate extents.
	Northern feather star aggregations on mixed substrata	▪ GeMS – point data. ▪ SNH polygon data.	Extent polygon provided by SNH.	Extent polygon provided by SNH extended to encompass outlying data points.	Extent is 50% of the MPA boundary area incorporating the intermediate extents.
	Serpulid aggregations	▪ ProF – point data ▪ SNH polygon data.	SNH polygon extent	SNH polygon extent	SNH polygon extent
Loch Sunart to the Sound of Jura	Common skate	▪ ProF – point data.	As the feature data is distributed throughout the MPA the full boundary extent is used for the feature.	As the feature data is distributed throughout the MPA the full boundary extent is used for the feature.	As the feature data is distributed throughout the MPA the full boundary extent is used for the feature.
	Glaciated channels/troughs	▪ GeMS – geodiversity layers	Geodiversity feature polygons which fall within the MPA boundary.	Geodiversity feature polygons which fall within the MPA boundary.	Geodiversity feature polygons which fall within the MPA boundary.

MPA proposal	Feature	Available data types and comments	Method on creation of lower extent for IA and management purposes	Method on creation of intermediate extent for IA and management purposes	Method on creation of upper extent for IA and management purposes
Loch Sween	Burrowed mud	▪ ProF – GeMS and 2010 survey data. ▪ Loch Sween 2013 provisional data.	Cluster of points, polygons were created using points to determine the extent.	Cluster of points, polygons were created using points to determine the extent.	The feature extent was created from the MPA boundary extent cut off at the loch entrance.
	Maerl beds	▪ ProF – GeMS and 1999 survey data. ▪ UKSeaMap combined EUNIS habitats. ▪ SNH Maerl bed polygons from Loch Sween survey.	SNH feature polygon extents and polygons created from the feature point data.	SNH feature polygon extents and polygons created from the feature point data.	Polygon extent of 'A5.5' from UKSeaMap encompassing the intermediate scenario polygons.
	Native oysters	▪ ProF – GeMS point data.	Cluster of points, polygons were created using points to determine the extent.	Cluster of points, polygons were created using points to determine the extent.	Cluster of points, polygons were created using points to determine the extent.
Monach Isles	Black guillemot	▪ ProF - GeMS point data.	The Monach Islands coastline was buffered to 2km and this area within the MPA boundary determined the extent.	The Monach Islands coastline was buffered to 2km and this area within the MPA boundary determined the extent.	The Monach Islands coastline was buffered to 2km and this area within the MPA boundary determined the extent.
	Landscape of areal glacial scour	▪ GeMS – geodiversity layers	Geodiversity feature polygons which fall within the MPA boundary.	Geodiversity feature polygons which fall within the MPA boundary.	Geodiversity feature polygons which fall within the MPA boundary.
	Marine geomorphology of scottish shelf seabed (components to be confirmed)	▪ GeMS – geodiversity layers	Geodiversity feature polygons which fall within the MPA boundary.	Geodiversity feature polygons which fall within the MPA boundary.	Geodiversity feature polygons which fall within the MPA boundary.
North-west sea lochs and Summer Isles	Burrowed mud	▪ ProF – point data. ▪ UKSeaMap	UKSeaMap mud habitat polygons extended to encompass the feature point data. This extent is 50% of the MPA area.	Full MPA boundary extent was used for the feature extent.	Full MPA boundary extent was used for the feature extent.
	Flame shell beds	▪ GeMS – point data ▪ UKSeaMap ▪ SNH Polygon	SNH polygon extent was used.	SNH polygon extent extended to encompass the feature point data.	SNH polygon extent extended to encompass the feature point data.
	Sublittoral kelp and seaweed communities on sediment	▪ GeMS – point data ▪ UKSeaMap	The feature point data was used to determine the extent.	The extent encompasses Infralittoral polygons from UKSeaMap and the lower scenario polygons.	The extent encompasses Infralittoral polygons from UKSeaMap and the lower scenario polygons.

MPA proposal	Feature	Available data types and comments	Method on creation of lower extent for IA and management purposes	Method on creation of intermediate extent for IA and management purposes	Method on creation of upper extent for IA and management purposes
	Maerl beds	▪ GeMS – point and polygon data. ▪ UKSeaMap ▪ SNH polygon data	SNH polygon extent	SNH polygon extent	The extent created was using UKSeaMap infralittoral sediments polygons and the intermediate scenario extents.
	Maerl or coarse shell gravel with burrowing sea cucumbers	▪ GeMS – point data ▪ UKSeaMap ▪ SNH polygon data	SNH polygon extent	SNH polygon extent	The extent created was using UKSeaMap infralittoral sediments polygons and the intermediate scenario extents.
	Native oysters	▪ GeMS – point data ▪ UKSeaMap ▪ SNH polygon data	SNH polygon extent	SNH polygon extent	SNH polygon extent
	Northern feather star aggregations on mixed substrata	▪ GeMS – point data ▪ SNH polygon data	SNH polygon extent	SNH polygon extent	SNH polygon extent extended to encompass the feature point data.
	Circalittoral muddy sand communities	▪ ProF – Marine recorder point data. ▪ UKSeaMap (predicted and combined habitats layers).	UKSeaMap polygons for “Circalittoral fine sand or circalittoral muddy sand” extended to include the feature point data.	UKSeaMap combined habitats polygons for A5.2 and A5.3 incorporating the lower extent polygons.	UKSeaMap combined habitats polygons for A5.2 and A5.3 incorporating the lower extent polygons.
	Glaciated channels/troughs	▪ GeMS – geodiversity layers	Geodiversity feature polygons which fall within the MPA boundary.	Geodiversity feature polygons which fall within the MPA boundary.	Geodiversity feature polygons which fall within the MPA boundary.
	Megascale glacial lineations	▪ GeMS – geodiversity layers	Geodiversity feature polygons which fall within the MPA boundary.	Geodiversity feature polygons which fall within the MPA boundary.	Geodiversity feature polygons which fall within the MPA boundary.
	Moraines	▪ GeMS – geodiversity layers	Geodiversity feature polygons which fall within the MPA boundary.	Geodiversity feature polygons which fall within the MPA boundary.	Geodiversity feature polygons which fall within the MPA boundary.
	Slide scars	▪ GeMS – geodiversity layers	Geodiversity feature polygons which fall within the MPA boundary.	Geodiversity feature polygons which fall within the MPA boundary.	Geodiversity feature polygons which fall within the MPA boundary.
	Pockmarks	▪ GeMS – geodiversity layers	Geodiversity feature polygons which fall within the MPA boundary.	Geodiversity feature polygons which fall within the MPA boundary.	Geodiversity feature polygons which fall within the MPA boundary.
	Banks of unknown substrate	▪ GeMS – geodiversity layers	Geodiversity feature polygons which fall within the MPA boundary.	Geodiversity feature polygons which fall within the MPA boundary.	Geodiversity feature polygons which fall within the MPA boundary.

MPA proposal	Feature	Available data types and comments	Method on creation of lower extent for IA and management purposes	Method on creation of intermediate extent for IA and management purposes	Method on creation of upper extent for IA and management purposes
Small Isles	Burrowed mud	▪ ProF – point data. ▪ UKSeaMap	UKSeaMap predicted A5.3 polygons were used for the feature extents.	UKSeaMap predicted A5.3 polygons extended to include feature data points was used to create the feature extent.	UKSeaMap predicted A5.3 polygons extended to include feature data points was used to create the feature extent.
	Horse mussel beds	▪ ProF – point data. ▪ UKSeaMap ▪ SNH polygon	SNH polygon extents.	SNH polygon extents.	SNH polygon extents extended to include feature point data.
	Northern sea fan and sponge communities	▪ ProF – point data. ▪ UKSeaMap ▪ SNH Polygon	SNH polygon extents.	SNH polygon extents.	Extent of UKSeaMap 'circalittoral rock' polygons.
	Fan mussel aggregations	▪ ProF – point data. ▪ SNH Polygon	SNH polygon extents.	SNH polygon extents.	SNH polygon extents extended to include feature point data.
	Northern feather star aggregations on mixed substrata	▪ ProF – point data. ▪ SNH to send polygon	SNH polygon extents.	SNH polygon extents.	SNH polygon extents extended to include feature point data.
	Black guillemot	▪ ProF (GeMS point data).	The coastline was buffered to 2km and this area within the MPA boundary determined the extent.	The coastline was buffered to 2km and this area within the MPA boundary determined the extent.	The coastline was buffered to 2km and this area within the MPA boundary determined the extent.
	Shelf deeps	▪ GeMS – Large Scale features polygons.	Extent of large scale feature polygon revised by SNH in March 2013.	Extent of large scale feature polygon revised by SNH in March 2013.	Extent of large scale feature polygon revised by SNH in March 2013..
	White cluster anemone *Not an MPA feature.	▪ GeMS – point data ▪ UKSeaMap ▪ Only of interest within Northern sea fan communities.	Extent is SNH polygons for Northern sea fan and sponge communities where feature points are within the polygons.	Extent is SNH polygons for Northern sea fan and sponge communities where feature points are within the polygons.	Extent is SNH polygons for Northern sea fan and sponge communities where feature points are within the polygons.
	Circalittoral sand and mud communities	▪ ProF – point data ▪ UKSeaMap	UKSeaMap circalittoral sand and mud polygons used to create extent.	UKSeaMap circalittoral sand and mud polygons used to create extent extended to encompass the feature point data.	UKSeaMap circalittoral sand and mud polygons used to create extent extended to encompass the feature point data.
	Glaciated channels/troughs	▪ GeMS – geodiversity layers	Geodiversity feature polygons which fall within the MPA boundary.	Geodiversity feature polygons which fall within the MPA boundary.	Geodiversity feature polygons which fall within the MPA boundary.
	Glacial lineations	▪ GeMS – geodiversity layers	Geodiversity feature polygons which fall within the MPA boundary.	Geodiversity feature polygons which fall within the MPA boundary.	Geodiversity feature polygons which fall within the MPA boundary.

MPA proposal	Feature	Available data types and comments	Method on creation of lower extent for IA and management purposes	Method on creation of intermediate extent for IA and management purposes	Method on creation of upper extent for IA and management purposes
South Arran	Burrowed mud	▪ ProF – point data. ▪ UKSeaMap ▪ SNH polygons	SNH polygon extents.	SNH polygon extents.	UKSeaMap extent of mud habitats extended to include the intermediate scenario polygons.
	Kelp and seaweed communities on sediment	▪ ProF – point data. ▪ UKSeaMap ▪ SNH Polygons	SNH polygon extents.	SNH polygon extents.	Extent of UKSeaMap infralittoral habitats extended to encompass the intermediate scenario polygons.
	Maerl beds	▪ ProF – point data ▪ UKSeaMap ▪ SNH Polygons	SNH polygon extents.	SNH polygon extents extended to encompass the feature point data.	UKSeaMap polygons for Infralittoral coarse or mixed sediments extended to include intermediate scenario extents.
	Maerl or coarse shell gravel with burrowing sea cucumbers	▪ ProF – point data ▪ UKSeaMap ▪ SNH Polygons	SNH polygon extents.	SNH polygon extents extended to encompass the feature point data.	UKSeaMap polygons for Infralittoral coarse or mixed sediments extended to include intermediate scenario extents.
	Seagrass beds	▪ ProF – point data and small polygons ▪ UKSeaMap ▪ SNH Polygons	SNH polygon extents.	SNH polygon extents extended to encompass the feature point data.	Use UKSeaMap polygons for Infralittoral sand, mud, mixed or coarse sediments extended to include the intermediate extent scenarios.
	Tide-swept coarse sands with burrowing bivalves	▪ ProF – point data ▪ UKSeaMap ▪ SNH Polygons	SNH polygon extents.	SNH polygon extents extended to encompass the feature point data.	Use UKSeaMap polygons for Infralittoral sand, mud, mixed or coarse sediments extended to include the intermediate extent scenarios.
	Ocean quahog	▪ ProF – point data. ▪ UKSeaMap	UKSeaMap polygon extents for 'circalittoral sand and mud' and 'deep circalittoral sand and mud' sediments.	UKSeaMap polygon extents for 'circalittoral sand and mud' and 'deep circalittoral sand and mud' sediments.	UKSeaMap polygon extents for 'circalittoral sand and mud' and 'deep circalittoral sand and mud' sediments.
	Herring spawning grounds	▪ ProF – 1991 egg presence polygon data created by SNH from papers.	SNH polygon extents.	SNH polygon extents.	SNH polygon extents.
Upper Loch Fyne and Loch Goil	Burrowed mud	▪ ProF – point data. ▪ UKSeaMap combined EUNIS habitats.	UKSeaMap combined EUNIS habitats polygon extents for 'infralittoral and circalittoral mud'.	The lower scenario extent extended to encompass outlying data points.	Full MPA boundary extent.
	Flame shell beds	▪ ProF – point data. ▪ SNH polygon data	SNH polygon extents.	SNH polygon extents.	SNH polygon extents.

MPA proposal	Feature	Available data types and comments	Method on creation of lower extent for IA and management purposes	Method on creation of intermediate extent for IA and management purposes	Method on creation of upper extent for IA and management purposes
	Horse mussel beds	▪ ProF – point data.	Cluster of points, polygons were created using points to determine the extent.	Cluster of points, polygons were created using points to determine the extent.	Cluster of points, polygons were created using points to determine the extent.
	Low or variable salinity habitats	▪ ProF – point data.	MPA boundary for Loch Goil area and Dubh Loch.	MPA boundary for Loch Goil area and Dubh Loch.	MPA boundary for Loch Goil area and Dubh Loch.
	Sublittoral mud and mixed sediment communities	▪ ProF – point data. ▪ UKSeaMap combined EUNIS habitats	UKSeaMap combined EUNIS habitats polygon extents for ‘infralittoral and circalittoral muds and mixed sediments’.	The lower scenario extent extended to encompass outlying data points.	Full MPA boundary extent.
	Ocean quahog	▪ ProF – point data ▪ UKSeaMap combined EUNIS habitats.	UKSeaMap combined EUNIS habitats polygons for ‘infralittoral and circalittoral mud and sand’.	Full MPA boundary extent.	Full MPA boundary extent.

Feature extents for offshore Nature Conservation MPA proposals:

MPA proposal	Feature	Available data types and comments	Method on creation of lower extent for IA and management purposes	Method on creation of intermediate extent for IA and management purposes	Method on creation of upper extent for IA and management purposes
Central Fladen	Burrowed mud (seapens and burrowing megafauna		Full MPA boundary extent.	Full MPA boundary extent.	Full MPA boundary extent.
	Burrowed mud (tall seapen)	▪ JNCC Polygon	JNCC polygon used for feature extent.	JNCC polygon used for feature extent.	MPA boundary extent for Central Fladen core.
	Tunnel Valley	▪ GeMS - geodiversity layers	Geodiversity feature polygons which fall within the MPA boundary.	Geodiversity feature polygons which fall within the MPA boundary.	Geodiversity feature polygons which fall within the MPA boundary.
East of Gannet and Montrose Fields	Ocean quahog aggregations (including offshore subtidal sands and gravels)		Full MPA boundary extent.	Full MPA boundary extent.	Full MPA boundary extent.
	Offshore deep sea muds	▪ UKSeaMap	UKSeaMap extent of ‘deep sea muds’.	UKSeaMap extent of ‘deep sea muds’.	UKSeaMap extent of ‘deep sea muds’.
Faroe-Shetland Sponge Belt	Ocean quahog aggregations	▪ JNCC Polygon	JNCC polygon used for feature extent, MPA boundary down to 400m.	JNCC polygon used for feature extent, MPA boundary down to 400m.	JNCC polygon used for feature extent, MPA boundary down to 400m.
	Deep sea sponge aggregations	▪ JNCC Polygon	Cluster of points, polygons created using points to determine the extent.	Cluster of points, polygons created using points to determine the extent.	JNCC polygon used for feature extent (400-600m depth band within MPA boundary).
	Offshore subtidal sands and gravel		Full MPA boundary extent.	Full MPA boundary extent.	Full MPA boundary extent.
	Continental slope	▪ GeMS – large scale feature extent	Extent of large scale feature polygon.	Extent of large scale feature polygon.	Extent of large scale feature polygon.
	Iceberg plough mark fields	▪ GeMS - geodiversity layers	Geodiversity feature polygons which fall within the MPA boundary.	Geodiversity feature polygons which fall within the MPA boundary.	Geodiversity feature polygons which fall within the MPA boundary.
	Continental slope channels	▪ GeMS - geodiversity layers	Geodiversity feature polygons which fall within the MPA boundary.	Geodiversity feature polygons which fall within the MPA boundary.	Geodiversity feature polygons which fall within the MPA boundary.
	Slide deposits	▪ GeMS - geodiversity layers	Geodiversity feature polygons which fall within the MPA boundary.	Geodiversity feature polygons which fall within the MPA boundary.	Geodiversity feature polygons which fall within the MPA boundary.
	Sediment wave fields and sand wave fields	▪ GeMS - geodiversity layers	Geodiversity feature polygons which fall within the MPA boundary.	Geodiversity feature polygons which fall within the MPA boundary.	Geodiversity feature polygons which fall within the MPA boundary.

MPA proposal	Feature	Available data types and comments	Method on creation of lower extent for IA and management purposes	Method on creation of intermediate extent for IA and management purposes	Method on creation of upper extent for IA and management purposes
Firth of Forth Banks Complex	Ocean quahog aggregations		Full MPA boundary extent.	Full MPA boundary extent.	Full MPA boundary extent.
	Offshore subtidal sands and gravel		Full MPA boundary extent.	Full MPA boundary extent.	Full MPA boundary extent.
	Shelf banks and mounds	▪ GeMS - geodiversity layers	Geodiversity feature polygons which fall within the MPA boundary.	Geodiversity feature polygons which fall within the MPA boundary.	Geodiversity feature polygons which fall within the MPA boundary.
	Moraines	▪ GeMS - geodiversity layers	Geodiversity feature polygons which fall within the MPA boundary.	Geodiversity feature polygons which fall within the MPA boundary.	Geodiversity feature polygons which fall within the MPA boundary.
Geikie Slide and Hebridean Slope	Burrowed mud	▪ JNCC feature polygon ▪ JNCC fishing corridors	JNCC feature polygon with the fishing corridor areas removed.	JNCC feature polygon with the fishing corridor areas removed.	Full extent of the JNCC feature polygon.
	Offshore deep sea muds (slope)	▪ JNCC feature polygon ▪ JNCC fishing corridors	JNCC feature polygon with the fishing corridor areas removed.	JNCC feature polygon with the fishing corridor areas removed.	Full extent of the JNCC feature polygon.
	Offshore subtidal sands and gravels (shelf and slope)	▪ JNCC feature polygon ▪ JNCC fishing corridors	JNCC feature polygon with the fishing corridor areas removed.	JNCC feature polygon with the fishing corridor areas removed.	Full extent of the JNCC feature polygon.
	Continental slope	▪ GeMS – large scale feature extent.	Extent of large scale feature polygon.	Extent of large scale feature polygon.	Extent of large scale feature polygon.
	Slide deposits	▪ GeMS - geodiversity layers.	Geodiversity feature polygons which fall within the MPA boundary.	Geodiversity feature polygons which fall within the MPA boundary.	Geodiversity feature polygons which fall within the MPA boundary.
Hatton-Rockall Basin	Deep sea sponge aggregations	▪ JNCC feature polygon	JNCC polygon used for feature extent.	JNCC polygon used for feature extent.	Full MPA boundary extent.
	Offshore deep sea muds		Full MPA boundary extent.	Full MPA boundary extent.	Full MPA boundary extent.
	Sediment drifts	▪ GeMS - geodiversity layers	Geodiversity feature polygons which fall within the MPA boundary.	Geodiversity feature polygons which fall within the MPA boundary.	Geodiversity feature polygons which fall within the MPA boundary.
	Polygonal fault systems	▪ GeMS - geodiversity layers	Geodiversity feature polygons which fall within the MPA boundary.	Geodiversity feature polygons which fall within the MPA boundary.	Geodiversity feature polygons which fall within the MPA boundary.
NE Faroe Shetland Channel	Deep sea sponge aggregations	▪ GeMS – point data ▪ JNCC feature polygon	Cluster of points, polygons were created using points to determine the extent.	Cluster of points, polygons were created using points to determine the extent.	JNCC polygon used for feature extent (400-600m depth band within MPA boundary).
	Offshore deep sea muds	▪ UKSeaMap	UKSeaMap extent of 'deep sea muds'.	UKSeaMap extent of 'deep sea muds'.	UKSeaMap extent of 'deep sea muds'.
	Offshore subtidal sands and gravels	▪ UKSeaMap	UKSeaMap extent of 'Offshore subtidal sands and gravels'.	UKSeaMap extent of 'Offshore subtidal sands and gravels'.	UKSeaMap extent of 'Offshore subtidal sands and gravels'.
	Continetal slope	▪ GeMS – large scale feature extent.	Extent of large scale feature polygon.	Extent of large scale feature polygon.	Extent of large scale feature polygon.

MPA proposal	Feature	Available data types and comments	Method on creation of lower extent for IA and management purposes	Method on creation of intermediate extent for IA and management purposes	Method on creation of upper extent for IA and management purposes
	Prograding wedge	▪ GeMS - geodiversity layers	Geodiversity feature polygons which fall within the MPA boundary.	Geodiversity feature polygons which fall within the MPA boundary.	Geodiversity feature polygons which fall within the MPA boundary.
	Slide deposits	▪ GeMS - geodiversity layers	Geodiversity feature polygons which fall within the MPA boundary.	Geodiversity feature polygons which fall within the MPA boundary.	Geodiversity feature polygons which fall within the MPA boundary.
	Contourite sand/silt	▪ GeMS - geodiversity layers	Geodiversity feature polygons which fall within the MPA boundary.	Geodiversity feature polygons which fall within the MPA boundary.	Geodiversity feature polygons which fall within the MPA boundary.
	Pilot whale diapirs	▪ GeMS - geodiversity layers	Geodiversity feature polygons which fall within the MPA boundary.	Geodiversity feature polygons which fall within the MPA boundary.	Geodiversity feature polygons which fall within the MPA boundary.
Northwest Orkney	Sandeels		Full MPA boundary extent.	Full MPA boundary extent.	Full MPA boundary extent.
	Sediment wave fields, sand banks and sand wave fields	▪ GeMS - geodiversity layers	Geodiversity feature polygons which fall within the MPA boundary.	Geodiversity feature polygons which fall within the MPA boundary.	Geodiversity feature polygons which fall within the MPA boundary.
Norwegian Boundary Sediment Plain	Ocean quahog aggregations (including offshore subtidal sands and gravels)		Full MPA boundary extent.	Full MPA boundary extent.	Full MPA boundary extent.
Rosemary Bank Seamount	Seamount communities	▪ JNCC feature data ▪ GeMS – point data	Cluster of points, polygons were created using points to determine the extent.	JNCC polygon used for feature extent, area is smaller extent than the upper scenario.	JNCC polygon used for feature extent.
	Deep sea sponge aggregations	▪ JNCC feature data ▪ GeMS – point data	Cluster of points, polygons were created using points to determine the extent.	JNCC polygon used for feature extent, area is smaller extent than the upper scenario.	JNCC polygon used for feature extent.
	Iceberg ploughmark fields	▪ GeMS - geodiversity layers	Geodiversity feature polygons which fall within the MPA boundary.	Geodiversity feature polygons which fall within the MPA boundary.	Geodiversity feature polygons which fall within the MPA boundary.
	Slide scars	▪ GeMS - geodiversity layers	Geodiversity feature polygons which fall within the MPA boundary.	Geodiversity feature polygons which fall within the MPA boundary.	Geodiversity feature polygons which fall within the MPA boundary.
	Scour moat	▪ GeMS - geodiversity layers	Geodiversity feature polygons which fall within the MPA boundary.	Geodiversity feature polygons which fall within the MPA boundary.	Geodiversity feature polygons which fall within the MPA boundary.
	Sediment drifts	▪ GeMS - geodiversity layers	Geodiversity feature polygons which fall within the MPA boundary.	Geodiversity feature polygons which fall within the MPA boundary.	Geodiversity feature polygons which fall within the MPA boundary.

MPA proposal	Feature	Available data types and comments	Method on creation of lower extent for IA and management purposes	Method on creation of intermediate extent for IA and management purposes	Method on creation of upper extent for IA and management purposes
	Sediment wave field	▪ GeMS - geodiversity layers	Geodiversity feature polygons which fall within the MPA boundary.	Geodiversity feature polygons which fall within the MPA boundary.	Geodiversity feature polygons which fall within the MPA boundary.
	Rosemary bank seamount	▪ GeMS - geodiversity layers	Geodiversity feature polygons which fall within the MPA boundary.	Geodiversity feature polygons which fall within the MPA boundary.	Geodiversity feature polygons which fall within the MPA boundary.
South-East Fladen	Burrowed mud		Full MPA boundary extent.	Full MPA boundary extent.	Full MPA boundary extent.
	Pockmarks	▪ GeMS - geodiversity layers	Geodiversity feature polygons which fall within the MPA boundary.	Geodiversity feature polygons which fall within the MPA boundary.	Geodiversity feature polygons which fall within the MPA boundary.
South-West Sula Sgeir & Hebridean Slope	Burrowed mud	▪ JNCC feature polygon. ▪ JNCC fishing corridors.	JNCC feature polygon with the fishing corridor areas removed.	JNCC feature polygon with the fishing corridor areas removed.	Full extent of the JNCC feature polygon.
	Offshore deep sea muds (slope)	▪ JNCC feature polygon. ▪ JNCC fishing corridors.	JNCC feature polygon with the fishing corridor areas removed.	JNCC feature polygon with the fishing corridor areas removed.	Full extent of the JNCC feature polygon.
	Offshore subtidal sands and gravels (shelf and slope)	▪ JNCC feature polygon. ▪ JNCC fishing corridors.	JNCC feature polygon with the fishing corridor areas removed.	JNCC feature polygon with the fishing corridor areas removed.	Full extent of the JNCC feature polygon.
	Continental slope	▪ GeMS – large scale feature extent.	Extent of large scale feature polygon.	Extent of large scale feature polygon.	Extent of large scale feature polygon.
	Iceberg ploughmarks	▪ GeMS - geodiversity layers	Geodiversity feature polygons which fall within the MPA boundary.	Geodiversity feature polygons which fall within the MPA boundary.	Geodiversity feature polygons which fall within the MPA boundary.
	Prograding wedge	▪ GeMS - geodiversity layers	Geodiversity feature polygons which fall within the MPA boundary.	Geodiversity feature polygons which fall within the MPA boundary.	Geodiversity feature polygons which fall within the MPA boundary.
	Slide deposits	▪ GeMS - geodiversity layers	Geodiversity feature polygons which fall within the MPA boundary.	Geodiversity feature polygons which fall within the MPA boundary.	Geodiversity feature polygons which fall within the MPA boundary.
The Barra Fan and Hebrides Terrace Seamount	Coral gardens	▪ JNCC feature polygon	JNCC polygon used for feature extent, area is smaller extent than the upper scenario.	JNCC polygon used for feature extent, area is smaller extent than the upper scenario.	JNCC polygon used for feature extent.
	Burrowed mud	▪ JNCC feature polygon. ▪ JNCC fishing corridors.	JNCC feature polygon with the fishing corridor areas removed.	JNCC feature polygon with the fishing corridor areas removed.	Full extent of the JNCC feature polygon.
	Offshore deep sea muds (slope)	▪ JNCC feature polygon. ▪ JNCC fishing corridors.	JNCC feature polygon with the fishing corridor areas removed.	JNCC feature polygon with the fishing corridor areas removed.	Full extent of the JNCC feature polygon.
	Offshore subtidal sands and gravels (Shelf and Slope)	▪ JNCC feature polygon. ▪ JNCC fishing corridors.	JNCC feature polygon with the fishing corridor areas removed.	JNCC feature polygon with the fishing corridor areas removed.	Full extent of the JNCC feature polygon.

MPA proposal	Feature	Available data types and comments	Method on creation of lower extent for IA and management purposes	Method on creation of intermediate extent for IA and management purposes	Method on creation of upper extent for IA and management purposes
	Orange roughy	▪ GeMS – geodiversity layers	The Hebrides terrace seamount geodiversity feature polygon was used to determine extent.	The Hebrides terrace seamount geodiversity feature polygon was used to determine extent.	The Hebrides terrace seamount geodiversity feature polygon was used to determine extent.
	Seamount communities	▪ JNCC feature polygons	JNCC polygon used for feature extent, area is smaller extent than the upper scenario.	JNCC polygon used for feature extent, area is smaller extent than the upper scenario.	JNCC polygon used for feature extent.
	Seamounts and continental slope	▪ GeMS - geodiversity layers	Geodiversity feature polygons which fall within the MPA boundary.	Geodiversity feature polygons which fall within the MPA boundary.	Geodiversity feature polygons which fall within the MPA boundary.
	Iceberg ploughmarks	▪ GeMS - geodiversity layers	Geodiversity feature polygons which fall within the MPA boundary.	Geodiversity feature polygons which fall within the MPA boundary.	Geodiversity feature polygons which fall within the MPA boundary.
	Prograding wedge	▪ GeMS - geodiversity layers	Geodiversity feature polygons which fall within the MPA boundary.	Geodiversity feature polygons which fall within the MPA boundary.	Geodiversity feature polygons which fall within the MPA boundary.
	Continental slope turbidite canyons	▪ GeMS - geodiversity layers	Geodiversity feature polygons which fall within the MPA boundary.	Geodiversity feature polygons which fall within the MPA boundary.	Geodiversity feature polygons which fall within the MPA boundary.
	Slide deposits	▪ GeMS - geodiversity layers	Geodiversity feature polygons which fall within the MPA boundary.	Geodiversity feature polygons which fall within the MPA boundary.	Geodiversity feature polygons which fall within the MPA boundary.
	Continental slope	▪ GeMS – large scale feature extent.	Extent of large scale feature polygon.	Extent of large scale feature polygon.	Extent of large scale feature polygon.
	Hebrides terrace seamount	▪ GeMS - geodiversity layers	Geodiversity feature polygons which fall within the MPA boundary.	Geodiversity feature polygons which fall within the MPA boundary.	Geodiversity feature polygons which fall within the MPA boundary.
Turbot Bank	Offshore subtidal sands and gravels		Full MPA boundary extent.	Full MPA boundary extent.	Full MPA boundary extent.
	Sandeels		Full MPA boundary extent.	Full MPA boundary extent.	Full MPA boundary extent.
	Shelf banks and mounds	▪ GeMS - geodiversity layers	Geodiversity feature polygons which fall within the MPA boundary.	Geodiversity feature polygons which fall within the MPA boundary.	Geodiversity feature polygons which fall within the MPA boundary.
West Shetland Shelf	Offshore subtidal sands and gravels	▪ UKSeaMap	Full MPA boundary extent.	Full MPA boundary extent.	Full MPA boundary extent.
Western Fladen	Burrowed mud		Full MPA boundary extent.	Full MPA boundary extent.	Full MPA boundary extent.
	Tunnel valley	▪ GeMS - geodiversity layers	Geodiversity feature polygons which fall within the MPA boundary.	Geodiversity feature polygons which fall within the MPA boundary.	Geodiversity feature polygons which fall within the MPA boundary.

Appendix C

Sector Descriptions and Scenarios

The Scottish Marine Protected Area Project – Developing the Evidence Base for Impact Assessments and the Sustainability Appraisal

Appendix C. Sector Descriptions and Scenarios

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C.1 Marine Aggregates

C.1.1 Introduction

This appendix provides an overview of existing and potential future activity for the marine aggregates sector in Scotland and outlines the methods used to assess the impacts of potential MPAs on this sector.

C.1.2 Sector Definition

Marine aggregate extraction relates to the removal of (mainly) sand and gravel from the seabed mainly used in the production of concrete for the construction industry.

C.1.3 Overview of Existing Activity

There are currently 2 licensed marine aggregate extraction sites, one located in the Firth of Forth off Edinburgh and one in the Tay Estuary (Figure C1). There is currently no production at either site.

C.1.4 Assumptions on Future Activity

In terms of construction aggregates, there is very little potential for marine aggregates in Scotland because of the alternative sources of aggregate (land-won supplies) that are available to service the existing markets. There is currently little demand for marine aggregate in Scotland and it is considered that significant future expansion to support traditional markets (general construction aggregate) is unlikely.

It is possible that marine supplies could become more important in the future for:

i. beach nourishment/coast defence requirements
ii. major contract fill/reclamation requirements
iii. gravity base foundations (both construction facilities, concreting aggregate and ballast)

However, such future requirements are very uncertain, both in terms of quantity, location and time scales. There could be a scenario where new resources had to be licensed locally in support of specific projects, or the resources may be able to be shipped in from existing production licence areas in English waters.

The Crown Estate has commissioned British Geological Survey to undertake a resource mapping exercise to define the potential locations of marine aggregate resources around the UK shelf, including Scottish seas. This will document deposits of marine sand (principally) that could be suitable for a range of potential end uses if the market demand arose.

C.1.5 Potential Interactions with MPA Features

The two existing licensed sites are more than 60km from the closest potential NC MPA. There are therefore no significant pathways by which potential NC MPA features might be impacted by marine aggregate extraction within these licensed sites.

C.1.6 Assumptions on Management Measures for Scenarios

Given the large distance between existing licensed sites and the closest potential NC MPAs, and uncertain location of any future extraction sites, there are no potential impact pathways and it has been assumed that no management measures will be required and therefore that no cost impacts will arise. Owing to the lack of current demand for marine aggregates in Scotland and the limited potential for future demand from traditional markets, it has been assumed that there will be no significant future marine aggregate extraction within Scottish waters during the assessment period (2014 to 2034). It has therefore been assumed that that no cost impacts will arise in relation to future marine aggregate extraction for traditional markets.

The lack of clarity on where potential future demands from new markets, e.g. coastal development, coastal protection and renewable energy development, may arise geographically or when, mean that cost impacts arising from areas of potential future resource interest are unable to be considered.

C.1.7 Assessment Methods

Not required.

C.1.8 Limitations

The number, location and timing of marine aggregate licence applications is uncertain.

C.2 Aquaculture - Finfish

C.2.1 Introduction

This appendix provides an overview of existing and potential future activity for the finfish aquaculture subsector in Scotland and outlines the methods used to assess the impacts of potential MPAs on this subsector.

C.2.2 Sector Definition

Finfish aquaculture relates to the production of marine finfish species within aquaculture installations for both food and non-food purposes.

C.2.3 Overview of Existing Activity

A list of sources to inform the writing of this baseline is provided in Table C.2.1.

Table C2.1 Finfish information sources

Scale	Information Available	Date	Source
Scotland	Production and turnover 2005-2009	2005-2009	Baxter *et al* (2011)
Scotland	Scottish fish farm production survey	2009	Marine Scotland (2009)
UK	Future trends	2006+	Wilding *et al* (2006)
Regional	Economic value and trends	2010	Scottish Salmon Producers Organisation (2010)
Regional	Pending finfish aquaculture sites	2013	http://publicaccess.argyll-bute.gov.uk/
Scotland	Finfish aquaculture locations	2013	Aquadat database Marine Scotland 2013

C.2.3.1 Location and intensity of activity

Marine finfish aquaculture sites in Scotland are currently situated in coastal areas within a few miles of the shore with no sites found further offshore. Most sites are usually situated in sheltered, semi-enclosed sea lochs and voes (sea-inlets). Finfish production sites are mostly distributed all along the West coast including the Hebrides and Northern Isles, see Figure C2.

In 2011, 254 of 535 approved salmon farms, and 33 rainbow trout farms in Scotland were active. Finfish aquaculture in Scotland is dominated by the farming of Atlantic salmon, although the production of rainbow trout significantly contributes to the industry. Other species of interest include brown trout, Arctic charr, cod and halibut, although production of these species has generally decreased in recent years (Marine Scotland, 2009). Behind Norway and Chile, Scotland is the world's third largest producer of Atlantic salmon, producing over 158,000 tonnes in 2011. In the same year, 4,619 tonnes of rainbow trout were produced. Scottish exports of farmed salmon have shown an increasing trend in recent years, rising to 60,599 tonnes in

2010 (Jan-Oct) (Marine Scotland, 2012). There are three halibut producers, one onshore, one cages farm at loch Melfort and one tank farm on Gigha.

C.2.3.2 Economic value and employment

Aquaculture in Scotland helps encourage sustainable economic growth in many coastal and rural communities in the Islands and Highlands.

In 2009, finfish aquaculture had a total turnover greater than £400m p.a. (at farm gate prices) with the principal contributions comprising Atlantic salmon (£412m), rainbow and brown trout (£6m) and halibut (£0.5m). Farmed salmon exports are valued at £285m annually, and exports from aquaculture make up Scotland's largest food export (Baxter *et al*, 2011).

Marine Scotland (2011) give total employment figures within farmed finfish production during 2011of 1,174. These figures refer specifically to fish production and do not include the associated processing and marketing activities. The total number of staff directly employed by SSPO (Scottish Salmon Producers' Organisation) member companies in 2011 is reported as 2,124, an increase of 13% compared to the previous year. These staffing figures are inclusive of farming, processing, sales and marketing, logistics, finance and environmental management (SSPO, 2012).

Gross pay by SSPO member companies in 2011 amounted to £53.7 million, 92% of which was paid to employees in remote, rural communities, and a total of £47.6 million of capital was invested in Highland and Island communities. Between 2006-2011 capital investment by SSPO member companies amounted to £205 million.

C.2.3.3 Future trends

Aquaculture continues to be the world's fastest-growing animal-food-producing sector. In the period 1970-2008, the production of food fish from aquaculture increased at an average annual rate of 8.3 percent and is set to overtake capture fisheries as a source of food fish (FAO, 2010; Commission of the European Communities, 2009). The global demand for seafood, coupled with the need to replace land-based sources suffering from climate change and the current health of the world's wild fish stocks, has seen an increased demand for Scottish production (Baxter *et al*. 2011).

Despite an overall decrease in rainbow trout production from 2008-2011, the immediate prospects for Scottish finfish aquaculture overall are good. The Scottish Government (2010) predicted that the opportunity for sustainable growth in the next five years for salmon may equate to an ex farm value of £152 million and a potential of 400 new jobs, partly due to an increased worldwide demand due to the collapse of Chilean salmon stocks. The salmon production industry in Scotland has outlined a plan to increase annual production to 210,000 tonnes by 2020, and in 2011 the SSPO reported that 86% of its companies planned to expand their business in the next five years, with 272 new jobs already created in 2011 (SSPO, 2012). A 2010 agreement to open the Chinese markets to Scottish salmon offers opportunity for further expansion of salmon exports. Scottish Development International have pledged to support Scotland's salmon industry in reaching targets set by the Scottish Government to increase salmon exports by 50% by 2017 (SSPO, 2010). The Scottish Government has stated its support for the ambitions of the aquaculture sector to increase production of farmed fish by 50 per cent by 2020 compared to 2009[26]. This target implies fin fish production in the order of 230,000 tonnes, up from 150,000 tonnes in 2009.

Emerging aquaculture species such as tilapia, barramundi, bass and bream may also increase the size of the UK finfish aquaculture market (Defra, 2008). Cod, haddock and halibut farming (which are currently only farmed on a relatively small scale) are also predicted to grow (Pugh, 2008). However, cod farming is now seen as a less attractive option due to recent increases in North Sea cod catch quotas. 'No Catch', Britain's only supplier of sustainable organic cod, based on the Shetland Isles, went into administration in early 2008. Due to a shortage of available investment there is now no commercial cod production and only three halibut producers in Scotland, despite reports from the British Marine Finfish Association that there is potential to increase halibut production. A number of aquaculture businesses are currently considering plans for the production of wrasse as a sea-lice control within salmon farms.

C.2.4 Assumptions on Future Activity

There is likely to be continued growth in the finfish aquaculture sector in the future with a target of achieving 50% growth by 2020 compared to 2009. However, the location, timing and intensity of such development remain uncertain. It is likely that there will be some development further offshore. Information on current marine fish farm planning applications in or adjacent to MPA proposals was obtained from relevant planning authorities – 2 applications were identified as being within or adjacent to MPA proposals - but it is recognised that this only provides an indication of development in the short-term. SSPO has indicated that around 12 applications for new marine fish farms and 9 applications for extension of existing marine fish farms may be brought forward within MPA proposals over the next five years but the locations of these sites cannot be disclosed for reasons of commercial confidentiality (J. Smith, SSPO, pers. comm.). The information on potential future applications therefore cannot be used to inform estimates of costs for individual MPA proposals, but has been used to inform estimates of potential cost impacts at a national level,

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26 The target, as set out in the Pre Consultation Draft Marine Plan (see here http://www.scotland.gov.uk/Publications/2011/03/21114728/14#a3) are as follows:
By 2020:

- To increase the sustainable production of marine finfish at a rate of 4% per annum to achieve a 50% increase in current production.

assuming that the rate of future development within proposed MPAs identified by SSPO is sufficient to contribute to the achievement of the 2020 target.

From time to time, fish farms may need to apply for new CAR licences for the use of alternative therapeutants. This occurs roughly every 5 to 10 years (H. Macleod, SEPA, pers. comm.). Depending on the formulation of the new therapeutant, this may require minor or more detailed consideration within the CAR assessment process. For the purposes of this assessment, it has been assumed that fish farms will require detailed consideration of a CAR licence application once every 10 years.

C.2.5 Potential Interactions with MPA Features

The principal impacts to potential Nature Conservation MPA features from finfish aquaculture relate to habitat damage as a result of organic enrichment/sediment deposition. The discharge of therapeutants poses a risk to water quality and sensitive fauna in the vicinity of releases. Microbial pathogens may be introduced to the environment, and further contamination of the water column may occur with the application of industrial pesticides to target species. (JNCC & NE, 2011). Finfish aquaculture infrastructure may cause habitat damage (anchors and mooring chains) and structures present low-scale barriers for mobile species, as well as a risk of death or injury by collision. Nutrient enrichment may occur in the vicinity of finfish farms but there is no evidence that this has led to eutrophication. Installations may also provide suitable surfaces for colonization by invasive non-indigenous species (INS) potentially supporting the wider spread of INS.

C.2.6 Assumptions on Cost Impacts for Scenarios

It is assumed that the impact of new marine fish farm activities on MPA features will be managed under the planning system and CAR licensing system. Two scenarios (‘lower’ and ‘upper’) have been developed to capture the possible costs of potential MPAs to the finfish aquaculture sector. These scenarios include potential costs associated with additional assessments required to inform decisions on planning and CAR licence applications and associated survey requirements.

It has been assumed that there will be no review of existing consents or permissions, although where existing fish farms apply for planning permission for extensions or apply for new CAR licences, these applications will be considered against the conservation objectives for features for which MPAs may have been designated.

It has not been possible to identify potential future development at site level – instead, a national assessment has been carried out based on assumptions about the number of future planning applications within or adjacent to proposed MPAs. It has not been possible to estimate the cost impact of potential additional mitigation measures for new planning applications for individual sites, because the location of such applications is not available. The potential requirement for mitigation measures has been described qualitatively at national level.

An intermediate ('best') estimate for each site has been based on SNH current views on management options and judgements made by the study team. The assumptions do not pre-judge any future site-specific licensing decisions. After MPA designation, the management of activities in MPAs will be decided on a site-by-site basis and may differ from the assumptions in this assessment.

Management measures applied under the lower and upper scenarios are detailed below. Specific management measure assumptions for each scenario (including the intermediate scenario) are defined in the MPA Site Reports (Table 4, Appendix E).

Lower Scenario

- Additional costs will be incurred for new site licence applications in assessing potential impacts to MPA features within 1km of proposed licence areas;
- Additional costs will be incurred for CAR licence applications for existing and new installations (therapeutant licences) in assessing potential impacts to MPA features within 1km of proposed licence areas;
- Mitigation measures may be required for non-OSPAR/BAP features ranging from:
  - No mitigation required for existing sites operating within the limits of an existing planning permission;
  - No additional mitigation required for new application/extended sites beyond existing good practice;
  - Restrictions on tonnages for new application/extended sites, enhanced rotation policies; and
  - Refusal of planning permission.

Upper Scenario

- Additional costs will be incurred for new site planning applications in assessing potential impacts to MPA features within 1km of proposed licence areas;
- Additional costs will be incurred for CAR licence applications for existing and new installations in assessing potential impacts to MPA features within 1km of proposed licence areas;
- Additional survey costs will be incurred to inform new planning applications (Baseline visual survey or extended survey) (based on SEPA, 2008);
- Additional survey costs will be incurred to inform CAR licence applications for existing installations where these installations are located within the MPA (Baseline visual survey or extended survey) (based on SEPA, 2008);
- Mitigation measures may be required for some OSPAR/BAP features for which adequate protection is not currently achieved[27] and all non-OSPAR/BAP features ranging from:

[27] Of the features currently on the OSPAR and UK BAP lists that occur in inshore areas, most are considered to already be adequately protected under OSPAR/UK BAP with the possible exception of ocean quahog and shallow tide-swept coarse sands with burrowing bivalves.

- No mitigation required for existing sites operating within the limits of an existing planning permission;
- Restrictions on tonnages for new application/extended sites, enhanced rotation policies;
- Restrictions on therapeutant use;
- Use of top net/change in type of top net in areas protected for black guillemot; and
- Refusal of planning permission.

C.2.7 Assessment Methods

Additional Licensing Costs

Where required, it is assumed that the additional costs will be as follows:

- Additional assessment costs for planning application - £5k per planning application. In the absence of information on the location of future applications, an assessment of potential cost impacts has been presented at a national level;
- Additional assessment costs for CAR licence - £500 per licence application incurred once every 10 years (assumed to be in 2019 and 2029 for all installations);
- Additional baseline visual survey costs - £1.6k per planning application or CAR licence application (extended drop down camera survey) (based on SSPO, pers. comm.)

Assessment of Costs Associated with New Planning Applications at National Level

It has been assumed that 21 planning applications (new installations or extensions to existing installations) will be submitted at a national level every 5 years within or adjacent to proposed MPAs. These applications will require additional assessment of the potential impacts to MPA features together with an extended visual survey. The additional assessment and survey costs will fall in 2017, 2022, 2027 and 2032.

Potential requirements for mitigation measures have been described qualitatively as it is not possible to determine specific requirements in the absence of information on the location of future development.

Cost of Uncertainty and Delays

The designation of NC MPAs has the potential to increase the time taken to determine planning or CAR licence applications and to negatively affect investor confidence. It has not been possible to quantify these potential impacts.

C.2.8 Limitations

- The level and location of future planning applications and applications for CAR licences is uncertain; and
- Site specific assessment for future planning applications and possible mitigation measures has not been possible.

C.2.9 References

Baxter, J.M., Boyd, I.L., Cox, M., Donald, A.E., Malcolm, S.J., Miles, H., Miller, B., Moffat, C.F., (Editors), 2011. Scotland's Marine Atlas: Information for the national marine plan. Marine Scotland, Edinburgh.

Commission of the European Communities, 2009. Building a sustainable future for aquaculture: A new impetus for the Strategy for the Sustainable Development of European Aquaculture
Defra, 2008. The United Kingdom operational program for the European Fisheries Fund (2007-2013).

FAO, 2010. The state of world fisheries and aquaculture.

JNCC and NE, 2011. General advice on assessing potential impacts of and mitigation for human activities on MCZ features, using existing regulation and legislation. Advice from the Joint Nature Conservation Committee and Natural England to the Regional MCZ Projects. June 2011. 107pp.

Marine Scotland, 2009. Scottish Fish Farms Annual Production Survey, 2009.

Marine Scotland, 2011. Scottish Sea Fisheries Statistics 2010. Published by Marine Scotland, The Scottish Government, September 2011 DPPAS11957 (08/11). 92pp

Marine Scotland 2012. Report to the Scottish Parliament on Progress to Identify a Scottish Network of Marine Protected Areas. The Scottish Government, December 2012 DPPAS13722 (12/12). 75pp.

Pugh, D. 2008. Socio-economic indicators of marine-related activities in the UK economy. The Crown Estate

Scottish Environment Protection Agency, 2008. Regulation and monitoring of marine cage fish farming in Scotland – a procedures manual. Annex F. Seabed Monitoring and Assessment, September 2008.

Scottish Government, 2010. Delivering Planning Reform for Aquaculture

SSPO, 2010. Scottish Salmon Producers' Organisation Annual Report. Scottish Salmon Producers' Organisation Limited. 12pp.

SSPO 2012. Scottish Salmon Farming. Industry Research Report. Scottish Salmon Producers' Organisation Limited, April 2012. 12pp.

C.3 Aquaculture – Shellfish

C.3.1 Introduction

This appendix provides an overview of existing and potential future activity for the shellfish aquaculture subsector in Scotland and outlines the methods used to assess the impacts of potential MPAs on this subsector.

C.3.2 Sub-sector Definition

Shellfish aquaculture relates to the production of marine shellfish within aquaculture installations excluding cultivated shellfish beds which are covered under commercial fishing. It includes long-line cultivation of mussels and oyster cultivation on shore.

C.3.3 Overview of Existing Activity

A list of sources to inform the writing of this baseline is provided in Table C.3.1.

Table C3.1 Shellfish information sources

Scale	Information Available	Date	Source
Scotland	Production and turnover 2005-2009	2005-2009	Baxter *et al* (2011)
Scotland	Scottish shellfish production survey	2010	Marine Scotland (2010)
Scotland	Finfish aquaculture locations	2013	Aquadat database Marine Scotland 2013
UK	Future trends	2006+	Wilding *et al* (2006)
Regional	Economic value and trends	2010	Scottish Salmon Producers Organisation (2010)
Regional	Pending Shellfish aquaculture sites	2013	http://pa.shetland.gov.uk/

C.3.3.1 Location and intensity of activity

Marine shellfish aquaculture sites in Scotland are currently situated in coastal areas within a few miles of the shore with no sites found further offshore. Most sites are also situated in sheltered, semi-enclosed sea lochs and voes (sea-inlets) and are distributed all along the West coast including the Hebrides and around Shetland with few sites located on the East coast, see Figure C3.

Shellfish aquaculture in Scotland is dominated by the production of mussels and Pacific oysters, although native oysters, scallops and Queen scallops are also produced on smaller scales. In 2011, shellfish aquaculture in Scotland produced 6,996 tonnes of mussel and 251 tonnes of Pacific oysters. Production of native oysters amounted to 28 tonnes, while scallop production amounted to 10 tonnes in total (1 tonne Queen scallop; 9 tonnes scallops). Much of the mussel production in Scotland is located in Shetland, which accounts for 65% of total mussel production.

The production of Pacific oysters is mostly limited to the Strathclyde region; producing around 84% of Scotland's total. In 2011, there were 335 active shellfish aquaculture businesses in Scotland, operating 335 sites, of which 161 were producing shellfish for the market.

Within Scotland only research scale developments into seaweed farms are currently being planned, although small scale activity does take place along the West coast where brown, red and green seaweeds are all harvested.

C.3.3.2 Economic value and employment

In 2011 the total value of shellfish aquaculture in Scotland at first sale was estimated at £9.8 million, an increase over the value of £8.3 million estimated during 2010. Mussel cultivation contributed the most to the value of the sector during 2011; valued at £8.3 million, while Pacific oysters amounted to £1.25 million; native oysters £0.14 million; scallops £0.09 million and Queen scallops £0.003 million.

The Scottish shellfish cultivation industry employed a total of 343 people in 2011, a decrease of 14% from 2010, which had shown an increase in employment from 2009. This decrease in the number of people holding jobs in the sector is attributed to the reduced number of authorised shellfish businesses in 2011 (Marine Scotland, 2011).

C.3.3.3 Future trends

Scotland is well positioned to contribute to continued growth in shellfish aquaculture within the EU, in line with the EU Aquaculture Strategy. In the 2009 European Fisheries Fund awards, grants to the mussel sector were made which could alone lead to a further increase of more than 2,000 tonnes of production (Baxter *et al*. 2011). A decline in Dutch mussel production may also contribute to an expansion of the Scottish industry, which has the potential to double its production by 2020 to 160,000 tonnes without having a significant impact on overall market supply and avoiding a reduction in the market value (Marine Scotland, 2011).

The Scottish Government has stated its support for the ambitions of the aquaculture sector to increase production of shellfish by 100 per cent by 2020 compared to 2009[28]. This target implies shellfish production in the order of 13,000 tonnes by 2020.

C.3.3.4 Assumptions on Future Activity

There is likely to be continued growth in the shellfish aquaculture sector in the future aimed at achieving a production level of 13,000 tonnes by 2020. However, the location, timing, nature (shellfish species) and intensity of such development remains uncertain. Information on current shellfish farm planning applications was obtained

28 The target, as set out in the Pre Consultation Draft Marine Plan (see http://www.scotland.gov.uk/Publications/ 2011/03/21114728/14#a3) is to increase the sustainable production of shellfish, mussels especially, by at least 100% by 2020.

from relevant planning authority planning portals (Highland, Argyll & Bute, Shetland and Western Isles Councils) - no current planning applications were identified in or adjacent to MPA proposals.

For the purposes of this assessment it was assumed that there would be 10 applications in or adjacent to MPA proposals at a national level every five years throughout the assessment period[29]. The information on potential future applications therefore cannot be used to inform estimates of costs for individual MPA proposals, but has been used to inform estimates of potential cost impacts at a national level.

C.3.4 Potential Interactions with MPA Features

Habitat loss may occur beneath shellfish lays and the deposition of 'mussel mud' and increased sedimentation may lead to smothering, although this may be temporary until harvesting occurs. Organic enrichment can lead to increased settlement and growth of green macroalgae and changes in community composition. Shellfish lays are known to cause a decrease in species richness and the number of individuals in nearby benthic communities, with a decrease in macrofauna and an increase in meiofauna. Anchors used to fix ropes for rope-grown mussels may also cause localised abrasion of the benthic environment (JNCC & NE, 2011). Installations may also provide suitable surfaces for colonization by invasive non-indigenous species potentially supporting the wider spread of INS.

C.3.5 Assumptions on Management Measures for Scenarios

It is assumed that the impact of new shellfish aquaculture on MPA features will be managed through the existing planning system. Two scenarios ('lower' and 'upper') have been developed to capture the possible costs of potential MPAs to the shellfish aquaculture sector. These scenarios include potential costs associated with additional assessments required to inform decisions on planning applications and associated survey requirements.

It has been assumed that there will be no review of existing consents or permissions, although where existing shellfish farms apply for planning permission for extensions, these applications will be considered against the conservation objectives for features for which MPAs may have been designated.

It has not been possible to identify potential future development at site level – instead, a national assessment has been carried out based on assumptions about the number of future planning applications within or adjacent to proposed MPAs. It has not been possible to estimate the cost impact of potential additional mitigation measures for new planning applications for individual sites, because the location of

29 This was based on the relative proportion of shellfish farms to finfish farms within or adjacent to MPA proposals multiplied by the estimated number of finfish planning applications within MPA proposals (n=21; see Appendix B2) and assuming that this rate of development within proposed MPAs is sufficient to contribute to the achievement of the 2020 target.

such applications is not available. The potential requirement for mitigation measures has been described qualitatively at national level.

An intermediate ('best') estimate for each site has been based on SNH current views on management options and judgements made by the study team. The assumptions do not pre-judge any future site-specific licensing decisions. After MPA designation, the management of activities in MPAs will be decided on a site-by-site basis and may differ from the assumptions in this assessment.

Management measures applied under the lower and upper scenarios are detailed below. Specific management measure assumptions for each scenario (including the intermediate scenario) are defined in the MPA Site Reports (Table 4, Appendix E).

Lower Scenario

- Additional costs will be incurred for new site licence applications in assessing potential impacts to MPA features within 1km of proposed licence areas;
- Mitigation measures may be required for non-OSPAR/BAP features ranging from:
  - No mitigation required for existing sites operating within the limits of an existing planning permission;
  - No additional mitigation required for new application/extended sites beyond existing good practice;
  - Restrictions on tonnages for new application/extended sites, enhanced rotation policies; and
  - Refusal of planning permission.

Upper Scenario

- Additional costs will be incurred for new site licence applications in assessing potential impacts to all MPA features within 1km of proposed licence areas);
- Additional survey costs will be incurred to inform new licence applications;
- Mitigation measures may be required for some OSPAR/BAP features for which adequate protection is not currently achieved[30] and all non-OSPAR/BAP features ranging from:
  - No mitigation required for existing sites operating within the limits of an existing planning permission;
  - Restrictions on tonnages for new application/extended sites, enhanced rotation policies; and
  - Refusal of planning permission.

[30] Of the features currently on the OSPAR and UK BAP lists that occur in inshore areas, most are considered to already be adequately protected under OSPAR/UK BAP with the possible exception of ocean quahog and shallow tide-swept coarse sands with burrowing bivalves.

C.3.6 Assessment Methods

Additional Licensing Costs

Where required, it is assumed that the additional costs will be as follows:

- Additional assessment costs for planning application - £1k per licence application
- Additional survey costs - £1.6k per licence application (extended drop down camera survey)

Assessment of Costs Associated with New Planning Applications at National Level

It has been assumed that 10 planning applications (new installations or extensions to existing installations) will be submitted at a national level every 5 years within or adjacent to proposed MPAs. These applications will require additional assessment of the potential impacts to MPA features together with an extended visual survey. The additional assessment and survey costs will fall in 2017, 2022, 2027 and 2032.

Potential requirements for mitigation measures have been described qualitatively as it is not possible to determine specific requirements in the absence of information on the location of future development.

Cost of Uncertainty and Delays

The designation of NC MPAs has the potential to increase the time taken to determine planning applications and to negatively affect investor confidence. It has not been possible to quantify these potential impacts.

C.3.7 Limitations

- The level and location of future planning applications is uncertain.

C.3.8 References

Baxter, J.M., Boyd, I.L., Cox, M., Donald, A.E., Malcolm, S.J., Miles, H., Miller, B., Moffat, C.F., (Editors), 2011. Scotland's Marine Atlas: Information for the national marine plan. Marine Scotland, Edinburgh.

JNCC and NE, 2011. General advice on assessing potential impacts of and mitigation for human activities on MCZ features, using existing regulation and legislation. Advice from the Joint Nature Conservation Committee and Natural England to the Regional MCZ Projects. June 2011. 107pp.

Marine Scotland, 2011. Scottish Sea Fisheries Statistics 2010. Published by Marine Scotland, The Scottish Government, September 2011 DPPAS11957 (08/11). 92pp.

C.4. Aviation

C.4.1 Introduction

This appendix provides an overview of existing and potential future activity for the aviation sector in Scotland and outlines the methods used to assess the impacts of potential MPAs on this sector.

C.4.2 Sector Definition

This sector relates to civil aviation, which comprises scheduled air transport (including all passenger and cargo flights operating on regularly scheduled routes) and general aviation (including all other civil flights, private or commercial including helicopters). Military aviation is covered under ‘Military Activities’, Appendix C9.

C.4.3 Overview of Existing Activity

Information sources used in the assessment are listed in Table C4.1.

Table C4.1 Aviation information sources

Scale	Information Available	Date	Source
Scotland	UK Air Passenger Demand Forecasts	2009+	Department for Transport (2009)
Scotland	Scottish Transport Statistics	2010	Scottish Government
Aerodromes / UK	Safeguarding maps	Current	CAA

C4.3.1 Location and intensity of activity

The importance of air travel to Scotland can be illustrated by what is termed the ‘propensity to fly’ which measures the number of return air trips in an area per head of population (but also includes trips made by out-of-area tourists and business people). Apart from London, Scotland records the highest ‘propensity to fly’ value in the UK (DfT, 2002, cited in ABPmer, RPA and SQW, 2011), this is likely to be due to the mountainous and island terrain and ease of transportation.

The airport locations in Scotland are shown in Figure C4, where the five ‘major’ airports are located in the West (Glasgow and Glasgow Prestwick airports), North East (Inverness and Aberdeen airports) and East (Edinburgh airport). Minor airports are located on the mainland in the East (Dundee airport), North East (Wick airport) and West (Campbeltown airport) and on islands in the North (Scrabster, Lerwick and Sumburgh airports in the Shetlands; Kirkwall airport in the Orkneys), North West (Stornoway, Benbecula and Barra airports in the Outer Hebrides) and West (Coll, Colonsay, Tiree and Islay airports).

In 2009, there were 22.5 million air terminal passengers (passengers who join or leave an aircraft at the reporting airport, excluding passengers carried on air taxi charter services) (Scottish Government, 2010). Passengers passing through Edinburgh, Glasgow, Aberdeen and Glasgow Prestwick comprised 94% of this total. In 2009, the total air freight (the weight of property carried out on an aircraft, excluding mail and passenger's and crew's permitted luggage) carried through Scottish airports was 45,659 tonnes. More detailed information on passenger numbers and freight quantities through all Scottish airports is available from ABPmer & RPA, 2012. The total number of aircraft movements in 2009 was 490,000; Edinburgh had the highest number of aircraft movements (116,000; 98% commercial movements), followed by Aberdeen (110,000) and Glasgow (85,000) (Scottish Government, 2010).

Helicopter Main Routes (HMRs) represent the routes typically flown by helicopters operating to and from offshore destinations and are 'signposts' to aid flight safety (i.e. signposting concentrations of helicopter traffic to other air space users) (see Figure C4). Whilst HMRs have no airspace status and assume the background airspace classification within which they lie, they are used by the Air Navigation Service Provider (ANSP) (i.e. NATS Aberdeen) and helicopter operators for flight planning and management purposes. While compliance with the HMR structure is not compulsory, in the interests of flight safety, civil helicopter pilots are strongly encouraged to plan their flights using HMRs wherever possible. The HMRs do not predict the flow of helicopter traffic (UK Aeronautical Information Package; NATS website).

C4.3.2 Economic value and employment

Aviation forms a critical component of Scotland's economy by providing direct access to markets as well as providing lifeline services to otherwise inaccessible settlements throughout the mountainous and island terrain (ABPmer, RPA and SQW, 2011). Helicopter routes are also important in servicing offshore oil and gas installations.

In 2009, BAA's operating profit for the three main airports (Edinburgh, Glasgow and Aberdeen) was £34.4 million. Highlands and Islands Airports (Barra, Benbecula, Campbeltown, Inverness, Islay, Kirkwall, Stornoway, Sumburgh, Tiree and Wick) recorded a loss of £1m for 2008/09 (Scottish Government, 2010).

C4.3.3 Future trends

The number of air passengers using UK airports is forecast to recover from the recent downturn. In a 'constrained' forecast, in which it is assumed that there will be no new runways and only incremental developments to airport terminals to make maximum use of existing runways, numbers of passengers are forecast to rise from 211 million passengers per annum (mppa) in 2010 to 335mppa in 2030 (range 300 - 380 mppa), and to 470mppa in 2050 (range 380 - 515 mppa). These forecasts imply average annual growth in passenger numbers to 2050 of 2.0% (within the range 1.5-

2.3%) significantly lower than the 3.7% average seen over the past twenty years (DfT, 2011). Unconstrained forecasts (in which it is assumed there are no airport capacity constraints) show that UK air travel would rise from 211mppa in 2010 to 345mppa in 2030 (central forecast, range 305-400mppa) and 520mppa (central forecast, range 400-700mppa) (DfT, 2011).

Constrained (maximum use) passenger capacity and ATM forecasts for major Scottish airports are shown in Table C4.2.

Table C4.2 Constrained terminal passenger and ATM 'central' forecasts for major Scottish airports

Numbers/ Movements	Airport	2010	2020	2030	2040	2050
Terminal passengers (mppa)	Glasgow	7	7	10	12	20
	Edinburgh	9	13	15	20	20
	Aberdeen	3	3	4	5	6
	Prestwick	2	2	2	3	4
	Inverness	<1	1	<1	<1	<1
Air Transport Movements (000's)	Glasgow	70	55	75	90	140
	Edinburgh	100	170	190	230	180
	Aberdeen	90	90	100	110	120
	Prestwick	15	20	25	25	30
	Inverness	15	30	15	15	15

C.4.4 Assumptions on Future Activity

It has been assumed that activity (aircraft movements) will increase by around 10% over the assessment period (2014 – 2034).

C.4.5 Potential Interactions with MPA Features

The main interaction relates to potential disturbance to birds (black guillemot) by low flying helicopters or aircraft. In particular, in inclement meteorological conditions, helicopters may need to lower their operating altitude.

C.4.6 Assumptions on Management Measures for Scenarios

SNH has advised that while low flying aircraft and helicopters may occasionally cause temporary disturbance to black guillemot, such impacts are not considered to significantly hinder the achievement of conservation objectives for black guillemot within potential NC MPAs. For the purposes of this assessment, it has therefore been assumed that no cost impacts will arise to the aviation sector.

C.4.7 Assessment Methods

Not required.

C.4.8 Limitations

The trends in future activity levels are uncertain and are likely to vary for individual airports.

C.4.9 References

ABPmer & RPA, 2012. Socio-economic Baseline Reviews for Offshore Renewables in Scottish Waters. ABP Marine Environmental Research Ltd, Report No. R.1905 to Marine Scotland.

ABPmer, RPA & SQW, 2011. Economic Assessment of Short Term Options for Offshore Wind Energy in Scottish Territorial Waters. ABPmer Report No. R1743, March 2011

Department for Transport (DfT), 2002. The future development of air transport in the UK: Scotland: a national consultation.

Department for Transport (DfT), 2011. UK Aviation Forecasts. August 2011. Available online: http://www.dft.gov.uk/publications/uk-aviation-forecasts-2011

NATS website: http://www.nats.co.uk/ (last visited 15/04/13)

Scottish Government, 2010. Scottish Transport Statistics. A national Statistics Publication for Scotland. No. 29, 2010 Edition.

C.5. Carbon Capture and Storage

C.5.1 Introduction

This appendix provides an overview of existing and potential future activity for the carbon capture and storage (CCS) sector in Scottish waters and outlines the methods used to assess the impacts of potential MPAs on this sector.

C.5.2 Sector Definition

CCS is a carbon abatement technology that will enable fossil fuels to be used with substantially reduced CO_2 emissions. CCS combines three distinct processes: capturing the CO_2 from power stations and other industrial sources, transporting it (usually via pipelines) to storage points, then injection of the CO_2 into deep geological formations (e.g. deep saline formations or depleted Oil and Gas fields) for long term storage.

C.5.3 Overview of Existing Activity

Information sources used in the assessment are listed in Table C5.1.

Table C5.1. Carbon capture and storage information sources

Scale	Information Available	Date	Source
Scotland	Potential CO2 storage sites, transport options between sources and storage sites (ship and pipeline)	2009	Scottish Centre for Carbon Storage (2009)
Scotland	Refined estimate of CO2 storage capacity in North East Region, estimates of timelines to CCS deployment and employment estimates	2011	Scottish Centre for Carbon Storage (2011)
Scotland	Potential transport options and possible European CCS Network	2010	Scottish Government and Scottish Enterprise (2010)
Scotland	Potential CO2 storage sites	2011	Baxter *et al* (2011)
UK	Aquifers (polygon)		BGS
UK	Large dome structures in the Bunter Sandstone Formation (polygon)		BGS / DECC
UK	Location of likely reservoirs		CCSA (NB was not possible to obtain for S coast work)
UK	Proximity of the UK's largest industrial emitters to least cost storage capacity	2012	DECC, 2012. CCS Roadmap
UK	Technical, economic, financial and social uncertainties facing CCS, potential role in UK power sector to 2030	2012	UK ERC, 2012

C5.3.1 Location and intensity of activity

A study into the opportunities for CO_2 storage around Scotland (Scottish Centre for Carbon Storage (SCCS), 2009) showed that within the Scottish Renewable Energy Zone[31], Scotland has an extremely large CO_2 storage resource. Out of the 204 hydrocarbon fields and 80 saline aquifers identified within the study area, 29 hydrocarbon fields and 10 saline aquifers were identified as having apparent potential for CO_2 storage, all of which lie in offshore waters within the Central and Northern North Sea (see Figure C5). Further assessment of these sites showed that four gas condensate fields (Brae North, Brae East, Britannia and Bruce Fields), one gas field (Frigg Field) and one oil field (Brent Field) present the most obvious opportunities as stores, with CO_2 storage capacities of between 300-1,000Mt. The report noted that the three high pressure high temperature (HPHT) gas condensate fields (Franklin, Elgin and Shearwater fields) are likely to be too expensive to develop as stores in the short term. Fourteen oil fields, including the Brent Oil Field, were identified as having potential for CO_2 storage in conjunction with enhanced oil recovery. The remaining seven oil fields offer large storage capacities but reservoir pressure may present obstacles to their use for CO_2 storage. Out of the 80 saline aquifers identified within the study, ten were identified as meeting both geotechnical and storage capacity requirements (all of which lie within offshore waters in the Central and Northern North Sea Figure C5) with a total potential CO_2 capacity in the range 4,600-46,000 Mt. The study concluded that these resources could easily accommodate the industrial CO_2 emissions from Scotland for the next 200 years, with likely sufficient storage to allow import of CO_2 from North East England, equating to over 25% of future UK large industry and power CO_2 output. Pipelines were assessed as the best option for the secure and continuous transport of CO_2 from different sources to collection hubs onshore and then to offshore storage hubs for local distribution to storage sites. In 2011, a study showed that the storage capacity of one of the saline aquifers identified in the 2009 study (the Captain Sandstone beneath the Moray Firth) was estimated to be over 360 Mt of CO_2, with the potential for an additional 1200 Mt storage capacity with significant investment (SCCS, 2011). This equated to about 15-100 years of CO_2 output from Scotland's existing industrial sources.

In March 2013, the Peterhead CCS Project was chosen as one of two CCS demonstration projects to progress to the next stage of the Government's CCS Commercialisation Competition funding. The project will transport CO_2 captured from Peterhead Power station by pipeline approximately 100km offshore to the Goldeneye platform, where it will be injected into the depleted Goldeneye gas reservoir for long-term storage. The project is expected to capture in the region of 1 Mt of CO_2 per annum during a 10-year demonstration phase. The development will largely use existing pipeline infrastructure running offshore to the Goldeneye Field.

31 Defined in The Renewable Energy Zone (Designation of Area) (Scottish Ministers) Order 2005, ISBN 0110736176.

C5.3.2 Economic value and employment

This sector is currently in its infancy and there is currently no CO_2 storage in place. Therefore no information is available on the current economic value or employment.

C5.3.3 Future trends

The Scottish Government and Scottish Enterprise (2010) stated that the emerging CCS-based industry in Scotland could support up to an estimated 10,000 new jobs in the next 15-20 years. A more recent study (SCCS, 2011) stated that an appropriately skilled and trained workforce, in addition to that already engaged in the engineering and offshore industries, will be an essential component of the new CCS industry in the UK and estimated that CCS could create 13,000 jobs in Scotland (and 14,000 elsewhere in the UK) by 2020 and increase in the following years (SCCS, 2011). This study also estimated that the UK plc share of the worldwide CCS business is potentially worth over £10 billion per year from around 2025, with the added value in the UK worth between £5-9.5 billion per year (SCCS, 2011).

CCS on fossil fuel power generation may have an important role in helping to meet Scotland's climate change targets of an 80% reduction in greenhouse gas (GHG) emissions by 2050. The Scottish Government and Scottish Enterprise (2010) state that in order to make significant progress towards Scotland's climate change targets the electricity generation sector needs to be decarbonised by 2030. To meet this target Scotland must have one or more demonstrator projects operational by 2015 to ensure that CCS is available on a commercial scale from 2020 and be widespread in the sector by 2030 (including the retrofitting of CCS to existing plants). However, challenges to this emerging sector include demonstrating that CCS is economically and technically feasible, that CCS is permanent (proposed sites must be investigated and evaluated to demonstrate they are suitable for secure storage of CO_2 for thousands of years) and whether the technology can be developed within a timescale that enables utilisation of the existing Oil and Gas infrastructure (platforms and pipelines) before decommissioning occurs (Baxter *et al*, 2011). Potential storage sites may increase as further hydrocarbon fields or saline aquifers suitable for CO_2 storage may yet be discovered (SCCS, 2009).

C.5.4 Assumptions on Future Activity

Scottish Enterprise and Scottish Development International (undated) set out a series of possible scenarios for the future development of CCS in Scotland up to 2040. The scenarios assume that by 2020, the only CCS development in Scottish waters will be between St Fergus and the Goldeneye platform, using existing infrastructure. By 2030, it is assumed that possible additional development may occur with possible new pipelines constructed between Cockenzie and Peterhead and from the Tees to the Goldeneye platform, although an alternative option would be to transport the CO_2 by ship (Figure C5).

For the purpose of this assessment, it is assumed that both of the two new pipelines are constructed, with licences obtained in 2026 with both pipelines becoming operational in 2030.

C.5.5 Potential Interactions with MPA Features

Impacts on MPA features associated with carbon capture and storage are likely to be similar to those associated with oil and gas exploration and production. Although additional impacts are not yet known due to the lack of CCS activity in UK waters, they include potential ocean acidification associated with the release of carbon dioxide (JNCC & NE, 2011).

C.5.6 Assumptions on Management Measures for Scenarios

It is assumed that the impact of CCS activities on MPA features will be managed through the existing marine licensing framework. Two scenarios ('lower' and 'upper') have been developed to capture the possible costs of potential MPAs to the CCS sector. These include a range of possible management measures, as detailed requirements will need to be based on site-specific factors.

The intermediate ('best') estimate for each site has been based on SNH/JNCC current views on management options and judgements made by the study team. The assumptions do not pre-judge any future site-specific licensing decisions. After MPA designation, the management of activities in MPAs will be decided on a site-by-site basis and may differ from the assumptions in this assessment.

Management measures applied under the lower and upper scenarios are detailed below. Specific management measure assumptions for each scenario (including the intermediate scenario) are defined in the MPA Site Reports (Table 4, Appendix E).

Lower Scenario

- Additional costs will be incurred for new pipeline licence applications in assessing potential impacts to MPA features within 1km of proposed pipeline route;
- Mitigation measures may be required for non-OSPAR/BAP features ranging from:
  - No additional mitigation required beyond existing good practice; and
  - Re-routeing of pipeline to avoid highly sensitive MPA features.

Upper Scenario

- Additional costs will be incurred for new site licence applications in assessing potential impacts to all MPA features within 1km of proposed pipeline route;
- Additional survey costs will be incurred to inform new licence applications;
- Additional post-licence monitoring of any MPA features within 500m of pipeline; and

- Mitigation measures may be required for some OSPAR/BAP features[32] for which adequate protection is not currently achieved and all non-OSPAR/BAP features ranging from:
  - Seasonal controls on new pipeline laying to minimise impacts to highly sensitive MPA features; and
  - Re-routeing of pipeline to avoid moderately and highly sensitive MPA features.

C.5.7 Assessment Methods

Additional Licensing Costs

Where required, it is assumed that the additional costs will be as follows:

- Additional assessment costs - £10k per licence application (based on equivalent cost for cables cited in Annex H6 of Finding Sanctuary et al, 2012); and
- Additional survey costs - £5k per km for length of pipeline route within MPA (based on ABPmer, 2011).

Additional Post Licensing Costs

Where required, it is assumed that additional costs will be incurred as follows:

- Additional monitoring costs £5k per km for MPA features within 500m of pipeline, three years post construction (ABPmer, 2011).

Mitigation Measures

Where required, it is assumed that the following additional costs may be incurred:

- Seasonal controls on new pipeline laying to minimise impacts to highly sensitive MPA features – site specific assessment; and
- Displacement of pipelines (£1m per km length of displacement; based on Annex H11 of Finding Sanctuary et al, 2012).

Cost of Uncertainty and Delays

The designation of NC MPAs has the potential to increase the time taken to determine licence and permit applications and to negatively affect investor confidence. It has not been possible to quantify these potential impacts.

[32] Some OSPAR/BAP features are already effectively afforded protection from activities with spatially-based licences; however, the following features are considered by the study team not to be given full protection: burrowed mud, inshore deep mud with burrowing heart urchins, offshore deep sea muds, offshore subtidal sands and gravels, shallow tide-swept coarse sands with burrowing bivalves and ocean quahog aggregations.

C.5.8 Limitations

- The number and location of CCS pipelines and installations that may be constructed during the assessment period is unknown; and
- The requirements for management measures are uncertain.

C.5.9 References

Baxter, J.M., Boyd, I.L., Cox, M., Donald, A.E., Malcolm, S.J., Miles, H., Miller, B., Moffat, C.F., (Editors), 2011. Scotland's Marine Atlas: Information for the national marine plan. Marine Scotland, Edinburgh.

Finding Sanctuary, Irish Seas Conservation Zones, Net Gain and Balanced Seas, 2012. Impact
Assessment materials in support of the Regional Marine Conservation Zone Projects' Recommendations. Annex H6 Cables.

Finding Sanctuary, Irish Seas Conservation Zones, Net Gain and Balanced Seas, 2012. Impact
Assessment materials in support of the Regional Marine Conservation Zone Projects' Recommendations. Annex H11 Oil, Gas and Carbon Capture and Storage.

JNCC and NE, 2011. General advice on assessing potential impacts of and mitigation for human activities on MCZ features, using existing regulation and legislation. Advice from the Joint Nature Conservation Committee and Natural England to the Regional MCZ Projects. June 2011. 107pp.

Scottish Centre for Carbon Storage (SCCS), 2009. Opportunities for CO2 storage around Scotland: An integrated strategic research study. Report for the Scottish Government. April, 2009.

Scottish Centre for Carbon Storage (SCCS), 2011. Progressing Scotland's CO2 storage opportunities. Report for the Scottish Government. March, 2011.

Scottish Government and Scottish Enterprise, 2010. Carbon Capture and Storage – A Roadmap for Scotland. March 2010.

C.6. Coast Protection and Flood Defence

C.6.1 Introduction

This appendix provides an overview of existing and potential future activity for the coast protection and flood defence sector in Scotland and outlines the methods used to assess the impacts of potential MPAs on this sector.

C.6.2 Sector Definition

This sector includes coastal defence measures used to prevent or reduce flood risk and coastal erosion (UKMMAS, 2010). Examples of coastal and flood defences include groynes, sea walls and embankments (termed 'hard engineering') and beach replenishment, managed retreat and coastal realignment (termed 'soft engineering').

C.6.3 Overview of Existing Activity

Information sources used in the assessment are listed in Table C6.1.

Table C6.1 Coast Protection and Flood Defence information sources

Scale	Information Available	Date	Source
Scotland	Coastal protection, flood defence and managed realignment schemes	2011	Scotland's Marine Atlas
Europe	EUROSION: Erosion trends and coastal defence works	2013	http://www.eurosion.org/database/index.html

C.6.3.1 Location and intensity of activity

SNH estimated that 307km of mainland Scotland's coast is comprised of coastal defences (reported in Baxter *et al*, 2011). The distribution of coastal protection schemes and hard and soft engineered flood prevention schemes in Scotland are shown in Figure C6.

C6.3.2 Economic value and employment

Coast protection and flood defences protect property, land and infrastructure, for example, the Scottish Environment Protection Agency (SEPA) currently estimate that around 26,000 houses and businesses are at risk from coastal flooding in Scotland[33]. However, coastal protection and flood prevention schemes do not contribute directly to the economy and hence it is not possible to assign an economic value to this sector. It has been predicted that Scotland will face an increased flood risk in the future, especially in the West although no cost estimates for coastal flooding are

[33] SEPA Coastal Flooding: www.sepa.org.uk/flooding/be_flood_aware/types_of_flooding/coastal_ flooding.aspx

available. The number of jobs associated with this sector is also difficult to assess accurately (Baxter *et al*, 2011).

C6.3.3 Future trends

Future sea level rise and the potential for increasingly severe storm events due to climate change may place Scotland's coastal infrastructure and habitats under increasing threat and hence increase the economic importance of this sector (UKMMAS, 2010; Baxter *et al*, 2011). The Flood Risk Management (Scotland) Act, which came into force in November 2009, requires SEPA to conduct a national assessment of flood risk by the end of 2011, produce new flood risk and hazard maps by 2013 and implement a national flood risk management plan by 2015.

C.6.4 Assumptions on Future Activity

There is no central source of information about potential future flood and coast protection works in Scotland. For the purposes of this assessment, it has been assumed that flood and coast defences will require replacement or significant maintenance once every 20 years. It has been assumed that one application will be submitted in 2024 for each discrete section of defences.

C.6.5 Potential Interactions with MPA Features

The impacts of the construction of coastal protection and flood defence structures will mainly affect intertidal habitats. Permanent coastal defence structures may result in 'coastal squeeze', whereby a landward migration of the intertidal habitat as a result of sea level rise is prevented. Intertidal habitats may therefore become sub-tidal. Such man-made structures could cause changes in coastal processes such as hydrodynamic and sediment regimes, potentially giving rise to changes in emergence regimes of intertidal species or leading to smothering or a net removal of material. Construction of coastal protection and flood defence structures will also create a barrier against the movement of mobile intertidal species (JNCC & NE, 2011).

C.6.6 Assumptions on Management Measures for Scenarios

It is assumed that the impact of coast protection and flood defence activities on MPA features will be managed through the existing marine licensing framework. Two scenarios ('lower' and 'upper') have been developed to capture the possible costs of potential MPAs to the coast protection and flood defence sector. These include a range of possible management measures, as detailed requirements will need to be based on site-specific factors.

It has been assumed that there will be no review of existing consents or permissions, although where existing asset owners apply for planning permission or a marine licence for maintenance works, these applications will be considered against the conservation objectives for features for which MPAs may have been designated.

The intermediate ('best') estimate for each site has been based on SNH/JNCC current views on management options and judgements made by the study team. The assumptions do not pre-judge any future site-specific licensing decisions. After MPA designation, the management of activities in MPAs will be decided on a site-by-site basis and may differ from the assumptions in this assessment.

Management measures applied under the lower and upper scenarios are detailed below. Specific management measure assumptions for each scenario (including the intermediate scenario) are defined in the MPA Site Reports (Table 4, Appendix E).

Lower Scenario

- Additional costs will be incurred for licence applications in assessing potential impacts to MPA features within 1km of proposed coast protection and flood defence activities;
- Mitigation measures may be required for non-OSPAR/BAP features ranging from:
  - No mitigation required for maintenance of existing or construction of new assets;
  - Seasonal restrictions on maintenance or new construction work; and
  - Offsetting measures for the construction of new assets.

Upper Scenario

- Additional costs will be incurred for new site licence applications in assessing potential impacts to MPA features within 1km of proposed coast protection and flood defence activities;
- Additional survey costs will be incurred to inform new licence applications;
- Additional post-licence monitoring of any features within 1km of works footprint;
- Mitigation measures may be required for some OSPAR/BAP features[34] for which adequate protection is not currently achieved and all non-OSPAR/BAP features ranging from:
  - No mitigation required for maintenance of existing or construction of new assets;
  - Seasonal restrictions on maintenance or new construction work; and
  - Offsetting measures for the construction of new assets.

[34] Some OSPAR/BAP features are already effectively afforded protection from activities with spatially-based licences; however, the following features are considered by the study team not to be given full protection: burrowed mud, inshore deep mud with burrowing heart urchins, offshore deep sea muds, offshore subtidal sands and gravels, shallow tide-swept coarse sands with burrowing bivalves and ocean quahog aggregations.

C.6.7 Assessment Methods

Additional Licensing Costs

Where required, it is assumed that the additional costs will be as follows:

- Additional assessment costs for planning application - £5k per licence application; and
- Additional survey costs - £3k per planning application (extended phase 1 habitat survey).

Additional Post Licensing Costs

Where required, it is assumed that additional costs will be incurred as follows:

- Additional monitoring costs £2.5k once every 3 years (extended ecological survey)

Mitigation Measures

Where required, it is assumed that the following additional costs may be incurred:

- Seasonal restrictions – assumed no additional cost for maintenance works (works scheduled to avoid sensitive periods) (site specific assessment); and
- Offsetting measures – site specific assessment of possible measures and costs.

C.6.8 Limitations

- Uncertainty concerning future maintenance and new construction requirements; and
- Uncertainty concerning required management measures.

C.6.9 References

Baxter, J.M., Boyd, I.L., Cox, M., Donald, A.E., Malcolm, S.J., Miles, H., Miller, B., Moffat, C.F., (Editors), 2011. Scotland's Marine Atlas: Information for the national marine plan. Marine Scotland, Edinburgh.

JNCC and NE, 2011. General advice on assessing potential impacts of and mitigation for human activities on MCZ features, using existing regulation and legislation. Advice from the Joint Nature Conservation Committee and Natural England to the Regional MCZ Projects. June 2011. 107pp.

United Kingdom Marine Monitoring and Assessment Strategy (UKMMAS), 2010. Charting Progress 2 Feeder Report Productive Seas. Department for Environment

Food and Rural Affairs on behalf of UKMMAS (Eds. Saunders, J. and McKie, J.) 472pp Available online: http://chartingprogress.defra .gov.uk/

C.7. Commercial Fisheries

C.7.1 Introduction

This annex provides an overview of existing and potential future activity for the commercial fisheries sector in Scottish waters and outlines the methods used to assess the impacts of potential MPAs on this sector.

C.7.2 Sector Definition

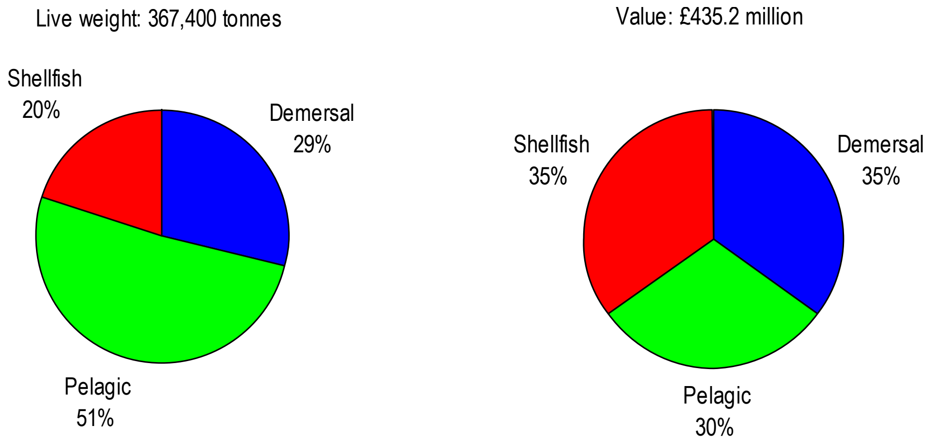
For the purpose of this study, commercial fisheries relates to all commercial fishing activity within Scottish waters and includes the subsequent handling and processing of catches. In this study, commercial fishing activity includes wild salmon and sea trout fisheries.

C.7.3 Overview of Existing Activity

Location and intensity of activity

Fish catching activities
Scotland is one of the largest sea fishing nations in Europe. In 2010, the Scottish fleet was responsible for landing 61% of the total UK value and volume of fish with Scottish vessels landing 367,000 tonnes of fish worth £435 million (Marine Scotland, 2011); in 2011 the value of landings increased to £501 million.

Pelagic species (herring, mackerel) made up 51% by volume and 30% (£129 million) of the total value of landings made by Scottish vessels in 2010. Demersal species (including cod, haddock, and monkfish) made up 29% by volume and 35% by value of landings by Scottish vessels with a total value of £152 million. Shellfish landings (including *Nephrops*, scallops, and crabs) made up 20% by volume and 35% by value of all landings by Scottish vessels with a total value of £154 million, see Image C7.1.



(Source: Marine Scotland, 2011)

Image C7.1. Quantity and Value of Landings by Scottish Vessels: Percentage of Each Species Type (2010)

Mackerel is the most valuable species to the Scottish fleet at £113m and *Nephrops* is the second most valuable species at £77m (based on 2010 landings data); in fact, almost half the catch by value from Scottish waters was made up of these two species over the period from 2001 to 2010. Monkfish, haddock and scallops are the next most valuable species landed by Scottish vessels: in 2010 the value of these landings was £32.6m, £32.4m and £31.9m, respectively (Marine Scotland, 2011).

Figure C7 shows the annual average value of all landings (2001 to 2010) by species type (demersal, pelagic and shellfish) caught in Scottish waters for the inshore and offshore areas. This shows that shellfish is particularly important (from a value perspective) for all inshore areas and also for the offshore areas of the south-west, north-east and east regions. Demersal fishing is most valuable for the offshore areas of the north and north-west regions, whilst pelagic fishing is the most valuable species type for the offshore areas of the north-west and north regions.

Figure C8 shows the annual average value of landings (2007 to 2011) for over-15m vessels, for all gear classes in relation to the area of capture (based on analysis of vessel monitoring system (VMS) information). The gear classes include: beam trawl, demersal trawl, *Nephrops* trawl, pelagic trawl, other trawl and dredges. This shows that the most valuable fishing grounds are near the coast in the west region, to the north and west of the Hebrides in the north-west region, and around the Shetlands in the north region. Much of this is dependent on catches of mackerel, the most valuable species to the Scottish fleet. Fishing grounds for mackerel can vary on an annual basis depending on the time of movement of the stock, catching opportunities (TAC), weather, marketing conditions and opportunities and the activity of other countries' fleets.

In 2010, 80% of the total value and 72% of the total volume of landings by Scottish vessels were landed into Scottish ports, a figure which has remained fairly constant since 2006.

The number of active Scottish vessels in 2010 was 2,150, which is the smallest fleet ever recorded; being 16% lower than in 2001.Over two thirds (69%) of the vessels were 10m and under in length, 12% were over 10m and under 15m, and 19% were over 15m in length (Image C7.2).

Figures C9 and C10 (in preparation) give a national overview of the over flight (surveillance) data by vessel type and nationality. The majority of British vessels (75%) are closest to the coast, with Norwegian, French and Danish vessels being predominantly seen on the periphery of the British vessels. Most of the vessels, 72% are demersal trawlers with other trawlers and gear types accounting for a further 18%.

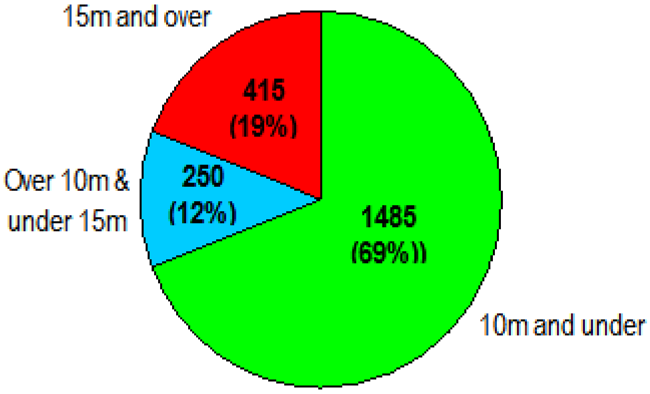


Image C7.2. Number of Active Scottish Based Vessels by Length Group as at 31 December 2010

The majority (87%) of under-10m vessels were employed in creel fishing; 83% of vessels over 10m and under 15m in length were mainly employed in *Nephrops* trawl or creel fishing. 29% of vessels over 10m in length carried out *Nephrops* trawling as their main fishing method and 27% carried out demersal trawling. Around 96% of vessels employed predominantly in pelagic fishing methods were over 50m in length.

The under-15m fleet focuses mainly on shellfish within the inshore waters along the east and west coasts of Scotland. A large proportion (85%) of this fleet is under 10m in length. The over-15m fleet catches the majority of the demersal and pelagic species (Table C7.1).

Table C7.1 Quantity and value of landings by Scottish based vessels by species type and vessel length (2010)

Species	10m and Under		Over 10m and Under 15m		15m and Over	
	(tonnes)	(£'000)	(tonnes)	(£'000)	(tonnes)	(£'000)
Demersal	98	146	70	1,493	105,079	150,167
Pelagic	606	430	3	2	188,534	128,808
Shellfish	10,575	34,937	11,223	28,771	50,583	90,408
Total Landings	**11,278**	**35,514**	**11,925**	**30,265**	**344,195**	**369,383**

The total of all landings into Scottish ports by Scottish, other UK and foreign fleets was 385,000 tonnes with a total value of £455 million. The top three districts in terms of both volume and value of landings were Peterhead, Shetland and Fraserburgh (Marine Scotland, 2011). Table C7.2 shows the volume and value of landings into the top three ports in Scotland by Scottish vessels in 2010, which collectively constituted 72% of all landings by UK vessels into Scotland by volume.

Table C7.2 Landings into the top three Scottish ports (2010)

Landings Data	Peterhead	Shetland	Fraserburgh
Volume (tonnes)	168, 000	91,000	28,000
Value (£)	140 million	82 million	46 million

Pelagic species accounted for 50% of the value of landings into Peterhead whilst 41% were demersal species and 9% were shellfish. Pelagic species were also the majority of landings into Shetland at just under two-thirds of the total value; demersal species represented 28% and shellfish 7%. In contrast, the landings in Fraserburgh were dominated by shellfish at nearly two-thirds of the total value; demersal species accounted for nearly a quarter and 14% were pelagic species (Marine Scotland, 2011).

Fish processing activities

Two distinct sub-sectors make up the processing industry: the primary processors involved in the filleting and freezing of fresh fish for onward distribution to fresh fish retail and catering outlets, and the secondary processors involved in brining, smoking, cooking, freezing, canning, breading, battering and the production of ready-to-eat meals for the retail and catering trades. There are also units carrying out a mixture of these two, known as mixed processors.

The north-east region is the most important supply region of fish to the primary and mixed processing sectors. Mixed processing units form the majority of the processing industry in this region, followed by primary processing units. Those processors based in the Grampian region purchase 65% of their supplies from within Grampian (Brown, 2009).

Economic value and employment

In 2010, 367,000 tonnes of fish with a first sale value of £435 million were landed in the UK from Scottish waters. This figure includes all fish caught by UK vessels in Scottish waters and fish caught by non-UK vessels in Scottish waters and landed in the UK (Marine Scotland, 2011). Estimates which consider the direct employment in the fisheries sector and indirect economic activity produced as a result of the demand for goods and services by the fisheries sector (for example, supplies such as ice, nets, boxes, fuel and maintenance and chandlery supplies to fishing vessels, packaging and electricity for the processing industry) provide an indication of the overall importance of the fishing sector to the economy as a whole. Fisheries-related employment is highly concentrated into relatively few areas, and for these areas the fisheries sector is considerably more important than for Scotland as a whole.

Fish catching activities

Scotland has 8.6% of the UK population, but landed 61% by value of the total fish catch in 2010. Scottish vessels made up 33% of the number of vessels in the UK fishing fleet, 59% of the capacity (GT) of the fleet and 48% of the power (kW) of the UK fleet (MMO, 2011). In 2007, it was estimated that the total effect on employment (taking account of ‘knock-on’ or indirect expenditure effects through the economy) of the fish catching industry alone in Scotland was 10,472 full-time equivalent (FTE) jobs. This activity represented £303 million (or 0.4%) GDP i.e. the value of the country’s income generated mostly in terms of profits and wages (BPA, 2008).

The number of fishermen employed on Scottish based vessels was 5,218 in 2010, which is 0.2% of the labour force in Scotland, and represents a decrease of 22% since 2001. 4,257 of these were regular, 909 were part-time and 52 were crofters. Fraserburgh has the highest number of fishermen in employment at 789 fishermen, followed by Ayr with 559 and Shetland with 448. The largest number of part-time fishermen is found on vessels administered by Shetland (217), see Table C7.3.

Although commercial fishing makes a relatively low contribution to Scotland’s overall GDP and the production and processing of fish directly accounts for about 1% of employment (3% in rural Scotland), it is a particularly important socio-economic activity in remote coastal regions in Scotland (UKMMAS, 2010). For Eilean Siar, Orkney and Shetland district the employment in fishing as a percentage of the labour force was the highest at 3.81%. Argyll and Bute district was next at 1.27%, followed by Aberdeenshire at 0.96% (Marine Scotland, 2011).

Table C7.3 Number of fishermen employed on Scottish based vessels, by district (2010)

District	Regular	Part-time	Crofters	Total
Eyemouth	148	45	-	193
Pittenweem	120	43	-	163
Aberdeen	94	58	-	152
Peterhead	400	24	-	424
Fraserburgh	671	118	-	789
Buckie	192	51	-	243
Scrabster	168	0	-	168
Total East Coast	**1,793**	**339**	**0**	**2,132**
Orkney	277	132	-	409
Shetland	231	217	-	448
Stornoway	350	73	17	440
Total Islands	**858**	**422**	**17**	**1,297**
Kinlochbervie	44	0	-	44
Lochinver	21	1	1	23
Ullapool	274	11	-	285
Portree	167	34	34	235
Mallaig	110	9	-	119
Oban	242	23	-	265
Campbeltown	231	28	-	259
Ayr	517	42	-	559
Total West Coast	**1,606**	**148**	**35**	**1,789**
All districts	**4,257**	**909**	**52**	**5,218**

(Source: Scottish Sea Fisheries Stats, 2010)

Seven of the top ten most profitable fleet segments operate in the North Sea and off the West coast of Scotland (UKMMAS, 2010). Key factors affecting the level of profits are fuel costs and the cost of access to fishing opportunities (for example, the cost of leasing additional quota). Vessels using more fuel-intensive fishing methods, such as otter trawl and beam trawl segments, experienced the biggest increases in fuel expenditure, while less fuel-intensive methods, such as seining and passive gear segments, experienced relatively modest increases. In 2007, the proportion of earnings spent on fuel ranged from 26% for large trawlers to 7% for smaller vessels (UKMMAS, 2010).

Quota trading has emerged as an economic activity, which allows vessels to carry on fishing beyond their existing quota allowance. Since 2001, many vessel owners have increasingly purchased or leased additional quota in order to remain in business. The increased expenditure on quota leasing has been particularly acute in the North Sea and West of Scotland demersal trawl fisheries for fin-fish (UKMMAS, 2010). Following the introduction of Days at Sea (DAS) regulations in 2003, a market for the purchase of DAS has also developed. It is estimated that some owners of vessels in the North Sea and West of Scotland demersal segments spent up to £20,000 on purchasing days at sea in 2006 (UKMMAS, 2010).

Fish processing activities
The processing and preserving of fish and fish products in Scotland provided a value of £255 million and a turnover of £898 million in 2007 (Baxter *et al*., 2011). Table C7.4 shows the number of employees employed in fish processing and retail activities in Scotland in 2009 and 2010.

Table C7.4 Employment in fish and shellfish processing and retail in Scotland

SIC, 2007	Full-time Employment		Part-time Employment		Total Employment	
	2009	2010	2009	2010	2009	2010
Processing and preserving of fish, crustaceans and molluscs (SIC 10200)	6,439	6,365	762	846	7,198	7,217

(Source: ONS, 2011)

In Annan and Fraserburgh, the fish processing sector was by far the main contributor to fisheries-related employment. This industry accounts for more jobs than the catching sector and provides employment for women in an otherwise male-dominated labour market. In the Grampian region, 86% of fish processing employees were female in 2008, a rise of 11% since 2004 and the highest proportion in the UK (Brown, 2009). In 2007, employment in fishing, processing and aquaculture activities by travel to work areas varied from 2% of the total employment in the East and North East to 5-10% in the West (Baxter, *et al* 2011).

Historic trends

Fish Catching Activities
The decline in the fishing industry (catching and processing) has been significant over the past two decades. The 2007 workforce in Scotland was approximately half that employed in the early 1970s (UKMMAS, 2010). However, total fishery landings and employment in the fishing industry have been fairly stable since the mid 2000s.

Fishing activity changes in response to a number of factors: scientific advice; the location of fish; policy measures such as catch limits (quotas), limits on fishing effort (days spent fishing multiplied by the power of the vessel), the need for possible closures and decommissioning schemes; and profitability.

Fishing effort has decreased significantly since the 1990s due to continuing restrictions on fishing activity in order to promote stock recovery (Baxter *et al*. 2011). EU controls on Total Allowable Catches (TACs) and fishing effort and decommissioning of vessels in the UK are likely to have contributed to reductions in total fishing effort in the international demersal fisheries of around 30% or more over the past eight years in the North Sea, West of Scotland and Irish Sea (UKMMAS, 2010). The UK whitefish demersal trawl fleet was reduced by around 15% in size by the two decommissioning schemes in 2001 and 2003, with a particularly large impact on the Scottish fleet (UKMMAS, 2010).

Fish Processing Activities

The reduction in landings has had a major impact on the fish processing industry. The number of fish processing units in the UK decreased by 25% between 1995 and 2000 alone, although total employment in the industry increased by 15% over the same period. Since 1995, Grampian has experienced a 10% decline in the number of units, principally in companies with 25 or fewer employees.

The decline in landings has had a particular impact on primary processors where there has been a shift away from primary processing towards secondary or mixed processing units. Since 2004, the number of demersal-only processing units has decreased by over 30% and employment has more than halved. Mixed species processing accounted for about 45% of the industry's processing units and provided around 58% of total employment in the UK in 2008 (Brown, 2009). The proportion of units processing only shellfish increased in recent years which may be a result of the increased volumes of shellfish landed by UK fishing vessels in recent years.

Future trends

Fish Catching Activities

The fisheries sector is currently, and is likely to remain, important to many rural areas in Scotland. Fisheries are potentially impacted by both environmental and anthropogenic factors, including:

- Climate change effects (warming seas), which may result in the decline of stocks of cold-water species, such as cod, in waters around the UK as the stocks move northwards. However, new opportunities for warmer-water species may emerge as these species extend northwards into UK seas. Existing more southerly stocks such as red mullet, John Dory and bass may also experience improved productivity in years with higher average sea temperatures (UKMMAS, 2010);
- Anthropogenic effects such as permanent structures, dumping at sea, oil and chemical spills, and the effects of the fisheries themselves, which may impact on the habitats where the fish live; and
- Profitability and political effects, as detailed below.

There are a wide range of factors influencing the financial performance of individual businesses: some are internal to the business (such as strategic decision making, assets and skills), while others are external (and include sectoral competitiveness, the management framework, market conditions and fuel prices). These interact to determine the actual business performance (Scottish Government, 2010).

Landings of fish subject to UK quotas set under the EU Common Fisheries Policy (CFP) generally reflect changes in the quota set, therefore, in the future as species-specific quotas are raised or lowered, this will have an impact on the amount of that species landed. This is difficult to predict and will depend on the recovery and sustainability of individual species as well as the details and implementation of CFP reform in 2013, including the implementation of a discards ban.

Fisheries management will continue to focus on bringing down rates of exploitation to Maximum Sustainable Yield (MSY) targets. The majority of scientifically-assessed stocks continue to be fished at rates well above the levels expected to provide the highest long-term yield (UKMMAS, 2010), therefore, there is increasing downward pressure on the levels of exploitation allowed. It is likely that pressure to reduce discarding will increase, though without allowing overall catch to rise. Management measures will need to reduce bycatch and discards, and be more responsive to changing patterns of fish migration and movement (Baxter *et al*. 2011).

Reform of the CFP in 2013 may result in significant changes to the aims and objectives of the policy with a consequent effect on management. The outcome of this reform process cannot be predicted with any certainty but it is likely that EU fisheries will be managed on a more regional basis and fishermen may be more directly involved in the management of the fish stocks. (Baxter *et al*. 2011).

The certification of sustainable fisheries by the Marine Stewardship Council (MSC) may bring marketing advantages in a climate of increasing public and commercial awareness of sustainability issues, and where there is a desire to source fish and shellfish from environmentally-responsible businesses. Currently, there are six Scottish fisheries with MSC certification, although the certification for the mackerel fishery is currently suspended (MSC website):

- Scottish Fisheries Sustainable Accreditation Group (SFSAG) North Sea haddock - this fishery was certified as sustainable in October 2010. It is located in the North Sea (ICES Sub-Area IVa, b) and contains 192 vessels using seine and trawl methods;
- Scottish Pelagic Sustainability Group Ltd Atlanto Scandian herring - this fishery was certified as sustainable in March 2010. It is located in the ICES Sub-Area I, IIa, IIb, V and XIV and contains 25 vessels from the Scottish RSW pelagic trawl fleet;
- Scottish Pelagic Sustainability Group Ltd (SPSG) North Sea herring - this fishery was certified as sustainable in July 2008. The Scottish fleet mainly exploits the Buchan sub-stock of herring located in the central and Northern North Sea within the EEZ of the EU and Norway;
- Scottish Pelagic Sustainability Group Ltd (SPSG) western component of North-East Atlantic mackerel – this fishery was certified in January 2009 and includes 21 Scottish-owned and operated large refrigerated seawater pelagic mid-water trawl vessels. The certification was suspended in 2012 due to the failure of countries exploiting the stock to agree on allocation of quotas that do not exceed the TAC set for the stock;
- SPSG West of Scotland herring pelagic trawl – this fishery was certified in April 2012 and includes 28 vessels fishing with pelagic trawl;
- SSMO Shetland inshore brown and velvet crab, lobster and scallop fishery – this fishery was certified in March 2012 and includes creel and pot fisheries for brown crab and velvet crab, and scallop dredge fishery for king scallops, within 6nm of Shetland.

Planned and possible future offshore renewables development in Scottish seas has the potential to affect the distribution of fishing activity and the value of fish landings in the future. A recent socio-economic assessment carried out for potential future offshore wind, wave and tidal energy development (ABPmer & RPA, 2013), estimated possible reductions in landings values of between £3.6m to £19.3m (Present value costs discounted over assessment period (2014 to 2035, 2012 prices). Planned and possible oil and gas development may also interact with commercial fishing activity at some locations, but the spatial footprint of such development is likely to be smaller than for offshore renewables. Decommissioning of oil and gas structures, particularly in the North Sea may create new fishing opportunities over the period of the assessment.

Fish Processing Activities

The availability, quality and conservation of fish stocks are major concerns for the processing industry. Landings of pelagic and demersal species have continued to decrease over the last decade, therefore, there is a lower volume of these species available to the processing industry (Brown, 2009). By contrast there is a larger volume of shellfish available to processors. No industry can continue unchanged while its major raw materials become less readily available. Firms engaged in some secondary processes or other diversification, are best placed to achieve financial stability in the near future. The process of rationalisation, which has been witnessed in recent years, will result in fewer bigger firms which are more likely to be geared up for obtaining supplies via direct routes and from overseas.

Wild Salmon and Sea Trout

Scotland is famous for its wild salmon *Salmo salar* and sea trout *Salmo trutta*. These fish spend several years in rivers, migrate to sea then return as adults to spawn. Marine migrations in salmon are generally more extensive than those of sea trout (Baxter *et al*. 2011).

All salmon fishing and sea trout fishing rights in Scotland, including in the sea, are private, heritable titles, which may be held separately from any land. They fall into one of three broad categories:

- Fixed engine fisheries - are restricted to the coast and must be set outside estuary limits;
- Net and coble fisheries - generally operate in estuaries and the lower reaches of rivers; and
- Rod and line fisheries - generally operate within rivers and above tidal limits.

There are 45 fishing stations in mainland Scotland: East coast - 22; North coast - 5; and West coast and islands - 18.

Salmon and sea trout fishing takes place within estuaries or on the coast, and no management measures or cost impacts are anticipated for wild salmon and sea trout fisheries as a result of the establishment of potential MPAs in Scottish waters.

C.7.4 Assumptions on Future Activity

The baseline review did not identify any clear future trends for commercial fisheries. Total fishery landings and employment in the fishing industry have been fairly stable since the mid-2000s. Species-specific quotas may be raised or lowered according to stock status and scientific advice, and stock size may change over time, but this is difficult to predict and a species- and area-specific analysis of this type, which would require bio-economic modelling to predict the response of individual fleet *métiers* and stocks to management measures under the Reformed CFP, is beyond the scope of this study. As a result of the lack of conclusive evidence on any clear direction for future trends, it has been assumed that the location and intensity of commercial fisheries activities do not change significantly over the period of the assessment. This assumption is consistent with that adopted for the Marine Conservation Zones (MCZs) in England which assumed the spatial distribution and value of landings would remain constant over the 20-year timeframe of the assessment, due to the lack of micro-scale forecasts of future activity (Finding Sanctuary *et al.,* 2012).

C.7.5 Potential Interactions with MPA Features

The principal impacts to proposed Nature Conservation MPA features from commercial fisheries activity relate to habitat damage as a result of mobile gears being drawn across the seabed. This principally relates to dredges and trawls (otter trawl for whitefish and *Nephrops* and beam trawl). Demersal seine nets are also drawn across the seabed and may cause damage to sensitive features, but the scale of impact is generally less than for trawled gear. Some particularly sensitive features, such as seamount communities, coral gardens and deep-sea sponge aggregations (vulnerable marine ecosystems) may also be vulnerable to the use of demersal static gear such as nets, lines and pots. Other biogenic features in inshore areas such as serpulid aggregations may be sensitive to pots being set on them, and they may also be dragged across the seabed when hauled.

C.7.6 Assumptions on Cost Impacts for Scenarios

It is assumed that the impact of commercial fisheries activities on MPA features will be managed through a range of fisheries-related measures or under Marine Conservation Orders where necessary:

- Inshore Fishing Orders (0–6nm);
- Several and Regulating Orders for a range of shellfish species;
- Marine Conservation Orders;
- CFP measures (beyond 6nm and offshore sites).

Three scenarios ('lower', 'intermediate' and 'upper') have been developed to capture the possible costs of proposed MPAs to the sector, on a site-by-site basis. The main cost impact to the sector that has been quantified is the value of landings from the proposed MPA area that would be lost if the proposed MPA were to be designated under the different scenarios, assuming all landings, derived from the affected area and gear types, are lost.

The management measures were identified on a feature-by-feature basis within each site, and feature extents were differed between the three scenarios where there was uncertainty in feature extents (see Appendix B).

Management measures by feature for each scenario for offshore proposed MPAs were identified by JNCC in a series of 'Management Option summaries for the Impact Assessment' documents (versions 0.6, dated 17 April 2013), and further developed by the study team, where necessary. For the inshore proposed MPAs, SNH identified the likely management option (none, reduce or remove the pressure) for different gear groups (e.g. demersal active/mobile gear, static gear) and the likely extent of management based on feature distribution and known management measures, for most features. The SNH-identified options were interpreted and used for the 'intermediate' scenario in each proposed MPA, with lower and upper scenarios developed to take into account the range of possible management measures. For some scenarios for a small number of sites, where the large number of features in some proposed MPAs (particularly inshore MPAs) would have resulted in a complex mosaic of management measures for different gear types, this has been simplified for the purposes of assessment, and also reflects management measures that would be possible to implement in practice. Lower scenarios were developed for offshore sites where JNCC had not identified a lower scenario.

The assumptions on management measures under the different scenarios have been developed by the study team for the purposes of the assessment of potential cost impacts to encompass the range of value of landings that may be affected and do not pre-judge any future site-specific management measures. The actual management measures that will be applied in NC MPAs will be developed through a further process of stakeholder consultation on a site-by-site basis, and may differ from the assumptions on management measures used in this assessment.

Where SNH/JNCC management advice indicated a 'partial closure' to certain gear types across a feature, the impact has been assessed as 50% of the value of landings from those gear types from across the feature. In practice, implementation of a 'partial closure' may be more or less than 50%, and the exact extent of it would be developed on a site-by-site and feature-by-feature basis in consultation with the industry.

Management measures were applied to specific gear types based on evidence regarding feature sensitivity to the pressures caused by those gear types. The following gear categories were used in the assessment, based on categories provided by Marine Scotland:

- Whitefish trawls;
- Whitefish seines;
- Nephrops trawls;

- Nephrops seines;
- Beam trawls;
- Other trawls;
- Other seines;
- Pelagic trawls and seines;
- Nets;
- Lines;
- Dredges;
- Pots;
- Other.

Mobile demersal (bottom contact) gears include whitefish trawls, whitefish seines, nephrops trawls, nephrops seines, beam trawls, other trawls, other seines and dredges. Static demersal gears include nets, lines and pots.

Examples of the type of management measures applied under the lower, intermediate and upper scenarios are detailed below. Specific management assumptions for each scenario are defined in the MPA Site Reports (Table 4, Appendix E).

Lower Scenario

- Management measures by feature may range from:
  - No additional management measures required;
  - Reduction in pressure where fishing activity interacts with sensitive/high risk features;
  - Zoned management (prohibition of fishing activity that interacts with sensitive/high risk features only in the areas within a proposed MPA where those features are present).

Intermediate Scenario

- Management measures by feature may range from:
  - No additional management measures required;
  - Zoned management (prohibition of fishing activity that interacts with moderately sensitive/moderate risk features only in the areas within a proposed MPA where those features are present), and may allow fishing to continue across a portion of the feature area;
  - Closure to certain gear types where fishing activity interacts with moderately sensitive/moderate risk features, either across the feature extent or across the whole MPA area.

Higher Scenario

- Management measures by feature may range from:
  - No additional management measures required;

- Zoned management (prohibition of fishing activity that interacts with moderately sensitive/moderate risk features only in the areas within a proposed MPA where those features are present);
- Total closure across whole proposed MPA extent.

The assessment may anticipate that there will be no cost impacts on the sector under some scenarios; this does not preclude the future adoption of management measures for these sites. Management measures may be required, for example to limit further expansion of fishing effort, which would not result in any reduction in the value of landings under the assessment methodology used here. Additionally, even where management measures are assessed in this study, it may be possible to implement them, in consultation with the industry, in such a way that cost impacts to the industry are minimised or reduced.

C.7.7 Assessment Methods

C.7.7.1 Loss of the Value of Landings

Where required, it is assumed that the following costs may be incurred:

- Spatial restriction of activities – site specific determination.

Assessment of the cost to the commercial fisheries sector of spatial restriction of fishing activities is in terms of the loss of the value of landings from the area to be closed to fishing (by gear type).

This was assessed quantitatively:

- For UK over-15m vessels (i.e. for which VMS data are available):
  - Value of landings from the area to be closed, based on annual average landings value adjusted by effort from VMS data for the years 2007 to 2011. The VMS-based landings estimates were calculated by allocating recorded landings in a day between all VMS fishing pings on that day, where a 'fishing ping' has been defined as one where the average speed since the previous ping is greater than zero and up to and including 5 knots for all gear types (including static gear). The effect of this is that the recorded landings by static gears have been allocated between a rather smaller number of pings than would otherwise have been the case, but no information on the landings has been lost. VMS ping data were extracted by Marine Scotland and are estimates of landings value by area of capture. The total annual landings values for each gear type were uprated to 2012 values using GDP deflators and averaged over five years for the final analysis.
- For UK under-15m vessels (i.e. for which VMS data are not available):
  - The value of landings from the ICES rectangles that overlap with the feature area for the years 2007 to 2011 (uprated to 2012 values and averaged over five years), with the value from each ICES rectangle

pro-rated according to the percentage of overlap, by gear type. The spatial resolution of value of landings at ICES rectangle level is not satisfactory for the purposes of assessing management measures across specific feature extents, but these data have been used as they are the official landings data. The ICES rectangle data for the under-15m length group may include cases where information on the vessel length and/or administrative port is missing from landings returns, and therefore may over-estimate impacts to the under-15m sector, particularly for some offshore sites. Provisional ScotMap data by gear type have been used to ground-truth the estimates from the ICES rectangle data, to identify where the ICES estimates are over- or under-estimates, based on the spatial distribution of the average annual earnings from ScotMap within an ICES rectangle, and on whether ScotMap indicates that a gear type is used within a proposed MPA or not. Where available, locality-specific information on fishing locations of the inshore fleet, e.g. from fishing activity maps, and information on known management measures, also informed the analysis.

- For non-UK vessels:
  - Value of landings data for non-UK vessels are not available for vessels that land into non-UK ports. Such data would have to be obtained from the flag states' fisheries authorities. The scope and timeframe of the project does not allow for this to be comprehensively undertaken. VMS ping data held by Marine Scotland for foreign vessels fishing in Scottish waters for 2012 were analysed to provide an indication of the number of vessels active in each proposed MPA. Likely gear types were identified by linking vessel identifiers to the EU Fleet Register database, using the most recent entry in the Fleet Register for that vessel. Vessels may have more than one gear type, so it was assumed that the most recent primary gear type as identified in the EU Fleet Register was used. No information on gear type was available for non-EU countries (specifically Norway, Faroe Islands and Greenland), and was missing for some EU vessels from the EU Fleet Register. The number of vessels affected by each MPA, by country, has been identified under non-quantified costs, based on known gear types (i.e. the number of vessels active within a proposed MPA area, for the gear types expected to be affected by management measures); and the number of vessels possibly affected has been identified for countries where gear type information was not available.
  - French authorities provided data on vessels active in some proposed MPAs. These data were used to provide additional context and scale of potential impacts on the French fleet. It was not possible to undertake a quantitative analysis as data were not available spatially to allow assessment against feature extents, nor broken down by gear type. Information is therefore provided in the description, and under 'non-quantified costs'. These data were provided for the years 2008 and

2011, the only years available from their information system at the time.

For UK VMS data (>15m vessels), it is not permitted, for reasons of confidentiality, to disclose data on annual landings values for fewer than five vessels. This has meant that for some sites which are fished by less than five vessels >15m (Barra and Hebrides Terrace Seamount, North-east Faroe Shetland Channel and Rosemary Bank Seamount) it has not been possible to disclose annual average landings. However, information on annual GVA has been presented for these sites, because these estimates have been derived using gear specific multipliers such that it is not possible to back-calculate to determine annual average landings. For other sites, estimates of annual average landings broken down by gear type are presented where this is not disclosive. This has sometimes required aggregation of affected gear types to avoid inappropriate disclosure.

C.7.7.2 Estimating the Impact of Lost Landings on Gross Value Added (GVA) and Employment

The potential costs of designation on the commercial fisheries sector are different in nature from those faced by most other sectors. For most sectors the potential costs of designation reflect potential increases in operating costs (e.g. additional costs of applying for licences, additional survey costs). For commercial fisheries, however, the potential cost of designation is a loss or displacement of current (and future) output, caused by restrictions on fishing activities required to protect vulnerable and sensitive MPA features. Any decrease in output will, all else being equal, reduce the GVA generated by the sector; this is the **direct** effect. If the decrease in output reduces this sector's demand on their suppliers, there will also be knock-on effects on those industries that supply commercial fishing vessels (e.g. diesel suppliers, equipment suppliers, boat manufacturers and repairers and transport providers); this is the **indirect** effect.

Estimating the potential impact of a decrease in output (i.e. lost landings) on the commercial fisheries sector and its downstream supply chain, has therefore involved assessing the:

- direct effect - the reduced contribution of the commercial fisheries sector to the Scottish economy in terms of GVA;
- indirect effect - the knock-on effects on downstream suppliers of the sector in terms of GVA;
- direct and indirect impact on employment – the reduction in employment in the commercial fisheries sector and its downstream supply chain.

Estimating the Direct Impact on GVA

The potential direct reduction in GVA due to the potential reduction in the value of landings has been estimated by applying fleet segment-specific 'GVA/total income' ratios to the value of landings affected. The GVA ratios have been calculated using data on total income and GVA from the Sea Fish Industry Authority Multi-year Fleet Economic Performance Dataset (Seafish, 2013). The GVA ratios are presented in Table C7.5 below.

The Seafish dataset contains financial, economic and operational performance indicators for approximately 30 UK fleet segments for the period 2005–2012 and provides total income and GVA estimates that are specific to individual fleet segments and gear types. The figures presented in Table C7.5 below are mean values of GVA/total income for each gear type, over the period 2007–2011. This period is consistent with that used for the landings data.

Table C7.5 GVA as a percentage of total income, by gear type, 2007–2011

Broad gear type	GVA as a percentage of total income, 2007–2011
Whitefish trawls	40
Nephrops trawls	46
Beam Trawls	36
Other seines	48
Dredges	43
Nets	54
Pots	48
Lines	43

(Source: Study team's calculations, based on Seafish, 2013).

It is clear from Table C7.5 that there are significant differences in the proportion of GVA/total income generated across the different gear types. This illustrates the importance of applying gear-specific estimates as opposed to sector-wide estimates.

Estimating the Direct and Indirect Impacts on GVA and Employment

The potential direct and indirect impacts of a reduction in output on GVA and employment has been assessed by applying the relevant multipliers from the Scottish Government's Input-Output Tables and Multipliers. These provide a complete flow of the goods and services in the Scottish economy and details the relationship between producers and consumers and the interdependencies of industries. The industry linkages are summarised as Type I and Type II Output, Employment, Income and GVA Multipliers and Effects. Type I multipliers sum together the direct and indirect effects while Type II multipliers also include induced effects.

The Scottish Government has recently revised its Input-Output Tables and Multipliers for Scotland (May 2013). The latest tables and multipliers relate to 2009. These are the first Scottish tables to implement the change to the new Standard Industrial Classification (SIC) of Economic Activities 2007. This classification change was effective from 1st January 2008 and represents a major revision of the classification system, motivated by the need to adapt the classifications to changes in the world economy. A major reworking of the Scottish Input-Output systems was required to produce tables using the new SIC (2007) Input Output Categories. Under the 2007 SIC, sea fishing is classified as 'Marine Fishing and Freshwater Fishing' (Division A, group 03, class 03.1).

The relevant 2009 Type I GVA multipliers and employment effects that have been applied are presented in Table C7.6 below.

Table C7.6 Marine Fishing and Freshwater Fishing: Type I and Type II GVA Multipliers and Employment Effects (Scotland 2009)

Sea Fishing Industry (3.1)	GVA Multiplier	Employment Effect
Type I	1.5	15.5

(Source: Scottish Input-Output Tables, 2009, published May 2013).

The GVA Multiplier is expressed as the ratio of the direct and indirect GVA change to the direct GVA change, due to a unit change in Final Demand. By applying the multiplier to the estimate reduction in GVA for the industry, it is possible to estimate the reduction in GVA for the economy as a whole. It is important to note that designation of the possible MPAs would not result in a reduction in the final demand for fish. Rather, by restricting fishing activity it would reduce the volume of fish landed and constrain the ability of Scottish fleet to supply the demand. If there is a genuine fall in the supply of Scottish fish, it can be assumed that the reduction in output is 'similar' to a fall in Final Demand. This assumes that the price of fish does not increase to offset the reduction in the value of landings.

The Employment Effect shows the direct plus indirect employment change to a direct output change due to a unit change in Final Demand. By multiplying the reduction in output (i.e. value of landings affected) by the Employment Effect for the sector, it is possible to estimate the direct and indirect reduction in employment that would result from the potential reduction in output). Another supply chain that is relevant in assessing the potential economic impact of designation is the supply of fish by commercial fishing vessels to fish processing facilities, hotels/restaurants and the wholesale and retail trades. Management measures that restrict commercial fishing activity have the potential to reduce the quantity of fish and shellfish landed locally at Scottish ports and hence to reduce the supply of locally-landed catch to these industries.

The potential cost of designation on the fish processing industry has been estimated in terms of the value of potential landings lost, by port of landing. Again, these have been assessed on a gear-specific (to the extent disclosure restrictions allow) and feature-by feature basis. The potential impacts on GVA and employment in the fish processing sector, from a reduction in the volume of locally landed fish, have not been assessed. This reflects the fact that:

- Designation would not reduce the final demand for fish. With no change in final demand, it can be assumed that fish processors will attempt to offset the

reduction in locally-landed supplies by importing a greater volume of imported fish; and
- Estimating the reduction in GVA and employment in this sector would also estimate the reduction in the commercial fisheries sector as an indirect effect, and hence would result in double counting.

All of the quantified impacts on the commercial fishing sector (whether in terms of value of affected landings, GVA or employment) assume that all affected fishing activity is lost, that is, that there is no adaption within the site or displacement of fishing activity to other grounds. This represents the worst-case impact and in reality, vessel owners are likely to try and adapt within the site (e.g. by changing gear type or target species), if that is possible, or, search for alternative fishing grounds in an attempt to maintain profitability. It is difficult to forecast the scale and nature of adaption or displacement of fishing activity that would occur and hence estimate, even qualitatively, the extent to which this would offset the reduced value of landings generated by MPA designation. This will depend on an array of different factors, for example:

- the availability of alternative fishing grounds;
- whether vessels change gear type and target species;
- the relative catch rates and associated profitability of the new fishing grounds; and
- the effect on other vessels fishing in these grounds.

There are also costs associated with adaption and displacement (such as the costs of developing new gear types and changing gears, increased fuel costs from longer steaming times, changes in costs and earnings patterns of individual vessels, possible additional quota and days at sea costs) and in some cases there may be a lack of suitable alternative fishing grounds. Displacement can also generate conflict between vessels displaced to a new site and vessels previously fishing in that site (or indeed reduce conflict if some gears are prohibited); as well as causing environmental impacts through targeting of new areas. In light of the difficulties involved in assessing the scale of adaption/displacement of fishing activity and the associated costs, these aspects have not been quantified.

C.7.8 Limitations

- The extent to which displacement of activity will occur (rather than loss of the value of landings) is uncertain. The quantification of cost impacts to the sector assumes that all affected fishing activity is lost. In reality, it is likely that some displacement would occur. The cost estimates presented for this sector, therefore, represent worst case estimates.
- The quantification of cost impacts to the sector is restricted to UK vessels, as comprehensive data on non-UK vessels were not available to allow quantification of impacts on a feature-by-feature basis. Impacts on non-UK vessels were assessed qualitatively and in terms of the number of vessels likely to be affected by proposed management measures.

- Spatial resolution of data on under-15m vessels is not sufficient for an accurate assessment of cost impacts to this fleet segment, and the 'under-15m' length group may include cases where information on vessel length and/or administrative port were missing on landings returns, particularly for offshore sites. Gear-specific estimates of landings from ScotMap data have been used to check ICES rectangle landings-based estimates, however, due to the provisional nature of the dataset, and the low level of coverage in some regions, ScotMap data have not been used to estimate the value of landings affected under the scenarios.
- VMS-based estimates of the value of landings may over- or under-estimate the costs to the sector.
- To avoid inappropriate disclosure, some annual average loss of landings figures cannot be presented and for others, affected gear types have been grouped.
- The requirements for management measures are uncertain, and the management measures assessed under the scenarios do not reflect the actual management measures that may be adopted on a site-by-site basis following further consultation.
- As the value of future landings cannot be forecast, it is assumed that the value of landings are constant over time. The average value of landings per year estimated for each MPA is therefore assumed to be the same in each of the 20 years covered by the IA. In reality, it is likely that the value of landings in each MPA will fluctuate over time and hence the estimated loss in landings may underestimate or overestimate the true future value of landings. As the GVA and employment estimates are based on the value of affected landings the same limitation applies.
- Although the Sea Fish Industry Authority Costs and Earnings Survey (Seafish, 2013) represents the best data available to estimate GVA on a sector-specific basis, the data have some limitations. For example, the total income, operating profit and crew share data includes income earned by fishing vessels from sources other than fishing (e.g. towage activities, selling quotas and days at sea). The VMS estimates do not include non-fishing income and this mismatch may overestimate or underestimate the impact on GVA for some fisheries. Non-fishing income, however, tends to be a fairly insignificant proportion (0%–10%) of total income.
- The multipliers used to estimate the indirect GVA impacts and the direct plus indirect employment effect, that could be generated from the estimated reduction in the value of landings, relate to 'Marine Fishing and Freshwater Fishing' and not the specific gear types affected. They may, therefore, underestimate or overestimate the impacts. The multipliers – which are national multipliers – have been applied at the MPA level and regional/port level to estimate the economic impacts by MPA and by region/port. Local and regional multipliers are not available and hence the application of national multipliers may overestimate or underestimate the impacts. Finally, application of the multipliers also assumes that a reduction in output is similar to a change in Final Demand and that there is no rise in the price of fish to offset the reductions in the value of landings.

C.7.9 References

ABPmer and RPA, 2012. Socio-economic baseline reviews for offshore renewables in Scottish waters. Volume 1: Main text. Report R.1905, September 2012.

ABPmer & RPA, 2013. Developing the Socio-Economic Evidence Base for Offshore Renewable Sectoral Marine Plans in Scottish Territorial Waters.

Baxter, J.M., Boyd, I.L., Cox, M., Donald, A.E., Malcolm, S.J., Miles, H., Miller, B., Moffat, C.F., (Editors), 2011. Scotland's Marine Atlas: Information for the national marine plan. Marine Scotland, Edinburgh.

British Ports Association (BPA), 2008. 'Scottish Ports Committee Ports In Scotland "Delivering Value".

Brown A., 2009. 2008 Survey of the UK Seafood Processing Industry. Published by Seafish. 104 pages.

Finding Sanctuary, Irish Seas Conservation Zones, Net Gain and Balanced Seas, 2012. Impact Assessment materials in support of the Regional Marine Conservation Zone Projects' Recommendations. Annex H7.

JNCC, 2011. Stanton Banks Site of Community Importance (SCI) Common Fisheries Policy (CFP) MAIA1 fisheries management workshop minutes. Available at http://www.maia-network.org/upload/iedit/10/403_1637_Stanton_Banks_SCI_Minutes_v3.pdf.

Marine Scotland, 2011. Scottish Sea Fisheries Statistics 2010. Published by Marine Scotland, The Scottish Government, September 2011 DPPAS11957 (08/11). 92 pages.

Scottish Government, 2010. Future of Fisheries Management in Scotland.

Scottish Government, 2011. Salmon Fishery Statistics – 2010 Season. Topic Sheet No. 68 v2. 4 pages.

Scottish Government, 2012a. Scottish Sea Fisheries Statistics 2011. Available at http://www.scotland.gov.uk/Publications/2012/09/1840

Scottish Government, 2012b. Scottish Annual Business Statistics 2010. Available at http://www.scotland.gov.uk/ Topics/Statistics/Browse/Business/SABS.

Scottish Government, 2013. Input-Output Tables and Multipliers for Scotland, 1998-2009. Available at http://www.scotland.gov.uk/Topics/Statistics/Browse/Economy/Input-Output.

SeaFish, 2013. Seafish Multi-Year Fleet Economic Performance Dataset. Sea Fish Industry Authority.

UKMMAS, 2010. Charting Progress 2 Feeder Report Productive Seas. Department for Environment Food and Rural Affairs on behalf of UKMMAS (Eds. Saunders, J. and McKie, J.). United Kingdom Marine Monitoring and Assessment Strategy. 472 pages. Available online: http://chartingprogress.defra.gov.uk/

C.8. Energy Generation

C.8.1 Introduction

This appendix provides an overview of existing and potential future activity for the energy generation sector in Scotland and outlines the methods used to assess the impacts of potential MPAs on this sector.

C.8.2 Sector Definition

The energy generation sector includes conventional energy generation (coal, gas, nuclear, etc.) as well as offshore renewables (offshore wind, wave and tidal) and marine biofuel (the production of algal biomass for use as a source of fuel). In addition to the power generation assets themselves, it also incorporates supply chains for renewables along with transmission capacity.

C.8.3 Overview of Existing Activity

Information sources used in the assessment are listed in Table C8.1.

Table C8.1 Energy Generation Information Sources

Scale	Information Available	Date	Source
Scotland	Amount of electricity generated by energy source in Scotland (Scottish Environmental Statistics Online)	2009	Scottish Government Statistics
Scotland	National Renewables Infrastructure Plan	2010	SE & HIE (2010)
Scotland	Blue Seas – Green Energy - A Sectoral Marine Plan for Offshore Wind Energy in Scottish Territorial Waters	2010	Scottish Government
Scotland	Potential Development Scenarios for Scottish Offshore Wind Supply Chain	2010	Scottish Renewables (2010)
Scotland	Scotland's Offshore Wind Route Map – Developing Scotland's Offshore Wind Industry to 2020	2010	Offshore Wind Industry Group
Scotland	The Offshore Valuation – A valuation of the UK's offshore renewable energy resource	2010	Public Interest Research Centre on behalf of The Offshore Valuation Group (2010)
Scotland	Scottish Offshore Wind: Creating an Industry to Scottish Renewables	2010	IPA Energy + Water Economics (2010)
Scotland	Information and analysis of wave and tidal market in Scotland	2011	Pure Marine Gen Ltd (2011)
Scotland	Draft Electricity Generation Policy Statement 2010	2010	Scottish Government

Scale	Information Available	Date	Source
Scotland	A Low Carbon Economic Strategy for Scotland	2010	Scottish Government
Pentland Firth and Orkney Waters	Supply Chain Demand - PFOW Round 1 Wave and tidal Projects	2011	BVG Associates (2011)
West Coast	Scottish Offshore Renewables Development Sites	2011	Scottish Development International, Highlands and Islands Enterprise, and Scottish Enterprise (2011)
Scotland	Scotland's Renewable Energy Potential: realising the 2020 target	2005	Scottish Executive (2005), Future Generation Group Report
Scotland	Scottish Renewable Energy Generation Capacity	2010	Scottish Renewables
Scotland	Interim Great Britain Seven Year Statement	2004	National Grid (2004)
Scotland	Scottish and Southern Energy plc Annual Report 2011	2011	Scottish and Southern Energy plc (2011)
UK	Marine Renewable Energy Atlas. Direction, speed, potential output and temporal variation (gridded square)	Current	ABPmer
UK	Wind farm turbine locations (point)	Current	E.ON
UK	Wind farm cable routes (R3 most likely routes) (polygon)	Current	E.ON
UK / Scotland	Existing wave and tidal lease areas	Current	The Crown Estate
Scotland	Existing wind farm locations	Current	Marine Scotland
Scotland	Proposed wind farm lease areas	Current	Marine Scotland
Scotland	Proposed wave and tidal lease areas	Current	Marine Scotland
UK	UK offshore wind and wind development rounds	Current	Renewable UK (www.renewableukcom/en/renewable-energy/wind-energy/offshore-windd/development-rounds.cfm; www.renewableukcom/en/renewable-energy/wind-energy/offshore-windd/index.cfm
UK	Digest of UK Energy Statistics 2012	2012	DECC (www.gov.uk/government/organisations/department-of-energy-climate-change/series/digest-of-uk-energy-statistics-dukes)
UK and Regional	National and Regional Renewables Statistics	2011	DECC (https://restats.decc.gov.uk/cms/national-renewables-statistics ; https://restats.decc.gov.uk/cms/regional-renewables-statistics)
UK	Renewable Energy Planning Database	Current	DECC (https://restats.decc.gov/uk/cms/planning-database)
UK	Location of coastal power stations extracting seawater for cooling	Current	CP2/ABPmer

Scale	Information Available	Date	Source
UK	Location of existing nuclear power stations	Current	CP2/ABPmer

C.8.3.1 Conventional electricity generation

At the end of March 2013 Scotland had four major coastal power stations in operation:

- Hunterston B in West Scotland: a nuclear power station commissioned in 1976 with an installed capacity of 820 MW;
- Torness in East Scotland: a nuclear power station commissioned in 1988 with an installed capacity of 1,230MW;
- Peterhead in North East Scotland: a gas/oil power station originally commissioned in 1980 with an installed capacity of 2,370 MW but limited to 1,540 MW due to transmission constraints. (It should be noted that since commissioning, various upgrading and conversion works have taken place. Also, two 250 MW gas turbines were decommissioned in 2009[35]); and
- Longannet in East Scotland: a coal fired power station which was commissioned in 1970 with an installed capacity of 2,304 MW.

Cockenzie Power Station closed on 15th March 2013. The locations of existing operational coastal power stations are shown in Figure C11.

C.8.3.2 Offshore Renewable Energy

Offshore renewable energy sources currently exploited include offshore wind, wave and tidal energy. Scotland currently has two operational offshore wind sites: the Beatrice demonstrator project (two 5 MW turbines) and Robin Rigg (180 MW capacity) (IPA Energy + Water Economics and Scottish Renewables, 2010). The EMEC test centre, operational since 2003, provides a testing facility for wave and tidal devices. The Islay LIMPET wave device was the world's first commercial wave power device connected to the United Kingdom's National Grid. Following the construction of a 75 kW prototype in 1991, a 500 kW unit was built in 2000. Other full scale devices installed or currently operating in Scottish Waters include the following wave and tidal devices (Renewable UK, 2013):

Tidal
- HS1000 (Andritz Hydro Hammerfest) – Fall of Warness, EMEC;
- Open Centre turbine (OpenHydro) – Fall of Warness, EMEC;
- SR250 (Scotrenewables Tidal Power) – Fall of Warness, EMEC; and
- DeepGen 1MW (Alstom) – Fall of Warness, EMEC.

35 See Engineering Timelines: http://www.engineering-timelines.com/scripts/engineeringItem.asp?id=988.

Wave
- Oyster 800 (Aquamarine Power) – Billia Croo, EMEC;
- Pelamis P2 (E.ON) – Billia Croo, EMEC;
- Pelamis P2 (ScottishPower Renewables) – Billia Croo, EMEC;
- Oceanus (Seatricity) – Billia Croo, EMEC; and
- Penguin (Wello) – Billia Croo, EMEC.

While the number of operational developments is small, within Scottish Territorial Waters, there are currently plans to install up to 4.4GW capacity of offshore wind in five short-term option sites (Argyll Array, Beatrice, Inch Cape, Islay, Neart na Gaoithe), together with a further 4.8GW capacity within two Round 3 sites in offshore waters (Moray and Firth of Forth). The European Offshore Wind Deployment Centre off Aberdeen has also recently secured consent. A large number of wave and tidal developments are also in planning, particularly associated with the Pentland Firth and Orkney Waters lease areas and lease awards made in relation to the Saltire Prize (see Table C8.2).

Current and planned offshore renewable energy generation sites in Scotland are presented in Figure C11.

Table C8.2. Planned wind, tidal and wave renewable energy projects around Scotland and within Scottish Territorial Waters as at 29 May 2013

Energy Type	Name/Location	Company (Project Website)	Status	Capacity (MW)
Wind	Robin Rigg, Solway Firth	E.ON Climate & Renewables (http://.eon-uk.com/generation/robin rigg.aspx)	Operational since Sep 2010.	90
Wind	Firth of Forth	SSE Renewables (http://www.seagreenwindenergy.com/ home.asp)	Pre-consent. Agreement to lease secured. ES for Phase 1 submitted Oct 2012. Scoping Report submitted for Phases 2 and 3.	3,465
Wind	Moray Firth	EDPR and Repsol Nuevas Energias UK (http://www.morayoffshorerenewables.com/Home.aspx)	Pre-consent. ES submitted in Aug 2012.	1,300
Wind	Argyll Array, Tiree	Scottish Power Renewables (http://www.argyllarray.com)	Pre-consent. Project currently on hold (Dec 2012).	1,800
Wind	Beatrice, Outer Moray Firth	Airtricity Holdings UK Ltd and Repsol Nuevas Energias UK (http://www.sse.com/Beatrice/Project Information)	Pre-consent. ES submitted Apr 2012.	920
Wind	Inch Cape	Repsol Nuevas Energias UK (http://www.inchcapewind.com)	Pre-consent. Scoping Report submitted Aug 2010.	905
Wind	Islay	Airtricity Holdings UK Ltd (http://www.sse.com/Islay/Project	Pre-consent. Agreement to lease	680

Energy Type	Name/Location	Company (Project Website)	Status	Capacity (MW)
		Information)	secured Oct 2011.	
Wind	Neart na Gaoithe	Mainstream Renewable Power Ltd (http://www.neartnagaoithe.com)	Pre-consent. ES for submitted Jul 2012.	450
			Wind Total	**9,610**
Tidal	Sound of Islay	Scottish Power Renewables (http://www.scottishpowerrenewables.com/pages/sound_of_islay.asp)	In planning. Consent granted Mar 2011. Awaiting construction.	10
Tidal	Kyle Rhea	SeaGeneration (MCT) (http://www.seagenkylerhea.co.uk/progress.php)	In planning. Agreement to lease secured. ES submitted.	8
Tidal	Westray South, Pentland Firth	SSE Renewables (http://www.sse.com/WestraySouth/ProjectInformation)	In development. Agreement to lease secured. Scoping Report submitted Nov 2011.	200
Tidal	Cantick Head, Pentland Firth	Cantick Head Tidal Development Ltd (SSE Renewables & OpenHydro) (http://www.sse.com/CantickHead/ProjectInformation)	In planning. Agreement to lease secured.	200
Tidal	Brough Ness, Pentland Firth	SeaGeneration Ltd (MCT)	In planning. Agreement to lease secured.	100
Tidal	Inner Sound, Pentland Firth	MeyGen Ltd (http://www.meygen.com/the-project/current-status)	In development. Agreement to lease secured. ES submitted. Phase 1 application submitted Jul 2012.	400
Tidal	Ness of Duncansby, Pentland Firth	Scottish Power Renewables (http://www.scottishpowerrenewables.com/pages/ness_of_duncansby.asp)	In development. Agreement to lease secured.	100
Tidal	Bluemull Sound, Shetland	Nova Innovation (http://www.novainnovation.co.uk/index.php/tidal)	In planning. Agreement to lease secured Oct 2011. Deployment planned for 2014/15.	0.5
Tidal	Ness of Cullivoe, Shetland	Nova Innovation (http://www.novainnovation.co.uk/index.php/media-menu/14-nova-30-crown-estate-lease)	In planning. Agreement to lease secured May 2011.	0.03
Tidal	Esk Estuary, Montrose	GSK and Swan Turbines (http://www.swanturbines.co.uk)	In planning. ES submitted.[10,19]	0.67
Tidal	Mull of Kintyre, Argyll	Nautricity	In planning. Agreement to lease secured.	3
Tidal	Sanda Sound	Oceanflow Energy (http://www.oceanflowenergy.com/project-details2.html)	In planning. Agreement to lease secured. Test device to be deployed late 2012.	0.035

Energy Type	Name/Location	Company (Project Website)	Status	Capacity (MW)
Tidal	Isle of Islay	DP Marine Energy and DEME Blue Energy (http://www.westislaytidal.com)	In planning. Agreement to lease secured.	30
Tidal	Fall of Warness	European Marine Energy Centre Ltd	Operational (test site).	N/A
Tidal	Shapinsay Sound	European Marine Energy Centre Ltd	In planning (test site).	N/A
			Tidal Total	**1,052**
Wave	Isle of Lewis (North West Lewis)	Aquamarine Power (http://www.aquamarinepower.com/projects/north-west-lewis)	In planning. Agreement to lease secured. Consent granted Sept 2012.	40
Wave	South West Shetland	Aegir Wave Power (Pelamis Wave Power & Vattenfall) (http://www.aegirwave.com)	In development. Agreement to lease secured May 2011.	10
Wave	Costa Head, Pentland Firth	SSE Renewables & ALSTOM UK (http://www.sse.com/CostaHead/ProjectInformation)	In development. Agreement to lease secured.	200
Wave	Marwick Head, Pentland Firth	Scottish Power Renewables (http://www.scottishpowerrenewables.com/pages/marwick_head.asp)	In development. Agreement to lease secured.	50
Wave	Brough Head, Pentland Firth	SSE Renewables & Aquamarine Power (http://www.aquamarinepower.com/projects/west-coast-orkney)	In development. Agreement to lease secured. Scoping Report submitted Aug 2011.	200
Wave	West Orkney Middle South (WOMS) and South (WOS), Pentland Firth	E.ON Climate and Renewables and Pelamis (WOS) (http://www.eon-uk.com/generation/OrkneyWaters.aspx)	In development. Agreement to lease secured. WOS Scoping Report submitted Mar 2012.	100
Wave	Farr Point, Pentland Firth	Ocean Power Delivery Ltd (Pelamis) (http://www.pelamiswave.com/our-projects/project/5/Farr-Point-Wave-Farm)	In development. Agreement to lease secured. Scoping process initiated Apr 2011.	50
Wave	Bernera, Isle of Lewis	Pelamis Wave Power (http://www.pelamiswave.com/our-projects/project/4/Bernera-Wave-Farm)	In planning. Agreement to lease secured Oct 2011.	10
Wave	Burghead, Moray Firth	AWS Ocean Energy	In planning. Agreement to lease secured.	0.5
Wave	Galson, Isle of Lewis	Lewis Wave Power Limited	In planning.	10
Wave	Siadar, Isle of Lewis	Voith Hydro Wavegen Ltd	In planning.	30
Wave	Billia Croo	European Marine Energy Centre Ltd	Operational (test site).	N/A
Wave	Scapa Flow	European Marine Energy Centre Ltd	In planning (test site).	N/A
			Wave Total	**700**
Source: The Crown Estate (http://www.thecrownestate.co.uk, Accessed 29 May 2013)				

Energy Type	Name/Location	Company (Project Website)	Status	Capacity (MW)
Offshore Wind Energy - http://www.thecrownestate.co.uk/energy-infrastructure/offshore-wind-energy/our-portfolio Tidal and Wave Energy - http://www.thecrownestate.co.uk/energy-infrastructure/wave-and-tidal/our-portfolio				

C.8.3.3 Marine biomass

Rising concern over global warming has encouraged the movement to alternate fuels (Kraan *et al*. 2011). Growth rates of marine macroalgae far exceed those of terrestrial biomass and provide a potential alternative as a biofuel to land-based crops such as corn and sugar cane, and for the production of biogas. Among marine macroalgae, species of the temperate brown algal order Laminariales (so-called kelp species) are among the fastest growing plants in the world (Kraan *et al*. 2011; Kelly and Dworjanyn, 2008). While wild harvest of these species is expected to be unsustainable or only produce insignificant amounts, cultivation is a viable option. Macroalgae are already farmed on a large scale in the Far East for food consumption but to a much lesser extent in Europe, primarily in France (Marine Scotland, 2009).

Within Scotland only research scale developments into seaweed farms are currently being planned, although small scale seaweed harvesting does take place along the West coast where brown, red and green seaweeds are all harvested.

C.8.3.4 Supply chain for offshore renewables

The supply chain for offshore renewables covers all the jobs associated with manufacturing, transporting and installing renewable devices, as well as related tasks such as maintenance, surveying, and operations. This baseline focuses on the main supply chain activities such as the manufacture, installation, operation and maintenance of renewable energy devices.

Although the supply chain for onshore wind is providing jobs across Scotland (Scottish Executive, 2005), development of the fixed offshore wind supply chain has been slow both in the UK and Europe as a whole (Public Interest Research Centre, 2010). However, IPA Energy + Water Economics (2010) report for Scottish Renewables notes that there is existing capacity in the Scottish supply chain for offshore wind. The report also notes the potential for the offshore wind industry to deliver up to £7.1bn of investment and create more than 28,000 FTE jobs. The main strengths of this supply chain are listed as (ibid):

- Offshore engineering with expertise in construction, operations and maintenance, project management and training (due to the offshore Oil and Gas sector);
- Design and development services including consultancy, engineering and project development services;

- Research and development expertise in the private sector, academia and public sector funded programmes;
- Existing port facilities with North Sea access and surrounding offshore service networks; and
- Fabrication and manufacturing of components.

IPA Energy + Water Economics and Scottish Renewables (2010) also note that there is much untapped potential for companies which are not currently involved in the sector. Indeed, stage 1 of the National Renewables Infrastructure Plan (NRIP) identified a list of sites which could be developed to support offshore wind. These included (Scottish Enterprise and Highlands and Islands Enterprise, 2010a):

- Leith – integrated manufacturing;
- Dundee – distributed manufacturing and operation/maintenance;
- Nigg (note that this site has already been used to support the Beatrice Demonstration Project) – integrated manufacturing;
- Energy Park Fife at Methil (some supply chain investment has already occurred here) – further manufacturing;
- Aberdeen – distributed manufacturing and operation/maintenance;
- Hunterston – integrated manufacturing;
- Arnish – distributed manufacturing;
- Campbeltown/Machrihanish (some supply chain investment has already occurred here) – further manufacturing and operation/maintenance;
- Ardersier – integrated manufacturing;
- Peterhead – distributed manufacturing and operation/maintenance; and
- Kishorn – distributed manufacturing.

For the wave and tidal supply chain, site owners at Scrabster and Lyness in Scapa Flow are developing investment proposals so that there is support at these sites for companies awarded leases by The Crown Estate (Scottish Enterprise and Highlands and Islands Enterprise, 2010b).

C.8.3.5 Current economic value and employment

The total amount of electricity generated in Scotland in 2011 was 51,223 GWh, up from 49,992 GWh in 2010[36]. Note however that over the past decade, the total generated has remained reasonably stable, with a high of 52,250 GWh in 2006 and a low of 48,080 GWh in 2007. Looking at the 2011 figure of 51,223 GWh, gross electricity consumption was 37,857 GWh whilst 13,366 GWh were exported from Scotland. Renewable energy generation was 13,728 GWh in 2011, representing 36% of total electricity generated. A comprehensive study by Scottish Renewables showed that during 2011/2012 the renewables industry in Scotland was the largest employer by generation type in Scotland. The industry supported 11,136 FTE jobs, with 943 of those in offshore wind energy and 521 in the wave and tidal energy

[36] All data on electricity generation sourced from DECC via the Scottish Government Energy Statistics Database: (http://www.scotland.gov.uk/Topics/Statistics/Browse/Business/Energy/Database).

sector[37]. This compares with a total for the energy sector as a whole (including water supply) of 42,000 people in 2008 (Scottish Government, 2010a). Although this latter figure represents 1.7% of total employee jobs in Scotland, it does not include those people who work in the supply chain, thus the actual figure[38] could be larger (Scottish Government, 2010a). Given the share of electricity generated by renewables, it is likely that employment related to renewable energy is also larger than the figure quoted, since this only relates to direct employment, and therefore does not consider indirect or knock-on jobs[39].

C.8.3.6 Future trends

C8.3.6.1 Electricity Generation

It has been suggested that significant reductions in Scotland's electricity generating capacity would occur as coal and nuclear power stations closed and the importance of renewables grew (Allan *et al*, 2006). However, in the next few decades, Scotland has the capacity to install offshore renewable generation devices which could produce over 60GW of generating capacity (Scottish Development International *et al*, 2011). Renewable energy is being promoted as an economic opportunity (Verso Economic, 2011). Indeed, the Scottish Government's target is to meet the equivalent of 100% of gross annual electricity consumption from renewables by 2020[40]. Scotland has some of the largest wave and tidal resources found anywhere in the world due to its large coastal exposure and there is the potential to practically and economically extract wave energy equating to around 13GW by 2020 (DECC, 2012).

Based on the offshore wind, wave and tidal developments currently in planning, there is likely to be a significant increase in installed capacity in the period up to and beyond 2020 with potentially up to 9.2GW of offshore wind capacity, 720MW of wave capacity and 1GW of tidal energy capacity (see Table C8.2 above).

In addition, the Scottish Government is considering adopting further plans for offshore wind, wave and tidal development based on up to 28 Draft Plan Option areas (see C11). These Draft Plan Option areas are currently the subject of a Sustainability Appraisal being led by Marine Scotland, with a view to adopting plans for further offshore wind, wave and tidal development in 2014.

There are currently no specific targets for offshore renewables development although Scottish Government (2012) provides projections for 'offshore and onshore'

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37 Scottish Renewables. Scotland's Renewable Energy Sector in Numbers. (http://www.scottishrenewables.com/scottish-renewable-energy-statistics-glance/)

38 Energy in Scotland: A Compendium of Scottish Energy Statistics and Information, Report produced Dec. 2010

39 Note that the Verso Economics figure is taken from a summary report; the full report does not appear to be publicly available. It is therefore not possible to identify the data from which the figure is extrapolated.

40 Scottish Government, Electricity Generation Statement 2012.

wind of 13,000MW installed capacity by 2020 and 16,500MW installed capacity by 2030.

SeaGreen estimate that the first phase of the Firth of Forth Round 3 Offshore Wind Farm (1GW capacity across two wind farms) could inject £315m - £788m to the Scottish economy. Additional ongoing economic benefits would arise over the 25 year operating life of the wind farms. Development of an additional 2.5GW generation capacity in the Firth of Forth Zone would have a further very significant contribution to the Scottish economy. Furthermore, The Crown Estate announced in 2010 that it development rights had been awarded to a number of tidal energy companies for eleven wave and tidal stream energy projects within the Pentland Firth and Orkney waters. The projects have a total potential capacity of 1,600MW, with development expected to take place between 2014 and 2020 (TCE, 2011).

Such confirmed and forecasted developments in the renewables industry around Scotland will result in significant local economic benefits. The final report of the Scottish Islands Renewable Project (Baringa, 2013) predicts that by 2020 up to 392 FTE jobs could be created in the industry in the Western Isles, 463 in Shetland, 416 in Orkney and an additional 3,000 in the rest of Scotland and the UK. By 2030, the report predicts that these numbers could increase to 3,500 in the Western Isles, around 2,900 in Shetland and over 4,500 in Orkney.

C8.3.6.2 Marine biomass

There is currently no clear development plan for marine biofuels, although a number of trials are underway in Scotland (Black, 2011). The Crown Estate estimates that up to 1.5% of the seabed area could be used for macroalgae cultivation. This could give an annual biogas yield equivalent to around 5% of the natural gas consumed in the UK in 2009 (The Parliamentary Office of Science and Technology, 2011). A number of Scottish initiatives are currently underway to demonstrate the viability of producing biofuels from macroalgae and to facilitate the cost effective exploitation of currently under-utilised seaweed resources, notably the Seaweed Anaerobic Digestion and the BIOMARA programmes (FRM, 2010).

C8.3.6.3 Transmission Capacity

Scotland’s transmission grid is mainly made up of 400 kV and 275 kV lines which join the major nuclear and coal-fired power stations in the central belt with the Peterhead plant in North East Scotland (National Grid, 2012). The Scottish grid is connected to the English grid with four transmission lines which form two double circuits; on the East, the circuit operates at 400 kV, whilst on the West part of the circuit operates at 400 kV and the remainder runs at 275 kV (ibid). Connection between Scotland and Northern Ireland is via the 450MW Moyle Interconnector which joins Ballantrae with Ballylumford (National Grid, 2012).

National Grid’s Electricity Ten Year Statement (ETYS) indicates that there is likely to be a need for new infrastructure/reinforcement in many areas of Scotland to ensure that generated power can be transmitted to where it is required, for example, new transmission infrastructure will be necessary to connect power generation around the Western Isles, Orkney and Shetland to the mainland transmission network (National Grid, 2012). Indeed, problems have already occurred in some areas. Within Scotland, wind connection is restricted due to insufficient transmission capacity across the Scottish border, with 16 GW of wind awaiting connection in 2007 (Public Interest Research Centre, 2010). There are also issues with congestion in the power transmission network between the North and the South of the UK (Public Interest Research Centre, 2010). However, plans do exist to increase the capacity of transmission lines from Scotland to both England and Northern Ireland, as well as for a new major transmission line to Norway (Scottish Development International *et al*, 2011). In addition, there are plans for around 1,800MW of subsea lines along the West and East coasts of Scotland (Scottish Development International *et al*, 2011), whilst plans for a strategic set of grid upgrades across Scotland are already progressing (Scottish Government, 2010b). It is therefore likely that the future trend in transmission capacity will be upwards.

It should however be noted that transmission capacity is complicated by the variability in generation which renewables provide (Public Interest Research Centre, 2010). Despite this, it is stressed by the Scottish Executive (2005) that transmission capacity has to be built on the basis of firm development proposals, rather than on the expectation that new or developing technologies will eventually be put in place. It is anticipated that energy generation companies will collaborate rather than compete on grid connection to ensure economies of scale are achieved. This is likely to be critical given that the best sources of renewable energy are typically located at the edges of the current grid network, rather than the centre (Scottish Government, 2011).

C8.3.6.4 Supply Chain for Renewables

It is believed that there is already a strong supply chain due to the well-established and experienced oil and gas sector (Scottish Development International *et al*, 2011). However, although several locations can deal with operations and maintenance, the future requirements of the renewables supply chain cannot yet be fully met at any one of Scotland's ports[41] (Scottish Enterprise and Highlands and Islands Enterprise, 2010a; 2010b). Plans are currently being developed for offshore wind manufacturing facilities at Leith and Ardersier, together with the creation of an offshore wind O&M facility at Dundee.

For wave and tidal development, facilities have already been developed at Scrabster and Lyness to support developments within the Pentland Firth. Further local development is also likely to occur to support development on the West Coast.

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41 Note that the National Renewables Infrastructure Plan (NRIP) is intended to deal with this issue through focusing on several supply chain ports.

C.8.4 Assumptions on Future Activity

It is assumed that coastal power stations will be decommissioned in accordance with current decommissioning timetables which are currently projected as Hunterston B 2016, Torness 2023, Peterhead (not known), and Longannet between 2020 and 2025. It is assumed that no new coastal power stations are built that interact with possible MPAs. It is assumed that no major marine biofuel sites are established within possible MPAs within the period of the assessment.

For offshore renewables, the following assumptions are made:

- The five sites identified in the current Plan for Offshore Wind in Scottish Territorial Waters (Scottish Government, 2011) that are being progressed will be built in line with current capacity and programme estimates;
- The two R3 OWF sites (Firth of Forth and Moray) will be built in line with current capacity and programme estimates;
- Wave and tidal sites with existing ‘agreements for lease’ will be developed in line with current capacity and programme estimates; and
- Development will also take place within the recently identified Draft Plan Option areas for offshore wind, wave and tidal development with assumed construction taking place between 2022 to 2025, based on the central case applied in the socio-economic assessment for offshore Renewable Sectoral Marine Plans (ABPmer & RPA, 2013). This study assumes development of 7GW offshore wind, 1.25GW wave and 1.25GW tide between 2020 and 2030. Indicative cable routes to shore have also been assumed based on ABPmer & RPA (2013).

C.8.5 Potential Interactions with MPA Features

Coastal power stations may interact with Scottish NC MPA features as a result of abstraction and discharge of cooling water and associated discharges. In normal operation, the buoyant nature of cooling water discharges should mean that there is little if any interaction with seabed habitats beyond the immediate vicinity of the outfall. The discharge of substances associated with the operation of coastal power stations (cleaning agents, corrosion inhibitors, biocides, sewage) in accordance with permit conditions should not pose significant risks to MPA features. However, there is some potential for accidental releases to affect MPA features.

The planning, construction, operation and decommissioning of offshore renewables development has the potential to affect MPA features through a number of impact pathways. In particular, the construction of infrastructure on the seabed may directly or indirectly change existing seabed substrates and/or lead to smothering of sensitive habitats as a result of sediment plumes. Significant levels of underwater noise may be generated during construction, depending on the methodologies used. This may pose significant risks to hearing-sensitive species, particularly fish. The presence of structures above and below sea level may pose a collision risk to mobile species (e.g. fish, birds). The transmission of electricity through seabed cables during the operational phase has the potential to introduce electromagnetic fields into the marine environment with the potential to affect electro- and magneto-sensitive species.

C.8.6 Assumptions on Cost Impacts for Scenarios

It is assumed that the impact of energy generation activities on MPA features will be managed through the existing marine licensing framework. Two scenarios ('lower' and 'upper') have been developed to capture the possible costs of potential MPAs to the energy generation sector. These scenarios include potential costs associated with additional assessments required to inform decisions on consent and licence applications and associated survey requirements.

It has been assumed that there will be no review of existing consents or licences, although where existing offshore energy installations apply for new consents or licences, these applications will be considered against the conservation objectives for features for which MPAs may have been designated.

The intermediate ('best') estimate for each site has been based on SNH/JNCC current views on management options and judgements made by the study team. The assumptions do not pre-judge any future site-specific licensing decisions. After MPA designation, the management of activities in MPAs will be decided on a site-by-site basis and may differ from the assumptions in this assessment.

It is assumed that repowering and/or decommissioning of offshore renewables developments will take place after 25 years. This will occur outside of the 20 year assessment period for all developments that may interact with MPAs and has therefore not been considered further in the assessment.

It is not common practice for JNCC to advise post-licence monitoring for operations taking place within existing MPAs in relation to oil and gas developments. Offshore renewables is a developing industry and so it cannot be categorically stated that post-licence monitoring would not be requested. For the one possible MPA that overlaps with an area for windfarm development – Firth of Forth Banks Complex – the proposed protected features are offshore subtidal sands and gravels and ocean quahog and JNCC would not advise post-licence monitoring is required for these features based on its current understanding (P. Chaniotis, JNCC. pers. comm.). On this basis, and for the purposes of this assessment, it has been assumed that no post-licence monitoring will be required for offshore wind development within the Firth of Forth Banks Complex MPA proposal.

Management measures applied under the lower and upper scenarios are detailed below. Specific management measure assumptions for each scenario (including the intermediate scenario) are defined in the MPA Site Reports (Table 4, Appendix E).

Lower Scenario

- Additional costs will be incurred for licence applications in assessing potential impacts to MPA features within 1km of proposed energy generation activities; and
- Mitigation measures may be required for non-OSPAR/BAP features within 12nm ranging from:
  - No additional mitigation required for maintenance of existing or construction of new assets beyond existing good practice; and
  - Re-routeing of cables to avoid highly sensitive features.

Upper Scenario

- Additional costs will be incurred for new site licence applications in assessing potential impacts to MPA features within 5km of proposed energy generation activities;
- Additional survey costs will be incurred to inform new licence applications where development is within 1km of MPA features; and
- Mitigation measures may be required for some OSPAR/BAP features for which adequate protection is not currently achieved[42] and all non-OSPAR/BAP features ranging from:
  - No additional mitigation required for maintenance of existing or construction of new assets beyond existing good practice;
  - Use of graded scour protection where scour protection is required around infrastructure;
  - Re-routeing of cables to avoid moderately and highly sensitive features; and
  - Relocation of development within Draft Plan Option area.

C.8.7 Assessment Methods

Additional Licensing Costs

Where required, it is assumed that the additional costs will be as follows:

- Additional assessment costs for licence application - £12k per licence application (based on average cost cited in Annex H14 of Finding Sanctuary et al, 2012); and
- Additional survey costs - £5k per km^2 for arrays or £5k per linear km (cables) (based on ABPmer, 2011).

[42] Some OSPAR/BAP features are already effectively afforded protection from activities with spatially-based licences; however, the following features are considered by the study team not to be given full protection: burrowed mud, inshore deep mud with burrowing heart urchins, offshore deep sea muds, offshore subtidal sands and gravels, shallow tide-swept coarse sands with burrowing bivalves and ocean quahog aggregations.

Mitigation Measures

Where required, it is assumed that the following additional costs may be incurred:

- Grading of scour protection around foundations – additional cost of £0.35m per foundation (indicative estimate provided by Seagreen Wind Energy Limited, for offshore wind turbine foundations in Firth of Forth Round 3 zones)
- Re-routeing of cables - £1.01m per km (Annex H14 of Finding Sanctuary et al, 2012);
- Relocation of development within AoS – [site specific assessment]

Cost of Uncertainty and Delays

The designation of NC MPAs has the potential to increase the time taken to determine licence applications and to negatively affect investor confidence. It has not been possible to quantify these potential impacts.

C.8.8 Limitations

- Uncertainty concerning scale and location of future development for marine biofuels and offshore renewables;
- Uncertainty concerning management measures.

C.8.9 References

ABPmer, 2011. Quantifying the Potential Impact of a Marine Conservation Zone (MCZ) Network on the Deployment of Offshore Renewables. Report to DECC.

ABPmer & RPA, 2013. Developing the Socio-Economic Evidence Base for Offshore Renewable Sectoral Marine Plans in Scottish Territorial Waters.

Allan, G., McGregor, P.G., Swales, J.K. and Turner, K., 2006. Impact of alternative energy generation technologies on the Scottish economy: an illustrative input-output analysis, Proceedings of the Institution of Mechanical Engineers, Vol. 221 Part A: J. Power and Energy, pp243-254.

Baringa, 2013. Scottish Islands Renewable Project: Final Report. Report prepared for DECC and Scottish Government.

Black, K., 2011. Macroalgae for energy: What's going on in Scotland and Chile? Presentation to The Crown Estate, 31 March 2011.

Department for Energy and Climate Change, 2012. UK Renewable Energy Roadmap Update 2012. 27th December 2012. Available online at https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/80246/

11-02-13_UK_Renewable_Energy_Roadmap_Update_FINAL_DRAFT.pdf [Last Accessed 31/05/2013]

Finding Sanctuary, Irish Seas Conservation Zones, Net Gain and Balanced Seas, 2012. Impact
Assessment materials in support of the Regional Marine Conservation Zone Projects' Recommendations. Annex H14 Renewable Energy.

FRM, 2010. A review of initiatives and related R&D being undertaken in the UK and internationally regarding the use of macroalgae as a basis for biofuel production and other non-food uses relevant to Scotland. Report commissioned by the Marine Scotland, 79pp.

IPA Energy + Water Economics for Scottish Renewables, 2010. Scottish Offshore Wind: Creating an Industry to Scottish Renewables, Final report, 4th August 2010, available from the Scottish Renewables Internet site (http://www.scottishrenewables.com/publications/scottish-offshore-wind-creating-industry/).

Kraan, S., 2011. Mass-cultivation of carbohydrate rich macroalgae, a possible solution for sustainable biofuel production. Mitigation and Adap.a.ion Strategies for Global Change. DOI 10.1007/s11027-010-9275-5

Kelly and Dworjanyn, 2008. The potential of marine biomass for anaerobic biogas production, The Crown Estate

Marine Scotland, 2009. Scottish Fish Farms Annual Production Survey, 2009.

National Grid, 2012. Electricity Ten Year Statement. November 2012.

Public Interest Research Centre on behalf of The Offshore Valuation Group, 2010. The Offshore Valuation, A valuation of the UK's offshore renewable energy resource. Report available from the Offshore Valuation Group Internet site (http://www.offshorevaluation.org/).

RenewableUK, 2013. Wave and Tidal Energy in the UK. Conquering Challenges, Generating Growth. February 2013.

Scottish Development International, Highlands and Islands Enterprise, and Scottish Enterprise, 2011. Scottish Offshore Renewables Development Sites, West Coast Cluster, available from the Scottish Development International Internet site (www.sdi.co.uk).

Scottish Enterprise & Highlands & Islands Enterprise, 2010a. National Renewables Infrastructure Plan. February 2010.

Scottish Enterprise & Highlands & Islands Enterprise, 2010b. National Renewables Infrastructure Plan Stage 2. July 2010.

Scottish Executive, 2005. Scotland's Renewable Energy Potential: realising the 2020 target, Future Generation Group Report 2005, available from the Scottish Government Internet site (www.scotland.gov.uk/Resource/Doc/54357/0013233.pdf).

Scottish Government, 2010a. Energy in Scotland: A Compendium of Scottish Energy Statistics and Information, Report produced December 2010.

Scottish Government, 2010b. Draft Electricity Generation Policy Statement 2010: Scotland – A Low Carbon Society, Report published by the Scottish Government, November 2010.

Scottish Government, 2011. 2020 Routemap for Renewable Energy in Scotland, available electronically on the Scottish Government Internet site (http://www.scotland.gov.uk/Publications/2011/08/04110353/0).

Scottish Government, 2012. Draft Electricity Generation Policy Statement, available from: http://scotland.gov.uk/Topics/Business-Industry/Energy/EGPS2012/DraftEPGS2012

The Crown Estate, 2011. Wave and tidal energy in the Pentland Firth and Orkney waters: How the projects could be built. A report commissioned by The Crown Estate and prepared by BVG Associates. May 2011. Available online at http://www.thecrownestate.co.uk/media/71431/pentland-firth-how-the-projects-could-be-built.pdf [Last Accessed 31/05/2013.

The Parliamentary Office of Science and Technology, 2011. Biofuels from Algae. POSTNOTE 384.

Verso Economics, 2011. Worth the Candle? The Economic Impact of Renewable Energy Policy in Scotland and the UK, March 2011, available from the Verso Economics Internet site (www.versoeconomics.com) .

C.9. Military Activities

C.9.1 Introduction

This appendix provides an overview of existing and potential future activity for military activities relating to Scottish waters and outlines the methods used to assess the impacts of potential MPAs on this activity.

C.9.2 Sector Definition

The military defence sector makes use of the Scottish coastline for the location of bases and training and use of the sea for training, test and evaluation activities and the surveillance and monitoring of waters to detect and respond to potential threats. In this assessment military interests comprise the use of the coast and seas by the Royal Navy (submarine bases, jetties and exercise areas), Army (training camps and firing ranges), Royal Air Force (bases, coastal Air Weapon Ranges and Danger Areas) and MoD (Defence Test and Evaluation Ranges to trial weapon systems) (Baxter *et al*, 2011).

C.9.3 Overview of Existing Activity

A list of sources to inform the writing of this baseline is provided in Table C9.1.

Table C9.1 Military Activities Information Sources

Scale	Information Available	Date	Source
Scotland	Scottish Naval Exercise Areas Information	2010	www.rnopsscotland.com/index.htm
Scotland	Defence Analytical Services and Advice. DASA Quad Service. 4	2010	www.dasa.mod.uk/
UK	Military Practice Areas	Current	SeaZone / UKHO
UK	Military low flying zones	Current	MOD (https://restats.decc.gov.uk/cms/aviation-safeguarding-maps)
UK	Munitions Disposal Sites (Chemical, Radioactive, Disused)	1945–1956 (Radioactive – no dates)	MOD
UK	Expenditure across relevant departments	1992–2011	UK Defence Statistics, MOD
UK	Military ports owned by MOD	2010	CP2

C9.3.1 Location and intensity of activity

Military activities occur in both inshore and offshore waters around the Scottish coast. All coastal military locations and the full area available for military training and other defence activities are shown in Figure C12. Principal marine-related defence activities include sea transport by naval vessels and sea training. Activities relating to maritime transport are mainly associated with naval bases and the only naval base in Scotland is Her Majesty's Naval Base (HMNB) Clyde at Faslane. Sea training is carried out within defined military practise and exercise (PEXA) training areas. Although the PEXA cover large areas of sea, military exercises cover only a proportion of these areas at any one time and are restricted temporally to a number of weeks per year. A major training exercise each year is the Joint Maritime Course in which Navy, Army and RAF exercises are conducted off the Scottish North West coast and which last for two weeks (UKMMAS, 2010). Two major NATO training exercises (Joint Warrior exercises) also take place each year in April and October. It is also noted that there is a regular military low flying area which partially overlaps with the Small Isles potential NC MPA.

C9.3.2 Economic value and employment

Defence activities do not generate a tangible output and therefore cannot be valued. However, one can examine the expenditure within relevant departments, e.g. the Commander-in-Chief (C-in-C) Navy Command which is responsible for the operation, resourcing and personnel training of ships, submarines and aircraft (UKMMAS, 2010).

UKMMAS (2010) estimated that in 2007/08, the UK military defence expenditure for the operation of marine activities was £1,796m with a GVA of £468m. Using the same methodology, the 2009/10 value has been recalculated using the Department Expenditure Limits (DEL) for the C-in-C Navy Command based on the UK Defence Statistics 2011 provided on the Defence Analytical Services and Advice website[43]. In 2009/10 the resource DEL allocated to the C-in-C Navy Command was £2,294m. Based on the assumption that the majority of this budget was for the operation of marine activity, and that 17.7% of this total budget (i.e. £406m) would be allocated to the C-in-C Naval Home Command for shore based operations, it can be estimated that expenditure for the operation of marine activities was £1,888m with a GVA of £491m. It is not possible to estimate what proportion of this value can be attributed to military defence activities in Scotland.

In terms of employment, at July 2011, there were 11,910 military (armed forces) personnel and 5,430 civilian personnel based in Scotland. The armed forces comprised 4,680 Navy, 3,200 Army and 4,030 RAF personnel (MOD, 2011a).

C9.3.3 Future trends

Specific defence projects may provide significant employment opportunities. For example, with respect to future aircraft carriers, building the hull sections and outfitting the vessels will provide work for about 10,000 people, including 3,500 at the two Clyde yards and 1,600 at Rosyth, Fife at the project's peak (UKMMAS, 2010).

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[43] Defence Analytical Services and Advice website: http://www.dasa.mod.uk/modintranet/UKDS/UKDS2011/c1/table105.php

Owing to the confidential nature of military defence activities it is difficult to assess likely future trends, however future employment will be governed by the forth coming spending cuts within the Ministry of Defence. In addition there are plans to build the next generation of submarines, which may be constructed in Scotland as in the past.

C.9.4 Assumptions on Future Activity

In the absence of information on future activity levels, it is assumed current locations and levels of usage will continue throughout the period of the assessment.

C.9.5 Potential Interactions with MPA Features

Many of the activities of the MoD have the potential to interact with MPA features. Underwater noise associated with SONAR use and military weapons trials may impact MPA features, and litter such as spent ammunition, depth charges and rockets will enter the marine environment. Weapons trials may cause surface and sub-surface abrasion to the seabed habitat and species, in some cases resulting in a direct loss of habitat. Associated synthetic pollutants may also enter the water column. Of lesser concern is the death or injury of mobile species by collision with military vessels, and the possible introduction or translocation of non-indigenous species (JNCC & NE, 2011).

Despite the potential for such interactions with MPA features, the infrequency of military activities and existing MoD procedures should ensure that environmental impacts are minimised.

C.9.6 Assumptions on Management Measures for Scenarios

As a public authority and operator, MoD is required under the Marine and Coastal Access Act 2009 and Marine (Scotland) Act 2010 to carry out its functions and activities in a way that will further, or least hinder, the conservation objectives of MCZs. The Secretary of State for Defence's Safety, Health, Environmental Protection and Sustainable Development in Defence policy statement directs MoD to introduce management arrangements which, so far as is practicable, ensure that outcomes are at least as good as those required by the European Union's Environmental Impact Assessment Directive, from which military activities are exempt (JNCC and NE, 2011). To assist in meeting its environmental obligations, MoD has developed a Maritime Environmental Sustainability Appraisal Tool (MESAT). This will include operational guidance to reduce significant impacts of military activities on MPAs.

For the purposes of this assessment, it is assumed that MoD will incur additional costs in adjusting MESAT and other MoD environmental assessment tools in order to consider whether its activities will impact on the conservation objectives of MPAs. It will also incur additional costs in adjusting electronic charts to consider MPAs.

For the purposes of the assessment, it is assumed that MoD will mitigate the impact of military activity on MPA features through additional planning consideration during operations and training (as provided through the revisions to MESAT) and during coastal military activities covered by Integrated Rural Management Plans.

For the MCZ IA, MoD provided a national estimate of cost impacts associated with meeting its obligations as a public authority (Annex H10 of Finding Sanctuary et al, 2012). It was not possible to break this information down by site owing to the confidential nature of military activities.

Similar assumptions have been adopted for the Scottish MPA assessment, for both the 'lower' and 'upper' scenarios and this will also be presented as the 'intermediate (best) estimate'. After MPA designation, the management of activities in MPAs will be decided on a site-by-site basis and may differ from the assumptions in this assessment.

C.9.7 Assessment Methods

- Initial revision of MESAT (and other MoD environmental tools) and additions to electronic charting by the Hydrographic Office are estimated to cost £25k in year 1 of the MCZ IA 20-year period of analysis (Annex H10 of Finding Sanctuary et al, 2012);
- Additional annual maintenance costs are estimated to be £5k (Annex H10 of Finding Sanctuary et al, 2012);and
- Mitigation measures:
  - As MoD is operational throughout Scottish waters and as MPAs are likely to be extensive and have varied management measures, it has been assumed that consideration of MPAs will be undertaken as part of planning for all MoD maritime activities. MoD estimated the proportion of staff time it anticipates it will need to do this for MCZ is £10k per year in the first four years of the IA period, reducing to £5k p.a. from year 5 onwards (Annex H10 of Finding Sanctuary et al, 2012). The same assumption has been applied for Scottish NC MPAs.

C.9.8 Limitations

- Uncertainty concerning the location and scale of future activity; and
- Uncertainty concerning the nature of any possible mitigation measures.

C.9.9 References

Baxter, J.M., Boyd, I.L., Cox, M., Donald, A.E., Malcolm, S.J., Miles, H., Miller, B., Moffat, C.F., (Editors), 2011. Scotland's Marine Atlas: Information for the national marine plan. Marine Scotland, Edinburgh.

Finding Sanctuary, Irish Seas Conservation Zones, Net Gain and Balanced Seas, 2012. Impact Assessment materials in support of the Regional Marine Conservation Zone Projects' Recommendations. Annex H10 National Defence.

JNCC and NE, 2011. General advice on assessing potential impacts of and mitigation for human activities on MCZ features, using existing regulation and legislation. Advice from the Joint Nature Conservation Committee and Natural England to the Regional MCZ Projects. June 2011. 107pp.

MOD, 2011a. TSP 10 - UK Regular Forces Stationed Location. Edition 01 July 2011. Released 11 August 2011. Available online:
http://www.dasa.mod.uk/applications/newWeb/www/index.php?page=48&pubType=0&thiscontent=100&PublishTime=09:30:00&date=2011-08-11&disText=01July2011&from=listing &topDate=2011-08-11

United Kingdom Marine Monitoring and Assessment Strategy (UKMMAS), 2010. Charting Progress 2 Feeder Report Productive Seas. Department for Environment Food and Rural Affairs on behalf of UKMMAS (Eds. Saunders, J. and McKie, J.) 472pp Available online: http://chartingprogress.defra.gov.uk/

C.10. Oil and Gas

C.10.1 Introduction

This appendix provides an overview of existing and potential future activity for the oil and gas sector relating to Scottish waters and outlines the methods used to assess the impacts of potential MPAs on this sector.

C.10.2 Sector Definition

This sector relates to the extraction of oil and gas in the sub-sea environment largely from offshore reserves. Oil reserves include both oil and the liquids and liquefied products obtained from gas fields, gas-condensate fields and from the associated gas in oil fields. Gas reserves are the quantity of gas expected to be available for sale from dry gas fields, gas-condensate fields and oil fields with associated gas. For this assessment, activity within this sector includes exploration, production, interconnectors and gas storage (i.e. the 'upstream' oil and gas sector).

C.10.3 Overview of Existing Activity

Information sources used in the assessment are listed in Table C10.1.

Table C10.1 Oil and Gas information sources.

Scale	Information Available	Date	Source
Scotland	All pipelines and cables	Current	SeaZone Solutions Ltd and UKDEAL
UK	Oil pipelines - Subsea pipelines and umbilical's related to the petroleum industry.	Current	UKDEAL
UK	Gas Pipeline Feeder (shapefile)	Current	National Grid
UK	Oil and gas employment	2012	Oil and Gas UK 2012 Economic reports: http://www.oilandgasuk.co.uk/knowledgecentre/economic_report.cfm
Scotland	Revenues and production from Scottish Sea areas (2005-2008). Oil, gas and NGL production and revenue (2005-2008) for all Scottish waters and regional breakdown.	2005-2008	Baxter *et al* (2011)
UK	Distribution of hydrocarbon fields (polygon)	Current	UKDEAL
UK	Locations and attributes of Hydrocarbon Blocks within UK Waters (polygon)	Current	UKDEAL
UK	UKCS Quads - Location and Attributes of DTI determined fields and arbitrary circular markers for undetermined fields (significant discoveries)	Current	UKDEAL

Scale	Information Available	Date	Source
	(polygon)		
UK	Current licence blocks (polygon)	Current	UKDEAL
UK	Surface infrastructure (Oil & Gas) - locations of platforms, FPSOs, buoys etc. (point)	Current	UKDEAL
UK	Subsea infrastructure (Oil & Gas) - locations of manifolds, tees, anchors etc. (point)	Current	UKDEAL
UK	Location of wells (point)	Current	UKDEAL
UK	Location of 25/26/27th Round Conditional Awards (licence blocks offered subject to clarification and agreement of licensing terms) (polygon)		UKDEAL
UK	Underground coal gasification licences (polygon)	Current	Coal Authority
UK	Digest of UK Energy Statistics	2012	DECC
UK	Oil and Gas production up to 2011	2011	DECC (https://www.gov.uk/oil-and-gas-uk-field-data

C10.3.1 Location and intensity of activity

There is extensive infrastructure associated with oil and gas developments in Scotland, including seabed and platform mounted production facilities and networks of pipelines bringing oil and gas ashore for processing (Baxter *et al*, 2011; Figure C13). It is estimated that there is approximately 12,800km of oil and gas pipeline in Scottish waters with the majority of pipelines outwith the 12nm limit (i.e. offshore). Virtually all hydrocarbon fields, platforms, pipelines and infrastructure occur within the central and northern North Sea and to the West of Shetland. The North Sea fields are generally mature, but there is the potential for significant new development to occur West of Shetland, particularly associated with the Laggan-Tormore fields.

Information on the production of oil, natural gas liquids (NGL) and gas from Scottish Sea areas between 2005 and 2008 are provided by Baxter *et al* (2011) and are shown in Table C10.2. The values show that production levels of Oil and Gas have remained roughly constant between 2005 and 2008, although there was a reduction in the tonnage of NGL in 2008 compared to previous years.

Table C10.2 Production and revenues from oil and gas from Scottish sea areas between 2005-2008

Production	2005	2006	2007	2008
Oil (tonnage)	56,751,985	51,734,343	54,900,487	53,081,406
NGL (tonnage)	5,439,147	5,458,028	5,551,411	4,435,130
Gas (therms) millions	18,218	16,311	17,200	19,606
Revenue	**2005**	**2006**	**2007**	**2008**
Oil (£M)	12,165	13,389	14,805	20,137
NGL (£M)	1,238	1,528	1,596	1,672
Gas (£M)	4,406	5,581	5,052	6,934
Total (£M)	**17,809**	**20,498**	**21,454**	**28,744**

(Source: Baxter *et al*. 2011)

Indicative figures for crude oil production from hydrocarbon fields which lie within the waters off Scotland have been estimated using offshore crude oil production data from the DECC website[44] (2009 = 61,341,301 tonnes; 2010 = 57,895,697 tonnes).

It was not possible to estimate dry gas or NGL production for 2009 and 2010 as production is not allocated to individual hydrocarbon fields (Clive Evans, DECC, pers. comm.).

C.10.3.2 Economic value and employment

The oil and gas industry is the principal source of fuel and power for Scotland, meeting more than 58% of the primary energy need in Scotland in 2008 (Baxter *et al*, 2011). The sector is the largest industrial contributor to the UK's GVA; the GVA of the upstream oil and gas sector (i.e. not including the value added by the supply chain) in the UK in 2010 was estimated at £32 billion. In 2011, supply chain exports were in the range of £6 billion (Oil and Gas UK, 2012a). Information on the total revenue from oil, natural gas liquids (NGL) is provided in Table C10.1. The table shows that the total revenue from oil, NGL and gas progressively increased between 2005 and 2008.

The industry is a major employer. It was estimated that in 2010, the oil and gas industry provided employment for about 440,000 people across the UK, these comprised of 32,000 being directly employed by oil and gas companies and major contractors. Exploration and extraction of oils and gas from the UKCS accounted for the majority of these jobs, providing around 340,000 jobs in 2010, plus 207,000 employed in the wider supply chain and 100,000 in jobs induced by the economic activities of employees. An additional 100,000 jobs were estimated to be supported by the oil and gas supply chain's growing export business, bringing the total employment provided by the sector to about 440,000 jobs in 2010 (Oil and Gas UK, 2012a). About 45% of the 340,000 UKCS related jobs (i.e. about 153,000) are

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44 DECC Oil and Gas website: https://www.og.decc.gov.uk/information/index.htm

located in Scotland not only in major cities such as Aberdeen, but across the whole of Scotland including the remoter areas of the country (Oil and Gas UK, 2012a). This data is three years old and is currently being updated. It is expected that employment will have risen and will continue to rise due to the increased investment and total expenditure in the past three years (Oil and Gas UK, 2012a).

C10.3.3. Future trends

Information on future trends relates to the UK and disaggregation of this data to regional (Scottish) level is not possible.

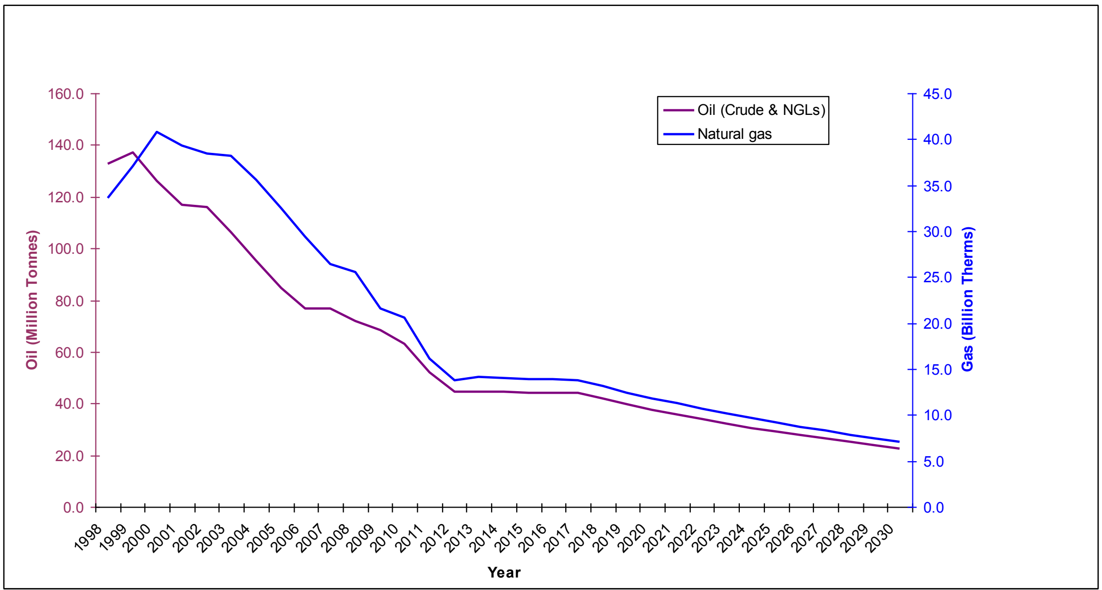
It has been estimated that in 2020, 70% of primary energy in the UK is still expected to come from oil and gas. The UKCS has the potential to satisfy about 50% of the UK's oil and gas demand in 2020, if the current rate of investment is sustained (Oil and Gas UK, 2012a). However, the amount of oil and gas imported into the UK is also likely to increase. By 2015, around 25% of the UK's annual gas demand is likely to be met by imports (increasing from 20% in 2008). Given the prediction for increasing dependence on imported gas, subsea gas storage facilities and associated pipelines are also likely to increase (Saunders *et al*, 2011), although no new gas storage is currently planned for Scottish waters.

Over 41 billion boe (barrels of oil equivalent) have been recovered so far from the UKCS, and a further overall recovery of 15 to 24 billion boe is forecast (Oil and Gas UK, 2012a). These are mainly in discoveries awaiting development, areas under current licence or regions where oil can be expected to be found but has not yet been explored (Baxter *et al*, 2011). Based on the average price of oil and gas forecast by the Energy Information Administration between 2009 and 2030, the wholesale gross value of these remaining reserves may be between £650 billion to £1.1 trillion (Baxter *et al*, 2011). A significant area of unexploited gas reserves lies to the West of Shetland and a new gas export pipeline from this area is currently being built to support output from the Laggan (about 125km West of Shetland) and Tormore (about 15km further South West) fields, scheduled to start production in 2014 (Baxter *et al*, 2011).

Image C10.1 shows oil and gas production levels in recent years and DECC's current (October 2012) projections (DECC, 2013). A substantial decrease in oil and gas production in the UK since 1998 and the projected 5% decrease from 2018 to 2030 (DECC 2013) is seen. The production projections for 2013 -2018 are consistent with those published by DECC at http://www.gov.uk/oil-and-gas-uk-field-data.

Around 500 individual structures (including platforms and tie backs) will be decommissioned over the next three decades (Saunders *et al*, 2011; Oil and Gas UK, 2012a). However, some depleted oil and gas fields, and oil and gas infrastructure, may potentially be used in the emerging CCS sector (see Section C5). From 2012 onwards, decommissioning expenditure for existing facilities is projected to be £28.7 billion by 2040, with a further £4.3 billion projected for new investments during the same period (Oil and Gas UK, 2012a). Over the next five years (2012-

2017), total forecast decommissioning expenditure is £4.5 billion (Oil and Gas UK, 2012b).



Source DECC, 2013.
'The production projections for 2013–2018 are consistent with those published by DECC at https://www.gov.uk/oil-and-gas-uk-field-data.

Image C10.1. Actual and Projected UK Oil and Gas Production 1998-2030.

C.10.4 Assumptions on Future Activity

Future oil and gas development depends on the presence of exploitable resources and the economic viability of development. Information on proposed front-end development activity (resource surveys and test wells) is available from awards made under DECC's oil and gas licensing rounds. However, it is difficult to anticipate the extent to which this front end activity might subsequently lead to development projects. Furthermore, information from recent and current licensing rounds provides a relatively short-term view of future activity. Over the next twenty years or so, it is possible that a further 10 or more licensing rounds will be announced by DECC (based on an average of a new round every 18 months to 2 years). In the light of these uncertainties, the MCZ IA (Finding Sanctuary et al, 2012) developed a series of assumptions on the scale of future activity based on awards made under the 26th and 27th oil and gas licensing rounds and these assumptions have largely been followed for the purposes of this assessment.

A significant proportion of existing oil and gas infrastructure will be decommissioned over the next 20 years. Information on draft and approved decommissioning programmes is available from DECC[45]. However, this provides only a short-term view on future decommissioning activity. DECC has indicated that, using current projections, around 41% of active oil and gas fields that overlap spatially with MPA proposals are expected to be decommissioned in the period 2014 to 2034 (E. Pizzolla, DECC, pers. comm).

It has been assumed that no new gas storage sites and no new gas interconnector projects are developed in waters off Scotland within the assessment period.

C.10.5 Potential Interactions with MPA Features

Infrastructure for the exploration and drilling for oil and gas may interact with MPA features in a number of ways. Seismic surveys in the exploration for oil and gas can cause significant impacts or disturbance to a variety of marine species, particularly fish. The installation of drilling infrastructure and drilling activities will have direct impacts on local benthic features. Benthic species may suffer lethal effects of surface and sub-surface abrasion and penetration. Disturbance and smothering may occur with the dispersion and deposition of drill cuttings, although this is dependent on hydrodynamic conditions and the particle size of the drill cuttings. Noise disturbance will also result from drilling activities. Once installed, the presence of drilling infrastructure has the potential to interrupt hydrodynamic processes and change local patters of sediment erosion and deposition. Scour protection to avoid potentially adverse impacts associated with erosion may involve replacing the original soft sediment on the seabed with a rocky substrate, inducing changes in habitat and community structure. Once in place drilling infrastructure may present a barrier to the movement of mobile species and may potentially result in death or injury by collision (JNCC & NE, 2011).

Trenching and burying of pipelines for the transport of oil and gas causes short-term disturbance to the benthic habitat along the route of the pipeline, after which the seabed would be re-colonised. If pipelines are laid directly on the seabed, they may disrupt the hydrodynamic regime and alter the natural transport of sediment within the area. Concrete mattresses may be utilised to stabilise pipelines, resulting in a permanent loss of soft sediment habitat and a shift to hard substrate. In areas of sand waves, sand crests may be ‘shaved’ to flatten the seabed for better pipeline installation, altering geomorphological characteristics of the area (JNCC & NE, 2011).

Oil spills can impact all habitat types, although areas of low wave energy are more vulnerable than high energy areas that can naturally disperse oil quickly. In addition to oil pollution, discharges of formation water, crude oil and other production chemicals may affect the surrounding environment if not managed in accordance with best practice.

45 https://www.gov.uk/oil-and-gas-decommissioning-of-offshore-installations-and-pipelines#table-of-approved-decommissioning-programmes

C.10.6 Assumptions on Cost Impacts for Scenarios

It is assumed that the impact of oil and gas activity on MPA features will be managed under the existing licensing frameworks. Two scenarios ('lower' and 'upper') have been developed to capture the possible costs of MPA proposals to the oil and gas sector. These scenarios include potential costs associated with additional assessments required to inform licensing and permitting decisions and associated survey requirements.

It has been assumed that there will be no review of existing licences or permits, although where operators of existing installations apply for new licences or permits, these applications will be considered against the conservation objectives for features for which MPAs may have been designated.

It has been assumed that a range of additional management measures will be required to minimise impact to sensitive habitats, including a requirement for additional survey to inform measures such as micro-siting of infrastructure.

It has not been possible to estimate the cost impacts for decommissioning activity at a site level associated with additional assessments required to inform licensing and permitting decisions, associated survey requirements, or potential additional mitigation measures, because the location of fields that will be decommissioned during the assessment period is confidential. An assessment of the potential cost of additional assessments required to inform licensing and permitting decisions [and associated survey requirements] has been prepared at a national level based on assumptions.

An intermediate ('best') estimate for each site has been based on SNH/JNCC current views on management options and judgements made by the study team. The assumptions do not pre-judge any future site-specific licensing decisions. After MPA designation, the management of activities in MPAs will be decided on a site-by-site basis and may differ from the assumptions in this assessment.

Management measures applied under the lower and upper scenarios are detailed below. Specific management measure assumptions for each scenario by MPA (including the intermediate scenario) are defined in the MPA Site Reports (Table 4, Appendix E).

Lower Scenario

- Additional costs will be incurred for new oil and gas licence and permit applications in assessing potential impacts to MPA features for 26th and 27th oil and gas licensing round awards within licensing blocks overlapping with MPA features;
- Additional costs will be incurred for decommissioning consents in assessing potential impacts to MPA features where the oil and gas fields to be decommissioned overlap with MPA features; and

- Mitigation measures may be required for non-OSPAR/BAP features ranging from:
  - No additional mitigation required beyond existing good practice;
  - Minimising alterations to seabed habitat; any deposited material should meet local habitat type;
  - Micro-siting of infrastructure in areas of reduced sponge density, drawing on data held by JNCC and collected by operators; and
  - Treat cuttings that use oil-based muds on site.

Upper Scenario

- Additional costs will be incurred for new oil and gas licence and permit applications in assessing potential impacts to MPA features for 26th and 27th oil and gas licensing round awards within licensing blocks overlapping with MPA features;
- Additional costs will be incurred for decommissioning consents in assessing potential impacts to MPA features where the oil and gas fields to be decommissioned overlap with MPA features;
- Additional survey costs will be incurred to inform new licence applications where management measures involving micro-siting are required; and
- Mitigation measures may be required for some OSPAR/BAP features[46] for which adequate protection is not currently achieved and all non-OSPAR/BAP features ranging from:
  - No additional mitigation required beyond existing good practice;
  - Avoidance of development in sensitive habitats;
  - Skip and ship of drill cuttings (transporting all drill cuttings to shore for disposal; i.e. water-based muds and oil-based muds);
  - Micro-siting of drill spud sites; development infrastructure such as jackets, anchors, manifolds and drill templates (optimising the layout of infrastructure in order to avoid sensitive/protected features); and
  - Re-routeing of new pipelines to avoid moderately or highly sensitive MPA features.

C.10.7 Assessment Methods

Additional Licensing and Permitting Costs

Where exploration or development activity occurs within the vicinity of features proposed for designation within MPA proposals, it will be necessary for the developer to provide information to DECC to determine whether such activity poses a significant risk to the achievement of the conservation objectives for those features.

[46] Some OSPAR/BAP features are already effectively afforded protection from activities with spatially-based licences; however, the following features are considered by the study team not to be given full protection: burrowed mud, inshore deep mud with burrowing heart urchins, offshore deep sea muds, offshore subtidal sands and gravels, shallow tide-swept coarse sands with burrowing bivalves and ocean quahog aggregations.

The assessment does not include any additional costs that may be incurred for assessment of environmental impact of projects for which consent is currently being sought. This is because these costs will be incurred before the start of the period covered by the assessment (2014) and are therefore considered to be sunk costs.

For licensing and permitting costs associated with new development activity that may be incurred from 2014 onwards, there are a number of stages to the licensing and permitting process and costs may be incurred at various points in this process (see Table C10.3 below from Annex H11 of Finding Sanctuary et al, 2012). In order to estimate the potential number of future developments and stages at which additional assessments might be required, the following assumptions have been made:

- Where the oil and gas licensing blocks with awards under the 26th or 27th licensing rounds which overlap with MPA features comprise blocks with 'significant discoveries' or 'fallow blocks and discoveries'[47]:
  - For 26th licensing round awards, it is assumed that they will have already completed phase 1 (see Table C10.3) by 2014 but that all awards will complete phases 2 and 3 during the assessment period (cost assumed to fall in 2016);
  - For 27th licensing round awards, it is assumed that they will complete phases 1 to 3 (see Table C10.3) during the assessment period (cost for phase 1 assumed to fall in 2016; cost for phases 2 and 3 assumed to fall in 2018);
  - For 26th and 27th licensing round awards, it is assumed that 50% of awards proceed to complete phases 4, 5 and 6 within the assessment period (cost for 26th round awards assumed to fall in 2022; cost for 27th round awards assumed to fall in 2024)
- Where the oil and gas licensing blocks with awards under the 26th or 27th licensing rounds which overlap with MPA features comprise blocks that do not have significant discoveries, fallow blocks or fallow discoveries:
  - It is assumed that these awards will complete phases 1 to 3 only (see Table C10.3) during the assessment period (cost for 26th licensing round - phase 1 assumed to fall in 2016; cost for phases 2 and 3 assumed to fall in 2018; cost for 27th licensing round - phase 1 assumed to fall in 2018; cost for phases 2 and 3 assumed to fall in 2020).

Where decommissioning activity occurs within the vicinity of features proposed for designation within MPA proposals, it will be necessary for the developer to provide information to DECC to determine whether such activity poses a significant risk to the achievement of the conservation objectives for those features. DECC has indicated that potentially 15 out of the 36 active oil and gas fields that overlap spatially with MPA proposals are expected to be decommissioned in the period 2014

[47] As listed on http://og.decc.gov.uk/en/olgs/cms/data_maps/offshore_maps/offshore_maps.aspx [accessed 11 April 2013].

to 2033 (E. Pizzolla, DECC, pers. comm). In the absence of information on the timing of decommissioning, it has been assumed that additional assessments will be undertaken in 2024 (the midpoint of the assessment period).

Additional survey costs

It has been assumed that additional survey costs will be incurred where there is a requirement for micro-siting to be implemented regarding the location of the well (all phases). The cost of these additional surveys has been estimated as £230k per survey (based on indicative cost estimate supplied by Oil & Gas UK, 2013). It has also been assumed that, should an award proceed to phases 4 to 6, additional survey costs will be incurred where there is a requirement for micro-siting of pipelines (see mitigation measures below); this cost has been estimated at £580k per survey (Oil & Gas UK, 2013).

Mitigation Measures

Where mitigation measures are required, it is assumed that the following additional costs may be incurred (based on indicative cost estimates supplied by Oil & Gas UK, 2013):

- Skip and ship of drill cuttings (transporting all drill cuttings to shore for disposal; i.e. water-based muds and oil-based muds) - £650k per well; and
- Re-routeing of new pipelines - £2 million per km of additional pipeline (10% of distance to the landward edge of the feature or MPA boundary)[48].

Quantifying costs associated with micro-siting wells has not been possible (only survey costs have been quantified as outlined above). It has also not been possible to quantify costs associated with the treatment of cuttings that use oil-based muds on site; however, this process is already considered good practice and unlikely to incur an additional cost.

It should be noted that relocation of a well to a new site may not be possible and the use of directional drilling limits the depth to which a site can be drilled. An indicative cost (provided by Oil & Gas UK, 2013) suggests three extra days of drilling would equate to an additional cost of £1.3 million. However, it has not been possible to incorporate this potential cost impact into this assessment due to uncertainties regarding the nature of individual projects.

[48] It is assumed that an arbitrary 10% increase in new pipeline length will be required to avoid moderately or highly sensitive MPA features during re-routeing. Having assumed the development will occur within the centre of the oil and gas award polygon, distances of new pipeline have been measured in a landward direction; this is assumed to be an overall shorter return length as opposed to an initial seaward direction to the edge of the feature extent or MPA boundary and then returning landwards.

Cost of Uncertainty and Delays

The designation of NC MPAs has the potential to increase the time taken to determine licence applications and to negatively affect investor confidence. It has not been possible to quantify these potential impacts.

Table C10.3 The anticipated additional requirements and costs for the assessment of environmental impact in future licence applications for the oil and gas sector arising as a result of MPAs (from Annex H11 of Finding Sanctuary et al, 2012)

Time period (number of years) over which each development phase occurs, in consecutive order	List of permits and applications that already take place in each development phase, for which it is assumed that an assessment of environmental impact is undertaken (which will need to include an assessment of impact upon MPA features)	Estimated additional resource inputs and cost arising as a result of MPA designation (e.g. £/day) for the entire phase*	Estimated additional cost (£m) for the entire phase as a result of MPA designation (one-off cost per application)
0.5 years Surveys and evaluation (phase one)	Up to 15 permits including consent to survey (Petroleum Operations Notice (PON) 14A)	£1,000 consultancy fees (2 days at £500/day) £1,000 additional input of staff time by the operator (2 days at £500/day)	0.002
0.25 years Drilling and exploration (phase two)	PON15b for drilling – this is both a chemical permit and determination of whether an Environmental Statement is required Environmental Statement (if required) Oil Pollution Emergency Plan (OPEP) for drilling and well test Chemical permit for drilling and well test Consent to locate rig The Offshore Petroleum Activities (Oil Pollution Prevention and Control) Regulations 2005 (OPPC) permit for drilling and well test	£2,000 consultancy fees (4 days at £500/day) £2,000 additional input of staff time by the operator (4 days at £500/day)	0.004

Time period (number of years) over which each development phase occurs, in consecutive order	List of permits and applications that already take place in each development phase, for which it is assumed that an assessment of environmental impact is undertaken (which will need to include an assessment of impact upon MPA features)	Estimated additional resource inputs and cost arising as a result of MPA designation (e.g. £/day) for the entire phase*	Estimated additional cost (£m) for the entire phase as a result of MPA designation (one-off cost per application)
0.25 years Drilling and appraisal (phase three)	PON15b for drilling – this is both a chemical permit and determination of whether an Environmental Statement is required Environmental Statement (if required) OPEP for drilling and well test Chemical permit for drilling and well test Consent to locate rig OPPC permit for drilling and well test	£2,000 consultancy fees (4 days at £500/day) £2,000 additional input of staff time by the operator (4 days at £500/day)	0.004
0.25 years Development (phase four)	PON15c for pipelines – this is both a chemical permit and determination of whether an Environmental Statement is required Environmental Statement (if required) OPPC permit Chemical permit Registration Pipeline Works Authorisation Consent to locate Consent to deposit materials	£2,000 consultancy fees (4 days at £500/day) £2,000 additional input of staff time by the operator (4 days at £500/day)	0.004

Time period (number of years) over which each development phase occurs, in consecutive order	List of permits and applications that already take place in each development phase, for which it is assumed that an assessment of environmental impact is undertaken (which will need to include an assessment of impact upon MPA features)	Estimated additional resource inputs and cost arising as a result of MPA designation (e.g. £/day) for the entire phase*	Estimated additional cost (£m) for the entire phase as a result of MPA designation (one-off cost per application)
19 years Operation and production (phase five)	PON15d for production operations – this is both a chemical permit and determination of whether an Environmental Statement is required Environmental Statement (if required) Emissions trading permit Chemical permit Radioactive sources permit OPEP Consent to flare Consent to vent OPPC permit Waste management plan UK Oil Payment Programme certificate	£500/permit/yr. Assuming 20 permit applications are submitted in the 20 year period of the IA, the additional cost comprises: £10,000 consultancy fees £10,000 additional input of staff time by the operator	0.02
20 years + Maintenance (phase six)	PON15f for well interventions – this is both a chemical permit and determination of whether an Environmental Statement is required Environmental Statement (if required) Pipeline Works Authorisation Consent to locate Chemical permit	£1,000 consultancy fees (2 days at £500/day) £1,000 additional input of staff time by the operator (2 days at £500/day)	0.002
20 years + Decommissioning (phase seven)	PON15e for decommissioning – this is both a chemical permit and determination of whether an Environmental Statement is required Environmental Statement (if required) Baseline environmental survey	£1,000 consultancy fees (2 days at £500/day) £1,000 additional input of staff time by the operator (2 days at £500/day)	0.002

Time period (number of years) over which each development phase occurs, in consecutive order	List of permits and applications that already take place in each development phase, for which it is assumed that an assessment of environmental impact is undertaken (which will need to include an assessment of impact upon MPA features)	Estimated additional resource inputs and cost arising as a result of MPA designation (e.g. £/day) for the entire phase*	Estimated additional cost (£m) for the entire phase as a result of MPA designation (one-off cost per application)
	Marine Licence under Marine & Coastal Access Act (covering decommissioning activities, e.g. removal/deposit and/or disposal of infrastructure from the seabed) Consent to locate Evaluate with regulator Decommissioning programme OPPC permit Chemical permit		

* Data supplied by Oil and Gas UK, August and September 2011

C.10.8 Limitations

- Uncertainty concerning the location, scale and timing of future development activity, particularly in later years of the assessment period;
- Uncertainty concerning the location and timing of decommissioning activity, particularly in later years of the assessment period;
- Uncertainty concerning the cost impact of project delays associated with additional assessment and monitoring requirements; and
- Uncertainty concerning nature of any possible mitigation measures and implications for future investment.

C.10.9 References

Baxter, J.M., Boyd, I.L., Cox, M., Donald, A.E., Malcolm, S.J., Miles, H., Miller, B., Moffat, C.F., (Editors), 2011. Scotland's Marine Atlas: Information for the national marine plan. Marine Scotland, Edinburgh.

Department for Energy and Climate Change (DECC). 2013. UKCS Oil and Gas Production Projections. https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/136390/production_projections.pdf

Finding Sanctuary, Irish Seas Conservation Zones, Net Gain and Balanced Seas, 2012. Impact

Assessment materials in support of the Regional Marine Conservation Zone Projects' Recommendations. Annex H11 Oil, Gas and Carbon Capture and Storage.

JNCC and NE, 2011. General advice on assessing potential impacts of and mitigation for human activities on MCZ features, using existing regulation and legislation. Advice from the Joint Nature Conservation Committee and Natural England to the Regional MCZ Projects. June 2011. 107pp.

Oil and Gas UK. 2012a. Economic Report 2012.
http://www.oilandgasuk.co.uk/cmsfiles/modules/ publications/pdfs/EC030.pdf

Oil and Gas UK 2012b. 2012 Decommissioning Insight.
http://www.oilandgasuk.co.uk/cmsfiles/modules/publications/pdfs/OP073.pdf

Saunders, J., Tinch, R., Ozdemiroglu, E. & Hull, S., 2011. Valuing the Marine Estate and UK Seas: Dynamic Baseline Assessment (draft). Marine Estate Research Report for The Crown Estate.

C.11. Ports and Harbours

C.11.1 Introduction

This appendix provides an overview of existing and potential future activity for the ports and harbours sector in Scotland and outlines the methods used to assess the impacts of potential MPAs on this sector.

C.11.2 Sector Definition

Ports provide the modal interchange points by which goods and people are transported from land to sea. Harbours are by definition, safe havens for vessels to reside and are often commensurate with ports areas. This assessment focuses on potential impacts to terminals and wharves, navigation channels and approaches, anchorages and dredge material disposal sites.

C.11.3 Overview of Existing Activity

A list of sources to inform the writing of this baseline is provided in Table C11.1.

Table C11.1 Information Sources

Scale	Information Available	Date	Source
UK	Employment and GVA multipliers for ports (all UK)	2009	Oxford Economics (March 2009): 'The Economic Contribution of Ports to the UK Economy' www.ukmajorports.org.uk/fil_library/file_library_files/download/173
UK	Ports and Harbours contribution to Employment and GDP (all UK)	2012	Oxford Economics, 2011. The economic impact of the UK's Maritime Services Sector (http://www.maritimeuk.org/key-statistics)
UK	Marine traffic, passenger numbers and cargo volume	2000-2011	Department for Transport 'Transport Statistics' http://www.dft.gov.uk/statistics/series/ports-statistics
UK	Port and harbour locations, port types, port ownership, contact details	Current	Ports and Harbours of the UK, 2011. Website: http://www.ports.org.uk/
UK	Location of UK Ports	2010	ABPmer/CP2
Scotland (including Orkney, Shetland and mainland)	Maritime transport statistics and overview, generalised information on Scottish Ports	2009-2010	Baxter *et al* (2011) The Scottish Government (2011) 'Scotland's Marine Atlas – Information for the National Marine Plan' March 2011.
Scotland	Commercial listings of ports in Scotland, service providers, contact details, description of services and current	Current to 2009	Port of Scotland (2010) – annual publication (current issue print date 2009)

Scale	Information Available	Date	Source
	development plans		
Scotland	Recent trends	To 2008	British Ports Association (2008)
UK	Anchoring areas and berths (polygon and point)	Current	SeaZone
UK	Anchoring areas (Associated British Ports) (confirm for which ports this is available)	Current	ABP
UK	Potential future port developments	2012	DfT National Policy Statement for Ports, 2012
UK	UK port demand forecasts	To 2030	UK Port Demand Forecasts to 2030. MDS Transmodal, 2006, and update 2007.
UK	Update to UK port demand forecasts, taking into account recession	To 2020 and 2030	Port Infrastructure Development UK. Gail Bradford, MDS Transmodal, 2011

C11.3.1 Location and intensity of current activities

There are three types of port ownership in Scotland; Trust, Municipal and Private. All ports operate on a commercial basis, independently from Government. Duties and responsibilities are conferred by legislation tailored to each Port, with port operations administered by Statutory Harbour Authorities (SHA). There are 15 Scottish ports classified by the Department for Transport (DfT) under the EC Maritime Statistics Directive as a major port, generally because they handle at least 1 million tonnes of cargo per year, see Figure C14. These are:

- Aberdeen;
- Ayr;
- Cairnryan;
- Clyde (Ports Group);
- Cromarty Firth;
- Forth (Ports Group);
- Glensanda;
- Inverness;
- Lerwick;
- Montrose;
- Orkney;
- Perth;
- Peterhead;
- Stranraer; and
- Sullom Voe.

Overall, there are around 270 ports and harbours in Scottish waters, ranging from very small piers and landing stages, to those with major facilities. They include:

- Large Oil and Gas terminals, e.g. Hound Point (Firth of Forth), Sullom Voe (Shetland), Flotta (Scapa Flow, Orkney);
- Large quarry product port - Glensanda;

- Large fishing ports, e.g. Peterhead, Fraserburgh;
- Smaller fishing ports, e.g. Buckie, Mallaig;
- Oil supply ports, e.g. Aberdeen, Cromarty Firth;
- Multi-purpose ports, e.g. Leith, Clyde;
- Large container ports - Grangemouth;
- Major ferry ports serving Ireland and Europe - Cairnryan, Stranraer and Rosyth - as well as lifeline ferry services within Scotland;
- Marine Works serving as pier heads for ferry services to Scotland's islands and for working boats associated with fish farm installations; and
- Marina facilities, e.g. Fairlie, Craobh Haven, Port Edgar.

C11.3.2 Economic value and employment

The ABI figures for GVA and numbers of jobs at 2009 prices, for sea and coastal water transport and supporting activities was £423m and 4,700 respectively (Baxter *et al*, 2011).

Cargo and passenger figures are published each year in the Scottish Transport Statistics and the Department for Transport Maritime Statistics. In 2009, 85.5 million tonnes of cargo was handled by all Scottish Ports and 10.5 million passengers were carried by ferries, with 15,222 vessels arriving at Scottish Ports during the same period. Over 67% of Scotland's total exports go out via Scottish ports, equating to 74 million tonnes each year (BPA, 2008).

Information presented in the ONS report identifies that in 2009 *circa* 11,000 jobs, and in 2010 *circa* 10,000 jobs were directly related to the ports and harbours sector (ONS, 2011). The potential additional knock-on employment of up to 21,000 is a result of indirect and induced expenditure effects through the supply chain. These figures exclude employment generated by the fishing and offshore oil and gas sectors which represent a very significant contribution to the Scottish economy (BPA, 2008).

Strongly related to the ports and harbours of Scotland is the shipbuilding industry which, in 2007, was worth £475m GVA with an estimated 5,800 jobs associated with building and repairing of vessels (Baxter *et al*, 2011). Scotland's shipbuilding sector is concentrated primarily on the manufacture and support of naval ships and specialist, more complex vessels for niche markets. Overall there are some 100 Scottish companies engaged in ship and boat building, with over 1,500 companies in the supply chain. It should be noted that almost 90% of these 100 businesses were small firms with less than 25 employees (BPA, 2008).

The oil and gas industry is a significant economic contributor to Scottish Ports. It is estimated that oil and gas production in the UK currently supports about 207,000 jobs in the supply chain, 40% of which are in Scotland. Using turnover figures relating to exports, it is estimated that direct export activity from the supply chain could be supporting a further 100,000 UK jobs. Scotland is also an important UK and European cruise destination and conservative estimates suggest that the cruise industry supports more than 800 employees, generating £23m GVA to the Scottish economy each year (BPA, 2008).

Of all the activities which take place at ports and harbours in Scotland, fishing is the most common and has therefore been considered under its own heading namely the commercial fishing sections of this report.

Ferry traffic has historically been an important aspect of Scottish port activity, this includes International, National and local services (BPA, 2008).

Smaller scale local ferry services, mainly between the Scottish mainland and outlying islands provide an important lifeline for residents. This service also opens a gateway for tourists to visit areas that might be otherwise inaccessible by car or train. Examples of this type of link include services provided by Caledonian MacBrayne, Orkney Ferries Ltd, Northlink Ferries and Shetland Islands Council. As an example, Northlink Ferries services between Aberdeen and Lerwick and Kirkwall carry *circa* 140,000 passengers each year. This gives considerable economic and social benefits to both the port and harbour operators as well as the surrounding area, allowing for the movement of commercial traffic, local passenger traffic and growing numbers of tourists and visitors (BPA, 2008).

Leisure moorings remain an important business income for many Scottish ports and help to support many businesses situated around harbours and marinas (discussed in detail in C 13.3.2). Many ports are examining the possibility of expanding so investment is generally concentrated on enhancing and refurbishing existing facilities (BPA, 2008).

C11.3.3 Future trends

The UK Government policy for ports was set out in the Interim Report of the ports policy review published in 2007 (DfT, 2007). This report stated that the Government sought to 'encourage sustainable port development to cater for long-term forecast growth in volumes of imports and exports by sea with a competitive and efficient port industry capable of meeting the needs of importers and exporters cost effectively and in a timely manner'. This provides confirmation that the ports industry is supported by Government policy into the future, providing assurance of sustained development.

Ports policy was reviewed in 2006 by the Scottish Government, this concluded that the sector benefits substantially from its independence and that the Scottish Government supported its mixed ownership structure, (i.e. Trust, Municipal and Private). Investment decisions are based on market needs rather than through central direction. The challenge for future development of this sector is based on world trade patterns and the economic climate (BPA, 2008).

The Scottish Government is formulating a National Planning Framework. This for the first time identifies Government development projects that will be rolled out during the next 20-30 years. The Scottish Government has said that its economic strategy requires a planning framework that supports sustainable economic growth across Scotland. Of the nine proposed National Developments three are large projects specifically related to the ports industry (BPA, 2008).

Scotland's National Transport Policy states that "An effective road and rail infrastructure to support national and international connections by sea is essential to ensure that the critical role of ports in supporting and contributing to Scotland's business and economic health is fully realised "Future areas of possible development are international transhipment, feeder services and short sea shipping". Also, "We will continue to support UK and international ferry routes including routes to Northern Ireland, Ireland, mainland Europe and beyond" (Scottish Executive, 2006b).

The importance of the oil and gas industry to the Ports industry within Scotland, specifically ports on the East Coast, Shetland and Orkney Isles, provide a close tie between these two sectors. Although the North Sea fields are considered to be 'mature' having produced 36 billion boe, estimates suggest that there may be another 25 million boe available. Operators who specialise in extracting oil and gas from the more mature fields have purchased several of these assets from the oil majors. This has seen higher investment levels for some older fields with increased production being achieved (BPA, 2008). The long term stability of extraction levels past 2020 is uncertain. However, the centre of excellence and expertise established in North East Ports has generated global trade in oil and gas equipment manufactured or services. Aberdeen Harbour (for example) already has three scheduled services to West African oil and gas producing countries and regularly handles other energy related cargoes to and from many other worldwide destinations (BPA, 2008).

The increase in offshore renewable activities provides a potential source of income for ports. This is both as a base for industrial processes including manufacture of offshore renewable devices, and as a service provider for the craft needed to install and maintain offshore renewable sites during the construction and operation. Market potential is driven by the location of offshore renewable developments, and the accessibility of ports for the types of craft involved in installation and maintenance activities.

The future use, growth and development of ports are intrinsically linked to world trade patterns and the economic climate, and are reactive to changing economic circumstances. Government policy continues to support the mixed ownership structure already established, with Government backing for National Infrastructure projects, all of which provides incentives to develop port facilities. Many ports in Scotland have identified opportunities around the developing marine renewables industry, which has the potential to change the landscape of port services and increase marine traffic.

C.11.4 Assumptions on Future Activity

The timing, location and nature of port development is difficult to predict as it occurs in response to demand. A number of developments are currently in planning to support offshore renewables development, for example, potential major developments at Leith, Dundee and Kishorn, together with proposals for development at a number of smaller ports to support wave and tidal development, for example at Scrabster. The National Renewables Infrastructure Plan (Scottish Enterprise, 2010) provides information on possible development sites to support offshore renewables expansion but the precise locations at which development occurs will be determined by market forces. While most of the development activity will be associated with construction of new quays, there is also a potential requirement for capital dredging works to improve access to berths.

In the absence of information on future port development, it has been assumed for the purposes of this assessment that major ports will undertake one development every five years over the assessment period (starting in 2016) and that all other ports will undertake one development over the period of the assessment (assumed to be in 2024).

It has been assumed that operators will need to apply for dredge material disposal licences once every 3 years. It has been assumed that locations of commercial anchorages and disposal sites do not change over the assessment period.

C.11.5 Potential Interactions with MPA Features

The main impacts of the construction and operation of ports and harbours within MPAs relate to direct damage to seabed habitats and species as a result of dredging or reclamation. Dredging may also lead to elevated concentrations of suspended sediment in the water column, affecting local water quality. Re-deposition of this sediment has the potential to cause smothering of existing seabed habitats. During construction and operational phases, underwater noise and vibrations may also be an issue.

Once constructed, ports and harbours may create a permanent barrier for the movement of mobile species, and pose a risk of death or injury by collision. Permanent changes to the hydrography and morphology of the area may change water flow and wave exposure, potentially inducing changes in the emergence regimes of intertidal species. The installation of moorings and regular anchoring of vessels has the potential to cause further damage to the local seabed, and could affect MPA features through pollution and the introduction of non-indigenous species into the area (JNCC & NE, 2011).

Anchorage of commercial vessels causes direct damage to habitats and species, with further surface and sub-surface abrasion of the seabed occurring from movement of the anchor and chain. A greater area of damage may be created by a circular movement of the ship at anchor. Direct collision of vessels into MPA features and collisions between vessels and shipping infrastructure will have similar impacts, although may be on a larger scale. Many seabed habitats are vulnerable to damage from shipping collisions, although recovery rates of sandy habitats are much faster than more sensitive biotopes such as biogenic reefs that may never fully recover.

C.11.6 Assumptions on Management Measures for Scenarios

It is assumed that the impact of ports and harbour activities on MPA features will be managed under the existing marine licensing framework (with the exception of anchorages which are not subject to a licensing regime). Two scenarios ('lower' and 'upper') have been developed to capture the possible costs of NC MPA proposals to the ports and harbours sector. These scenarios include a range of possible management measures, as detailed requirements will need to be based on site-specific factors.

It has been assumed that there will be no review of existing licenses or consents, although where operators of existing installations apply for new licences (for example, dredge disposal licences), these applications will be considered against the conservation objectives for features for which MPAs may have been designated.

The intermediate ('best') estimate for each site has been based on SNH current views on management options and judgements made by the study team. The assumptions do not pre-judge any future site-specific licensing decisions. After MPA designation, the management of activities in MPAs will be decided on a site-by-site basis and may differ from the assumptions in this assessment.

Management measures applied under the lower and upper scenarios are detailed below. Specific management measure assumptions for each scenario (including the intermediate scenario) are defined in the MPA Site Reports (Table 4, Appendix E).

Lower Scenario

- Additional costs will be incurred for new licence applications for port development, navigation dredging and disposal in assessing potential impacts to MPA features within 1km of proposed licence areas; and
- Mitigation measures may be required for non-OSPAR/BAP features ranging from:
  - No additional mitigation required for existing activities beyond existing good practice;
  - No additional mitigation required for new development beyond good practice;
  - Seasonal controls on construction, dredging and/or disposal activity; and
  - Refusal of licence/planning application.

Upper Scenario

- Additional costs will be incurred for licence applications for port development, navigation dredging and disposal in assessing potential impacts to MPA features within 5km (major ports) or 1km (non-major ports) of proposed licence areas;
- Additional survey costs will be incurred to inform licence applications;
- Additional post-licence monitoring of any features within 1km of development footprint; and
- Mitigation measures may be required for some OSPAR/BAP features[49] for which adequate protection is not currently achieved and all non-OSPAR/BAP features ranging from:
  - No additional mitigation required for existing activities beyond existing good practice;
  - No additional mitigation required for new development beyond good practice;
  - Seasonal controls on construction, dredging and/or disposal activity;
  - Mitigation of underwater noise from percussive piling activities;
  - Mitigation of water quality impacts from dredging (controls on overspilling, dredging rates/methods);
  - Requirement for offsetting measures for port development or anchorage impacts; and
  - Refusal of licence/planning application.

C.11.7 Assessment Methods

Additional Licensing Costs

Where required, it is assumed that the additional costs will be as follows:

- Additional assessment costs for licence application - £6.75k per licence application (Annex H12, Finding Sanctuary et al, 2012); and
- Additional survey costs – site specific determination.

Additional Post Licensing Costs

Where required, it is assumed that additional costs will be incurred as follows:

- Additional monitoring costs - site specific determination

[49] Some OSPAR/BAP features are already effectively afforded protection from activities with spatially-based licences; however, the following features are considered by the study team not to be given full protection: burrowed mud, inshore deep mud with burrowing heart urchins, offshore deep sea muds, offshore subtidal sands and gravels, shallow tide-swept coarse sands with burrowing bivalves and ocean quahog aggregations.

Mitigation Measures

Where required, it is assumed that the following additional costs may be incurred:

- Seasonal controls on construction, dredging and/or disposal activity – site specific determination;
- Mitigation of underwater noise from percussive piling activities – site specific determination;
- Mitigation of water quality impacts from dredging - site specific determination;
- Relocation of anchorages or disposal sites to less sensitive habitats or more representative areas of habitat;
- Requirement for offsetting measures – site specific determination; and
- Refusal of licence/planning application – site specific determination.

Cost of Uncertainty and Delays

The designation of NC MPAs has the potential to increase the time taken to determine licence applications and to negatively affect investor confidence. It has not been possible to quantify these potential impacts.

C.11.8 Limitations

- The location, nature and timing of future port development activity is uncertain; and
- The requirements for management measures are uncertain.

C.11.9 References

Baxter, J.M., Boyd, I.L., Cox, M., Donald, A.E., Malcolm, S.J., Miles, H., Miller, B., Moffat, C.F., (Editors), 2011. Scotland's Marine Atlas: Information for the national marine plan. Marine Scotland, Edinburgh.

British Ports Association (BPA), 2008. 'Scottish Ports Committee Ports In Scotland "Delivering Value".

Department for Transport (DfT) 2007. Ports Policy Review Interim Report, 19 July 2007. Available from: www.dft.gov.uk/pgr/shippingports/ports/portspolicyreview/portspolicyreviewinterimreport

Finding Sanctuary, Irish Seas Conservation Zones, Net Gain and Balanced Seas, 2012. Impact Assessment materials in support of the Regional Marine Conservation Zone Projects' Recommendations. Annex H12 Ports, Harbours and Shipping

JNCC and NE, 2011. General advice on assessing potential impacts of and mitigation for human activities on MCZ features, using existing regulation and legislation. Advice from the Joint Nature Conservation Committee and Natural England to the Regional MCZ Projects. June 2011. 107pp.

Office for National Statistics (ONS), 2011. Business Register and Employment Survey (2008 to 2010). Available at: http://www.nomisweb.co.uk/ Accessed: 17/11/11

Scottish Executive, 2006b. 'Scotland's National Transport Policy'. December 2006 Accessed: 15 November 2011.
http://www.scotland.gov.uk/Resource/Doc/157751/0042649.pdf

Scottish Government, 2013. Scotland's Third National Planning Framework: Main Issues Report and Draft Framework. April 2013 Accessed 31 May 2013.
http://www.scotland.gov.uk/Resource/0042/00421073.pdf

C.12. Power Interconnectors and Transmission Lines

C.12.1 Introduction

This appendix provides an overview of existing and potential future activity relating to power interconnectors and transmission lines in Scottish waters and outlines the methods used to assess the impacts of potential MPAs on this sector.

C.12.2 Sector Definition

This sector is concerned with the transmission of power through submarine cables, including international, national and inter-island links. This assessment excludes power cables to/from individual developments (e.g. power supplies to oil and gas installations, export cables from offshore wind farms).

C12.2.1 Overview of Existing Activity

A list of sources to inform the writing of this baseline is provided in Table C12.1.

Table C12.1 Information Sources

Scale	Information Available	Date	Source
Scotland	All pipelines and cables	Current	SeaZone Solutions Ltd
Scotland/UK	Power interconnectors and Transmission Lines	Current	SeaZone
Scotland	Power cables (submarine electricity cables)	Current	Baxter *et al*. (2011)
Scotland	Potential future subsea cable developments / reinforcements	2009	National Planning Framework for Scotland Annex National development 11 (Scottish Government, 2009b)

C12.2.2 Location and intensity of activity

There are approximately 900km of submarine power cables in Scottish waters (Baxter *et al*, 2011) predominately created to connect island communities to the mainland national grid infrastructure (UKMMAS, 2010). This is reflected in Figure C15 which shows subsea grid infrastructure connections in inshore waters between areas of mainland Scotland and between the mainland and islands. Note, subsea power cables to/from developments (e.g. oil and gas platforms) are not shown.

C12.2.3 Economic value and employment

There is no agreed methodology for calculating the economic value of subsea power cables. In the absence of information on economic value, the capacity of interconnector cables may be used as an indicator of both value and activity (UKMMAS, 2010).

C.12.3 Future trends

The location of offshore renewables resources, often remote from locations of power demand, and the large proposed expansion of offshore renewables development may drive the development of an offshore grid network and interconnectors.

UKMMAS (2010) reported that over the period 2007-12 the Office of the Gas and Electricity Markets (Ofgem) provided for capital investment of up to £4.3 billion in the electricity transmission network, an increase of 160% over the previous 5-year price control period, with much of this investment planned for Scotland.

The Scottish National Planning Framework 2 (Scottish Government, 2009b) identifies ‘electricity grid reinforcements’ as one of the fourteen national developments essential to the delivery of the spatial strategy set out in the second National Planning Framework. The strategic grid reinforcements are essential to provide the transmission capacity necessary to realise the potential of Scotland’s renewable energy sources, maintain long-term security of electricity supply and support sustainable economic development. This development would occur throughout Scotland, from the English border to the Shetland Islands and, in relation to marine power interconnectors and transmission lines, would include:

- Reinforcement of the sub-sea cable link between Orkney and the Scottish mainland; and
- New sub-sea cable links for the Outer Hebrides and the Shetland Islands.

In addition, there are a number of proposed marine power interconnector developments in the UK at various stages of maturity in the planning process. Those that are relevant to Scotland are shown in Table C12.2 and Figure C15. If these developments proceed, they would significantly increase the length and capacity of interconnector and offshore grid cables compared to the current baseline. However, the nature and form of the overall development of the offshore grid remains uncertain particularly in the long-term (Saunders *et al*, 2011).

Table C12.2 Potential Future Power Interconnector Cables and Transmission Lines

Project	Description	Current Project Stage*	Earliest Completion Date
Western HVDC Link	West Coast 1.8GW High Voltage Direct Current (HVDC) link between Hunterston and Connah's Quay in North Wales	Construction	2015
Eastern HVDC Link	1.8GW HVDC link between Peterhead and Hawthorne Pit in Humberside	Optioneering	2018 (Q2)
Shetland HVDC Link	Island link connecting Shetland Islands to Moray Firth offshore hub	Design	2017 (Q4)
Orkney 132kV Subsea Link	Island link connecting Orkney and Pentland Firth Subsea Link	Design	2015 (Q4)
Western Isles HVDC Link	Island Link	Planning	2015 (Q4)
Hunterston-Kintyre 240MVA AC subsea link	AC subsea link between Hunterston and Carradale in Argyll and Bute	Planning	2015 (Q4)
Caithness-Moray HVDC reinforcement	HVDC Link: from Caithness to the Moray Coast via the Moray Firth Offshore hub	Design	2016 (Q4)
UK-Norway NorthConnect	Interconnector between Norway (Sima and Samnanger) and Scotland (landfall Peterhead).	Co-operation agreement signed in February 2011	Expected to be operational before 2020
HVDC Norway - England	Hylen, Sundal in Norway to Blyth in the United Kingdom. Expected to be operational by 2020. (Source: Wikipedia)	Optioneering	Expected to be operational by 2020. (Source: Wikipedia)

***Current Project Stage:**
Optioneering – Transmission Operator believes that the need case is firm, number of design options provided for public consultation so that a preferred design solution can be identified;
Design – designing the preferred solution into greater level of detail and preparing for the planning process;
Planning – continuing with public consultation and adjusting the design as required through the planning process application process;
Construction – planning consent has been granted and/or contracts have been awarded and manufacturing underway.

C.12.4 Assumptions on Future Activity

It has been assumed that all currently planned and proposed interconnector projects (see Table C12.2) will be constructed in the period to 2020.

C.12.5 Potential Interactions with MPA Features

The installation and operation of submarine power cables will have similar effects on MPA features as that of telecom cables, and is discussed in detail in the Telecom Cables appendix. In addition to these impacts, interconnecting power cables induce electromagnetic changes in the local environment that are detectable by some electro-sensitive and magneto-sensitive species, notably elasmobranchs. The significance of these effects for individuals and populations remains uncertain (JNCC & NE, 2011).

C.12.6 Assumptions on Management Measures for Scenarios

It is assumed that the impact of power interconnectors and transmission lines on MPA features will be managed under the existing marine licensing framework within 12nm (there is no requirement for cables beyond 12nm to apply for a licence). Two scenarios ('lower' and 'upper') have been developed to capture the possible costs of proposed MPAs to the sector. These include a range of possible management measures, as detailed requirements will need to be based on site-specific factors.

It has been assumed that there will be no review of existing consents or licences, although where existing power interconnectors and transmission lines within 12nm apply for new consents or licences, these applications will be considered against the conservation objectives for features for which MPAs may have been designated.

The intermediate ('best') estimate for each site has been based on SNH/JNCC current views on management options and judgements made by the study team. The assumptions do not pre-judge any future site-specific licensing decisions. After MPA designation, the management of activities in MPAs will be decided on a site-by-site basis and may differ from the assumptions in this assessment.

Management measures applied under the lower and upper scenarios are detailed below. Specific management measure assumptions for each scenario (including the intermediate scenario) are defined in the MPA Site Reports (Table 4, Appendix E).

Lower Scenario

- Additional costs will be incurred for new licence applications within 12nm in assessing potential impacts to MPA features within the proposed development footprint; and
- Mitigation measures may be required for non-OSPAR/BAP features within 12nm ranging from:

- No additional mitigation required for existing power interconnectors and transmission lines beyond existing good practice;
- No additional mitigation required for new developments beyond good practice; and
- Re-routeing of cables to avoid highly sensitive MPA features.

Upper Scenario

- Additional costs will be incurred for new licence applications within 12nm in assessing potential impacts to MPA features within 1km;
- Additional survey costs will be incurred to inform new licence applications (within 12nm) for cables intersecting features proposed for designation within potential NC MPAs;
- Additional post-licence monitoring of any features proposed for designation within potential NC MPAs within 100m of cable within 12nm; and
- Mitigation measures may be required for some OSPAR/BAP features[50] for which adequate protection is not currently achieved and all non-OSPAR/BAP features within 12nm ranging from:
  - No additional mitigation required for existing power interconnectors and transmission lines beyond existing good practice;
  - No additional mitigation required for new developments beyond good practice;
  - Seasonal controls on new cable laying to minimise impacts to highly sensitive MPA features – site specific assessment; and
  - Re-routeing of cables to avoid moderately and highly sensitive MPA features.

C.12.7 Assessment Methods

Additional Licensing Costs

Where required, it is assumed that the additional costs will be as follows:

- Additional assessment costs for licence application - £5k per licence application; and
- Additional survey costs - £5k per km of cable route within potential MPA.

Additional Post Licensing Costs

Where required, it is assumed that additional costs will be incurred as follows:

50 Some OSPAR/BAP features are already effectively afforded protection from activities with spatially-based licences; however, the following features are considered by the study team not to be given full protection: burrowed mud, inshore deep mud with burrowing heart urchins, offshore deep sea muds, offshore subtidal sands and gravels, shallow tide-swept coarse sands with burrowing bivalves and ocean quahog aggregations.

- Additional monitoring costs £5k per km of cable route within potential MPA, three years after construction.

Mitigation Measures

Where required, it is assumed that the following additional costs may be incurred:

- Seasonal controls on new cable laying to minimise impacts to highly sensitive MPA features – site specific assessment; and
- Re-routeing of cables to avoid moderately and highly sensitive features - £1.01m/km (based on Annex H14 of Finding Sanctuary et al, 2012).

Cost of Uncertainty and Delays

The designation of NC MPAs has the potential to increase the time taken to determine licence applications and to negatively affect investor confidence. It has not been possible to quantify these potential impacts.

C.12.8 Limitations

- The number and location of interconnectors that may be constructed up to 2020 is uncertain and beyond 2020 is unknown; and
- The requirements for management measures are uncertain.

C.12.9 References

Baxter, J.M., Boyd, I.L., Cox, M., Donald, A.E., Malcolm, S.J., Miles, H., Miller, B., Moffat, C.F., (Editors), 2011. Scotland's Marine Atlas: Information for the national marine plan. Marine Scotland, Edinburgh.

Finding Sanctuary, Irish Seas Conservation Zones, Net Gain and Balanced Seas, 2012. Impact
Assessment materials in support of the Regional Marine Conservation Zone Projects' Recommendations. Annex H14 Renewable Energy.

JNCC and NE, 2011. General advice on assessing potential impacts of and mitigation for human activities on MCZ features, using existing regulation and legislation. Advice from the Joint Nature Conservation Committee and Natural England to the Regional MCZ Projects. June 2011. 107pp.

Saunders, J., Tinch, R., Ozdemiroglu, E. & Hull, S., 2011. Valuing the Marine Estate and UK Seas: Dynamic Baseline Assessment (draft). Marine Estate Research Report for The Crown Estate.

Scottish Government, 2009. National Planning Framework for Scotland 2.

United Kingdom Marine Monitoring and Assessment Strategy (UKMMAS), 2010. Charting Progress 2 Feeder Report Productive Seas. Department for Environment Food and Rural Affairs on behalf of UKMMAS (Eds. Saunders, J. and McKie, J.) 472pp Available online: http://chartingprogress.defra. gov.uk/

C.13. Recreational Boating

C.13.1 Introduction

This appendix provides an overview of existing and potential future activity for the recreational boating sector in Scotland and outlines the methods used to assess the impacts of proposed MPA on this sector.

C.13.2 Sector Definition

For the purpose of this study, recreational boating is considered to include recreational activities undertaken in medium and large sailing vessels, yachts, powerboats and motorboats. Information on small sailing boat activity such as dinghies (usually taken out of water at end of use) and other types of water sports are covered under water sports. It is possible that general tourism values may overlap with values specifically associated with recreational activities. General tourism is described separately. There is some possibility of a degree of double counting using this approach but not to the extent that it materially affects the results of the study.

C.13.3 Overview of Existing Activity

A list of sources to inform the writing of this baseline is provided in Table C13.1.

Table C13.1 Information Sources

Scale	Information Available	Date	Source
Scotland	Statistics on sailing tourism	No date	Tourism Resources Company *et al* (2010)
All Regions	Number of resident home berths Number of visiting berths Proportion of total Scotland berths Demand for home berths (occupancy) Visiting craft demand for berths Average annual spend per boat (high, medium and low) Direct expenditure Multipliers (from Scottish Tourism Multiplier Study) Visiting boat nights Visiting boat expenditure Employment Gross Value Added	No date	Tourism Resources Company *et al* (2010)
Scotland	Sailing area value and berth numbers	No date	Baxter *et al* (2011)
Scotland	RYA cruising routes and sailing areas	No date	Baxter *et al* (2011)
UK	RYA Racing Areas (polygon)	2008	RYA

Scale	Information Available	Date	Source
UK	RYA Sailing Areas (polygon)	2008	RYA
UK	RYA coastal recreational sailing routes (polyline)	2008	RYA
UK	RYA Sailing Clubs (point)	2008	RYA
UK	Locations of existing and proposed marinas and numbers of berths (point)	2008	RYA
UK	Boat Launch – Slipways		Boat Launch (www.boatlaunch.co.uk)
UK	Boat Launch – Marinas (NB does not include yacht clubs with moorings)		Boat Launch (www.boatlaunch.co.uk)
UK	UK leisure, super yacht and small commercial marine industry economic statistics based on key performance indicators	2011/2012	BMF (2011b)

C.13.3.1 Location and intensity of activity

The UK Atlas of Recreational Boating (RYA, 2008) and data from the Royal Yachting Association (RYA) indicates that recreational boating within Scotland is concentrated in the Clyde and along the West Coast, the Moray Firth, Solway Firth and the Firths of Tay and Forth which are the traditional cruising grounds for recreational sailors and power boaters. However, recent developments along the East Coast, and within the Orkney and Shetland Isles have increased the potential for cruising routes between the Caledonian Canal and the Shetlands with well placed facilities and stopping points en route. The RYA's Position Statement on offshore energy developments (RYA, 2009), which encompasses the whole of the UK, notes that most of the general day sailing and racing areas are close to the shore. The location of sailing and racing areas, recreational anchorages and indicative sailing routes are presented in Figure C16.

Indicative estimates of the number of people participating in sailing and power/motor boating activities in Scotland can be taken from the British Marine Federation (BMF) Water sports and Leisure Participation Survey 2009 (BMF *et al*., 2009). This report estimated that in 2009, 57,047 people participated in sailboat activities and/or yacht cruising, 12,486 participated in sailboat and/or yacht racing and that 49,015 engaged in motor boating/ cruising or canal boating in the Border and Scotland ITV regions[51].

C.13.3.2 Economic value and employment

The Scottish Coast, and particularly the West coast, is identified as being one of the World's premier destinations for sailing. Recreational boating and marine and sailing

[51] The Border and Scotland ITV Regions comprise the Grampian, Scottish and Border ITV Regions. Grampian Television covers the North and North East of Scotland, Scottish Television covers Central Scotland and Border Television covers the Dumfries and Galloway region, part of the south west area of Ayrshire, the Scottish Borders but also parts of Northumbria and most of Cumbria in England.

tourism contribute about £300 million to the Scottish economy[52]. Overall, the sector is expected to grow in the long term (UKMMAS, 2010).

An assessment of the current economic impact of sailing in Scotland was undertaken by Scottish Enterprise (2010) and a summary is shown below in Table C13.2. The study indicated that there is a total berthing/mooring capacity available across Scotland for 12,500 vessels. The study stated that the value of the market could increase from its current value of £101 million to £145 million after 10 years.

Table C13.2 Economic impact of sailing in Scotland

Activity	Total Activity (by Scottish and Non-Scottish Boat Owners)	Tourist Activity (by Non-Scottish Boat Owners Only)
Expenditure	£101.3million	£27.0 million
Employment (FTEs)	2,732	724
GVA	£53.0million	£14.0million

(Source: Scottish Enterprise, 2010)

In Scotland, the BMF estimates that in 2009/10 the total turnover of the leisure, super yacht and small commercial marine industry was £92.7million (BMF, 2010). Of this, the 'value added contribution' which is the principal measure of national economic benefit was £29.2million. This study focuses more on business values (such as boat building, specialised equipment manufacture, sales, training, consumer services, insurance services and finance) than the Scottish Enterprise (2010) study which is focused much more on expenditure related values of boat owners and visiting tourists. The industry in Scotland supported around 1,579 FTE jobs. It should be noted that a proportion of this revenue comes from inland activities. UKMMAS (2010) estimated that 62% of the total value in 2006/07 related to the marine environment. Using the same proportion, the indicative total value related to the marine environment in 2009/10 was £57.5million. No national employment figures derived from the Business Register and Employment Survey (using UK SIC codes) have been included for activities relating to recreational boating. This is because the codes are for the entire sports sector and do not permit disaggregation to a useful level.

C.13.3.3 Future trends

UKMMAS (2010) reports that whilst marine recreation has experienced recent growth, future growth and stability of the sector is dependant upon the general health of the UK economy. A strong economy results in consumers having more disposable income to spend on leisure and recreation activities. As a result of the recent global economic downturn, there has been some short-term decline in

52 Cited in the RYA Scotland's and the SBA's Offshore Wind SEA consultation responses. This value was based on a report by Scottish Enterprise (2006) (Mike Balmforth, SBA, pers. comm. 18 Jan 2011). This report estimated that the annual economic impact of the marine leisure industry in Scotland was £250 million, supporting around 7,000 jobs.

participation in recreational activities within the UK. However, with infrastructure and technology in place to support the sector, it is expected to continue to grow over the long term and the prospects for growth in Scotland are good.

Scotland's Marine Atlas (Baxter *et al*., 2011) comments that despite the recent downturn in the global economy, and subsequent reduction in disposable incomes, the recreational sector could have the potential to play an increasingly significant role in Scotland's rural economy. This is evidenced by the recent development of marina facilities at Wick, and the Orkney Islands. Combined with active marketing by marina owners, and support from local authorities (such as Orkney Island's Council as seen in recent developments) the potential for future growth is apparent.

Climate change may also play a small part in increasing overall participation numbers. As the frequency of months when conditions are more comfortable for tourism in North-West Europe (MCCIP, 2008) improve, the warmer weather is more likely to attract visitors to coastal locations in Scotland. The net result will be an extension of the tourist season beyond its traditional limits and opening up new destinations. Climate change as a positive influencing factor must be balanced against predictions of increased storminess, and the severity of storms. Provided increased storminess is predominantly in the winter months, this may not be a factor in future recreational boating trends.

The Scottish Enterprise (2010) report concludes that as long as infrastructure (marinas and shore side facilities) continue to attract investment, resident berthing could increase by 3-5% per annum. The growth potential in visitor berthing is projected at up to 5% per annum. Both of these projects bring an associated increase in expenditure into the local economy.

Planned and possible future offshore renewables development over the assessment period could interact with recreational boating activity. Such development may constrain recreational boating within the vicinity of arrays and increase sailing distances on some cruising and sailing routes. Concentration of developments along the East and West coasts of Scotland may increase the challenges of sailing along these routes with the potential to deter sailors.

C.13.4 Assumptions on Future Activity

It is assumed that recreational sailing routes, recreational anchorages and sailing and racing areas do not change significantly over the period of the assessment. There is some potential for levels of activity to increase in Scottish waters, dependent on continued investment in facilities and wider economic conditions.

C.13.5 Potential Interactions with MPA Features

The primary interactions of recreational boating with MPA features relate to the construction and use of boating infrastructure. The construction of boating infrastructure such as marinas and slipways may result in a complete loss of local habitat and the potential pollution of the habitats and species within the surrounding area. The installation and use of moorings may cause further physical damage to the seabed, notably to those MPA features particularly vulnerable to disturbance. Similar effects are associated with the regular anchoring of boats, although most marine habitats are resilient to this kind of disturbance. Leachates entering the environment from infrastructure may further pollute surrounding habitats and species, and increased shading as a result of infrastructure development may cause a loss of algal species and the associated infauna. Underwater noise may also be associated with construction activities (JNCC & NE, 2011).

The potential impacts of the use of recreational boats are generally low. Of most concern is the pollution of sensitive MPA features with fuel, oil and lubricants. The introduction of invasive species into new habitats is also of concern. Other interactions of boating with MPA features include pollution with litter, sewage, zinc anodes and physical impacts associated with boat launching, haulout and disposal (JNCC & NE, 2011).

C.13.6 Assumptions on Management Measures for Scenarios

It is assumed that the impact of recreational boating activities on MPA features will be managed through Marine Conservation Orders or voluntary measures. Two scenarios (‘lower’ and ‘upper’) have been developed to capture the possible costs of potential MPAs to the recreational boating sector. These include a range of possible management measures, as detailed requirements will need to be based on site-specific factors.

The lower and intermediate (‘best’) estimates for each site have been based on an assessment carried out by SNH of the overlaps between recreational anchorages and The Crown Estate’s moorings and feature presence records held by SNH, including 100m and 200m buffer zones. This assessment incorporated feature sensitivity and where uncertainty on feature presence data exists, SNH expert judgement was used to determine management measures required. The upper estimates have been based on assessments made by the study team using the overlap between anchorages and The Crown Estate’s moorings and upper feature extents as defined in Appendix B, as well as feature sensitivity to anchoring pressures. The assessment focused only on individual moorings (taken as TCE mooring data <0.001km^2), and when mooring data showed overlaps with more than one feature record, the feature most sensitive to anchoring pressures was used in the assessment as a precautionary measure. It is noted that those Crown Estate mooring areas with few or no individual moorings present may be potential underestimates, as it is expected that additional mooring points are likely to be present within the larger mooring areas that are not represented by the data.

The assumptions do not pre-judge any future site-specific decisions on management. After MPA designation, the management of activities in MPAs will be decided on a site-by-site basis and may differ from the assumptions in this assessment.

Management measures applied under the lower and upper scenarios are detailed below. Specific management measure assumptions for each scenario (including the intermediate scenario) are defined in the MPA Site Reports (Table 4, Appendix E).

Lower Scenario

- Mitigation measures may be required for all MPA features (depending on sensitivity) ranging from:
  - No additional mitigation measures required beyond existing good practice; and
  - Relocation of recreational anchorages to less sensitive areas or more representative areas of habitat.

Upper Scenario

- Mitigation measures may be required for all MPA features (depending on sensitivity) ranging from:
  - No additional mitigation measures required beyond existing good practice; and
  - Relocation of recreational anchorages to less sensitive areas or more representative areas of habitat.

C.13.7 Assessment Methods

Mitigation Measures

Where required, it is assumed that the following additional costs may be incurred:

- Voluntary restriction/relocation/closure of anchorages – site specific assessment.

C.13.8 Limitations

- The future level and location of marina development applications is uncertain; and
- The management measure requirements for new development are uncertain.

C.13.9 References

Baxter, J.M., Boyd, I.L., Cox, M., Donald, A.E., Malcolm, S.J., Miles, H., Miller, B., Moffat, C.F., (Editors), 2011. Scotland's Marine Atlas: Information for the national marine plan. Marine Scotland, Edinburgh.

BMF, MCA, RYA and Lifeboats 2009. Water sports and Leisure Participation Survey 2009. Available online:

http://www.britishmarine.co.uk/upload_pub/WatersportsandLeisureOmnibus2009finalpublic.pdf

BMF, 2010. UK Leisure and Small Commercial Marine Industry Key Performance Indicators 2009/10. Available online: http://www.britishmarine.co.uk/upload_pub/KPIReport2010.pdf

JNCC and NE, 2011. General advice on assessing potential impacts of and mitigation for human activities on MCZ features, using existing regulation and legislation. Advice from the Joint Nature Conservation Committee and Natural England to the Regional MCZ Projects. June 2011. 107pp.

MCCIP, 2008. Marine climate change impacts. Annual Report Card 2007–2008

RYA, 2009. The RYA's Position on Offshore Energy Developments, December 2009.

RYA, 2008. UK Coastal Atlas of Recreational Boating. Second Edition.

Scottish Enterprise, 2010. 'Sailing Tourism In Scotland' February 2010

United Kingdom Marine Monitoring and Assessment Strategy (UKMMAS), 2010. Charting Progress 2 Feeder Report Productive Seas. Department for Environment Food and Rural Affairs on behalf of UKMMAS (Eds. Saunders, J. and McKie, J.) 472pp Available online: http://chartingprogress.defra. gov.uk/

C.14. Shipping

C.14.1 Introduction

This appendix provides an overview of existing and potential future activity for the shipping sector in Scottish waters and outlines the methods used to assess the impacts of proposed MPAs on this sector.

C.14.2 Sector Definition

Shipping provides for the transport of freight and passengers both within Scottish waters and internationally. Commercial shipping routes can be split into two distinct types; transiting vessels passing through Scottish Waters and vessels with either their origin or destination port within Scotland. Anchorages are covered under Ports and Harbours.

C.14.3 Overview of Existing Activity

A list of sources to inform the writing of this baseline is provided in Table C14.1.

Table C14.1 Information Sources

Scale	Information Available	Date	Source
Scotland	Number of passengers, cars and commercial vehicles on ferries (graph), Shipping traffic: no of vessels in a given area during 1st week of Jan 2010 (map), AIS regional maps	2005-2009	Baxter *et al* (2011) The Scottish Government (2011) 'Scotland's Marine Atlas – Information for the National Marine Plan' March 2011.
Scotland	Scottish Transport Statistics	2009	Scottish Government (2009)
Scotland	Scottish Transport Statistics	2010	DfT (2010)
Scotland	Baseline review of data on commercial shipping		ABPmer (2012)
UK	Shipping intensity (MCA AIS data)		MCA / ABPmer (will our dataset cover Scottish waters?)
UK	Recommended Route Areas (polygon, line, point)	Current	SeaZone
UK	Traffic Separation Scheme (point and line)	Current	UKHO

Data from the Department for Transport (DfT) for 2008 shows that 15,173 vessels arrived at the 16 major Scottish ports, the ship type breakdown is shown in Table C14.2; the main shipping routes are shown in Figure C17 with the ferry services are shown in Figure C18.

Table C14.2 Ship type arrivals at 16 major ports

Port	Tankers	RoRo	Container	Other	Total
Aberdeen	420	673	417	39	**1,549**
Ayr	1	0	220	2	**223**
Cairnryan	0	2,543	0	0	**2,543**
Clyde	188	16	585	345	**1,134**
Cromarty Firth	49	5	111	4	**169**
Dundee	60	5	189	17	**271**
Forth	1,892	161	1,188	97	**3,338**
Glensanda	0	0	47	106	**153**
Inverness	158	0	109	0	**267**
Lerwick	72	677	195	19	**963**
Montrose	11	0	215	7	**233**
Orkney	100	1,334	126	5	**1,565**
Perth	0	0	93	0	**93**
Peterhead	102	15	109	5	**231**
Stranraer	0	2,174	0	0	**2,174**
Sullom Voe	263	0	4	0	**267**
Total					**15,173**

(Source: DfT, 2010)

C14.3.1 Location and intensity of current activities

AIS information presented within Scotland's Marine Atlas (Baxter *et al*, 2011) shows information as a gridded density map, which provides an indication of intensity of sea area use, but not any quantifiable detail necessary to carry out site specific evaluation.

C14.3.2 Economic value and employment

In 2008, a total of 67.4Mt of freight was recorded as being lifted by water transport in Scotland. Of this, 23.3Mt was coastwise traffic to other ports in the United Kingdom (including Scotland), 1.8Mt of one port traffic to offshore installations, and 42.4Mt of exports from the major Scottish ports (Baxter *et al*, 2011).

Oxford Economics (2011) reports for the Chamber of Shipping have estimated that from a turnover of £9.5 billion, the shipping industry contributes about £4.7bn GVA to the UK. The UK Major Ports Group suggests that ports contribute around £7.7bn to UK GDP. Neither source of information presents a breakdown for Scottish Shipping or Ports (Baxter *et al*, 2011). It can be assumed that shipping transiting through Scottish Waters, but not making port calls provides no economic value to Scotland. Indirect value may be obtained from transitory shipping through jobs related to safety of shipping in Scottish waters and commodity transportation originating in Scotland, but shipped through other UK ports.

In 2009, the number of jobs for sea and coastal water transport supporting activities was estimated at 4,700, the equivalent GVA was £432M. These values cannot be disaggregated to individual sea areas (Baxter *et al*, 2011). Employment figures from ONS (2011) are given in Table C14.3 however the SIC codes do not provide a breakdown that directly relates to the shipping industry.

Table C14.3 Employees in the shipping sector

SIC, 2007	Full-time Employees		Part-time Employees	
	2009	2010	2009	2010
Sea and coastal passenger water transport (SIC 50100)	1,346	1,267	216	245
Sea and coastal freight water transport (SIC 50200)	612	440	20	64
Renting and leasing of passenger water transport equipment (SIC 77341)	32	17	1	2
Renting and leasing of freight water transport equipment (SIC 77342)	115	49	6	7
Total	**2,105**	**1,773**	**243**	**318**

(Source: ONS, 2011)

C14.3.3 Future trends

Shipping volumes bear a direct relationship to the global economic market. As markets react to the changing financial situation, shipping lines respond with services to move goods and people. The most notable variable to affect the volume and intensity of shipping into the future will be the technology and innovations used to design future shipping. Ship design seeks for bigger, faster and more economic transhipment of goods and people.

The introduction of bigger ships places expectations that existing ports will increase the depth of water in entrance channels and alongside berths to accommodate changing ship requirements. This implies that investment is necessary in port infrastructure, both in terms of shore side facilities and access to the ports. Channel widths may need to increase to take account of the wider ship beam, which in addition may lead to the requirement for turning circles to be enlarged to take account of greater vessel length. Although all of these pressures have to be taken into account, probably the most significant factor to challenge traditional ports in the context of their ability to accommodate bigger ships is sea access, and in particular vessel draught. New future shipping routes may also lead to shipping increases, especially in respect to the potential for a viable North West passage

In respect of lifeline ferry services, which make up significant proportion of vessel movements within Scottish waters, the Scottish Government have prepared a long-term ferries strategy (2013-2022). The Draft Ferries Plan was published in December 2011 and the consultation period ran until March 2012, with the final Ferries Plan published in December 2012. The plan makes recommendations regarding where investment should be focused to improve connections for island and remote rural communities, improve reliability and journey times, maximising opportunities for employment, business, leisure and tourism and promoting social inclusion (Transport Scotland, 2012).

Planned and possible future offshore renewables development over the assessment period could interact with commercial shipping activity. Such development is likely to preclude passage of commercial vessels through areas occupied by arrays with the potential to increase steaming distances and times on some routes. However, the overall impacts on shipping activity are considered to be relatively minor.

C.14.4 Assumptions on Future Activity

Shipping volumes directly relate to the global economic market. As markets react to the changing financial situation, shipping lines respond with services to move goods and people. The most notable variable to affect the volume and intensity of shipping into the future will be the technology and innovations used to design future shipping. It is assumed that numbers of vessels and routes remain relatively constant over the assessment period (2014 to 2034).

C.14.5 Potentially Significant Interactions with MPA Features

The main pressure arising from commercial shipping vessels on features identified within the current list of potential NC MPAs relates to disturbance to seabed habitats from anchoring (covered under Ports and Harbours).

Oil spills as a result of shipping activities may impact all habitat types, although low energy areas such as intertidal habitats will be more sensitive to pollution. In areas of high wave energy, oil will be dispersed quickly. Other pollutants such as sewage or those released by accidental cargo spillage also have the potential to contaminate MPA features, resulting in nutrient enrichment of waters (JNCC & NE, 2011).

Ballast water discharge provides a key pathway for the spread and introduction of non-indigenous and invasive species which may out-compete native species and cause a shift in community structure (JNCC & NE, 2011).

C.14.6 Assumptions on Management Measures for Scenarios

The main risk to features identified within the current list of proposed MPAs relates to disturbance to seabed habitats from anchoring. This is covered under Ports and Harbours. The other potential impact pathways are already adequately managed through international law.

In the absence of any significant pressures on features identified within the current list of proposed MPAs, it has been assumed that there will no requirement for additional management measures on the shipping sector and thus no cost impact will arise.

Further consideration of potential shipping impacts could be necessary if NC MPA proposals are brought forward for mobile features such as marine mammals.

C.14.7 Assessment Methods

Not required

C.14.8 Limitations

- Information on the distribution and intensity of commercial shipping activity in Scottish Waters is not spatially well-resolved.

C.14.9 References

Baxter, J.M., Boyd, I.L., Cox, M., Donald, A.E., Malcolm, S.J., Miles, H., Miller, B., Moffat, C.F., (Editors), 2011. Scotland's Marine Atlas: Information for the national marine plan. Marine Scotland, Edinburgh.

Department for Transport (DfT), 2010. Marine Transportation Statistics. Accessed 07 Nov 2011 : http://www.dft.gov.uk/statistics/series/ports/

JNCC and NE, 2011. General advice on assessing potential impacts of and mitigation for human activities on MCZ features, using existing regulation and legislation. Advice from the Joint Nature Conservation Committee and Natural England to the Regional MCZ Projects. June 2011. 107pp.

Office for National Statistics (ONS), 2011. Business Register and Employment Survey (2008 to 2010). Available at: http://www.nomisweb.co.uk/ Accessed: 17/11/11

Oxford Economics, 2011. The economic impact of the UK Ports Industry. May 2011

Transport Scotland. 2012. Scottish Ferry Services: Ferries Plan (2013-2022). 89pp. http://www.transportscotland.gov.uk/files/documents/reports/j254579_1.pdf

C.15. Telecom Cables

C.15.1 Introduction

This appendix provides an overview of existing and potential future activity for the telecom cables sector in Scottish waters and outlines the methods used to assess the impacts of proposed MPAs on this sector.

C.15.2 Sector Definition

This sector relates to fibre optic submarine telecommunication cables, which carry telephone calls, internet connections and data as part of national and international data transfer networks utilised for the majority of international communication transmissions.

C.15.3 Overview of Existing Activity

A list of sources to inform the writing of this baseline is provided in Table C15.1.

Table C15.1 Information Sources

Scale	Information Available	Date	Source
Scotland	All pipelines and cables	Current	SeaZone Solutions Ltd
Scotland	Power cables (submarine electricity cables)	Current	Baxter *et al*. (2011)
Scotland	Potential future subsea cable developments / reinforcements	2009	National Planning Framework for Scotland Annex National development 11 (Scottish Government, 2009b)
UK	Telecom cables laid on seabed or buried underwater (polyline)		KISCA / SeaZone
UK	Status of telecoms sector	2010	CP2 Feeder Report
UK	Socio-economic importance and trends	2008	Pugh, 2008

C15.3.1 Distribution level and intensity of activity

Telecommunication cables within the Scottish Continental shelf include fibre optic international cable links and domestic inter-island cables which are mainly copper wire. Over 4,000km of international cables (comprising approximately 40% of all the UK's active international cables) and 600km of inshore cables exist in Scottish seas (Baxter *et al*, 2011) (see Figure C19). An international network passes North and South of Shetland connecting Europe to North America, Faroe Islands, Iceland and Greenland, while networks connecting Scotland and Northern Ireland occur in waters off the West and South West of Scotland. Cables also connect the Scottish mainland and island communities.

C15.3.2 Economic value and employment

The economic value and employment associated with subsea telecommunications cables is uncertain, although they are very important in supporting regional, national and international communication networks.

C15.3.3 Future trends

According to the UK Cable Protection Committee (UKCPC, now Subsea Cables UK) around 95% of international trans-ocean traffic is carried by cable, hence, submarine cables will be vital for the foreseeable future (Baxter *et al*, 2011). However, there is little information available on how this sector may change in the future (Saunders *et al*, 2011). According to UKMMAS (2010), changes in bandwidth and the development of high speed internet as well as continued growth in the sector are using up the spare capacity in the current telecommunication networks. The further development of more resilient networks requires a greater reliance on a number of submarine cable routes rather than a few, and major domestic and international systems are now being installed. Future developments in telecom cables are likely to focus on upgrading and increasing the capacity of existing cables along the same routes that are currently present (ABPmer, RPA & SQW, 2011). The extent to which new cables will be laid in Scottish waters is not known (Baxter *et al*, 2011).

C.15.4 Assumptions on Future Activity

It is assumed that future activity is limited to replacing existing telecom cables. It is assumed that 50% of existing telecom cables transecting MPAs within 12nm will require replacement over the assessment period (assumed to be in 2024).

C.15.5 Potential Interactions with MPA Features

The burying of telecom cables in the seabed generally involves the use of jetting or a plough, disturbing the local seabed area and producing temporary sediment plumes. Sediment may also be removed from the seabed. The overall level of disturbance to sediments and benthic fauna is, however, likely to be minimal and impacts on MPA features likely to be short-lived, although recovery rates vary between environments. Sandy and mixed sediment environments, for example, recover more rapidly from disturbance than intertidal sediments supporting biogenic reefs and macrophyte assemblages (JNCC & NE, 2011).

Where cable burial is not feasible, mattressing, grout bags or rock dumping may be used. The effects of these techniques may lead to a direct loss of habitat in the surrounding area, particularly where rock dumping may create a hard substrate on originally soft sediment, which may also provide a pathway for non-indigenous species to migrate across an area (JNCC & NE, 2011). During cable installation vessels will need to be anchored, causing abrasion to the local seabed, and underwater noise will also be generated by the presence of vessels. A risk of death or injury to mobile species will also be associated with vessels involved in cable installation.

The potential impacts of telecom cable installation and use are likely to be short-term and the impacts on the seabed will remain local. JNCC and Natural England state that in most cases the installation of cables has no significant impact on marine features in an area (JNCC & NE, 2011).

C.15.6 Assumptions on Management Measures for Scenarios

It is assumed that the impact of telecom cables on MPA features will be managed under the existing marine licensing framework within 12nm. Two scenarios ('lower' and 'upper') have been developed to capture the possible costs of potential MPAs to the sector. These include a range of possible management measures, as detailed requirements will need to be based on site-specific factors.

It has been assumed that there will be no review of existing consents or licences, although where existing cables within 12nm apply for new consents or licences, these applications will be considered against the conservation objectives for features for which MPAs may have been designated.

The intermediate ('best') estimate for each site has been based on SNH/JNCC current views on management options and judgements made by the study team. The assumptions do not pre-judge any future site-specific licensing decisions. After MPA designation, the management of activities in MPAs will be decided on a site-by-site basis and may differ from the assumptions in this assessment.

Management measures applied under the lower and upper scenarios are detailed below. Specific management measure assumptions for each scenario (including the intermediate scenario) are defined in the MPA Site Reports (Table 4, Appendix E).

Lower Scenario

- Additional costs will be incurred for new licence applications within 12nm in assessing potential impacts to MPA features within the proposed development footprint; and
- Mitigation measures may be required for non-OSPAR/BAP features within 12nm ranging from:
  - No additional mitigation required for existing power interconnectors and transmission lines beyond existing good practice;
  - No additional mitigation required for new developments beyond good practice; and
  - Re-routeing of cables to avoid highly sensitive MPA features.

Upper Scenario

- Additional costs will be incurred for new licence applications within 12nm in assessing potential impacts to MPA features within 1km; and
- Additional survey costs will be incurred to inform new licence applications for cables intersecting features proposed for designation within proposed MPAs within 12nm;
- Mitigation measures may be required for some OSPAR/BAP features[53] for which adequate protection is not currently achieved and all non-OSPAR/BAP features within 12nm ranging from:
  - No additional mitigation required for existing power interconnectors and transmission lines beyond existing good practice;
  - No additional mitigation required for new developments beyond good practice;
  - Seasonal controls on new cable laying to minimise impacts to highly sensitive MPA features – site specific assessment; and
  - Re-routeing of cables to avoid moderately and highly sensitive MPA features.

C.15.7 Assessment Methods

Additional Licensing Costs

Where required, it is assumed that the additional costs will be as follows:

- Additional assessment costs for licence application - £10k per licence application (based on Annex H6 of finding Sanctuary et al, 2012); and
- Additional survey costs - £5k per km of cable route within potential MPA (ABPmer, 2011).

Mitigation Measures

Where required, it is assumed that the following additional costs may be incurred:

- Seasonal controls on new cable laying to minimise impacts to highly sensitive MPA features – site specific assessment; and
- Re-routeing of cables to avoid moderately and highly sensitive features - [£1.01m/km (based on Annex H14 of Finding Sanctuary et al, 2012).

53 Some OSPAR/BAP features are already effectively afforded protection from activities with spatially-based licences; however, the following features are considered by the study team not to be given full protection: burrowed mud, inshore deep mud with burrowing heart urchins, offshore deep sea muds, offshore subtidal sands and gravels, shallow tide-swept coarse sands with burrowing bivalves and ocean quahog aggregations.

Cost of Uncertainty and Delays

The designation of NC MPAs has the potential to increase the time taken to determine licence applications and to negatively affect investor confidence. It has not been possible to quantify these potential impacts.

C.15.8 Limitations

- The number and location of new telecom cables is uncertain; and
- The requirements for management measures are uncertain.

C.15.9 References

ABPmer, RPA & SQW, 2011. Economic Assessment of Short Term Options for Offshore Wind Energy in Scottish Territorial Waters. ABPmer Report No. R1743, March 2011

Baxter, J.M., Boyd, I.L., Cox, M., Donald, A.E., Malcolm, S.J., Miles, H., Miller, B., Moffat, C.F., (Editors), 2011. Scotland's Marine Atlas: Information for the national marine plan. Marine Scotland, Edinburgh.

Finding Sanctuary, Irish Seas Conservation Zones, Net Gain and Balanced Seas, 2012. Impact Assessment materials in support of the Regional Marine Conservation Zone Projects' Recommendations. Annex H6 Cables.

Finding Sanctuary, Irish Seas Conservation Zones, Net Gain and Balanced Seas, 2012. Impact Assessment materials in support of the Regional Marine Conservation Zone Projects' Recommendations. Annex H14 Renewable Energy.

JNCC and NE, 2011. General advice on assessing potential impacts of and mitigation for human activities on MCZ features, using existing regulation and legislation. Advice from the Joint Nature Conservation Committee and Natural England to the Regional MCZ Projects. June 2011. 107pp

Saunders, J., Tinch, R., Ozdemiroglu, E. & Hull, S., 2011. Valuing the Marine Estate and UK Seas: Dynamic Baseline Assessment (draft). Marine Estate Research Report for The Crown Estate.

United Kingdom Marine Monitoring and Assessment Strategy (UKMMAS), 2010. Charting Progress 2 Feeder Report Productive Seas. Department for Environment Food and Rural Affairs on behalf of UKMMAS (Eds. Saunders, J. and McKie, J.) 472pp Available online: http://chartingprogress. defra.gov.uk/

C.16. Tourism

C.16.1 Introduction

This appendix provides an overview of existing and potential future activity for the tourism sector in Scottish waters and outlines the methods used to assess the impacts of proposed MPAs on this sector.

C.16.2 Sector Definition

Tourism can be defined as 'a stay of one or more nights away from home for holidays, visits to friends or relatives, business/conference trips or any other purposes excluding activities such as boarding education or semi-permanent employment' (VisitScotland[54]). In this baseline, day trips are also included. Marine and coastal tourism can be defined as any recreational activity that makes use of the marine environment and intertidal coastal zones (Benfield and McConnell, 2007). This can include a range of activities such as walking along the sea-front to sea-side based horse riding. Both non-motorised (walking/picnicking) and motorised (boat-based tourism e.g. wildlife viewing) activities can be included in marine and coastal tourism. Recreational boating and water sports activities are considered as separate sectors. For this assessment, tourism is defined as relevant activities not already included within recreational boating and water sports, to avoid double counting.

C.16.3 Overview of Existing Activity

A list of sources to inform the writing of this baseline is provided in Table C16.1.

Table C16.1 Information Sources

Scale	Information Available	Date	Source
Scotland	Leisure and recreation statistics	2011	Baxter *et al* (2011)
Scotland	Economic impact of offshore wind farms	2009	GCal Uni (2009)
Scotland	Visitor numbers by region	- 2010	Visit Scotland
Scotland	The tourism prospectus: investing for growth	2007	Visit Scotland
Scotland	Expenditure by coastal and marine wildlife visitors in Scotland.	2009	Bournemouth University (2010)
Scotland	Value of whale watching in Scotland	2009	O'Connor *et al*. (2009)
Scotland	Value of conserving whales: impacts of cetacean-related tourism on the economy of rural	2003	Aquatic Conservation: Marine and Freshwater Ecosystems Journal

54 See VisitScotland Internet site (http://www.visitscotland.com/). The definition of sport includes casual participation in physical recreations such as walking (2+ miles), dance, darts and snooker/billiards/pool as well as more organised sports.

Scale	Information Available	Date	Source
	West Scotland		
Scotland	Scotland's Coastal and Maritime Managed Heritage Assets; Visitor Numbers and Revenue	2004-2009	Historic Scotland; Visit Scotland
Scotland	Fishing tourism research	2007	Visit Scotland
Scotland	Value to economy of tourism	No date	
Scotland	Towards a Strategy for Scotland's Marine Historic Environment	2009	Historic Scotland
Scotland	Coastal and marine heritage tourism resources (World Heritage Sites, Designated Wrecks, top wreck dives)	2011	Scotland's Marine Atlas
UK/Scotland	UK Designated protected wreck sites (point)		MCA, MOD, Historic Scotland, SeaZone, UKHO
UK/Scotland	Protected Wreck Sites (with buffer) (polygon)		SeaZone, MCA
UK/Scotland	Heritage Coasts (polygon)		Historic Scotland
UK/Scotland	World Heritage Sites (point/polygon)		UNESCO
Scotland	Designated Bathing Waters		Scotland's Marine Atlas
UK/Scotland	Blue Flag Beaches (point)		Encams / CP2

C16.3.1 Location of current activity

Figure C20 shows the locations of the various tourist related sites within Scotland. Although there is a high concentration of sites within the central belt, coastal areas are also well represented with a range of site types present in all regions including the North East, North West and North. Indeed, in these three regions the majority of tourist sites are located on the coast rather than inland.

Table C16.2 provides summary statistics on the type of places visited for recreation. The table shows that the seaside accounted for around 12% to 13% of visits by respondents to the Scottish Recreation Survey, 2011. These visits represent those most likely to be affected by the designation of NC MPAs.

Table C16.2 Places visited

Activity	2006	2007	2008
	% (Number of Visits)	% (Number of Visits)	% (Number of Visits)
A town or city	30% (22,149)	35% (27,530)	40% (35,449)
The countryside (including inland villages)	58% (43,296)	52% (40,998)	46% (40,585)
The seaside (a resort or the coast)	13% (9,592)	12% (9,692)	13% (11,529)

(Source: Scottish Recreation Survey, 2011)

C16.3.2 Types of activity

People undertake a range of activities relating to the marine and coastal environment in Scotland. However, Scotland's Marine Atlas (Baxter *et al*, 2011) notes that there is not much standardised information on participation in marine related leisure activities. Individual groups or sectors may gather their own data, for example, the British Marine Federation (BMF) has used estimates of participation for 2007-2009 to indicate that the five most popular marine leisure related activities in Scotland are (ibid) [55]:

- Spending general leisure time at the beach: 309,250;
- Coastal walking: 230,500;
- Outdoor swimming: 224,500;
- Boating activity: 213,750; and
- Sea angling from shore or boat 139,000.

Scottish Natural Heritage (SNH) has also worked on marine and coastal recreation in Scotland, and has determined that walking/hiking is one of the more popular activities (see Image C16.1) (Baxter *et al*, 2011).

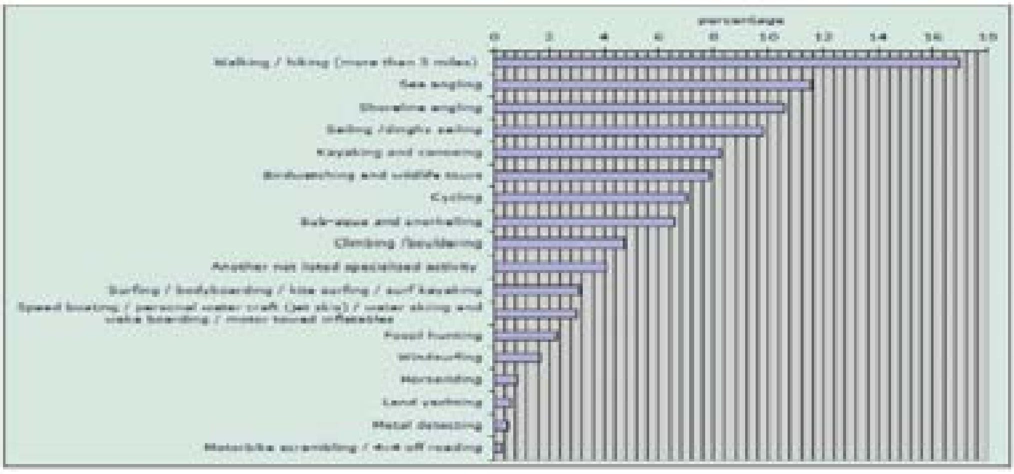


Image C16.1 Proportion of People Undertaking Different Types of Marine and Coastal Activity

The SNH findings are reinforced by those of the Scottish Recreation Survey. The survey results (available for 2006 to 2008) are summarised in Table C16.3 by main activity undertaken. This table shows the importance of walking as a main activity[56], with an increasing trend from 2006 to 2008 (73% to 78%). The Survey additionally shows that 70% used paths or a network of paths in 2006, increasing to 74% in 2007 and 76% in 2008. Of these paths, 62% (2006), 65% (2007) and 70% (2008) had

[55] Note that the figures are aggregated estimates for 2007-2009, thus they indicate the likely number of people participating in each activity over a three year time period.

[56] It should be noted that figures for walking encompass both land-based and seaside tourism, though a separate category for Hill walking/Mountaineering, likely to be a more land-based activity, is not included in the walking analysis.

signposts or way marking. This is likely to reflect the fact that walking is the second most popular choice of activity holiday in Scotland (Sport Industry Research Centre, 2008).

Table C16.3 Main tourism activities

Activity	2006	2007	2008
All walking	73% (54,857)	77% (640,489)	78% (68,091)
Walking <2 miles	30% (22,357)	37% (28,716)	37% (32,456)
Walking 2-8 miles	40% (30,310)	38% (29,746)	37% (32,572)
Walking >8 miles	2% (1,320)	1% (854)	2% (1,830)
Sightseeing/visiting attractions	2% (1,360)	2% (1,210)	1% (930)
All cycling and mountain biking	4% (3,203)	4% (2,870)	3% (2,989)
Family outing	10% (7,481)	7% (5,093)	6% (5,656)

(Source: Scottish Recreation Survey, 2011)

Another popular activity in Scotland is wildlife tourism. Marine and coastal wildlife tourism defined by a recent Scottish Government study as (Scottish Government, 2010):

- Marine – studying or viewing marine mammals from a boat; and
- Coastal – studying/viewing/enjoying wildlife on the coast, which includes viewing birds from a boat and watching marine mammals from land.

The popularity of wildlife tourism in Scotland is probably partially influenced by the number of designated Marine Special Areas of Conservation[57]; there are 36 sites in total covering intertidal waters, reefs, coastline and seal breeding areas. Indeed in a survey carried out by IFAW (2009), Scotland had the largest proportion of Europe's cetacean watchers with 27%. This equated to 3% of the global number of cetacean watchers, with 223,941 tourists taking part.

C16.3.3 Economic Value and Employment

Marine and coastal wildlife tourism in Scotland (including cetacean related tourism) has a combined total expenditure of £160 million and total income of £92 million (Table C16.4), with peak activity occurring in May and June (Scottish Government, 2010).

Table C16.4 Economic contribution by type of wildlife tourism

Area	Expenditure £ million	Income £ million
Terrestrial	114	64
Marine	63	36
Coastal	100	56
Total	277	156

(Source: Scottish Wildlife Tourism, 2011)

57 http://jncc.defra.gov.uk/page-1445

C16.3.4 Expenditure and income

Tourism generates £4.5 billion turnover for the Scottish economy each year and employs around 200,000 people (Sport Industry Research Centre, 2008)[58]. Certain areas of the country do particularly well from tourism; the Cairngorms National Park economy receives substantial income from tourists (RPA and Cambridge Econometrics, 2008). The popularity of walking has also brought in considerable income in the past. UK residents who visited Scotland specifically to go walking spent £125 million per year, made 400,000 trips and generated 2.7 million bed-nights in the period 2001-2003, (this excludes spending by overseas visitors) (Sport Industry Research Centre, 2008). Although these figures are rather dated, and cover all walking as opposed to just coastal walking, they indicate that the activity is likely to be making an important contribution to Scotland's tourism economy.

The tourism figures above may also provide an indication of the value of some of the benefits from wild land, wilderness and tranquillity. Although McMorran *et al* (2008) note that few studies enable the benefits from wild land to be identified, they comment that recreation and tourism data do provide some information. For example, in the Highlands and Islands Enterprise area, wild landscapes accounted for up to 19.9 million day visits in 2003 (ibid). These were associated with an expenditure of £411-£751 million (McMorran *et al*, 2008). It is likely that some of this total can be allocated to coastal tourism and thus the value of seascapes[59].

Other studies considering tourist expenditure include the Scottish Recreation Survey. This provides an indication of the mean expenditure during trips (across all those who spent money) and is shown in Table C16.5.

Table C16.5 Mean tourism expenditure

Type of Expenditure	2006	2007	2008
A town or city	£19.47	£21.55	£18.24
The countryside (including inland villages)	£33.82	£35.49	£24.31
The seaside (a resort or the coast)	£38.25	£45.45	£40.64

Source: Scottish Recreation Survey, 2011)

C16.3.5 Employment

Marine and coastal tourism generated 4,386 full-time positions in 2009 (Table C16.6). It should be noted that wildlife tourism supports mainly small enterprises, which employ large numbers of seasonal volunteers; 10% use more than 16 volunteers (Scottish Government, 2010).

58 Note that it is not clear how much of this figure can be allocated to marine and coastal tourism; this lack of information represents a data gap.

59 Natural landscapes and seascapes may also have value in terms of providing health and wellbeing benefits. However, these benefits are not considered here since they are very difficult to quantify and relate to the wider population rather than just to tourists.

Table C16.6 Employment generated from wildlife tourism

Area	Employment FTE Employees
Terrestrial	3,061
Marine	1,705
Coastal	2,681
Total	7,446

(Source: Scottish Government, 2010)

C16.3.6 Future Trends in Tourism

Tourism within Scotland is supported by VisitScotland, whose aim is to "maximise the economic benefits of tourism to Scotland[60]". VisitScotland's strategy has five objectives including:

- Maximise the sustainable economic benefit of tourism in Scotland;
- Inspire through information provision;
- Deliver quality assurance;
- Work in partnership; and
- Establish Scotland as perfect stage for events.

The organisation is currently running a new corporate campaign entitled "The Winning Years". This builds on a series of eight events over the years 2012-2014, with each year having a particular theme as follows:

- 2012 – Year of Creative Scotland;
- 2013 - Year of Natural Scotland; and
- 2014 – Year of Homecoming Scotland.

The aims of the campaign are to encourage enthusiasm, support and investment in tourism in Scotland, and to ensure that tourism businesses benefit from the opportunities available. Earlier estimates have indicated that visitor numbers to Scotland are forecast to grow at an average of 2.3% per annum from 2005 to 2015 (RPA and Cambridge Econometrics, 2008), with a 50% increase in gross tourism revenue by 2015 (from 2005) (Scottish Executive, 2006a). However, it is likely that any major developments in tourism in the short term will be affected by this campaign, and also current economic conditions. Indeed, in 2010, overnight visitors to Scotland from the United Kingdom made 12.4 million trips and spent a total of over £2.6 billion (VisitScotland, 2011). These figures represented a decline of 1% in the number of trips and a 4% decrease in expenditure when compared with 2009 data (VisitScotland, 2011). Interestingly, for the same year, international tourism showed a decline in trips of 8% but a growth in expenditure of 6% (VisitScotland, 2011). Therefore, short term tourism trends are uncertain.

60 See VisitScotland Internet site: (http://www.visitscotland.org/).

Considering trends in particular areas of tourism, the Scottish Recreation Survey has shown that since 2004, there has been an increase in the number of shorter duration visits made closer to home (TNS, 2011). In addition, the percentage of visits taken on foot grew from 50% to 64% in 2008 (TNS, 2010). If these trends are to continue, then it is likely that in the future more tourism will occur close to centres of population and at sites which are easily accessible. Indeed, Brown *et al* (2010) note that the most likely trend in future outdoor recreation is that there will be a greater range of activities available, but these will be concentrated in a smaller number of locations, dependent amongst other factors on their accessibility. This suggests that areas which are hotspots for particular activities (e.g. surfing) will be the ones which flourish. However, it should be noted that external factors, such as global climate change may also impact tourism. For example, climate change may affect the distribution and range of cetacean species and thus wildlife watching tourism in Scotland (Lambert *et al*, 2011). However as such tourism develops, it is important that proper guidelines and management are enforced, so that the growing trend in recreational activities involving the marine and coastal environment does not compromise or destroy the assets which attract so many visitors (Joint Marine Programme, 2004).

C.16.4 Future Trends

It is assumed that the location of tourism activities does not change over the period of the assessment. Levels of tourism activity reflect the economic cycle but are generally expected to increase in the long-term.

C.16.5 Potential Interactions with MPA Features

Potential interactions of tourism activity with MPA features are likely to be similar to those of water sports and recreational boating, and as such are covered in more detail in Appendices C17 and C13 respectively.

C.16.6 Assumptions on Management Measures for Scenarios

The main pressures on the marine environment from tourism relate to associated recreational boating and water sports activities. It is possible that minor management measures may be necessary to limit public access to parts of NC MPAs, but the cost impact to the tourism sector from such measures is considered to be negligible.

It is also possible that should significant impacts to recreational boating or water sports be identified for any particular site that this could have consequential impacts on tourism, by reducing the attractiveness of the location for recreational boating users or water sports enthusiasts, leading to a reduction in visitor footfall and spend. Where significant impacts are identified for recreational boating or water sports sectors, the consequential impacts for the tourism sector will be considered on a site specific basis.

C.16.7 Assessment Methods

Assessment of potential consequential impacts on site specific basis.

C.16.8 Limitations

- Uncertainty surrounding impacts to recreational boating or water sports.

C.16.9 References

Baxter, J.M., Boyd, I.L., Cox, M., Donald, A.E., Malcolm, S.J., Miles, H., Miller, B., Moffat, C.F., (Editors), 2011. Scotland's Marine Atlas: Information for the national marine plan. Marine Scotland, Edinburgh.

Benfield, S and McConnell, S, 2007. Marine and Coastal Visitor Management, Public Engagement and Interpretation in Argyll and the Islands: the way forward. Marine and Coastal Development Unit, Argyll & Bute Council, 2007, pp1-145.

Brown, K.M., Curry, N., Dilley, R., Taylor, K. & Clark, M., 2010. Assessing future recreation demand. Scottish Natural Heritage Commissioned Report No.404.

IFAW, 2009. Whale watching worldwide, tourism numbers, expenditures and expanding economic benefits, a report from the International Fund for Animal Welfare, pp1-239.

Joint Marine Programme, 2004. The tangle of the Clyde, why we must reform the management of Scotland's marine environment, WWF and Scottish Wildlife Trust, April 2004, pp 1-16.

Lambert, E., MacLeod, C.D., Hunter, C. and Pierce, G.J., 2011. The Future of Cetacean Watching in Scotland under Different Climate Change Scenarios – The Changing Nature of Scotland, eds. S.J. Marrs, S. Foster, C. Hendrie, E.C. Mackey, D.B.A. Thompson. TSO Scotland, Edinburgh.

McMorran R, Price MF, Warren CR. 2008. The call of different wilds: The importance of definition and perception in protecting and managing Scottish wild landscapes. Journal of Environmental Planning and Management 51:177–199.

RPA & Cambridge Econometrics, 2008. The Economic Impact of Scotland's Natural Environment. Scottish Natural Heritage Commissioned Report No.304 (ROAME No. R07AA106).

Scottish Executive, 2006a. Scottish Tourism: the next decade. A tourism framework for change, Report published by the Scottish Executive, March 2006.

Scottish Government, 2010. The economic impact of wildlife tourism in Scotland, Scottish Government Social Research, pp1-51.

Sport Industry Research Centre, 2008. What Paths do for Scottish Society: An Economic and Social Impact Study, Scottish Natural Heritage Commissioned Report No. 280 (ROAME No. RO6AA607).

TNS Research International, 2011. Scottish Recreation Survey: annual summary report 2010. Scottish Natural Heritage Commissioned Report No.465.

TNS Research International, 2010. Scottish Recreation Survey: annual summary report 2009. Scottish Natural Heritage Commissioned Report No.395.

VisitScotland, 2011. Domestic Tourism – Review of Domestic Overnight Tourism to Scotland in 2010.

C.17. Water Sports

C.17.1 Introduction

This appendix provides an overview of existing and potential future activity for the water sports sector in Scottish waters and outlines the methods used to assess the impacts of proposed MPAs on this sector.

C.17.2 Sector Definition

Water sports are recreational activities undertaken on or immersed in a body of water. The main marine water sports undertaken in Scotland are recreational angling, surfing, windsurfing, sea kayaking, small sail boat activities (such as dinghy sailing) and scuba diving (BMF *et al*., 2009). Recreational boating activity in larger vessels such as yachts is covered separately in Appendix C13.

C.17.3 Overview of Existing Activity

A list of sources to inform the writing of this baseline is provided in Table C17.1.

Table C17.1 Information Sources

Scale	Information Available	Date	Source
Scotland	Number of sea anglers	2006-2007	Radford *et al* (2009)
Scotland	Economic impact of sea angling (by region)	No date	Radford *et al* (2009)
Scotland	Angler days by resident, by origin, by type (short, boat, charter)	No date	
Scotland	Expenditure	No date	
Scotland	Trends (days fished, competitiveness of region)	No date	
Scotland	Output of DREAM® model gives multipliers (associated with angling)	No date	
Scotland	Estimated regional sea angling activity and expenditure (also for Scotland)	No date	Baxter *et al* (2011)
Scotland	Origin and destination of overnight fishing trips to Scotland	2006-2007	Radford *et al* (2009)
Highlands and Islands	Statistics on water sports	No date	George Street Research & Jones Economics (2004)
UK/Scotland	Snorkelling and Diving Locations (not spatial		www.snorkling.co.uk and www.ukdiving.co.uk
UK/Scotland	Kitesurfing and Windsurfing locations (user-updated)		www.thewindmap.co.uk
UK	Indicative location of coastal watersports centres	2010	Defra/CP2
Scotland	Surfing and diving locations	2011	Scotland's Marine Atlas Ch5

Scale	Information Available	Date	Source
UK	Surfing locations		SAS (2009) and the 'Stormrider Guides' (www.lowpressure.co.uk)
UK	Indicative location of coastal diving areas (Recreational and otherwise)		CP2 / Magic Seaweed
UK	Statistics on water sports participation levels	2010	BMF (2011a)
UK	Location of scuba diving sites		Dive Site Directory www.divesitedirectory.co.uk/uk
UK	Location of windsurf sites		Windsurf Magazine www.windsurf.co.uk/beach-guide

C.17.3.1 Location and intensity of activity

Indicative estimates of the number of people participating in water sports activities in Scotland have been taken from the BMF Water sports and Leisure Participation Survey 2009 (BMF *et al*., 2009). This report estimated that 52,869 adults (> 16 years) participated in surfing, 23,952 adults participated in windsurfing, 12,443 in scuba diving, 37,416 participated in canoeing[61] and 23,937 in small sail boat activities in the Border and Scotland ITV regions[62]. Radford *et al* (2009) estimated that 125,188 adults and 23,445 children went sea angling in Scotland in 2008.

Separately, Surfers Against Sewage (SAS, 2010) conducted an initial study into the number of recreational water users in Scotland in 2010 and estimated that there were approximately 300,000 recreational water users (this number included surfers, windsurfers, and kayakers amongst a range of other activities) using the coastal waters of Scotland. A summary of the distribution of different water sports, highlighting key areas activities in Scotland is described below.

A survey looking into marine and coastal recreation in Scotland commissioned by SNH found that overall, around 87% of all recorded visits to the coast were day trips. Above average proportions of short-breaks or weekend visits were made by sea and shoreline anglers, and divers and snorkelers (Land Use Consultants, 2007).

Recreational Angling

Sea angling is carried out along most of the Scottish coastline mostly within 6nm (The Scottish Sea Angling Conservation Network's (SSACN) Offshore Wind SEA consultation response, available on the Scottish Government website: http://www.scotland.gov.uk/Publications/2010/11/03131226/0[63]). The highest

61 Canoeing is a general term for a range of 'paddle sports' which includes sea kayaking, surf kayaking, sit-on-top kayaking and Canadian canoeing.

62 Some of these activities are carried out inland as well as at the coast. Table 44 in the BMF (2009) study indicates what proportion of each activity is actually carried out at the coast and this information was used to adjust overall totals.

63 The Scottish Sea Angling Conservation Network's (SSACN) Offshore Wind SEA consultation response, available on the Scottish Government website: http://www.scotland.gov.uk/Publications/2010/11/03131226/0.

densities of anglers are found in the more heavily populated areas of coast around Glasgow, Clyde, Edinburgh and Fife (Baxter *et al*. 2011). Sea angling launch points are also heavily concentrated along the Argyll Coast and Islands, Solway Firth, Firth of Clyde, Firth of Tay, North Coast, and East Grampian Coast (Land Use Consultants, 2007).

Surfing and Windsurfing

A variety of different types of water craft are used to surf waves including surfboards, body boards, windsurfing boards and kayaks (SAS, 2009). Many surfers are willing to travel large distances to undertake surfing at good quality spots (Lazorow, 2009). Therefore, high quality waves located in remote areas could bring economic benefits to a rural area through travel, accommodation and subsidence expenditure of visiting surfers. Surfing is focused around the far North coast of Scotland (particularly around Thurso), the North coast from Buckie to Fraserburgh and locations down the East coast including Fife, and from North Berwick to the border. Other locations include the Kintyre peninsula, Islay, Tiree, the Western Isles (particularly the West coast of Lewis) and the North coast of Orkney (Baxter *et al*., 2011; Land Use Consultants, 2007), see Figure C21.

Sea Kayaking

The majority of sea kayaking is undertaken close inshore, exploring interesting aspects of the coast such as sea caves, inlets and wildlife. Safety issues and a lack of interesting features in general prevent kayaking further offshore. However, open crossings (between two points such as a headland and an offshore island), often through strong tidal currents are regularly undertaken by more experienced sea kayakers. Unlike other water sports activities which are often undertaken in relatively discrete areas (such as a surf spot or diving site), sea kayaking has the potential to be undertaken along much of the Scottish coast and is only constrained by the availability of suitable launching spots such as beaches or slipways. Popular kayaking areas include the Inner Hebrides, East Grampian Coast, Firth of Clyde and Firth of Forth (Land Use Consultants, 2007), see Figure C21. The Scottish Canoeing Association undertook an online survey of sea kayakers in 2011. The survey had a total of 392 respondents. The survey found that the most popular areas for sea kayaking in Scotland was Arisaig, Knoydart, Sound of Sleat, Argyll Islands, Oban to Fort William and the Clyde.

Scuba Diving

The most popular locations for scuba diving around Scotland are Scapa Flow, Orkney (considered to be one of the best wreck diving areas in the world) and the Voluntary Marine Reserve of St Abbs and Eyemouth off the Berwickshire coastline. Historic Scotland has estimated that around 1,220 records of known shipwrecks and documented losses are located within the proposed MPA boundaries (Historic Scotland, 2013, pers. comm.).The islands of the Inner Hebrides, the Firth of Forth and coast to the Scottish border, all of the East coast from North of Dundee to the

Dornoch Firth are also popular diving destinations (Land Use Consultants, 2007; Baxter *et al*, 2011; Scottish Executive, 2007; UKMMAS, 2010), see Figure C21.

Small Sail Boat Activity

Small sail boat activity is defined as dinghies, day boat or other small keelboats, usually taken out of water at the end of use. Small sail boat activity is widespread along the Scottish coast but the Firth of Clyde and Firth of Forth are noted as a particularly good place to learn to sail in dinghies (Land Use Consultants, 2007), see Figure C21.

C.17.3.2 Economic value and employment

Radford *et al* (2009) estimated a total expenditure of £141 million on sea angling in 2008. Sea angling in Scotland also supported 3148 FTE jobs in 2008, representing an income of £69.67million[64] (Radford *et al*., 2009).

There is limited data concerning the expenditure and employment levels of surfing-related tourism (SAS, 2009). At a UK level the economic value of the surf industry was estimated at £200 million in 2007 (UKMMAS 2010). The total number of people participating in surfing in the UK in 2009 was estimated to be 645,827 (BMF *et al*., 2009). If it is assumed that the Scottish value is pro rata to the estimated number of individuals engaging in surfing activity in Scotland, this would give a Scottish value of around £16.4m p.a.

'Informed opinion suggests that sea kayaking, particularly on the West coast, and surf kayaking could be worth an estimated £0.5 million per annum'. This statement was based on a study carried out by British Waterways and reported in Bryden *et al*. (2010), in which average paddlers in the Great Glen (2,500 per annum) spent approx. £97 per day locally on overnight visits, or approximately £730K per annum.

A survey commissioned by SNH reviewing marine and coastal recreation in Scotland identified the amount typically spent per year on equipment for water sports activities (Table C17.2). The highest average amounts spent were for sea angling (£1375) and shoreline angling (£860). Kayaking and canoeing, sub-aqua and snorkelling, and windsurfing each had an average spend of between £635 and £645, whilst surfing had a lower average spend of £290 per year. In total, sea angling and shoreline angling accounted for around half of the total spending recorded by the survey. However due to the small sample sizes these results are subject to high levels of standard error and it should be noted that these figures are generally overestimates (Land Use Consultants, 2007).

64 The authors highlighted that the jobs and incomes supported by sea angling in Scotland were estimated using a model of the Scottish economy and not by summing the totals for each region. Hence there was a slight difference between the Scottish totals and the sum of the regional values even though conceptually they should have been identical.

Table C17.2 Total and average annual spending, by water sport activity

Activity	Total Spending (£)	Average Spending (£)
Sea angling	131960	1375
Shoreline angling	70575	861
Kayaking	36100	645
Sub aqua/ snorkelling	33935	640
Windsurfing	6345	635
Surfing	5800	290

(Source: Land Use Consultants, 2007)

No national employment figures derived from the Business Register and Employment Survey (using UK SIC codes) have been included for activities relating to water sports. This is because the codes are for the entire sports sector and do not permit disaggregation to a useful level. However in general the largest numbers of employees for these activities are concentrated in the East and West Regions, which reflect the higher population concentrations in these regions.

C.17.3.3 Future trends

The leisure and recreation sector has experienced large growth in a number of diverse areas over the past decade. The growth and stability of the water sports sector in Scotland is heavily dependent on the general health of the UK economy. A strong economy means that consumers have more disposable income and are more inclined to spend money on this sector than when the economy is weaker. The recent UK economic downturn may lead to a reduction in such activities but in the long-term the sector is expected to continue to grow.

There is little information on future levels of recreational angling activity. Levels of activity are likely to vary in response to trends in the overall economy, changes in fish stocks as a result of improved fisheries management and changes in fish distributions in response to climate change. The nature and direction of these changes remains unclear.

C.17.4 Assumptions on Future Activity

It is assumed that the locations of water sports activities do not change over the period of the assessment. Levels of participation in water sports activities reflect the economic cycle but are generally expected to increase in the long-term. However, for the purposes of this assessment, in the absence of reliable forecasts on future growth, it has been assumed that levels of participation remain constant over the period of the assessment.

C.17.5 Potential Interactions with MPA Features

Many water sports have no known significant impacts on MPA features. For those that do the impacts are low and generally concern the removal of species or physical damage through trampling or disturbance. The introduction and spread of invasive non-indigenous species may also be associated with water sports.

C.17.6 Assumptions on Management Measures for Scenarios

It is assumed that the impact of water sports activities on MPA features will be managed through voluntary measures or under Marine Conservation Orders where necessary. Two scenarios (‘lower’ and ‘upper’) have been developed to capture the possible costs of potential MPAs to the sector. These include a range of possible management measures, as detailed requirements will need to be based on site-specific factors.

The intermediate (‘best’) estimate for each site has been based on SNH/JNCC current views on management options and judgements made by the study team. The assumptions do not pre-judge any future site-specific management decisions. After MPA designation, the management of activities in MPAs will be decided on a site-by-site basis and may differ from the assumptions in this assessment.

Management measures applied under the lower and upper scenarios are detailed below. Specific management measure assumptions for each scenario (including the intermediate scenario) are defined in the MPA Site Reports (Table 4, Appendix E).

Lower Scenario

- Mitigation measures may range from:
  - No additional mitigation measures required beyond existing good practice; and
  - Adherence to voluntary codes of practice.

Upper Scenario

- Mitigation measures may range from:
  - No additional mitigation measures required beyond existing good practice;
  - Adherence to voluntary codes of practice; and
  - Marine Conservation Order restricting particular water sports activities within MPAs (temporally or spatially).

C.17.7 Assessment Methods

Mitigation Measures

Where required, it is assumed that the following additional costs may be incurred:

- Adherence to voluntary codes of practice – site specific determination; and
- Spatial or temporal restriction of activities – site specific determination.

C.17.8 Limitations

- Participation rates and location of future water sports activities are uncertain; and
- The requirements for management measures are uncertain.

C.17.9 References

Baxter, J.M., Boyd, I.L., Cox, M., Donald, A.E., Malcolm, S.J., Miles, H., Miller, B., Moffat, C.F., (Editors), 2011. Scotland's Marine Atlas: Information for the national marine plan. Marine Scotland, Edinburgh.

BMF, MCA, RYA and Lifeboats 2009. Water sports and Leisure Participation Survey 2009. Available online: http://www.britishmarine.co.uk/upload_pub/WatersportsandLeisureOmnibus2009finalpublic.pdf

Bryden, D.M., Westbrook, S.R., Burns, B., Taylor, W.A., and Anderson, S. 2010. Assessing the economic impacts of nature based tourism in Scotland Scottish Natural Heritage Commissioned Report No. 398.

Land Use Consultants, 2007. A Review of Marine and Coastal Recreation in Scotland. Report No. F05AA608.

Lazarow, N. 2009. Using observed market expenditure to estimate the value of recreational surfing to the Gold Coast, Australia. Journal of Coastal Research, SI 56 (Proceedings of the 10th International Coastal Symposium), 1130-1134.

Radford, A., Riddington, G. and Gibson, H., 2009. Economic Impact of Recreational Sea Angling in Scotland. Prepared for the Scottish Government. July 2009. ISBN: 978-0-7559-8130-4

Surfers Against Sewage (SAS), 2009. Guidance on environmental impact assessment of offshore renewable energy development on surfing resources and recreation.

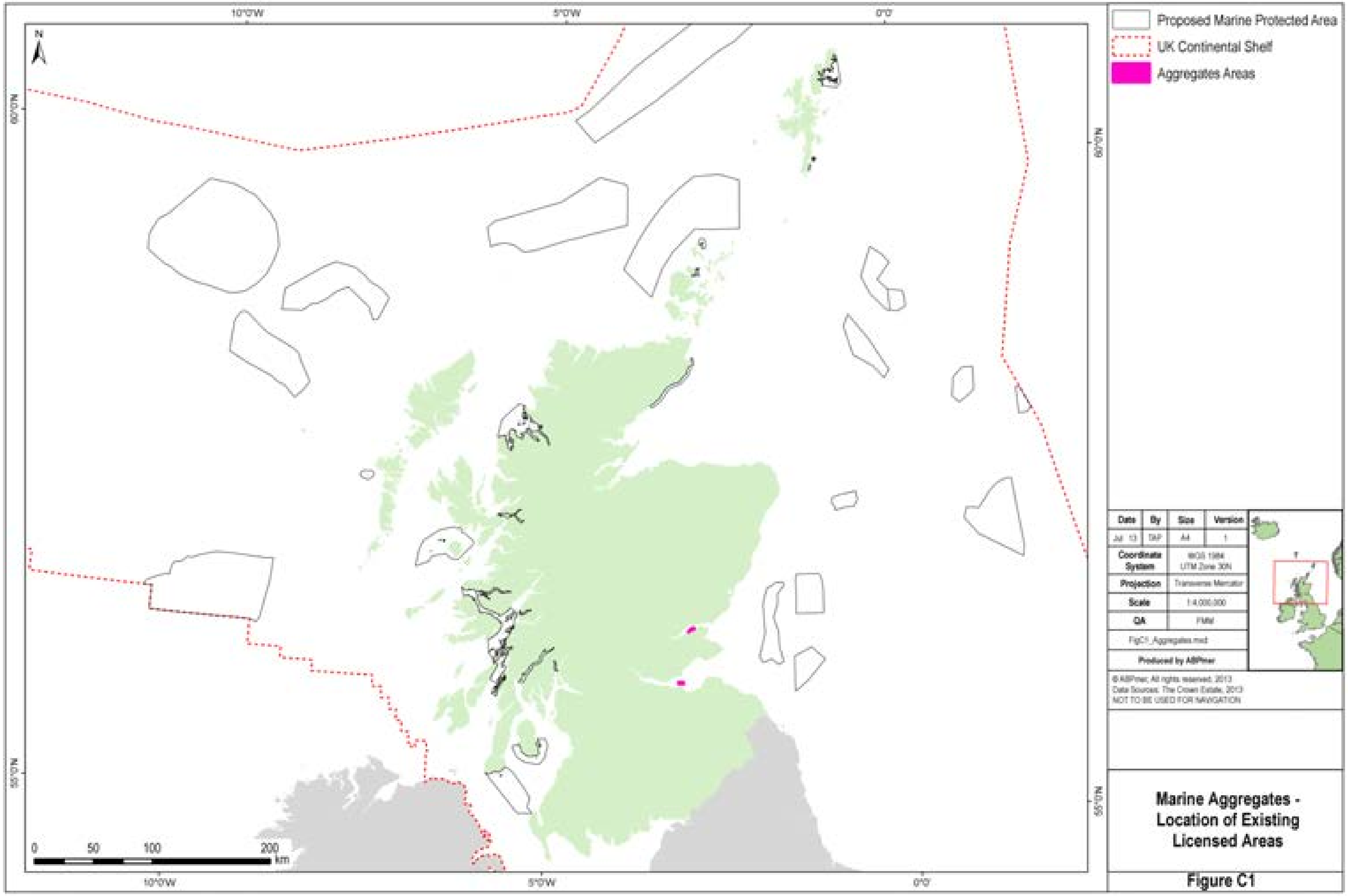
Surfers Against Sewage (SAS), 2010. The WAR Report: Waves Are Resources. Available online: http://www.sas.org.uk/news/2010/08/04/sas-release-the-war-report-waves-are-resources/

Scottish Executive, 2007. Scottish Marine Renewables SEA

Scottish Sea Angling Conservation Network's (SSACN) website: http://www.scotland.gov.uk/ Publications/2010/11/03131226/0)

United Kingdom Marine Monitoring and Assessment Strategy (UKMMAS), 2010. Charting Progress 2 Feeder Report Productive Seas. Department for Environment Food and Rural Affairs on behalf of UKMMAS (Eds. Saunders, J. and McKie, J.) 472pp Available online: http://chartingprogress.defra.gov.uk/

Appendix C Figures



Proposed Marine Protected Area
UK Continental Shelf
Aggregates Areas
10°0'W
5°0'W
0°0'
60°0'N
55°0'N
N
0
50
100
200
km
Date | By | Size | Version
Jul 13 | TAP | A4 | 1
Coordinate System | WGS 1984 UTM Zone 30N
Projection | Transverse Mercator
Scale | 1:4,000,000
QA | FMW
FigC1_Aggregates.mxd
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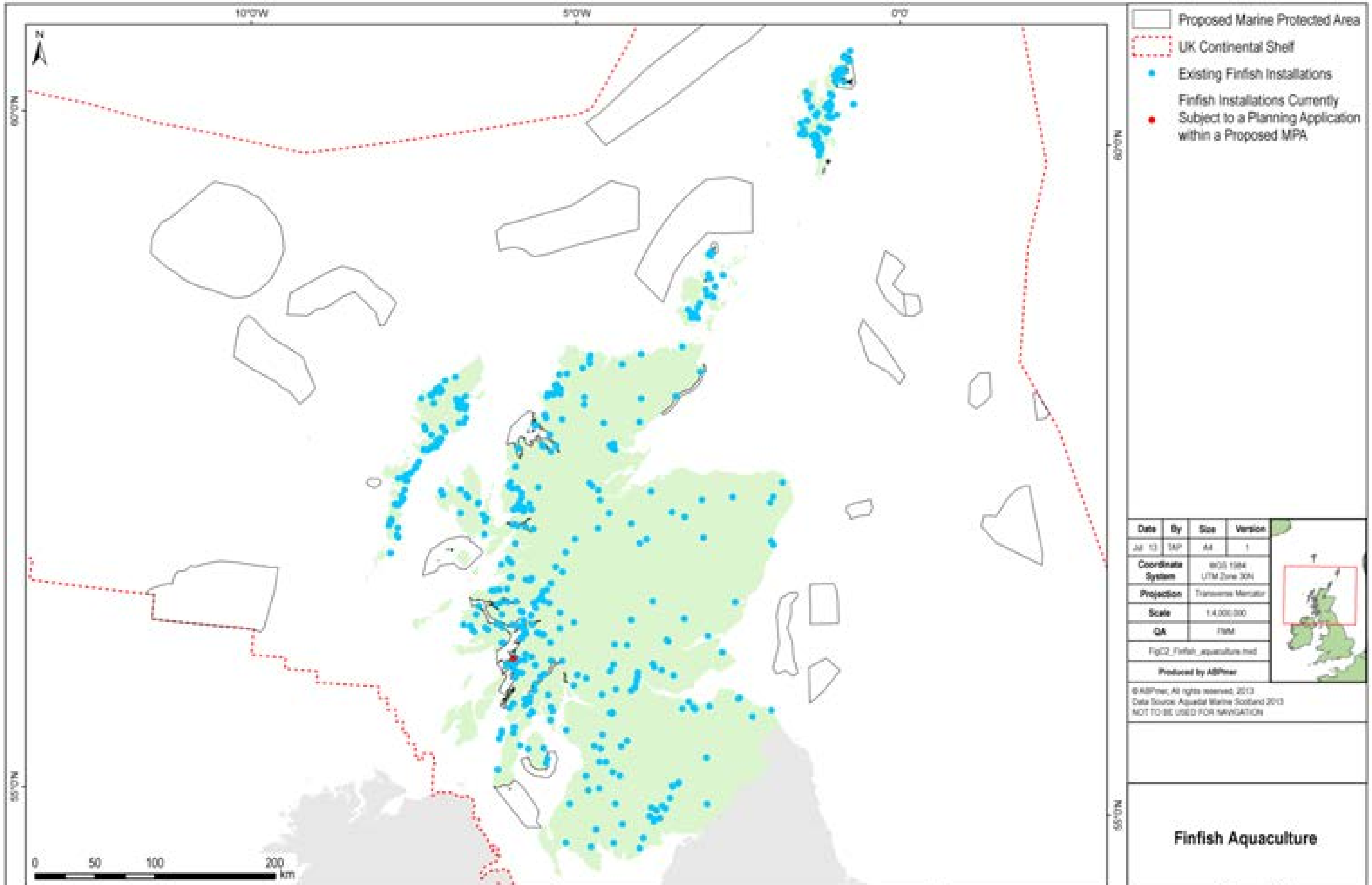
Data Sources: The Crown Estate, 2013
NOT TO BE USED FOR NAVIGATION
Marine Aggregates - Location of Existing Licensed Areas
Figure C1



10°0'W
5°0'W
0°0'
60°0'N
55°0'N
N
0 50 100 200 km
Proposed Marine Protected Area
UK Continental Shelf
Existing Finfish Installations
Finfish Installations Currently Subject to a Planning Application within a Proposed MPA
Date
By
Size
Version
Jul 13
TAP
A4
1
Coordinate System
WGS 1984 UTM Zone 30N
Projection
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QA
FMM
FigC2_Finfish_aquaculture.mxd
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Data Source: Aquatat Marine Scotland 2013
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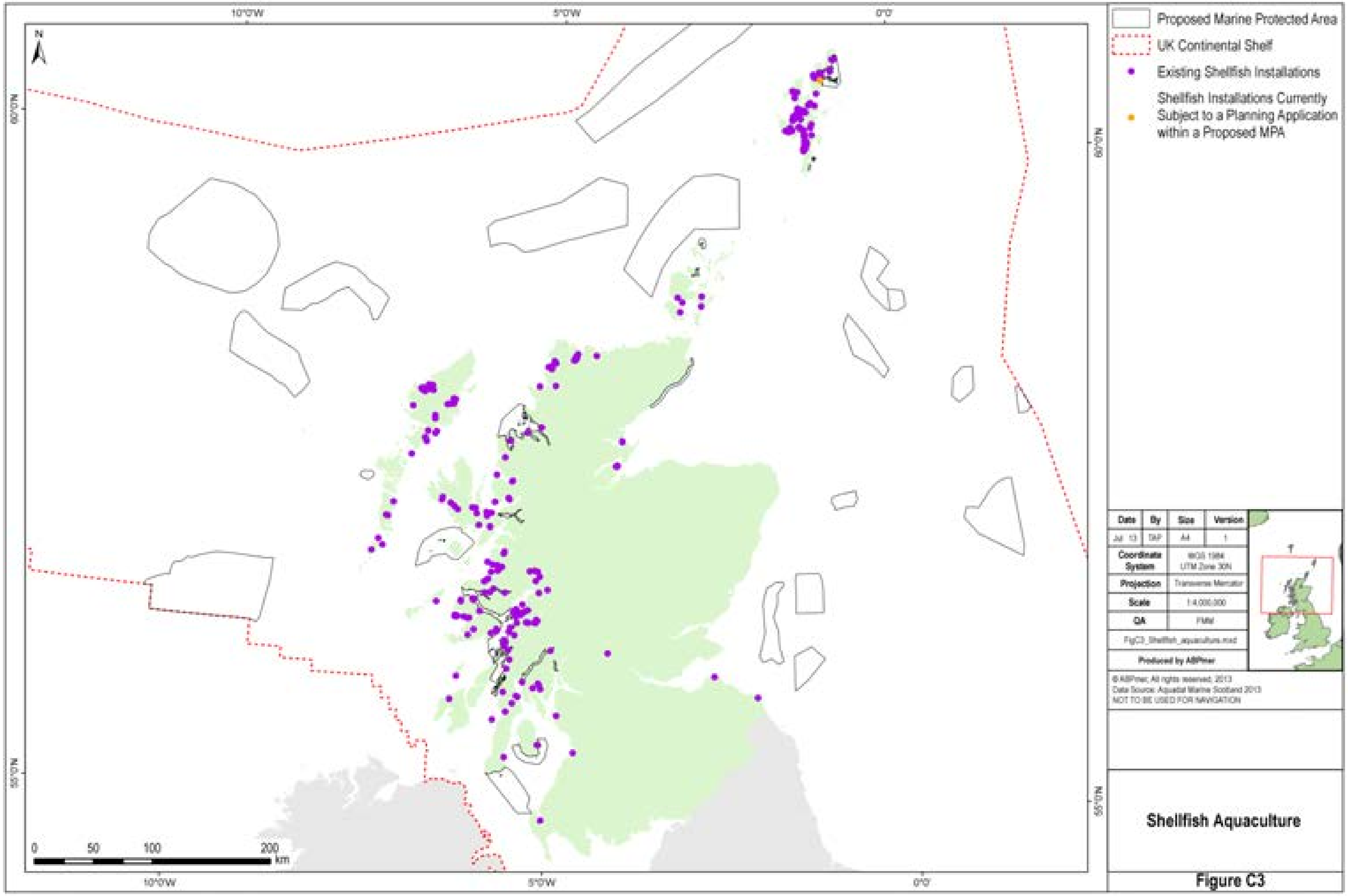
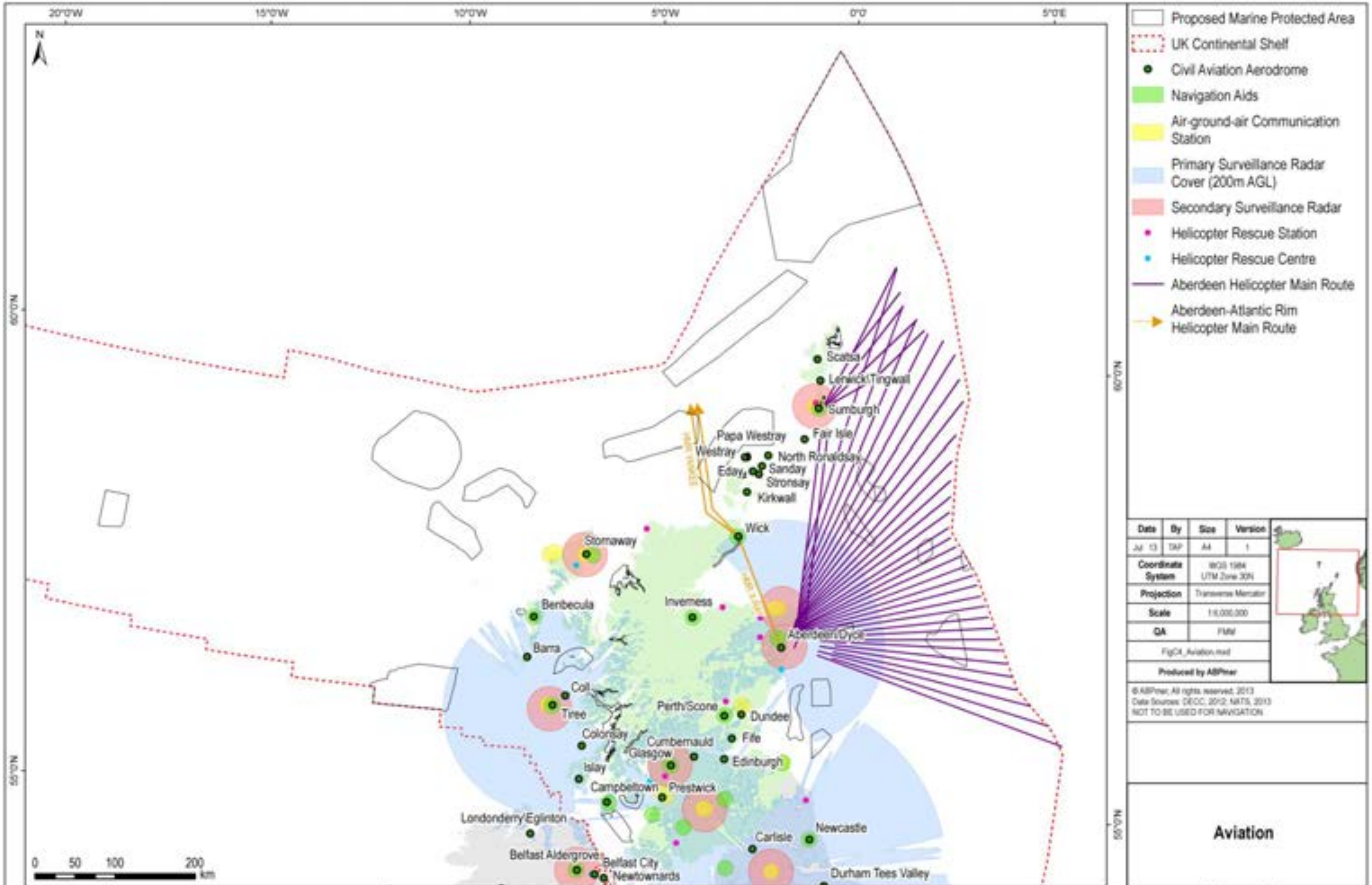
Finfish Aquaculture

Figure C2



Shellfish Aquaculture

Figure C3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5°0'E
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55°0'N
N
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Scatsta
Lerwick/Tingwall
Sumburgh
Fair Isle
Papa Westray
Westray
North Ronaldsay
Eday
Sanday
Stronsay
Kirkwall
Wick
Stornaway
Benbecula
Inverness
Aberdeen/Dyce
Barra
Coll
Tiree
Perth/Scone
Dundee
Colonsay
Cumbernauld
Fife
Glasgow
Edinburgh
Islay
Campbeltown
Prestwick
Londonderry Eglinton
Newcastle
Carlisle
Belfast Aldergrove
Belfast City
Newtownards
Durham Tees Valley
Proposed Marine Protected Area
UK Continental Shelf
Civil Aviation Aerodrome
Navigation Aids
Air-ground-air Communication Station
Primary Surveillance Radar Cover (200m AGL)
Secondary Surveillance Radar
Helicopter Rescue Station
Helicopter Rescue Centre
Aberdeen Helicopter Main Route
Aberdeen-Atlantic Rim Helicopter Main Route
Date
By
Size
Version
Jul 13
TAP
A4
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Coordinate System
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FMW
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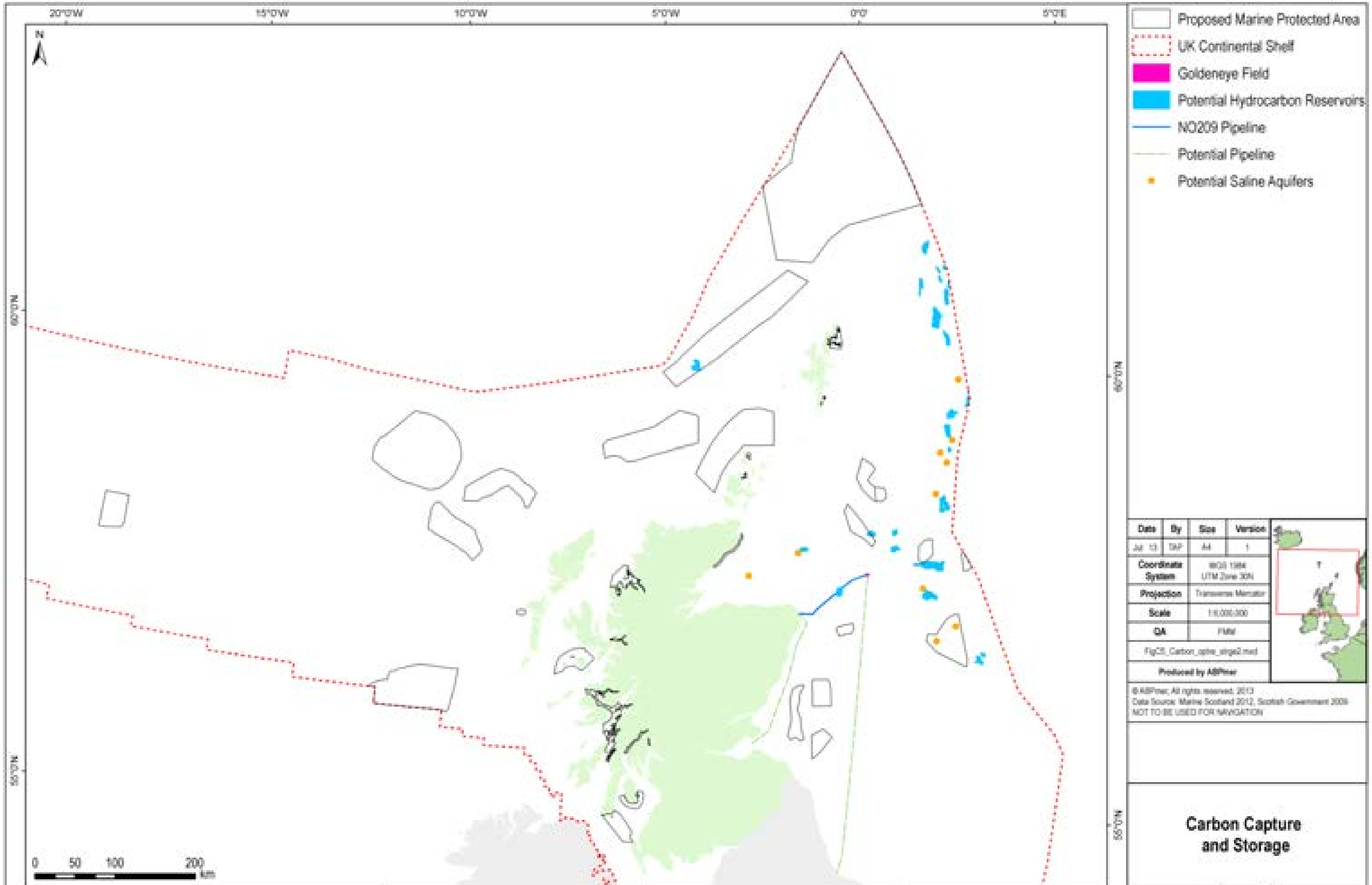
Aviation

Figure C4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Goldeneye Field
Potential Hydrocarbon Reservoirs
NO209 Pipeline
Potential Pipeline
Potential Saline Aquifers
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15°0'W
10°0'W
5°0'W
0°0'
5°0'E
60°0'N
55°0'N
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km
Date
By
Size
Version
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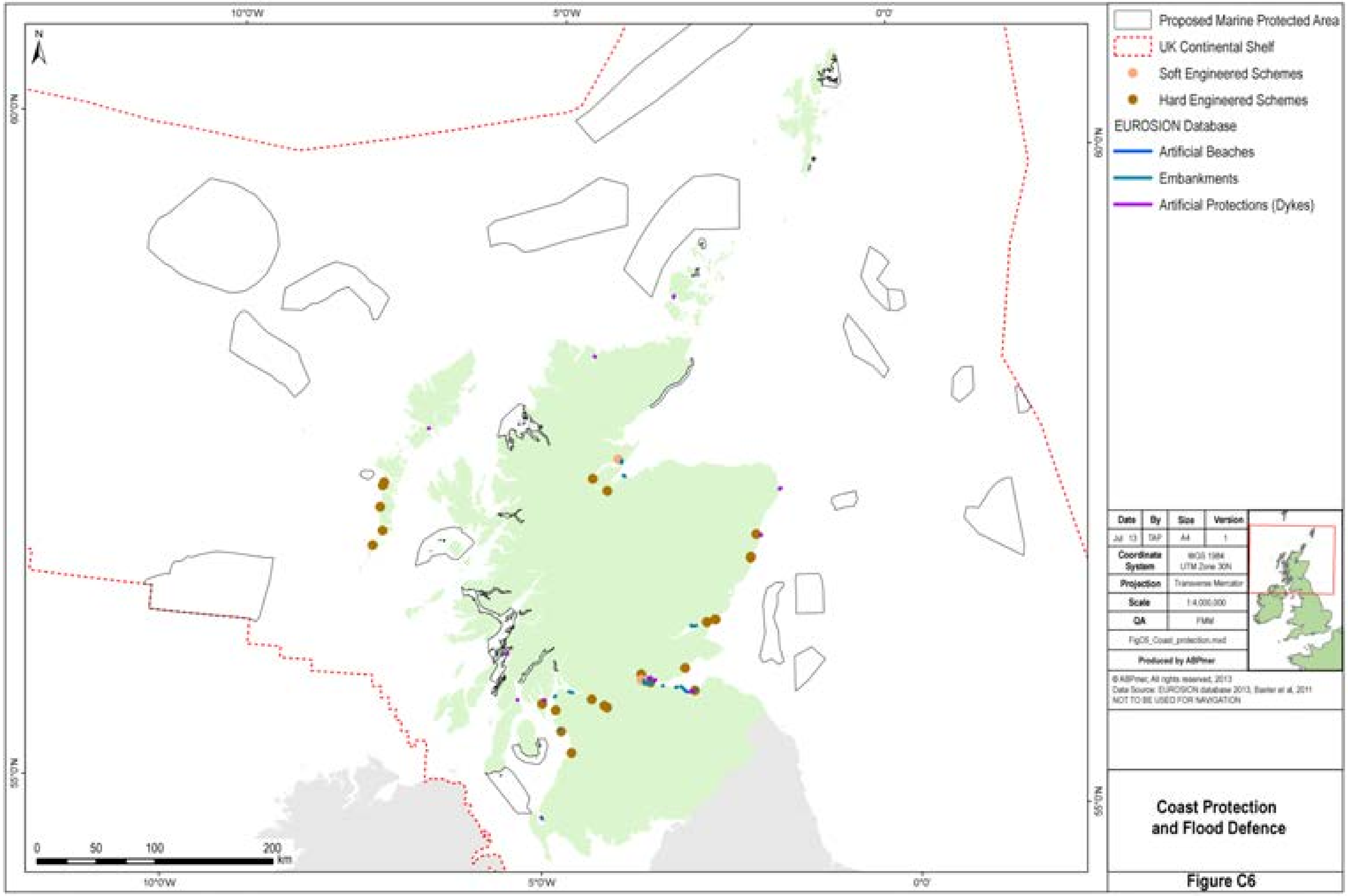
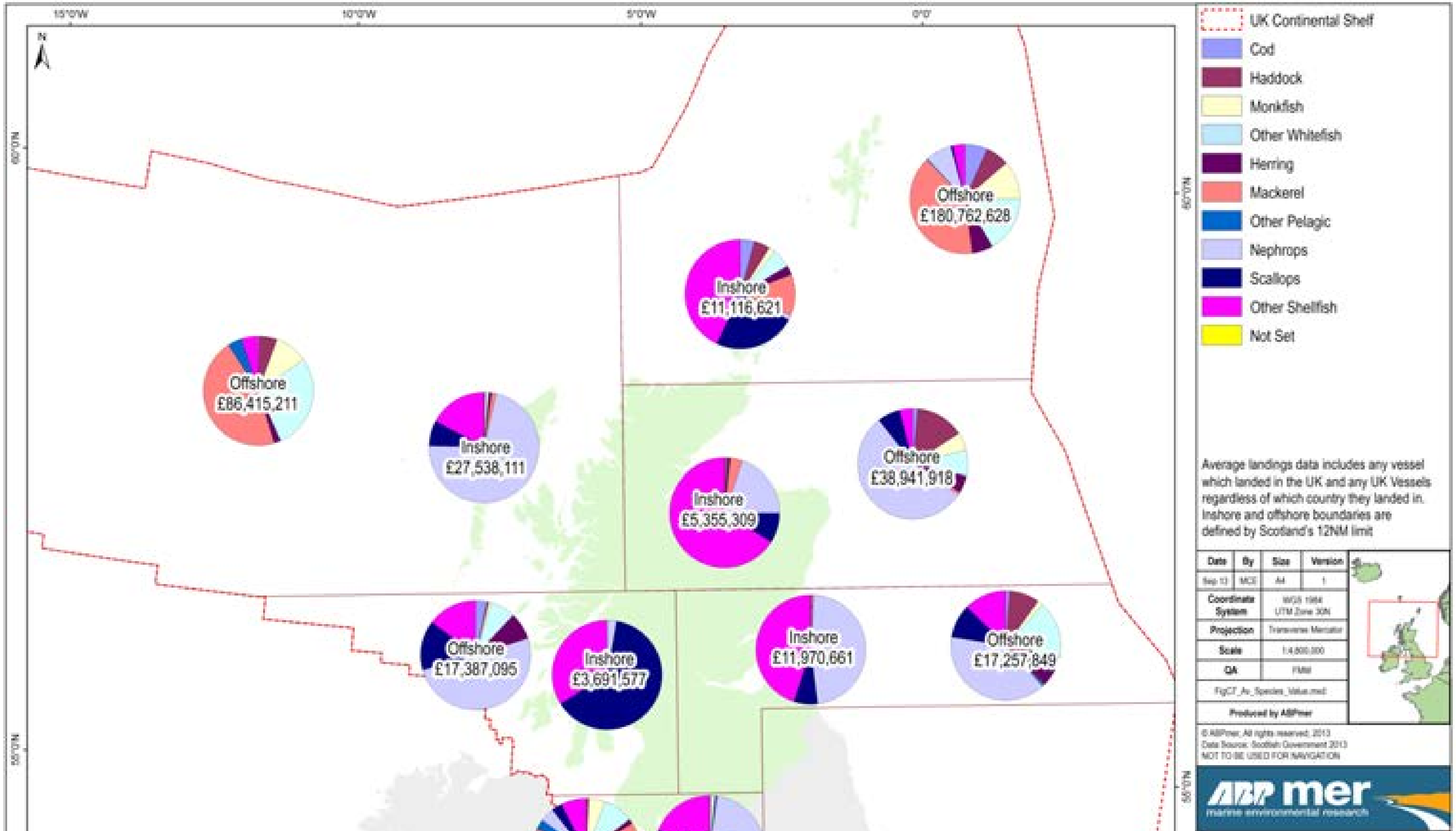
Carbon Capture and Storage

Figure C5



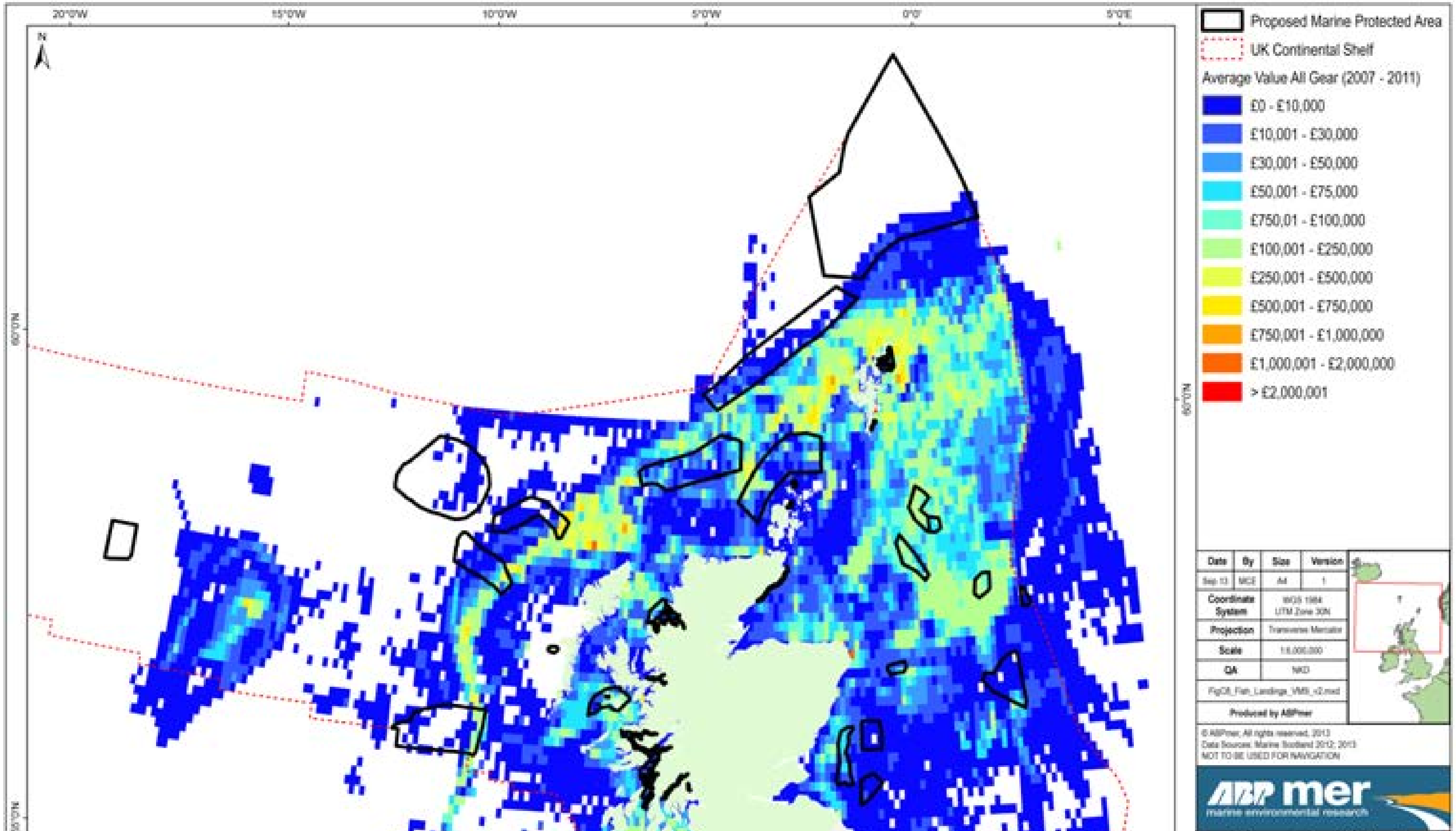
Coast Protection and Flood Defence

Figure C6



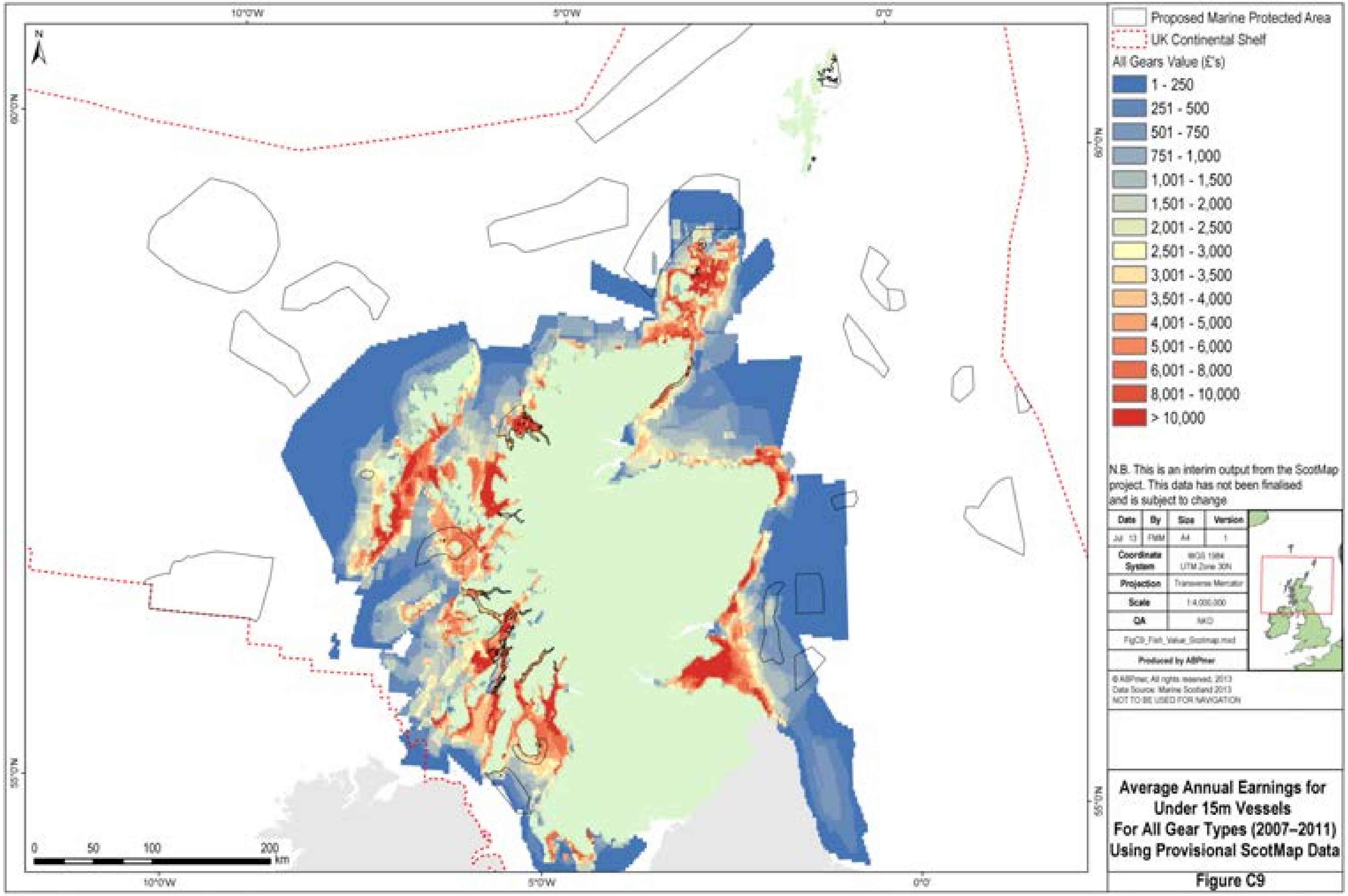
Annual Average Value of Landings (2007 to 2011) from Inshore and Offshore Areas, By Region

Figure C7



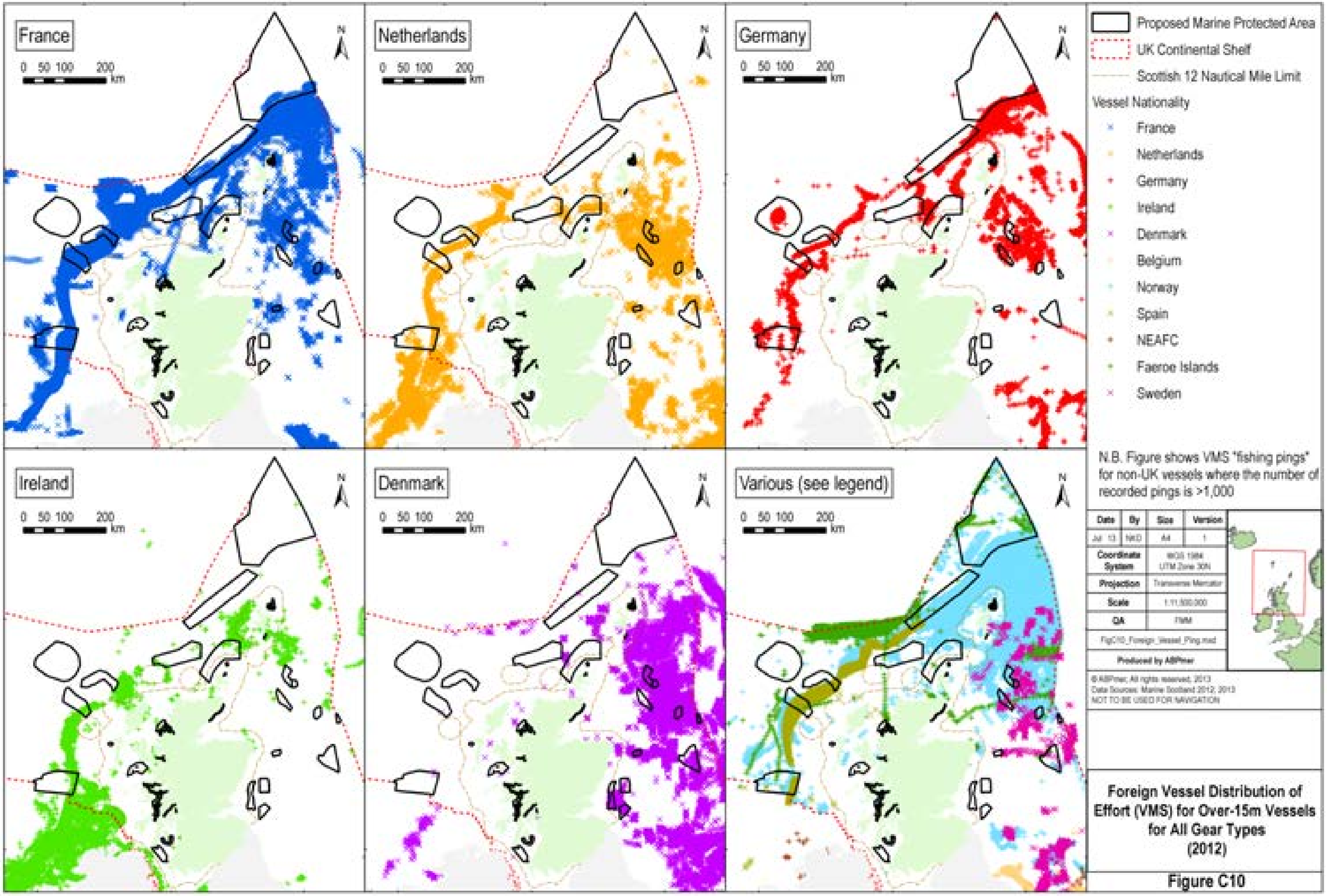
Average Annual Value of Landings Based on Distribution of Effort (VMS) for Over-15m Vessels for All Gear Types (2007–2011)

Figure C8



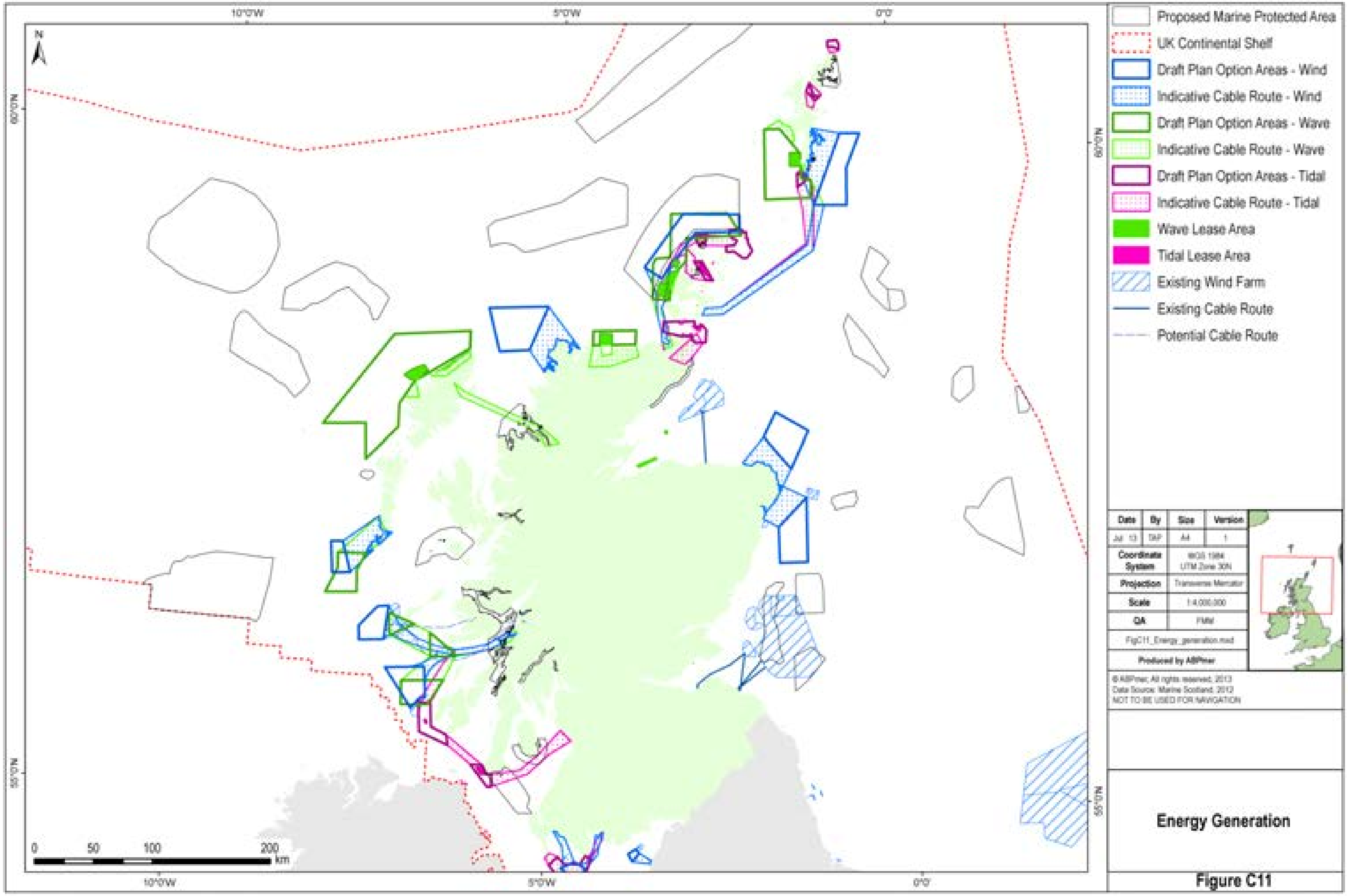
Average Annual Earnings for Under 15m Vessels For All Gear Types (2007–2011) Using Provisional ScotMap Data

Figure C9



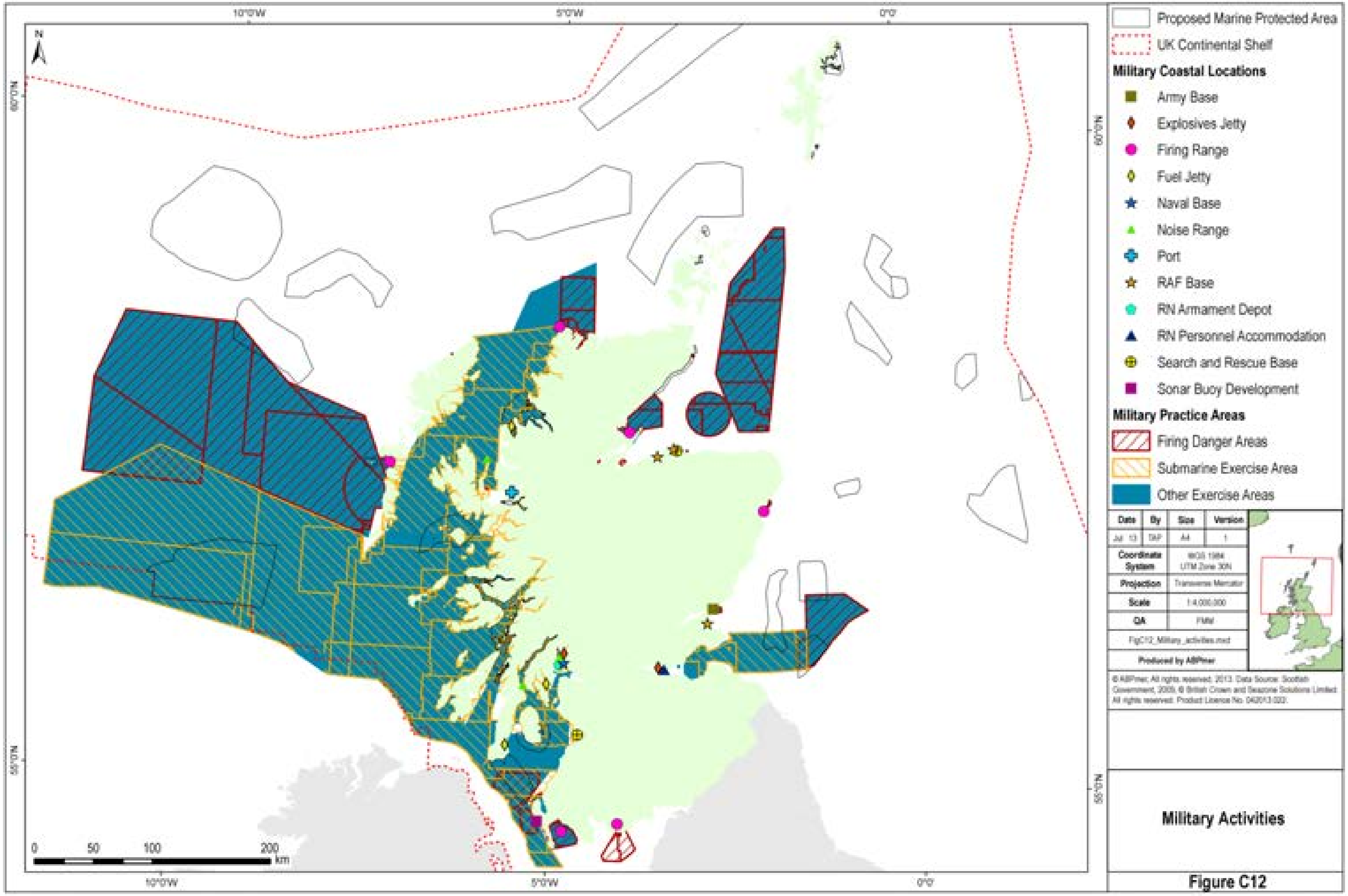
Foreign Vessel Distribution of Effort (VMS) for Over-15m Vessels for All Gear Types (2012)

Figure C10



Energy Generation

Figure C11



10°0'W
5°0'W
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60°0'N
55°0'N
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km
Proposed Marine Protected Area
UK Continental Shelf
Military Coastal Locations
Army Base
Explosives Jetty
Firing Range
Fuel Jetty
Naval Base
Noise Range
Port
RAF Base
RN Armament Depot
RN Personnel Accommodation
Search and Rescue Base
Sonar Buoy Development
Military Practice Areas
Firing Danger Areas
Submarine Exercise Area
Other Exercise Areas
Date
By
Size
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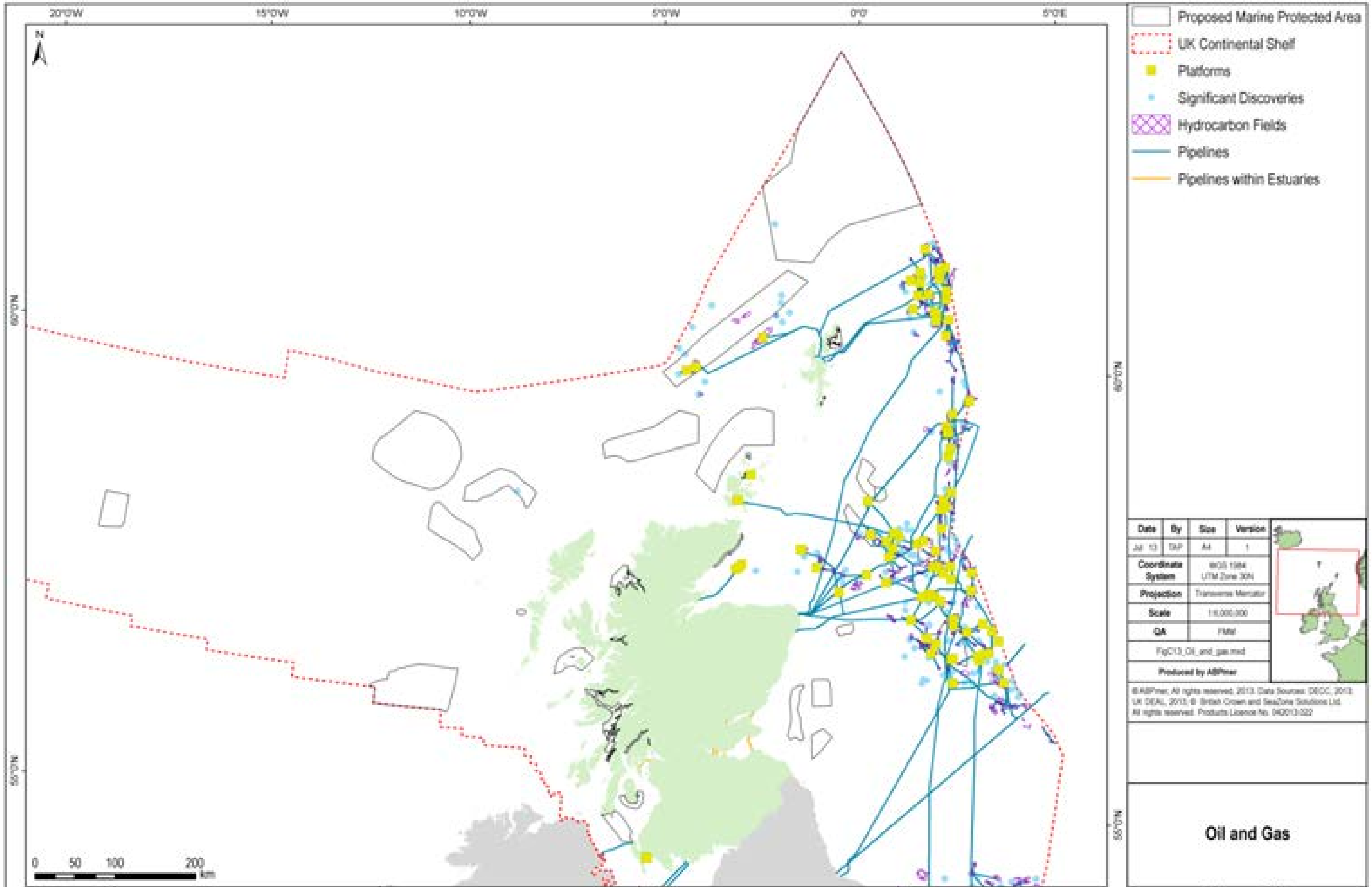
Military Activities
Figure C12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5°0'W
0°0'
N
0 50 100 200
km
Proposed Marine Protected Area
UK Continental Shelf
Platforms
Significant Discoveries
Hydrocarbon Fields
Pipelines
Pipelines within Estuaries
Date
By
Size
Version
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TAP
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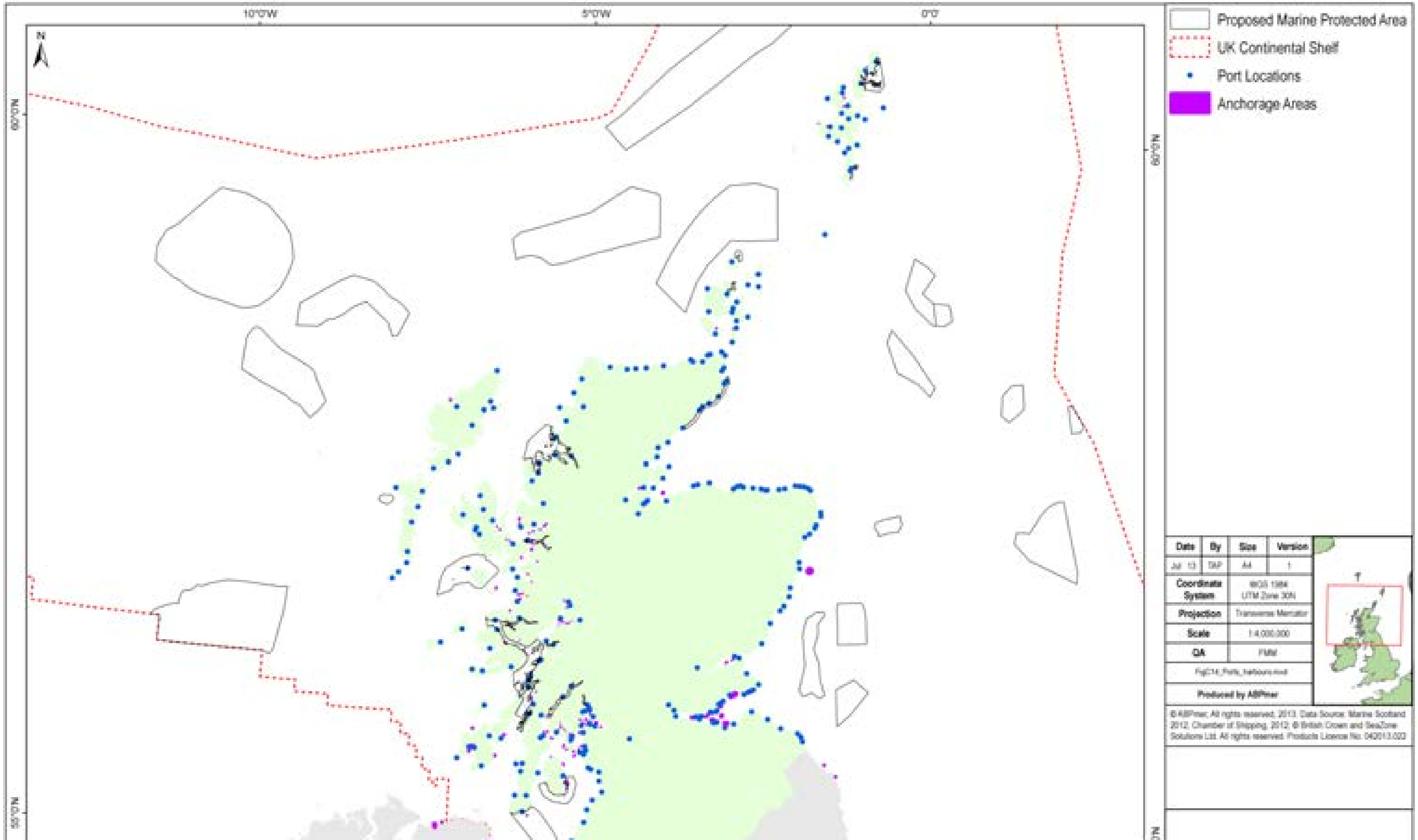
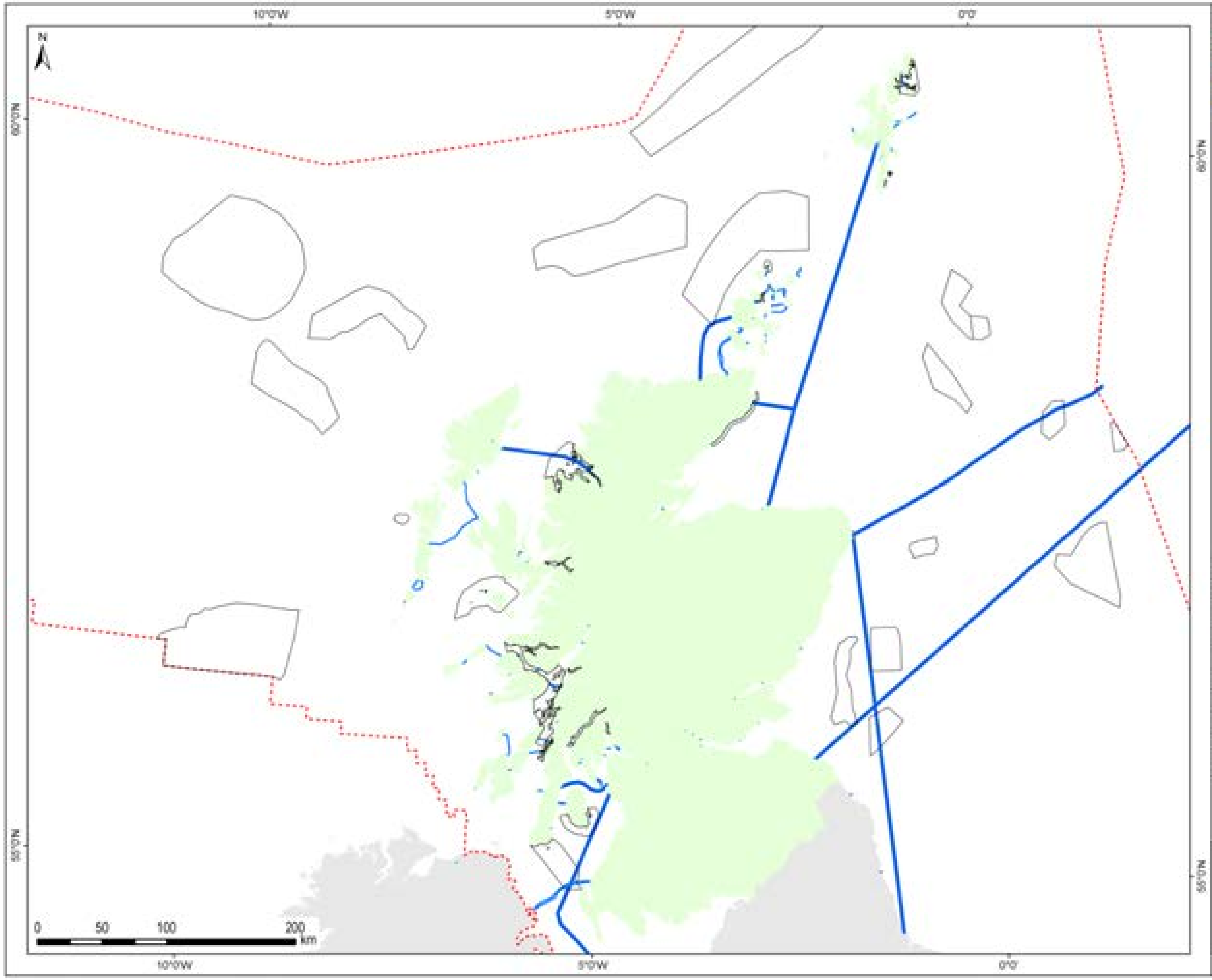
Oil and Gas

Figure C13



Ports and Harbours

Figure C14



Proposed Marine Protected Area

UK Continental Shelf

Existing Power Interconnectors

Future Proposed Interconnectors

Date	By	Size	Version
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Projection	Transverse Mercator		
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QA	FMM		
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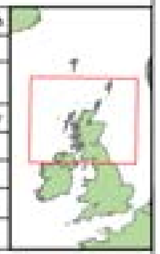
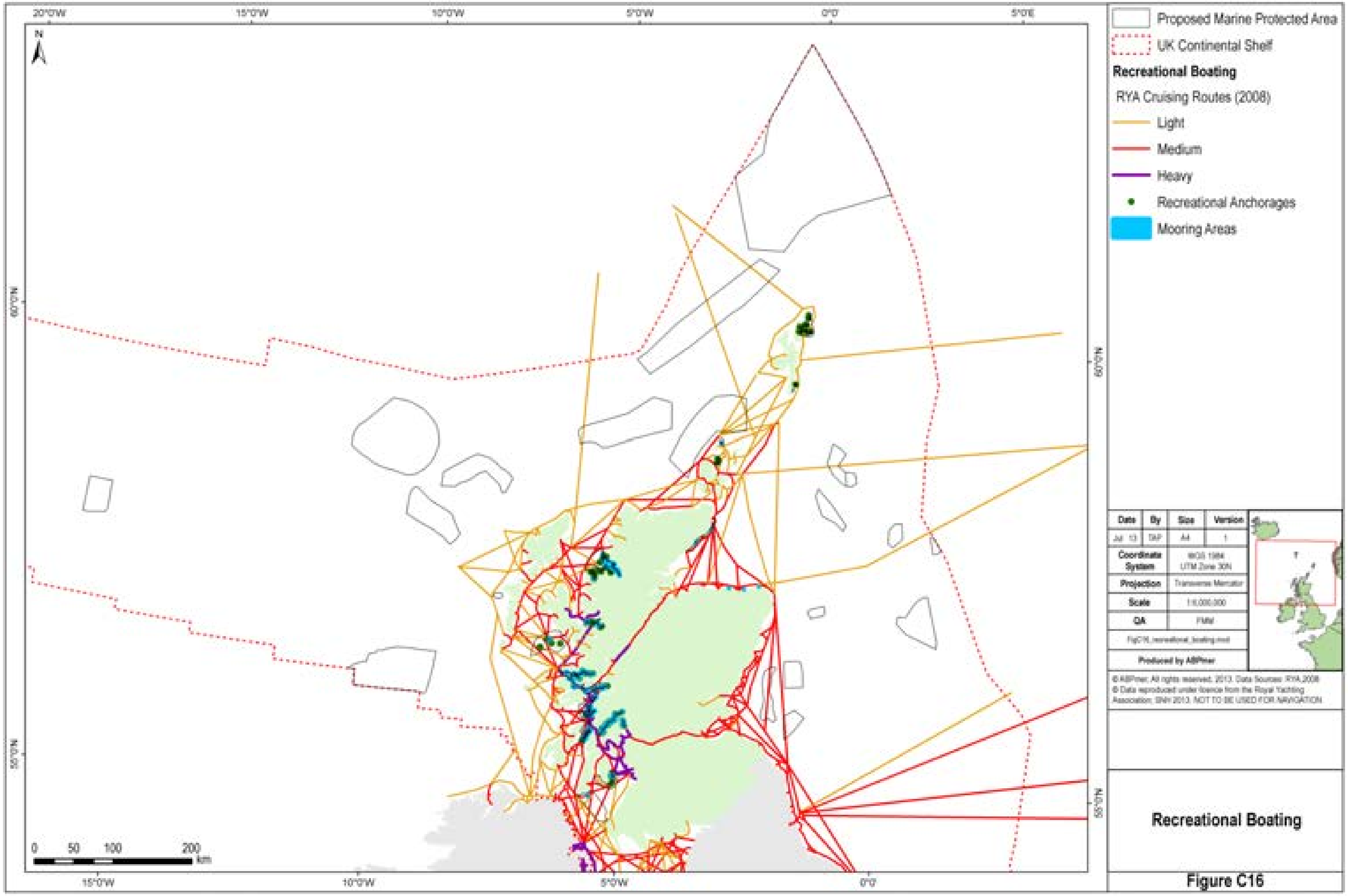


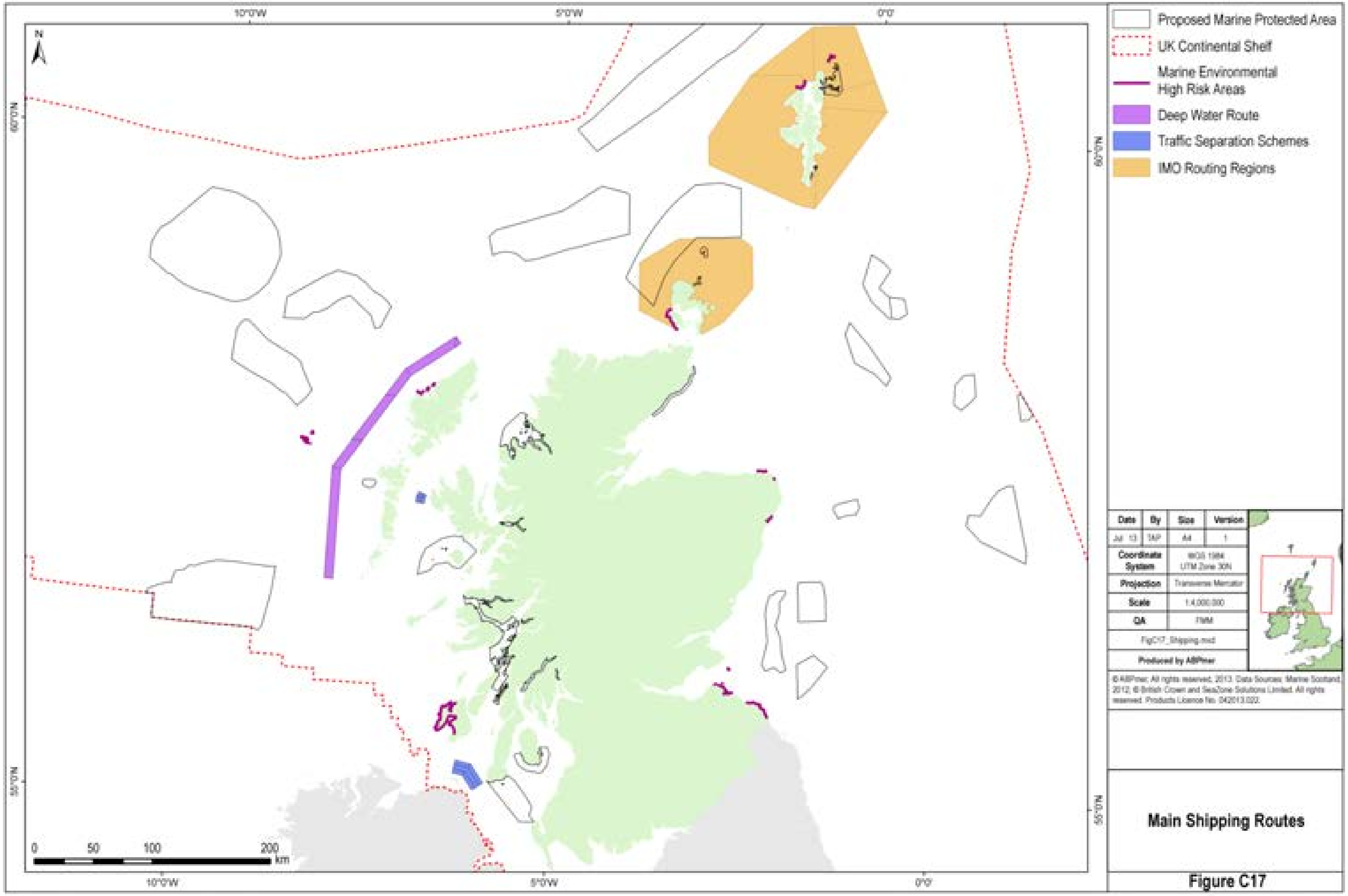
Power Interconnectors

Figure C15



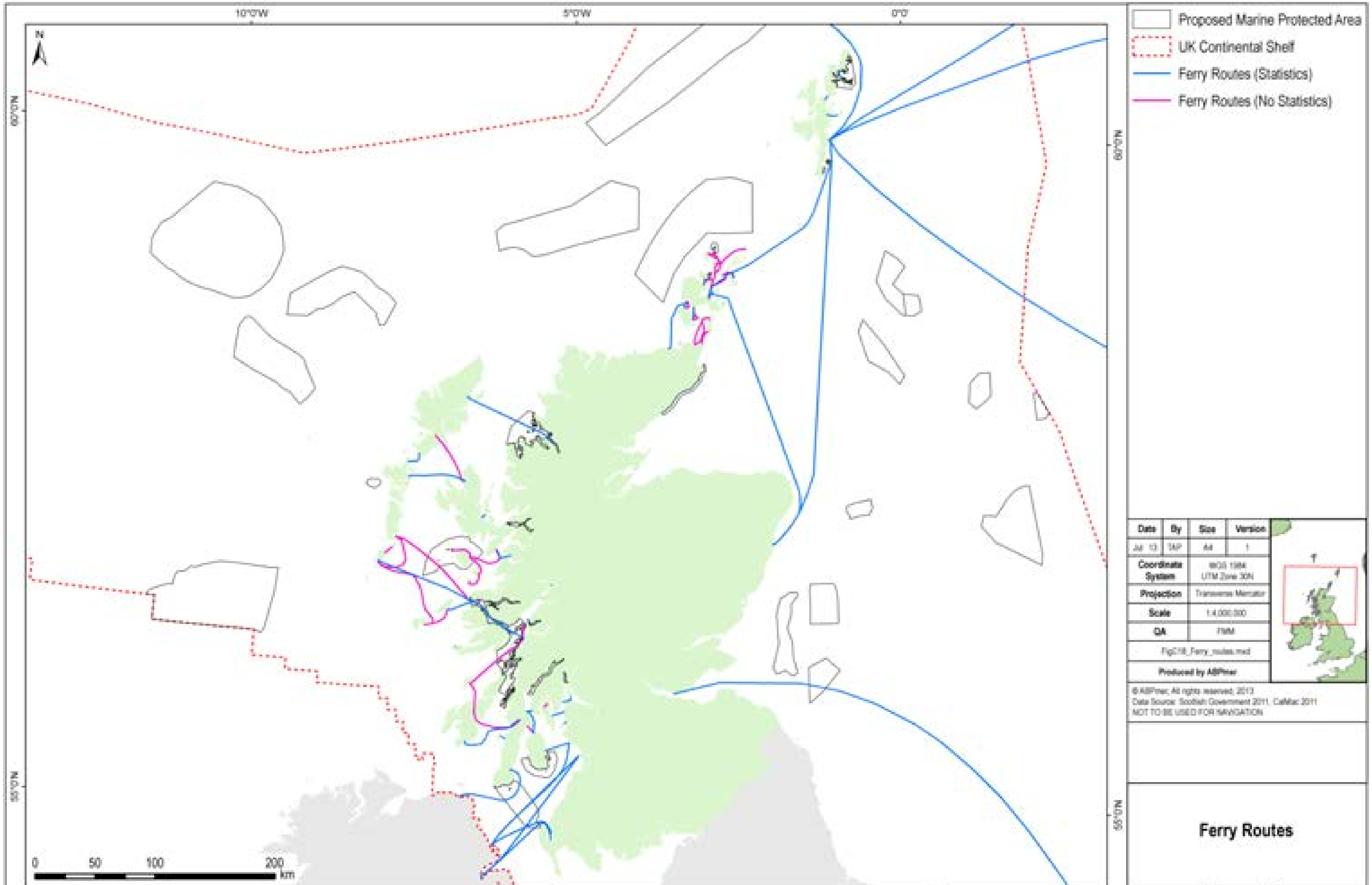
Recreational Boating

Figure C16



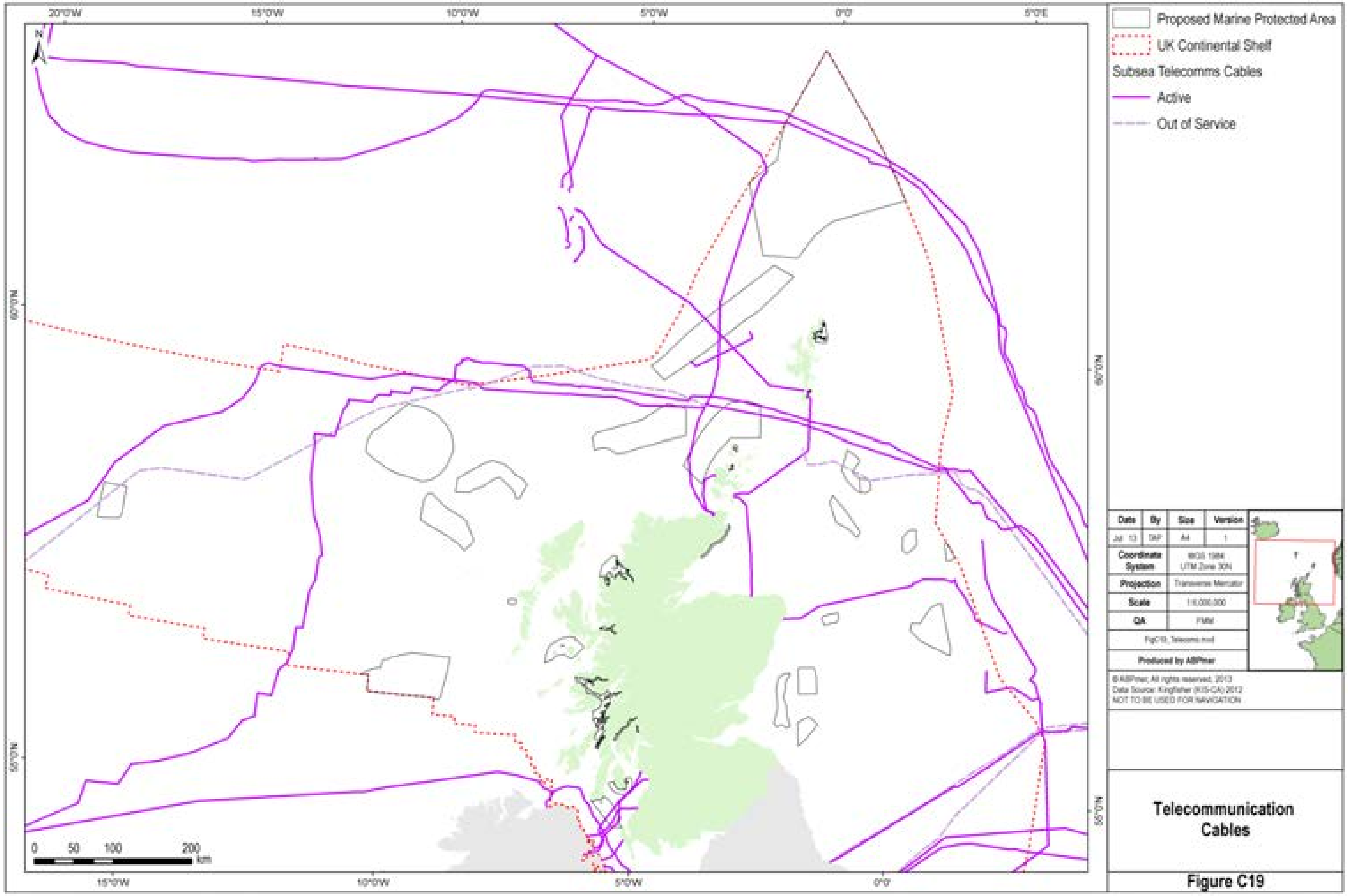
Main Shipping Routes

Figure C17



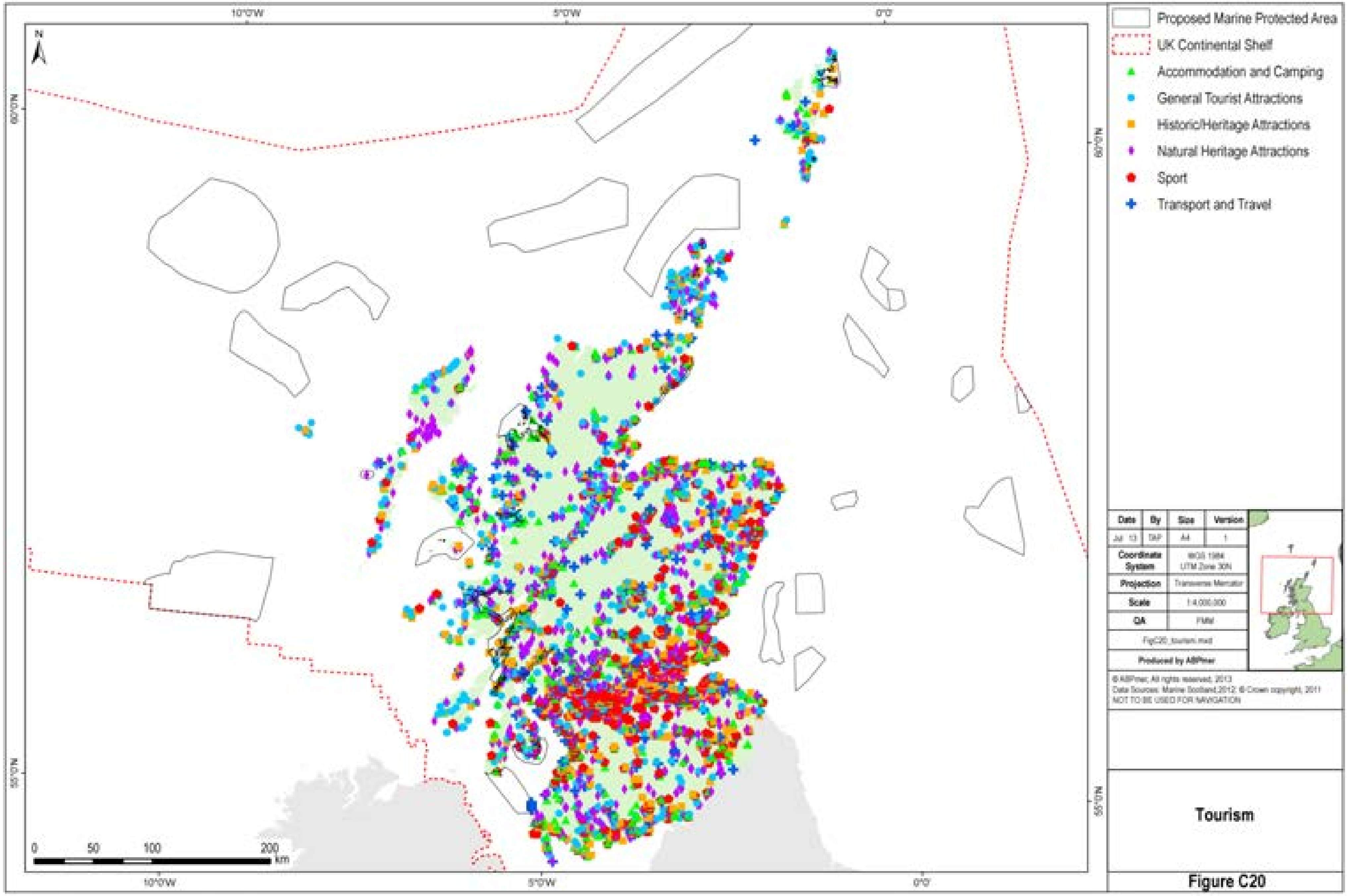
Ferry Routes

Figure C18



Telecommunication Cables

Figure C19



Proposed Marine Protected Area
UK Continental Shelf
Accommodation and Camping
General Tourist Attractions
Historic/Heritage Attractions
Natural Heritage Attractions
Sport
Transport and Travel
10°0'W
5°0'W
0°0'
60°0'N
55°0'N
N
0
50
100
200
km
Date
By
Size
Version
Jul 13
A4
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UTM Zone 30N
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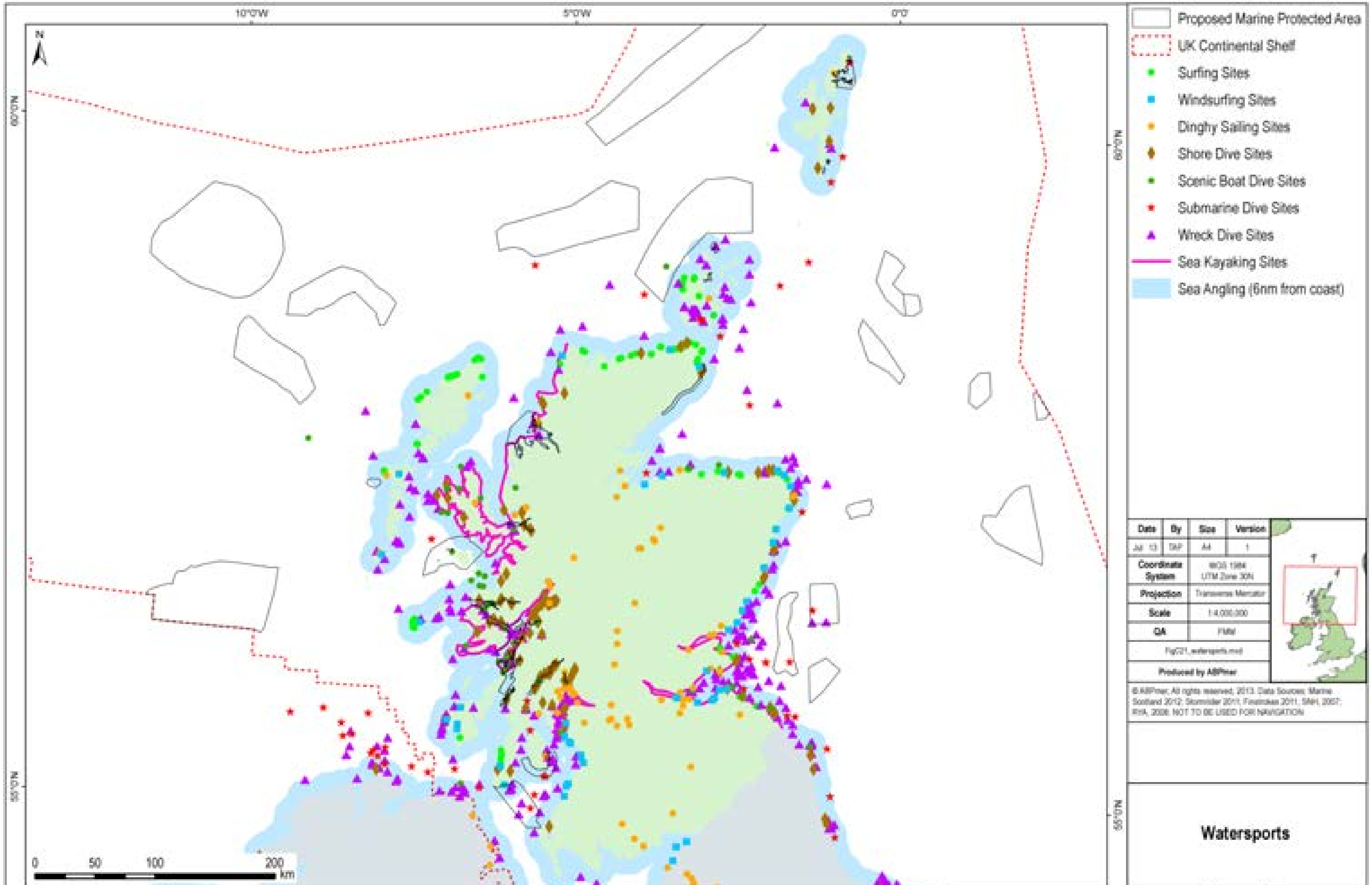
Data Sources: Marine Scotland 2012; © Crown copyright, 2011
NOT TO BE USED FOR NAVIGATION
Tourism
Figure C20



Proposed Marine Protected Area
UK Continental Shelf
Surfing Sites
Windsurfing Sites
Dinghy Sailing Sites
Shore Dive Sites
Scenic Boat Dive Sites
Submarine Dive Sites
Wreck Dive Sites
Sea Kayaking Sites
Sea Angling (6nm from coast)
10°0'W
5°0'W
0°0'
60°0'N
55°0'N
0
50
100
200
km
Date
By
Size
Version
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Scale
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Watersports

Figure C21

Appendix D

VNN Matrix of Ecosystem Services for Relevant Scottish MPA Features

Appendix D. VNN Matrix of Ecosystem Services for Relevant Scottish MPA Features

Number of features per site (Biodiversity + Geodiversity) (Split into offshore/inshore)

		Intermediate Services														Goods and benefits												
		Supporting services									Regulating services					from Provisioning services					from Regulating services				from Cultural services			
Inshore/ Offshore	Site code	Primary production	Secondary production	Larval gamete supply	Food web dynamic	Nutrient cycling	Genetic resources	Formation of species habitat	Species diversity	Formation of physical barriers	Climate regulation	Natural hazard regulation	Regulation of water quality	Regulation of sediment quality	Biological control	Wild food (incl. fisheries)	Fertiliser	Ornaments	Aquaria	Blue Biotechnology	Reduced Greenhouse gas emissions	Prevention of coastal erosion	Provision of clean water	Provision of clean sediments	Spiritual / Cultural significance	Tourism / Nature walking	Art	Research & Education
Off	CFL	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Off	CFL_c	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Off	EGM	2	2	1	2	1		1	2			2		1		2						1	1		2	1	1	2
Off	FSS	3	3	2	3	1		2	3	2	1	3	1	1	1	3	1	1	1	1	1	2	1	1	3	3	2	4
Off	FOF	2	2	1	2	1		1	2	1	1	2	1	1	1	2	1	1	1	1	1	1	1	1	2	2	1	3
Off	GSH	3	3	3	3	3	1	3	3	2	2	3	2	3	2	3	2	2	2	2	2	3	3	2	3	2	3	3
Off	HRB	2	2	2	2	1		2	2	1		2		1		2						2	1		2	1	2	2
Off	FSC	3	3	3	3	2		3	3	2	1	3	1	2	1	3	1	1	1	1	1	3	2	1	3	2	3	5
Off	NWO	1			1				1							1									1	1		1
Off	NSP	1	1		1				1			1				1									1	1		1
Off	RBS	1	1	1	1			1	1	1		1				1						1			1	1	1	3
Off	SEF	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Off	SSH	3	3	3	3	3	1	3	3	2	2	3	2	3	2	3	2	2	2	2	2	3	3	2	3	2	3	4
Off	BHT	7	6	5	6	5	3	6	7	5	3	5	3	4	3	7	3	3	3	3	3	5	4	3	7	6	5	8
Off	TBB	2	1	1	2	1		1	2	1	1	1	1	1	1	2	1	1	1	1	1	1	1	1	2	2	1	2
Off	WSS	1	1	1	1	1		1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Off	WFL	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1

		Intermediate Services														Goods and benefits												
		Supporting services									Regulating services					from Provisioning services					from Regulating services				from Cultural services			
Inshore/ Offshore	Site code	Primary production	Secondary production	Larval gamete supply	Food web dynamic	Nutrient cycling	Genetic resources	Formation of species habitat	Species diversity	Formation of physical barriers	Climate regulation	Natural hazard regulation	Regulation of water quality	Regulation of sediment quality	Biological control	Wild food (incl. fisheries)	Fertiliser	Ornaments	Aquaria	Blue Biotechnology	Reduced Greenhouse gas emissions	Prevention of coastal erosion	Provision of clean water	Provision of clean sediments	Spiritual / Cultural significance	Tourism / Nature walking	Art	Research & Education
In	CSS	3	3	3	3	3	1	3	3	2	1	2	1	2	1	3	2	2	2	2	2	3	3	2	3	2	3	3
In	ECC	1	1	1	1	1	1	1	1	1						1	1	1	1	1	1	1	1	1	1	1	1	1
In	FTH	5	6	5	6	6	3	6	6	4	2	3	2	5	3	6	4	3	3	3	3	4	4	4	6	4	6	6
In	LCR	1	1	1	1	1		1	1		1	1			1	1					1	1			1	1	1	1
In	LSU	3	2	2	3	2		2	3		2	2	1		1	3			1		2	2	1	1	3	3	2	3
In	SJU	1	1	1	1	1	1	1	1							1									1	1		1
In	LSW	2	3	3	3	3	1	3	3	2	2	2	2	2	3	3	2	1	1	1	2	2	2	1	3	3	3	3
In	DLA	2	2	2	2	2	1	2	2	1	2	2	1	1	2	2	1	1	1	1	2	2	1	1	2	2	2	2
In	MOI	1	1	1	1	1	1	1	1	1						1	1	1	1	1	1	1	1	1	1	1	1	1
In	MTB	1			1				1							1									1	1		1
In	NWS	6	6	6	7	6	2	7	8	3	4	5	3	4	5	7	3	2	2	2	4	5	4	2	7	6	6	9
In	NOH	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
In	PWY	1	1	1	1	1	1	1	1	1						1	1	1	1	1	1	1	1	1	1	1	1	1
In	SMI	6	6	4	6	4	3	6	7	3	2	3	2	3	2	6	3	4	3	3	3	4	5	3	6	5	4	6
In	ARR	5	7	5	7	5	4	7	8	4	3	4	3	5	4	7	4	3	3	3	3	3	3	4	7	5	5	6
In	LFG	6	6	5	6	5	2	5	6	3	4	6	3	4	4	6	3	3	3	3	4	5	4	3	6	5	5	6
In	WYR	2	2	2	2	2	1	2	2	2	1	1	1	2	2	2	2	1	1	1	1	1	1	1	2	2	2	2

Note: The numbers in the cells are the number of features per site which make a contribution to each ecosystem service. Other than this contribution being assessed as more than negligible, this does not reflect the level of the service from each feature.

Appendix E

MPA Site Reports

Appendix E. MPA Site Reports

Supplied as separate documents

Part 1 - Inshore Sites:

Clyde Sea Sill (CSS)
East Caithness Cliffs (ECC)
Fetlar to Haroldswick (FTH)
Loch Creran (LCR)
Loch Sunart (LSU)
Loch Sunart to the Sound of Jura (SJU)
Loch Sween (LSW)
Lochs Duich, Long and Aish (DLA)
Monach Isles (MOI)
Mousa to Boddam (MTB)
North-west Sea Lochs & Summer Isles (NWS)
Noss Head (NOH)
Papa Westray (PWY)
Small Isles (SMI)
South Arran (ARR0
Upper Loch Fyne & Loch Goil (LFG)
Wyre and Rousay Sounds (WYR)

Part 2 - Offshore Sites:

The Barra Fan & Hebrides Terrace Seamount (BHT)
Central Fladen (CFL)
Central Fladen (core) (CFL(core))
East of Gannet & Montrose Fields (EGM)
Faroe-Shetland Sponge Belt (FSS)
Firth of Forth Banks Complex (FOF)
Geikie Slide & Hebridean Slope (GSH)
Hatton-Rockall Basin (HRB)
North-east Faroe-Shetland Channel (NEF)
Norwegian Boundary Sediment Plain (NSP)
North-west Orkney (NWO)
Rosemary Bank Seamount (RBS)
South-east Fladen (SEF)
South-west Sula Sgeir & Hebridean Slope (SSH)
Turbot Bank (TBB)
West Shetland Shelf (WSS)
Western Fladen (WFL)

Appendix F

Stakeholder List

Appendix F. Stakeholder List

This list identifies stakeholders that have been contacted in relation to the project. It was based on the Scottish MPA Stakeholder List, items in **bold** are additional stakeholders added through the current study.

Organisation
Argyll & Bute Council
Aberdeen University
Association of Scottish Shellfish Growers
British Canoe Union
British Geological Survey (BGS)
British Kitesurfing Association
British Marine Federation
British Ports Association
British Shipping (UK Chamber of Shipping)
Built Environment Forum Scotland
Centre for Environment, Fisheries and Aquaculture Science (CEFAS)
Clyde Coastal Forum
Clyde Fishermen's Association
Community of Arran Seabed Trust (COAST)
Coast Hebrides - Comhairle Nan Eilean Siar (Western Isles Council)
Convention of Scottish Local Authorities (CoSLA)
Cumbria University
David MacBrayne Ltd
Department for Environment, Food and Rural Affairs (DEFRA)
Department of Energy and Climate Change (DECC)
Department of Environment for Northern Ireland (DOENI)
Directorate of Fisheries Norway
Danish Fishermen’s Association
The Directorate-General for Maritime Affairs and Fisheries (DG MARE) – (European Commission)
East Coast Biodiversity Partnership
East Grampian Coastal Forum
EMU consultants
Euronor, Boulogne sur mer
Fair Isle Marine Environment & Tourism Initiative (FIMETI)
Fishermens Association Ltd
Heriot Watt University
Highland and Islands Enterprise/Scottish Enterprise
Highland Council
Historic Scotland
Inshore Fisheries Groups (IFG)
Clyde Inshore Fisheries Group
South East Inshore Fisheries Group
Mull & Small Isles Inshore Fisheries Group
North West Inshore Fisheries Groups
International Centre for Island Technology
Joint Nature Conservation Committee (JNCC)
Killybegs Fishermen’s Organisation (KFO)
Law Society
Lorn Environmental Action Forum (LEAF)

Organisation
Loch Duart Ltd
Mallaig and North West Fishermen's Association (MNWFA)
Manx Fish Producers Organisation
The Marine Alliance for Science & Technology for Scotland (MASTS)
Marine Biological Association
Marine Harvest Ltd
Marine Scotland Science (MSS)
Marine Turbines
Maritime & Coastguard Agency
Ministry of Defence (MOD)
Marine Protected Areas Coalition (MPAC)
Mull Aquaculture and Fisheries Association
Napier University
National Federation of Fishermen's Organisations (NFFO)
National Grid
National Oceanography Centre (NOC)
National Trust
North Atlantic Fisheries College (NAFC Marine Centre)
North East Atlantic Fisheries Commission
Northern Isles Salmon
Northern Lighthouse Board
Northwest Responsible Fishing Association
Norwegian Fishermen's Association
Nova Innovation
OceanFlow Energy
Orkney Fisheries Association (OFA)
Orkney Islands Council
Offshore Renewable Energy
Oil and Gas UK
Oslo and Paris Commission (OSPAR)
Plymouth University
Pulse Tidal
QinetiQ
Regional Advisory Councils (EU stakeholders)
North Sea Regional Advisory Council
North Western Waters Regional Advisory Council (NWWRAC)
Pelagic Stocks Regional Advisory Council
Renewable Energy Association
Renewable UK
Repsol
Republic of Ireland fish producers organisation
Royal Haskoning
Royal Town Planning Institute (RTPI)
Royal Yachting Association Scotland
Sail Scotland
Sir Alister Hardy Foundation for Ocean Science (SAHFOS)
Scottish Association for Marine Science (SAMS)
Scottish Subaqua Club (ScotSAC)
Scottish and Southern Energy (SSE)
Scottish Boating Alliance (SBA)
Scottish Canoe Association
Scottish Coastal Forum

Organisation
Scottish Development International
Scottish Enterprise
Scottish Environment Link (SELINK)
Hebridean Whale and Dolphin Trust (HWDT)
Marine Conservation Society (MCS)
National Trust for Scotland (NTS)
Plantlife
Royal Society for the Protection of Birds
Whale and Dolphin Conservation Society (WDCS)
Scottish Wildlife Trust (SWT)
Scottish Environment Protection Agency (SEPA)
Scottish Fishermen's Federation (SFF)
Scottish Fishermen's Organisation (SFO)
Scottish Hydro-electric Transmission Ltd (SHETL)
Scottish Inshore Fisheries Trust (SIFT)
Scottish Natural Heritage (SNH)
Scottish Pelagic Fishermen's Association (SPFA)
Scottish Power Renewables
Scottish Renewables Forum
Scottish Salmon Company
Scottish Salmon Producers Organisation
Scottish Sea Angling Conservation Network (SSACN)
Scottish Surfing Federation
Scottish Sustainable Management Environment Initiative (SSMEI)
Scottish Whitefish Producers Association (SWFPA)
Seafish
Seagreen Wind Energy
Sea Mammal Research Unit (SMRU)
Shetland Isles Council
Small Isles Community Council
Solway Firth partnership
Sport Scotland
Statoil
Subsea Cables UK
Surfers Against Sewage
Surfing GB
Sustainable Inshore Fisheries Trust (SIFT)
The Crown Estate (TCE)
UK Chamber of Shipping
UK Major Ports Group
UK Windsurfing Association
University of Glasgow
Visit Scotland
Welsh Assembly Government
Wessex Archaeology
Western Isles Council
Western Isles Fishermans Association
Wester Ross Fisheries Trust
Wild Scotland

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