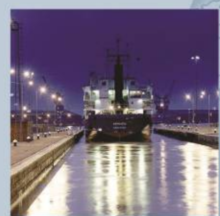
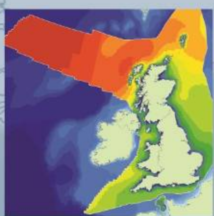
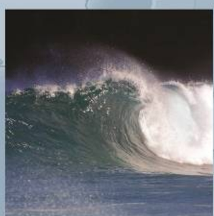
Joint Nature Conservation Committee

Developing the Evidence Base for Impact Assessments for Recommended dSACs and dSPAs
Appendix B: Context for Marine Activities and Proposed Assessment Methods for dSACs

Report R.2462

August 2015

Creating sustainable solutions for the marine environment

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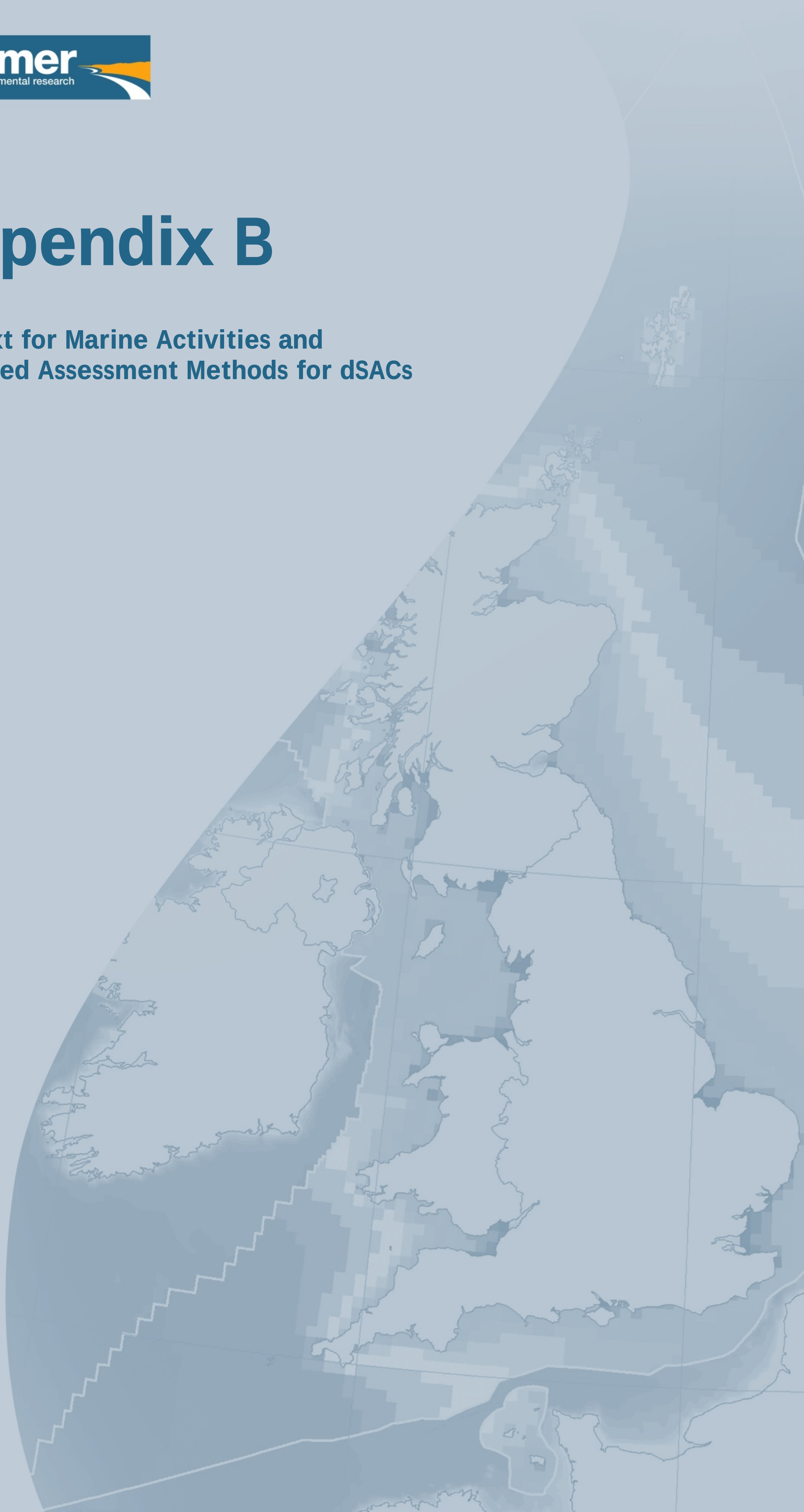
Appendix B

Context for Marine Activities and Proposed Assessment Methods for dSACs



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B.1 Aggregates

B.1.1 Introduction

This appendix provides an overview of existing and potential future activity for the marine aggregates sector and outlines the methods used to assess the impacts of potential dSACs on this sector.

B.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.

B.1.3 Overview of Existing Activity

A list of sources to inform the writing of this baseline is provided in Table B.1.1.

Table B.1.1 Marine aggregate information sources

Scale	Information Available	Date	Source
ROI and Wales	Irish Sea Marine Aggregate Initiative (IMAGIN) Policy Report	2008	Sutton *et al*. (2008)
UK	Marine aggregates capability and portfolio 2014	2014	The Crown Estate (2014)
UK	Active, licensed and application areas for aggregate extraction	Current	The Crown Estate (http://www.thecrownestate.co.uk/energy-and-infrastructure/aggregates/our-portfolio)
UK	Location of all current Crown Estate marine aggregate application, exploration, option and licence areas currently being progressed in the UK Continental Shelf (UKCS)	Current	The Crown Estate (http://www.thecrownestate.co.uk/energy-and-infrastructure/downloads/maps-and-gis-data)
UK	The Crown Estate Leases and Oil and Gas Licences	Current	DECC

B.1.3.1 Location and Intensity of Activity

Figure B.1.1 shows the areas of this activity in UK waters, including existing licensed, option and application areas.

Marine aggregate extraction occurs at various locations around the English coast, with The Crown Estate permitting areas for the Humber and North East, East Coast, Thames Estuary, East English

Channel, South Coast, South West and North West. It should be noted that extraction from the South West and North West regions include licenced areas in English and Welsh waters. In 2013, 14.7 million tonnes of primary aggregates were extracted from marine licenced areas in England and Wales (Table B.1.2); this equates to less than half of the total permitted removal from these regions (37.5 million tonnes) (The Crown Estate, 2014). A further 1.3 million tonnes of secondary marine aggregates were extracted for beach nourishment in 2013 (The Crown Estate, undated).

Table B.1.2 Regional marine aggregate statistics for 2013

Region	Permitted Primary Extraction (million tonnes)	Aggregates Extracted (million tonnes)		Total Extracted (million tonnes)
		Primary	Secondary	
Humber and North East	4.8	1.5	0.6	2.1
East Coast	9.7	4.2	-	4.2
Thames Estuary	1.4	0.7	-	0.7
East English Channel	9.8	3.4	-	3.4
South Coast	8.7	3.4	0.2	3.6
South West	2.2	1.0	-	1.0
North West	1.0	0.4	0.5	0.9
Total	37.5	14.7	1.3	16.0

(Source: The Crown Estate, undated; 2014)

Marine aggregate extraction in England predominantly occurs off the East Coast, as well as the East English Channel and South Coast regions. Aggregates dredged from English licenced areas are either delivered to nearby wharves within the same region, delivered to other UK regions with high demand, particularly London (3.7 million tonnes in 2013) and the South East (4.6 million tonnes in 2013), or exported to the European market (e.g. France, Belgium and the Netherlands) (The Crown Estate, 2014). The typical destination of aggregates varies between regions; for example, in 2013, more than three quarters of aggregates extracted in the South West region were also landed in the South West, while almost half of the aggregates from the East Coast (East Anglia) and Humber regions were landed in London and Denmark, respectively.

Marine aggregate licence areas in Welsh waters are located in two separate regions, specifically to the North beyond the Dee (North West) and to the South within the Bristol Channel and Severn Estuary (South West) (Table B.1.2). South Wales is particularly dependent on marine sand aggregates due to shortages in local land-won sources where there are currently no realistic alternatives (Welsh Government, 2014). On a tonnage basis, Welsh marine aggregates account for approximately 7% of the UK sand and gravel aggregate production (Highley *et al*. 2007). In 2013, the majority (60%) of aggregates dredged from the South West region were landed at wharves in Wales, while a smaller proportion (15%) was landed in Wales from the North West region (The Crown Estate, 2014).

There are currently no licensed marine aggregate extraction sites in Scotland and exploitation of marine aggregates is not, as yet, widespread in Northern Ireland. Between 1998 and 2012, the area of seabed licensed by The Crown Estate in the UK decreased by 748 km^2, which is reflected in the reduction of area dredged by 126 km^2 (The Crown Estate and British Marine Aggregate Producers Association (BMAPA), 2014).

B.1.3.2 Economic Value and Employment

Extraction of marine aggregates leads to a number of economic impacts. These include job creation in the operating and servicing of dredging vessels, in wharves, offices and administration; a reduction in the need for processing as initial aggregate sorting occurs before the aggregates are loaded onto the dredger (thus reducing waste at the wharf and leading to lower processing costs); and delivery of the aggregates to wharves close to the point of use resulting in lower supply costs (Austen *et al*. 2009; UK Marine Monitoring and Assessment Strategy (UKMMAS), 2010). Wider social and economic benefits include skilled, stable employment and the generation of income through the construction industry supply chain (HM Government, 2011).

The following information on the social impacts of the sector, in terms of gross value added (GVA) and employment, at the UK level has been taken from Charting Progress 2 (UKMMAS, 2010). The aggregates industry employs about 640 staff, 500 of which are ship crew and the rest provide shore support and administration (British Geological Survey (BGS), 2007). However, the number of jobs that rely on the marine aggregates sector are significantly more than this. A further 600 staff are employed on the wharves that receive UK marine aggregates and an estimated 500 related to the primary delivery of sand and gravel (i.e. from wharves to point of initial use). The industry also supports employment for the manufacture of ready-mixed concrete and concrete products and the distribution of these products to the construction industry. In terms of ancillary activities, the industry supports jobs related to the representation of the industry (e.g. BMAPA), ship building and maintenance, manufacture of specialised surveying and dredging equipment, and environmental monitoring and assessment (Highley *et al*. 2007; UKMMAS, 2010).

B.1.3.3 Future Trends

A market study by Ernst & Young, commissioned by The Crown Estate, has indicated that there is potential for growth in the demand for marine aggregates in UK waters over the next 15 years. This is due to onshore (land-based) resource constraints and changes in supply patterns within the construction industry. The study predicted that annual demand for marine aggregates will grow by 3% per year from 2012 to reach 29 million tonnes by 2030, whilst also indicating that licence capacity will not be a constraint to projected future demand. Current national estimates suggest there are approximately 20 years of primary marine aggregate production permitted, based on current 10-year average annual extraction figures (The Crown Estate, 2014).

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.

The Irish Sea Marine Aggregates Initiative (IMAGIN) has identified and highlighted marine aggregate resources in the Irish Sea that represent a future additional aggregate supply option (Sutton *et al*. 2008). A marine aggregate strategy for the Irish Sea is likely to be developed in the near future. At present, the only licenced activity occurs in the north-east Irish Sea, but the demand for marine aggregates is growing as inland sources are depleted and thus other sites may be established. Along the west coast of Wales, the lack of suitable (new) ports for marine sand, adequate road links and intrinsically low demand rules out marine sand making a substantial contribution above existing levels in these areas (Sutton, 2008).

The Crown Estate commissioned the BGS to undertake a resource mapping exercise to define the potential locations of marine aggregate resources around the UK shelf (e.g. Bide *et al*. 2013a, Welsh Waters and Irish Sea; Bide *et al*. 2011, Southern North Sea; Bide *et al*. 2013b, English Channel and Thames Estuary; Green *et al*. 2013, Scottish Waters and the Central North Sea). These reports help to document deposits of marine sand (principally) that could be suitable for a range of potential end uses if the market demand arose.

It is possible that marine supplies could become more important in the future for:

- Beach nourishment/coast defence requirements;
- Major contract fill/reclamation requirements; and
- Gravity base foundations (construction facilities, concreting aggregate and ballast).

However, future changes in the scale of marine aggregate production are very uncertain, both in terms of quantity, location and time scales. The aggregates supply business is closely linked to the construction sector, and therefore the wider economy as a whole. Demand for marine aggregate materials is likely to respond to large scale infrastructure projects such as the expansion and development of ports and renewable energy, for example, offshore wind farms.

B.1.4 Assumptions on Future Activity

For the purposes of this assessment it has been assumed that existing licences continue to term, and that all application and option areas are progressed. The Crown Estate is currently undertaking an aggregates licensing round which is due to conclude in spring 2015. This may lead to further areas being awarded leases. While many existing production licences have recently been renewed for periods of up to 15 years, all existing licences will expire during the time period for the impact assessment and will require renewal if operators wish to continue with aggregate extraction at these locations.

B.1.5 Potential Management Measures

Marine aggregate extraction is already highly regulated to minimise environmental risks and the designation of harbour porpoise dSACs is considered unlikely to require significant changes.

Underwater noise associated with geophysical surveys has the potential to injure or disturb harbour porpoise. JNCC has published guidance on the deliberate disturbance of marine protected species (JNCC, 2008) which includes disturbance from geophysical surveys. The MMO has also issued a voluntary notification form for developers proposing to undertake geophysical or seismic surveys to reduce the risk of contravening European Protected Species legislation (https://www.gov.uk/perform-a-marine-seismic-or-geophysical-survey).

Table B.1.3 sets out the management measures that have been identified by JNCC and the country nature conservation agencies as potentially being required to support the achievement of conservation objectives in specific dSACs (see also Appendix D: Management Scenarios).

Table B.1.3 Potential management measures for aggregate sector

Management Measure	Scenario		
	Lower	Intermediate	Upper
Habitats Regulations Assessment of geophysical surveys within or near site boundaries	✔	✔	✔
Enhanced mitigation measures to reduce or limit impacts of geophysical surveys within site boundaries		✔	✔
Limiting the number and duration of geophysical surveys within or near site boundaries			✔

B.1.6 Assessment Methods

B.1.6.1 HRA of Geophysical Surveys Within Sites

Based on JNCC and country nature conservation agency advice, it is assumed that following designation, HRA could be required for certain geophysical surveys proposed within site boundaries under all scenarios. This could include sub-bottom profiler surveys and possibly multibeam surveys.

JNCC and the country nature conservation agencies have indicated that the primary concern about the impacts of geophysical surveys relates to their contribution to overall levels of underwater noise. It is recognised that it would be onerous for individual operators to prepare HRAs which each take account of potential cumulative underwater noise. It has therefore been suggested that a strategic HRA should be progressed as a joint initiative between regulators, SNCBs and industry covering all the dSACs. This would document the location and nature of planned surveys and make a judgement on the extent to which such survey activity was consistent with achievement of dSAC conservation objectives. (The SNCBs' current view is that the levels of survey activity are compatible with achievement of the site conservation objectives). An indicative cost of preparing the strategic HRA has been suggested to be around £100k, for which it is anticipated that the costs would be shared between the public sector and industry (oil and gas, offshore renewables and aggregates). This might result in a one-off cost to the marine aggregates sector of around £10k. It is assumed that thereafter the strategic HRA would be maintained by the relevant regulators based on information provided by industry.

Assuming that a strategic HRA is in place and that this concludes that current levels of disturbance are not significant, the process for considering project level HRAs for marine aggregate geophysical surveys should be relatively simple and require relatively little effort from operators to provide the information that regulators require. For example, this might entail providing similar or slightly expanded information to that which is required in the MMO's voluntary notification form. For the purposes of this IA it has been assumed, on a conservative basis that all multibeam and sub-bottom profiler surveys will require HRA and that there will be a nominal additional cost to operators of £1k per HRA.

The number of marine aggregate areas (full licence, application or option areas) within site boundaries has been calculated through a spatial analysis using ArcGIS based on data from The Crown Estate (Table B.1.4).

Table B.1.4 Number of licence, application and option areas within dSACs

dSAC	Licence	Application Area	Option Area
Southern North Sea	21	22	11
Bristol Channel Approaches / Dynesfeydd MÃ´r Hafren	1	0	1

The number of potential future geophysical surveys that might occur within site boundaries has been estimated on the following basis:

- Existing licences – it is assumed that multibeam and side scan sonar surveys will be undertaken approximately every 3 years over parts of each licence area. It is assumed from 2017 that monitoring of existing licences relevant to the Southern North Sea dSAC is carried out on a regional basis with surveys covering the Humber, Anglian and Thames marine aggregate regions. It is assumed that one survey is carried out in each region each year from 2017.
- Application Areas – it is assumed that full licences will be obtained in 2017. It is assumed that a pre-dredge sub-bottom profiler, multibeam and side-scan survey will be carried out for each site in that year. Thereafter monitoring of the licences will be incorporated within the regional monitoring programmes for the southern North Sea dSAC area.
- Option Areas – it is assumed that sub-bottom-profiler, multibeam and side-scan sonar surveys will be undertaken in 2016 and that full licences for these areas will be obtained in 2021. It is assumed that a pre-dredge sub-bottom profiler, multibeam and side-scan survey will be carried out for each site in that year. Thereafter monitoring of the licences will be incorporated within the regional monitoring programmes.

This information has been used to estimate the additional costs of preparing HRAs over the time period of the assessment (2015 to 2034).

B.1.6.2 Enhanced Mitigation Measures to Reduce or Limit Impacts of Geophysical Surveys Within Site Boundaries

Based on JNCC and country nature conservation agency advice, it has been assumed that additional mitigation could be required for sub-bottom profiler surveys within site boundaries under the intermediate and upper scenarios. Historically, the marine aggregates industry has not previously been required to apply any specific measures in relation to European Protected Species. The proposed measures have therefore been treated as additional for the purposes of this assessment.

JNCC and the country nature conservation agencies have indicated that the additional measures that might need to be considered include:

- Soft start – (where practicable); and
- Use of Marine Mammal Observers (MMOs), following EPS protocol.

The main cost associated with these additional measures is considered to be the cost of employing MMO's. The cost of complying with the soft start requirements and applying the EPS protocol are considered to be minimal.

The annual additional cost for employing MMO's has been estimated based on the following assumptions:

- Sub-bottom profiler surveys undertaken for each option area identified in Table B.1.4 in 2016 and 2021;
- Sub-bottom profiler surveys undertaken for each application area identified in Table B.1.4 in 2018;
- Number of hours of required sub-bottom profiler survey estimated based on the spatial extent of option and application areas (km²) and assuming sub-bottom profiler surveys carried out at 200m line spacing with a vessel speed of 4 knots (7km/h). Number of hours increased by 50% to take account of steaming time to and from sites; and
- The daily cost for an MMO has been assumed to be £400 (Gardline pers. comm. indicated a daily cost of £300 - £600). It has been assumed that two MMO's would be required to provide 24hr working.

The industry has noted that depending on the survey vessel used to undertake the surveys, it may not have sufficient space to accommodate extra survey staff. Should this prove to be the case, then larger survey vessels would need to be hired, potentially resulting in a doubling of survey costs. It has not been possible to estimate these potential additional costs within the IA.

B.1.6.3 Limiting the Number and Duration of Geophysical Surveys

Based on JNCC and country nature conservation agency advice, it has been assumed that there may be a requirement to limit the number and duration of geophysical surveys within a site under the upper scenario, subject to the provisions of Article 6 of the Habitats Directive. However, such requirements will be site specific and in the absence of detailed information on site activity and thresholds, it is not possible to quantify the potential impacts. The intermediate estimate value has been used in the absence of a cost for the upper scenario.

B.1.7 Limitations

- The number of geophysical surveys required over the assessment period within and around each site has been estimated; and
- The extent to which the number and duration of geophysical surveys might need to be limited is unclear.

B.1.8 References

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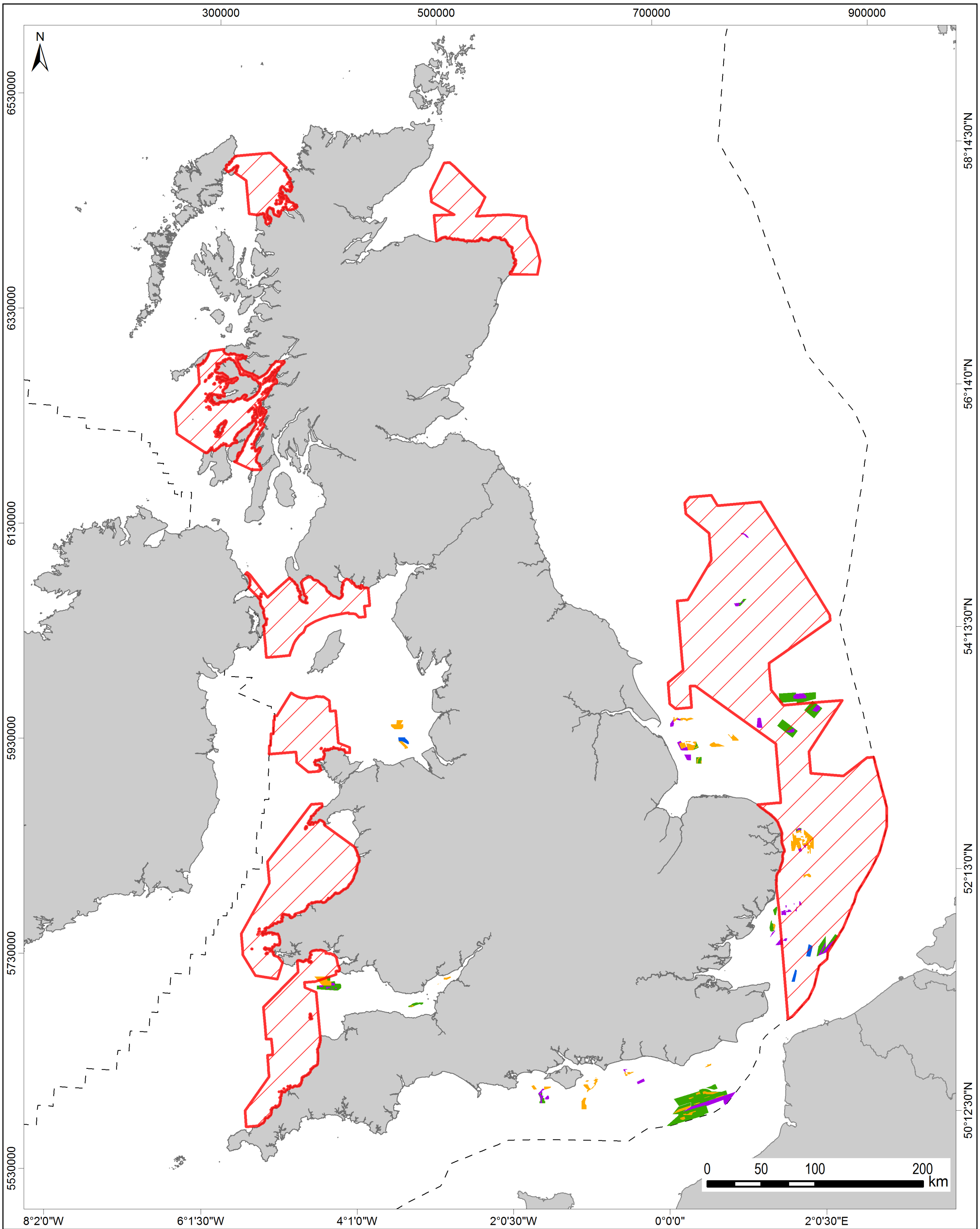

Recommended dSAC

Continental Shelf

Aggregates Application Area

Aggregates Exploration and Option Area

Aggregates Licence Area

Aggregates Option Area

Date	By	Size	Version
Jun 15	DLW	A4	1
Coordinate System		WGS 1984 UTM Zone 30N	
Projection		Transverse Mercator	
Scale		1:5,000,000	
QA		NKD	
4321 - FigB1_Aggregates.mxd			
Produced by ABPmer			

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Aggregates

Figure B1.1

B.2 Aquaculture – Finfish

B.2.1 Introduction

This appendix provides an overview of existing and potential future activity for the finfish aquaculture subsector and outlines the methods used to assess the impacts of potential dSACs on this subsector.

B.2.2 Sector Definition

Finfish aquaculture relates to the production of marine finfish species within aquaculture installations for both food and non-food purposes.

B.2.3 Overview of Existing Activity

A list of sources to inform the writing of this baseline is provided in Table B.2.1.

Table B.2.1 Finfish aquaculture information sources

Scale	Information Available	Date	Source
UK	Aquaculture employment and value (not finfish specific)	2011, 2012	Cefas (2013) and Ellis *et al*. (2015)
UK	Future projections	2015 and 2011	FAO and Baxter *et al*., (2011)
Scotland	Economic value, economic trends and employment	2013	Scottish Salmon Producers Organisation (2013)
Scotland	Finfish aquaculture locations	2014	Scotland's Aquaculture (2014)
Scotland	Scottish Aquaculture production	2012	Marine Scotland Science (2013)
Scotland	Aquaculture statistics, production volumes, general location and targets for 2020	2009 and 2012	Scottish salmon farming
Scotland	Location of aquaculture in Scotland	2014	Scotland's Aquaculture
Scotland	Aquaculture future trends	2009, 2012, 2014, 2015 and 2012	Scottish Salmon Farming, Scottish Government, Cefas
England	Aquaculture in England	2015	Ellis *et al*. (2015)
Northern Ireland	Number of finfish farms, overall tonnage and value	2013	DARDNI (2013) and AECOM & ABPmer (2015)
Northern Ireland	Species cultivated and location of licenced areas	2015	AECOM and ABPmer (2015)
Northern Ireland	Future trends (targets for growth and employment in fisheries and aquaculture combined)	2012	Agri-Food Strategy Board (2013)
Wales	Future (2020) aquaculture production target	2013	Welsh Government and Cefas
England	Future trends/targets	2012 and 2013	English Aquaculture Plan Consultation Group and MMO

B.2.3.1 Location and Intensity of Activity

The main farmed marine finfish species in the UK are Atlantic salmon, sea trout, sea bass, and halibut (Cefas, 2013 and Ellis *et al*., 2015). Other species including wrasse (several species), Dover sole, Atlantic cod, haddock, and whiting are also farmed but to a lesser extent (Marine Scotland Science 2013). The location of marine finfish aquaculture sites are shown in Figure B2.1, however, it should be noted that spatial data was not available for all jurisdictions within the UK. Further information regarding the location of finfish aquaculture sites is provided below where available.

Finfish aquaculture statistics produced by Cefas provide information on the total annual production of finfish from Scotland, Northern Ireland, England and Wales (statistics are not collated for the IOM). The volume of finfish produced in 2013 (the latest available data) for these regions are shown in Table B.2.2. The total number of marine farm sites on which these production volumes were based was not stated.

Table B.2.2 Total volume of finfish produced in seawater systems in 2012 for England, Scotland, Northern Ireland and Wales

Species	Production Volume (Tonnes)			
	England	Scotland	Northern Ireland	Wales
Seabass				247.0
Halibut		73.0		
Atlantic salmon	4	162,220.4	c*	
Sea trout		8.2		
Rainbow trout		2076.0		
c* Confidential information due to limited number of companies.				

(Source: Ellis *et al*. 2013)

These data indicate that Atlantic salmon is the most intensively farmed finfish in seawater systems around the UK. A very large proportion of this production occurs in Scotland; however, there are some smaller activities in England and Northern Ireland (NI) although the amount of fish produced in NI was not published due to commercial sensitivity. Overall Scotland is the largest producer of farmed finfish in the UK and appears to be the only devolved administration to culture sea trout, halibut and rainbow trout in seawater systems. Additionally, wrasse were also farmed to some degree in Scotland in 2012, however the tonnage of fish produced could not be published due to commercial sensitivity. These fish were produced mainly for the salmon farming industry where they act as clearer fish. The only finfish produced in seawater systems in Wales are sea bass, a practice that does not occur anywhere else in the UK.

Scottish finfish aquaculture is dominated by Atlantic salmon farming which produced 163,234 tonnes of fish in 2013. Other species farmed include rainbow trout (5,611 tonnes), brown/sea trout (44 tonnes), halibut (56 tonnes), cod, several wrasse species (Marine Scotland Science, 2013). On a smaller scale Dover sole, haddock, sea bass, turbot and whiting were also farmed in sweater systems in Scotland (Marine Scotland Science, 2013). Marine finfish aquaculture is concentrated on the west coast of the Scottish Mainland, Western Isles, Orkney and Shetland. Sites in these locations are generally positioned in sea lochs, voes and inlets (Scotland's Aquaculture, 2014a). Figure B2.1 shows the location of active and inactive seawater finfish sites and active combined seawater and freshwater finfish sites in Scotland.

In Northern Ireland, Atlantic salmon is the only finfish species to be cultivated in seawater systems. Rainbow trout and brown trout are also farmed in Northern Ireland but this tends to occur inshore in freshwater systems. These trout farms produced 563.2 and 44.4 tonnes of fish respectively in 2012. In total, 32 licensed aquaculture sites exist in Northern Ireland; two of these sites are marine salmon farms located in Glenarm Bay and Red Bay (each licenced to produce 450 tonnes of salmon), the rest comprise of inland sites (DARDNI, 2013; AECOM and ABPmer, 2015). Finfish aquaculture sites in Northern Ireland are highlighted in Figure B2.1.

Several species of finfish are produced in freshwater production systems in England (Arctic char, Atlantic salmon, Nile tilapia, brown trout and rainbow trout). The only finfish to be produced in seawater systems in 2012 was Atlantic salmon; however unlike salmon produced in Scotland and Northern Ireland, the 4 tonnes of fish was produced release into the wild rather than for consumption (Ellis, *et al*., 2012).

Commercial finfish aquaculture in Wales has traditionally focused on the freshwater production of salmonids, including Atlantic salmon (for stocking), rainbow trout and brown trout (for consumption and recreational fishing) (Cefas *et al*. 2014). The production of salmonids in this way is an onshore activity that requires freshwater and hence is not considered further in this baseline. There is a sea bass farm at Beaumaris in the Menai Straits (Cefas *et al*. 2014), although this involves land-based production in seawater tanks.

B.2.3.2 Economic Value and Employment

In Scotland, aquaculture is a key sector underpinning sustainable economic growth and provides high quality and secure employment, particularly in remote rural and coastal communities. In 2012 the industry directly provided 1700 jobs to these areas and an additional 3000 jobs are estimated to have been produced indirectly due to fish processing. Direct regional employment in the Scottish Salmon Industry in 2013 is provided by the Scottish Salmon Producers Organisation (SSPO) (2013):

- Western Isles: 289 (+9%);
- Highland: 676 (-1%); and
- Argyll and Bute: 486 (-1%).

Scottish Atlantic salmon production alone was worth £537 million in 2012 and is Scotland's top food export. Overall the aquaculture industry contributed £560m, at the farm gate, to the Scottish economy in 2012 (see Table B.2.3 for species breakdown) (Marine Scotland Science, 2013).

In 2012, Northern Ireland's finfish aquaculture sector produced over 946 tonnes of finfish valued at £4.12 million. No specific employment figures were available for the finfish sector, however overall the aquaculture sector (finfish and shellfish) directly employs 73 Full Time (FT) and 40 Part Time (PT) employees (DARDNI, 2013).

No economic or employment figures have been provided for England as there was no seawater finfish production (for consumption) in England in 2011 and hence it has been assumed that the data presented in Cefas (2013) represents the economic value and employment associated with freshwater finfish production.

Between 2009 and 2010 the finfish aquaculture industry in Wales employed a total of 57 people, a value that included freshwater aquaculture. No estimates of employment specifically within the marine finfish aquaculture sector within this time period were provided by Cefas (2012). However, more recent figures suggest that, aquaculture provided 28 jobs Wales in 2012 (assuming sea bass were the only species cultivated in seawater systems) (Ellis *et al*. 2013).

Table B.2.3 Value of finfish produced in seawater systems for consumption in 2011 for Scotland, Northern Ireland and Wales

Region	Species	Production Volume (Tonnes)	£ Per Tonne	Imputed Farm Gate Value (£)
Scotland	Atlantic salmon	158,013	3,720	587,808,360
	Halibut	83.1	6,000	498,600
	Sea trout	17.5	2,400	42,000
	Rainbow trout	1,156	2,600	3005600
Northern Ireland	Atlantic salmon	292	3,720	1,086,240
Wales	Sea bass	490	4,500	2,205,000

B.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 % and is set to overtake capture fisheries as a source of food fish (FAO, 2010).

The long term trend for the aquaculture industry is expected to be one of continued growth, despite recent declines in the level of activity in some areas due to the economic downturn. Aquaculture is considered to be a key area for development by UK administrations due to its potential to contribute to the sustainability and security of the UK food supply.

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).

A consultation document 'Planning for sustainable growth in the English Aquaculture Industry' (English Aquaculture Plan Consultation Group, 2012), sets out a vision for sustainable long term growth of the English aquaculture sector and states that the two major drivers for expansion of aquaculture (fish and shellfish) in the UK are food security (i.e. aquaculture will be required to meet the increasing demand as wild capture fisheries plateau) and health benefits (England Aquaculture Plan Consultation Group, 2012). Once fully developed, the English Aquaculture Plan is likely to seek to support significant growth in the finfish aquaculture sector in England, however, the availability of suitable locations and conditions for finfish aquaculture will be the major factor influencing the development of marine based finfish farming in England (MMO, 2013).

In Scotland, the mariculture industry has moved from small operators to being dominated by a few large scale mariculture operators from Norway and Scotland. The expansion of the industry is continuing as with a record level of capital investment (£47.6 million) occurring in 2011 and 86% of companies planning business expansion in the near future (Scottish Salmon Farming, 2012). An estimated undersupply of as much as 190,000 tonnes in 2010 combined with an increasing global demand for salmon suggests good prospects for continued growth in the industry in Scotland (Scottish Salmon Farming, 2009).

In the Scotland's National Marine Plan (2015), the Scottish Government stated its support for the ambitions targets provided by the aquaculture sector to increase total production of all finfish aquaculture to 210,000 tonnes (from 170,000 in 2011) by 2020 (Scottish Government 2015; Cefas, 2013). However, the location, timing and intensity of such development remain uncertain. It is likely that there will be some development further offshore or at more 'exposed' (higher energy) locations (Scottish Government, 2014).

In April 2013, the Northern Ireland Agri-Food Strategy Board published the "Going for Growth Strategy" (Agri-Food Strategy Board, 2013). The Strategy sets challenging targets that reflect the industry's ambition for increased sales, as well as job creation and overall contribution prosperity and contains a number of recommendations aimed at accelerating the growth of fishing and aquaculture. No specific targets are given for finfish aquaculture, however, 'fish and aquaculture' targets for 2020 (which incorporates commercial fishing, processing and ancillary services as well as aquaculture) include growing turnover by 34% to £90million and employment by 9% to 600 FT employees (Agri-Food Strategy Board, 2013).

The Welsh Government's Marine and Fisheries Strategic Action Plan states that it is committed to the sustainable development of aquaculture (marine and freshwater) and aims to double annual finfish aquaculture output from 1000 tonnes to 2000 tonnes by 2020 (Welsh Government, 2013). In order to ensure such growth, the current administrative and licensing procedures must be simplified, supporting innovation and collaboration between industry and academic research centres and developing the co-location of aquaculture with other marine industries.

The initial strategic scoping report for Marine Planning in Wales estimated the growth rate of the aquaculture sector (fish and shellfish) to be 1% annually for the first 5 years, increasing to 2% annually thereafter. The current small scale of the sector means that it will have slow growth initially, however once sufficient growth has occurred and the sector has proven to be sufficiently profitable in the region, the growth rate is expected to rise to 2%. This reflects the assumption that over time the aquaculture sector will become more significant in the Welsh marine plan areas (Cefas *et al*. 2014).

B.2.4 Assumptions on Future Activity

Development of the aquaculture industry is closely linked to changes in wild fisheries, site availability, the environmental carrying capacity and the availability of investment. Hence, the likely future activity within this sector is difficult to predict with accuracy (Cefas *et al*. 2014).

Expansion of the aquaculture sector is likely to be achieved initially through expansion of current farm sites but also in the longer term through development of offshore aquaculture (e.g. MMO, 2013), dependent on the required technological advancements and suitable locations, which currently are not identified.

There are possibilities that in the future offshore wind farms and decommissioned oil and gas rigs, could provide infrastructure for fish and/or shellfish farms, though based on current market knowledge, such installations appear to be uneconomic due to their likely distance from the shoreline (Cefas *et al*. 2014).

B.2.5 Potential Management Measures

Marine finfish aquaculture production is already high regulated to minimise environmental risks and the designation of harbour porpoise dSACs is considered unlikely to require significant changes.

Incorrectly tensioned anti-predator nets to deter seals have the potential to pose an entanglement risk for harbour porpoise. Underwater noise from Acoustic Deterrent Devices (ADDs) also used to deter predation by seals has the potential to disturb and displace harbour porpoise (Coram *et al*. 2014; Lepper *et al*. 2014; Northridge *et al*. 2010).

Table B.2.4 sets out the management measures that have been identified by JNCC and the country nature conservation bodies as potentially being required to support the achievement of conservation objectives in specific dSACs (see also Appendix D: Management Scenarios).

Table B.2.4 Potential management measures for finfish aquaculture sector

Management Measure	Scenario		
	Lower	Intermediate	Upper
Habitats Regulations Assessment of new applications or extensions within or near site boundaries	✔	✔	✔
Review of existing permissions/licences within or near site boundaries	✔	✔	✔
Adoption of good practice measures for net tensioning for installations within site boundaries		✔	✔
Controls on use of ADDs for installations within site boundaries		✔	
Prohibition of ADDs for installations within site boundaries			✔

The methods for estimating the potential cost impacts of the proposed management measures are described below. In addition, it is possible that some of these requirements could result in development project delays and/or act as a deterrent to investment. However, it is difficult to quantify these impacts. The potential for these impacts to occur is discussed in the presentation of the results within the main report.

B.2.6 Assessment Methods

B.2.6.1 HRA of New Applications and Extensions

Based on JNCC and country nature conservation agency advice, it is assumed that following designation, Habitats Regulations Assessments would be required for new applications and extensions for installations within 1km of site boundaries under all scenarios in relation to the harbour porpoise feature.

The number of potential future applications that might occur within 1km of site boundaries has been estimated by SSPO as follows:

- Southern Sea of Hebrides dSAC – 10 over the next five years; and
- North Minch dSAC – 5 over the next five years.

For the purposes of the IA, it is assumed that this level of applications will continue for the duration of the assessment period and that the additional assessments will fall in 2017, 2022, 2027 and 2032.

The additional cost of preparing each HRA has been estimated to be £5,200 at 2015 prices. It is recognised that some of the dSACs overlap with other existing or proposed designated sites and that applications in such areas would already be required to prepare an HRA for the features for which those sites were designated/proposed for designation. This may result in some minor cost saving in preparing an HRA for the harbour porpoise dSAC feature.

This information has been used to estimate the additional costs of preparing HRAs over the time period of the assessment (2015 to 2034).

B.2.6.2 Review of Existing Permissions and Consents

Designation of the sites will trigger a requirement for a review of any existing consents to determine whether the activity is consistent with achievement of each site's conservation objectives. It has been assumed that all consents within 1km of site boundaries will require review.

The number of licensed finfish aquaculture installations located within 1km of site boundaries has been calculated based on Marine Scotland's Aquadat database and from Northern Ireland data as follows:

- Southern Sea of Hebrides dSAC – 35 licensed sites; and
- North Minch dSAC – 10 licensed sites

The costs associated with reviewing existing consents would fall on the relevant licensing authorities and SNCBs and are reported under public sector costs.

As a result of the review of consents, finfish aquaculture installation operators may experience additional costs associated with implementing mitigation measures including:

- Improvements to anti-predator net tensioning for existing installations (see section 2.6.3 below);
- Controls on the use of ADDs within site boundaries (intermediate scenario) (see section 2.6.4 below); and
- Prohibition on the use of ADDs within site boundaries (upper scenario) (see section 2.6.5).

B.2.6.3 Adoption of Good Practice Measures for Net Tensioning

Based on JNCC and country conservation agency advice, it has been assumed that under the intermediate and upper scenarios, all marine finfish aquaculture installations will need to implement good practice measures for anti-predator net tensioning.

For new installations and extensions, SSPO has indicated that adoption of good practice would not entail and significant additional costs.

For existing installations, SSPO has indicated that additional costs could be incurred in replacing existing nets and tensioning systems. SSPO estimates that less than 10% of finfish aquaculture sites currently use anti-predator nets and the great majority of these (95%+) already use appropriate tensioning.

It is estimated that there are approximately 20 operational finfish aquaculture sites in Southern Sea of Hebrides dSAC and 4 within North Minch dSAC based on the Aquadat database. This would indicate that possibly only around 2 finfish aquaculture sites within the Southern Sea of Hebrides dSAC might be using anti-predator nets and less than one in the North Minch dSAC. Assuming 95% of these were already following best practice measures for tensioning of anti-predator nets, it is unlikely that any of the sites would require improvement measures. For the purposes of the IA it has been assumed that the cost is £0.

B.2.6.4 Controls on the Use of ADDs Within Site Boundaries

Based on JNCC and country conservation agency advice, it has been assumed that under the intermediate scenario finfish aquaculture installation operators may need to modify their use of ADDs for installations within site boundaries. This might include:

- Seasonal controls on the use of ADDs;
- Using ADDs only at certain stages of salmon development; and
- Using ADDs that reduce disturbance to harbour porpoise.

The costs of implementing seasonal controls or limiting use of ADDs to certain stages of salmon development would be site specific and dependent on the precise nature and duration of such controls. It has therefore not been possible to quantify these potential cost impacts.

The cost of replacing existing ADDs with harbour porpoise friendly ADDs has been estimated based on the proportion of aquaculture sites within dSACs likely to be using ADDs and the costs of replacing existing ADDs with harbour porpoise friendly ADDs. SSPO indicates that the cost of installing existing ADDs is around £108k per site (SSPO pers. comm, assuming a typical arrangement of around 12 circular cages).

SSPO has indicated that approximately 95% of existing finfish aquaculture sites within the Southern Sea of Hebrides and North Minch dSACs currently use ADDs (SSPO, pers. comm). This roughly equates to around 19 sites in Southern Sea of Hebrides dSAC and 4 sites in North Minch dSAC. SSPO indicated that harbour porpoise friendly ADDs are not currently commercially available but are likely to become so in the next 1 – 2 years. There is some current uncertainty surrounding the possible costs of harbour porpoise friendly ADDs because there is currently only one potential supplier. SSPO estimate that the additional cost of installing harbour porpoise friendly ADDs may be around 20% more than for existing ADDs, but this estimate is uncertain (SSPO, pers. comm.). The costs of changing to harbour porpoise friendly ADDs will also depend on whether the transition can be aligned with business investment cycles. SSPO estimate that ADDs require replacement every 6 years. If the transition to harbour porpoise friendly ADDs can be made over this time period, the costs to the industry would be lower.

For the purpose of this IA, it has been assumed that the transition to harbour porpoise friendly ADDs is linked to industry investment cycles and that existing ADDs are only replaced at the end of their operating life. It has been further assumed that a competitive market for the supply of harbour porpoise friendly ADDs emerges and that there is only a limited (20% cost differential) compared to existing ADDs.

For each dSAC, the costs of transitioning to harbour porpoise ADDs has been based on the estimated number of installations using ADDs within each dSAC (the proportion of finfish aquaculture sites using ADDs x number of sites) and assuming that one-sixth of the sites replace their ADDs each year, starting in 2017.

B.2.6.5 Prohibition on the Use of ADDs Within Site Boundaries

Based on JNCC and country conservation agency advice, it has been assumed that under the upper scenario the use of ADDs may be prohibited for finfish aquaculture installation operators located within site boundaries, subject to the provisions of Article 6 of the Habitats Directive. The cost impacts that might arise as a result of this measure could include:

- Cost of installing and maintaining anti-predator nets; and
- Cost of increased predation and/or escapes.

The cost of installing anti-predator nets has been estimated based on the number of finfish aquaculture sites within each dSAC estimated to currently be using ADDs (see section B.2.6.4 above) and the cost per site for providing anti-predator nets. SSPO estimate that the cost of purchasing and installing an anti-predator net at a typical finfish aquaculture site (assuming a typical arrangement of around 12 x 90m circumference circular cages) is approximately £45k. The cost of maintaining anti-predator nets has been assumed to be negligible. It has been assumed that all finfish aquaculture sites currently using ADDs are required to replace them with anti-predator nets in 2016 and that the nets require replacement every 6 years thereafter (i.e. replacement in 2022, 2028 and 2034).

It has not been possible to quantify the costs associated with increased predation and escapes. SSPO has indicated that there is evidence that seal activity around finfish aquaculture installations can lead to increased background mortality and reduced growth rates of finfish due to stress. If the main finfish cages are compromised, this can lead to the loss of the whole stock within a cage. An increase in the number of escapes may pose risks to wild salmon through genetic dilution and/or disease/parasite transfer.

B.2.7 Limitations

- Uncertainty concerning the level and location of future planning applications;
- Uncertainty concerning the timing of any transition to harbour porpoise friendly ADDs and linkages to industry investment cycles; and
- Costs of harbour porpoise friendly ADDs is currently uncertain.

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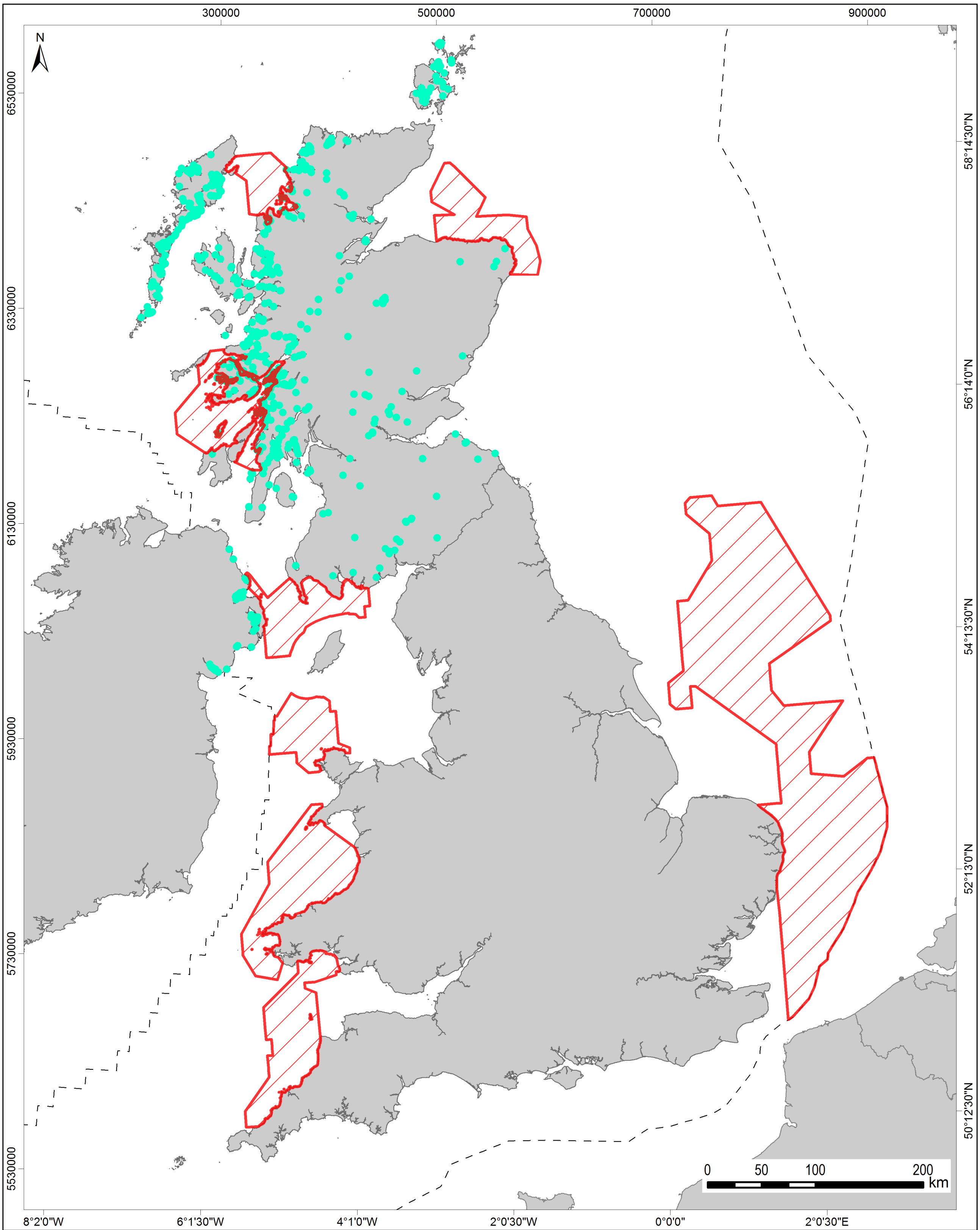


Recommended dSAC

Continental Shelf

Existing Finfish Installations

Date	By	Size	Version
Jun 15	DLW	A4	1
Coordinate System	WGS 1984 UTM Zone 30N		
Projection	Transverse Mercator		
Scale	1:5,000,000		
QA	NKD		
4321 - FigB2_Aquaculture.mxd			
Produced by ABPmer			

Data Source: Aquadat Marine Scotland, 2015; DARD, 2015.
NOT TO BE USED FOR NAVIGATION

ABP mer marine environmental research

Finfish Aquaculture

Figure B2.1

B.3 Commercial Fisheries

B.3.1 Introduction

This section provides an overview of existing and potential future activity for the commercial fisheries sector in UK waters. It outlines the methods used to assess the impacts of potential harbour porpoise SACs on this sector.

B.3.2 Sector Definition

For the purpose of this study, commercial fisheries relates to all commercial fishing activity within UK waters and includes the subsequent handling and processing of catches. It includes wild salmon and sea trout fisheries.

B.3.3 Overview of Existing Activity

Information sources used in the assessment are listed in Table B.3.1.

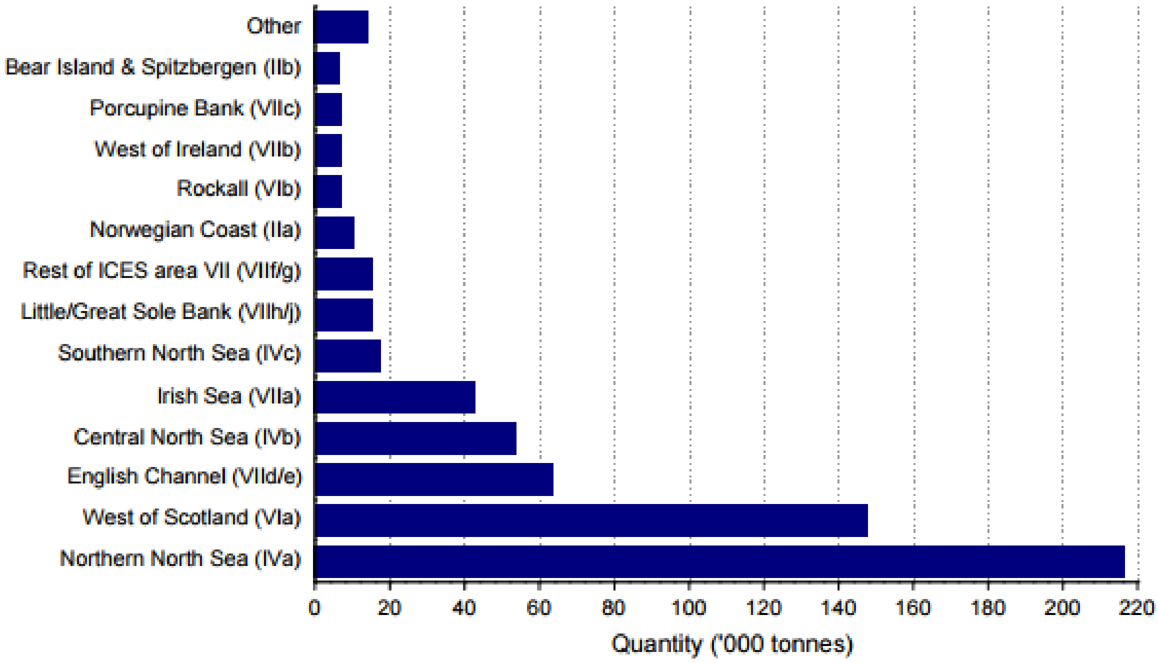
Table B.3.1 Commercial fisheries information sources

Scale	Information Available	Date	Source
UK	ICES rectangle landings data for UK >10m and <10m vessels	2009-13	MMO
UK	VMS data for non-UK vessels in UK waters (1/200th ICES rectangle), number of vessels by gear type	2007-2010	MMO
UK	UK fishing vessel numbers by fishing port and length	2013	MMO / EA Geostore
UK	UK Fleet Register – number of vessels and size, by port	2015	MMO
UK	EU Community Fleet Register – details of EU vessels including declared primary and secondary gear type	2015	European Commission
UK	Surveillance sightings data, all vessels including nationality, vessel length and gear type	2011–2013	MMO
UK Fleet	Economic performance of fleet segments	2009–2013	Seafish
UK	Survey of UK Seafood Processing Industry	2015	Seafish

B.3.3.1 Location and Intensity of Activity

The majority of commercial fisheries landings by volume derive from the Northern North Sea (ICES Area IVa), followed by West of Scotland (Area VIa). The English Channel (Area VIId/e), Central North Sea (Area IVb) and Irish Sea (VIIa) each contributed between 6–10% of total UK landings, with less than 3% from the Southern North Sea (Area IVc) (Image B.3.1).

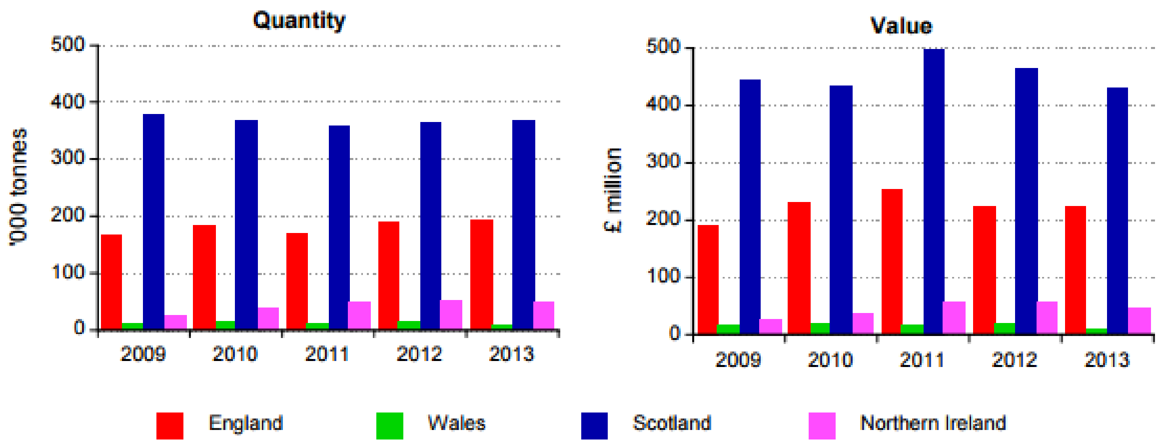
Figure B.3.1 shows the value of landings by gear type for UK vessels from each site, using the proportional ICES rectangle technique (see section B.3.7.2).



(Source: MMO, 2014)

Image B.3.1 Catch by sea area, UK vessels (2013)

Scottish vessels account for the majority of landings by the UK fleet, with 59% by volume and 60% by value (Image B.3.2). English vessels accounted for 31%, with Northern Irish vessels accounting for 8% and the Welsh fleets 1%.

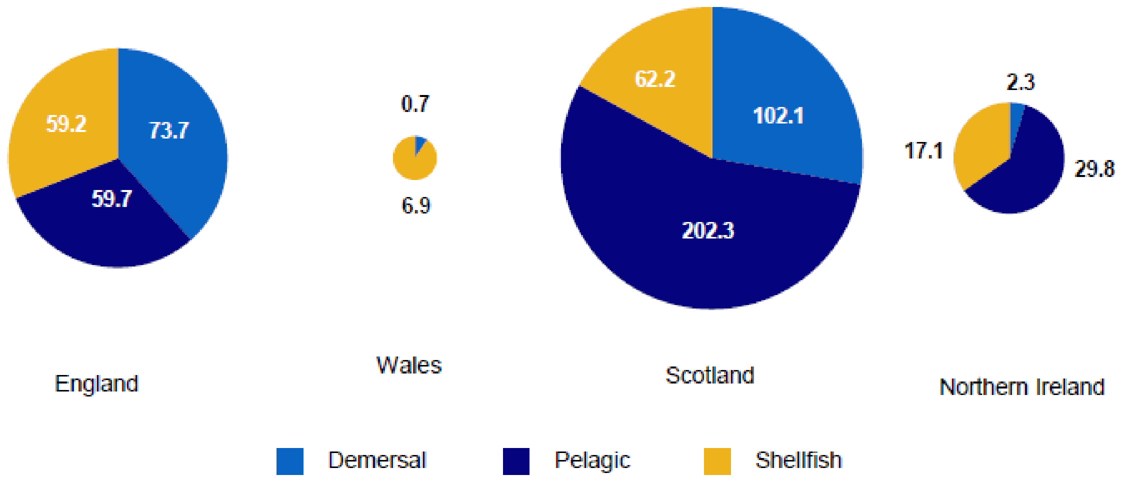


(Source: MMO, 2014)

Image B.3.2 Quantity and value of landings into the UK and abroad by UK vessels by vessel nationality: 2009 to 2013

Of the fish caught by UK vessels, 65% by volume and 76% by value were landed into the UK, with the remainder being landed directly into overseas ports. The largest amount, 262,000 tonnes, was landed into Scotland with a value of £344 million. Landings into England were 101,000 tonnes with a value of £157 million.

Image B.3.3 shows the breakdown of each country's landings by species type. English vessels' landings are made up predominantly of demersal species (e.g. haddock, cod, whiting, plaice, sole), with equal quantities of pelagic (sardines, horse mackerel) and shellfish species (scallops, nephrops, crabs, lobsters, whelks). Welsh vessels land mainly shellfish species, with a small amount of demersals. Scottish vessels land predominantly pelagic species (55% by volume, mainly mackerel and herring), with 28% demersals (haddock, saithe, cod, whiting) and the remainder shellfish (scallops, nephrops, crabs). The Northern Irish fleet *also* lands predominantly pelagic species (herring and mackerel), followed by shellfish (nephrops, scallops), with only a small amount of demersal fish.



(Source: MMO, 2014)

Image B.3.3 Landings into the UK and abroad by vessel nationality and species group: 2013 ('000 tonnes)

Over-12m fishing vessels using set nets are required to use pingers to avoid cetacean bycatch under Regulation EC No 812/2004, which requires the mandatory use of acoustic deterrent devices ('pingers') in certain fisheries. In ICES areas VII d to h and j, the Regulation applies to all EU vessels 12 metres or over, using bottom set gill or entangling nets. In Area IV, it applies to all EU vessels 12 metres or over using bottom set gill or entangling nets with a mesh size of 220 mm or more, and those using nets of 400 metres in length or less (of any mesh size) (the latter for the period 1 August to 31 October).

Non-UK vessels also fish in UK waters, having access under the Common Fisheries Policy to waters beyond 12nm. Specific EU Member States also have access to defined areas within 6–12nm, based on historical access. Figure B.3.2 shows fishing areas for non-UK vessels for 2007–2010, based on VMS data. These data show that Dutch and Belgian vessels fish in the North Sea and English Channel, predominantly with demersal trawl and seine gear, with the Dutch vessels also using some pelagic gear and in the English Channel dredges; Belgian vessels also fish in the Celtic and Irish Seas using demersal trawl and seine gear; German and Danish vessels also fish in the North Sea, using mainly demersal trawl and seine gear, and some pelagic, with Danish vessels operating further north and also with some vessels using nets; Irish vessels fish in the Irish Sea, Celtic Sea and West of Scotland, predominantly with pelagic gear, nets and demersal trawl and seine, and also dredges in the Irish Sea; French vessels fish in the English Channel, Celtic Sea and West of Scotland with a range of gears (demersal trawl and seine, pelagic gears, some nets and traps, and dredges in the Channel); and Spanish vessels fish to the West of Scotland, predominantly with lines and demersal trawls and seines. There are also small amounts of effort by Norwegian, Swedish and Faroese vessels.

Salmon and sea trout: Wild salmon *Salmo salar* and sea trout *Salmo trutta* 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.

Management measures may be considered for fixed engine fisheries within proposed dSACs, to avoid by-catch of harbour porpoise in the nets, and to reduce the potential interactions with acoustic deterrent devices for seals, which are used by the fixed engines.

The maximum reported median monthly netting effort, and catches, from fixed engines within each district, are shown in Table B.3.2 for 2013 and 2014. Reported catch in the fixed engine fishery was 13,343 wild salmon and grisle, and 3,728 sea trout, in 2014. Catch and effort have declined over much of the period covered by records (since 1952), and remain at historically low levels. The reported catch was 5% of the maximum reported catch in the time series. Fishing effort in 2014 was 203.5 trap months, the fifth lowest since records began in 1952. The catch statistics from 2014 show a general decline in effort and catches across most districts, with some increases in the north. 2014 also saw the discontinuation of use of station(s) in Snizort, Shiel and Fleet (Kirkcudbright) districts. Sunart district reported catches in 2014 but not in 2013.

Table B.3.2 Effort and catch from fixed engines by district, 2013

District	Region	Max Monthly Median Netting Effort*, 2013	Max Monthly Median Netting Effort*, 2014	Total Catch (kg), 2013	Total Catch (kg), 2014
Tweed	East	4	2.0	3,644	567
South Esk	North East	20	19.5	21,548	17,477
North Esk	North East	5	3.5	1,204	997
Ythan	North East	1	1.0	777	557
Ugie	North East	2	1.0	127	17
Deveron	Moray Firth	8	8.5	7,408	5,386
Conon	Moray Firth	4	3.0	607	464
Kyle of Sutherland	North	1	2.0	217	238
Thurso	North	6	8.5	3,081	4,130
Halladale	North	1	1.0	563	299
Strathy	North	5.5	6.0	7,236	7,833

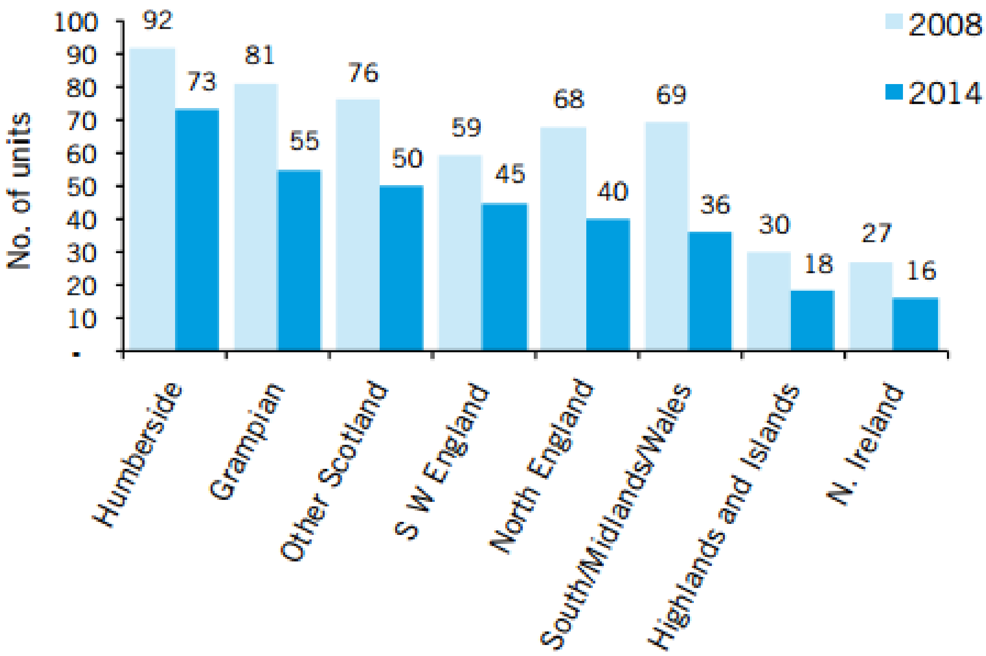
District	Region	Max Monthly Median Netting Effort*, 2013	Max Monthly Median Netting Effort*, 2014	Total Catch (kg), 2013	Total Catch (kg), 2014
Sligachan	North West	1	1.0	85	30
Snizort	North West	1	-	12	-
Shiel	North West	0.5	-	125	-
Sunart	West Coast	-	0.5	-	269
Lochy	West Coast	1	1.0	402	547
Fleet (Kirkcudbright)	Solway	1	-	29	-
Urr	Solway	3.5	3.0	310	96
Nith	Solway	44.5	56.0	1,680	1,097
Annan	Solway	58	74.5	4,461	3,504
	Total	168	192	53,515	43,507

* Netting effort is given as the median number of nets operated in a given district in any one month

(Source: Marine Scotland, 2014; Marine Scotland, 2015)

The latest Seafood Processing Industry Report (Seafish, 2105) presents an overview and analysis of the seafood processing industry. In 2014, there were 403 fish processing units in the UK providing a total of 19,511 full-time equivalent (FTE) jobs. 333 of these processing units were for sea fish, providing a total of 14,305 FTE jobs.

The processing industry is mainly concentrated in the Humberside and Grampian regions, which together accounted for 38% of sea fish processing units and 52% of FTEs in 2014 (Image B.3.4). The processing units tend to be larger than average in these regions. Some regions, such as Highlands and Islands, may not account for a large proportion of UK processing capacity, but in these remote regions, the contribution of the processing industry to local employment can be substantial.

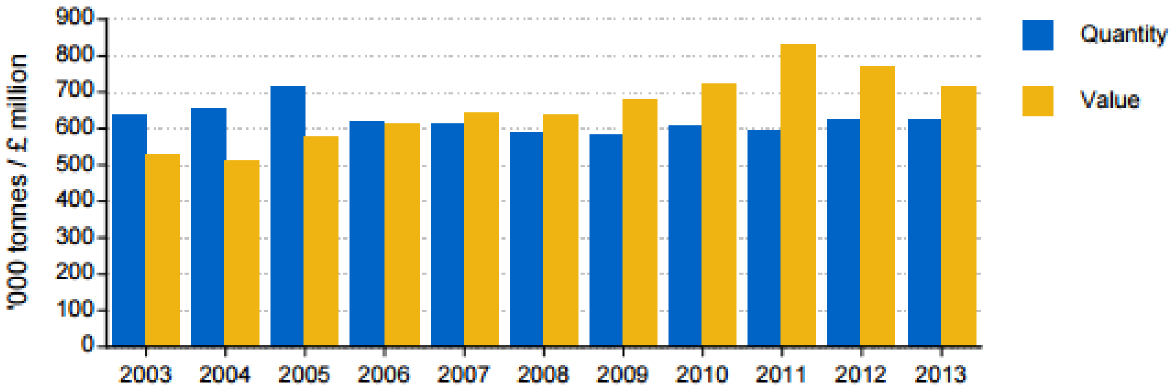


(Source: SeaFish, 2015)

Image B.3.4 Number of sea fish processing units by region, 2008 and 2014

B.3.3.2 Economic Value and Employment

In 2013, UK vessels landed 624,000 tonnes of fish and shellfish into the UK and abroad, with a value of £718 million. The quantity of fish and shellfish landed has remained relatively stable since 2005, with the value steadily rising from 2004 to a peak in 2011, and subsequently declining to 2010 levels in 2013 (Image B.3.5). The gross value added (GVA) for fishing has fluctuated in recent years. GVA for fishing was £476 million in 2013, an increase of 29% in ten years (MMO, 2014).



(Source: MMO, 2014)

Image B.3.5 Quantity and value of landings by UK vessels into the UK and abroad: 2003 to 2013

Demersal species made up 38% of the landings by value in 2013, with 37% of landings value from shellfish and 27% from pelagic species. The contribution of demersal species to value has declined since 2003 (when they made up 42% of the value).

The UK fleet has declined from 8,667 vessels in 2003 to 6,399 vessels in 2013. The decline in fleet numbers has been in part the result of several decommissioning schemes which aimed to remove excess fleet capacity in the face of overexploited stocks and falling quotas.

The largest number of vessels are registered in England (49% of vessels by number), with 32% in Scotland. The English fleet is made up of a high proportion of under-10m vessels, whereas the Scottish fleet includes larger and more powerful vessels, such that the majority of the fleet by tonnage and power is based in Scotland. Parts of the Scottish fleet are engaged in fisheries that are low value but high volume, such as herring and mackerel, and therefore have moved towards having higher capacity vessels, which, for economic viability, cover large sea areas and can catch several hundred tonnes of fish per trip. Wales and Northern Ireland's fleets represent 6% and 5% of UK vessels by number, respectively, and 4% and 8% by power. The English under-10m fleet operates close inshore and specialises in low volume high value species including lobster, sole, cod and bass. The under-10m vessels often operate a range of different gear types, including pots, lines, nets and sometimes trawls, to target locally-available stocks seasonally.

The number of fishermen on UK-registered vessels has decreased by 7% since 2003 from 13,122 to 12,152 in 2013. Of these, around 5,600 were based in England, 730 in Wales, 5,000 in Scotland and 810 in Northern Ireland. Part-time fishermen accounted for 15% of the total, down 7 percentage points over the last ten years (MMO, 2014). This reflects an increase in the number of regular fishermen and a decrease in the number of part-time fishermen. The decrease in overall numbers of fishermen may be associated with reductions in fleet size as well as decreased fishing opportunities, while the increase in the number of regular fishermen and decrease in the number of part-time fishermen suggests a change in working patterns within the industry.

Total sea fish processing annual industry turnover was an estimated £4.2 billion in 2012, a 16% increase since 2008 in nominal terms. The Gross Value Added (GVA) of the sea fish processing industry was an estimated £766 million in 2012, a nominal increase of 2% from 2008 to 2012 (Seafish, 2015).

The SeaFish (2015) report highlighted the supply of raw materials, regulatory and trade developments such as exchange rate movements, skill shortages, securing finance and retailer pressure on suppliers as creating problems for many businesses in the seafood processing industry.

Average processing unit size (average number of FTE jobs per unit) increased by 33% from 2008 to 2012, driven by the slower pace of contraction in employment relative to the decline in the number of units over the period. Average unit size remained stable between 2012 and 2014 at 43 FTEs. The data suggest that industry concentration continued into 2014, albeit at a slower rate than previous years (SeaFish, 2015).

B.3.3.3 Future Trends

Across the North Sea and European North-East Atlantic waters, fishing pressure on stocks has been reduced significantly in the past decade, with a number of stocks starting to return to more sustainable levels. The number of overfished stocks (where the fishing mortality is higher than that which will provide Maximum Sustainable Yield) has declined from 94% of assessed stocks in 2005 to 39% of assessed stocks in 2013. The number of assessed stocks has increased over the period, from 68 to 82 (COM(2013) 319 final).

The fisheries sector is currently, and is likely to remain, important to many coastal areas in the UK. 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 implementation of the 2013 CFP reform, including the landings obligation.

CFP reform, including the implementation of the landings obligation, may affect the distribution of fishing activity and the value of fish landings in the future. The annual Total Allowable Catches, determined by area, and the drive to meet the target to achieve an exploitation rate consistent with Maximum Sustainable Yield (F_{MSY}) by 2015 where possible and by 2020 at the latest, together with the development of Multiannual Plans, will also affect the distribution of effort and catches.

Between 2012 and 2014 the number of seafood processors declined by 3% and the number of FTE jobs declined by 4%. This continues the decline seen in previous years in the number of processing units, from 573 in 2004 to 403 units in 2014. However, the number of FTEs in the industry has increased overall, from 18,810 FTEs in 2004 to 19,511 FTEs in 2014, reflecting the larger size of individual processing units required to achieve economies of scale. The growing demand for seafood and signs of economic recovery underpin the UK sea fish processing industry confidence in the long-term sustainability and profitability of seafood processing in the UK (SeaFish, 2015).

B.3.4 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. Prices, which may vary according to supply of fish from EU waters (but are also influenced by global demand and supply factors), will affect the value of landings, but are also difficult to predict. 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 (Defra, 2012) and the impact assessments for Nature Conservation MPAs and dSACs in Scottish waters.

B.3.5 Potential Interactions with dSAC Features

The principal impact to harbour porpoise from commercial fishing activities include:

- By-catch in set nets;
- Reduction in prey resources (mobile bottom gears and pelagic gears);
- Acoustic disturbance from ADDs on fixed engine salmon nets.

B.3.6 Potential Management Measures

Table B.3.3 sets out the management measures that have been identified by JNCC and the country nature conservation bodies as potentially being required to support the achievement of conservation objectives in specific dSACs, and that are assessed in this impact assessment.

Table B.3.3 Potential management measures for the commercial fisheries sector

Management Measure	Scenario		
	Lower	Intermediate	Upper
Bycatch mitigation measures for harbour porpoise (pingers) on all vessels using static nets within dSACs (applies to vessels under-12m, as over-12m vessels are already required to use them) (non-GVA cost impact).		✓	
Closure of static net fisheries within dSACs (GVA impact).			✓
Mitigation measures on fixed engines within site to reduce harbour porpoise bycatch, as appropriate; seasonal or annual (non-quantified impact).		✓	✓
10% reduction in mobile bottom gear effort across the site (likely to be focussed seasonally) (GVA impact).			✓
10% reduction in pelagic gear effort across the site (likely to be focussed seasonally) (GVA impact).			✓

Prohibition of the use of seal ADDs on fixed engine salmon nets within dSAC boundaries was considered as a management measure for the upper scenario, but research underway and future net developments are expected to resolve any potential impacts on harbour porpoise and therefore no measures have been costed.

Under the upper scenario, as a worst case, it has been assumed that some reduction in fishing effort could be required within the dSACs to support achievement of site conservation objectives. For the purposes of the assessment, this has been expressed as a 10% overall reduction in fishing effort. However, should such measures prove necessary, it is likely that they would be targeted towards specific locations and activities rather than a general blanket reduction in fishing effort. It is recognised that the upper scenario is considered very unlikely to occur.

The potential management measures assessed for each site under lower, intermediate and upper scenarios are detailed in Appendix G.

B.3.7 Assessment Methods

B.3.7.1 Cost of Pingers

The cost of installing pingers on set nets was assessed based on an estimation of the number of under-12m vessels operating with nets in each site (as over-12m vessels are already required to use pingers under European legislation), the average length of nets used (since pingers need to be spaced at intervals throughout the net), and the unit cost of pingers.

The number of under-12m vessels likely to be operating in each site was estimated by identifying fishing ports within 20km of each dSAC's boundary, using the MMO UK Fishing Vessels by Home Port (2013) layer. The under-12m vessels with those ports identified as 'home port' in the UK Fleet Register were identified. These were matched with records in the EU Community Fleet Register (CFR), using the Registration of Shipping and Seamen number, to identify those vessels that operate drift gillnets, set gillnets or trammel nets as either their primary or secondary gear, as identified in the CFR. These estimates were then revised based on feedback from the IFCAs, Welsh Government and Scottish Government, as appropriate.

The cost of pingers was based on information provided by the North-East IFCA (Table B.3.4). The cost used for the impact assessment was the FishTek Banana pinger. It was assumed that batteries are replaced each year, and a pinger has a five-year lifespan.

Table B.3.4 Acoustic cetacean deterrent cost comparison

Unit Name	Manufacturer	Unit Cost	Maximum Spacing*	Unit Cost /100m of Net	Battery Replacement Cost	External LED	5 Year Cost /100m of Net
Banana pinger	Fishtek	£35	200m	£35	£2.12	Y	£43.48
F10 Porpoise pinger	Future Oceans	£59.8**	100m	£119.6	£6.2***	Y	£169.2
Gillnet pinger	Airmar EMS	£41.5**	100m	£83	£2.12	N	£99.96

* Implementation of Council Regulation (EC) 812/2004 to reduce by-catch of cetaceans information pack. Updated 28 August 2013. MMO.
** Currency conversion 1 EUR = 0.83 GBP
*** Currency conversion 1 USD = 0.62 GBP. Manufacturer's batteries must be used to maintain warranty.

Average length of nets was assumed to be 550m unless site-specific consultations indicated otherwise. The length of nets indicated by IFCAs ranged from 50m to tens of thousands of metres, therefore deriving an average value was problematic. Better information on length of nets used by under-12m vessels in each region would improve these estimates, which should be revisited before this management measure is taken forward. Further consideration should be given to the potential impact on harbour porpoise of large numbers of nets deploying pingers, which may result in the exclusion of harbour porpoise from important feeding and mating areas, together with the feasibility of implementation and enforcement of such a measure. The estimate of the cost of installing pingers on all under-12m netters for each site is provided in Table B.3.5.

Table B.3.5 Cost of pingers by site

Site	Estimate of Number of <12m Vessels	Average Length of Nets Used for Calculation (m)	Total Cost Over 20 Years (£ '000)	Average Annual Cost (£ '000)	Present Value of Total Cost (£ '000)
Southern North Sea	156	1000 for Lincolnshire; 700 for Norfolk; 2000 for Suffolk, 550 for other areas	317.4	15.9	250
Outer Moray Firth	0	-	-	-	-
North Minch	7	550	7.3	0.4	6
Southern Sea Of Hebrides	0	-	-	-	-
North Channel And Outer Solway	1	550	1.0	0.1	1

Site	Estimate of Number of <12m Vessels	Average Length of Nets Used for Calculation (m)	Total Cost Over 20 Years (£ '000)	Average Annual Cost (£ '000)	Present Value of Total Cost (£ '000)
North Anglesey Marine / Gogledd MÃ´n Forol	37	550	38.6	1.9	30
Bristol Channel Approaches / Dynesfeydd MÃ´r Hafren	178	550 (3000 for Cornish vessels)	690.8	34.5	544
West Wales Marine / Gorllewin Cymru Forol	36	550	37.6	1.9	30
		Total	1092.7	54.6	861

B.3.7.2 Loss of the Value of Landings

Where required, it is assumed that the following costs may be incurred:

- Closure of dSAC areas to set net fisheries.
- Reduction in mobile bottom gear effort.
- Reduction in mobile pelagic gear effort.

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 and vessel size). Where the management measure is a restriction of effort (e.g. 10%), this is applied pro-rata to the value of landings from the area where the restriction is applied, assuming constant catch-per-unit-effort.

This was assessed quantitatively:

- For UK vessels: Value of landings from the area to be closed was calculated for affected gear types, based on annual average landings value from ICES rectangle landings data for the years 2009 to 2013. The value of landings from the ICES rectangles that overlap the dSAC site were pro-rated according to the proportion of the ICES rectangle overlapping the site (having first accounted for overlaps with land). These data have been used as they are the official landings data and represent the whole UK fleet of all vessel sizes, and VMS ping data for over-15m vessels were not made available within the timeframe required to carry out the assessment. The ICES rectangle data do not include information on home port, administrative port or port of landing, therefore it was not possible to attribute employment impacts (based on home ports of vessels) geographically, although assumptions can be made for smaller vessels which have a more limited operating range. It was also not possible to attribute potential impacts on the processing sector (based on where catches are landed). The total annual landings values for each gear type were uprated to 2015 values using GDP deflators and averaged over five years for the final 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. Information from VMS pings from non-UK vessels from MMO was used, that indicated the total number of vessels by nationality and gear type fishing in a 1/200th ICES rectangle for the period 2007–2010. The potential number of non-UK vessels that may be affected by management measures in each site, was estimated from the maximum recorded in an ICES sub-rectangle for a particular gear type over the period. This may

underestimate the number of vessels affected, particularly in larger sites such as Southern North Sea, as there was no way of identifying whether vessels recorded in each sub-rectangle for each gear type are the same vessel or different vessels.

It was assumed that management measures are implemented in year 1 (no costs in year 0), and the value of landings affected is the same in each subsequent year.

Estimating the impact of lost landings on Gross Value Added (GVA) and employment

The loss of landings that results from a loss of set net fishing grounds reduces the output of the sector. Any decrease in output will, all else being equal, reduce the Gross Value Added (GVA) generated by the sector (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) (the **indirect** effect).

Estimating the potential impact of a decrease in output (i.e. lost landings) on the commercial fisheries sector and its upstream supply chain, has therefore involved assessing the:

- Direct impact on GVA — the reduced contribution of the commercial fisheries sector to the UK economy in terms of GVA;
- Indirect impact on GVA — the knock-on effects on upstream suppliers of the sector in terms of GVA; and
- Direct and indirect effect on employment — the resulting reduction in employment in the commercial fisheries sector and its upstream supply chain.

Estimating the direct impact on GVA

Where relevant, the impact of the loss of landings has been converted to loss of GVA for the catching sector 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, 2014). The average GVA ratios by gear type are presented in Table B.3.6 below.

The Seafish dataset contains financial, economic and operational performance indicators for approximately 30 UK fleet segments for the period 2005–2013 and provides total income and GVA estimates that are specific to individual fleet segments and gear types. The figures presented in Table B.3.6 below are mean values of GVA/total income for each gear type, over the period 2009–2013. This period is consistent with that used for the landings data.

Table B.3.6 GVA as a percentage of total income, by area, fleet segment and gear type, 2009–2013

Gear Type	GVA as a Percentage of Total Income (Mean, 2009–2013)		Seafish Fleet Segments on Which Based	
	Under-10m	Over-10m	Under-10m	Over-10m
All areas				
Dredge	49%	49%	UK scallop dredge under 15m	UK scallop dredge over 15m
Drift and fixed nets	59%	46%	UK drift and fixed nets under 10m	UK Gill netters over 10m
Gears using hooks	50%	36%	UK hooks under 10m	UK Longliners over 10m
Pelagic seine	51%	51%	Over-40m Pelagic trawls	Over-40m Pelagic trawls
Pots and traps	50%	47%	UK pots and traps under 10m	Average of UK pots and traps 10m-12m and UK Pots and traps over 12m
Area IV (North Sea)				
Beam trawl	9%	12%	North Sea beam trawl under 300kW	Average of North Sea beam trawl over 300kW and North Sea beam trawl under 300kW
Demersal trawl/seine	46%	36%	UK demersal trawls and seines under 10m	Average of North Sea nephrops trawl over 300kW, North Sea nephrops trawl under 300kW, North Sea and West of Scotland demersal trawl over 24m, North Sea and West of Scotland demersal pair trawls and seines, North Sea and West of Scotland demersal seiners, North Sea and West of Scotland demersal trawl under 24m, over 300kW, North Sea and West of Scotland demersal trawl under 24m, under 300kW
Other mobile gears	46%	32%	UK demersal trawls and seines under 10m	Average of North Sea beam trawl over 300kW, North Sea beam trawl under 300kW, North Sea nephrops trawl over 300kW, North Sea nephrops trawl under 300kW, North Sea and West of Scotland demersal trawl over 24m, North Sea and West of Scotland demersal pair trawls and seines, North Sea and West of Scotland demersal seiners, North Sea and West of Scotland demersal trawl under 24m, over 300kW, North Sea and West of Scotland demersal trawl under 24m, under 300kW, UK scallop dredge over 15m
Area VIa (West of Scotland)				
Beam trawl	22%	23%	Average of North Sea beam trawl under 300kW and South West beam trawl under 250kW	Average of North Sea beam trawl over 300kW, North Sea beam trawl under 300kW, South West beam trawl under 250kW , South West beam trawl over 250kW
Demersal trawl/seine	46%	37%	UK demersal trawls and seines under 10m	Average of North Sea and West of Scotland demersal trawl over 24m, North Sea and West of Scotland demersal pair trawls and seines, North Sea and West of Scotland demersal seiners, North Sea and West of Scotland demersal trawl under 24m, over 300kW, North Sea and West of Scotland demersal trawl under 24m, under 300kW, West of Scotland nephrops trawl over 250kW, West of Scotland nephrops trawl under 250kW

Gear Type	GVA as a Percentage of Total Income (Mean, 2009–2013)		Seafish Fleet Segments on Which Based	
	Under-10m	Over-10m	Under-10m	Over-10m
Other mobile gears	46%	32%	UK demersal trawls and seines under 10m	Average of North Sea beam trawl over 300kW, North Sea beam trawl under 300kW, North Sea and West of Scotland demersal trawl over 24m, North Sea and West of Scotland demersal seiners, North Sea and West of Scotland demersal trawl under 24m, over 300kW, North Sea and West of Scotland demersal trawl under 24m, under 300kW, South West beam trawl under 250kW, North Sea and West of Scotland demersal pair trawls and seines, South West beam trawl over 250kW, UK scallop dredge over 15m
Area VIIa (Irish Sea)				
Beam trawl	22%	23%	Average of North Sea beam trawl under 300kW and South West beam trawl under 250kW	Average of North Sea beam trawl over 300kW, North Sea beam trawl under 300kW, South West beam trawl under 250kW , South West beam trawl over 250kW
Demersal trawl/seine	46%	40%	UK demersal trawls and seines under 10m	Average of Area VIIA demersal trawl over 10m, Area VIIA nephrops over 250kW, Area VIIA nephrops under 250kW
Other mobile gears	46%	33%	UK demersal trawls and seines under 10m	Average of Area VIIA demersal trawl over 10m, Area VIIA nephrops over 250kW, Area VIIA nephrops under 250kW, North Sea beam trawl over 300kW, North Sea beam trawl under 300kW, South West beam trawl under 250kW , South West beam trawl over 250kW, UK scallop dredge over 15m
Other passive gears	53%	44%	Average of UK drift and fixed nets under 10m, UK pots and traps under 10m, UK hooks under 10m	Average of UK Gill netters over 10m , UK Longliners over 10m, UK pots and traps 10m-12m, UK Pots and traps over 12m
Area VIIf/g (Bristol Channel)				
Beam trawl	34%	34%	South West beam trawl under 250kW	Average of South West beam trawl under 250kW , South West beam trawl over 250kW
Demersal trawl/seine	46%	34%	UK demersal trawls and seines under 10m	Average of Area VIIb-k trawlers 10-24m, Area VIIb-k trawlers 24-40m
Other passive gears	53%	44%	Average of UK drift and fixed nets under 10m, UK pots and traps under 10m, UK hooks under 10m	Average of UK Gill netters over 10m , UK Longliners over 10m, UK pots and traps 10m-12m, UK Pots and traps over 12m
Other mobile gears	46%	37%	UK demersal trawls and seines under 10m	Average of Area VIIb-k trawlers 10-24m, Area VIIb-k trawlers 24-40m, South West beam trawl under 250kW , South West beam trawl over 250kW, UK scallop dredge over 15m

(Source: Study team's calculations, based on Seafish, 2014).

Estimating the indirect impact on GVA and the direct and indirect impacts on employment

The knock-on effects on GVA and employment for commercial fisheries have been estimated using appropriate multipliers.

The industry detail presented in the Input-Output Tables are based on the Standard Industrial Classification (SIC) of Economic Activities 2007 (SIC (2007)), under which sea fishing is classified as 'Marine Fishing and Freshwater Fishing' (Division A, group 03, class 03.1). 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 relevant 2011 Type I GVA Multiplier and Employment Effect that have been applied are presented in Table B.3.7 below. The Scottish multipliers are used, as in ABPmer & eftec (2015), because UK or England data will be skewed by the London and south-east bias towards the service sector. The Scottish multipliers are still suitable because some of the proposed sites are around Scotland, and for most of the other sites the areas affected (e.g. west Wales) have a much more similar economic structure to Scotland than to the UK.

Table B.3.7 Marine fishing and freshwater fishing: Type I and Type II GVA multipliers and employment effects

Sea Fishing Industry (3.1)	GVA Multiplier	Employment Effect
Type I	1.4	15.9

(Source: Scottish Government, 2014).

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. Applying the multiplier to the estimate reduction in GVA for the industry provides an estimate of the reduction in GVA for the economy as a whole. It is important to note that designation of the possible dSACs 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 the UK fleet to supply the demand.

The Employment Effect (Table B.3.7) 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 in millions) 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.

The potential cost of designation on the fish processing industry has not been possible to estimate due to limitations in the data sources available, which do not provide any information on port of landing. 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 using 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.

Displacement issues

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 as a result of designating a dSAC. 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.

B.3.7.3 Mitigation Measures, Seasonal or Annual, on Salmon Fixed Engines Within dSACs

This management measure is specified under the intermediate scenario, and would apply to those sites where fixed engines operate. Relevant sites are: Southern Sea of Hebrides, North Channel and Outer Solway, and Outer Moray Firth dSACs.

As the type of mitigation measures and their application are not clearly specified, it has not been possible to quantify the potential impact of this management measure.

B.3.8 Limitations

- Information on the number of under-12m vessels that fish within the sites are subject to a range of uncertainties, and may over- or under-estimate the numbers of vessels that may be affected. For example, vessels may change gear type and this may not be registered in the CFR. The CFR only allows two gear types to be registered, whereas many vessels, particularly under-10m vessels, may use more than two different gear types. Therefore, there may be vessels that operate nets that are not identified through this methodology. A 20km buffer was applied to sites to identify ports, but some vessels may travel further to fishing grounds.

- The average length of nets that under-12m vessels operate varies considerably from vessel to vessel and depending on the species targeted. Many regions were unable to provide an estimate of average net length. The average length used may therefore over- or under-estimate the actual costs of purchasing, installing and maintaining pingers.
- This methodology identifies vessels that may fish in a site based on proximity of their home port (as specified in the UK Fleet Register) to the site. Vessels identified may not fish in the site, and vessels in other ports that were not identified, may in fact fish within the site.
- The methodology to assess the value of loss of landings due to effort restrictions or closures used ICES rectangle data. For most sites the spatial resolution of these data is too coarse to provide an accurate picture of the value of landings from the site. The methodology also assumes that the value of landings derived from an ICES rectangle is distributed evenly across the area, which may not be the case. These issues may result in an over- or under-estimate of the value of landings affected.
- 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, subject to the uncertainties above.
- The quantification of cost impacts to the sector is restricted to UK vessels, as data on non-UK vessels were not available to allow quantification of impacts. Impacts on non-UK vessels were assessed in terms of the number and nationality of vessels likely to be affected by proposed management measures where possible. This may underestimate the number of vessels affected, particularly in larger sites such as Southern North Sea, as there was no way of identifying whether vessels recorded in each sub-rectangle for each gear type were the same vessel or different vessels (they were assumed to be the same).
- 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 dSAC is therefore assumed to be the same in each of the years covered by the IA (except the first year, for which it is assumed management measures are not yet in place). In reality, it is likely that the value of landings in each site 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, 2014) 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 cost 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 for Scotland – have been applied at the dSAC site level to estimate the economic impacts by dSAC. Local and regional multipliers are not available and hence the application of 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.

- It was not possible to quantify some costs (e.g. mitigation measures, seasonal or annual), and therefore overall quantified costs are underestimates.

B.3.9 References

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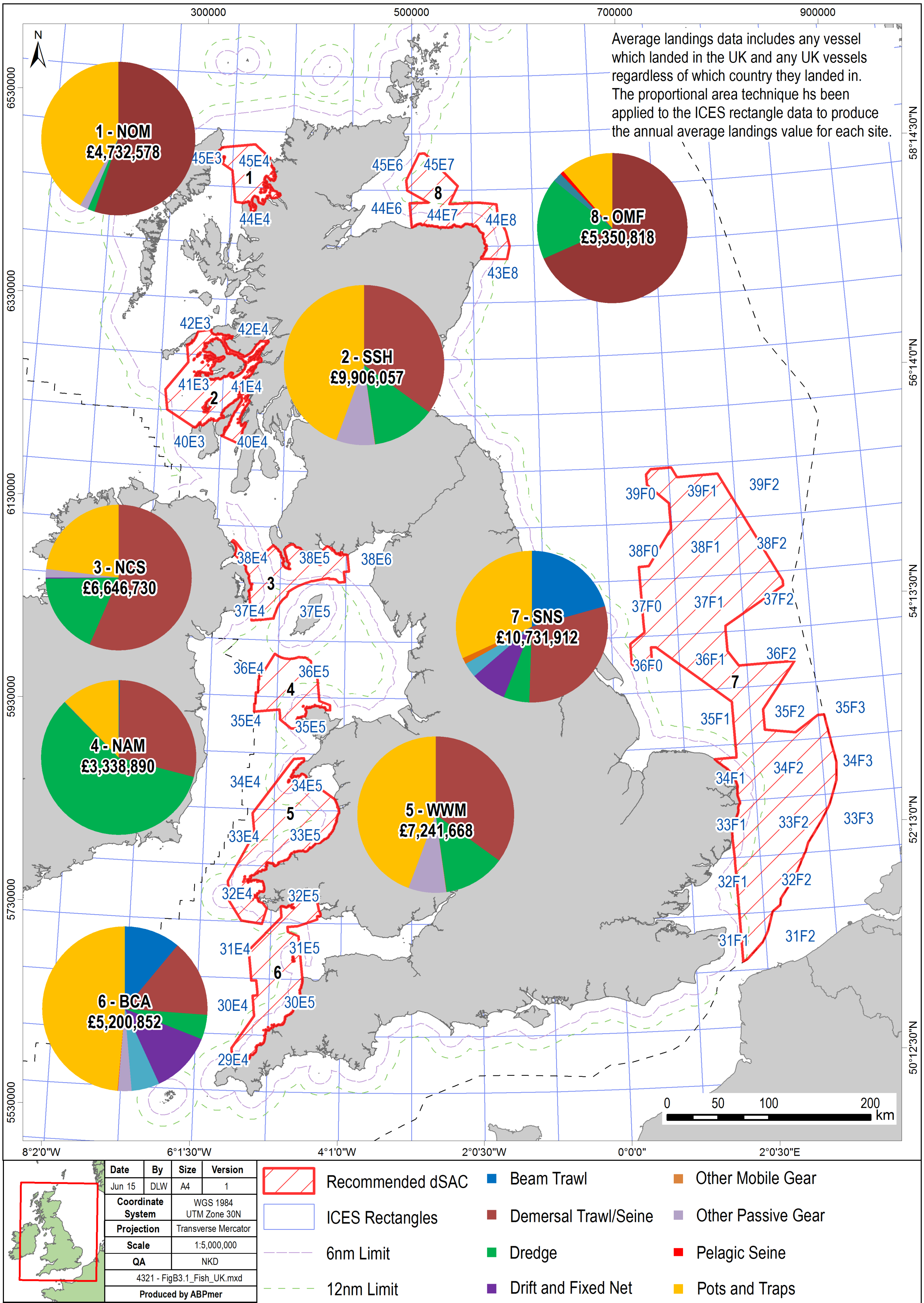

Data Source: MMO, 2015
NOT TO BE USED FOR NAVIGATION

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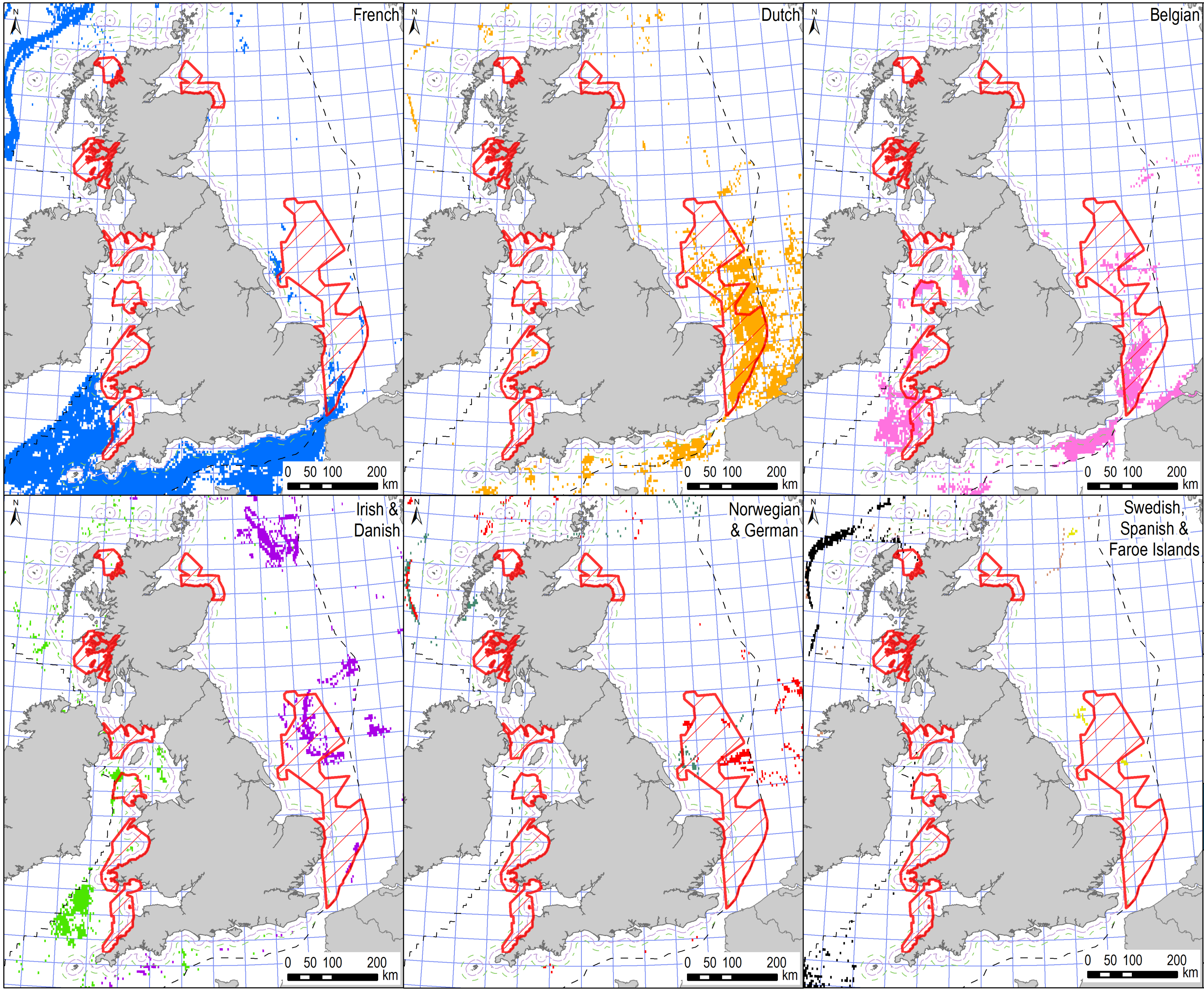
Proportion of Annual Average Value of Landings (2009 to 2013) from ICES Rectangles by dSAC Site

Figure B3.1



Recommended dSAC
6nm Limit
12nm Limit
Continental Shelf
ICES Rectangles

Fishing Activity by Nationality

French
Dutch
Belgian
Irish
Danish
Norwegian
German
Swedish
Spanish
Faroe Islands

Based on Non-UK VMS data. Gridded at 1/200th ICES rectangle.

Date	By	Size	Version
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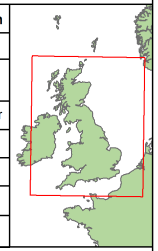
Coordinate System	WGS 1984 UTM Zone 30N		
Projection	Transverse Mercator		
Scale	1:11,700,000		
QA	NKD		
FigB3.2_Fish_Non-UK.mxd			
Produced by ABPmer			



Data Source: MMO, 2015.
NOT TO BE USED FOR NAVIGATION

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Non-UK Fishing Activity Over-15m Vessels for All Gear Types (2007-2010)

Figure B3.2

B.4 Military Activities

B.4.1 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 harbour porpoise SACs on this sector.

B.4.2 Sector Definition

The military defence sector makes use of the UK 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).

B.4.3 Overview of Existing Activity

A list of sources to inform the writing of this baseline is provided in Table B.4.1.

Table B.4.1 Military activities information sources

Scale	Information Available	Date	Source
UK	Military Practise Areas	2010 and 2011	UKMMAS (2010) and Baxter *et al*. (2011)
UK	Military low flying zones	Current	DECC (https://restats.decc.gov.uk/cms/aviation-safeguarding-maps)
Scotland	Joint warrior information	2015	MoD
UK	Munitions Disposal Sites (Chemical, Radioactive, Disused)	1945–1956 (Radioactive – no dates)	MoD
UK	Strength of the UK armed forces and future trends	2014	Rutherford (2014)
UK	Economic statistics	2010	UKMMAS
England	Location of Naval bases	2015	Royal Navy website
Scotland	Location of military activity areas	2011	Baxter *et al*. (2011)
Northern Ireland	Intensity and location of military activity	2014	AECOM and ABPmer (2014)
Isle of Man	Military activity	2013	Finney *et al*. (2013)
Wales	Areas of military activity	2010, 2012 and 2015	UKMMAS, MoD and RAF

B.4.3.1 Location and Intensity of Activity

Military activities occur in both inshore and offshore waters. All coastal military locations and the full area available for military training and other defence activities are shown in Figure B4.1. 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. Sea training is carried out within defined military practise and exercise (PEXA) training areas. The UK low flying system (LFS) allows training within the whole of the UK airspace and surrounding seas, to 3nm, from the surface to 2,000 feet above the ground or mean sea level.

England possesses two of the three naval bases that currently exist in the UK, these are located at Portsmouth and Devonport (Plymouth) (Royal Navy). Water column exercise areas exist off the north west and the north east coasts, along with air/ surface exercise areas off the Northumberland and Cambrian coasts. The southern east coast, south of the Humber, supports less activity with only three small air/surface exercise areas and a single water column exercise area. Two explosive dumping grounds are also present off the coast of East Anglia. The south coast supports a number of exercise areas including coastal landing areas and explosive dumping grounds. A large offshore water column exercise area is located off the south west coast of Cornwall, surrounding the Scilly Isles. Only two coastal RAF base exists in England, RAF Holmpton (East Yorkshire) and RAF Holbeach (East Anglia), both of which are located on the east coast. There are no Army bases located on the coast of England, however the Navy have a Commando Training centre for the Royal Marines on the River Exe and the Territorial Army have a centre in Plymouth.

The only naval base Scotland is Her Majesty's Naval Base (HMNB) Clyde at Faslane in Scotland. Several military exercise areas are present in Scottish waters, most of which are designated as Navy exercise areas suggesting that both surface and submarine activities occur in the areas. The majority of these exercises areas are located off the west coast of Scotland, ranging from Cape Wrath down to the English boarder, spanning most of the west coast. A smaller area exists off the east coast just west of the Firth of Forth. Exercise Joint Warrior is the major training exercise to occur off the Scottish coast each year and involves all three armed forces. This operation is the largest of its kind in Europe and stretches from the Irish Sea north of Cape Wrath and east toward the Moray Firth; it lasts for approximately two weeks and occurs biannually (MoD, 2015).

A number of firing ranges and 'Other exercise' areas exist, the largest of which extend west from North and South Uist off the west coast, are present north of Loch Eribol and in the Moray Firth stretching north past the east coast of Orkney. 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 (UKMMAS, 2010). Additionally there are three coastal RAF bases located at Lossiemouth, Kinross and Leuchars, and two coastal army bases at Fort George and St Andrews. A number of other military related facilities are present around the coast including explosives jetties, fuel jetties, ports, navy armament depot, noise ranges, sonar buoys, navy accommodation, and search and rescue bases (Scottish Marine Atlas 2011). As a result of the offshore military activity in Scotland there are overlaps with exercise areas, firing ranges and dSACs.

In Northern Ireland, military activity occurs extensively, principally as a result of naval activities which use the PEXA areas for submarine, general surface fleet and aircraft exercises (see Figure B4.1). There is no ammunition firing in the PEXA areas or air force training areas within the NI territorial waters (AECOM and ABPmer, 2014).

Two weapons ranges are located in the NI: the Magilligan and Ballykinler ranges which are controlled by the Army, where both areas are covered by byelaws and certain civilian activities are restricted. The MoD is currently undertaking a review of the practice and exercise areas under byelaw and is also considering proposing new byelaw areas; no information is yet available on the location these.

Relatively little military activity occurs in the Welsh waters, partly due to the lack of naval bases along the coast. However, there are several military practice areas within Welsh waters that are used by a combination of Royal Navy, Army and Royal Air Force for practice in air-to-air combat manoeuvres, bombing and firing test areas. This includes the Air Defence Range at Manorbier Head on the Pembrokeshire coast, the Pembrey Sands Air Weapons Range and the Castlemartin firing range in Pembrokeshire (MoD 2012). Cardigan Bay is also a military practice area and there are some relatively small munitions dumping grounds off the coast of Pembrokeshire (UKMMAS 2010 summarised in Cefas *et al*. 2014). Additionally RAF Valley on Anglesey is the principal base in Wales where fast jet pilot training occurs (RAF 2015).

B.4.3.2 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 £1,796million with a GVA of £468 million. 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. In 2009/10 the resource DEL allocated to the C-in-C Navy Command was £2,294million. 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. £406million) 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 £1,888million with a GVA of £491million.

On 1 July 2014, the total strength of the UK Armed Forces was 163,670. Approximately 149,000, or 91%, were trained and 13,000 untrained. UK Regulars comprise 96% of the total UK Armed forces, the Gurkhas 2% and the FTRS 2%.The majority of UK Armed forces serve in the Army (59%), with 21% serving in the RAF and 20% in Naval Service (Rutherford, 2014). It is unclear whether 'total strength' can be used as an accurate proxy for total employment by the UK armed forces due to uncertainty surrounding the types of personnel included under total strength. It is likely that these figures refer exclusively to combat personnel, suggesting that these are a minimum estimate of the total employment by the armed forces.

In January 2010, 11,920 personnel belonging to the MoD and Armed Forces were based in Scotland, comprising 4,230 Navy personnel, 3,300 Army personnel and 4,390 RAF personnel. A further 5,830 civilians were employed (Scottish Marine Atlas, 2011).

B.4.3.3 Future Trends

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 MoD. In October 2010 the Strategic Defence and Security Review recommended that by 2015 the full-time trained strength of the Navy should decrease to 30,000, the Army to 95,000 and the RAF to 33,000 (The Strategic Defence and Security Review, 2010) The RAF figure is on top of the 2,000 reduction decided in Planning Round 10. Although not explicitly mentioned it would appear that these are reductions in the full time trained strength of UK Armed Forces personnel (Rutherford, 2014).

On 18 July 2011 the Secretary of State for Defence indicated in a statement in the House of Commons that Army strength would reduce to 84,000 by 2020. By 2020, if the Territorial Army develops in the expected fashion, a total force of around 120,000 would be present, with a regular to reserve ratio of around 70:30. It appears from the available statistics that such reductions would result in the trained strength of the Army standing at levels not seen for around 150-200 years, although historical strength data is not available for each individual year (Rutherford, 2014).

Specific defence projects may provide significant employment opportunities.

B.4.4 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.

B.4.5 Potential Management Measures

As part of its Marine Environment and Sustainability Assessment Tool (MESAT), the Royal Navy has produced an interactive military layer for use on its electronic charts to provide advice on the suitability of military activities in the vicinity of designated marine protected areas across the UK's marine area. The Royal Navy uses a computerised modelling and risk assessment tool to guide ship commanders on the minimisation of the environmental impacts from use of active sonar. JNCC provides (via the UK Hydrographic Office) some of the underlying data on the distribution of marine mammals and participates in regular technical reviews of the tool (now held 2 yearly) providing views on the degree to which the tool meets legislative requirements. The science which goes into the sonar risk assessment tool and that which UK regulators are utilising to underpin their guidance and advice is independently reviewed to ensure that the risk assessment process remains valid and capable of meeting regulatory requirements.

All activities adhere to the EPS guidance to avoid harm and disturbance of cetaceans with mitigation following a plan, look, listen, act process which involves the use of dedicated visual and PAM monitoring around the source immediately prior to transmission to determine whether cetaceans are present in the area.

Table B.4.2 sets out the management measures that have been identified by JNCC and the country nature conservation bodies as potentially being required to support the achievement of conservation objectives in specific dSACs (see also Appendix D: Management Scenarios).

Table B.4.2 Potential management measures for military activities

Management Measure	Scenario		
	Lower	Intermediate	Upper
Update to MoD Environmental Protection Guidelines to encompass the proposed sites and any seasonal sensitivities		✔	✔
Compliance with Environmental Protection Guidelines		✔	✔

B.4.6 Assessment Methods

B.4.6.1 Update to MoD Environmental Protection Guidelines

The costs to MoD have been assessed at a national level. It has been assumed that the following costs are incurred:

- Initial revision of EPG (and other MoD environmental tools) and additions to electronic charting by the Hydrographic Office are estimated to cost £26,350 (at 2015 prices) based on an estimate of £25k at 2012 prices (Defra, 2012). This cost would be incurred in 2016; and
- Additional annual maintenance costs are estimated to be £5,200 (at 2015 prices) based on an estimate of £5k at 2012 prices (Defra, 2012). This cost would be incurred annually from 2017.

B.4.6.2 Compliance with MoD Environmental Protection Guidelines

As MoD is operational throughout UK waters, it has been assumed that consideration of the harbour porpoise SACs will be undertaken as part of planning for all MoD maritime activities. It has been estimated that the costs to MoD will be £10, 350 per year in the first four years of the IA period, reducing to £5,200 p.a. from year 5 onwards (at 2015 prices) based on Defra (2012).

B.4.7 Limitations

- Owing to the confidential nature of military defence activities it is difficult to assess the extent and frequency of activity in the marine environment and future trends (UKMMAS, 2010).

B.4.8 References

AECOM and ABPmer, 2014. Marine Plan for Northern Ireland – Sustainability Appraisal Scoping Report.

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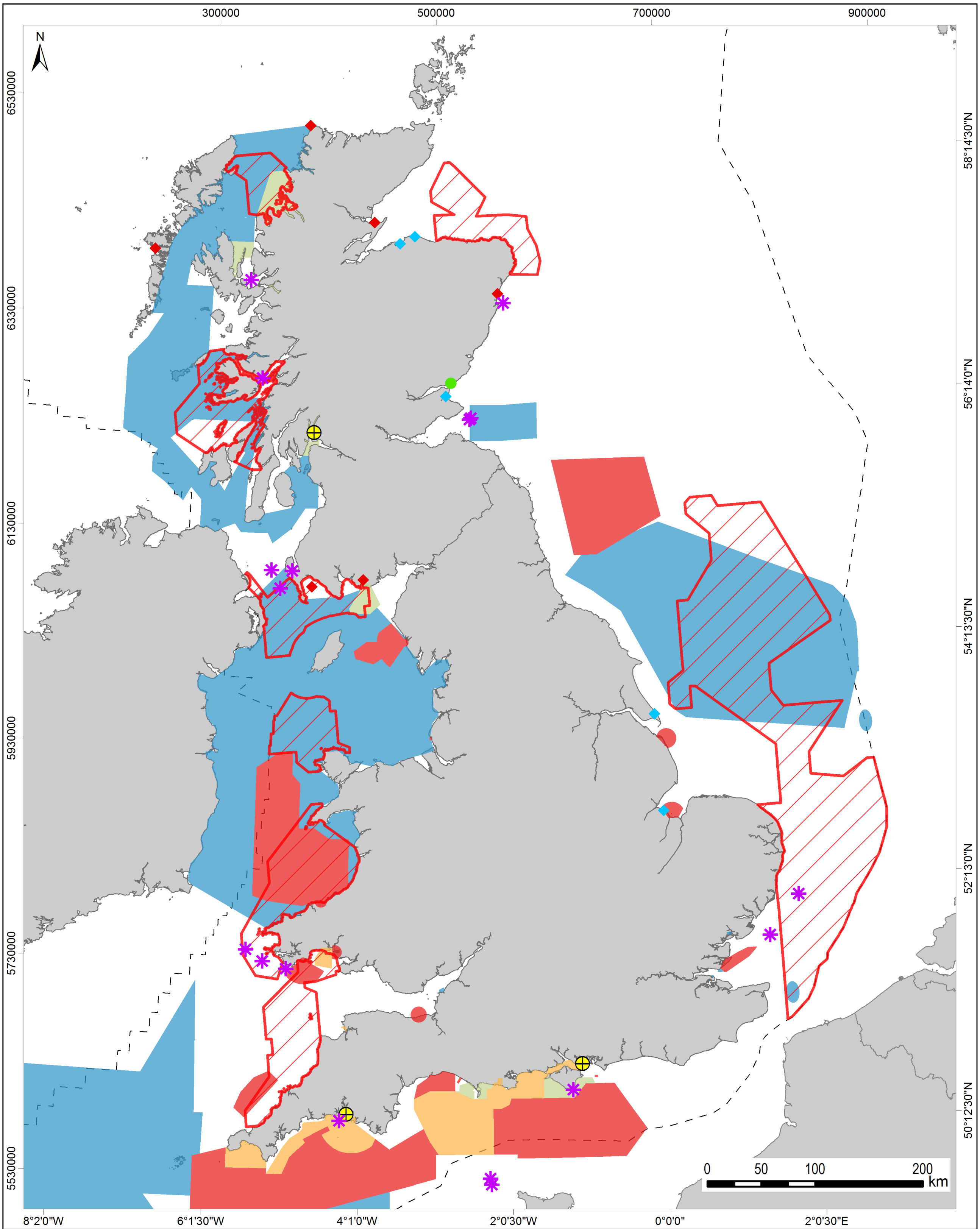

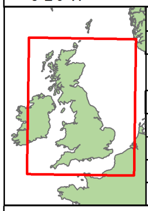

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Projection		Transverse Mercator	
Scale		1:5,000,000	
QA		NKD	
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Produced by ABPmer			

Recommended dSAC
Continental Shelf

MoD Activity Area

Air/Surface
Coastal landing
Sea bed sampling
Water column
Explosives Dumping Ground

Military Coastal Locations

Army Base
Firing Range
Naval Base
RAF Base

Data Source: Scottish Government, 2009; JNCC, 2015.
NOT TO BE USED FOR NAVIGATION

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Military

Figure B4.1

B.5 Offshore Renewables

B.5.1 Introduction

This appendix provides an overview of existing and potential future activity for the offshore renewables sector and outlines the methods used to assess the impacts of potential dSACs on this sector.

B.5.2 Sector Definition

The offshore renewables sector includes offshore wind, wave and tidal development, including export cables.

B.5.3 Overview of Existing Activity

Information sources used in the assessment are listed in Table B.5.1.

Table B.5.1 Offshore renewables information sources

Scale	Information Available	Date	Source
UK	Digest of UK Energy Statistics 2014	2014	Department of Energy & Climate Change (DECC) (www.gov.uk/government/organisations/department-of-energy-climate-change/series/digest-of-uk-energy-statistics-dukes)
UK	Renewable Energy Planning Database	Current	Department of Energy & Climate Change (DECC) (https://www.gov.uk/government/statistics/renewable-energy-planning-database-monthly-extract)
UK	UK Renewable Energy Roadmap Update 2013	2013	Department of Energy & Climate Change (DECC) (https://www.gov.uk/government/publications/uk-renewable-energy-roadmap-second-update)
UK	National and Regional Renewables Statistics	Current	Department of Energy & Climate Change (DECC) (https://www.gov.uk/government/statistics/regional-renewable-statistics)
UK	UK offshore wind and wind development rounds	Current	Renewable UK (RUK) (http://www.renewableuk.com/en/renewable-energy/wind-energy/offshore-wind/development-rounds.cfm)
UK	Marine Renewable Energy Atlas. Direction, speed, potential output and temporal variation (gridded square)	Current	ABPmer (http://www.renewables-atlas.info)
UK	Electricity Ten Year Statement	2014	National Grid (2014) (http://www2.nationalgrid.com/UK/Industry-information/Future-of-Energy/Electricity-Ten-Year-Statement/)

Scale	Information Available	Date	Source
UK	Transmission Entry Capacity (TEC)	Current	National Grid (http://www2.nationalgrid.com/UK/Services/Electricity-connections/Industry-products/TEC-Register)
UK	Existing wave and tidal lease areas	Current	The Crown Estate
UK	Maps of existing and planned offshore wind farms	Current	The Crown Estate (http://www.thecrownestate.co.uk/energy-and-infrastructure/downloads/maps-and-gis-data/)
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
Scotland	A Low Carbon Economic Strategy for Scotland	2010	Scottish Government
Scotland	Supply Chain Demand - Pentland Firth and Orkney Waters Round 1 Wave and tidal Projects	2011	BVG Associates (2011)
Scotland	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	Scottish and Southern Energy plc Annual Report 2014	2014	Scottish and Southern Energy plc (2014)
Scotland	Scotland's National Marine Plan	2014	Marine Scotland (2014)
Scotland	Existing wind farm locations and proposed wind farm lease areas	Current	Marine Scotland
Scotland	Proposed wave and tidal lease areas	Current	Marine Scotland
Northern Ireland	Strategic Environmental Assessment (SEA) of Offshore Wind and Marine Renewable Energy in Northern Ireland	2009	Department of Enterprise, Trade and Investment (DETI) (2009a; 2009b)
Northern Ireland	Marine Plan for Northern Ireland – Sustainability Appraisal Scoping Report	2014	AECOM and ABPmer (2014)

Scale	Information Available	Date	Source
Wales	Energy Wales: A Low Carbon Transition	2012	Welsh Government (2012)
Wales	Renewable Energy in Wales: in figures	2013	National Assembly for Wales (2013)

B.5.3.1 Location and Intensity of Activity

Table B.5.2 provides an overview of current operational, consented and planned wind, tidal and wave energy projects in UK waters, these are shown in Figure B5.1.

Numerous fully operational offshore wind farms are located in English waters off the East and North-west coast, equating to approximately 3.7GW of installed capacity (not including developments currently under construction with partial generation). Developments off the East coast contribute the majority of installed capacity (approximately 2.6GW), particularly the significant developments of Thanet (330MW), London Array Phase 1 (630MW), Greater Gabbard (504MW), Sheringham Shoal (317MW), Lynn and Inner Dowsing (194MW) and Lincs (270MW). In the North-west, there are five fully operational offshore wind farms, namely Barrow (90MW), Burbo Bank (90MW), Ormonde (150MW), Walney (Phases 1 and 2) (367MW) and West of Duddon Sands (389MW). No wave or tidal energy arrays are currently present in English waters.

At present, Robin Rigg (180MW) is the only fully operational, commercial-scale offshore windfarm in Scottish waters, located in the Solway Firth and comprising 60 turbines between two sites (East and West). Two demonstration projects, Beatrice (10MW) and Methil (Samsung) (7MW), are also fully operational in Scottish waters. However, it should be noted that the Tiree (Argyll) Array (1,800 MW) offshore wind project has recently been cancelled due to technical and financial challenges, while further investment in the Islay (690MW) offshore wind project has been halted for the foreseeable future; thus, neither project has been considered in this assessment. The small North Yell community owned tidal device (0.03MW), located in Bluemull Sound in the Shetlands, is the only operational tidal development in Scottish waters. The LIMPET wave device on the coast of Islay, Scotland was the world's first commercial wave powered device connected to the UK National Grid. Following the construction and testing of a 75kW prototype in 1991, a 0.5MW turbine unit was built in 2000 (although the nameplate capacity has since been downgraded to 0.25MW). The European Marine Energy Centre (EMEC) provides a range of testing facilities for wave and tidal devices around Orkney. Operational devices are currently being tested at the Billia Croo (wave), Scapa Flow (wave), Fall of Warness (tidal) and Shapinsay Sound (tidal) sites.

In December 2014, the First Flight Wind Farm development (400MW), proposed for construction off the coast of County Down, Northern Ireland, was ceased due to timeframes likely to be required under the new market rules. Therefore, there are currently no operational or planned offshore wind farms in Northern Ireland. The SeaGen (1.2MW) tidal device, located in Strangford Lough, was installed in 2008 and leads the way in global tidal current technology.

There are two operational offshore wind farms in Welsh waters, namely Rhyl Flats (90MW) and North Hoyle (60MW), whilst the significant Gwynt y Môr development (576MW) is nearing completion (partial generation). However, it should also be noted that several major wind farm projects in Welsh waters, specifically the Atlantic Array and Celtic Array (Rhiannon, South West and North East Potential

Development Areas), have been halted in recent years due to environmental concerns and financial constraints (RWE Innogy website, Celtic Array website). A single full-scale, tidal stream device (0.4MW) is currently being installed off the coast of Pembrokeshire (Ramsey Sound). The project will be used to demonstrate the capability of the DeltaStream tidal device with the aim of constructing an array off the coast of St David's Head (up to 10MW, not currently consented).

It is also worth noting that the Isle of Man has significant wind, wave and tidal resources in the Irish Sea; however, in view of the relatively early stage of project development, it will be a number of years before significant generation capacity is possible in the Island's territorial waters (Milne *et al*. 2013).

Table B.5.2 Operational, consented and planned wind, tidal and wave renewable energy projects in UK waters as at 24 April 2015

Type	Name/ Location	Company (Project Website)	Status	Capacity (MW)
Wind	Navitus Bay, England	Eneco Wind UK Ltd (Eneco) and EDF Energy Renewables (http://www.navitusbaywindpark.co.uk)	Environmental Statement submitted in April 2014. Currently under consideration by Secretary of State.	970
Wind	Rampion, England	E.ON Climate & Renewables UK (https://www.eonenergy.com/About-eon/our-company/generation/planning-for-the-future/wind/offshore/rampion-offshore-wind-farm)	Consent granted in July 2014. Awaiting construction.	700
Wind	Thanet, England	Vattenfall (http://corporate.vattenfall.co.uk/projects/operational-wind-farms/thanet)	Fully operational since September 2010.	300
Wind	Kentish Flats, England	Vattenfall (http://corporate.vattenfall.co.uk/projects/operational-wind-farms/kentish-flats)	Fully operational since 2005.	90
Wind	Kentish Flats Extension, England	Vattenfall (http://corporate.vattenfall.co.uk/projects/wind-energy-projects/kentish-flats-extension)	Consent granted in February 2013. Early stages of construction.	49.5
Wind	London Array Phase 1, England	E.ON, DONG Energy, Masdar and La Caisse de dépôt et placement du Québec (http://www.londonarray.com)	Fully operational since April 2013. Plans for Phase 2 withdrawn in February 2014.	630
Wind	Gunfleet Sands I and II, England	DONG Energy (http://www.gunfleetsands.co.uk/en)	Fully operational since March 2010.	173
Wind	Gunfleet Sands III – Demonstration Project, England	DONG Energy (http://www.gunfleetsands.co.uk/en/demonstration-project)	Fully operational since April 2013.	12
Wind	Greater Gabbard, England	SSE Renewables and RWE Innogy (http://sse.com/whatwedo/ourprojectsandassets/renewables/greatergabbard/)	Fully operational since 2012.	504

Type	Name/ Location	Company (Project Website)	Status	Capacity (MW)
Wind	Galloper (Greater Gabbard Extension), England	SSE Renewables and RWE Innogy (http://www.galloperwindfarm.com/)	Consent granted in May 2013. Developers currently securing investment.	336
Wind	East Anglia ONE, England	ScottishPower Renewables (http://www.scottishpowerrenewables.com/pages/east_anglia_one.asp)	Consent granted in June 2014. Awaiting construction.	714
Wind	East Anglia, THREE and FOUR, England	ScottishPower Renewables and Vattenfall (https://www.eastangliawind.com)	In planning. Scoping Reports submitted in November 2012.	2,400
Wind	Scroby Sands, England	E.ON UK (http://www.eon-uk.com/481.aspx)	Fully operational since March 2004.	60
Wind	Sheringham Shoal, England	Statoil and Statkraft (http://scira.co.uk/#)	Fully operational since 2012.	317
Wind	Lynn and Inner Dowsing, England	Centrica Renewable Energy and EIG Partners (http://www.centrica.com/index.asp?pageid=923&project=project4&projectstatus=operational#project4)	Fully operational since March 2009.	194
Wind	Lincs, England	Centrica Renewable Energy, DONG Energy and Siemens Project Ventures (http://www.centrica.com/index.asp?pageid=923&project=project5&projectstatus=operational#project5)	Fully operational since September 2013.	270
Wind	Race Bank, England	DONG Energy (http://www.dongenergy.co.uk/uk-business-activities/wind-power/offshore-wind-farms-in-the-uk/race-bank)	Consent granted in July 2012. Awaiting construction.	580
Wind	Dudgeon, England	Statoil, Masdar and Statkraft (http://dudgeonoffshorewind.co.uk)	Consent granted in July 2012. Project design changed since initial application. Awaiting construction.	402
Wind	Triton Knoll, England	RWE Innogy and Statkraft (http://www.rwe.com/web/cms/en/306900/rwe-innogy/sites/wind-offshore/developing-sites/triton-knoll/)	Consent granted in 2013. Project design changed since initial application. Awaiting construction.	900
Wind	Humber Gateway, England	E.ON UK (https://www.eonenergy.com/About-eon/our-company/generation/planning-for-the-future/wind/offshore/humber-gateway)	Under construction/ partial generation. Works estimated for completion in mid-2015.	219
Wind	Westermost Rough, England	DONG Energy, Marubeni Corporation and the UK Green Investment Bank (http://www.westermostrough.co.uk/en)	Under construction/ partial generation. Works estimated for completion in mid-2015.	210

Type	Name/ Location	Company (Project Website)	Status	Capacity (MW)
Wind	Hornsea Project One, England	DONG Energy (http://www.hornseaprojectone.co.uk/en/about-hornsea-project-one)	Consent granted in December 2014 for Phase 1 (Heron Wind and Njord – 600MW each). Awaiting Construction.	1,200
Wind	Hornsea Project Two, England	SMart Wind Limited (http://www.smartwind.co.uk/project2.aspx)	Agreement to lease secured. Environmental Statement submitted in January 2015.	1,800
Wind	Teesside (Redcar), England	EDF Energy (http://www.edfenergy.com/news/offshore-wind-farm)	Fully operational since April 2014.	62
Wind	Blyth Offshore Wind Demonstration Site, England	EDF Energy Renewables (http://www.thecrownestate.co.uk/news-and-media/news/2014/edf-energy-renewables-signs-deal-for-rights-to-develop-blyth-offshore-wind-test-site/)	Consent granted in November 2013. Awaiting construction.	100
Wind	Dogger Bank – Creyke Beck A and B, England	Forewind (RWE Innogy UK, SSE, Statkraft and Statoil) (http://www.forewind.co.uk/projects/dogger-bank-creyke-beck.html)	Consent granted in February 2015. Awaiting construction.	2,400
Wind	Dogger Bank – Teesside A and B, England	Forewind (RWE Innogy UK, SSE, Statkraft and Statoil) (http://www.forewind.co.uk/projects/dogger-bank-teesside-a-b.html)	Agreement to lease secured. Environmental Statement submitted in March 2014. Currently under consideration by Secretary of State.	2,400
Wind	Dogger Bank – Teesside C and D, England	Forewind (RWE Innogy UK, SSE, Statkraft and Statoil) (http://www.forewind.co.uk/projects/dogger-bank-teesside-c-d.html)	Agreement to lease secured. Environmental Statement expected to be submitted in 2016.	2,400
Wind	Barrow, England	DONG Energy and Centrica (http://www.dongenergy.co.uk/uk-business-activities/wind-power/offshore-wind-farms-in-the-uk/barrow-offshore-wind-farm)	Fully operational since June 2006.	90
Wind	Burbo Bank, England	DONG Energy (http://www.burbobank.co.uk/en)	Fully operational since July 2007.	90
Wind	Burbo Bank Extension, England	DONG Energy (http://www.burbobankextension.co.uk/en)	Consent granted in September 2014. Awaiting construction.	258
Wind	West of Duddon Sands, England	DONG Energy and Scottish Power Renewables (http://www.westofduddonsands.co.uk/en)	Fully operational since October 2014.	389
Wind	Walney Phases 1 and 2, England	DONG Energy (http://www.walneyoffshorewind.co.uk/en)	Fully operational since April 2012.	367
Wind	Walney Extension, England	DONG Energy (http://www.walneyextension.co.uk/en)	Consent granted in November 2014. Awaiting construction.	750

Type	Name/ Location	Company (Project Website)	Status	Capacity (MW)
Wind	Ormonde, England	Vattenfall (http://www.vattenfall.co.uk/en/ormonde.htm)	Fully operational since February 2011.	150
Wind	Robin Rigg (East and West), Solway Firth, Scotland	E.ON Climate & Renewables (https://www.eonenergy.com/About-eon/our-company/generation/our-current-portfolio/wind/offshore/robin-rigg)	Fully operational since September 2010.	180
Wind	Beatrice Demonstrator Project, Scotland	Scottish and Southern Energy (SSE) and Talisman Energy (UK) (http://www.seaenergy-plc.com/beatrice.html)	Fully operational since 2007.	10
Wind	Beatrice, Outer Moray Firth, Scotland	Beatrice Offshore Windfarm Limited (BOWL) (http://sse.com/whatwedo/ourprojectsandassets/renewables/Beatrice)	Consent granted in March 2014. Awaiting construction (aiming to start in 2016).	664
Wind	Methil (Samsung) Demonstrator Project, Scotland	Samsung (http://www.energyparkfife.co.uk)	Fully operational since October 2013.	7
Wind	Seagreen Phase 1, Firth of Forth, Scotland	SSE Renewables (http://www.seagreenwindenergy.com)	Consent granted for Project Alpha and Project Bravo in October 2014. Awaiting construction (aiming to start in 2015/2016).	1,050
Wind	Seagreen Phases 2 and 3, Firth of Forth, Scotland	SSE Renewables (http://www.seagreenwindenergy.com)	Agreement to lease secured. Scoping Report submitted for Phases 2 and 3 in June 2011.	2,600
Wind	Inch Cape, Scotland	Repsol Nuevas Energias UK (http://www.inchcapewind.com)	Consent granted in October 2014. Awaiting construction (aiming to start in 2017).	784
Wind	Neart na Gaoithe, Scotland	Mainstream Renewable Power Ltd (http://www.neartnagaoithe.com)	Consent granted in October 2014. Awaiting construction (aiming to start in 2015).	450
Wind	Moray Firth (Eastern Development Area), Outer Moray Firth, Scotland	EDPR and Repsol Nuevas Energias UK (http://www.morayoffshorerenewables.com/Home.aspx)	Consent granted for Telford, Stevenson and MacColl offshore windfarms in March 2014. Awaiting construction (aiming to start in 2015).	1,116
Wind	Moray Firth (Western Development Area), Outer Moray Firth, Scotland	EDPR and Repsol Nuevas Energias UK (http://www.morayoffshorerenewables.com/Home.aspx)	In planning. Project dependent on the Eastern Development Area (see above).	360
Wind	Kincardine, Scotland	Kincardine Offshore Windfarm Limited (KOWL) (http://www.gov.scot/Resource/0044/00448819.pdf)	In planning. Scoping Report submitted in April 2014.	50

Type	Name/ Location	Company (Project Website)	Status	Capacity (MW)
Wind	Hywind Scotland Pilot Park Project, Scotland	Statoil Wind Limited (SWL) (http://www.statoil.com/en/environmentsociety/environment/impactassessments/newenergy/intwind/pages/hywindscotland.aspx)	In planning. Agreement to lease secured. Scoping Report submitted in October 2013.	30
Wind	European Offshore Wind Deployment Centre, Scotland	Aberdeen Offshore Wind Farm Ltd (AOWFL) (http://corporate.vattenfall.co.uk/projects/wind-energy-projects/european-offshore-wind-deployment-centre/)	Consent granted in March 2014.However, modification made to design. Construction date unknown.	100
Wind	2-B Energy Test Site, Scotland	Forthwind Limited (http://www.thecrownestate.co.uk/news-and-media/news/2014/first-uk-site-for-two-bladed-offshore-wind-turbines)	In planning. Agreement to lease secured.	12
Wind	North Hoyle, Wales	RWE Innogy UK (http://www.rwe.com/web/cms/en/311610/rwe-innogy/sites/wind-offshore/in-operation/north-hoyle)	Fully operational since December 2004.	60
Wind	Rhyl Flats, Wales	RWE Innogy UK (http://www.rwe.com/web/cms/en/310584/rwe-innogy/sites/wind-offshore/in-operation/rhyl-flats/summary)	Fully operational since December 2009.	90
Wind	Gwynt y Môr, Wales	RWE Innogy UK (http://www.rwe.com/web/cms/en/1202906/rwe-innogy/sites/wind-offshore/under-construction/gwynt-y-mr)	Construction completed in late 2014 (partial generation). In final stages of connection to the grid.	576
Wind Total				30,290
Tidal Stream	North Yell, Bluemull Sound, Shetland, Scotland	Nova Innovation (http://www.novainnovation.co.uk/index.php/north-yell)	Fully operational since 2014.	0.03
Tidal Stream	Sound of Islay, Scotland	Scottish Power Renewables (http://www.scottishpowerrenewables.com/pages/sound_of_islay.asp)	Consent granted in March 2011. Awaiting construction.	10
Tidal Stream	Ness of Duncansby, Pentland Firth, Scotland	Scottish Power Renewables (http://www.scottishpowerrenewables.com/pages/ness_of_duncansbyasp)	In planning. Agreement to lease secured.	95
Tidal Stream	Kyle Rhea, Scotland	SeaGeneration (MCT) (http://www.seagenkylerhea.co.uk/progress.php)	In planning. Agreement to lease secured. Environmental Statement submitted in 2013.	8
Tidal Stream	Westray South, Pentland Firth, Scotland	DP Energy (http://sse.com/whatwedo/ourprojectsandassets/renewables/WestraySouth)	Agreement to lease secured. Scoping Report submitted November 2011.	200
Tidal Stream	Brough Ness, Pentland Firth, Scotland	SeaGeneration Ltd (MCT) (http://www.pentlandfirthrenewables.co.uk/portfolio/brough-ness)	In planning. Agreement to lease secured. Aiming to receive consent by 2015 and start construction in 2016.	100

Type	Name/ Location	Company (Project Website)	Status	Capacity (MW)
Tidal Stream	Inner Sound, Pentland Firth, Scotland	MeyGen Ltd (http://www.meygen.com/the-project/current-status)	Consent granted in January 2014. Awaiting construction.	400
Tidal Stream	Mull of Kintyre, Argyll, Scotland	Argyll Tidal Ltd (http://www.gov.scot/Topics/marine/Licensing/marine/scoping/ArgyllTidalArray)	Consent granted in May 2014. Awaiting construction.	3
Tidal Stream	Sanda Sound, Scotland	Oceanflow Energy (http://www.oceanflowenergy.com/project-details2.html)	In planning. Agreement to lease secured. Test device to be deployed late 2012.	0.035
Tidal Stream	Isle of Islay, Islay, Scotland	DP Marine Energy Ltd (http://www.westislaytidal.com)	In planning. Agreement to lease secured. Environmental Statement submitted in 2013.	30
Tidal Stream	Lashy Sound, Scotland	Scotrenewables Tidal Power Limited (SRTP) (http://www.gov.scot/Resource/0045/00456955.pdf)	In planning. Agreement to lease secured. Scoping Report submitted in July 2014.	30
Tidal Stream	Brims Tidal Array (formerly Cantick Head), Scotland	SSE Renewables and OpenHydro Group Ltd (http://sse.com/whatwedo/ourprojectsandassets/renewables/brims)	In planning. Agreement to lease secured. Scoping Report submitted in August 2013.	200
Tidal Stream	Mull of Galloway, Scotland	Marine Current Turbines (http://www.marineturbines.com/News/2014/07/08/siemens-welcomes-latest-boost-tidal-technology)	In planning. Agreement to lease secured.	30
Tidal Stream	Fall of Warness, Scotland	European Marine Energy Centre Ltd	Test site.	N/A
Tidal Stream	Shapinsay Sound, Scotland	European Marine Energy Centre Ltd	Test site.	N/A
Tidal Stream	Islay Demonstration Zone, Scotland	European Marine Energy Centre Ltd	Test site.	N/A
Tidal Stream	Stronsay Firth, Scotland	European Marine Energy Centre Ltd	Test site.	N/A
Tidal Stream	Torr Head, Northern Ireland	Tidal Ventures (http://www.tidalventures.com/about.html)	Feasibility and site research.	100
Tidal Stream	Fair Head, Northern Ireland	Fair Head Tidal Energy Park Limited (http://www.fairheadtidal.com/)	Feasibility and site research.	100
Tidal Stream	Strangford Lough, Northern Ireland	SeaGeneration Limited (http://www.seageneration.co.uk/)	Fully operational since 2008.	1.2
Tidal Stream	Strangford Lough (Minesto 1) , Northern Ireland	Minesto AB (http://www.minesto.com)	Under construction and testing.	0.003
Tidal Stream	Strangford Lough (Minesto 2) , Northern Ireland	Minesto AB (http://www.minesto.com)	Under construction and testing.	0.003
Tidal Stream	Skerries, Anglesey, Wales	SeaGeneration (Wales) Limited (http://seagenwales.co.uk)	Consent granted in 2013. Construction planned for 2016.	10

Type	Name/ Location	Company (Project Website)	Status	Capacity (MW)
Tidal Stream	Holyhead Deep	Minesto (http://www.minesto.com/technologydevelopment/index.html)	Agreement for Lease granted, consent application is being prepared.	10
Tidal Stream	West Anglesey Demonstration Zone	Menter Mon Cyf (http://morlaisenergy.com/en/)	In development. The site has been designated as a tidal current demonstration zone (as of July 2014). Site manager must now attract developers to use the site and collect environmental data	120
Tidal Stream	St David's Head, Wales	Tidal Energy Developments South Wales Ltd (TEDSWL) (http://www.tidalenergyltd.com/?page_id=1346)	In planning. Agreement to lease secured.	10
Tidal Stream	Ramsey Sound, Wales	Tidal Energy Limited (http://www.tidalenergyltd.com/?page_id=650)	Consent granted and awaiting installation.	1.2
Tidal Stream	North Devon Tidal Demonstration Zone	WaveHub (http://www.wavehub.co.uk/north-devon-tidal-zone)	Agreement for lease granted	Up to 200
Tidal Stream Total				1,658
Tidal Range	Tidal Lagoon Swansea Bay, Wales	Tidal Lagoon (Swansea Bay) plc (http://www.tidallagoonswanseabay.com)	Environmental Statement submitted in 2014. Currently under consideration by Secretary of State.	240
Tidal Range	Tidal Lagoon Cardiff, Wales	Tidal Lagoon Cardiff Ltd (http://www.tidallagooncardiff.com)	In planning. Scoping Report submitted in March 2015.	2,800
Tidal range	Newport Tidal Lagoon	Tidal Lagoon Power (http://www.tidallagoonpower.com/h/lagoons/newport/141/)	Stakeholder and community consultation is underway. Scoping report is expected to be submitted in mid-2015	Between 1,800MW and 2,800MW
Tidal Range Total				5840
Wave	LIMPET, Islay, Scotland	Wavegen (Voith Hydro) (http://voith.com/en/index.html)	Fully operational since 2002.	0.25
Wave	Isle of Lewis (North West Lewis), Scotland	Aquamarine Power (http://www.aquamarinepower.com/projects/north-west-lewis)	Consent granted in May 2013. Awaiting construction.	40
Wave	Costa Head, Pentland Firth, Scotland	SSE Renewables & ALSTOM UK (http://sse.com/whatwedo/ourprojectsandassets/renewables/CostaHead)	In planning. Agreement to lease secured. Scoping Report submitted May 2012.	200
Wave	Marwick Head, Pentland Firth, Scotland	Scottish Power Renewables (http://www.scottishpowerrenewables.com/pages/marwick_head.asp)	In planning. Agreement to lease secured. Scoping Report submitted December 2012.	50
Wave	Brough Head, Pentland Firth, Scotland	SSE Renewables & Aquamarine Power (http://www.aquamarinepower.com/projects/west-coast-orkney)	In planning. Agreement to lease secured. Scoping Report submitted August 2011.	200

Type	Name/ Location	Company (Project Website)	Status	Capacity (MW)
Wave	West Orkney Middle South (WOMS) and South (WOS), Pentland Firth, Scotland	E.ON Climate and Renewables and Pelamis (http://www.pentlandfirthrenewables.co.uk/portfolio/west-orkney-south)	In planning. Agreement to lease secured. Scoping Report (WOS) submitted March 2012.	100
Wave	Galson, Isle of Lewis, Scotland	Lewis Wave Power Limited	In planning.	10
Wave	Billia Croo, Scotland	European Marine Energy Centre Ltd	Operational (test site).	N/A
Wave	Scapa Flow, Scotland	European Marine Energy Centre Ltd	In planning (test site).	N/A
Wave	Harris Demonstration Zone, Scotland	European Marine Energy Centre Ltd	In planning. Agreement to lease secured (test site).	N/A
Wave	WaveHub Site	WaveHub (http://www.wavehub.co.uk/wave-hub-site)	Fully consented with a 25 year seabed lease	48
Wave	South Pembrokeshire Demonstration Zone	Wavehub (http://www.wavehub.co.uk/)	The site has been designated as a wave demonstration zone (as of July 2014). Site manager must now attract developers to use the site and collect environmental data.	30
Wave Total				630.25

B.5.3.2 Current Economic Value and Employment

The potential for employment generation as a result of new offshore renewable developments is regularly referred to in literature. Both job creation and regional development are identified as key potential benefits of offshore wind developments (European Wind Energy Association (EWEA), 2007; Johnson *et al*. 2013). Employment creation is noted a central driver to support offshore renewable energy development in political terms. Literature indicates that marine renewable energy may generate in the region of 20,000 jobs (Kerr *et al*. 2014). Impacts of employment (split between manufacturing, installation and operation/maintenance phases) are also anticipated to be experienced onshore (Johnson *et al*. 2013).

Benefits of economic development and revitalisation of declining communities is also noted in the literature. Johnson *et al*. (2013) report the potential for employment and associated in-migration to rural areas could be 'considerable', while also providing a steady pace of increasing employment opportunities over a considerable period (covering manufacture, deployment and servicing), thus contributing to sustainable regeneration of communities. However, a net increase in sustainable long-term employment is noted by Ison (date unknown) as a possible, not definite outcome. From a political and development stand point, marine energy (as a high-value sector) is identified as a tool to address social issues such as declining population, unemployment, seasonable employment and youth out-migration in declining and/or peripheral locations (Cowell *et al*. 2012; Johnson *et al*. 2013).

The total amount of electricity generated in the UK in 2013 was 359,149 GWh, down from 381,127 GWh in 2010. Renewable energy generation was 53,667 GWh in 2013, representing approximately 15% of total electricity generation.

In 2013, a survey found that the UK wind (onshore and offshore) and marine energy sector directly employed 18,465 full-time equivalent (FTE) jobs (approximately 37% in offshore wind and 9% in marine) and had a turnover of £8.1 billion (RenewableUK, 2013a). Another comprehensive study by Scottish Renewables showed that during 2013 the renewables industry in Scotland was the largest employer by generation type in Scotland. The industry supported 11,695 FTE jobs, with 1,842 of those in offshore wind energy and 805 in the wave and tidal energy sector[1]. Similarly, the Department for Business, Innovation and Skills (2015) reported 2,100 and 1,000 jobs were associated with the offshore wind and marine (wave and tidal) energy sectors respectively in Scotland in 2013. This compares with a total for the energy sector as a whole (including water supply) of 42,000 people in 2008 (Scottish Government, 2010b). 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[2] could be larger (Scottish Government, 2010b). 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[3].

B.5.3.3 Future Trends

In accordance with the UK Climate Change Act 2008, the UK is committed to a reduction in emissions of 80% in the year 2050 compared to 1990 levels. In order to achieve this target, significant development of the renewable energy sector is likely to occur, including consideration of marine-based resources (e.g. wind, wave and tidal energy).

Based on the offshore wind, wave and tidal developments currently in planning, there is the potential for a significant increase in installed capacity in the period up to and beyond 2020, with potentially 30GW of offshore wind capacity, and, in the longer term, 600MW of wave capacity and 4.4GW of tidal energy capacity (see Table B.5.2 above). In the longer-term further development proposals are likely to come forward but the nature, timing and location of these is uncertain.

Renewable UK (2011) estimates that by 2022, the UK offshore wind industry could generate £60 billion of Gross Value Added, supporting up to 45,000 jobs. More recently, the Centre for Economics and Business Research (2012) identified that by 2020 the UK offshore wind sector could support 0.4% of UK GDP and employ 97,000 people.

B.5.4 Assumptions on Future Activity

For the purposes of this assessment, it is assumed that all consented but not yet built and all planned offshore wind, wave and tidal (tidal stream and tidal range) development proceeds to construction and operation. This may result in an overestimate of impacts as it is possible that some of these planned developments will not proceed.

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1 Scottish Renewables. Scotland's Renewable Energy Sector in Numbers. (http://www.scottishrenewables.com/scottish-renewable-energy-statistics-glance/)

2 Energy in Scotland: A Compendium of Scottish Energy Statistics and Information, Report produced Dec. 2010.

3 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.

It is recognised that additional project proposal may come forward during the period covered by the IA. However, it is not possible to determine where or when such development might occur. This will result in an underestimate of impacts.

B.5.5 Potential Management Measures

The main pressures where JNCC and the country nature conservation agencies consider that additional management measures may be required for offshore renewables developments within or near harbour porpoise dSACs comprise:

- Underwater noise associated with geophysical surveys or percussive piling which has the potential to injure or disturb harbour porpoise, or restrict use of the habitat within the SAC; and
- Collision risk associated with tidal turbines (tidal stream and tidal range) which may pose a risk of injury or death.

Where tidal turbine installations occur in or across narrow channels, they may create a barrier to individuals accessing functionally important areas. However, this is not currently considered to be an issue in the context of the proposed dSACs.

Offshore renewables development is already strictly regulated and a number of measures are already in place to manage environmental risks. In particular, JNCC has published guidance on the deliberate disturbance of marine protected species (JNCC, 2008) which includes disturbance from geophysical surveys. The MMO has also issued a voluntary notification form for developers proposing to undertake geophysical or seismic surveys to reduce the risk of contravening European Protected Species legislation (https://www.gov.uk/perform-a-marine-seismic-or-geophysical-survey).

Governments require the consideration of three potential management options for measures as part of the socio-economic impact assessment for the designation of proposed sites. These reflect a ‘business as usual’ or lower scenario, an intermediate scenario where some additional management of activities is expected as a result of the designation and an upper scenario which outlines the likely highest societal demands that could be made to protect the feature for which the proposed site is being designated.

Table B.5.3 sets out the management measures that have been identified by JNCC and the country nature conservation bodies as potentially being required to support the achievement of conservation objectives in specific dSACs (see also Appendix D: Management Scenarios).

The methods by which the cost impacts of these potential management measures have been assessed are described below. It is possible that some of these requirements could result in project delays and depending on when these occur, the industry has indicated they could be very costly and may mean that projects do not proceed. This is particularly the case for projects that are nearing the construction phase. It is difficult to reliably quantify the potential cost impact of delays as the impact will depend on the particular stage a project has reached when designation decisions are made. In addition, the uncertainty caused by the designations and requirements for management measures may act as a deterrent to investment. Where management measures have the potential to cause project delays or project cancellations, this is noted below in relation to the relevant measures.

Table B.5.3 Potential management measures for offshore renewables sector

Management Measure	Scenario		
	Lower	Intermediate	Upper
Habitats Regulations Assessment (HRA) of new development and geophysical surveys within or near site boundaries	✔	✔	✔
Review of consents for existing offshore renewables developments within or near site boundaries	✔	✔	✔
Limited spatio-temporal conditions on piling activity or reducing sound levels at source within site boundaries		✔	
Prohibition on pile driving within site boundaries			✔
Additional mitigation measures for tidal turbines (tidal stream, tidal range) to reduce or limit collision risk within site boundaries		✔	
Removal or avoidance of collision risk pressure with tidal turbines within site boundaries			✔
Enhanced mitigation measures to reduce or limit impacts of geophysical surveys within site boundaries		✔	
Limiting the number and duration of geophysical surveys within site boundaries			✔

B.5.6 Assessment Methods

Table B.5.4 to Table B.5.9 below summarise planned offshore wind and tidal stream development projects in relation to individual dSACs based on publicly available information. This includes information on planned capacity (MW), project status, indicative project timeline (based on published information) and extent of overlap with dSAC boundaries. This information has been used variously within the specific assessments described below.

Table B.5.4 Planned offshore wind development in the vicinity of Southern North Sea dSAC

Development	Project	Status	Programme	Capacity (MW)	No of Turbines	Development Within dSAC (%)	Development Outside of dSAC But Within 26km (%)	Development 26 – 50km From dSAC (%)
Hornsea One	Heron	Consented, not yet built.	Project website indicates offshore construction works to start in 2018 and be completed in 2021. Assumed to be operational by 2022. Note, project website indicates development will consist of two projects (Heron and Njord). However, the DCO provides option for Hornsea One to be built out in three projects (Heron, Njord and Vi Aura) with same maximum capacity.	600	120	23.3	76.7	0.0
Hornsea One	Njord	Consented, not yet built.	Project website indicates offshore construction works to start in 2018 and be completed in 2021. Assumed to be operational by 2022. Note, project website indicates development will consist of two projects (Heron and Njord). However, the DCO provides option for Hornsea One to be built out in three projects (Heron, Njord and Vi Aura) with same maximum capacity.	600	120	0.0	100	0.0
Hornsea Two	Optimus	In planning.	Application currently in examination. Construction timeline unclear. Developments anticipated to occur sequentially (i.e. Hornsea Two after Hornsea One) (DECC, pers. comm.).	900	180	6.7	93.3	0.0
Hornsea Two	Breesea	In planning.	Application currently in examination. Construction timeline unclear. Developments anticipated to occur sequentially (i.e. Hornsea Two after Hornsea One) (DECC, pers. comm.).	900	180	99.9	0.1	0.0
Dogger Bank Creyke Beck	A	Consented, not yet built.	Construction timeline unclear. Construction could start as early as 2018.	1200	200	100	0.0	0.0
Dogger Bank Creyke Beck	B	Consented, not yet built.	Construction timeline unclear. Construction could start as early as 2018..	1200	200	100	0.0	0.0
Dogger Bank Teesside	A	In planning.	Construction timeline unclear. Developments anticipated to occur sequentially (i.e. Dogger Bank Teesside A and B after Dogger Bank Creyke Beck A and B) (DECC, pers. comm.).	1200	200	0.0	0.8	77.7
Dogger Bank Teesside	B	In planning.	Construction timeline unclear. Developments anticipated to occur sequentially (i.e. Dogger Bank Teesside A and B after Dogger Bank Creyke Beck A and B) (DECC, pers. comm.).	1200	200	21.4	78.6	0.0
Dogger Bank Teesside	C	In development.	Construction timeline unclear. Developments anticipated to occur sequentially (i.e. Dogger Bank Teesside C and D after Dogger Bank Teesside A and B) (DECC, pers. comm.).	1200	200 *(based on Creyke Beck A/B and Teesside A/B)*	56.0	44.0	0.0

Development	Project	Status	Programme	Capacity (MW)	No of Turbines	Development Within dSAC (%)	Development Outside of dSAC But Within 26km (%)	Development 26 – 50km From dSAC (%)
Dogger Bank Teesside	D	In development.	Construction timeline unclear. Developments anticipated to occur sequentially (i.e. Dogger Bank Teesside C and D after Dogger Bank Teesside A and B) (DECC, pers. comm.).	1200	200 (*based on Creyke Beck A/B and Teesside A/B*)	0.0	31.1	68.8
East Anglia	One	Consented, not yet built.	Contract for Difference awarded in 2015. ScottishPower Renewables aims to start construction in 2017, with the first turbines installed by 2019 and the project fully operational during 2020.	714	100	100	0.0	0.0
East Anglia	Three	In development.	Construction timeline unclear. Developments anticipated to occur sequentially (i.e. East Anglia Three after East Anglia One) (DECC, pers. comm.).	1200	172	100	0.0	0.0
East Anglia	Four	In development.	Construction timeline unclear. Developments anticipated to occur sequentially (i.e. East Anglia Four after East Anglia Three) (DECC, pers. comm.).	1200	240	100	0.0	0.0
Triton Knoll	-	Consented, not yet built.	Construction timeline unclear. Construction could start as early as 2018.	900	288	0.0	31.4	68.6
Dudgeon	-	Consented, onshore works started.	Project website indicates onshore construction works commenced in 2014, with offshore works to start in 2016 and be completed in 2017. Operational by 2017.	402	67	0.0	89.9	10.1
Race Bank	-	Consented, not yet built.	Construction timeline unclear. Construction could start as early as 2018.	580	91	0.0	0.0	97.8
Galloper Extension	-	Consented, not yet built.	Construction timeline unclear. Construction could start as early as 2018.	336	56	100	0.0	0.0

Table B.5.5 Planned offshore wind development in the vicinity of Outer Moray Firth dSAC

Development	Project	Status	Programme	Capacity (MW)	No of Turbines	Development Within dSAC (%)	Development Outside of dSAC But Within 26km (%)	Development 26 – 50km From dSAC (%)
Moray Firth	Telford	Consented, not yet built.	Construction timeline unclear. Developments anticipated to occur sequentially (DECC, pers. comm.). Construction could start as early as 2018 (Note staggered start of construction for three windfarms, may occur in different order).	372	62	90.6	9.4	0.0
Moray Firth	Stevenson	Consented, not yet built.	Construction timeline unclear. Developments anticipated to occur sequentially (DECC, pers. comm.).	372	62	100	0.0	0.0
Moray Firth	MacColl	Consented, not yet built.	Construction timeline unclear. Developments anticipated to occur sequentially (DECC, pers. comm.).	372	62	100	0.0	0.0
Beatrice	-	Consented, not yet built.	Contract for Difference awarded in 2014. Beatrice Offshore Windfarm Limited (BOWL) aims to start construction in 2016, assumed to be completed in 2019. Operational by 2020.	664	140	87.9	12.1	0.0
Hywind	-	In development.	Construction timeline unclear. Application could be submitted in 2016.	30	5	0.0	100	0.0
European Offshore Wind Deployment Centre	-	Consented, not yet built.	Construction timeline unclear.	100	11	0.0	100	0.0

Table B.5.6 Planned offshore wind development in the vicinity of North Channel and Outer Solway dSAC

Development	Project	Status	Programme	Capacity (MW)	No of Turbines	Development Within dSAC (%)	Development Outside of dSAC But Within 26km (%)	Development 26 – 50km From dSAC (%)
Walney Extension	Phases 1 and 2	Consented, not yet built.	Project website indicates offshore construction works to start in 2016 and be completed in 2019.	750	207	0.0	0.0	39.1

Table B.5.7 Planned tidal stream development in the vicinity of North Anglesey Marine / Gogledd Môn Forol dSAC

Development	Project	Status	Programme	Capacity (MW)	No of Turbines	% of Development Within dSAC	% of Development Outside of dSAC But Within 5km
Anglesey Skerries Tidal Array	-	Consented, not yet built.	Project website indicates construction works to start in 2016. Could be completed as early as 2017.	10	10	100	0.0
West Anglesey Demonstration Zone	-	In development.	Test site.	-	-	85.3	14.7
Holyhead Deep	-	In development.	Application could be submitted as early as 2016...	10	20	100	0.0

Table B.5.8 Planned tidal stream development in the vicinity of West Wales Marine / Gorllewin Cymru Forol dSAC

Development	Project	Status	Programme	Capacity (MW)	No of Turbines	% of Development Within dSAC	% of Development Outside of dSAC But Within 5km
Ramsey Sound	-	Consented, not yet built.	Initial 400 kW devices to be installed in 2015, followed by scaled up version (i.e. to 1.2 MW) in 2016.	1.2	3	100	0.0
St David's Head	-	In development.	Project website indicates construction works to be completed in 2017.	10	27	100	0.0

Table B.5.9 Planned tidal stream development in the vicinity of North Channel and Outer Solway dSAC

Development	Project	Status	Programme	Capacity (MW)	No of Turbines	% of Development Within dSAC	% of Development Outside of dSAC But Within 5km
Mull of Galloway	-	In development.	Application could be submitted as early as 2016.	30	30*	100	0.0
* No information available. As both developments incorporate MCT devices, the number of turbines is scaled from the Anglesey Skerries Tidal Array.							

B.5.6.1 HRA of New Development and Geophysical Surveys Within or Near Site Boundaries

Based on JNCC and country nature conservation agency advice, it has been assumed for the purposes of this assessment that HRA could be triggered for new development applications (applications not determined by date of designation), consented but not yet constructed developments (following or to inform a Review of Consents) and for certain types of planned geophysical surveys as follows:

- Offshore wind development within 26km (lower and intermediate scenarios)[4] or 50km (upper scenario) of site boundaries;
- Tidal turbine development (tidal stream, tidal range) within site boundaries (lower and intermediate scenarios) or within 5km of site boundary (upper scenario); and
- Sub-bottom profiler and possibly multibeam geophysical surveys within site boundaries (all scenarios).

HRAs for development projects

The number and timing of new development applications and consented but not yet built projects has been based on a review of published project time scales and additional information provided by developers with some informal comments from regulators (see Table B.5.4 to Table B.5.9).

For offshore wind developments, it has been assumed that all planned projects within 26km (lower and intermediate scenarios) or 50km (upper scenario) will incur additional costs in relation to HRA, either at the point of submitting their development consent application, to support determination of an existing application or to provide additional information to inform a Review of Consent. It has been assumed that these costs are incurred in 2016 for consented projects or projects for which consent has been applied for. For projects for which consent has not yet been applied for, it is assumed that the costs are incurred in the year in which the consent application is proposed to be made.

For tidal stream developments, it has been assumed that all planned projects within site boundaries (lower and intermediate scenarios) or within 5km of site boundaries (upper scenario) will incur additional costs in relation to HRA, either at the point of submitting their development consent application, to support determination of an existing application or to provide additional information to inform a Review of Consent. It has been assumed that these costs are incurred in 2016 for consented projects or projects for which consent has been applied for. For projects for which consent has not yet been applied for, it is assumed that the costs are incurred in the year in which the consent application is proposed to be made.

Consultation with the industry has indicated differing views on the possible cost of preparing HRAs for harbour porpoise dSACs, dependent on the extent to which relevant information and assessment might have already been included within EIAs and depending on the timing of the requirement. Indicative cost estimates ranged from tens of thousands up to £1m. There is significant uncertainty surrounding the scope of such HRAs, particularly relating to what might be required to provide a suitably robust assessment.

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[4] Based on advice from JNCC. This is the distance over which Tougaard *et al* (2014) estimate that significant disturbance of harbour porpoise may occur during percussive piling of large monopiles.

JNCC and the country nature conservation agencies have indicated that the primary concern about the impacts of new development and geophysical surveys relates to their contribution to overall levels of underwater noise. It is recognised that it would be onerous for individual operators to prepare HRAs which each take account of potential cumulative underwater noise. It has therefore been suggested that a strategic HRA should be progressed as a joint initiative between regulators, SNCBs and industry covering all of the dSACs. This would document the location and nature of planned activity and make a judgement on the extent to which such activity was consistent with achievement of dSAC conservation objectives. An indicative cost of preparing the strategic HRA has been suggested to be around £100k, for which it is anticipated that the costs would be shared between the public sector and industry (oil and gas, offshore renewables and aggregates). A possible level of contribution from the offshore renewables sector might be of the order of £20k. It is assumed that thereafter the strategic HRA would be maintained by the relevant regulators based on information provided by industry.

If such a tool is developed, assuming that existing information provides a sufficient basis for documenting the findings within an HRA, that there are no substantive issues with cumulative underwater noise, and that there is clear guidance from the SNCBs in terms of required outcomes, it is suggested that the costs of undertaking and documenting the HRA for offshore wind or tidal turbine development might be of the order of £30k. This level of cost has been assumed for development projects for the purposes of the IA.

The offshore wind industry has expressed strong concerns about the potential consequential impacts on developers associated with the HRA process for new developments, should the designations give rise to significant additional requirements. Where projects have already proceeded through examination in public, any new requirement for HRA could potentially be a material change, requiring additional examination. The delay to this process could result in a development missing a Contract for Difference (CfD) window leading to project delays and possible project cancellation. For projects that have been consented and obtained a CfD, if there was a requirement to prepare a further HRA which entailed significant additional work, this could cause delays, resulting in projects missing legally binding CfD milestones. Such delays could, as a worst case, lead to project cancellation. Developers also expressed concerns that any significant uncertainties created by the designations could deter investors, again leading to project cancellation. The advice from JNCC and the other SNCBs is that based on their current views on requirements for conservation measures, the designations should not impose significant additional burdens on offshore wind developers and therefore there should not be any significant delays or uncertainties created by the designations. The assessment has been prepared based on the JNCC/SNCB assumptions.

HRAs for certain geophysical surveys

Based on JNCC and country nature conservation agency advice, it is assumed that following designation, HRA could be required for certain geophysical surveys proposed within site boundaries under all scenarios. This could include sub-bottom profiler surveys and possibly multibeam surveys.

Assuming that a strategic HRA is in place (see section above) and that this concludes that current levels of disturbance/temporary loss of habitat are not significant, the process for considering project level HRAs for sub-bottom profiler and/or geophysical surveys may be straightforward and require relatively little effort from developers to provide the information that regulators require over and above the information already provided for MMO's voluntary notification form. For the purposes of this IA it has been assumed, on a conservative basis that all multibeam and sub-bottom profiler surveys will require HRA and that there will be a nominal additional cost to developers of £1k to provide the necessary information to inform the HRA. Where a series of surveys are planned within a single year, it is assumed that a single HRA would cover the whole survey campaign.

The number of survey campaigns for each dSAC has been estimated taking account of published project construction timetables and additional information provide by developers (see Table B.5.4 to Table B.5.9), based on the following assumptions:

- A site characterisation geophysical survey 3 years before planned application year (it is assumed that these have largely already been completed);
- A pre-construction survey 1 year before construction;
- A post-construction geophysical survey one year after planned operational year; and
- Subsequent post-construction geophysical surveys (for operational purposes and to fulfil licence conditions) - it is assumed that some level of activity will be required annually for each development.

B.5.6.2 Review of Existing Consents

Designation of the sites will trigger a requirement for a review of existing consents to determine whether the activity is consistent with achievement of each site's conservation objectives. The following assumptions have been made for the purposes of the assessment:

- Review of consents carried out for all consented but not yet built offshore wind farms, tidal stream or tidal range developments under all scenarios, taking account of the following buffers:
  - Offshore wind farms – 26km (lower and intermediate scenarios); 50km (upper scenario);
  - Tidal stream and tidal range developments - within site boundary (lower and intermediate scenarios); 5km (upper scenario);
- For consented but not yet built offshore wind farms, measures to manage the effects of underwater noise associated with piling activities may need to be considered from the date of designation (see Sections 5.6.3 and 5.6.4);
- For tidal turbines, consideration may need to be given to the requirement for additional measures to manage collision risk from the date of designation (Section 5.6.5 and 5.6.6); and
- For all consented but not yet built projects, there may be a requirement to seek further information form the developer (see previous section).

The potential costs associated with reviewing existing consents would fall on the relevant licensing authorities and SNCBs and are reported under public sector costs. It has been assumed that the competent authorities would carry out any necessary Appropriate Assessments based on existing information (e.g. information contained within EIAs or European Protected Species assessments). Potential costs to developers associated with the implementation of any necessary management measures are assessed separately (see sections B.5.6.3 to B.5.6.6 below).

The industry has identified concerns that depending on the timing of designations and the review of consents and the outcomes of these reviews this could introduce delay and uncertainty at critical points in the decision-making process for individual projects and that this could lead to the cancellation of projects.

The advice from JNCC and the other SNCBs is that based on their current views on requirements for conservation measures, the designations should not impose significant additional burdens on offshore wind developers and therefore there should not be any significant delays or uncertainties created by the designations. The assessment has been prepared based on the JNCC/SNCB assumptions.

B.5.6.3 Spatio-Temporal Conditions on Piling Activity or Reducing Sound Levels at Source Within Site Boundaries

Based on JNCC and country nature conservation agency advice, under the intermediate scenario, it has been assumed that underwater noise generated from percussive piling activity could be restricted within site boundaries through spatio-temporal measures (limiting the amount of piling that can occur at any one time and/or limiting the piling activity to particular times of year). Should this be insufficient to achieve site conservation objectives, there may also be a requirement to reduce sound levels at source through mitigation measures. In addition there may be a requirement for additional post consent monitoring in order to assess impact predictions.

Spatio-temporal measures

In order to manage the levels of disturbance to harbour porpoise within dSACs, JNCC and the country nature conservation agencies have indicated that there may be a requirement to establish limits for the spatial extent of dSACs that might be affected by underwater piling noise over a given time period. JNCC has indicated that the limits might be set at 20% of a site being unavailable to harbour porpoises as a consequence of noise disturbance (within 26km of locations of percussive piling) during the season for which the site is important and that if that limit is exceeded then the average should not exceed 20% over a period of 8 years. Such limits and thresholds recognise that a level of disturbance of harbour porpoise within dSACs would not compromise the achievement of site conservation objectives. There are two dSACs within which offshore wind farm construction is planned to occur within the time period of the assessment – Southern North Sea dSAC and Outer Moray Firth dSAC. Offshore wind developers have indicated that in the short to medium term all offshore wind farm developments will be reliant on percussive methods for foundation installation - either monopiles or steel jackets (pin piles).

For the Southern North Sea dSAC which occupies an area of around 37,000km^2, the threshold would allow for two to three offshore wind farms to be constructed concurrently using percussive piling methods without exceeding the threshold. The number of offshore windfarm developments that might be constructed concurrently within the southern North Sea dSAC is uncertain. While the current published developer time lines indicate that multiple developments could be constructed concurrently (Table B.5.4), particularly from 2018 onwards, the published timelines are acknowledged by the industry as being unlikely to be met. Indeed, the experience of the industry to date has been that project time lines slip. In addition, the indicative timelines do not take account of the likely availability of CfD, nor the availability of installation plant. DECC has indicated that these constraints mean that the installation rate over the next five years within the Southern North Sea dSAC is unlikely to exceed 1

GW p.a. (DECC, pers. comm.). On this basis, it is considered unlikely that the threshold for piling noise in the Southern North Sea dSAC would be exceeded within the next five years and therefore no additional management measures would be required during this period.

Beyond five years, it is possible that higher rates of installation became more economically and technically feasible. However this is uncertain. It is possible that during this period, other cost effective foundation designs may become available which are not reliant on percussive methods which could mean that the piling threshold would not be exceeded. For the purposes of this assessment it has been assumed that no significant additional costs will be incurred beyond five years.

For the Outer Moray Firth dSAC, which occupies an area of 4,300km², there are two planned offshore wind farm developments located in the northernmost section of the site (Table B.5.5). Even should these developments be constructed concurrently, it is estimated that on average less than 20% of the site would be subjected to significant noise disturbance from percussive piling and for a period of considerably less than 10 years. On this basis, it is considered unlikely that the threshold for piling noise in the Outer Moray Firth dSAC would be exceeded and therefore no additional management measures would be required.

Underwater noise reduction measures

There is a growing evidence base on the costs and effectiveness of measures to reduce underwater noise at source. These measures primarily include the use of bubble curtains, sound dampers or noise mitigation screens. The performance of these measures in reducing underwater noise are reviewed in Bellman (2014), based on over 700 measurements for offshore wind farm pile installation in the German North Sea and Baltic Sea (see also Koschinski and Lüdemann, 2013). All of the measures are probably capable of achieving an order of magnitude reduction in sound levels. Recent data for sound damper systems indicate that these systems may be capable of achieving greater levels of sound reduction and more consistently. For example, Elmer and Savery (2014) indicate reductions of up to 23dB SEL are achievable, while Dziedzicka *et al*. (2015) report sound reductions of 12-14dB SEL with a theoretical maximum reduction of 44dB SEL for W3G Marine's HydroNAS™ system.

Some information on the costs of these mitigation measures is also available. Pondera Consult (2014) report costs of mitigation measures for a 288MW German offshore wind farm comprising 80 monopiles to be in the region of €20m (roughly £15m at April 2015 exchange rates). These costs included the deployment of 2 dedicated vessels, 12 compressors, 3 Big Bubble Curtains (BBC), pingers, seal scarers and measurements of hydrosound and C-PODS. The great majority of these costs are likely to have been associated with the deployment of the bubble curtains. An average cost per pile of using BBC technology might be around £170k (roughly 90% of total cost of £15m divided by 80 piles). These costs do not include any costs associated with extension of the construction programme, which could be significant.

Vattenfall (pers. comm.) estimated the cost of using bubble curtains for East Anglia One as between €36m - €72m for c200 monopiles and/or jackets. Based on evidence from other windfarms, Vattenfall estimates that the cost of such mitigation measures is between 10-30% of total foundation costs which in turn may be 20-30% of total project costs. Such measures would therefore represent a significant additional cost and could compromise the viability of a project.

W3G Marine Ltd has provided indications of the costs for deploying its HydroNAS™ system (W3G Marine Ltd, pers. comm. This indicated an average cost of approximately £15k for a 5m pile assuming a water depth of 20m or £11k per pile assuming a water depth of 8m. Separately, Nehls *et al* (2007) estimated the cost of deploying sound damper systems as between €20,000 to €25,000 (£15,000 to £18,750 at April 2015 exchange rates) per pile. Such systems are claimed to cause very little interference to the piling process and might therefore reduce time delays compared to other mitigation measures. However, sound dampers have not been used for commercial scale developments and thus remain unproven. The requirement to attach the sound dampers to piles prior to installation may also require additional space on the installation vessel, reducing the number of foundations that could be transported to a site in an installation cycle. This could potentially have time and cost implications.

Based on current assumptions about likely offshore wind farm installation rates in the Southern North Sea dSAC, it is considered unlikely that sound reduction measures would be required in the next five years. Beyond this time period, it is possible that the implementation of sound reduction measures could play a role in supporting compliance with a piling noise threshold for installation rates in excess of 1GW p.a. However, given the uncertainty concerning whether such measures might be required, no assessment of possible costs has been included within this assessment.

Additional post-consent monitoring

Where mitigation measures are applied to limit or reduce underwater noise, there may be a requirement to undertake post-consent monitoring to assess impact predictions. JNCC has indicated that this might be based on a combination of modelling and aerial survey. The modelling work might build on the suggested noise register and modelling tool proposed to facilitate the assessment of cumulative impacts within HRAs. These costs are already accounted for under HRA costs and are therefore not duplicated here. JNCC has indicated that post consent monitoring would be best carried out at a strategic scale as a partnership between the SNCBs and industry. Annual costs to the SNCBs, assuming a 12 year cycle and a 50% contribution are estimated to be around £40k (see Appendix E). For the purposes of this IA it is assumed that the offshore renewables industry would contribute a similar amount of funding at a national level.

B.5.6.4 Prohibition on Pile Driving Within dSACs

Based on JNCC and country nature conservation agency advice, as a worst case under the upper scenario, it has been assumed that percussive piling (both monopiles and steel jackets) may be prohibited within the boundaries of each dSAC.

Koschinski and Lüdemann (2013) provide a review of alternative foundation technologies including suction cup, gravity base and floating offshore wind. A number of projects are trialling the use of alternative foundation technologies and installation methods as part of the Carbon Trust's Foundations Innovation Programme (http://www.carbontrust.com/our-clients/o/offshore-wind-accelerator) and the results from these trials should be available during 2015. However, the offshore wind industry has indicated that it does not anticipate any of these technologies becoming available for widespread use within the next five to ten years. This could effectively mean that none of these planned projects could proceed. As a worst case scenario for the purposes of this IA, it has been assumed that no offshore wind farm development within the dSACs planned for construction in the period to 2020 proceeds (see

Table B.5.4 and Table B.5.5) but that thereafter alternative foundation types or installation methods become available at a competitive cost.

The costs of constructing and operating individual wind farms and tidal turbine developments and the associated economic benefits (in terms of Gross Value Added and employment) will be site specific. Seagreen Wind Energy (2012) presents indicative information on the potential economic benefits associated with the Seagreen Phase 1 (Projects A and B) offshore wind development based on an installed capacity of around 1GW:

- Estimated GVA to UK during construction (based on estimated expenditure figures) of £80m to £513m (average £296m);
- Operational GVA to UK estimated to lie between £17.4m to £32.4m p.a. (average £24.9m p.a.);
- Construction employment in UK ranging between 1728 to 11489 FTE jobs during the four year construction period (average 6608); and
- UK operational employment of approximately 200 jobs for 25 years.

For the purposes of this IA, when considering the potential impacts of not proceeding with development, the above values have been used as indicative of all offshore wind projects. It should be recognised that any lost energy generation capacity would most likely be offset by additional capacity elsewhere within the energy supply system. The net cost to the UK economy as a whole might therefore be expected to be smaller.

It is also noted that the loss of renewable energy generation capacity could result in a relative increase in carbon emissions, depending on which energy generation technologies replace that loss. This could result in an additional economic impact but this impact has not been quantified in this assessment.

B.5.6.5 Additional Mitigation Measures for Tidal Turbines to Reduce or Limit Collision Risk Within Site Boundaries

Based on JNCC and country nature conservation agency advice, it is assumed that tidal stream and tidal range turbines within site boundaries may need to implement additional measures to reduce or limit collision risk under the intermediate scenario.

As at April 2015, the only proposals for tidal range turbines in UK waters which are in the planning domain are in the Severn Estuary (Cardiff) and Bristol Channel (Swansea Bay). Neither of these locations is within 5km of a harbour porpoise dSAC and therefore would not be expected to incur any additional costs associated with designation of these sites. In the absence of any other firm proposals for tidal range developments, it is not possible to assess potential cost impacts to this sub-sector.

For tidal stream projects in Wales, NRW has indicated that any mitigation measures for harbour porpoise would already be triggered by European Protected Species legislation and therefore there would be no additional mitigation costs attributable to the dSAC designations under the intermediate scenario.

For tidal stream projects in Scotland, SNH has indicated that active sonar might need to be fitted to 20% of devices within dSACs as an additional measure to EPS requirements. In addition, devices might need to be automatically shut down should harbour porpoise be detected in the vicinity (within 30m) when in operation. The cost of installing a single active sonar system on a tidal device is approximately £40k.

For the purposes of this IA, it has been assumed that additional one-off costs of £40k will be incurred in the installation year for 20% of tidal turbines within site boundaries for the incorporation of active sonar and shut down systems based on Table B.5.8 and Table B.5.9 It has been assumed that annual running costs for equipment maintenance will be minor and that routine maintenance will be carried out during planned shutdowns. It has been assumed that the equipment will need to be replaced every five years.

It is difficult to estimate the number and duration of any shutdowns that might be required as there is relatively little evidence of how frequently harbour porpoise might approach within 30m of devices when in operation. Experiences from the Marine Current Turbine deployment in Strangford Lough indicate that the maximum number of shutdowns experienced for that turbine was of the order of 5 per week. However, most of these shutdowns were in relation to seals rather than harbour porpoise, with the latter generally avoiding the vicinity of the turbines. Should a significant number of shutdowns be required for harbour porpoise at locations within dSACs, this could have a material impact on electricity generation and thus on project revenues. In the absence of certainty concerning the amount of electricity that will be generated, this could be a significant deterrent to investment. However, it is not possible to reliably quantify this impact.

B.5.6.6 Removal or Avoidance of Collision Risk Pressure Within Site Boundaries

Based on JNCC and country nature conservation agency advice, as a worst case under the upper scenario, it has been assumed that tidal stream developments within site boundaries would not proceed resulting in an impact on economic output from the sector. The potential changes have therefore been estimated in terms of impacts on Gross Value Added (GVA) and employment (jobs) based on information from Regeneris Consulting and Cardiff University (2013).

Regeneris Consulting and Cardiff University (2013) provide estimates of the GVA and employment impacts of a number of hypothetical wave and tidal development scenarios in Wales. From these scenarios, indicative total (direct, indirect and induced) GVA and employment impacts can be derived for tidal stream projects Table B.5.10.

Table B.5.10 Potential economic benefits of tidal stream development

Stage	Total GVA £m per MW	Total Employment per MW (Number of jobs)
Construction	1.28	35 (during construction period)
Operation	0.04 p.a.	0.83 p.a.

(Source: Regeneris Consulting and Cardiff University, 2013)

These estimates have been applied to planned developments that may be affected by the management measure based on the proposed capacity of each development. Where more than 50% of a proposed development area overlaps with a dSAC boundary, it has been assumed that none of the development would proceed. While the estimates indicate the potential impact to the offshore renewables sector, it is recognised that the lost energy generation capacity could be offset by additional capacity elsewhere within the energy supply system. The net cost to the UK economy as a whole would therefore be expected to be smaller.

It is also noted that the loss of renewable energy generation capacity could result in a relative increase in carbon emissions, depending on which energy generation technologies replace that loss. This could result in an additional economic impact but has not been quantified here.

B.5.6.7 Enhanced Mitigation Measures to Reduce or Limit Impacts of Geophysical Surveys Within Site Boundaries

Based on JNCC and country nature conservation agency advice, additional mitigation could be required for some types of geophysical surveys within site boundaries under the intermediate scenario.

For sub-bottom profiler surveys), the proposed management measures could require:

- Soft start procedures (if appropriate); and
- Use of Marine Mammal Observers, following EPS protocol

In Scottish Territorial Waters, soft start and MMO's are already required to meet EPS provisions. For surveys in these waters, it is not expected that additional costs would be incurred in meeting these requirements. Elsewhere within UK waters, additional costs may be incurred. The main cost associated with these additional measures is considered to be the additional cost of employing MMO's. The cost of complying with the soft start requirements and applying the EPS protocol are considered to be minimal.

The annual additional cost for employing MMO's has been estimated based on the following assumptions:

- Sub-bottom profiler surveys are carried out as follows:
  - Offshore wind:
    - To inform site characterisation (it has been assumed that site characterisation has already largely been undertaken);
    - A pre-construction survey to inform engineering for foundation design (it has been assumed that this will be required for each planned project for which a CfD has not yet been obtained and that each survey will require approximately 10 days of survey effort);
    - The daily cost for an MMO has been assumed to be £400 (Gardline pers. comm indicated a daily cost of £300 - £600). It has been assumed that two MMO's would be required to provide 24 hour working.
  - Tidal stream:
    - To inform site characterisation and engineering for foundation design (it has been assumed that this will be required for each planned project and that each survey will require approximately 1 day of survey effort);
    - The daily cost for an MMO has been assumed to be £400 (Gardline pers. comm indicated a daily cost of £300 - £600). It has been assumed that only one MMO would be required as the surveys are likely to be completed within 1 day.

The industry has noted that depending on the survey vessel used to undertake the surveys, it may not have sufficient space to accommodate extra survey staff. Should this prove to be the case, then larger survey vessels would need to be hired, potentially resulting in a doubling of survey costs. It has not been possible to estimate these potential additional costs within the assessment.

B.5.6.8 Limiting the Number and Duration of Geophysical Surveys Within or Near Site Boundaries

Based on JNCC and country nature conservation agency advice, it has been assumed that there may be a requirement to limit the number and duration of geophysical surveys within a site, subject to the provisions of Article 6 of the Habitats Directive. However, such requirements will be site specific and in the absence of detailed information on site activity and thresholds, it is not possible to quantify the potential impacts. The intermediate estimate value has been used in the absence of a cost for the upper scenario.

The offshore wind industry has indicated that the potential costs associated with delays in undertaking surveys could be very large, particularly where surveys are on the critical path for a development. Such delays could mean that CfD milestones are not met and affect the viability of a project. Delays in the timing of surveys may also push surveys into less favourable weather windows and increase survey costs as a result of weather down time.

B.5.7 Limitations

- Uncertainty concerning scale and location of future development for offshore renewables;
- Uncertainty concerning the specific management measures required for individual projects; and
- Uncertainty concerning delays and their potential implications for projects.

B.5.8 References

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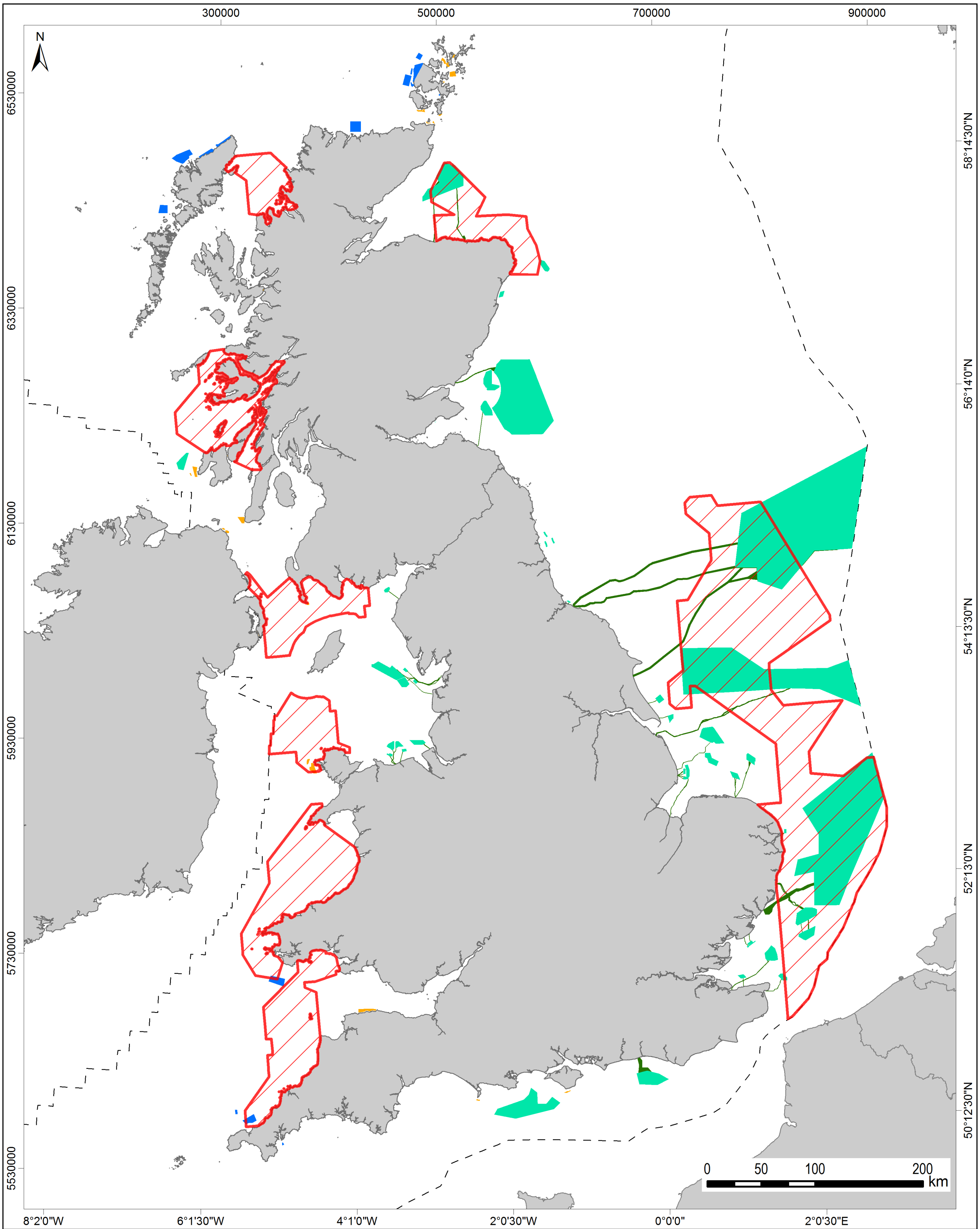

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Projection	Transverse Mercator		
Scale	1:5,000,000		
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Produced by ABPmer			

- Recommended dSAC
- Continental Shelf
- Wave Lease Area
- Existing Wind Farm
- Wind Farm Export Cable Agreements
- Tidal Lease Area
- Tidal Export Cable Agreements

ABP mer marine environmental research

Offshore Renewables

Figure B5.1

B.6 Oil and Gas

B.6.1 Introduction

This appendix provides an overview of potential future exploration and decommissioning activity for the oil and gas sector in UK waters and outlines the methods used to assess the impacts of potential dSACs on this sector.

B.6.2 Sector Definition

This sector relates to exploration, production and decommissioning activity undertaken by the oil & gas industry in the sub-sea environment. 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. This assessment focuses on exploration and decommissioning activities as these have been identified by JNCC as potentially requiring management measures to support achievement of harbour porpoise dSAC conservation objectives.

B.6.3 Overview of Existing Activity

Information sources used in the assessment are listed in Table B.6.1.

Table B.6.1 Oil and gas information sources

Scale	Information Available	Date	Source
UK	Oil and gas pipeline, field and terminal station location (	2015	DECC
UK	Location of currently licenced areas	2015	DECC
UK	Oil and gas economic and employment statistics	2014	Oil and Gas UK
UK	Recent trends in the oil and gas industry	2015	Oil and Gas UK
UK	Future trends of the oil and gas industry	2015, 2014 & 2011	DECC, Oil and Gas UK and Baxter *et al.* (2011)
UK	Potential interactions between dSAC and Oil and Gas industry	2011	JNCC and Natural England
UK	Identification of potential mitigation measures	2015	Oil and Gas UK
UK	Oil and gas pipeline, field and terminal station location (	2015	DECC
UK	Location of currently licenced areas	2015	DECC
UK	Oil and gas economic and employment statistics	2014	Oil and Gas UK
UK	Recent trends in the oil and gas industry	2015	Oil and Gas UK
UK	Future trends of the oil and gas industry	2015, 2014 & 2011	DECC, Oil and Gas UK and Baxter *et al.* (2011)

B.6.3.1 Location and Intensity of Activity

The location of oil and gas activity in relation to the dSAC boundaries around the UK are shown in Figure B6.1.

A number of blocks currently licenced by the Department of Energy and Climate Change (DECC) exist around the UK; the majority of these are located in the North Sea off the east coast of England and Scotland. Other smaller licenced areas also exist off the south and north-west coasts of England, the north and north east coasts of Scotland, the north-east coast of Northern Ireland and the south-west coast of Wales. A UKCS infrastructure wallmap showing oil and gas activity (DECC, 2015a) around the UK identified 154 oil fields in the Southern North Sea. Field status was only available for 124 of these fields which indicated that 92 were producing oil, 19 has ceased production and 13 had suspended production in April 2015 (DECC, 2015b). Oil extracted from these fields is transported to shore via pipeline to four oil terminal stations located at Bacton, Theddlethorpe and Easington (x2). Only one gas field was identified in the area, however the status of the field was not available.

B.6.3.2 Economic Value and Employment

In 2013 the oil and gas sector remained 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 2013 was estimated at £30 billion (Oil and Gas UK, 2014). In 2012, sales from the UKCS generated over £20 billion in the UK supply chain, an additional £15 billion was added to the supply chain via sales through the export of services and goods. In 2014 however the industry experienced the lowest production revenues since 1998 (£24.4 billion) and a negative cash flow of £5.3 billion which equates to the worst cash flow since 1970. Such losses were a result of lower oil prices which average out at $99 per barrel (bbl) but crashed from $76/bbl in quarter 4 to $55/bbl at the end of December (Oil and Gas UK 2015a).

The industry is also a major employer. It was estimated that in 2014, the oil and gas industry provided employment for about 450,000 people across the UK, these comprised of 36,000 being directly employed by oil and gas companies and major contractors, plus 200,000 employed in the wider supply chain and 112,000 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 (Oil and Gas UK, 2014). Overall, approximately 45% of these jobs were located in Scotland with other concentrations of employment being located in London, East Anglia and north east England (Oil and Gas UK, 2014).

B.6.3.3 Future Trends

It has been estimated that in 2030, 70% of primary energy in the UK is still expected to come from oil and gas (Oil and Gas UK, 2014). Overall demand for oil and gas has been predicted to fall slightly during this time period, from 146 million tonnes of oil equivalent (mtoe) in 2014 to 140 mtoe in 2020 (DECC 2015c). 2014 saw approximately 50% of oil and gas demand being produced from the UKCS resulting in the remaining 50% being imported into the country. Net production levels from the UKCS have been predicted to fall between 2014 and 2020 from 76 mtoe to 57 mtoe respectively; hence dependency of the UK on imported oil and gas is predicted to increase to 59% in 2020, an 11%

increase on 2014 levels. Oil and gas production in the UKCS is predicted to fall further, each decreasing 5% per annum between 2020 and 2030 (DECC 2015c).

According to the Economic Report of 2014 (Oil and Gas UK, 2014) almost 43 billion boe have been recovered so far from the UKCS, and a further overall recovery of 15 to 24 billion boe is forecast. The investment plans currently in place have the potential to extract 10 billion boe comprising 6.6 billion boe from existing or fields currently under development and approximately 4 billion boe from new field and incremental developments that have not yet been approved (Oil and Gas UK 2014).

A prediction made by Baxter *et al*., (2011) suggested that the wholesale gross value of the remaining reserves held within the UKCS between 2009 and 2030 may be worth between £650 billion to £1.1 trillion. This prediction however was made using the average price of oil and gas forecast by the Energy Information Administration between 2009 and 2030. The central price prediction for a single barrel of oil suggests that value will fall between 2014 and 2020 from $105.0 US per barrel to $96.2 US per barrel respectively. In contrast, the price of gas is predicted to increase slightly from 55.8 p/th to 60.3 p/th between 2014 and 2020 (using the central price prediction) (DECC 2014).

Image B.6.1 shows oil and gas production levels in recent years and DECC's current (March 2015) projections (DECC 2015c). A substantial decrease in oil and gas production in the UK since 1998 is clearly evident. In 2014 the production of oil decreased very slightly while gas production levels increased very slightly. Predicted oil and gas productions levels have been revised downwards relative to previous predictions as a result of the recent drop in oil prices and the lower forecasted future investment. These predictions are consistent with the post-measures forecasts published by the Office for Budget Responsibility in its March 2015 Economic and Fiscal Outlook. (DECC 2015c).

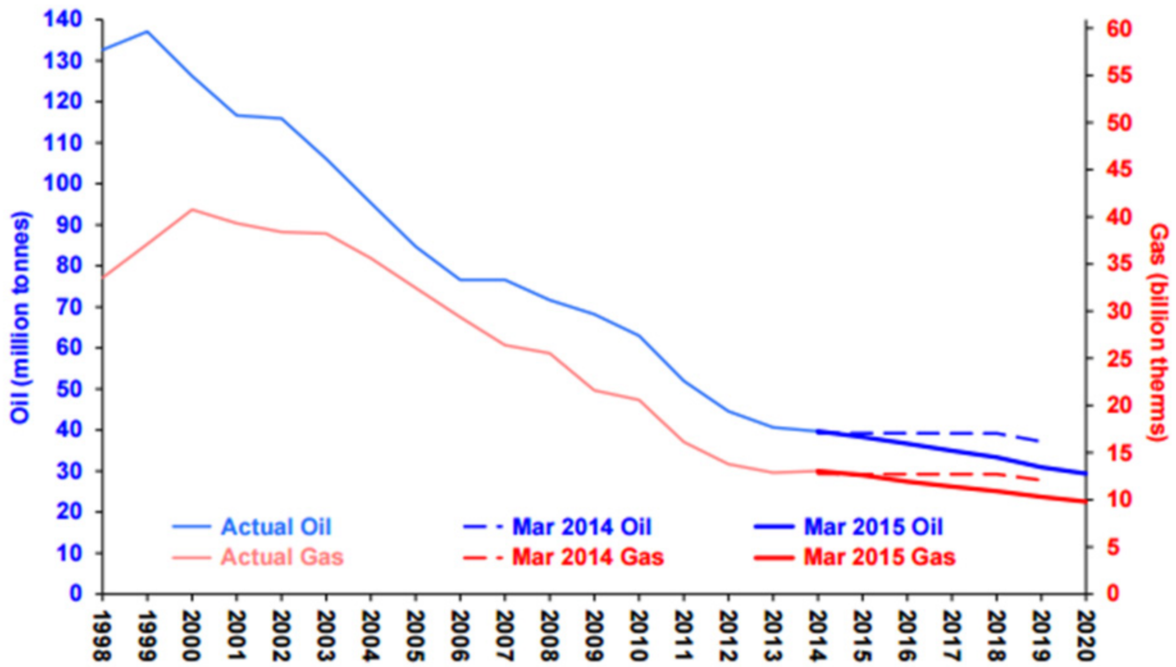

Image B.6.1 Actual/projected UKCS oil and gas production

B.6.4 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).

Decommissioning of current infrastructure, especially that present in the southern North Sea may also be a relevant consideration. Since 1970, £3 billion has been spent on decommissioning assets that have ceased production within the UKCS. In 2013 alone £900 million was spent on decommissioning activities, a figure predicted to rise to an average of £1.3 billion per year for the remainder of the decade (Oil and Gas UK 2014). Eventually, approximately 475 installations, 10,000 km of pipelines, 15 onshore terminals and 5,000 wells must be decommissioned from the UKCS. Total cost of decommissioning between 2014 and 2040 is predicted at £37 billion (Oil and Gas UK 2014).

B.6.5 Potential Management Measures

Oil and gas exploration and development may interact with harbour porpoise dSAC features in a number of ways. Such activities are already highly regulated to minimise environmental risks and the designation of harbour porpoise dSACs is considered unlikely to require significant changes.

Underwater noise associated with geophysical (including seismic) surveys or the use of explosives during decommissioning activities have the potential to injure or disturb harbour porpoise. JNCC guidelines for minimising the risk of injury and disturbance to marine mammals from seismic surveys (JNCC, 2010) already require the use of trained MMOs whose role is to advise on the use of the guidelines and to conduct pre-shooting searches for marine mammals before commencement of any seismic activity. A further duty is to ensure that the JNCC reporting forms are completed for inclusion in the MMO report. In addition to the visual mitigation provided by MMOs, if seismic surveys are planned to start during hours of darkness or low visibility it is considered best practice to deploy Passive Acoustic Monitoring (PAM).

JNCC has published draft guidelines for minimising acoustic disturbance to marine mammals whilst using explosives (JNCC, 2008).These guidelines require consideration to be given to requirements for mitigation measures, the use of MMO or PAM systems where appropriate to monitor for the presence of marine mammals within a 'mitigation zone', delaying the use of explosives for at least 30 minutes following the last record of a marine mammal in the mitigation zone and controlling the detonation of explosives to minimise potential environmental impact.

Table B.6.2 sets out the management measures that have been identified by JNCC and the country nature conservation bodies as potentially being required to support the achievement of conservation objectives in specific dSACs (see also Appendix D: Management Scenarios).

Table B.6.2 Potential management measures for oil and gas sector

Management Measure	Scenario		
	Lower	Intermediate	Upper
Habitats Regulations Assessment (HRA) of geophysical surveys or decommissioning activities using explosives within or near site boundaries	✔	✔	✔
Review of consents for proposed geophysical surveys or decommissioning activities using explosives within or near site boundaries	✔	✔	✔
Enhanced mitigation measures to reduce or limit impacts of geophysical surveys within or near site boundaries		✔	
Limiting the number and duration of geophysical surveys within or near site boundaries			✔
Enhanced mitigation measures to reduce or limit impacts associated with use of explosives during decommissioning activities within or near site boundaries		✔	
Prohibition on use of explosives in decommissioning activities within or near site boundaries			✔

The methods by which the cost impacts of these management measures have been assessed are described below. It is possible that some of these requirements could result in project delays. Depending on when these delays occur, they could be expensive. It is therefore difficult to reliably quantify the potential cost impact of delays. Where management measures have the potential to cause delay, this is noted below in relation to the relevant measures.

In addition, the uncertainty caused by the designations and requirements for management measures may act as a deterrent to investment. It is difficult to quantify this potential impact as it is unclear what level of uncertainty or additional cost might dissuade an investor. The potential for these impacts to occur is discussed in presenting the results within the main report.

B.6.6 Assessment Methods

B.6.6.1 HRA of Geophysical Surveys and Decommissioning Activities using Explosives

Based on JNCC and country nature conservation agency advice, it is assumed that following designation, HRA could be required for certain geophysical surveys proposed within site boundaries under all scenarios. This could include sub-bottom profiler surveys and possibly multibeam surveys in addition to seismic surveys. Similarly it is assumed that HRA could be required for all decommissioning activities using explosives within 1km (intermediate scenario) and 5km (upper scenario) of site boundaries.

Currently, operators are required to notify DECC of multibeam and side-scan sonar surveys and to apply for and obtain consent for sub-bottom profiler and seismic surveys. Operators are also required to obtain consent for the use of explosives.

JNCC and the country nature conservation agencies have indicated that the primary concern about the impacts of geophysical surveys relates to their contribution to overall levels of underwater noise. It is recognised that it would be onerous for individual operators to prepare HRAs which each take account of potential cumulative underwater noise. It has therefore been suggested that a strategic HRA should be progressed as a joint initiative between regulators, SNCBs and industry covering all of the dSACs. This would document the location and nature of planned surveys and make a judgement on the extent to which such survey activity was consistent with achievement of dSAC conservation objectives. (The SNCBs current view is that the levels of survey activity are compatible with achievement of the site conservation objectives). An indicative cost of preparing the strategic HRA has been suggested to be around £100k, for which it is anticipated that the costs would be shared between the public sector and industry (oil and gas, offshore renewables and aggregates). This might result in a one-off cost to the oil and gas sector of around £20k. It is assumed that thereafter the strategic HRA would be maintained by the relevant regulators based on information provided by industry.

Assuming that a strategic HRA is in place and that this concludes that current levels of disturbance are not significant, the process for considering project level HRAs should be relatively simple and require relatively little effort from operators to provide the information that regulators require over and above the information that is already provided to inform consent (seismic, sub-bottom profilers and explosive use) or which is provided on the voluntary notification form (multibeam, side-scan). For the purposes of this IA it has been assumed, on a conservative basis that all multibeam, sub-bottom profiler and seismic surveys and use of explosives will require HRA and that there will be a nominal additional cost to operators of £1k per HRA.

It is possible that some planned geophysical surveys may require more detailed assessment, for example where the spatial coverage of the survey is very large and/or large air gun arrays are being used for seismic surveys. Such costs would be project specific and it has not been possible to estimate costs for these within the IA.

An estimate of the annual number of seismic sub-bottom profiler and multibeam surveys within each dSAC potentially requiring HRA has been made based on PON14 application records (https://www.gov.uk/oil-and-gas-environmental-data) for the period 2012 to 2014 (Table B.6.3).

Table B.6.3 Numbers of oil and gas geophysical surveys within dSACs (2012 to 2014)

dSAC	Year		
	2012	2013	2014
Southern North Sea	26	24	25
Outer Moray Firth	3	4	1
North Minch	0	0	1
Total Number of Surveys	29	28	27

The survey in North Minch is considered to be a one-off survey and may not be repeated. For the purposes of the IA, it has been assumed that in the future geophysical surveys potentially requiring HRA will only take place in the Southern North Sea and Outer Moray Firth dSACs. It is assumed that there will be 25 surveys per year. In the Southern North Sea dSAC requiring HRA and 3 surveys in the Outer Moray Firth dSAC. To reflect an anticipated decline in the number of surveys required over time, it has been assumed that the number of applications decreases by 50% over the time period of the assessment (roughly 2% reduction per year).

DECC (Derek Saward pers. comm.) has indicated that it is unlikely that explosives would be required for well head removal in any of the dSAC areas given the availability of alternative well head removal techniques (e.g. cutting). It was estimated that possibly up to 10 operations per year within the Southern North Sea dSAC may require the use of explosives associated with the decommissioning of some smaller structures (Derek Saward pers. comm.). It has therefore been assumed that 10 HRAs would be required per year in relation to applications for the use of explosives within the southern North Sea dSAC for the duration of the assessment period.

B.6.6.2 Review of Existing Consents for Proposed Geophysical Surveys or Decommissioning Activities using Explosives Within or Near Site Boundaries

Designation of the sites will trigger a requirement for a review of existing consents to determine whether the activity is consistent with achievement of each site's conservation objectives. The following assumptions have been made for the purposes of the IA:

- Review of consents carried out for all consented but not implemented seismic and sub-bottom profiler surveys within site boundaries; and
- Review of consents for all consented decommissioning activities proposing the use of explosives within site boundaries and within 1km of site boundaries (intermediate scenario) or 5km of site boundaries (upper scenario).

The potential costs associated with reviewing existing consents would fall on the relevant licensing authorities and Statutory Nature Conservation Bodies and are reported under public sector costs.

Assuming that designation occurs in late 2015, DECC has indicated that there would be a relatively small number of open seismic survey/sub-bottom profiler consents as most consents are applied for and implemented within a calendar year to take advantage of the spring/summer survey window. Given that potential impacts to marine mammals and harbour porpoise from seismic/sub-bottom profiler surveys or explosive use will have been considered as part of the consent, DECC has indicated that it does not anticipate that the review of consents would lead to any requirement to change consent conditions and thus that there would be no significant costs to operators associated with any review of consents process.

B.6.6.3 Enhanced Mitigation Measures to Reduce or Limit Impacts of Geophysical Surveys Within Site Boundaries

Based on JNCC and country nature conservation agency advice, additional mitigation could be required for seismic and sub-bottom profiler surveys within site boundaries under the intermediate scenario.

For seismic surveys, this could include the use of Passive Acoustic Monitoring (PAM) systems for all surveys (whether they commence during daylight hours or at night, and whether they occur in winter or summer). Currently seismic surveys are only required to use PAM systems if seismic activity is planned to commence during the night and for winter surveys, given reduced daylight hours and generally lower visibility.

The additional costs associated with the enhanced mitigation measures for seismic surveys are considered to relate to the requirement to have an additional PAM operative on board the survey vessel (Gardline, pers. comm.). An indicative daily cost for a PAM operative is estimated to be £400 (Gardline pers.comm, daily cost range £300 - £600).

An estimate of the annual number of seismic survey days within each dSAC has been made based on PON14 application records (https://www.gov.uk/oil-and-gas-environmental-data) for the period 2012 to 2014 (Table B.6.4).

Table B.6.4 Number of seismic survey days within dSACs (2012 to 2014)

dSAC		Year		
		2012	2013	2014
Southern North Sea	Seismic	427	295	288
Outer Moray Firth	Seismic	10	23	0
North Minch	Seismic	0	0	164

The survey in North Minch is considered to be a one-off survey and may not be repeated. For the purposes of the IA, it has been assumed that in the future seismic surveys potentially requiring additional PAM monitoring will only take place in the Southern North Sea and Outer Moray Firth dSACs. It is assumed that there will be 300 survey days per year in the Southern North Sea dSAC and 10 survey days per year in the Outer Moray Firth dSAC. To reflect an anticipated decline in the number of surveys required over time, it has been assumed that the number of applications decreases by 50% over the time period of the assessment (roughly 2% reduction per year).

For sub-bottom profiler surveys), the proposed management measures could require:

- Soft start procedures (if appropriate); and
- Use of Marine Mammal Observers, following EPS protocol.

An estimate of the annual number of sub-bottom profiler survey days within each dSAC has been made based on PON14 application records (https://www.gov.uk/oil-and-gas-environmental-data) for the period 2012 to 2014 (Table B.6.5).

The cost of complying with these measures is assessed to be minimal as they are considered to reflect existing EPS practice for the oil and gas sector.

Table B.6.5 Number of sub-bottom profiler survey days within dSACs (2012 to 2014)

dSAC		Year		
		2012	2013	2014
Southern North Sea	Sub-bottom profiler	78	93	71.5
Outer Moray Firth	Sub-bottom profiler	0	0	4
North Minch	Sub-bottom profiler	0	0	0

B.6.6.4 Limiting the Number and Duration of Geophysical Surveys Within or Near Site Boundaries

Based on JNCC and country nature conservation agency advice, it has been assumed that there may be a requirement to limit the number and duration of geophysical surveys within a site, subject to the provisions of Article 6 of the Habitats Directive. However, such requirements will be site specific and in the absence of detailed information on site activity and thresholds, it is not possible to quantify the potential impacts. The quantified cost for the intermediate scenario has therefore been used as an indication of the quantified cost for the upper scenario, but with recognition that the upper scenario may also give rise to additional costs which cannot be quantified.

B.6.6.5 Enhanced Mitigation Measures to Reduce or Limit Impacts Associated with Use of Explosives During Decommissioning Activities Within or Near Site Boundaries

It has been assumed that under the intermediate scenario, enhanced mitigation measures will be required to reduce or limit impacts associated with the use of explosives during decommissioning within sites or within 1km of site boundaries.

Operators already follow JNCC's guidelines for minimising acoustic disturbance to marine mammals whilst using explosives (JNCC, 2008). These guidelines require consideration to be given to requirements for mitigation measures, the use of MMO or PAM systems where appropriate to monitor for the presence of marine mammals within a 'mitigation zone', delaying the use of explosives for at least 30 minutes following the last record of a marine mammal in the mitigation zone and controlling the detonation of explosives to minimise potential environmental impact.

The enhanced mitigation measures are likely to relate to the timing of the use of explosives to limit their use to periods when harbour porpoise presence is lower. If such restrictions resulted in the use of explosives during less favourable weather windows, this could lead to significant increases in the costs of such activities. There could also be a cost associated with project delays if vessels had to remobilise. Such costs would be very project specific and cannot be readily quantified. They could range from £0 up to several hundreds of thousands of pounds, depending on the nature and degree of impact on the activity. It is not possible to provide an accurate cost estimate for this potential impact.

B.6.6.6 Prohibition on Use of Explosives in Decommissioning Activities Within or Near Site Boundaries

It has been assumed that under the upper scenario, the use of explosives during decommissioning would be prohibited within sites or within 5km of site boundaries, subject to the provisions of Article 6 of the Habitats Directive.

DECC estimates that possibly up to 10 applications per year might be received for the use of explosives within the Southern North Sea dSAC. Should the use of explosives prove not to be possible, alternative decommissioning strategies would need to be considered, which could have cost implications. If there was no viable alternative to the use of explosives, this may result in structures being left *in situ*.

The potential cost impacts would be site and situation specific. They could range from £0 up to £m depending on the nature and degree of the activity. It is not possible to provide an accurate cost estimate for this potential impact.

B.6.7 Limitations

- Uncertainty concerning the location, scale and timing of future development activity, particularly in later years of the assessment period; and
- Uncertainty concerning the location, nature and timing of decommissioning activity, particularly in later years of the assessment period.

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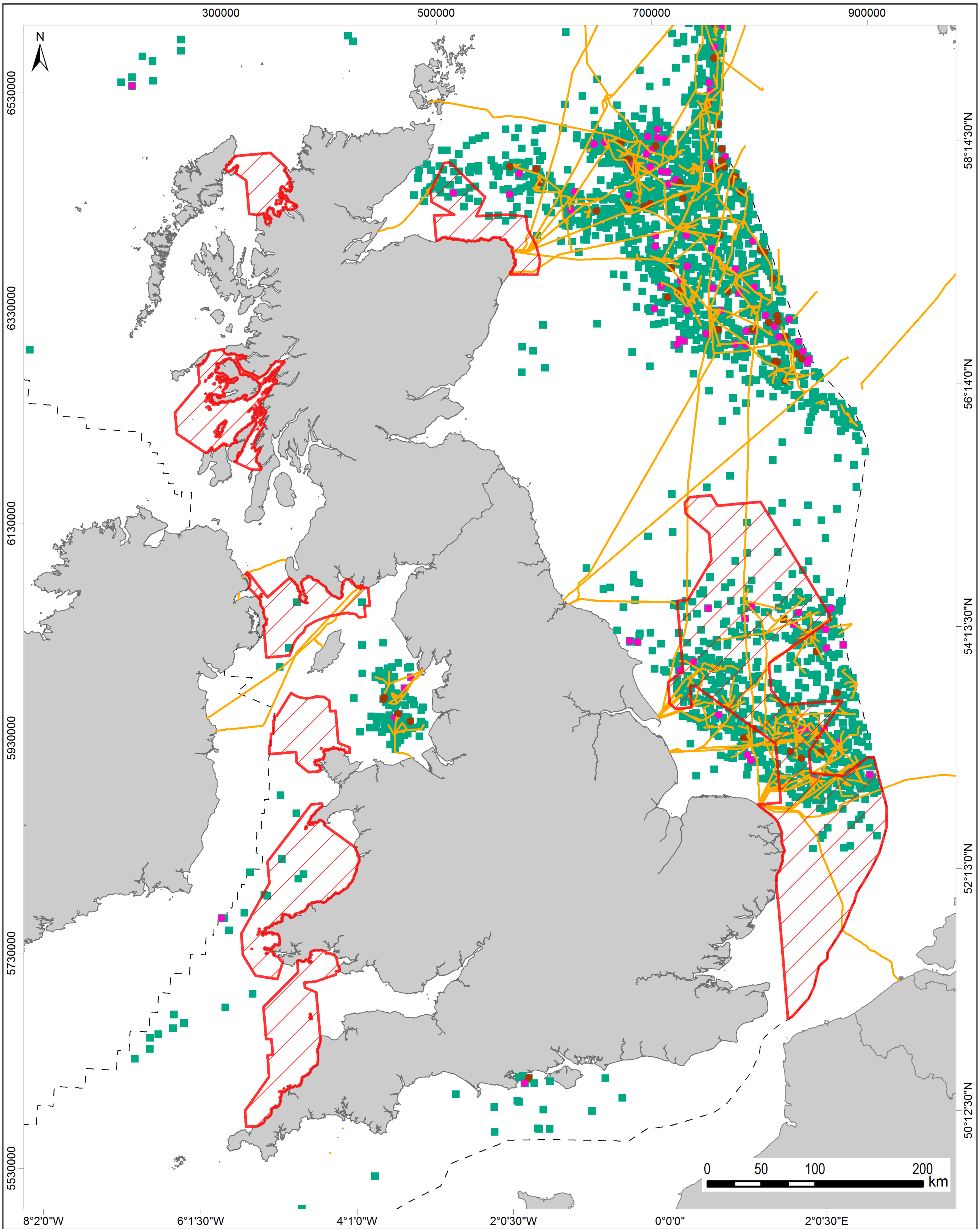

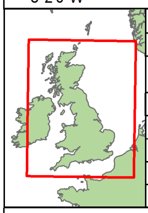

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Recommended dSAC

Continental Shelf

Pipelines

Fallow Discoveries

Significant Discoveries

Wells

Data Source: DECC, 2015; Oil and Gas UK, 2015.
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Figure B6.1

B.7 Ports and Harbours

B.7.1 Introduction

This appendix provides an overview of existing and potential future activity for the ports and harbours sector in the UK and outlines the methods used to assess the impacts of potential new SACs on this sector.

B.7.2 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.

B.7.3 Overview of Existing Activity

A list of sources to inform the writing of this baseline is provided in Table B.7.1.

Table B.7.1 Information Sources

Scale	Information Available	Date	Source
Regional	Ports and Harbours contribution to Employment and GDP (all UK)	2013	Oxford Economics, 2011. The economic impact of the UK's Maritime Services Sector (http://www.maritimeuk.org/key-statistics)
UK	Location of major ports, marine traffic and cargo statistics	2013	Department for Transport 'Transport Statistics' http://www.dft.gov.uk/statistics/series/ports-statistics
UK	Potential future port developments	2007	DfT
UK	Renewables pressure on ports and future predictions	2010	Scottish Enterprise
UK	Dredge sites around the UK	2015	Cefas
UK	Anchorage locations	Waiting on source	

B.7.3.1 Location and Intensity of Current Activities

There are three types of port ownership in the UK (Scotland, Northern Ireland, England and Wales) these are namely; 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 40 major ports in the UK that each handled over 1 million tonnes of freight in 2013. These ports are organised into their respective nations are listed below (DfT, 2014).

England:

- River Trent;
- Goole;
- Shoreham;
- Ipswich;
- Plymouth;
- Portsmouth;
- Harwich;
- Heysham;
- Manchester;
- Tyne;
- Medway;
- Rivers Hull and Humber 3;
- Bristol;
- Hull;
- Dover;
- Felixstowe;
- Liverpool;
- Southampton;
- Tees and Hartlepool;
- London; and
- Grimsby & Immingham.

Scotland:

- Orkney;
- Stranraer;
- Cairnryan;
- Cromarty Firth;
- Aberdeen;
- Glensanda;
- Sullom Voe;
- Clyde; and
- Forth.

Northern Ireland:

- Killroot Power Station Jetty;
- Londonderry;
- Larne;
- Warrenpoint; and
- Belfast.

Wales:

- Holyhead;
- Milford Haven;
- Port Talbot;
- Newport; and
- Cardiff.

A number of smaller ports, characterised by a quay or jetty and used by a range of vessels, are also present around the UK. Port type and location around the UK are shown in Figure B7.1.

The total amount of freight passing through UK ports in 2013 remained broadly similar to 2012 at 503.0 million tonnes. Major ports handled 98% of this freight (491.4 million tonnes) which again was a similar value to the previous year. The remaining 2%, 11.6 million tonnes, was handled by minor ports. In terms of tonnage handled in 2013, the top three busiest ports in the UK were Grimsby & Immingham, London and Milford Haven handling 62.6, 43.2 and 41.1 million tonnes respectively. The majority of freight moving through major British ports was liquid bulk (197.0 million tonnes) which was mainly composed of crude oil, oil products and liquefied gas. Dry bulk also made a significant contribution (121.4 million tonnes) to total freight handled of which coal was the main contributor. Further contributions came from Ro-Ro, Lo-Lo and Other General Cargo (DfT 2014).

B.7.3.2 Economic Value and Employment

A number of industries are strongly related to the ports and harbour sector, for example, ship building (building and repairing of vessels), oil and gas, commercial fishing, maritime transport (including ferry services) and leisure moorings. Many of these activities are described in separate section of this Appendix.

The Oxford Economics Report 'The Economic Impact of the UK Maritime Services Sector: Ports' (Oxford Economics, 2013) presented regional GVA values and employment breakdown for the port sector. Data was sourced from the ONS' Annual Business Survey (ABS), which provides a regional breakdown of UK GVA by broad industrial sector. Table B.7.2 provides regional GVA values for the UK in 2011.

Table B.7.2 GVA - impact of the UK ports industry in 2011

Country	Direct (£M)	Indirect (£M)	Induced (£M)	Total (£M)	% of UK GVA
England	4,780	6,980	4,430	16,170	1.4
Scotland	2,040	730	490	3,260	2.9
Northern Ireland	850	150	120	1,120	3.8
Wales	220	220	210	650	1.3

In terms of employment, Table B.7.3 provides a breakdown of the amount of employment provided by UK ports in 2011.

Table B.7.3 Employment of the UK ports industry in 2011

Country	Direct	Indirect	Induced	Total	% of UK Employment
England	75,800	144,000	91,100	310,800	1.2
Scotland	31,000	15,100	10,000	56,200	2.1
Northern Ireland	11,600	3,100	2,400	17,000	2.1
Wales	3,000	4,600	4,400	12,000	0.9

B.7.3.3 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.

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.

B.7.4 Assumptions on Future Activity

The timing, location and nature of port development is difficult to predict as it occurs in response to demand. The National Renewables Infrastructure Plan (NRIP) (Scottish Enterprise, 2010) and Marine Renewables Infrastructure Plan (M-RIP) (Highlands & Islands Enterprise, 2014) provide information on possible development sites to support offshore renewables expansion in Scotland 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 specific 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 2017) and that minor ports will undertake one development every twenty years over the assessment period (assumed to be in 2026).

B.7.5 Potential Management Measures

The main pressure for which JNCC and the country nature conservation agencies consider that additional management measures may be required for port and harbour developments relates to underwater noise associated with noisy piling activity or use of explosives which has the potential to injure or disturb harbour porpoise. JNCC has published guidance on the deliberate disturbance of marine protected species (JNCC, 2008) which includes disturbance from piling activity and underwater explosives.

Table B.7.4 sets out the management measures that have been identified by JNCC and the country nature conservation bodies as potentially being required to support the achievement of conservation objectives in specific dSACs (see also Appendix D: Management Scenarios). It has been assumed that measures to ensure compliance with European Protected Species legislation would already be in place. The potential management measures therefore consider additional measures above and beyond these requirements.

Table B.7.4 Potential management measures for ports and harbours sectors

Management Measure	Scenario		
	Lower	Intermediate	Upper
Habitats Regulations Assessment (HRA) of port developments involving percussive piling or use of explosives within or near site boundaries	✔	✔	✔
Review of consents for consented but not yet built port developments involving percussive piling or use of explosives within or near site boundaries	✔	✔	✔
Enhanced mitigation measures to reduce or limit impacts of port developments involving percussive piling or use of explosives within or near site boundaries		✔	
Prohibition on port developments involving percussive piling or use of explosives within or near site boundaries			✔

The methods by which the cost impacts of these management measures have been assessed are described below. It is possible that some of these requirements could result in project delays. Depending on when these delays occur, they could be expensive. It is therefore difficult to reliably quantify the potential cost impact of delays. Where management measures have the potential to cause delay, this is noted below in relation to the relevant measures.

In addition, the uncertainty caused by the designations and requirements for management measures may act as a deterrent to investment. It is difficult to quantify this potential impact as it is unclear what level of uncertainty or additional cost might dissuade an investor. The potential for these impacts to occur is discussed in presenting the results within the main report.

It is also recognised that the ports sector may be affected where management measures affect other marine sectors as this could affect trade passing through ports. The potential for such effects to occur is discussed in the main report.

B.7.6 Assessment Methods

B.7.6.1 HRA of Port Developments Involving Percussive Piling or Use of Explosives Within or Near Site Boundaries

It is assumed that following designation, HRA would be required for new port and harbour developments involving percussive piling of cylindrical piles >1m diameter or use of explosives to assess potential impacts on the harbour porpoise feature as follows:

- Percussive piling - development within 26km (lower and intermediate scenarios) or 50km (upper scenario) of dSAC site boundaries; and
- Use of explosives - within site boundaries and within 1km (lower and intermediate scenarios) or 5km (upper scenario) of dSAC site boundaries.

For the purposes of the IA, it has been assumed that each major port (see section B.7.3.1) will undertake one development involving percussive piling activity of cylindrical piles >1m diameter or use of explosives every 5 years during the assessment period. It has been assumed that minor ports will not undertake such activities, as construction works tend to be more minor and do not involve piling of larger diameter cylindrical piles.

Where consented but not yet built port developments are subject to a review of consents (see section B.7.6.2), or where applications are awaiting consent, it is assumed that the port developers may be required to provide additional information to inform HRA. Based on a review of the Marine Management Organisation public register and the Planning Inspectorate portal (which includes Nationally Significant Infrastructure Projects in England and Wales), the following port developments were identified as being consented but not yet built or awaiting consent (all lie between 26 and 50km of the Southern North Sea dSAC):

- Green Port Hull (consented);
- Able Humber Marine Energy Park (consented);
- Immingham Western Deepwater Jetty (awaiting consent);
- Immingham Outer Harbour Berth Zero (consented); and
- Infill at William Wright Dock, Hull (awaiting consent).

In addition, a review of the Marine Scotland public register identified one proposed port development awaiting consent - the Inner Harbour Deepening and New Fish Market Development Project at Peterhead - which is adjacent to the Outer Moray Firth dSPA. No information has been obtained for planned port developments in Northern Ireland.

Given that all of the Humber developments are at least 26km from the Southern North Sea dSAC, it is considered unlikely that additional information for these projects would be required. However, the Peterhead development is immediately adjacent to the outer Moray Firth dSAC and it is therefore assumed that additional HRA information would be required in relation to this project.

The additional cost of preparing each HRA has been estimated to be £7,100 (at 2015 prices) based on Annex H12 of Defra (2012). This information has been used to estimate the additional costs of preparing HRAs over the time period of the assessment (2015 to 2034). It has been assumed that the additional HRA information for the Peterhead development is prepared in 2016. For future port development, it is assumed that projects apply for consent in 2017, 2022, 2027 and 2032.

B.7.6.2 Review of Existing Consents for Consented but not yet Built Port Developments Involving Percussive Piling or Use of Explosives Within or Near Site Boundaries

Designation of the sites will trigger a requirement for a review of existing consents that have not yet been implemented to determine whether the activity is consistent with achievement of each site's conservation objectives. The following assumptions have been made for the purposes of the IA:

- Review of consent carried out for all consented but not yet built major port developments involving percussive piling of cylindrical piles >1m diameter where these ports are located within site boundaries and within 26km (lower and intermediate scenarios) or 50km (upper scenario) of site boundaries; and
- Review of consent carried out for all consented but not yet built major port developments involving use of explosives where these ports are located within site boundaries and within 1km (lower and intermediate scenarios) or 5km (upper scenario) of site boundaries.

The potential costs associated with reviewing existing consents would fall on the relevant licensing authorities and Statutory Nature Conservation Bodies and are reported under public sector costs. Based on section B.7.6.1, at least three port developments have bene identified that may require review of consent although these are all between 26 to 50km from the southern North Sea dSAC and are thus unlikely to significantly affect harbour porpoise within the site.

B.7.6.3 Enhanced Mitigation Measures to Reduce or Limit Impacts Associated with Port Developments Involving Percussive Piling or Use of Explosives Within or Near Site Boundaries

Based on JNCC and country conservation agency advice, it has been assumed that under the intermediate scenario seasonal controls for piling and explosive use and/or mitigation of piling noise could be required for relevant developments and/or the application of noise reduction measures as follows:

- Percussive piling – within 26km of site boundaries; and
- Use of explosives – within 1km of site boundaries.

The general experience of the ports sector is that it is possible to comply with seasonal restrictions through careful timing of construction activity, where such controls are required for less than 6 months of the year. For the purposes of this IA it has been assumed that implementation of seasonal controls would not impose significant additional costs on the ports sector. However, should it not be possible to work within specified construction windows, significant additional costs could be incurred as a result of demobilisation/remobilisation of plant.

There is limited experience within the UK ports sector of using noise reduction measures during percussive piling activities, other than the use of seasonal controls. Based on trials at the Port of Dundee, which used sound damper technology, source noise level reductions of 12 – 14 dB SEL were achieved (Dziedzicka *et al*. 2015). Internationally, there is also some experience of using bubble curtains to reduce noise levels at source.

There is little if any experience of applying noise reduction measures to blasting activities where such methods are used to facilitate depending of navigation channels. The costs of implementing such mitigation measures would be site/project specific. Should measures be required for percussive piling activities, the costs could be significant, of the order of several hundred thousand pounds for a large development. It is unlikely to be possible to reduce noise levels associated with rock blasting to deepen navigation channels.

For the purposes of the IA it has been assumed that the timing of development can be managed to minimise significant risks to harbour porpoise, with minimal additional cost. However, it is recognised that there is considerable uncertainty surrounding this assumption and that significant cost impacts could arise if other mitigation measures were required (e.g. noise reduction measures).

B.7.6.4 Prohibition on Port Developments Involving Percussive Piling or Use of Explosives Within or Near Site Boundaries

Based on JNCC and country conservation agency advice, it has been assumed that under the upper scenario port developments involving percussive piling of tubular piles >1m diameter or which require the use of explosives would not be consented as follows (subject to the provisions of Article 6 of the Habitats Directive):

- Percussive piling – within 26km of site boundaries; and
- Use of explosives – within 1km of site boundaries.

Tubular steel piling is commonly used within port construction projects. For quay wall, alternatives such as concrete caissons may sometimes be cost effective, but for structures such as jetties, other solutions are not generally available.

A number of alternatives to percussive piling for offshore wind farms are currently being trialled. The most relevant of these alternatives to ports and harbours are the use of drilling or vibropiling for large monopiles. Such methods may provide alternative options for inserting monopiles in the future. The cost differential for alternative installation options is uncertain and would be site specific.

Historically, relatively few port and harbour developments have required the use of explosives. The use of explosives to modify navigation channels and berths is a last resort if other physical methods of dredging will not be effective. There is unlikely to be any alternative to the use of explosives and in such circumstances it may be that a project would not be able to proceed unless it met the tests in Article 6 of the Habitats Directive and adequate compensatory measures were provided.

Given that the cost impacts would be site specific, it has not been possible to quantify the potential costs under this scenario. As a worst case, it is possible that some developments would not proceed. This could affect the future development of the affected port and its long-term profitability.

B.7.7 Limitations

- The location, nature and timing of future port development activity is uncertain; and
- The requirements for management measures are uncertain.

B.7.8 References

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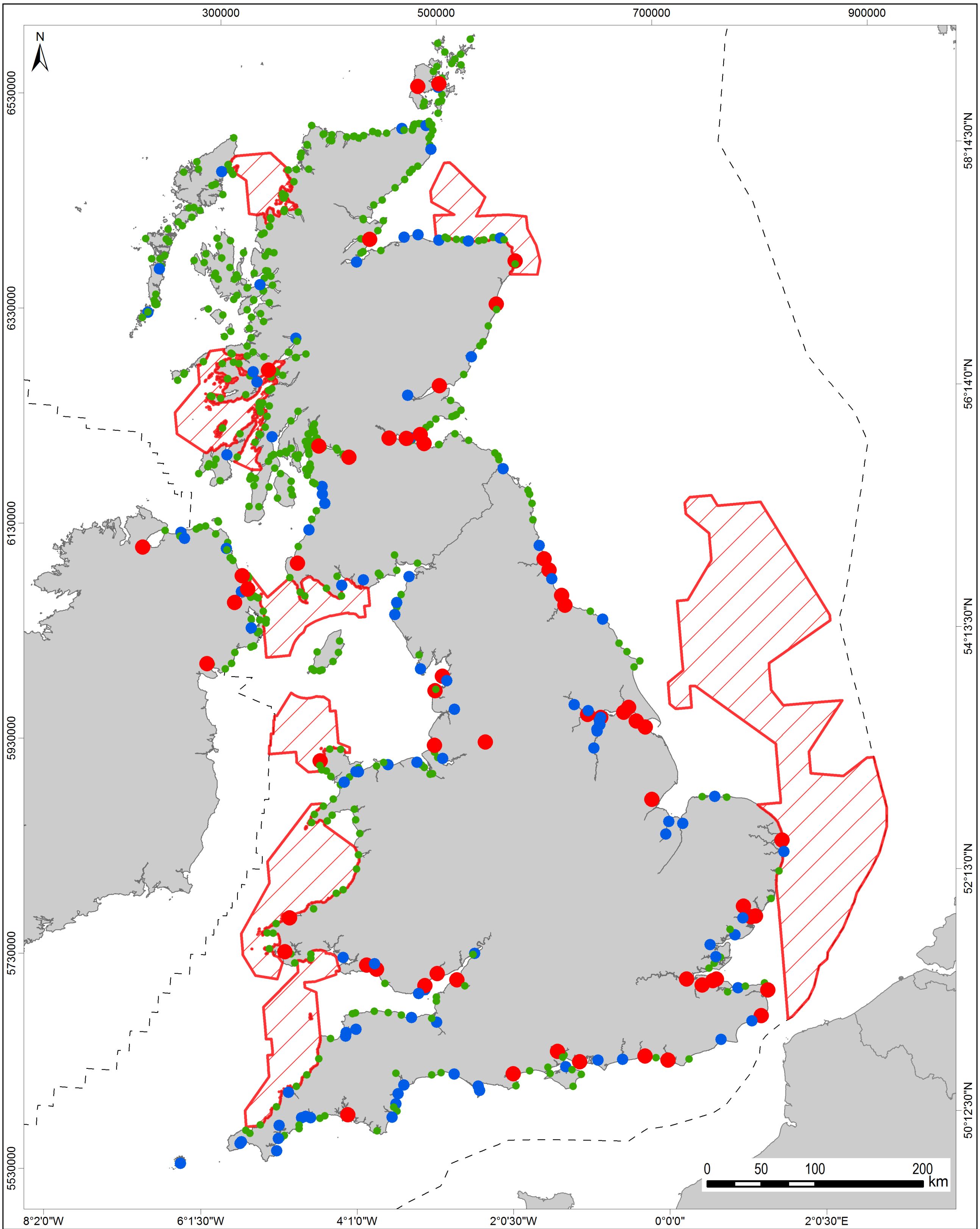

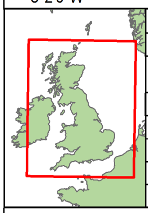

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