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Social impacts and interactions between marine sectors

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Social Impacts and Interactions between Marine Sectors

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Please note:

The MMO is considering inclusion of further information on the telecommunications cables sector in this report.

Please contact evidence@marinemanagement.org.uk if you have any queries or data you would like to highlight.

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Executive Summary

The aim of the project was to establish a body of evidence on social impacts as an assessment of interactions within and between sectors detailed in the Marine Policy Statement (MPS), which can be used to assist marine plan development and implementation. The report outputs are designed to be used to inform social impact scoping exercises and to aid the design of bespoke assessments. The report is based on a combination of desk-based reviews and stakeholder input, and builds on the evidence base and concepts established through MMO1035 (MMO, 2013a).

Conceptually the research is grounded in the 'capitals approach' put forward by the work of the Government Economics Service (GES)/Government Social Research (GSR) Social Impacts Taskforce in Price *et al.* (2010) and Harper & Price (2011). The interactions between two sectors can be thought of in terms of depreciating or enhancing the stock of capital (or access to the stock of capital) that the sectors use in order to generate flows of goods and services, and associated social impacts. The report outputs are not however presented using the language of stocks and flows, in order to maximise their accessibility. A typology of social impacts was established in order to act as a guide to what constitutes the social domain. A broad typology was adopted to ensure its relevance across all marine sectors and interaction types.

This report presents social interaction-impact tables for 14 MPS sectors and sub-sectors. Each table represents the potential interactions that a given sector is susceptible to, and describes the impact pathways that can lead to primary and secondary social impacts. Each table is supported by evidence on the impact pathways and social impacts, which is based on the currently available literature as well as stakeholder views.

The evidence base on the social impacts of marine sector interactions is limited in scope and depth, although is expanding. Whilst the social interaction-impact tables provide summaries of the evidence in order to demonstrate potential impact pathways, the evidence will not always be directly transferable to any given situation. Care should therefore be taken when applying the generalised table output and evidence bases to specific situations.

A broad number of potential social impacts of marine sectors and their interactions were identified. Employment is recognised as being a particularly important generator of social benefit. Some marine sectors e.g. oil & gas and ports, help to generate nationally significant quantities of jobs and can therefore be thought of as significant generators of social benefit. Others, such as commercial fishing, are less significant employers, but generate specific social benefits linked to people's way of life and personal and community identity. Where a certain activity has taken place in an area for a long time, it can become a strong feature of that community's and location's identity and sense of place. Whilst economic restructuring often offers economic, and in turn employment and income benefits, it can also erode the traditional identity or sense of place of a community or location. Degradation and enhancement of the natural environment can affect a number of sectors, most notably the commercial fishing, recreation and tourism sectors.

An approach was developed to explore how social impacts of marine sectors can be spatially represented and to highlight areas where interactions between marine sectors may significantly impact on these social benefits. It suggests a method that enables consistent coverage of the social impacts of MPS sectors, thereby allowing the spatial data layers of different sectors to be overlaid and contrasted. This is an important point that enables the outputs of the method to potentially be used to inform the planning process.

As the primary aim of this spatialisation was to explore potential ways of mapping social impacts, it was beyond the scope of the study to collate comprehensive social impact data. Instead, an illustrative approach was taken, using readily available social ‘indicators’ for a core set of the significant social impact types: income, employment, social cohesion[1], culture and environment. The approach combined proxy indicators for these social impact types with a weighted multi-criteria analysis to generate spatial data layers for the beneficial social impacts of each MPS sector. These layers were then overlaid to provide an understanding of where sector interactions may put at risk areas of high social value. Given the significant limitations of the data sets used and necessary assumptions made, the outputs of this exercise are indicative only. However, improved spatial data and quantitative social impact data will enable greater consideration of social issues in the marine planning process.

The report provides a series of high level recommendations that could be usefully taken forward in order to improve the social impact evidence base for marine sector interactions.

[1] Please review http://www.publications.parliament.uk/pa/cm200304/cmselect/cmodpm/45/45.pdf for a description of social cohesion as understood by the Home Office.

1. Introduction

1.1 Project aim

The aim of the project was to establish a body of evidence on social impacts as an assessment of interactions within and between sectors detailed in the Marine Policy Statement (MPS), which can be used to assist marine plan development and implementation. The project objectives can be summarised as:

- To develop a body of evidence for social impacts and interactions across all MPS sectors.
- Present this information in a framework by which to see the relative importance of the impacts between marine activities, their dependencies, interconnectivity and geographical distribution.
- Detail a process for updating the framework and body of evidence so that it can develop and be updated as marine planning progresses into the future
- Ensure the social interactions body of evidence and framework fulfil the social requirements for implementing a marine co-existence/co-location tool, cumulative effects assessments framework and the ecosystem approach to marine planning being developed in concurrent MMO projects.
- Provide recommendations for including the outputs of this project in marine plans and supporting Impact and Sustainability Assessments including those currently drafted and in process. Highlight gaps in the evidence base for marine planning and how to fill them.

The MMO require a robust social science evidence base to support marine planning. Whilst it is acknowledged that there are limitations in current social impact evidence, by bringing together current knowledge in a usable form, this will help the MMO to start to understand the potential social impacts that can occur from marine interactions, and thereby help them to develop more robust marine plan options.

There are significant differences in the scope and depth of social impact evidence for different sectors and different interactions. Further, evidence of the social impacts from one interaction at a particular time and place cannot necessarily be applied to a similar interaction occurring at a different time and place – the nature and scale of social impacts are nearly always event and context specific similarly to environmental or economic impacts.

The report outputs are designed to be used to inform social impact scoping exercises and to aid the design of bespoke assessments. In particular this is in relation to marine plan impact assessments and sustainability assessments, as well as the social elements of various projects that are currently under development: the MMO's marine co-existence/co-location tool, the cumulative effects assessment framework, and the ecosystem approach to marine planning. The work builds on previous social impacts evidence gathering for some marine sectors (MMO 2013a).

Further, the report explores options for representing social information and impacts on maps, and identifies key social impact research gaps and recommendations for future research.

1.2 Methodology

The report is based on a combination of desk-based reviews and stakeholder input, and builds on the evidence base and concepts established through MMO1035 (MMO, 2013a).

The desk-based reviews use a combination of relevant search terms identified from a list of social impact types (e.g. community, social cohesion) and search engines (such as Science Direct and Google[2]) as well as tracing references from identified literature. Both peer reviewed and grey literature were included.

Given the limited base of published research on the social impacts of interactions for many of the sectors considered, the desk-based reviews were augmented with stakeholder input. A request was sent out to over 50 individuals from academia, the public sector, NGOs and marine industry/user groups, representing a variety of sectors. The requests were formed of two parts: (1) a general request for research on the social interactions and impacts of and between sectors, and (2) suggestions and amendments, based on either professional opinion or research, to an initial set of interactions and social impacts for each sector.

[2] Google is recognised by the team as a useful search engine for identifying grey literature

2. Conceptual Framework

2.1 The capitals approach

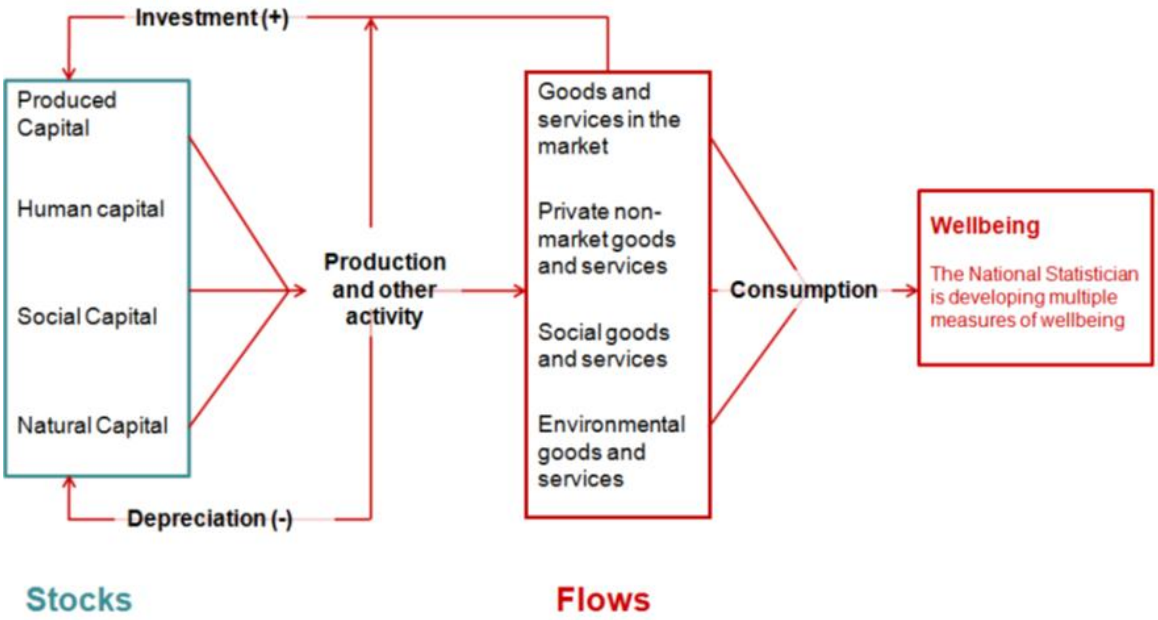
In order that the research and outputs carried out under this project are appropriately grounded and can be readily built upon in the future, it was useful to establish a conceptual framework which defines the process through which social impacts are generated by MPS activities and how interactions between MPS activities can create social impacts.

In this regard, the 'capitals approach' put forward by the work of the Government Economic Service and Government Social Research Service Social Impacts Taskforce in Price *et al.* (2010) and Harper and Price (2011) provides a suitable conceptual framework. It aligns with the MMO goals of adopting an ecosystem approach to marine planning and for resulting marine plans to help deliver sustainable development. The inclusion of capital stocks as part of the 'capitals approach' is considered to be an operational way of incorporating sustainable development into policy appraisal and decision making (Price *et al.*, 2010). Further, its 'stocks and flows' design is directly linked to the language and concepts of natural capital and ecosystem services, consideration of which form an important principle of the ecosystem approach (MMO, in prep a).

It is noted that the capitals approach does not explicitly provide for consideration of the distributional dimension of social impacts across society. As such in any given impact assessment, distributional analyses should be factored in.

Figure 1 provides a simple diagram depicting how the capitals approach utilises the concepts of stocks and flows. Please see Harper and Price 2011 for an explanation of terms.

Figure 1: Stock and flows framework for capitals approach (Harper and Price, 2011)



With regard to Figure 1, all MPS sectors can be considered to be either productive or other forms of non-productive activity. These activities utilise a range of capital stock inputs (typically a mixture of the different types of capital) in order to generate flows of goods and services. Both the production and consumption of these goods and services can have economic, social and environmental impacts.

Social impacts can be generated directly as a result of the production and consumption of goods and services, and indirectly as a result of non-social direct impacts. The social impacts generated through the production and consumption of goods and services by MPS activities can change in response to changes in the quantity and quality of the stocks of capital that they utilise. For example, overfishing reduces the stock of natural capital on which the flow of goods and services and resulting social impacts of fishing depend. Interactions between two MPS sectors can result in such changes. This includes where there is no fundamental change in the stock of capital, but where one sector's ability to access their desired capital input (e.g. a particular fixed location) is compromised by the actions of another sector.

Table 1 provides simple examples utilising the conceptual capitals approach language. It demonstrates how (from left to right) a sector interaction results in a particular consequence that in turn affects the stock of capital and the flows of benefits that are generated by the use of that capital. The table provides examples of the impacts to the commercial fishing sector of particular interactions with another sector.

Table 1: Examples of how activity interactions conceptually affect stocks and flows.

Interaction	Consequence	Conceptual stock & flow effect
Access to marine space	Exclusion/ displacement of fishers from historic fishing grounds	Reduced access to natural capital (i.e. a fishing ground) which impacts on ability of the fishing sector to deliver flows of goods and services (i.e. jobs, fish) and in turn impacts on the social impacts of these flows
	Damage to fishing gear from collision with infrastructure e.g. submarine cables	Depreciation of the stock of produced capital (i.e. damaged fishing gear) resulting in reduced benefit flows (fisher profitability) with associated social impacts
Provision of services	Less suitable harbour facilities / better facilities	Reduced/improved quality of produced capital (harbour facilities) affecting the efficiency with which fishers operate, diminishing/increasing benefit flows (fisher profitability), with associated social impacts

2.2 Typology of social impacts

This section considers three social impact typologies which have been put forward in recent research and assessments – one from a recent marine-based impact assessment (Marine Scotland, 2013), one by the UK Government (IAIA, 2011), and one in relation to social impact practices across the European Union (The Evaluation Partnership and The Centre for European Policy Studies (CEPS), 2010). The typology used for this study was based on these examples.

Social impacts are effects on individuals, communities and society and can be considered to encompass both market and non-market goods and services. They can vary in their desirability, scale, extent of duration (temporal and spatial), intensity and severity, as well as the extent to which they affect particular groups or are compounded by cumulative effects. Such issues are likely to be context-specific.

There is no single definition of what social impacts are, and no single list that characterises them. When considering what an appropriate typology of social impacts might be, it is important to ensure that the typologies allow for the inclusion of the full likely range of potential impacts and do not inadvertently close the door to certain lines of enquiry. The nature of the policy or plan being assessed may help to steer the choice of social impacts for consideration. However care should be taken to ensure that potential unintended social impact types, or social impacts which may occur as lower order (i.e. indirect) effects, are not scoped out. For the purposes of this research project, which is to amass and assimilate the available evidence on social impacts and interactions, it is appropriate to take a wide view when defining potential social impact types.

A marine impact assessment (Marine Scotland, 2013) established social impact typologies (key areas) based on discussion set out in Harper and Price (2011), which states:

> "The Social Impacts Taskforce commissioned a study to identify, categorise and highlight consistencies and inconsistencies in the way UK government departments assess social impacts. The initial mapping exercise identified social impacts in seven key policy areas: access to services, crime, culture and heritage, education, employment, environment and health".

The key areas identified are 'policy areas' rather than a considered list of social impacts. As such, similar social impacts may occur under more than one policy area and care is needed when utilising the list to ensure appropriate coverage of impacts. Marine Scotland (2013) also defined impacts for each of the key areas in terms of 'access' and/or 'experience'. This addition provides a particularly useful way of thinking about how social impacts under each key area may materialise and has been considered in the development of this project.

Table 2: Social impact typology of Marine Scotland (2013b).

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

MMO (2013a) uses the International Association for Impact Assessment (IAIA) (2003) definition of social impacts, which are also referred to in Harper and Price (2011) and the related research by Maxwell *et al.* (2011). The typology includes a broad range of potential impacts, including useful supporting descriptors. IAIA (2003) identify social impacts as changes occurring in one or more of the following:

- People’s way of life – how people live, work, play and interact with one another on a day-to-day basis.
- Their culture – their shared beliefs, customs, values and language or dialect.
- Their community – its cohesion, stability, character, services and facilities.
- Their political systems – the extent to which people are able to participate in decisions that affect their lives, the level of democratisation that is taking place, and the resources provided for this purpose.
- Their environment – the quality of the air and water people use; the availability and quality of the food they eat; the level of hazard or risk, dust and noise they are exposed to; the adequacy of sanitation, their physical safety, and their access to and control over resources.

- Their health and wellbeing – health is a state of complete physical, mental, social and spiritual wellbeing and not merely the absence of disease or infirmity.
- Their personal and property rights – particularly whether people are economically affected, or experience personal disadvantage which may include a violation of their civil liberties.
- Their fears and aspirations – their perceptions about their safety, their fears about the future of their community, and their aspirations for their future and the future of their children.

Research by The Evaluation Partnership (TEP) and The Centre for European Policy Studies (CEPS) (2010) undertook a review of European Union Member State social impact assessment processes and made recommendations for the implementation of effective social impact analysis. The report found that where detailed preconceived lists of potential social impacts were utilised in guidance, these often include grey areas, duplications and/or overlaps that can make them hard for an analyst to employ. Such potential for duplication can be seen in the above IAIA list of social impacts e.g. impacts under 'environment' on the quality of air people use, and impacts under 'health and wellbeing' which may be affected by people's use of air of a certain quality.

TEP and CEPS (2010) concluded that the vast majority of social impacts can be summarised under a relatively limited list of impact types, which provides a useful basic reference framework and avoids any overlap or duplication:

- Employment (including labour market standards and rights)
- Income
- Access to services (including education, social services, etc.)
- Respect for fundamental rights (including equality)
- Public health and safety.

They recognise that some issues of focus for social impact assessment are not explicitly stated in the above 5-point list. In such instances, the issues can be generally considered to occur as a combination of one or more of the above social impact types. Social inclusion or exclusion is normally understood as the result of a combination of many of the factors listed above. Similarly, deprivation is generally considered as a combination of factors (for example, see Office for National Statistics (ONS) indices of multiple deprivation). The approach in the IAIA (2003) typology is to include such issues as impact types in their own right.

Given the above discussion there appear to be two potential options which can be readily used to define a set of social impacts through which to both frame the research for this project, and utilise to ensure consistency of language when describing social impacts.

A list along the lines proposed by TEP and CEPS (2010) is succinct, avoids duplication, and the issues can be readily understood and translated into obvious policy areas, and/or onto any available data sets. As such there may be benefit in utilising such a list when focussing and phrasing impact assessments. The longer IAIA (2003) list provides more insight into the range of social issues which may be of relevance. Whilst this may create potential duplications and overlaps, it can help to ensure as full a consideration of potential social impacts as is possible, removing the potential for accidental omissions that may occur under the shorter TEP list.

The core aim of this research project is to collate a body of evidence for future use. Whilst it is recognised that the body of evidence on social impacts of marine activities is relatively light and potentially narrow in focus, the MMO have requested that the framework used should not be led by the availability of literature, but should be broad enough to help identify evidence gaps, unintended consequences of activities, and be suitable for continued use in the future. This would seem to indicate that a list in line with that of IAIA (2003) would be most appropriate for this project specifically because of its breadth and additional contextual information.

The social impact typology set out in Table 3 was adopted for use in this project. It should be noted that this is a broad typology and that there is potential overlap between some of the different impact types. Further it is not a dictionary of social impact types i.e. it does not capture all relevant descriptive terms for different social impact types. The typology is based on the IAIA (2003) list with some amendments which seek to address relevant shortfalls, namely:

- Additional explicit reference to employment and income was made under ‘way of life’. This was felt useful due to their significance with regard to the impacts of major marine economic sectors.
- Sense of place was added under ‘community’ in order to pick up on the terminology being used in some of the latest literature on coastal areas.
- Landscapes and seascapes were added under ‘environment’ due to their relevance for marine planning and licensing.
- Equity was included with ‘personal and property rights’. The capitals approach does not explicitly include a consideration of intra-generational equity, but it is generally considered that a key part of social impact analysis is to understand the potential equity of impacts across different groups. It was therefore felt useful to explicitly include this as a social impact type to ensure that it could be readily captured in the report outputs and picked up by the MMO when using the report.
- ‘Wellbeing’ was excluded from ‘health and welfare’ in order to avoid confusion to the broader definition of the term as used in, for example, the ONS national wellbeing measures.

Table 3: Preferred social impact typology for this work.

Impact type	Description
People’s way of life	how people live, work (including employment and income), play and interact with one another on a day-to-day basis
Culture	their shared beliefs, customs, values and language or dialect
Community	its cohesion, stability, character, sense of place, services and facilities
Political systems	the extent to which people are able to participate in

Impact type	Description
	decisions that affect their lives, the level of democratisation that is taking place, and the resources provided for this purpose
Environment	the quality of landscapes and seascapes, the quality of the air and water people use; the availability and quality of the food they eat; the level of hazard or risk, dust and noise they are exposed to; the adequacy of sanitation, their physical safety, and their access to and control over resources
Health	health is a state of complete physical, mental, social and spiritual wellbeing and not merely the absence of disease or infirmity
Personal and property rights and equity	particularly whether people are economically affected or personally disadvantaged, which may include a violation of their civil liberties; equality and effects on minority group or other relevant or disadvantages groups
Fears and aspirations	their perceptions about their safety, their fears about the future of their community, and their aspirations for their future and the future of their children

3. Interaction-Impact Tables and Evidence

3.1 Impact matrices and tables

This project has built on the exploratory work undertaken in MMO (2013a), which designed a social impact matrix in order to trial the concept. That project raised a number of issues which were used to guide the further development of a social impact matrix under this project, including:

- Social impact information cannot be readily summed into a single number or conclusion.
- Aggregated matrices necessarily need to lose or ignore particular impacts.
- Fully aggregated matrices can be too coarse to be of use.

In the example social impacts table produced in MMO (2013a), each cell is populated using just one piece of evidence on the potential social impact between two interacting sectors. Whilst this is due to the fact that MMO (2013a) were only seeking to test what a social impact matrix could look like, it automatically leads to a question of how multiple evidence sources on multiple impact types, for social impacts that cannot be readily summed, can be articulated through a single matrix cell. The conclusion is that multiple, layered matrices may be required in order to allow multiple social impacts to be demonstrated (and the evidence linked). This is particularly the case when considering distributional impacts - differing impacts to different stakeholders or communities - as the differentiation would not be able to be shown in a single matrix cell.

MMO (2013a) demonstrates how the economic connection between sectors (this does not mean that any spatial relationship necessarily exists) can generate employment impacts, which can be assessed using input-output tables and employment multipliers. In discussion of how some similar comprehensive quantitative assessments covering all relevant social impacts could be enabled, MMO (2013a) identifies the concept of wellbeing. However it concludes that the difficulties and non-standardisation issues of generating an appropriately weighted wellbeing index (i.e. aggregating largely qualitative, non-comparable social impacts) preclude this from being a realistic way forward at this time. Further it is noted that data on social impacts of marine activities are few and far between.

A key issue is that an aggregated sector-by-sector matrix[3] necessarily has to utilise relatively high level sector headings. It was noted in MMO (2013a) that this can cause problems, because when considering potential co-location issues, 'detail is crucial'. As an example of how detail is lost in an aggregated matrix, MMO (2013a) states that it colour coded a co-location matrix based on the 'dominant type of co-location issue' (and utilised the same approach for the related social impact matrix). Instantly it can be seen that those non-dominant issues, which may or may not in themselves be significant issues, are lost. Further the sector-by-sector matrix design

[3] One which provides an aggregate picture of social impacts between all sectors through the use of a single matrix with an identical list of sectors for each of the column and row headings, and some form of +/- summarising the assumed aggregate direction of the potential social impact of their interaction.

is likely to be of less use when the issue is on cumulative impacts of particular types of pressure from a range of sectors, rather than a single sector.

A similar example can be seen in the ‘activity-feature’ matrix designed for the regional marine conservation zone (MCZ) projects, which combined two matrices[4] in order to understand the potential impact of anthropogenic activities on MCZ features. Its coarseness was found to be unhelpful in aiding research and of limited help in facilitating stakeholder discussion on potential management (Finding Sanctuary, pers. com., 15.01.14). Another example of an aggregated matrix is the C-SCOPE Interactions Matrices[5] (http://www.cscope.eu/en/results/). This matrix seeks to provide a simple colour-coded conclusion on the merit of interaction between two sector activities, with supporting text in a comparable matrix that sits behind the front end matrix. Whilst it is a neat output, it necessarily excludes detail on the nature of different types of interaction and generated impacts to be able to usefully act as a portal through which to explore the range of potential social impacts and associated literature.

MMO (2013a) notes that stakeholders may often not agree on the aggregated social impact of any two given sectors, but concludes that the approach can nevertheless provide an opportunity to generate discussion amongst stakeholders of the social implications of marine activities and planning – a matrix such as C-SCOPE’s would serve such a purpose well. This is an important point to note regarding the usefulness of an aggregated matrix. That is, it can be useful to generate discussion, often through disagreement by stakeholders with the particular conclusions set out in the matrix. Nevertheless, experience at Finding Sanctuary MCZ Project notes that aggregated compatibility matrices can also generate unproductive argument and disengagement in stakeholder discussion (Finding Sanctuary, pers. com., 15.01.14).

Because of its lack of detail, an aggregated matrix appears to be less useful as a tool for individuals to explore, outside of (or before) a broader stakeholder discussion, the detail and strength of evidence of a range of potential social impacts that an activity may impose on another interacting activity. Providing a greater level of detail may also enable more fruitful discussions when used as a tool to facilitate stakeholder consultation.

Given the pilot work done in MMO (2013a) as well as consideration of the limitations of other known matrices, it is clear that there is a trade-off between the simplicity of the impact conclusion offered by any given aggregated matrix, and the ability to demonstrate the potential multiple interaction and social impact pathways that may result from the interaction of one or more sectors.

By making the primary aim of the matrix a doorway into the range of social impacts and associated literature rather than as a single sound bite on the aggregate social

[4] One matrix was ‘sector-pressures’ to what sectors caused what environmental pressures, the other ‘pressures-features’ to see how sensitive MCZ features of conservation importance were to environmental pressures.
[5] The Combining Sea and Coastal Planning in Europe (C-SCOPE) project aimed to provide a comprehensive planning and information resource to underpin sustainable coastal management at a local level. Further information and outputs can be found here: http://www.cscope.eu/en/results/

impact of sector interactions, the framework for this work can better hold the relevant body of evidence and be of more use in guiding future applied assessments.

Therefore, rather than a matrix characterised by a list of identical sectors along the row and column headers, this study developed a series of tables, taking a bottom up approach to building an understanding of the social impacts of sector interactions. This allows an ‘entry’ into the evidence by individual activity and interaction type which is considered to be a more useful arrangement for its use in future assessment processes. It will act as a look-up table for each affected activity type, referenced by a typology of potential interactions which the activity is sensitive to. For each interaction type, the body of evidence on the social impact pathways and their influencing parameters can then be amassed and referenced. In this sense the tables will act as an exploratory tool for researchers using any of the assessment tools mentioned in section 3.3, by which to identify potential social impacts resulting from given interaction types, along with key parameters to understand and related literature/evidence. On the back of this, researchers may be able to apply the information to generate first cut conclusions on likely social impacts of an interaction, and design appropriately targeted bespoke research in order to generate more detailed assessments of the social impacts of any given interaction, should this be required (i.e. where potentially significant social impacts are identified).

As such, the series of social interaction-impact tables have not been aggregated into a single table. Nonetheless, they still represent an aggregation of the available evidence in order to form an appropriately accessible guide. Importantly they are supported by text which discusses the relevant literature and provides the range of evidence sources.

3.2 Developing interaction-impact tables

In order to begin to understand the potential for social impacts as a result of the interactions between the sectors of the MPS, it is first necessary to establish an understanding of how different sectors potentially interact with each other, both positively and negatively. Although it was beyond the scope of the current study to develop a comprehensive understanding of, or tool for assessing interactions, an understanding of potential interactions and their consequences has been developed in order to pursue and present evidence on the potential social impacts of interactions. As such, a generic typology of interactions was developed in which all potential interactions and their ‘first order’ effects (consequences) on activities can be assumed.

Initial drafts of the interactions-impacts tables were developed based on a review of key studies in which potential interactions between marine sectors have been proposed or described (e.g. Marine Scotland, 2013a; Marine Scotland, 2013b; MMO, 2014b; MMO, 2013a) as well as the knowledge of the project team. These draft tables were sent to over 50 stakeholders from a broad range of sectors so that they could provide direct input – utilising both professional experience as well as research – into the tables to help ensure that a comprehensive set of interaction-consequence-impact pathways were identified and described. A response rate of 24% was achieved. The views and literature provided by stakeholders was then combined with a desk-based evidence review undertaken by the project team in order to produce the final interaction-impact tables and their supporting evidence base.

The tables and evidence are presented for each MPS sector (see section 4). Where appropriate, MPS sectors have been broken down into sub-sectors, for example, ‘energy’ has been broken down into oil & gas, carbon capture and storage, offshore renewable and nuclear recognising the different types of social interactions and impacts associated with these sectors. Some sectors have been slightly re-grouped to reflect available information. The tables demonstrate the potential social impacts arising from a change in the activity of the given sector, as a result of some form of interaction.

The social interaction-impact tables illustrate how different types of interaction may affect how a sector operates, and in turn the potential primary and secondary social impacts of the interaction. These are supported with a written review of the available evidence, including sources.

The MPS sectors/sub-sectors included are:

- Aquaculture
- Carbon Capture and Storage (CCS)
- Commercial Fishing
- Commercial Shipping
- Defence
- Marine Aggregates
- Marine Protected Areas (MPAs)
- Nuclear Energy
- Offshore Renewables
- Oil and Gas
- Ports, Dredging and Disposal
- Recreation
- Surface Water and Waste Water Management
- Tourism.

Much of the sector-specific economic and social literature does not extend to discussion regarding employment beyond the potential for a sector, and sector interactions, to create jobs or unemployment. Employment is recognised as the most important means by which to fulfil material wellbeing, as being central to individual identity and social status, and as being an important contributor to physical and mental health as well as social capital and cohesion. Conversely, unemployment can be detrimental to physical and mental health, as well as a key cause of deprivation, social exclusion and low community cohesion. As such, an additional section has been included in section 4, which sets out in generic terms the potential social benefits of employment and disbenefits of unemployment.

It should be noted that local communities can interact with MPS sectors resulting in positive and negative social impacts. In most instances these impacts actually occur as a result of sector-sector interactions, with local communities being a particularly prominent group of society affected e.g. where commercial fishing is affected via competition for space with a port development, resulting in reduced commercial fishing income and employment, the impact of which is felt by local fishers in a particular coastal community and potentially more broadly across all members of the community; or where new development affects access to or the environmental amenity associated with a particular leisure and recreation area such as a coastal park or beach.

The relative strength of the evidence base underpinning the interactions-impacts is represented in the social interaction-impacts tables. The likely significance of the impact is also represented, although it should be recognised that this will nearly always depend on context-specific factors.

The strength of the evidence base is categorised as follows:

- Low Confidence: There is limited or no specific or suitable proxy information on the social impact. The assessment is based largely on expert judgement.
- Medium Confidence: There is some specific evidence or good proxy information on the social impact.
- High Confidence: There is good information on the social impact. The assessment is well supported by the scientific or grey literature.

Given that significance tends to be context specific, the evaluation of the significance of particular social impacts associated with interactions between MPS sectors has been based on the potential significance of social impacts having regard to the general nature and scale of those impacts. The following categories of significance devised by this project’s authors have been applied:

- Not significant – no evidence that the interaction has given rise to a social impact. Interaction does not have the potential to affect income or employment. Interaction does not have the potential to materially affect social cohesion, culture or environment.
- Low significance: no evidence that the interaction has given rise to a significant social impact. Interaction has the potential to affect income or employment for <10 individuals; local community has low dependency on activity that could be affected; interaction has limited potential to affect social cohesion, culture or environment.
- Moderate significance: some evidence that the interaction has given rise to a significant social impact in the past. Interaction has the potential to affect income or employment for <100 individuals; local community has recognised dependency on activity that could be affected; interaction could affect social cohesion or culture for <1000 people; interaction could have an environmental impact, the value of which is similar to the income derived from the area.
- High significance: evidence that the interaction has given rise to significant social impacts in the past; the social impact has the potential to affect income or employment for >100 individuals; interaction could affect social cohesion or culture for >1000 individuals; interaction could have an environmental impact, the value of which is significantly greater than the income derived from the area.

These assessments of evidence strength and impact significance are presented in bold square brackets alongside the social impacts in each interaction-impact table, presented as one of either [H], [M], or [L]. The strength of evidence is presented first, followed by the significance of impact. Therefore, for an interaction with a social impact for which there is high confidence in the evidence and low impact significance, the assessment is presented as [H,L]. In all instances these scores are the judgement of the report authors and should not be treated as definitive.

3.3 Social impact assessment and the use of impact-interaction tables

3.3.1 Social impact assessment

Social impact assessment (SIA) is a process for analysing, monitoring and managing the intended and unintended social consequences of policies (and programmes and projects) (IAIA, 2003). Including analysis of social impacts enables us to consider the widest possible range of impacts that policies can have on individuals, communities and society. As many social impacts do not have market values, they often cannot be readily monetised for inclusion in cost-benefit analysis. Adequately linking social impacts with particular policy interventions can be challenging and is often most appropriately tackled using both quantitative and qualitative approaches (Maxwell *et al.*, 2011).

In relation to sustainable development and the Capitals Approach, social impact assessment is seen as a critical tool in enabling the coverage of the 'social capital' dimension. With regard to the Capitals Approach, it is important to note that its focus on stocks of capital lends itself to understanding issues of inter-generational equity i.e. whether the stock of capital today is the same or otherwise as the stock of capital tomorrow, but is less good at capturing intra-generational equity i.e. how costs and benefits are distributed across societal groups. Social impact assessment is an important tool to enable impacts across different groups to be explored (Maxwell *et al.*, 2011).

Discussion on techniques for social impact assessment, and for monetary and non-monetary valuation of impacts can be found in Maxwell *et al.* (2011), the HM Treasury Green Book (HM Treasury, 2011a) and Magenta Book (HM Treasury, 2011b).

3.3.2 Use of the interaction-impact tables and evidence base

The interaction-impact tables and their supporting evidence base (section 4) have been designed to act as a look-up table of the possible social impacts of sector interactions. There are a series of tables representing each of the MPS sectors, or subsectors, and one generic 'employment' table.

The affected sector or sub-sector and the interaction type act as the root of each table. As such these act as the 'way in' to identify possible pathways and social impacts. For each sector activity, the tables present a series of interaction types which the activity is potentially sensitive to. For each interaction type, the social impact pathways are then shown using the following headings:

- Interaction: the physical or non-physical interaction between one activity and another.
- Consequence: the non-social consequences that may occur due to the interaction.
- Primary social impact: the first order social impact that may occur due to the consequence.
- Secondary social impact: the second order social impact that may occur due to the first order social impact.

The tables themselves provide headline interaction, consequence and impact types, which are linked to a supporting evidence base which takes the form of a synthesis of the available literature.

The aim of the tables is to provide a tool for researchers to explore the potential social impacts that may result from any given interaction between one sector and another. On the back of this, researchers may be able to apply the information to generate first cut conclusions on likely social impacts of an interaction, as well as use the information to help design appropriately targeted bespoke research in order to generate more detailed assessments of the social impacts of any given interaction, should this be required (i.e. where potentially significant social impacts are identified). Further, because the impact pathway is readily identified, the tables may help to guide the design of mitigation measures for potentially significant social impacts.

What the interaction-impact tables do not do is provide a firm conclusion on whether social impacts will occur, and if they do, how significant they will be. In all instances it will be necessary to combine the information from the tables with information on the baseline situation and contextual issues which are relevant for the policy or project being assessed. Further, it should be borne in mind that the evidence base for the social impacts of marine sector interactions is not well developed and as such the interaction-impact tables may not necessarily provide evidence of all potential social impacts of an interaction.

There are a number of planning and assessment tools of relevance to the MMO which the interaction-impact tables can feed into in the ways described above. These include:

- Cumulative effects assessment (CEA) framework
  Cumulative effects assessment is a tool for understanding the potential significance of impacts that arise from multiple pressures. Research project MMO1055 (in prep b) is working to establish an approach to cumulative effects assessment that can be applied at a strategic level. The approach allows for consideration of economic, environmental and social impacts.

- Marine co-existence assessment framework
  MMO (2014b) outlined a framework that could be applied to the consideration of co-existence between MPS sectors within marine planning and the MMO's other key functions. This framework seeks to establish the potential for different MPS sectors to co-exist within the same or adjacent sea space and

thus to support the sustainable use of marine plan areas. Consideration of social impacts forms an important part of this framework.

- Impact assessment (IA)
  IA is a tool used to analyse and present the costs and benefits of a particular policy (or programme or project). Its purpose is to help decision-making and consultation and to provide input to the policy design process. The Government's principle guide for impact assessments, the Green Book (HM Treasury, 2011a), advocates that IA's take the form of cost-benefit analyses, covering economic, environmental and social impacts seeking to establish the affect on welfare (i.e. not just financial impacts). Where market and non-market valuation techniques cannot be used to monetise impacts it recognises the use of qualitative assessment and tools such as multi-criteria analysis. This is particularly relevant for many social impacts.

- Sustainability appraisal (SA)
  SAs can be undertaken for policies, plans or programmes, and can incorporate requirements under the European Strategic Environmental Assessment (SEA) Directive. It holds the concept of sustainability at its heart, seeking to identify the economic, environmental and social impacts of a plan or policy and assessing their significance. Importantly a key focus of an SA is to establish appropriate mitigation measures where significant impacts are identified. Therefore, an SA should be conducted during the plan or policy making process, so that its recommendations can be incorporated into the final design.

3.3.3 Links with sustainable development and the ecosystem approach

Social impact assessment can be used as a key tool to aid marine planning and licensing decision makers deliver sustainable development, and for implementing the principles of the ecosystem approach.

The capitals approach conceptual framework presented earlier is specifically designed to include a focus on both the stocks of capital as well as the flows of impacts. Following a Government review on the economics of sustainable development (Price *et al.*, 2010), Harper and Price (2011) state that focussing on whether the stock of wealth-creating and wellbeing-enhancing assets we pass on to future generations is in better or worse condition than currently, is a key analytical component of mainstreaming sustainable development. However, Price *et al.* (2010) notes that robust measures of social capital do not exist and are probably some way off. As such, the Government recommend that effort should be put into ensuring systematic and consistent assessments of the social impacts of policies (Price *et al.*, 2010). The interactions-impacts tables and their supporting evidence presented in this report are specifically focussed on social impacts.

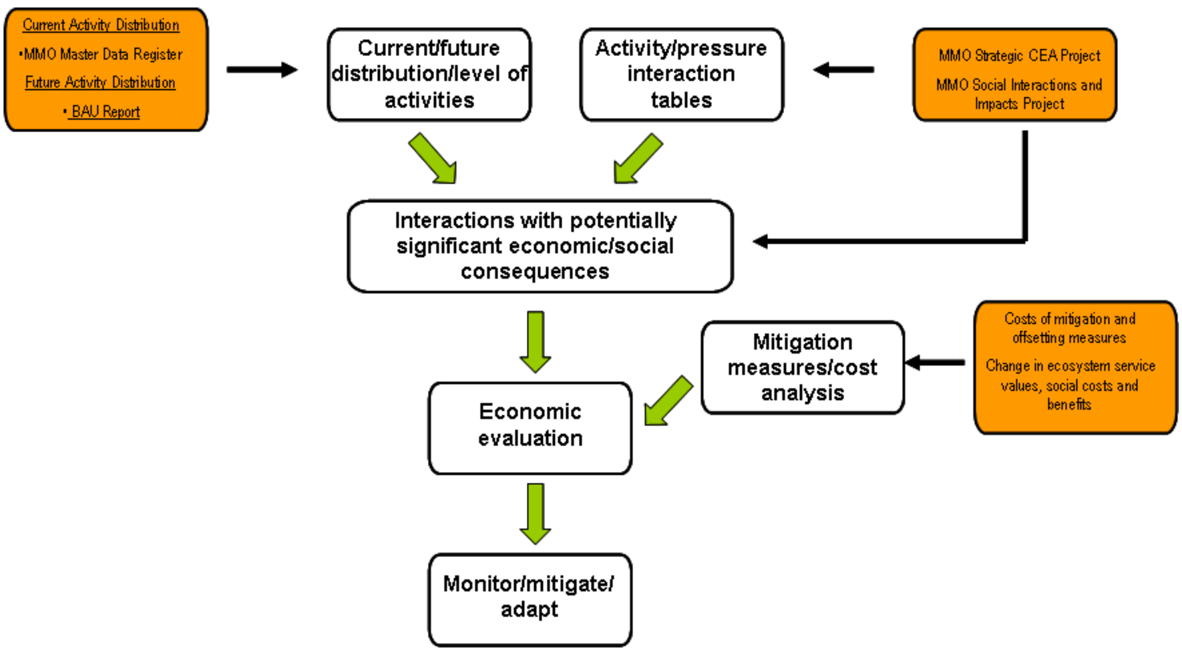
The MMO intends to explore how to improve on implementing principles of the ecosystem approach in the preparation of marine plans. A recent report (MMO, in prep a) identified that a principle of the ecosystem approach, and a requirement under the MPS, is to integrate economic, environmental and social factors into marine planning in order to support sustainable development. As such there is a strong link between the ecosystem approach and social analysis.

MMO (in prep a) recommends that in order to improve such integration the MMO may wish to consider applying more quantitative methods for assessing social and economic impacts and to seek to monetise such impacts through the use of Cost Benefit Analysis (CBA), in line with 'Green Book' methods (HM Treasury, 2011a). The impact-interaction tables and their supporting evidence base can be used to aid the identification of potential social impacts to be included, and ideally monetised, in CBA. Figure 2, reproduced from MMO (in prep a), explicitly shows where the interaction-impacts tables fit within its suggested ecosystem approach environmental assessment framework.

The aim of full monetisation of costs and benefits is qualified (as it is in 'The Green Book') by noting that in the absence of quantified social and or economic values, qualitative analysis of the impacts of marine planning on human activities can be undertaken, for example by using multi-criteria analysis (MCA) techniques. This is particularly relevant for social impacts, many of which are difficult to quantify and monetise (as noted earlier in Section 3.3).

A limited evidence base and a tendency of impact assessments to focus on national level impacts rather than distributional impacts means that social impacts are often not well represented (MMO, in prep a). Social impact assessments can therefore specifically address this key principle of the ecosystem approach, improving the scope of impacts addressed.

Figure 2: Indicative socio-economic assessment model (MMO in prep a).



3.4 Interaction-impact evidence base – a summary

This section provides a summary of some of the most notable social impacts associated with different marine activities, and the types of interactions that appear to hold the potential for significant social impacts. It does not cover all social impact types, or all interactions. For full descriptions of the social interactions and impacts of each marine sector, as well as full reference citations, please see section 4.

3.4.1 Income and employment

Employment is recognised as the most important means by which to fulfil material wellbeing, as well as being central to individual identity and social status and an important contributor to physical and mental health. It can also contribute to the development of social capital and community cohesion. Conversely, unemployment can be detrimental to individual identity and social status, physical and mental health, as well as a key cause of deprivation, weak social capital and community cohesion.

The most significant generator of marine income and employment in the UK is the ports sector, which sustains well over 100,000 direct jobs. Other major employers include defence and oil & gas sectors, both with close to 40,000 direct jobs. Including jobs sustained in their supply chains (indirect) and through expenditure of employees (induced), these figures rise significantly: to 450,000 for the oil and gas sector (Oil & Gas UK, 2013) and 390,000 for the ports sector (Oxford Economics, 2013), both of which represent close to 1.5% of total UK employment.

However, whilst sectors such as commercial fishing and aquaculture make more modest contributions at a national scale, they often provide important sources of employment for particular coastal communities, the significance of which is heightened where opportunities for other economic activity are constrained (e.g. due to peripherality). There is a significant body of evidence (e.g. Creative Research, 2009) on the sense of identity that commercial fishing gives to both individual fishers and to communities, which can be held more dearly than the income attained from fishing. This is a social benefit not specifically identified in the evidence for other marine economic activities.

For some sectors, the direct economic and social value of their operation is not thought to be a good indicator of their value to society. The most notable of these is subsea telecommunications cables, on which so much of the modern world critically depends.

Interactions that occur as a result of competition for space appear to hold notable potential for impacts on employment and income. Such impacts typically result in winners and losers, with the sector obtaining a marine area having a positive impact on income and employment and the sector being displaced having a negative impact on income and employment.

In reality, mitigation measures and the ability of sectors and individuals to adapt can help to minimise potential impacts of interactions on income and employment. However, even when such mitigation and adaptation is possible, the uncertainty and upheaval that result from threats to people’s jobs and livelihoods can have detrimental effects on health (e.g. through stress) and community cohesion (e.g. through the breakdown of social networks as a result of employment induced migration).

Where marine sectors are linked economically, positive income and employment impacts can occur where the expansion of one activity creates an increase in economic activity in another. The most notable of these is offshore wind energy, which is believed to hold significant potential for growth in other marine sectors, most notably the ports sector. To a lesser extent opportunities for diversification of commercial fishing incomes linked to tourism are identified, although such action can also have negative social impacts.

There are also examples of enhanced tourism employment and income generated as a result of activities, events or facilities linked to other marine sectors, for example fish festivals and wind farm visitor centres. There are obvious links between the recreation and tourism sector, with many recreation participants also being tourists, and many recreation-based events e.g. sailing regattas drawing large numbers of tourists.

3.4.2 Culture and community

All sectors contribute indirectly to the provision of social infrastructure and facilities through local and national taxes. The tourism and recreation sectors, through the provision of infrastructure and facilities, can directly provide social benefits to communities even where the local community is not the target beneficiary. Improved access to social infrastructure and recreation facilities can help to reduce social exclusion and to build community cohesion.

Where a certain activity has taken place in an area for a long time, it can become a strong feature of an area's identity and sense of place. Examples of this can be seen in the defence sector and the commercial fishing sector. Interactions which lead to, or are part of broader trends towards, economic restructuring or redevelopment of the built environment, can alter the cultural identity of whole communities and localities. There is a growing evidence base on the role of commercial fishing on sense of place and the social impacts that occur where it is eroded. In many coastal areas the tourism sector is the emerging sector that is altering cultural identity and sense of place.

Social impacts of economic restructuring are not confined to sector-to-sector interactions, or where community identity is particularly strong or tied to a given sector. There are well publicised cases of increased second home ownership and reductions in permanent populations resulting in key social infrastructure and facilities becoming unviable, reducing the quality of life of residents in an area.

Positive community-level impacts can also occur where significant growth in one marine sector provides opportunities for growth in one or more other marine sectors. The offshore wind energy sector is currently identified as holding the potential for significant growth over the next 20 years, and associated economic activity in ports and other marine and non-marine sectors is thought to be able to have transformational impacts on coastal communities (MMO, 2014).

In nearly all instances there are likely to be both positive and negative community-level impacts (as described above) from any broad based economic restructuring in a coastal community.

Some sectors play an important role in enabling coastal communities to exist. For island communities the shipping sector, through its provision of ferry services and transport of goods, provides a fundamental lifeline to enable communities to exist. Interaction which affects such services could result in community severance. Marine aggregates play a key role in servicing the nation's demand for construction aggregates, essential for the development of our built environment, and supplying materials for the maintenance of coastal and flood protection defences required for climate change adaptation. Such activity is key to creating and maintaining sustainable coastal communities.

Where interaction between two sectors results in conflict, this can result in increased social tension and reduced community cohesion. Examples of such conflict can be seen between different commercial fishing metiers (e.g. towed and static gears) and between recreation activities (e.g. Personal Water Craft users and other recreation activity participants) as well as between recreation participants/tourists and local residents.

3.4.2 Environment and health

There is an extensive literature base on the physical and mental health benefits of recreation. Particularly in relation to mental health, the setting (including environmental quality, landscape and seascape) in which recreation takes place can be an important variable in determining the magnitude and nature of the benefit. Further information on this can be found in section 4.

Construction of infrastructure can fundamentally alter the seascape. There are numerous studies which have assessed people's perceptions of developments such as offshore windfarms (OWFs). However, despite the existence of OWFs in the UK, there is very little post-development evaluation evidence on the actual social impacts of OWFs through their effect on the seascape. Notably evidence indicates that the negative effect on tourism performance where wind farms have already been established may not be as great as the feared impact assumed prior to wind farm construction.

The primary aim of most MPAs is to deliver environmental conservation benefits. MPAs hold the potential to create both negative and positive social impacts. Negative impacts link primarily to those discussed under income and employment above, as a result of exclusion and displacement of activity. Positive impacts can stem both from the improvement in the marine environment that they enable, and also from the use of the designation label as a marketing tool.

Positive impacts resulting from MPA environmental improvements are most likely to be felt by those sectors that are closely linked to the natural environment, e.g. commercial fishing and some recreation (and therefore tourism) activities, such as diving, angling and wildlife watching. Whilst there is a good international evidence base on the positive impacts of MPAs on the environment and in turn increased social benefits for these sectors, the UK evidence base is still developing. A small number of studies indicate improved recreation experiences can occur due to MPAs, whilst evidence on benefits to commercial fishing is mixed, with outcomes depending on the purpose and size of the MPA, its management regime and the characteristics of fishing fleets.

Whilst most sectors have some sort of detrimental impact on the environment, some can also have positive impacts. Offshore renewable energy generation can result in reduced greenhouse gas emissions compared to other energy sources, and therefore can help to reduce the UK's contribution to climate change, the value of which can be estimated via the social cost of carbon.

3.4.3 Assessing significance

The social impact of any given interaction type will always be context specific and as such it is very difficult to generalise on the significance of any given interaction. In order to understand the potential social impacts of sector interactions and their significance, it is necessary to understand the extent of the interaction and the scale and nature of the consequences of that interaction. The significance of the social impact of that consequence will then depend on the characteristics of the individual or community affected, including their vulnerability, adaptability and preferences.

Vulnerability, adaptability and preferences will vary across marine sectors, groups of society and geographic areas. For example, some sectors may be less adaptable than others in the face of competition for space interactions due to their particular spatial requirements. For example, tidal stream technologies typically target very specific areas of appropriate resource, whilst inshore fishermen are typically constrained to fishing within a certain distance of their home port. Some sectors or groups of society may be more vulnerable than others. For example, more peripheral communities may be dependent on a single sector for employment and cultural identity, making them highly vulnerable to changes in the performance of that sector. MMO1035 (2013a) explored adaptability in five MPS sectors.

3.5 Interaction-impact gaps

In general there is little literature evidencing the social impacts of marine sectors. In some sectors, or for some specific issues, it is growing, but there remain numerous gaps that could be usefully filled to help inform marine planning and other marine policy development and decision-making.

Based on the types of interactions identified and the strength of the evidence base identified during this project, section six sets out a number of recommendations for future research to fill certain evidence gaps.

4. Social interaction-impact tables and evidence

This section brings together current knowledge in an accessible form so that it can be utilised to start to understand the potential social impacts that can occur from marine interactions, and thereby help the MMO to develop more robust marine plan options. This section includes sector-specific interaction-impact tables and supporting evidence reviews.

4.1 Employment

4.1.1 Social impacts associated with employment and unemployment

Employment is recognised as the most important means by which to fulfil material wellbeing, as well as being central to social linkages, individual identity, social status and an important contributor to physical and mental health. Conversely, unemployment can be detrimental to physical and mental health, as well as a key cause of deprivation and associated community cohesion issues.

Much of the sector-specific economic and social literature does not extend discussion regarding employment beyond the potential for a sector, and sector interactions, to create employment or unemployment. As such, this section provides a non-sector specific overview of a number of social issues that are associated with employment and unemployment.

The employment review is structured below in a series of tables as follows:

- Health: physical health
- Health: mental health
- Health: culture and sport
- Community: social cohesion
- Community: social identity and mobility
- Community: social linkages and social capital
- Way of life: education and training
- Rights and equity: young people
- Rights and equity: migrants
- Political systems
- Fears and aspirations: crime.

Table 4: Health: physical health

<table>
<tr><td>Loss of Employment</td><td>The loss of employment in an area can have negative impacts upon individuals and their family's health. Further physical affects from unemployment include (Waddell et al., 2006):
• Higher mortality.
• Poorer general health, long-standing illness, limiting longstanding illness.
• Higher medical consultation, medication consumption and hospital admission rates.
• Unemployment increases the probability of poor physical health outcomes.
• Heart attacks in later life.</td><td rowspan="2">Specific Impact on Coastal Communities:
There is some evidence of good health attributed to coastal living (Depledge and Bird, 2009). However, there is little known evidence about the impacts of employment changes on physical health in coastal communities. There will be certain considerations which are important, for example some marine sectors have seasonal employment which can drive a negative impact upon different labour market groups[6].</td></tr>
<tr><td>Creation of Employment</td><td>The creation of employment can have positive health impacts through re-employment, many of which are the opposite to those from a loss of employment (e.g. lower mortality and medical health admissions). There are other impacts from being employed which are positive including access to maternity and paternity leave (Kaplana, 2013), time with children, access to private healthcare and pensions which have positive effects on the health of an individual and their family (WHEC, 2011). However, this often depends on the type of jobs created with differing impacts associated with jobs that are part time (e.g. higher levels of uncertainty (IPHI, 2011)) and lower paid jobs (e.g. ability to access nutrition, physical activity, housing, transport, medical care and hygiene) (IHI, 2013).</td></tr>
<tr><td colspan="3">Data: Health impacts can be identified through public health statistics (e.g. from the NHS) and labour market statistics (from the ONS) around unemployment connected to poor health, part-time/full-time split and income rates.</td></tr>
<tr><td colspan="3">Further pathway linkages: Poor physical health is also associated with many of the other social impacts, particularly mental health and accessing a range of services (e.g. sport) and engaging with other community groups or political structures.</td></tr>
</table>

[6] The positive link between employment and health is also picked up in the Social impacts of fisheries, aquaculture, recreation, tourism and marine protected areas (MPAs) in marine plan areas in England (MMO, 2013).

Table 5: Health: mental health

Loss of Employment	A lack or loss of employment has a negative impact upon an individual's and their family's mental health. Unemployment is a stressful life event that makes people unhappy (Bell and Blanchflower, 2009), there have been several studies which demonstrate the link between unemployment and self-esteem and mental health. The impacts of becoming unemployed include psychological distress, minor psychological/psychiatric morbidity. There are wider health impacts with unemployment increasing the susceptibility to malnutrition, illness and self-harm (Cohen, 1999). However, there is less clear evidence that the transition from employment to unemployment has on an individual's mental health. There are other clear additional benefits which are lost when someone is made unemployed such as social status, physical and mental activity, and use of one's skills (Artazcoz, 2004). Evidence has also shown there are particular difficulties for young people and the longer an individual is unemployed.	*Specific Impact on Coastal Communities:* Coastal employment opportunities provide the means for people to live in coastal areas. There is a programme of work entitled the Blue Gym which is examining the health benefits that can be obtained from residency in coastal environments. Evidence reviewed by the MMO already acknowledges that coastal environments are conducive to reducing stress and increasing physical exercise
Creation of Employment	Again, much of the literature explores the impact of unemployment and identifies the positive impacts as likely to be the reverse. As such less psychological distress leads to wider positive impacts around health and wealth. The association between improved mental health and employment appears to be strong (Waddell and Burton, 2006).	
Data: Whilst not as comprehensive as physical health, the range of local level data that is available has increased and data holders (such as the NHS) have a number of datasets which could be used to show mental health impacts.		
Further pathway linkages: The impact of unemployment on mental health is not equally distributed across the different categories of gender, family role, and social class (Artazcoz, 2004). It is known that there is highly negative effect from long-term unemployment and in general there are strong linkages between poor mental health and many of the other social indicators explored in this section.		

Table 6: Health: culture and sport

<table>
<tr><td>Loss of Employment</td><td>There is a negative relationship between unemployment and physical fitness (Jerstad, 2010). The unemployed are at danger of a lack of exercise that can cause deterioration in general health. Being economically disadvantaged can mean that there is a lack of financial or social means to access cultural activities (European Commission, 2005). Both of these can have further negative impacts upon individuals including disenchantment and feeling disconnected from society.</td><td rowspan="2">Specific Impact on Coastal Communities:
There are clearly activities which are predominantly found at coastal areas (e.g. sports such as surfing) and cultural activities (e.g. festivals) which contribute to wellbeing. Little is known of the impact that changes in employment have on these activities. The majority of literature looks at impacts of events and sport on local areas.</td></tr>
<tr><td>Creation of Employment</td><td>Those in employment are more likely to access certain sports and cultural and arts facilities (Jones and Millward, 2011). Culture and sport can contribute to enhancing a reduction in long term unemployment, ensure less crime, better health and better qualifications, but can also help to develop the individual pride, community spirit and capacity for responsibility (DCMS, 2013).
There are benefits from employment including increased access to culture and sport leading to social inclusion, building skills and self-confidence, increasing access to information and service and promoting social integration (especially amongst older people).</td></tr>
<tr><td colspan="3">Data: Sport and cultural participation statistics are available from Sport England and DCMS. These can be used to understand the impact of an activity on employment and therefore sports and cultural participation.</td></tr>
<tr><td colspan="3">Further pathway linkages: A consequence of poor cultural and sporting wellbeing can drive social exclusion and affect health, crime, employment and education in deprived communities (Belfiore, 2004) Sport and cultural activities and enable interactions across communities, overcoming barriers to cohesion such as language issues, perceptions of cultural difference and stereotyping, unemployment, fear of crime and racial harassment. Employment can also drive regeneration of sport and cultural facilities.</td></tr>
</table>

Table 7: Community: social cohesion

<table>
<tr><td>Loss of Employment</td><td>The loss of employment can have a range of impacts upon individuals and their social cohesion. Research has shown that lack of employment or redundancies can reduce income equality and social cohesion (Leitch Review, 2006). However, there are further studies that show in the short-term there can be increases in close family ties, mutual aid and voluntarism (Forrest and Kearns, 2001). Over the longer term deprivation and employment disadvantage play a pivotal role in the breakdown of social cohesion and can also negatively affect relationships including racial tensions, struggles for resources such as employment and housing, language issues, perceptions of cultural difference and stereotyping, unemployment, fear of crime and racial harassment (Hudson, Phillips and Ray, 2007).</td><td rowspan="2">Specific Impact on Coastal Communities:
There is a range of literature which looks at the social cohesion resulting from natural disasters and indigenous community interaction. From wider literature a number of considerations about the labour market should be noted in including demographic (e.g. age, gender, ethnicity) and social profile (social and occupational class).</td></tr>
<tr><td>Creation of Employment</td><td>Employment provides social empowerment, builds agency (capacity of someone to act), collaboration and increases access to democratic structures (World Bank, 2013). New employment can create economic and social ties and build incentives within communities to work across boundaries and resolve issues. There is also evidence of benefits to a range of individual’s skills including problem solving, empathy, communication and attitude and motivation to work (Copps and Plimmer, 2013).</td></tr>
<tr><td colspan="3">Data: Social impacts are difficult to measure through secondary information. Many of the additional impacts around access to transport and internet exist in secondary data whereas data connected to community engagement, linkages and issues either do not exist or do not exist at a sufficient geographical level in national statistics.</td></tr>
<tr><td colspan="3">Further pathway linkages: Social cohesion can be integral to communities and play a part in negative (e.g. ghettoization, poor health outcomes, and crime) and positive outcomes (e.g. healthy, educated, and productive communities) (Baeker, 2002).</td></tr>
</table>

Table 8: Community: social identity and mobility

<table>
<tr>
<td>Loss of Employment</td>
<td>The loss of employment can have a range of impacts upon an individual’s sense of self and their ability to move within social structures. Studies like Kelvin (1981) demonstrate how work is central to an individual's self-concept, values and structure to life. The loss of employment can affect identify through poorer self-esteem and leads to negative or no social identity with unemployed groups (Sheeran, 1995). Loss of employment can have impacts which include identity connected psychological (e.g. mental health), interpersonal (e.g. relationships with others), mobility (e.g. social mobility) impacts. Stigma impacts upon identity and can often lead to a devalued social identity and negative spiral for the individual (Levin and Van Laar, 2006).

Social mobility is also closely linked to employment and like identity is negatively impacted by periods of unemployment (Quadrini, 2000). Since unemployment contributes to social exclusion, it also affects social mobility. Youth unemployment can also affect future mobility (Sackmann *et al.,* 2001), polarise labour markets and increase inequality.</td>
<td rowspan="2">*Specific Impact on Coastal Communities:*

Coastal communities and their inhabitants are often described or self-designated as having their own identity (MMO, 2011). Little work has explored the social identity or mobility impacts of unemployment or new employment specifically on coastal area. Studies have sought to explore identity in connection with fishing (e.g. Acott and Urqhuart, 2014) and studies explore impact of loss of employment on coastal communities (Stead, 2005) but little work has connected identity and unemployment together. Social mobility is a concept which is so hard to measure that studies at a local level or focusing upon coastal communities are almost non-existent</td>
</tr>
<tr>
<td>Creation of Employment</td>
<td>Employment provides a range of benefits to identity and options for future social mobility. Moving from unemployment to employment can help to distance individuals from an undesirable social group and lead to improved well-being (Sheeran, 1995). Employment can support an individual’s ambitions, creativity, mobility and competition (Levin and Van Laar, 2006). Being in work is highly important to social mobility and different elements like the type of work, distribution of wealth and amount of savings also have an impact upon an individual’s social mobility. However, other factors are also important for social mobility and identity including: education, geography and social background.</td>
</tr>
<tr>
<td colspan="3">*Data:* Social identity and mobility is difficult to capture in secondary statistics. Data exists to explore social status but this is heavily linked to the occupation of an individual and there would be significant work involved to undertake a mobility or social</td>
</tr>
</table>

background study.
Further pathway linkages: Social status (although ill defined) and identity link across all of the impact topics. Low social status within society can negatively impact health and education indicators as well as incidence of crime. Identity is such a complex and multifaceted term that it links across all of the impact topics, with key connections to mental health and social linkages.

Table 9: Community: social linkages and social capital

<table>
<tr><td>Loss of Employment</td><td>A related concept to social cohesions is that of social linkages (the interactions between an individual and other people in the social structure (OECD, 2007)). There has been a range of literature which shows that the loss of employment reduces social networks and opportunities. This is significant because of the link between social linkages and networks and an individual’s employment chances, which are highlighted by statistics which show how a high proportion of people obtain their job through informal channels (friends, families and contacts). There is evidence that social linkages are particularly important for low skilled people and without them people can be marginalised from the labour market (Topa, 2001; Woolcock, 1998).</td><td rowspan="2">Specific Impact on Coastal Communities:
Linkages are not looked at specifically in connection with coastal communities but from the wider literature, it is important to understand local labour market dynamics (skills levels, key industries) and explore historical networks within the communities</td></tr>
<tr><td>Creation of Employment</td><td>Employment improves an individual’s social capital (the information, trust, and norms of reciprocity inherent in one's social networks) (Woolcock, 1998). Employment creates chances for new linkages to be formed and for socially integrated individuals to have greater access to useful job information flows.</td></tr>
<tr><td colspan="3">Data: There is little direct data to identify social linkages in the workforce or perceptions of these.</td></tr>
<tr><td colspan="3">Further pathway linkages: Unemployment can also affect wider social linkages and networks which can negatively affect future labour market interaction for an individual including; access to transport and internet (Inspiring Impact, 2013, Lorenzo and Tatsiramos, 2010). Employment is seen to create social linkages and information sharing, which areas of high unemployed (for example, council housing schemes) can restrict because of a lack of information.</td></tr>
</table>

Table 10: Way of life: education and training

Loss of Employment	A negative impact upon employment in an area can lead to more people undertaking education and training in an effort to retrain, reskill or upskill to increase their chances of reintegration into the labour market. However, over the longer term there is no significant cross-country correlation found between training and unemployment rates. In some cases though, an increase in unemployment in an area can erode the reward to undertake education and dissuade education or training take-up (OECD, 2004).	*Specific Impact on Coastal Communities:* There is a range of existing education and training research connected to different marine sectors. These should be considered when understanding the activity changes in employment. There will also be specific educational institution that will play different roles in helping to upskill, reskill and educate the local labour market
Creation of low-skilled employment:	The creation of low paid and low skilled work can improve unemployment rates for a local area which has an existing labour market which matches this profile. However, more lowly skilled and low paid jobs can create a low skills trajectory scenario which restricts the future prosperity of an area by placing additional cost on training for businesses and an economic environment in which skills progression is challenging (Wilson and Hogarth, 2003).	
Creation of high-skilled employment:	High paid and highly skilled employment can bring a range of additionalities including more spend in the local area, demand for social and cultural activities. However, more spending is also required from business in recruitment and training (Wilson and Hogarth, 2003) and the length of time that workers stay in an area can be limited if these further impacts are not embedded or reciprocated by the local area.	
Data: Education and training impacts can be noted through national statistics rates which cover incidence of training, qualification levels, and occupational and skill level profile.		
Further pathway linkages: Education and training can have a range of impacts which connect to many of the other social impact themes. For example education has positive impacts upon levels of crime (Lochner and Moretti, 2001) and health (Ross and Wu, 1995)		

Table 11: Rights and equity: young people

Loss of Employment	The impact of loss of employment in an area on young people is well-documented. There are several negative impacts upon young people of the loss of employment chance including: • Repressed ambitions for young people in the labour market. • Increased incidence of crime by those not in education or jobs. • Higher welfare dependency (Coles *et al.,* 2010). • Homelessness and increase use of drugs like heroin (Johnston *et al.,* 2000). • Experiences of unemployment when young increases propensity for unemployment when older (Dorsett and Lucchino, 2012). • Lack of disposable income to participate in activities and purchasing of products (Coles *et al.,* 2010) • Exclusion from the relationships and social networks created in the work or educational environment • Danger that some young people may opt out of participation in civil society or may engage at the extremes of the political spectrum • The later-life consequences of young people being unemployed (or not in training) varies according to gender (Graetz, 1993). For males, the main consequences were poor labour market experiences. For females however, the vast majority of whom were teenage mothers, negative mental health outcomes (e.g. depression) were also observed (Robson and Marie Curie Team, 2008).	*Specific Impact on Coastal Communities:* There has been some research which explores the impact of changes on certain marine industries to young people in the labour market. This work is not always comprehensive and is part of some wider research. For example it considers the need for upskilling and familiarity with industry equipment but does not explore further impacts or requirements of young people.
Creation of Employment	Many young people benefit in the same way as older people from moving into employment. This includes socio-economic factors such as better social linkages, improved future employment chances and reduced chances of crime and welfare dependency (Copps and Plimmer, 2013). However, there have been some studies which explore how young people moving into employment can have different impacts. One of these includes the rate at which young people change jobs, obtaining employment when young can reduce the impact of transition	

	between jobs and have better impacts upon future employment choices (Copps and Plimmer, 2013). There are studies which identify how young people in employment are more likely to engage in civic processes.	
Data: Crime statistics are fairly straightforward to assess at a local level. However, many of the other social impacts connected to it are difficult to assess and there can be difficulty in interrogating cross tabulated data around crime and age for example.		
Further pathway linkages: Unemployment while young, especially of long duration, can cause "permanent scars rather than temporary blemishes". For young people, a spell of unemployment does not end with that spell; it raises the probability of being unemployed in later years and has a wage penalty. These effects are much larger than for older people (Ellwood, 1982).		

Table 12: Rights and equity: migrants

Loss of Employment	In this section we refer to migrants from outside of the UK and internal migrants from within the UK. Some research studies find the impact of loss of employment on migrant groups to have different effects since immigrants may be substitutes for some native-born individuals (Gange *et al.,* 1999). Unemployment can affect migrants from outside the UK because of inferior human capital, although this is not the case for all migrants. Furthermore, migrants from outside the UK can receive less favourable labour market outcomes due to a less positive selection process, and greater difficulties in adapting to a new environment resulting from stressful experiences surrounding their migration. Generally, immigrants have higher unemployment rates than native born people, which limits both their earnings and their social integration into networks of native colleagues, thus seriously jeopardising their chances for upward social mobility. Internal migrants can be displaced by unemployment and seek emigration, wages and economic adjustment. Given their movement, they can contribute to a brain drain (Dayton-Johnson, 2008) or be underemployed. Their movement elsewhere can have impacts if they are a keystone worker – a skilled worker whose job	*Specific Impact on Coastal Communities:* Work by DCLG suggests that the population of coastal areas is rising from in-migration. Research highlighted by MMO (2011) shows that certain groups are more attracted to coastal living and therefore more likely to move to coastal areas. Seasonality is also an important consideration and needs to be considered when exploring issues of movement and labour market dynamics.

	might affect the wider labour markets (Dayton-Johnson, 2008).	
Creation of Employment	There is a perception that migrants from outside the UK receive favourable experiences at the expense of local employment during periods of employment growth. However this is debated across academia. Migrants can have higher unemployment rates when they arrive, but unemployment rates decline the longer a group has been residing in a host country (Hurst and Chiswick, 2000). Employment creation can lead to the underemployment of migrants from outside the UK, with their skills levels being underutilised. There are a range of social multipliers which migrants can provide for local areas including social cohesion and new experiences, as well as displacement of jobs.	
Data: There is some statistical evidence of migrant movement and data also exists on the population of those born outside of the UK.		
Further pathway linkages: This is a politically sensitive topic and this should be considered when exploring other linkages across the other social impact themes. There is research evidence which explores migrants and crime, social cohesion and education although this should be considered in its spatial context.		

Table 13: Political systems

Loss of Employment	There is a strong body of literature which explores how unemployment affects political engagement. The body largely covers the impacts of unemployment which shows a range of impacts including increases in right wing activities to a lack of voting and engagement with local democracy (Falk and Zweimuller, 2005). Certain groups of the labour market can also be limited by unemployment. For example, younger people and disabled people are most likely to see political participation levels decline because of the linkages between political systems and social cohesion.	*Specific Impact on Coastal Communities:* There is little or no available research on this theme
Creation of Employment	There is a relationship between the creation of employment and issues of political engagement. Social cohesion encourages and shapes political capital, for example attitudes of trust in government, political efficacy, and interest in politics. Political capital is strengthened most by an individual attachment and investment to their community, such as owning a home and having children in the local school (Beauvais and Jenson 2002). However, growth in economic inequality can also make politics less important to all citizens, especially if it affects the political engagement of those with lower incomes.	
Data: The proportion of the population that votes is a good indicator political engagement. This data is regularly updated and at a local level. There is little other data which is available at a local level to support this theme.		
Further pathways: Crime can drive the loss of political engagement altogether (through lack of voting rights as a prisoner). There is also negative relationship between health and political engagement.		

Table 14: Fears and aspirations: crime

<table>
<tr><td>Loss of Employment</td><td>There are a range of effects of unemployment on people’s involvement in crime. Unemployment can motivate crime but also restrict opportunities to undertake crime (e.g. whitecollar). The majority of studies identify that as unemployment rates increase, crime rates tend to rise, especially property crime. Youth unemployment and adult unemployment are both significantly and positively related to burglary, theft, fraud and forgery and total crime rate. Related to this, there is some evidence that poor housing conditions and the relative youth of the population are factors affecting levels of criminal activity and drug use (Reilly and Witt, 1996).</td><td rowspan="2">Specific Impact on Coastal Communities:
There is little or no research available on this topic but considerations should be made on the activities at coastal areas. For example, certain tourism activities have been observed to see an increased crime rate</td></tr>
<tr><td>Creation of Employment</td><td>Generally areas of strong employment rates have lower crime rates. There are some points which demonstrate the complexity of the issues. For example, there has also been an observation that more inequality can drive crime, whilst other studies can show that education is the major determinant in reducing crime (Machin and Meghir, 2004). There is also evidence that alcohol consumption and drink driving can decrease in the short term when there is a drop in unemployment (Morgan, 2000).</td></tr>
<tr><td colspan="3">Data: There is a range of data that is related to crime, with some data available on perception and incidence of crime. Context is important; a growth in crime rates may be triggered by a development which increases the opportunity for crime (e.g. a new supermarket).</td></tr>
<tr><td colspan="3">Further pathways: Crime can drive further unemployment (lack of job linkages, reputation) (Calvo-Armengol and Zenou, 2003) in an area and also provide additional economic and social costs like drug use and lack of educational attendance (Witt et al., 1998).</td></tr>
</table>

4.1.2 Employment References

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4.2 Aquaculture

4.2.1 Social impact of aquaculture

This section provides a short overview of the key social impacts produced by the aquaculture sector, in the absence of any specific interaction. For the purposes of this review aquaculture relates to the production of marine species such as finfish and shellfish within aquaculture installations including cultivated shellfish beds.

Income and employment

The aquaculture sector provides employment and income (e.g. Lantra, 2006; Neiland *et al*. 1991 both cited in MMO, 2013a; MMO, 2013b) often in coastal regions where incomes are often depressed and unemployment high (MMO, 2013c). The sector provides potential for continued professional development for employees in relation to knowledge of regulations, legislative frameworks, environmental management techniques, literacy and computer skills (Lantra, 2006 cited in MMO, 2013a).

The following information on the social impacts of the sector, in terms of GVA and employment, at the UK level has been taken from Charting Progress 2 (UKMMAS, 2010). In 2007, the turnover from finfish farming in Scotland (where the majority of marine based finfish farming is located) was £327 million and shellfish farming in the UK was £23 million providing a total of £350 million. Assuming a value added factor of 0.55 (as used by Pugh and Skinner, 2002) gives £193 million GVA for the principal production process. In 2004, UK employment for shellfish cultivation was estimated at around 416 full-time and 418 part time staff. Employment in the finfish sector totals an estimated 1396 full-time and 268 part time staff. Converting this to full-time equivalent (FTE) levels gives a combined total of 2163 for the aquaculture production sector in the UK.

Employment is recognised as the most important means by which to fulfil material wellbeing, as well as being central to individual identity and social status and an important contributor to physical and mental health (see Section 1).

Communities and culture

Aquaculture can contribute to the stability and development of the community by offering full time and part time work (e.g. in West Scotland; Neiland *et al*., 1991; cited in MMO, 2013a). Aquaculture can benefit the wider community due to the investment in infrastructure and the demand for traditional skills such as boat building. These elements within the local economy contribute to the reduction in emigration and maintenance of traditions and culture providing stability to these often peripheral communities (White and Costelloe, 1999; summarised in MMO, 2013a). Employment is recognised as an important contributor to social capital and community cohesion (see Section 1).

Environment – provision of food and other beneficial ecosystem services

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. A recent Government report has highlighted the importance of the sector, suggesting that aquaculture could become the greatest source of fish and shellfish production that will be needed in the coming decades to bridge the gap between diminishing food resources and the increasing demand for food (Environment, Food and Rural Affairs Committee, 2009; cited in MMO, 2013d). Furthermore aquaculture can benefit consumers through lower prices (through increasing supply of product) and providing good quality food (Neiland *et al*., 1991).

In addition to food provision, some cultivated shellfish species, may provide additional beneficial ecosystem processes and services. For example, Herbert *et al*. (2012) found evidence that cultivated oyster species provide ecosystem processes including climate regulation and water purification, whilst beneficial ecosystem services include the provision of construction materials (e.g. oyster shells being used for lime mortar).

4.2.2 Social impacts of changes in the aquaculture sector arising from marine sector interactions

Interactions and impacts – summary table

The potential interactions between MPS activities and the aquaculture sector are shown in Table 15. This table was compiled based on a review of key studies in which potential interactions between marine sectors have been proposed or described (e.g. Marine Scotland, 2013a; Marine Scotland, 2013b; MMO, 2014; MMO, 2013a), and an additional grey and peer-reviewed literature search and through consultation with stakeholders. Available evidence detailing the occurrence of these potential marine sector interactions, consequences and subsequent social impacts are described after the table.

Table 15: Aquaculture interaction-impact table.
Key: H/M/L = High Medium Low - Representing: **[strength of the evidence that the impact can occur**; **judgement on the significance of the impact as presented in the literature]**

Issue	Interaction	Consequence	Social Impact	
			Primary	Secondary
Competition for space	Exclusion from sea or coastal areas	Potential constraint on expansion of existing farms or on development of future farms, including in offshore locations (i.e. reduced aquaculture potential)	Reduction in income (aquaculture producers) **[L,L]** Reduction in investor confidence **[L,L]**	Reduction in employment (aquaculture producers) **[L,L]** Reduction in future income and employment (aquaculture) **[L,L]** Reduction in employment (downstream supply chain) **[L,L]** Effects of unemployment on individual identity, health, and social capital and cohesion **[L,L]**
	As above	Increased conflict with other sectors	Increase/decrease in social tension and impacts on community cohesion **[L,L]** Impact on way of life (income) if conflict results in increased costs **[L,L]**	
	Nature Conservation designations	Constraint on expansion of existing farms or establishment of new farms due to interpretation and application of nature conservation legislation and restrictions on species for	Reduction in income (aquaculture producers) **[M,M]** Reduction in investor confidence **[M,M]**	Reduction in employment (aquaculture producers) **[L,M]** Reduction in future income and employment (aquaculture) **[L,M]** Reduction in employment (downstream supply chain)

Issue	Interaction	Consequence	Social Impact	
			Primary	Secondary
		cultivation (e.g. Pacific oyster); Additional time and cost burden to sector (e.g. associated with pre and/or post consent survey/monitoring requirements, additional mitigation measures) in relation to developments in or near EMS sites		**[L,L]** Effects of unemployment on individual identity, health, and social capital and cohesion **[L,L]**
Increase in vessel traffic	Increase in interactions between vessels	Increased collision risk (vessel to vessel)	Increased safety fears and health impacts **[L,L]**	
		Possible delays in operation (e.g. husbandry, harvesting) or maintenance of infrastructure through presence of other sector vessels, leading to reduced operational efficiency	Reduction in income (aquaculture producers) **[L,L]**	Loss of community and cultural stability **[L,L]**
		Facilitation of spread of non-native species which may be detrimental to cultivated species or their habitat	Reduction in income (aquaculture producers) **[L,L]**	Reduction in employment (aquaculture industry) **[L,L]**
Infrastructure	Noise disturbance related to infrastructure construction	Disturbance or injury to aquaculture species	Reduction in income (aquaculture producers) **[L,L]**	Reduction in employment (aquaculture industry) **[L,L]**; Reduction in employment (downstream supply chain) **[L,L]**
	Potential for co-	Development of new or	Increased income (offshore	Health benefits (through the

Issue	Interaction	Consequence	Social Impact	
			Primary	Secondary
	location of activities	more efficient aquaculture opportunities resulting in increased economic activity and production. Reduction in spatial conflict between aquaculture and activity outside of co-location areas	aquaculture producers) **[L,M]** Future employment opportunities **[L,M]** Potentially improved community cohesion, particularly with fishing communities and lobbies **[L,L]** Increased availability of seafood (beneficial ecosystem service) from UK waters **[L,L]**	consumption of seafood) **[L,L]** Impact on way of life (in relation to income and employment) for inshore aquaculture producers? **[L,L]**
		Increased collision risk (vessel to vessel and vessel to infrastructure); Increased risk to safety from harsher offshore environmental conditions where infrastructure (e.g. OWF arrays) deployed;	Increased safety and health impacts **[L,L]**	
		Potential increased costs/investment required	Reduction in income (aquaculture producers) **[L,L]** Reduction in investor confidence **[L,L]**	
Water Quality	Re-suspension of sediment associated with disturbance (e.g. physical abrasion) of seabed	Reduction in water quality and deterioration of growing conditions for aquaculture species (particularly shellfish); Potential closure of shellfish beds)	Reduced business profitability **[M,L]** Reduction in income (aquaculture producer) **[M,L]**	Reduction in employment (aquaculture industry) **[L,L]** Reduction in employment (downstream supply chain) **[L,L]**

Issue	Interaction	Consequence	Social Impact	
			Primary	Secondary
	Release of contaminants associated with disturbance of sediments	Reduction in water quality and contaminant uptake by aquaculture species (shellfish); Potential closure of shellfish beds		
	Accidental release of contaminants from vessels/infrastructure	Reduction in water quality and contaminant uptake by aquaculture species (shellfish); Decreased productivity; Potential closure of shellfish bed		
	Capital investment in waste water treatment and infrastructure	Improved shellfish water quality (increased grade shellfish waters), resulting in development of new aquaculture opportunities; Increased investment in current facilities and increased production	Increase in employment opportunities **[L,L]** Increased business profitability **[L,L]** Increase in income (aquaculture producer) **[L,L]**	

Potential social impacts – supporting literature review
The following review identifies evidence of the occurrence of these interactions and the social impacts that may arise as a consequence where such evidence was available. Where specific evidence of primary and/or secondary social impacts arising from changes in employment level within this sector were found, they are described below. However, it can be noted that, in general, unemployment can be detrimental to individual identity and social status, physical and mental health, as well as a key cause of deprivation, weak social capital and community cohesion (see Section 1)

Competition for space - exclusion
It is possible that other marine sector activity/expansion may constrain the development of aquaculture in the future through excluding the industry from areas into which current farms could expand, or where new farms could be established. Several reports have highlighted the potential for the development of the aquaculture industry to be constrained by recreational activities (e.g. due to the incompatibility of marine recreational activities such as diving and yachting race courses with the presence of aquaculture infrastructure; MMO, 2013c; MMO, 2013a). Competition for space with recreational activities may be reduced in more offshore waters; however, competition for space with other activities or sectors may occur in these locations, particularly with offshore wind (e.g. James and Slaski, 2006; Faber Maunsell Limited, 2008, both cited in Marine Scotland, 2013a; Mee, 2006 cited in MMO, 2013b).

Despite the potential for competition for space (inshore and offshore) to potentially constrain development/expansion of the aquaculture sector, no specific evidence could be found on the social impacts of competition for space on the aquaculture sector.

Competition for space – policy related constraints including nature conservation designations
The interpretation and application of nature conservation related legislation is considered by the aquaculture industry to be the primary factor constraining the future growth and investment in the shellfish aquaculture industry (David Jarrad, Shellfish Association of Great Britain, pers. comm.). Numerous reports have highlighted the potential for the development of the aquaculture industry to be constrained by nature conservation designations and complex regulatory systems requiring aquaculture developments to minimise or eliminate impacts to protected species, communities or habitats (e.g. MMO, 2013d; MMO, 2013e). Aquaculture industry stakeholders confirmed that management measures associated with European Marine Sites (EMS) have resulted in a lack of availability of wild seed due to policy-related management measures in designated sites preventing collection e.g. through the use of dredge gears for seabed culture systems; MMO, 2013e). Woolmer (2009 and references therein) described how conservation and fisheries managers are frequently presented with varying degrees of ‘uncertainty’ when attempting to assess or consent new shellfisheries and shellfish farm developments in European Marine Sites and how this uncertainty and lack of knowledge can cause significant delays or prevent the consenting process of new shellfishery or farm developments in these sites. The author provides example case studies in which shellfish (Pacific oyster) cultivation trial applications have been delayed due to remaining uncertainties over the effects of the development on EMS features and

while the operators subsequently decide whether to proceed with the application. Such delays in the consenting process and/or increased pre- or post-consent survey/monitoring requirements or mitigation measures will increase costs to the sector and may deter investment. Policy-related constraints on the species which can be introduced for cultivation and issues relating to translocation of non-indigenous species are also considered to constrain the development of the aquaculture industry (MMO, 2013e; see also Herbert *et al*., 2012).

In general, exclusion or displacement of aquaculture arising from this interaction is considered to provide a barrier to the expansion and investment in the industry (David Jarrad, Shellfish Association of Great Britain, pers. comm).

Increased vessel traffic – increased collision risk, delays to operations
An increase in vessel traffic associated with other marine sector activity may increase vessel density within a given sea area resulting in a potential increase in collision risk (vessel to vessel or vessel to aquaculture infrastructure) or the potential to delay aquaculture operations that require use of a boat (e.g. husbandry, access to subtidal shellfish beds).

No specific evidence could be found on the social impacts of increased vessel traffic on the aquaculture sector.

Increase in vessel traffic and introduction of infrastructure - transmission vector for infectious disease or non-native species
Marine organisms can move or be moved to a new sea area either by natural vectors such as water currents or as the result of human activities, in particular shipping (in ships' ballast water and as hull fouling) and aquaculture (intentional introduction of non-native species for cultivation and accidental introduction and transfers). For example, more than 20 non-native species have been introduced by imports of the Pacific oyster (*Crassostrea gigas*) to France for cultivation (although only 4 of these spread and became established; Grizel and Heral, 1991, cited in Herbert *et al*., 2012). Non-native species have impacted shellfish farming activities in English waters for many years, through competition with the farmed species for food or other resources (e.g. slipper limpet), parasitism or predation on the farmed species (e.g. the parasitic copepod *Mytilicola orientalis* and the oyster predator the American oyster drill), or through causing significant fouling of aquaculture infrastructure or smothering of farmed organisms (e.g. *Sargassum muticum*) (JNCC, 1997 cited in MMO, 2013e; Reid *et al*., 2009). In a review focussing on the impacts of climate change on non-native species, Reid *et al*. (2009) noted that infrastructure development in the marine environment (e.g. sea defences, harbour developments, marina developments) can provide ‘islands’ of hard substrate which may act as stepping stones for the spread of ‘hard-bottom’ fauna and flora, including non-native species, responding to climate change. The authors highlighted how the growth of marinas, especially on the South coast of England may provide a substrate for the spread of organisms in this way, and that these sites are also potentially interlinked by the movement of boats carrying adult sessile organisms as hull fouling. Kelly *et al.* (2013) estimated that the cost to prevent damage to aquaculture in Ireland and Northern Ireland from invasive and non-native species fouling of vessel hulls (through cleaning and antifouling treatment) is about £318,000 and that the estimated cost of cleaning shellfish produce fouled with non-native organisms is

about £1.7million, such that the total cost of invasive and non-native species on the aquaculture sector in Ireland and Northern Ireland is approximately £2million/yr.

Infrastructure – noise disturbance (finfish only)
Marine Scotland, (2013a) highlighted that potential negative impacts on aquaculture may occur through disturbance or injury to finfish aquaculture species through underwater noise. Noise associated with installation activities and operation of certain sector infrastructure might arise from vessel traffic, infrastructure (e.g. turbine) movement, possible requirements for bed levelling, driving and drilling of piles, and installation of power export cables (i.e. ploughing through sediment areas, rock cutting in hard sea beds, bolting to the sea bed and/or directional drilling).

There is an increasing understanding of the source noise levels and frequencies associated with marine construction activities from various reports largely associated with offshore wind farms (Nedwell and Howell, 2004; Thomsen *et al*., 2006 cited in Marine Scotland, 2013a). The impacts from pile driving and the use of explosives are of most concern (e.g. IECS, 2007 cited in Marine Scotland, 2013a). This is because pile driving generates very high sound pressure levels over a relatively broad frequency range (20Hz - >20kHz). Studies of the impacts of construction, operation and shipping noise on fish (not specifically on fish cultivated in aquaculture installations) indicate that some exposures will result in changes or damage to sensory structures and hearing capabilities, impacts on other aspects of fish physiology and mortality (Hastings & Popper, 2005 cited in Marine Scotland, 2013a). Specifically, noise impacts from pile driving may result in permanent or temporary threshold shifts for species in close proximity to the activity (Thomsen, *et al*. 2006 cited in Marine Scotland, 2013a). To date, no direct evidence of this potential interaction has been sourced.

No specific evidence could be found on the social impacts of noise disturbance on the aquaculture sector.

Infrastructure – opportunities for co-location of activities
Locating aquaculture activities within offshore windfarms has been proposed as a potential opportunity to share resources and increase spatial efficiency in the offshore marine environment (e.g. James and Slaski, 2006; Mee, 2006, Blyth-Skyrme, 2010, Michler-Cieluch *et al*., 2009). Aquaculture stakeholders have stated that offshore aquaculture potential will be increased by the possibility of co-location with offshore renewables (MMO, 2013e stakeholder workshop output).

The culture of aquaculture species such as mussels on OWF structures has been shown to be biologically and economically feasible if suitable management measures are followed (e.g. Syvret *et al*., 2013; Michler-Cieluch and Krause, 2008, Buck *et al*., 2010), although success will depend on improved safety and technological development (Faber Maunsell Limited, 2008; Defra, 2008 cited in Marine Scotland, 2013a). For example, Syvret *et al*. (2013) provide a comprehensive review of the feasibility of shellfish aquaculture in OWF sites in which the trials of seabed cultivation of blue mussels (*Mytilus edulis*) within the North Hoyle 'nearshore' wind farm is described. The authors describe how in the short term the blue mussel is the most obvious species for economically viable commercial operations in OWFs although further work is required to fully assess aquaculture feasibility. Once UK operators have gained experience in operating in offshore environments, there will be an opportunity to diversify into other shellfish species (e.g. oysters). Little information is available at present on the feasibility of co-locating finfish culture with OWFs (MMO, 2013b).

Syvret *et al.* (2013) also describes how the primary driver behind investigating co-location in offshore wind farms is for food production, although in the future aquaculture for non-food purposes (e.g. bio-fuel) may also be a possibility. Issues recognised by Defra that amount to a strong case for developing and increasing aquaculture, particularly offshore include (taken from Syvret *et al*., 2013):

- Food security
- Population health (through consumption of seafood)
- Improved environmental sustainability
- Increased socio-economic activity.

Cheney *et al*. (2010) describe the advantages of developing offshore aquaculture which include:

- A reduction of production costs owing to larger farm design, economies of scale with consequent reductions in unit production costs ultimately leading to increased profitability. Increased efficiency that will be gained with experience of working offshore and increased research efforts should help to recover the extra costs involved with lease negotiations, new equipment costs, etc. associated with working offshore.
- Improved growth rates of shellfish (in the case studies considered by Cheney *et al*. (2010) growth rates, meat yields and production rates are stated as being comparable to those of the best inshore farms in those areas). Reasons for these increased growth rates may include lower stress (e.g. from the more constant environmental conditions offshore when compared to inshore sites), reduced turbidity and better water exchange.
- Enhanced market image and perception linked to the idea that these offshore cultivated shellfish are grown in pristine water conditions. This could be linked to certification standards in terms of reduced environmental impacts, reduction on non-native issues, shellfish hygiene, etc.

Further benefits include the potential of co-location of industries to reduce spatial conflict elsewhere, enhance the social acceptance of developments in local communities and the provision of further employment for local communities (Michler-Cieluch and Krause, 2008 cited in Syvret *et al*. 2013). An additional potential social benefit of co-location of aquaculture and offshore wind is the opportunity for employment diversification for fishermen. For example, Michler-Cieluch and Krause (2008) describe how the co-location of OWFs and open sea aquaculture installations in Germany may provide an alternative livelihood for fishermen faced with losing their traditional fishing grounds (summarised in MMO, 2013b). MMO (2013b) also highlights that utilising the experience and knowledge of local fishermen could avoid the need for training other personnel (which presumably would decrease costs for the sector). In assessing stakeholder perceptions towards integrating aquaculture (seaweed) within OWFs in the German North Sea, Michler-Cieluch and Krause (2008) reported that support for co-location revolved around the additional social benefit from economic opportunities and potential for this to provide additional community support for developments (summarised in Syvret *et al*., 2013).

Water quality
The construction or operational activities of other marine sectors may result in the release of contaminants (synthetic and non-synthetic chemicals including heavy metals and oil, and sewage) which have the potential to negatively impact on water quality. This could have the potential to lead to a failure of waters to meet regulatory standards (e.g. Shellfish Waters, WFD) which has the potential to impact particularly on the shellfish aquaculture industry. However, it can be noted that activities that have the potential to result in the release or discharge of contaminants (e.g. dredging, construction which disturbs sediment) are subject to licensing and activities which discharge waste emissions to the marine environment are regulated.

As shellfish are filter feeders their flesh quality is largely a function of the water quality in the areas within which they grow. Shellfish harvesting waters are classified as Class, A, B, C or Prohibited based on the numbers of certain bacteria (faecal coliforms and E. coli) in samples of shellfish flesh. Bivalve molluscs from Class A areas can be harvested for direct human consumption, whilst shellfish harvested from Class B or Class C areas are required to be ‘relayed’ in a ‘higher’ classification area or be heat treated to be cleansed of bacteria prior to being sold for human consumption.

Changes (downgrades or upgrades) in the classification of a Shellfish Water and/or pollution events, have a financial impact which can be assessed in terms of the cost to human health (arising from consumption of shellfish) and the reduced productivity of the affected shellfish businesses.

In terms of costs to human health, Fitzgerald (2008) describes how the human health cost of shellfish related foodborne illness has become a central driver in proposals to modify shellfish management on the basis of viral risk. Norovirus annually costs the UK NHS over £100million with over 1 million cases within the population. The Food Standards Agency (FSA) have attributed norovirus cases as the main pathogen in shellfish related food borne illness and have calculated that each shellfish water classification upgrade from Class C to B would save £16,000 in human health costs through a reduction in cases.

In terms of costs to businesses, the classification of a shellfish area has a direct bearing on its subsequent value. Class A areas are often considered to be more valuable as a result of some major retailers preferring to purchase from these areas due to quality issues (FSA, 2006 cited in Fitzgerald, 2008). Productivity losses through classification downgrade can be significant with few relaying options available for Class C areas and vastly increased operating costs undermining business viability. Classification downgrades from B to C can result in businesses that have been operating for many years being put out of businesses (David Jarrad, Shellfish Association of Great Britain, pers. comm.). Estimates of the direct costs per shellfish bed of classification downgrade are variable. In 2006, the FSA estimated lost productivity costs were £1.6million/year (~£31,000/harvest bed/year) for Class C areas. Industry assessments from business case studies indicated significantly higher losses, with an estimated cost of about £165,000/year/harvest bed/year in direct costs (Syvret, 2007). The latter study also highlighted the existence of indirect costs to aquaculture businesses associated with a class downgrade, as a permanent Class B grower would have the confidence to invest in more depuration facilities and would be able to double production to 9tons/week. This loss of potential sales equated to £583,000/year (summarised in Fitzgerald, 2008).

Conversely, an upgrade to Class A provides a number of advantages (taken from Fitzgerald, 2008 and references and personal communications within):

- Potential for improved market price for outlets that perceive Class A to have a premium
- Improved national market penetration (many of the retail chains are thought to preferentially source shellfish from Class A waters)
- Improved international market penetration (overseas buyers have expressed interest in Class A waters)
- Reduced production costs. No depuration is required although in practice many operators will still condition in a depuration system for a period to re-water after harvesting and to provide increased product confidence. However, the ability to process shellfish without the required 42hr depuration period vastly improves product turnover. Increased productivity in Class B waters is limited by the capital costs/capacity of the associated depuration system.

The author noted that contact with shellfish operators had suggested that for some markets the advantages of a Class A shellfish area would allow the shellfish producers to double their investment with increased security.

Hence shellfish cultivation depends on cooperation with other sectors and users of coastal areas, to ensure clean, designated, unpolluted waters for shellfish production. Major capital investment schemes by water companies therefore in theory may provide benefit to the shellfish aquaculture sector. However, Fitzgerald (2008) notes that between 2000 and 2007 a significant investment of £75million had been made by the Water Utilities in the UK on waste water treatment and infrastructure to improve shellfish water quality, with no apparent increase in the number of the highest grade Class A shellfish waters. Indeed some shellfish operators have undergone a drop in classification status with a direct financial impact on productivity and business profitability.

Establishing significance

The review has found little evidence of significance levels of social impacts relating to aquaculture or of the significance of social impacts of interactions between aquaculture and other marine sectors. The significance of social impacts are likely to be site specific and related to the socio-economic context, including the community dependence on the industry within a given location.

Anecdotal evidence from previous aquaculture stakeholder engagement (see MMO, 2013e) has indicated that the most significant impact on the shellfish aquaculture industry arises from management measures related to nature conservation policy. Social impacts arising from these interactions are likely to affect individuals and their families in the aquaculture production sector but potentially not communities as it has been assumed from a lack of evidence in the literature that community dependency on this sector is relatively low. The exception to this is likely to be in Scotland where the majority of aquaculture takes place. However, evidence suggests that there is potential (i.e. it is feasible) for co-location of shellfish aquaculture with other offshore industry infrastructure, which could facilitate expansion of the shellfish aquaculture industry and presumably associated beneficial social impacts of increased employment and income opportunities (in the production sector and potentially in the downstream sector e.g. processing). Hence the significance of this interaction has been rated as medium.

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4.3 Carbon Capture and Storage (CCS)

4.3.1 Social impact of carbon capture and storage

This section provides a short overview of the key social impacts produced by the offshore carbon capture and storage (CCS) sector, in the absence of any specific interaction. For the purposes of this review offshore CCS relates to the capturing of industrially produced CO_2 and injecting it deep into rock formations under the seabed.

A review has highlighted a limited base of literature relating to social implications of CCS. Certainly social science research relating to the impacts of CCS has not to date been a key priority of researchers or the sector in general. Greater emphasis has been placed on technological capability, financial viability and environmental impacts. However literature notes that although less covered in research, societal concerns are ‘crucial’ (ECO_2 Project, 2013). Literature that is available is overall very recently published given the recent rise of interest in CCS (Markusson *et al.*, 2012). Additionally, uncertainty surrounding the development and deployment of CCS (e.g. finance, technological, developability) contributes to the difficulties of identifying the nature of social impacts (Insight, date unknown).

Income and employment

There is currently no commercial CCS activity in the UK. There are 2 pilot CCS projects being established under the UK Government’s CCS Commercialisation Completion funding plans. The two full scale demonstration projects are White Rose CCS (Yorkshire) and Petershead CCS project (Aberdeenshire). Literature does however indicate the significant potential for CCS in the UK due to a mix of offshore geological storage, and an academic community to support research and engineering skills for implementation (ENGO, 2011; Gough and Shackley, 2005).

Literature points to the significant employment potential for the CCS sector (CCS Association, 2013; Scottish Enterprise, date unknown). The CCS Association (2013) indicates that CCS has the potential for job creation and economic growth to benefit localities where storage is located and that the wider contribution to a low carbon economy is highly significant. Examples in the literature indicate economic potential for Scotland (Scottish Enterprise, date unknown) of £2bn in GVA and employment creation of approximately 13,000 jobs by 2025. A wider view across the UK (CCS Association, 2013) identifies potential employment creation of approximately 100,000 jobs by 2030 and additional £6.5bn contribution to the UK economy. CCS associated with abatement of new coal-fired power stations could provide GVA of £1-2bn/ year by 2020 for the UK, sustaining in the region of 30,000-60,000 jobs by 2030 with a 50% direct/ 50% indirect employment split (AEA, 2008).

Research by Scottish Enterprise (date unknown) notes the wider legacy benefits of CCS including a new wave of jobs, skills and investment for the North and Irish Sea for another generation following on from oil and gas extraction in these areas. This benefit will be heightened if the CCS project can utilise existing skills in the locality (ECO_2 Project, 2013).

CCS is also noted as having the potential to play an important role for many industrial sectors in the broader economy in the future (e.g. steel, chemical production). These sectors have limited alternatives for reducing their emissions aside from CCS as carbon dioxide is a by-product of the industrial process. The ability of CCS to be developed for these sectors will therefore help maintain many of these vital industries in the UK, making a significant contribution to local prosperity, and retaining a large number of jobs – direct and indirect (CCS Association, 2013). Employment is recognised as the most important means by which to fulfil material wellbeing, as well as being central to individual identity and social status and an important contributor to physical and mental health (see Section 1).

Environment - climate change

Much of the literature notes the importance and potential of CCS as a means to abate carbon emissions and tackle issues of climate change while meeting energy demand (Insight, date unknown; CCS Association, 2013; AEA, 2008; ECO_2 Project, 2013). Coninck *et al.* (2006) notes that the acceptance of climate change as a key problem, and the need to reduce CO_2 emissions as the central solution, are key aspects of social perceptions that must be overcome to tackle climate change and energy security issues effectively. Research has indicated that the severity and urgency associated with addressing climate change impacts ensures that CCS is viewed favourably by the public (Gough and Shackley, 2005).

It is estimated that the capture and abatement of CO^2 emissions from power generation through CCS has the potential to deliver a 90% reduction in emissions for coal power station, using existing CCS related technology that has yet to be utilised on a commercial scale (Insight, date unknown). This view is supported by further research (ECO_2 Project, 2013; CCS Association, 2013), and given this potential CCS is identified as a key part of UK Government strategy to reduce carbon emissions by 80% by year 2050.

Carbon emissions contribute to climate change, which is expected to result in significant social costs. The social cost of carbon can be captured and a monetary value applied using techniques as set out by Government guidance (HM Treasury, 2013), therefore the value of a reduction in carbon emissions can be presented and shown as a social benefit.

On an international scale the IEA states that CCS could reduce global carbon emissions by 19%, and that fighting climate change could cost 70% more without CCS (CCS Association, 2013).

Community and fears/ aspirations

Barros *et al.* (2012) notes that the geological storage of CO_2 may have wider socio-economic impacts on communities neighbouring or in close proximity to storage sites. The literature also indicates that a lack of public understanding and knowledge relating to CCS can result in wider concerns relating to negative impacts on property prices in the locality (Insight, date unknown; Coninck *et al.*, 2006). Public perception and acceptability of CCS projects are seen as key priorities/ issues with regard to implementation of CCS (Coninck *et al.*, 2006). Further literature suggests that in addition to geological and technical aspects, the social characteristics of an area need to be considered as this will influence the receptivity (and possible local resistance) to a CCS project (ECO_2 Project, 2013).

Research (ECO$_2$ Project, 2013) also indicates that positive social perceptions and acceptability of CCS projects are greater if they are associated with the provision of new employment opportunities in areas of industrial decline and high unemployment. Employment is recognised as an important contributor to social capital and community cohesion (see Section 1).

Health

Barros *et al.* (2012) note that geological storage of CO_2 may have impacts on human health and safety. Issues surrounding uncertainty, and difficulties in assessing and managing the risks to health and safety of CCS, especially over the medium to long-term, are also noted in literature (e.g. Coninck *et al.*, 2006; Insight, date unknown). Research by Gough and Shackley (2005) indicates that impacts due to leakage are ‘uncertain’ but with adequate long-term monitoring leakages from storage should have only localised impacts, assuming said leaks are repaired quickly.

4.3.2 Social impacts of changes in the CCS sector arising from marine sector interactions

Interactions and impacts – summary table

The potential interactions between MPS sectors and the CCS sector are shown in Table 16. This table was compiled based on an initial review of key studies in which potential interactions between marine sectors have been proposed or described (e.g. Marine Scotland, 2013a; Marine Scotland, 2013b; MMO, 2014, MMO, 2013a), an additional grey and peer-reviewed literature search and through consultation with stakeholders. Any available evidence detailing the occurrence of these potential marine sector interactions, consequences and subsequent social impacts are described after the table.

Table 16: CCS interaction-impact table.
Key: H/M/L = High Medium Low - Representing: **[strength of the evidence that the impact can occur**; **judgement on the significance of the impact as presented in the literature]**

Issue	Interaction	Consequence	Social Impact	
			Primary	Secondary
Competition for space	Sterilisation of potential storage areas	Development constrained (reduced CCS capacity)	Reduction in future employment opportunities **[L,M]**	Reduction in future employment opportunities in downstream sectors **[L,H]**
			Increase in net carbon emissions and the social costs of climate change **[L,H]**	
	Obstruction of potential pipeline routes	Increased cost as a result of re-routing pipelines or cable/pipeline crossings leading to a decrease in profitability	Reduction in future income **[L,L]**	
		Increased cost as a result of re-routing pipelines or cable/pipeline crossings leading to a lack of investment in CCS technologies	Reduction in future employment opportunities **[L,M]**	Reduction in future employment opportunities in downstream sectors **[L,H]**
			Increase in net carbon emissions and the social costs of climate change **[L,H]**	
	Increased difficulty of access at crossing points	Increased maintenance costs leading to a decrease in profitability	Reduction in income **[L,L]**	

Issue	Interaction	Consequence	Social Impact	
			Primary	**Secondary**
		Increased maintenance costs leading to a lack of investment in sector	Reduction in future employment opportunities **[L,M]**	Reduction in future employment opportunities in downstream sectors **[L,H]**
			Increase in net carbon emissions and the social costs of climate change **[L,H]**	
Increase in vessel traffic	Increased vessel traffic	Increased collision risk of maintenance vessels (vessel to vessel) and Increased risk of environmental pollution (e.g. oil spill)	Increased safety fears and health impacts **[L,L]**	Increased social tension **[L,L]**
Infrastructure	Interference with navigational equipment	Increased collision risk of maintenance vessels and Increased risk of environmental pollution (e.g. oil spill)	Increased safety fears and health impacts **[L,L]**	Increased social tension**[L,L]**
	Presence of infrastructure	Increased collision risk of maintenance vessels (vessel to infrastructure) and Increased risk of environmental pollution (e.g. oil spill)	Increased safety fears and health impacts **[L,L]**	Increased social tension **[L,L]**
		Increased steaming distances/time, leading to increased maintenance costs	Reduction in income **[L,L]**	

Potential social impacts – supporting literature review

The following review identifies evidence of the occurrence of these interactions and the social impacts that may arise as a consequence where such evidence was available. As many of the social impacts are common to a number of interaction types, this review is structured by social impact type.

Income and employment

Activity of CCS developments and other marine sectors primarily generate issues that are the result of competition for space, increased vessel traffic or infrastructure demands. Interactions with other sectors such as competition for sea area usage (e.g. fisheries) or infrastructure cables (e.g. offshore energy) could result in constraining new CCS development which in turn results in social impacts in the form of loss of potential future employment (EOn, 2010). Constraining development (potential reasons outlined in Table 16) can result in limiting investment, and reduced operational capacity as raised in the literature reviewed, although detail is limited as to the size/significance of the impact on future employment.

Employment is recognised as the most important means by which to fulfil material wellbeing, as well as being central to individual identity and social status and an important contributor to physical and mental health. Conversely, unemployment can be detrimental to individual identity and social status, physical and mental health, as well as a key cause of deprivation, weak social capital and community cohesion (see Section 1)

Environment - Climate change

Interactions with other sectors as a result of new development being excluded from sea areas or competition for land and materials which result in new development being constrained or limits the capacity/size has social impacts in relation to loss of carbon reduction potential (EOn, 2010). The net increase in carbon emissions (compared to the baseline with CCS) will have a social cost (as valued through HM Treasury, 2013)

Health

Interactions with other sectors as a result of increased vessel traffic which increases collision risk results in increased risk to personal safety and the environmental. Personal safety risks can increase stress and have physical and mental health impacts if they materialise (see Section 4 for details on stress related effects of interactions). Risks to the environment can result in pollution incidents if they materialise, which can have direct impacts on human health and broader impacts if flows of ecosystem services are affected. This in turn may increase social tensions in the locality (EOn, 2010).

Establishing significance

A review has found little tangible evidence of social impacts relating to CCS, primarily as the sector is not currently commercially operational in the UK. However the inference taken from what literature is available indicates that factors such as perceptions of the threat of climate change, proximity of communities to storage sites and the potential to extend (and further develop) from the economic (employment) benefits of oil and gas in coastal areas will contribute to the determination of the significance of social impacts.

In the future, as more evidence is available, the understanding of the relative significance of some interactions may change.

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4.4 Commercial Fishing

4.4.1 Social impact of commercial fishing

This section provides a short overview of the key social impacts produced by the commercial fishing sector, in the absence of any specific interaction but in light of general industry trends. For the purposes of this review information presented on commercial fishing relates to the marine catching sector and not to other forms of fishing.

Income and Employment

Whilst many fishers can earn good livings, even in light of prevailing trends of decline, the sector is often associated with financial pressures. This is largely due to low and intermittent income (seasonal/weather dependent fishing opportunities), and leverage as a result of investments in fishing boats and equipment (Creative Research, 2009).

Whilst 'weather' is identified as the most important factor determining whether to put to sea on any given day (Creative Research, 2009), modelling studies have found that the most important factor determining fishing strategies on where to fish is 'profitability' (Abernethy, 2010).

Many fishers supplement their fishing income, nearly always through necessity rather than choice (Creative Research, 2009). Further, declining fortunes in many fleet segments has seen an emergence of wives and partners becoming significant secondary or primary household income earners (Iris Consulting and Greenwich Maritime Institute, 2009).

Employment in the commercial fishing sector has been in long term decline, although has stabilised somewhat since 2000 (UKMMAS, 2010) and the sector is not a significant employer at the national scale. However at a local level employment supported through the catching and downstream fish processing sector can be significant (UKMMAS, 2010). Anderson *et al.* (2007) produced multipliers based on input-output modelling for the fish catching and the fish processing sectors.

A study of the South west England fishing sector notes that the dependency of small ports on the fishing sector is typically less than that of larger ports as fish are not typically landed there so the downstream businesses are not present (EKOS Consulting & Nautilus Consultants, 2003).

Identity

A number of studies recognise that fishing is considered by those involved to be not just a job but a 'way of life', providing a sense of identity to fishers (e.g. Acott *et al.*, 2012; Creative Research, 2009; MRAG *et al.*, 2013, Reed and Courtney, 2011). As part of this, fishing provides a broad range of intangible benefits to those involved such as independence, a sense of adventure/excitement and achievement (Creative Research, 2009). Many fishers come from fishing families, sometimes stretching back several generations and they are extremely proud of this tradition (Creative Research, 2009). As such socio-economic variables, such as income, are not considered to be sufficient as indicators of individual wellbeing (MRAG *et al.*, 2013). Related to this, monetary valuations of fishing focussed on its productive value can be considered underestimates as they do not reflect the value placed upon the 'inspiration and identity benefits of fishing' (Chan *et al.*, 2012, in Acott *et al.*, 2012).

Communities and culture
Between fishermen in a given area there can be a strong sense of shared culture, as well as solidarity in the face of external stigmatisms (Reed and Courtney, 2011; Urquhart and Acott, 2013a), which build community cohesion (Urquhart and Acott, 2013b). Support and cohesion can arise in the interests of safety. For inshore boats, it is not uncommon for boats to go out 'in company' to assist each other in difficult conditions (Reed and Courtney, 2011).

Some communities can be classified as 'fishing dependent communities'. The literature offers many definitions that recognise that there are both economic and social and cultural aspects of such communities. Brookfield *et al.* (2005) offer that "a fisheries-dependent community is a population in a specific territorial location which relies upon the fishing industry for its continued economic, social and cultural survival – or maybe just success". However the identification of fishing dependent communities is nearly always carried out with the use of economic measures (primarily due to their availability): Jamieson (2009) and Brookfield *et al.* (2005) note that figures of 5% and 10% of local working population are often used. In addition to employment, MegaPesca *et al.* (2000) utilise ratios of GVA and of CFP quota catch. Studies often assume that a fisheries-dependent area, as defined economically, is also a community that socially and culturally values fishing (Jamieson, 2009). There is a perceived greater identity and community regard for fishermen in communities with higher concentrations of fishers (Creative Research, 2009).

Reed and Courtney (2011) conclude that in England, economic dependency is not usually found at the community level, due to its relatively low economic impact and that for many communities tourism has become the main source of income. But even where a community is not classified as fishing-dependent, the sector often still plays an important role in economic strategies, although often only as a 'cultural icon' (Brookfield *et al.*, 2005; Jamieson, 2009) e.g. in relation to tourism marketing (Acott *et al.*, 2012).

Fishing creates a particular distinctiveness, sense of place and identity (Acott *et al.*, 2012; Reed and Courtney, 2011; Urquhart and Acott, 2013b). This encompasses place attachment, place identity, place dependence and place meanings as well as belonging, rootedness and satisfaction. With regards fisheries dependence, Jacob *et al.* (2001, in Acott *et al.*, 2012) suggest the industry supports the sense of community and its history. This can be enhanced through fishing-related festivals (Reed and Courtney, 2011). Acott *et al.* (2012) conclude that sense of place can be considered through four aspects: identity, character, relationships and influences.

Equity - Women
There are few women involved in the catching sector and there are considered to be a number of barriers to their involvement (Iris Consulting *et al.*, 2011; Zhao *et al.* 2013). Those that are, are typically involved through family businesses (MacAlister Elliot & Partners Ltd, 2002) and report the same sense of identify and achievement as fishers in general (Iris Consulting *et al.*, 2011).

Women play a traditional role, as 'fisher wives', but also as business administrators, political and community representatives, with multiple responsibilities – these roles can be significant but are typically unpaid and often invisible (Iris Consulting *et al.*, 2011; MacAlister Elliot & Partners Ltd, 2002; , Reed and Courtney, 2011; Zhao *et al.*, 2013). Their role in community and political activity sees them act as 'social connectors' (Reed and Courtney, 2011). However changes affecting the economics of the sector are leading to many wives and partners becoming significant second, or primary, household income earners (Iris Consulting *et al.*, 2011).

There are a high proportion of women working in the processing sector, and an increasing proportion of female migrants (Iris Consulting *et al.*, 2011).

Environment – provision of food

The commercial fishing sector is an important provider of fish as a food for human (and non-human) consumption. The UK commercial fishing sector is an important, although not the primary, supplier of fish for consumption in the UK. The volume of fish and fish product imports into the UK was over double the volume of fish landed by UK vessels in 2012 (MMO, 2013a).

4.4.2 Social impacts of changes in the commercial fishing sector arising from marine sector interactions

Interactions and impacts – summary table

The potential interactions between MPS marine sectors and the commercial fishing sector are shown in Table 17. This table was compiled based on a review of key studies in which potential interactions between marine sectors have been proposed or described (e.g. Marine Scotland, 2013a; Marine Scotland, 2013b; MMO, in prep; MMO, 2013b), an additional grey and peer-reviewed literature search and through consultation with stakeholders. Any available evidence detailing the occurrence of these potential marine sector interactions, consequences and subsequent social impacts are described after the table.

There are a high number of potential interactions that can affect the fishing industry. In many cases the social impacts that result from these follow similar pathways, although the significance of those impacts is likely to vary markedly by interaction and site-specific context.

Table 17: Commercial fishing interaction-impact table
Key: H/M/L = High Medium Low - Representing: **[strength of the evidence that the impact can occur**; **judgement on the significance of the impact as presented in the literature]**

Issue	Interaction	Consequence	Social Impact	
			Primary	Secondary
Competition for space – marine area	Exclusion / displacement from traditional fishing grounds	Reduced vessel profit (through increased costs or decreased revenues)	Impact on way of life (in relation to income, employment and identity) **[M,M]**	Health, community, women, recruitment **[M,L]**
		Changes in fishing patterns including areas fished, gears used and species targeted	Impact on rights and equity (decreased or no opportunity to access traditional fishing grounds) **[M,M]**	Social networks and community cohesion **[M,L]**
			Potential loss of knowledge of culture/heritage (between generations) **[L,L]**	Impact on way of life (in relation to income, employment and identity) **[L,L]**
		Compensation payments for loss of fishing grounds in safety (exclusion) zones	Decrease in social tension **[L,M]** and mitigation of social impacts of reduced vessel profit consequences **[M,M]**	
		Increased conflict with other fishing vessels/gear types.	Increase/decrease in social tension and impacts on community cohesion. **[H,M]**	
			Impact on way of life (income, employment) **[H,M]**	Health, community, women, recruitment **[M,L]**
		Increased safety at sea risks	Impact on safety fears and health	

Issue	Interaction	Consequence	Social Impact	
			Primary	Secondary
		through changes in fishing practices.	(of fishers and their families) **[H,M]**	
		Targeted management of fishing practice of a single sub-sector	Impact on rights and equity **[H,M]**	Community structure and social status (social stratification) **[H,L]**
		Increased environmental impacts (e.g. on benthic habitats) in new areas targeted by displaced fishers – potential reduction in marine productivity, landings and income	Impact on way of life (in relation to income, employment and identity) **[L,M]**	Health, community, women, recruitment **[H,L]**
		Improved environment resulting in improved fish stocks (size or abundance) from *de facto* closed areas, refuge for fish and shellfish species, protection of important habitat types (spawning and nursery grounds) – which can result in improved fish landing either directly (on site) or through spillover benefits	Impact on way of life (in relation to income, employment and identity) **[M,M]**	Health, community, women, recruitment **[M,L]**
	Physical obstruction of navigation routes	Changes in steaming route, distance and time	Impact on way of life (in relation to income, employment and identity) **[L,M]** Impact on safety fears and health (of fishers and their families) **[L,M]**	Health, community, women, recruitment **[H,L]**
Competition	Displacement of	Increase/decrease time and costs	Impact on way of life (in relation	Health, community,

Issue	Interaction	Consequence	Social Impact	
			Primary	Secondary
for space – change in harbour facilities	fishing vessels from home port	associated with relocating to a new home port	to income, employment and identity) **[L,M]**	women, recruitment **[H,L]**
		Loss of fishing assets that changes the character of an area	Impact on community character, sense of place and culture **[H,M]**	Impacts on social networks and social service provision **[L,M]**
	Less suitable facilities / better facilities	Changes in turnaround times (which may lead to changes in fishing effort, landings and income)	Impact on way of life (in relation to income, employment and identity) **[L, M]**	Health, community, women, recruitment **[H,L]**
	Higher / lower cost for using facilities	Changes in costs	Impact on way of life (in relation to income, employment and identity) **[L,M]**	Health, community, women, recruitment **[H, L]**
Infrastructure	Disturbance or damage to species / habitats	Disturbance of commercially-important species and disruption or damage to habitats, nursery and spawning grounds from infrastructure leading to reduced productivity, landings and income	Impact on way of life (in relation to income, employment and identity) **[M,M]**	Health, community, women, recruitment **[H,L]**
	Damage to fishing gear	Loss of, or damage to, fishing gear, increase in gear costs	Impact on way of life (in relation to income, employment and identity) **[H,M]**	Health, community, women, recruitment **[H,L]**
		Compensation payments to fishers for gear damage	Decrease in social tension **[L,M]** and mitigation of social impacts of reduced vessel profit consequences **[M,M]**	
		Increased risks to safety at sea through increased vessel traffic or	Impact on safety fears and health (of fishers and their families)	

Issue	Interaction	Consequence	Social Impact	
			Primary	Secondary
		changes in fishing practices.	**[H,M]**	
	Development / decommissioning of infrastructure	Diversification and new income opportunities (e.g. infrastructure construction or decommissioning may create new fishing, aquaculture, tourism and income opportunities (e.g. oil guard)	Impacts on way of life (income, employment and identify) **[H,M]**	Health, social structure and cohesion. **[M,L]**
Economic diversification	Tourism (or other sector)	Development that changes the character of an area	Impact on community character, sense of place and culture **[H,M]**	Impacts on social networks and social service provision **[L,M]**
		Income diversification e.g. additional income from application of local knowledge for recreational angling charters	Impacts on way of life (income, employment and identify) **[H,M]**	Health, social structure and cohesion. **[M,L]**

Potential social impacts – supporting literature review

The following review identifies potential impacts and their pathways and connections, as identified in recent fisheries literature. It does not set the review against any particular locality or set of characteristics and therefore says nothing about the potential significance of any impact, or extent to which all potential impacts of an interaction may occur. It should not be assumed that any particular impact identified in the review can be readily generalised to all fisherman of all gear types or to all fishing community types. As such, it should not be assumed that any particular impact (or chain of impacts) identified in the review will actually occur in practice.

With the exception of 'impact on way of life (income and identity)', which is a key social impact pathway associated with multiple interaction consequences, the following review is set out by consequence, with discussion on primary social impacts preceding that of secondary impacts in each case.

The flow of impacts presented should be treated as a simplification of reality. In practice impact pathways can be complex and unexpected. As such there are potential inter-linkages between the different sections presented.

Income, employment and identity

Competition for space and infrastructure interactions have the potential to impact on the way of life of fishers, both in terms of income as well as their sense of identity.

Any interaction that results in a change in the effectiveness and financial efficiency of fishing can increase costs or reduce revenue (e.g. increased steaming distance/time, changes in time available to fish, fishing less profitable grounds, loss of knowledge and therefore fishing effectiveness, reduced stock levels, gear or vessel damage, changes in harbour location, costs and efficiency) and therefore have social impacts due to lost income.

In the case of displacement/exclusion, these impacts are not limited to those vessels directly affected by the interaction, but also by fishers affected by the change in fishing patterns of the directly affected vessels. For example, Mangi *et al.* (2012) report that static gear fishers active outside of an MPA in Lyme Bay were negatively affected by trawlers that relocated from the MPA to the area fished by those static gear fishers.

Similarly, gear types which can occupy ground freed up by the exclusion of other gear types can benefit. They may be able to increase fishing effort in the area of exclusion and see reduced level of gear conflict, as was also found due to the Lyme Bay MPA (Mangi *et al.*, 2012) – in such cases social impacts on that group will be positive i.e. increased income and reduced social tension and any resulting positive second order impacts.

There is little evidence of mobility between fleet segments (MRAG, 2013). Diversification across fleet segments in response to the Lyme Bay MPA was witnessed by those already fishing with multiple gears (i.e. trawls and pots switching to just pots), or switching gear as crew members change (Mangi *et al.*, 2012).
In certain instances such interactions may result in job losses and unemployment. The generic social impacts associated with unemployment are discussed in Section

1. For fishers it is clear from the literature that where interactions result in unemployment, or even changes in the status of their fishing employment e.g. from full time to part time fisherman, or the type of employment e.g. from fisher to another profession, there is a potentially significant effect on individual identity (e.g. Creative Research, 2009).

Health (secondary impact):
Increased fishing costs, or reduced revenues, which results in reduced income can result in a loss of job security for fishers, with them becoming more concerned about survival than making a good living (Abernethy, 2010). A feeling of uncertainty over the future viability of fishing because of displacement was prevalent amongst mobile gear fishers affected by the Lyme Bay MPA (Mangi *et al.*, 2012). In such instances when a fisher's way of life is affected, and when the future is uncertain, there can be negative effects on individual (and family) health (e.g. through stress and/or loss of purpose) and on community stability (Delaney, 2009).

Community (secondary impact):
Uncertainty can also hinder the ability of fishing businesses to plan for the future, and may similarly affect other local businesses (Delaney, 2009). Bankruptcy and negative equity can lead to low morale within the community (Stead, 2005). Short-term losses that put fishers out of business may jeopardise the underlying infrastructure of the fishery (e.g. markets, processors, and shore-workers), which can then result in the degradation of a fishing community, encourage out migration and degrade the community structure as a whole (Rossiter and Stead, 2003; Stead, 2005).

Outward migrations of the workforce have been witnessed in Scottish fishing communities due to individuals/families seeking more secure employment (Stead, 2005). It is noted that a reduction in the number of fishers can 'dissolve the fabric' of a community (Jentoft, 2000), reducing social capital and cohesion. A loss of working age population can affect the viability of local service provisions (e.g. schools). If these cannot be maintained then community networks can be affected. Further they make an area less attractive as a place to live (Arthur *et al.*, 2011), potentially compounding the problem.

Second order effects can occur in relation to recruitment, out-migration and economic diversification. Notably effects on an individual's income will not necessarily result in broader community-level effects – this is likely to depend on the scale of the effect and community characteristics. For example Mangi *et al.* (2012) reports that despite a range of negative economic, environmental and social impacts being identified as a result of the Lyme Bay MPA, all stakeholders agreed that the closure had not affected the local communities so far.

Equity - women (secondary impact):
Changes to the fishing industry have seen many wives and partners become significant secondary or primary earners of household income (Iris Consulting and Greenwich Maritime Institute). Interactions that diminish fishing incomes are likely to add weight to this prevailing trend.

The fish processing sector employs large numbers of women, including an increasing number of female migrants (Iris Consulting and Greenwich Maritime Institute, 2009). Therefore, where economic impacts are large enough to have effects on the performance of the downstream processing sector, this could have a significant impact on women.

Recruitment (secondary impact):
A decline in profitability and inability to plan for the future can result in difficulties getting fishing crews (Delaney, 2009). In relation to a period of high fuel prices and reduced profitability, one third of Southwest England skippers interviewed said that they were having problems recruiting deck crews because of lowered wages (Abernethy, 2010). Further, young people are often discouraged from entering the industry due to profitability pressures and uncertainty over the future (Jamieson, 2009; ESRC, 2008; Reed and Courtney, 2011).

In Scottish fishing communities use of migrant workers has been seen as a reluctant response to difficulties in recruiting local crew as well as a way of getting cheap labour (Jamieson, 2009). Where migrant labour is recruited through agencies, payment of wages is not through the traditional system of 'sharing the value'. A reduction in recruitment from family and neighbours is thought to result in a loss of sense of loyalty to and from local crews (Jamieson, 2009). Further, use of migrant workers can be a source of conflict within the fishing community (Creative Research, 2009).

If crew recruitment problems result in not enough crew or skilled crew this can compromise safety and lead to an increase in accidents (Delaney, 2009). Communication difficulties between skipper and crew can also compromise safety (Creative Research, 2009).

Compensation – social tension, income and identity
Compensation may be offered to fishers to address the economic impacts of interactions such as displacement and gear damage. A UK example is the Oil & Gas UK Fishermen's Compensation Fund[7]. The fund settles claims in relation to damage to fishing gear and vessels and losses of fishing time caused by oil-related debris where the oil company responsible cannot be established or where the incident occurred in an unlicensed oil block.

There does not appear to be any literature on the social impacts of compensation. However, one might assume that as a minimum compensation can go at least part way to mitigating the social impacts that may occur as a result of lost income (see 'Impacts on Way of Life'). Where compensation is paid as a result of a permanent interaction (e.g. permanent exclusion from an area) that permanently affects the effectiveness of efficiency of fish, many of the impacts under 'income and identity' may still hold true. Further, it may go some way to mitigating social tensions created by the interaction.

[7] http://www.sff.co.uk/OGUKFCF

Safety at Sea: Health
Fishing is acknowledged by fishermen to be an intrinsically dangerous job (Creative Research, 2009). Displacement interactions (from fishing grounds and from steaming routes) and other forms of restriction can lead to changes in fishing practices that increase health and safety risks. This includes fishing in more distant grounds without the safety net of their home ports and spending longer periods of time at sea in vessels that are not designed for long trips (small and ill-equipped living quarters) (Mangi *et al.*, 2012), as well as fishing in rougher weather (Creative Research, 2009). Such impacts may be less relevant for the inshore fleet, who are less able to travel to more distant grounds (although they may feel income-related effects more strongly as a result).

These effects have obvious implications for the health of fishers. However they also have effects on the health of their families, as they spend more time away from home and may worry more about the safety of the fishers, particularly in bad weather (Mangi *et al.*, 2011).

Targeted management: Rights and equity
The Lyme Bay MPA resulted in the exclusion of trawlers from the MPA. Affected towed gear fishers felt a sense of unfairness and discrimination as the MPA only targeted the traditional user rights of the towed gear community (Mangi *et al.*, 2012; Rees *et al.*, 2013). Concerns about fairness were also raised by other non-towed gear stakeholder groups, indicating a sense of empathy (Rees *et al.*, 2013).

Static gear fishers outside of the Lyme Bay MPA who were affected by displaced trawlers also felt a feeling of injustice, although along slightly different lines (Mangi *et al.*, 2012). The example is provided of such a static gear fisher feeling that they had been ‘sold off’. This appears to be aligned with broader issues of trust with, and resentment of, Defra (and related management/policy bodies) that are felt by fishers more generally (Creative Research, 2009).

This targeting of mobile gear fishers and associated negative portrayal in the media had negative effects on some trawler fishers’ sense of identity and a positive effect on static gear fishers’ sense of identify (Mangi *et al.*, 2012).

(Secondary impact) Jentoft (2000) argues that installing limited access to fishing for some fishers but not others can result in communities become more socially stratified as some members get the opportunity to accumulate capital, and hence power, which others are fenced off from. This is discussed by Jentoft in relation to quota-rights and licences. However it may be applicable to any situation that enforces ‘haves and have nots’ in a community. As removal of use and access rights essentially shifts the position of individuals within a local community, it can marginalise them (Jones, 2009) from social networks and reduce community cohesion.

Conflict – Community, income, employment and identity
There can often be gear conflict within the fishing industry as fishers compete for space and fish, such as between the inshore fleet and over 10 metre fleet (Creative Research, 2009). However where interactions cause new conflicts to arise, these can be harder to overcome than those already occurring. In relation to the Lyme Bay

MPA, Mangi *et al.* (2012) find that where new conflict occurred between people who were not familiar with each other, the absence of shared social capital between the groups made conflict resolution more problematic; the necessary familiarity and trust relationships were absent.

Where gear conflict results in fishers losing or damaging gear, this can affect costs and therefore income. Notably, some static gear fishers within the Lyme Bay MPA who no longer had to compete for space with trawlers reported a decrease in social tension (Rees *et al.*, 2010).

(*Secondary impact)* Within a particular fishery, competition between fishers can erode social cohesion (Jentoft, 2000). This can remove any ‘shared management’ of the resource and in certain situations could lead to a ‘tragedy of the commons’[8] effect (Jentoft, 2000). In instances where this occurred there would be further knock on effects as described under ‘way of life (income, employment and identity)’.

Improved environment – Income, employment and identity
Environmental improvements can have positive effects on fish stocks. Most typically relevant environmental improvements occur as a result of an interaction that displaces/excludes fishers (or certain gear types) from particular areas. The extent to which localised improvements in environmental quality can result in the realisation of commercial fishing benefits depends on the extent to which the improvement affects fish populations, and whether commercial fishers are still able to catch those fish.

There is a rapidly growing literature on the potential benefits of MPAs (for fisheries or more general nature conservation purposes). Reviews of evidence are included in Sweeting and Polunin (2005) and Finding Sanctuary *et al.* (2012). The evidence for realised commercial fishing benefits from individual MPAs in temperate waters which do not have a ‘fisheries’ aim is limited and demonstrates that whilst there are potential benefits they are by no means guaranteed.

Where positive effects on fish catches and landings does occur, the social impacts will stem primarily through the improved income that is supported (with positive effects in relation to the [negative] impacts discussed under ‘way of life (income and identity)’ set out earlier). *(Secondary impact):* Notably, where fishers are able to fish more efficiently, they may chose to spend less time at sea (Creative Research, 2009), with positive effects on health (as described under ‘safety at sea’ earlier).

Economic diversification – Community, identity
Economies which can diversify away from commercial fishing sometimes use the ‘idea’ of a fishing community to market themselves. Research by Brookfield (2005) identifies Lowestoft as such a place. In such instances commercial fishing can become to be seen as a heritage industry rather than a real economic activity. But it is questioned whether a purely heritage based industry (i.e. retention of non-working fishing vessels and gear) would hold the authenticity required to generate the original sense of place (Acott *et al.*, 2012).

[8] The ‘tragedy of the commons’ refers to the depletion of common resources due to lack of coordinated sustainable use.

Jamieson (2009) notes that whilst retaining fishing as a form of ‘heritage industry’ can serve both to retain the identity needs of the people of a local fishing community, it can also act as a source of ‘demoralisation and loss of cultural authenticity’. Conflict can arise if tourism development proposals challenge the special qualities of place (Acott, 2012). Notably it is felt (perhaps unsurprisingly) that ports with higher numbers of vessels are better able to absorb the effects of diversification and reduced fishing activities than smaller ports (Creative Research, 2009).

There can often be conflict between local fishermen and non-fisher ‘new comers’ (Creative Research, 2009) affecting community cohesion (Reed and Courtney, 2011). However, for the broader question of diversification of culture and built environment change there can be mixed opinions amongst local fisher groups. An example of a divide in local fisher opinions is given by Acott *et al.* (2012) and Urquhart and Acott (2013a) in relation to the development of the Jerwood [art] Gallery in Hastings: some can see the benefits (e.g. community facilities and protection of the Stade)[9] whilst some see it as furthering the change to a culture of which they do not feel a part and will threaten the character of the ‘old town’.

(Secondary impact): Rolfe (2006) cites research that demonstrates that whilst economic restructuring can sever some community relationships (primarily through out migration) it can also create new relationships and ‘connections’ to other places and communities. Restructuring can therefore be a negative and positive influence on a community and an individual’s wellbeing.

(Secondary impact): Where a growing tourism sector results in an influx of second home owners, and effective out-migration of permanent residents (not just fishers), it can have effects on community service provision and networks (as discussed under ‘out-migration’).

Income diversification – Income and employment, identity, culture, community and health

Diversification by fishers to supplement their earnings can be seen as a mechanism to boost incomes and insulate against fluctuating market conditions, although onshore diversification is primarily seen as an option for artisanal fishers only (Brookfield *et al.*, 2005). Where fishers do take seasonal or permanent employment outside of fishing this is typically through necessity rather than choice, and is often short lived due to a lack of satisfaction with the loss of way of life that fishing provides (Creative Research, 2009). Fundamentally, even where diversification opportunities exist, fishers may wish to remain in fishing for its intrinsic value and sense of identity, community and overall purpose, and may not consider alternative jobs (MRAG, 2013)

Notably the ability of fishers to diversify into other activities (within or outside of fishing) is limited by both differing skill requirements and as capital is often tied up in their investments in fishing capacity (Arthur *et al.*, 2011). Poor literacy rates can reduce non-fishing employment opportunities (Creative Research, 2009)

[9] The Stade is the name given to the fishing beach in Hastings.

Opportunities for diversification, particularly in relation to tourism, are often discussed. This can play a positive part in local economic development strategies, however much of the literature focuses on the potential negative effects of such action.

Beyond the economic effects of sometimes low paid tourism jobs, the supplanting of fishing by tourism can affect a fisher's identity, social status and perceived role within a community (Brookfield *et al.*, 2005). Fishermen who diversify can become thought of as 'not proper fisherman' by those who are able to make a full-time living fishing (Acott, 2012). At the community level, traditional roles, routines and social positions can be lost (Brookfield, 2005).

Establishing significance

In order to understand the potential social impacts of sector interactions and their significance, it is necessary to first understand the characteristics of the area of focus – 'the degree and consequence of any impact is also a function of the characteristics of the fishing community' (Delaney, 2008). How coastal communities would be affected by changes in fishing activity is variable and will depend on a number of factors, including the adaptability of fishing practise and fishers, the range of other industries in the town, the dependency of the community on fishing and the extent to which fishing is bound up with community identity.

Delaney (2009) suggests community profiling as a necessary first step for understanding how impacts that are typically economic can be evaluated in a broader [social] context. In many instances negative impacts may be contributing to an existing trend, rather than being new influences. In many instances impacts from an interaction may be influenced by other interaction sources – in such instances it is necessary to consider cumulative effects, and in turn may be hard to disentangle the impacts of the individual interaction of focus.

The critical point is the vulnerability of the community to negative repercussions of the management action and the resilience the community has in being able to absorb them (Delaney, 2008). Work by Delaney (2009) identifies five key issues that provide the fundamental background in order to be able to understand impacts and their significance. The issues are:

Economic vulnerability

The more economically vulnerable an individual or community is, the more limited the interaction consequence needs to be to generate significant economic, and in turn social, impacts. Economic vulnerability depends on the prevailing conditions faced by a fisher trying to maintain an economically viable (i.e. profitable) fishing business and by a community in maintaining a successful economy (i.e. its economic dependency on fishing).

Existence of alternatives

The more alternatives available to an individual/community within and outside of fishing, the greater their ability to deal with change and mitigate potential impacts. Within the fishing industry, the ability of a fisher to change their fishing strategy in response to a given interaction is influenced by the availability of resource/fishing grounds (which is also affected by the extent of the resource/grounds being affected by the interaction) and fishing practices (e.g. the gear types used and which gear types the available grounds are suitable for) (MRAG, 2013). Outside of the fishing industry, the existence of alternative non-fishing sources of employment can vary significantly across locations (see Brookfield *et al.*, 2005), and are typically fewer the more remote the location (Arthur *et al.*, 2011) as economies may be less diversified.

Resilience and Adaptability
This concerns the capacity of individuals, families and communities to respond to and cope with change. The inability of communities and individuals to adapt to changing conditions and be resilient increases their vulnerability and, with it, the potential negative consequences of changing conditions (Arthur *et al.*, 2011).

Adaptability can be affected by institutional factors e.g. representative bodies, regional initiatives and the existence of structural funds. Resilience can be related to community support. Social capital (i.e. networks of people able to lend aid) can help communities absorb economic and social impacts better (Delaney, 2009). For example, a coping strategy directed at diffusing stress is seeking support from others (Rolfe, 2006).

For individuals, adaptability may be reduced where they have limited ability (e.g. poor literacy) or desire (e.g. uninterested in non-fishing jobs, Creative Research, 2009) to pursue alternatives. Remaining within the fishing sector, adaptability is dependent on the fisher characteristics and their fishing strategies, which can be influenced by social conditions. Based on a case study of Southwest fishers, Abernethy (2010) devises four archetypes of fisher through which fisher reactions can be explored. For example, the study found that those skippers with a higher level of financial pressure on them at home, with more people depending on their income, tend to have a more risk averse, defensive fishing strategies. Modelling is often used to understand how a particular management measure (or other interaction) will affect patterns of fishing and landings (e.g. Pascoe and Mardle, 2006).

4.4.3 Commercial Fisheries References

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4.5 Commercial Shipping

4.5.1 Social impact of commercial shipping

This section provides a short overview of the key social impacts produced by the commercial shipping sector, in the absence of any specific interaction. For the purposes of this review commercial shipping is considered as the transport of freight and passengers both within English waters and internationally.

There is an intrinsic link between shipping and ports, however the interactions and issues in relation to other MPS sectors are often distinctly different and hence interactions with Ports and Harbours, Dredging and Disposal are presented in a separate review section.

Income and employment

In 2007, the turnover of UK shipping was £9.5 billion with a direct contribution to Gross Value Added (GVA) of £4.7 billion (UKMMAS, 2010 and references therein). No employment figures specific to shipping was cited in UKMMAS (2010), however, employment figures are described in the Ports and Harbours, Dredging and Disposal review.

Employment is recognised as the most important means by which to fulfil material wellbeing, as well as being central to individual identity and social status and an important contributor to physical and mental health (see Section 1).

Community - services

In 2007, 24.8 million international sea passengers went through UK ports (DfT, 2008). Of these 23.7 million were short-sea ferry passages, with the majority of passengers travelling to France and the Republic of Ireland (ROI), while 1.1 million passengers undertook cruises and other long-sea journeys (DfT, 2008). In addition to this, in 2007, 24.2 million domestic sea passengers travelled between ports in the UK. Domestic passengers include those on: (1) sea crossings between mainland Britain, Northern Ireland, Isle of Man, Orkney and Shetland and Channel Islands plus miscellaneous day cruises and crossings, (2) inter-island services including those to and within the Isle of Wight, and (3) river crossings, for example, on the Mersey, Thames and other harbours. The total (24.2 million) also includes 18.7 million inter-island crossings, of which 10.7 million passenger trips were made between Hampshire and the Isle of Wight and 8.0 million between the Scottish Islands (DfT, 2008; Scottish Government, 2008). There were also 2.35 million passenger crossings between Northern Ireland and Great Britain. Based on Chamber of Shipping enquiries the revenue raised from passengers is estimated as £430 million (DfT, 2008; summarised in UKMMAS, 2010).

Environment

Discharges and littering from ships have the potential to impact on the environment (e.g. affecting water quality) and hence the potential to have negative social impacts (e.g. if the water quality of bathing waters are affected or litter washes up on the shore). Incidents can range from minor discharges of oil, galley waste and other domestic waste to major incidents where ships lose cargo. Operational discharges are often small in scale. Accidental spills or losses of cargo, resulting from maritime incidents, can be significantly larger – although they are infrequent (UKMMAS, 2010). Recent major incidents include the loss of the MSC Napoli in 2007, which led to the pollution of Branscombe beach where washed up containers were broken open by salvagers and an incident in the English Channel in 2008 in which the Ice Prince lost 2000 tonnes of timber, which subsequently washed up all along the South coast (UKMMAS, 2010).

Emissions from shipping also contribute to anthropogenic sources of greenhouse gases. While shipping is generally a very carbon efficient form of transport, the Committee on Climate Change (CCC) predicts that continued growth in the sector will significantly increase global emissions (CCC, 2008 cited in UKMMAS, 2010).

Most environmental shipping impacts are managed through the International Maritime Organization (IMO).

4.5.2 Social impacts of changes in the commercial shipping sector arising from marine sector interactions

Interactions and impacts – summary table

The potential interactions between MPS sectors and the commercial shipping sector are shown in Table 18. This table was compiled based on a review of key studies in which potential interactions between marine sectors have been proposed or described (e.g. Marine Scotland, 2013a; Marine Scotland, 2013b; MMO, in prep; MMO, 2013a), and an additional grey and peer-reviewed literature search and through consultation with stakeholders. Any available evidence detailing the occurrence of these potential marine sector interactions, consequences and subsequent social impacts are described after the table.

Table 18: Commercial shipping interaction-impact table.
Key: H/M/L = High Medium Low - Representing: **[strength of the evidence that the impact can occur**; **judgement on the significance of the impact as presented in the literature]**

Issue	Interaction	Consequence	Social Impact	
			Primary	Secondary
Competition for space	Obstruction or displacement of shipping or ferry routes (including adverse weather routes)	Loss of navigable sea room for vessel manoeuvre/alteration of course which may lead to increased risk of collision (vessel to vessel and/or vessel to structure); Potential for increased insurance costs;	Impact on safety fears and health (on seafarers and family) **[L,L]**	
		Increased steaming distances and time, leading to increased emissions, costs to sector and reduced profitability; Potential reduced ferry service turnaround times resulting in a reduction in route competitiveness; Critical life-line services become uneconomic leading to service termination.	Potential impact on way of life (in relation to income and employment) **[L,L]** Reduced service or loss of service (to community) **[L,H]** Environmental impacts associated with increased emissions **[L,L]**	Effects of unemployment on individual identity, health, and social capital and cohesion **[L,L]** Community severance **[L,H]**
	Impingement in / displacement of formal and informal anchorage areas	Increased steaming distance to relocated anchorages, leading to increased costs and reduced profitability; Increased costs associated with lifting and relaying mooring buoys (where part of displaced anchorage); Increased risk to safety if access/usage of anchorage areas restricted or prohibited	Potential impact on way of life (in relation to income and employment) **[L,L]** Impact on safety fears and health (on seafarers and family) **[L,L]**	
Infrastructure	Increased vessel traffic associated	Increased collision risk (vessel to vessel and or vessel to infrastructure)	Impact on safety	

Issue	Interaction	Consequence	Social Impact	
			Primary	Secondary
	with development construction, operation and/or maintenance of another sector activity		fears and health (on seafarers and family) **[L,L]**	
	Physical interaction between shipping anchors and subsea cables	Loss of anchor; Damage to ship	Not anticipated to cause social impacts	
	Interference with navigational equipment (radar interference)	Increased collision risk (vessel to vessel and or vessel to infrastructure)	Impact on safety fears and health (on seafarers and family) **[L,L]**	

Potential social impacts – supporting literature review
The following review identifies evidence of the occurrence of these interactions and the social impacts that may arise as a consequence, where such evidence was available. Where specific evidence of primary and/or secondary social impacts arising from changes in employment level within this sector were found, they are described below. It can be noted that, in general, unemployment can be detrimental to individual identity and social status, physical and mental health, as well as a key cause of deprivation, weak social capital and community cohesion (see Section 1).

It should be noted that any marine development site (e.g. for offshore renewables) would be subject to assessment including evaluation of shipping and navigational risk. The majority of development site navigational risk assessments would also be underpinned by a marine traffic survey relevant to the baseline marine traffic use (Marine Scotland, 2013a, Appendix B).

Competition for space - Obstruction or displacement of shipping or ferry routes and anchorages
Due to the commercial navigation intensity combined with other water users such as fishing and recreational users, the potential for vessel to vessel encounters exists. This does not however translate to vessel to vessel collision risk or vessel to structure collision. Instead, the collision risk and frequency would depend on a wide range of factors including conditions, visibility, vessel characteristics and vessel speed (Marine Scotland, 2013a).

Offshore developments are likely to preclude passage of commercial vessels through areas occupied by infrastructure (e.g. renewable energy arrays). Displacement of commercial ships/ferries may result in increased vessel density within a given sea area and/or reduce navigable sea room for vessel manoeuvre/alteration of course which may lead to increased risk of collision (vessel to vessel and/or vessel to structure) and the potential to increase steaming distances and times on some routes and therefore increase costs to the sector. Anecdotal evidence of these potential interactions on the shipping sector include queries raised by Peel Ports in relation to additional shipping route displacement potentially arising from the installation of subsea export cables from OWFs (proposed and under construction) in an area already occupied by substantial MPS activity infrastructure (e.g. oil and gas infrastructure).

There may also be changes in costs to the sector associated with changes in steaming distance from a given port to a relocated (displaced) anchorage and the associated costs with lifting and laying ship mooring buoys (Marine Scotland, 2013a). Anchorages are integral to the operational and logistical aspects of commercial shipping, when vessels need to wait at anchor for tidal access to a port or to await a space within port. In addition anchorages may provide shelter and refuge and are therefore considered an essential navigational safety asset. The locations of anchorages have generally evolved over many years of commercial shipping due to being naturally sheltered safe areas for refuge in stormy conditions and the suitability of the sea-floor for anchoring and hence generally cannot be easily re-located (Liz English, ABP, pers. comm.).

Anecdotal evidence of other MPS activities potentially impinging on anchorage sites and hence affecting the shipping industry includes concerns regarding fishing activity, submarine cable laying (including export cables from OWFs) and management measures associated with designated sites (e.g. European Marine Sites and MCZs in which anchoring may be restricted or banned) in the vicinity of various ports around the UK. The potential consequence of these interactions is the need for established anchorage sites to be re-delineated and/or impacts on navigational safety. For example, the St Helen's anchorage, located off Bembridge to the east of the Isle of Wight, is considered to be a critical safety feature for the local harbour authorities and due to its proximity to the shore it is of particular importance to smaller vessels. The anchorage is coincident with a proposed recommended MCZ site and concerns have been raised that constraints of the current or future use of this anchorage area may have serious navigational safety impacts (i.e. increase the risks for mariners and safety of their vessels; Liz English, ABP, pers. comm.).

Any reductions in the profitability of the commercial shipping sector, related to increased steaming distances and time on shipping routes arising from displacement/obstruction of shipping channels and/or anchorages, may have the potential to impact on employment within the sector.

For ferry services, increases in steaming distance and time may result in a reduction in turnaround time, potentially reducing the competitiveness of a route. If a ferry route was no longer profitable, the service may be terminated impacting the communities/customers that it serves. Such a loss of a life-line service may result in 'community severance' defined as a perceived barrier to people's movement through an area that is created by the transport infrastructure' (Markovich and Lucas, 2011). Anecdotal evidence of the significance of such an impact is highlighted in the Planning Inspectorate's decision letter for the Public Inquiry into the Wightlink Lymington to Yarmouth (Isle of Wight) Class C Ferries (The Planning Inspectorate, 2011). This document described how any potential restrictions on the Lymington to Yarmouth ferry service (through a designated site) were likely to result in discontinuation of the service and described the significant economic and social impacts on the communities of the Isle of Wight and the New Forest, Hampshire. The ferry service is used by commuters, school and college pupils on the Isle of Wight who rely on the ferries, and the reverse traffic of tourists and visitors to the Isle of Wight, which supports local businesses in areas of the island which are locationally disadvantaged. The principal adverse economic and social effects if the ferry service was discontinued included the loss of jobs and visitor spending, increased travel times and vehicle operation costs, general competitive disadvantages for local firms and significant inconvenience for all current and future ferry users. These economic losses and associated negative social impacts would be even more significant in the context of the Isle of Wight's geographic isolation (The Planning Inspectorate, 2011).

However, in general, there is a paucity of direct evidence of these interaction and consequences occurring. Site specific Environmental Impact Assessments model pre and post development vessel to vessel and vessel to structure (under power or drifting) collision risk based on baseline and revised traffic patterns respectively. The Neart na Gaoithe OWF Environmental Statement (Mainstream Renewable Power 2012) highlights that there have been no reported 'passing' drifting ('Not under

Command') ship collisions with offshore installations on the UKCS in over 6,000 operational years (since the late 1960s there have been oil and gas installations on the UKCS – the operational years are calculated as the number of installations x number of years each installation is operational).

Infrastructure

The presence of structures above, on or below the sea surface poses a risk to all vessels through collision or snagging of vessel lines with structures and their moving parts while the vessel is either underway or anchoring (described in Marine Scotland, 2013a, Appendix C, no specific evidence presented). For offshore renewables developments (wind, wave or tidal), the outer structures are most exposed to shipping collision and relate to vessels navigating in restricted visibility, or those with inadequate bridge watch keeping, or vessels adrift and/or not under command. Any development would be identified on a chart and appropriately marked with buoyage as an exclusion zone. The effectiveness of these controls relies on both commercial and recreational vessels monitoring up to date charting information and maintaining an effective watch whilst at sea (Marine Scotland, 2013a). In terms of vessel to vessel collisions, wind farm developments may be a contributory factor if radar systems are affected by reflection from blades and towers (see below).

Installation of infrastructure, such as subsea cables, may affect shipping during the process of laying cables with temporary increases in collision risk and/or a requirement to avoid areas of work to reduce the risk of marine incidents. Developers are responsible for ensuring appropriate Navigational Risk Assessments are provided for their marine works (described in Marine Scotland, 2013a, Appendix B, no specific evidence presented). Evidence of the interaction between shipping and subsea cables is reported by ICPC and UNEP (2009) which states that, based on records spanning several decades, it may be estimated that c.100–150 [submarine] cable faults occur annually world-wide. Anchoring, including anchors being deployed unintentionally from commercial ships, is the second major cause of faults after fishing activity. Consequences of subsea cables and anchor interactions for the shipping sector may include loss of anchor and damage to vessels (no direct evidence sourced).

Radar interference from offshore wind installations is a known factor with respect to marine safety. Trials on the impact of offshore wind farms on marine radar systems have been carried out at North Hoyle (QinetiQ and MCA, 2004) and Kentish Flats (Marico Marine, 2007) and highlighted a risk to the use of both ship-borne and shore-based radar as an effective aid to both vessel and mark detection and, consequently, for ship-to-ship collision avoidance in the proximity of wind farms. The presence of wind farm structures can produce false (multiple and reflected) radar echoes, due to the vertical extent of the wind turbine generators. At the same time the turbines can introduce interference and cause shadowing round the structures or development. The potential for radar induced collision is greater with commercial vessel and smaller craft interaction, as smaller craft provide a limited radar return potential, which could potential be 'lost' if wind farm radar effects are significant. The concern is that due to the interference on radar systems from wind farm developments, commercial vessels will reduce the gain of their radar sets and as a result lose smaller recreational craft (Marine Scotland, 2013a). These effects can be mitigated by vessels keeping well clear of wind farms in open water or, where navigation is restricted, keeping the wind farm boundaries at suitable distances from established traffic routes, port approaches, routeing schemes, etc. (QinetiQ and MCA, 2004). The electromagnetic fields (EMF) from cables and offshore substations also have potential to interfere with navigational equipment (Red Penguin Associated Ltd, 2012; potential impact described, no specific evidence cited).

Establishing significance
The review has found little evidence of significance levels of impacts of interactions between shipping and other MPS activities except for in relation to the loss of life-line ferry services. The significance of social impacts are likely to be site specific and related to the socio-economic context. However, it is clear that any MPS activity interaction which resulted in a reduction or loss of a 'life-line' ferry service would have highly significant negative social impacts on dependent communities.

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4.6 Defence

4.6.1 Social impact of military defence

This section provides a short overview of the key social impacts produced by the military defence sector, in the absence of any specific interaction. The military defence sector makes use of the marine environment to provide security and protection of people and assets in the UK. The military defence activities in the marine environment largely involve training, surveillance and monitoring, and sea transport by naval vessels, the latter activity being mainly associated with naval bases. For the purposes of this review military defence relates to the use of the marine environment by the Royal Navy (submarine bases, jetties and exercise areas), the Army (training camps and firing ranges), Royal Air Force (bases, coastal Air Weapon Ranges and Danger Areas) and Ministry of Defence (MOD) (Defence Test and Evaluation Ranges to trial weapon systems).

Income and employment

The following information on the social impacts of the sector, in terms of GVA and employment, at the UK level has been taken from Charting Progress 2 (UKMMAS, 2010). For 2007/08 the total expenditure was £1.8 billion for the operation of marine activities (including sea transport by naval vessels and sea training) with a GVA of £468 million and £1 billion for ancillary activities (including home command services and ship building). A large amount of public expenditure has recently been directed towards building of new warships with £1.15 billion spent on shipbuilding and repair in 2006/07. Activities and hence the location of the value to the economy are mainly related to the location of the Naval bases and exercise areas. In 2008 the Naval Service as a whole comprised approximately 38,600 service personnel and the Commander of Chief Fleet employed 4,600 civilian personnel. Wider indirect benefits can flow on into the surrounding regional community (local economies) which also benefit from activities associated with the Naval bases. In England, these include HMNB Portsmouth and HMNB Devonport.

There is an indirect value obtained from the surveillance and monitoring that is carried out by the Royal Navy and others for military defence purposes. In particular, defence provides economic stability through the indirect protection of industry activities and assets. It has been suggested that there are also unquantifiable benefits for law enforcement, i.e. incentive for fishers and other marine environment users to comply with existing laws.

Employment is recognised as the most important means by which to fulfil material wellbeing, as well as being central to individual identity and social status and an important contributor to physical and mental health (see Section 1).

Community

Defence activity has frequently taken place in certain locations for generations, and local environments, heritage and neighbouring uses reflect that fact (Roger Tym and Partners and OCSI, 2011).Employment is recognised as an important contributor to social capital and community cohesion (see Section 1).

Fears and aspirations

It has been assumed that military defence activities may influence people's sense of safety (positively or negatively).

Health

Although the primary role of military Search and Rescue (SAR) units is to recover military aircrew from crashed aircraft, the vast majority of callouts are to provide emergency relief for the general public. Much of this is via helicopters and specialised aircraft. There have been no ship callouts since 1998 (UKMMAS, 2010).

Environment

Scotland's National Marine Plan (Consultation Draft) (Marine Scotland, 2013a) describes how in military firing ranges, permanent installations (associated with other marine sectors) would be at risk from live firing damage and are therefore not compatible. The Draft Plan states that in these situations the restriction of other activities often has positive impacts and potential benefits for nature conservation, i.e. it suggests there is a positive indirect benefit of military Practice and Exercise Areas (PEXA) on nature conservation.

4.6.2 Social impacts of changes in the military defence sector arising from marine sector interactions

Interactions and impacts – summary table

The potential interactions between MPS activities and the military defence sector are shown in Table 19. This table was compiled based on a review of key studies in which potential interactions between marine sectors have been proposed or described (e.g. Marine Scotland, 2013a; Marine Scotland, 2013b; MMO, in prep; MMO, 2013a), and an additional grey and peer-reviewed literature search and through consultation with stakeholders. Any available evidence detailing the occurrence of these potential marine sector interactions, consequences and subsequent social impacts are described after the table.

Table 19: Military defence interaction-impact table.
Key: H/M/L = High Medium Low - Representing: **[strength of the evidence that the impact can occur**; **judgement on the significance of the impact as presented in the literature]**

Issue	Interaction	Consequence	Social Impact	
			Primary	Secondary
Competition for space – marine area	Displacement / exclusion of defence activities	Displacement activity from an area (e.g. PEXA), leading to increased costs to sector	No social impact anticipated	
Competition for space – change in port facilities	Changes in use or access to port and/or naval base	Displacement / relocation of military facilities	Impact on way of life (in relation to income and identity) for military and non-military employees **[L,H]**	Effects of unemployment on individual identity, health, and social capital and cohesion **[L,H]**
Increase in vessel traffic	Increase in vessel interaction	Increased collision risk (vessel to vessel)	Increase in social tension; Increased safety fears and health impacts **[L,L]**	
Infrastructure	Interference with radar systems	Displaced activity, leading to increased costs for sector; Increased collision risk (vessel to vessel or vessel to infrastructure)	Increased safety fears and health impacts **[L,L]**	
	Interference with underwater communications	Displaced activity, leading to increased costs for sector; Increased collision risk (vessel to vessel or vessel to infrastructure)	Increased safety fears and health impacts **[L,L]**	

Potential social impacts – supporting literature review

The following review identifies evidence of the occurrence of these interactions and the social impacts that may arise as a consequence where such evidence was available. Where specific evidence of primary and/or secondary social impacts arising from changes in employment level within this sector were found, they are described below. However, it can be noted that, in general, unemployment can be detrimental to individual identity and social status, physical and mental health, as well as a key cause of deprivation, weak social capital and community cohesion (see Section 1). However, changes in direct employment (i.e. of military personnel) in this sector are considered more likely to be related to Government spending on defence rather than a consequence of MPS activity interactions.

Competition for space – displacement / exclusion of defence activities

There is the potential for other marine sector activities/expansion to interfere with military activities in the marine environment (e.g. see proposed interactions described in Marine Scotland, 2013b; MMO, 2013b and MMO, 2013c). Military training activities occur within military Practice or Exercise areas (PEXA), which include military low flying areas, firing and test ranges and defence ship/submarine exercise areas. The presence of permanent infrastructure in such areas is clearly incompatible. Furthermore, unexploded munitions may be left on the seabed in firing and test ranges (MMO, 2013b) which could potentially pose a risk to other marine users (no specific evidence found).

The draft East Inshore and East Offshore Marine Plans (MMO, 2013d) highlight the importance of certain areas for military defence activities (for example, the East marine plan areas are significant for the practice of air to air combat manoeuvres, bombing and submarine exercises off Flamborough Head) and the potential for other marine activities (not specified) to impact on such military defence activities in danger and exercise areas. The draft Plan also highlights the potential for interference from wind turbines on defence radars and some training facilities within the East Offshore Marine Plan Area.

Marine Scotland (2013b) proposed that the consequence of such physical interference with military defence activities is an increased economic cost to the military defence sector where developments (e.g. offshore renewable arrays or cable corridors) overlap with PEXA, although consultation with the MOD Defence Infrastructure Organisation (DIO) indicated that it was not possible to quantify the economic cost impact that would arise from the loss of military testing facilities should activity be displaced (DIO pers. comm., cited in Marine Scotland, 2013b).

Given the importance of this sector to national security, marine planning policies will likely be implemented to ensure that such interactions with military activities do not occur. For example, the draft East Inshore and East Offshore marine plans (MMO, 2013d) proposes a marine policy (DEF1) to avoid such conflict between existing defence activities in the marine environment and potential new licensable marine activities in the East plan areas and states:

“Proposals in or affecting MOD danger and exercise areas should not be authorised without agreement from the MOD”

Potential economic costs to the MOD are likely to occur in relation to the designation of MCZ through the requirement for the MOD to adjust environmental assessment tools (e.g. the Maritime Environmental Sustainability Appraisal Tool; MESAT) in order to consider whether its activities will impact on the conservation objectives of MCZs, and from the adjustment of charts and application of mitigation measures (Finding Sanctuary *et al.,* 2012).

Despite these potential interactions resulting in additional economic costs to the sector, it has been assumed that this would not have any subsequent social impacts and no evidence was found to suggest otherwise. The Strategic Defence Review outlines that by 2015 there will be 5,000 job losses in the Navy. Roger Tym and Partners and OCSI (2011) state, however, that changes in future activity in this sector will be driven by policy, and that the marine planning process will not be likely to have great influence over the prevalence or location of defence activities, i.e. the job losses are not arising as a result of interactions between MPS activities.

Competition for space – change in port facilities
It is possible that changes in naval port facilities may result in social impacts. For example, the proposed cessation of shipbuilding operations at Portsmouth naval base in the second half of 2014, as part of the Military Defence Review, would result in 940 job losses at Portsmouth dockyard, although employment related to maintaining and servicing Royal Navy ships at the naval base would continue[10].

Increase in vessel traffic – increase in vessel interaction
Access to PEXAs is prohibited when firing or other activities are taking place (MMO, 2013c). Scotland's National Marine Plan (Consultation draft) (Marine Scotland, 2013a) describes how The Right of Innocent Passage granted by UNCLOS (United Nations Convention on the Law of the Sea) could in certain circumstances significantly disrupt MOD operations where, for example, vessels from a marina regularly cross a range danger area in territorial waters, in which case bye-laws could not be enforced against the Rights of Innocent Passage and firing would have to cease. However, although large areas of sea are covered by PEXAs, military exercises cover only a proportion of these areas and exercises are held intermittently and hence there is no permanent exclusion of other mobile activities (MMO, 2013b).

Infrastructure – interference with radar systems and/or underwater communications
Wind turbines can adversely affect a number of MOD operations including radars, seismological recording equipment and communications facilities (DECC website, cited in Marine Scotland, 2013b). For example, there is the potential for wind turbines to cause radar interference when turbine heights exceed certain levels. Anecdotal evidence of this interaction/consequence was provided by the MOD Defence Infrastructure Organisation (DIO) which confirmed that interference with radar would arise in relation to wind arrays occurring within the line of sight of radar (DIO pers. comm. cited in Marine Scotland, 2013b). In these instances, mitigation for radar interference from offshore wind arrays will be required as a condition of consent if there is a potentially significant effect (a cost that would be transferred to the OWF developer; Marine Scotland, 2013b). However, a recent breakthrough in radar technology may eliminate the need for MOD to object to wind farm projects on this basis (Ministry of Defence, 2012 cited in MMO, 2013c).

[10] http://www.theguardian.com/business/2013/nov/06/bae-closure-portsmouth-shipyard-jobs

Underwater communications refer to submarine listening devices, underwater communication systems (submarines) and sonar used by surface vessels. Such interference could lead to the displacement of activity leading to increased costs.

Establishing significance
The review has found little evidence of significance levels of impacts of interactions between defence and other MPS activities. The significance of social impacts is likely to be site specific and related to the socio-economic context. The significance of any social impacts could be high if the interaction affects major defence employment centres such as HMNB Portsmouth. However, it is considered unlikely that a government would allow its strategic defence interests to be compromised by another activity.

4.6.3 Defence References

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4.7. Marine Aggregates

4.7.1 Social impacts of marine aggregates

This section provides a short overview of the key social impacts associated with the marine aggregates sector, in the absence of any specific interaction. For the purposes of this review marine aggregates relate to the mixture of natural sands and gravels used in construction, civil engineering and beach replenishment, derived from marine sources (TCE and BMAPA, 2010).

Income 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; 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 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 (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/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. the British Marine Aggregate Producers Association (BMAPA)), ship building and maintenance, manufacture of specialised surveying and dredging equipment, and environmental monitoring and assessment (UKMMAS, 2010; Highley *et al*., 2007).

Employment is recognised as the most important means by which to fulfil material wellbeing, as well as being central to individual identity and social status and an important contributor to physical and mental health (see Section 1).

Community and culture

Marine aggregates are essential for their contribution to creating and maintaining the ‘structural framework of the built environment’ (BGS, 2007). In 2005, marine sand and gravel accounted for 19% of total sand and gravel sales in England and 46% in Wales. Therefore, marine sources of aggregates have a role in underpinning the security of supply for the construction industry. Marine aggregates are essential minerals, and are mainly used in concrete, for example for the construction of homes, schools, hospitals, infrastructure, and also ‘as dredged’ for the replenishment of beaches and the protection of coasts from erosion and flooding (EMU, 2012). Government policy (DCLG, 2006; HM Government, 2011) recognises that marine aggregates play a key role in servicing the nation’s demand for construction aggregates, essential for the development of our built environment, and supplying materials for the maintenance of coastal and flood protection defences required for climate change adaptation. Marine aggregates also contribute to energy security and economic development through the provision of fill for major coastal infrastructure projects, for example ports, renewable energy and nuclear energy projects.

Marine aggregates can present reduced impacts on local communities compared to the extraction of land-won aggregates, in particular with regard to the extraction process and transportation. Substantial volumes of marine aggregates are landed on wharves close to where they are needed and locally distributed by rail, water (through barges) and road (HM Government, 2011), significantly reducing air and noise pollution and road congestion from lorry traffic (MMO, 2013a). There are also regional differences in the significance of wider socio-economic benefits of the industry. Marine aggregates make a ‘crucial’ contribution to London and the Southeast, which together account for over one third of construction and economic activity in the UK (BGS, 2007; UKMMAS, 2010).

Additionally, it is recognised there are often no practicable alternative sources to marine aggregates for the maintenance of coastal defences required for climate change adaptation (MMO, 2013). This in turn may lead to a positive change in amenity value of sections of coastline and potential benefits to recreational activities (Austen *et al*., 2009).

The data generated from seabed mapping, prospecting, EIAs, industry funded research and monitoring from the aggregates sector benefits the marine aggregates industry but also other marine industries by improving their understanding of the marine environment and by providing scientific insights into the dynamics of sedimentary and ecological systems (UKMMAS, 2010). This can lead to improved management processes and more highly focused research and monitoring. It also represents a significant educational resource capable of raising public awareness of the habitats and species that exist in the seas around the UK. Raising awareness of the marine environment has a wider beneficial effect as the general public pay more attention to the health and value of our marine resources (Austen *et al*., 2009).

It is also well documented that extraction of marine aggregates can potentially influence heritage resources (Wessex Archaeology, 2003). Dredging operations affect submerged pre-historic landscapes and can damage artefacts within or on the seabed, or move artefacts from their original position thereby losing valuable contextual information. Conversely, archaeological heritage may be improved through extraction of marine aggregates if dredging operations result in discovery of artefacts that may previously have lain undiscovered. Additionally, the survey data collected during dredging monitoring is of value when mapping potential archaeological interests and improving understanding of the location of wrecks on the seabed (Austen *et al*., 2009).

Environment

Dredging for marine aggregates interacts with the seabed both directly through the dredge and indirectly through plume effects. These pressures may affect fisheries in the short term by deterring fish and in the long-term by affecting recruitment processes. Direct impacts from the passing of the drag head tend to be short-term and localised while plume effects are more widespread (UKMMAS, 2010).
Dredging for marine aggregates contributes to emissions of greenhouse gases through shipping and indirectly through downstream production activities. In 2007, the amount of marine gas oil used to transport and produce marine aggregates was

2.39 kg per tonne of landed aggregates and total carbon dioxide (CO_2) emissions in 2007 were 7.614 kg per tonne of landed aggregates (a total of 157,000 tonnes) (UKMMAS, 2010). However, as noted above, dredging for marine aggregates also provides positive benefits to reducing the level of greenhouse gas emissions. Marine aggregates can be supplied close to where they are needed (generally at the coast) lessening the need for land-based transport, thereby reducing related greenhouse gas emissions and impacts on land-based infrastructure. In 2007, the industry delivered 20,000 tonnes of marine aggregates every day to London, the equivalent of 1000 lorry loads (BMAPA, 2008; UKMMAS, 2010). In addition, the use of marine aggregates within beach replenishment schemes can reduce the risk of coastal flooding for local communities.

As a result of an extensive research programme through the Marine Aggregate Levy Sustainability Fund (MALSF), well developed on-board monitoring systems and regional environmental assessments (REAs), means that there is a good understanding of the environmental impacts from marine aggregates extraction and the characterisation of regional aggregate resources and palaeolandscapes (UKMMAS, 2010).

4.7.2 Social impacts of changes in the aggregates sector arising from marine sector interactions

Interactions and impacts – summary table

The potential interactions between MPS activities and the aggregates sector are shown in Table 20. This table was compiled based on a review of key studies in which potential interactions between marine sectors have been proposed or described (e.g. MMO, 2013), an additional grey and peer-reviewed literature search and through consultation with the BMAPA. Any available evidence detailing the occurrence of these potential marine sector interactions, consequences and subsequent social impacts are described after the table.

Table 20: Marine aggregates interaction-impact table.
Key: H/M/L = High Medium Low - Representing: **[strength of the evidence that the impact can occur**; **judgement on the significance of the impact as presented in the literature]**

Issue	Interaction	Consequence	Social Impact	
			Primary	Secondary
Competition for space	Spatio-temporal restrictions within / exclusion from licenced aggregates extraction sites	Reduction in tonnage available to be extracted and reduced ability to meet demand (potential loss of capital asset associated with this); Reduced efficiency due to vessels having to work in confined areas or relocating to alternative locations (potential increases in operational costs)	Reduction in income **[L,L]** Relocation of employment **[L,L]** Environmental impacts associated with increased costs/reduced amounts of aggregates for flood and coastal defences **[L,M]**	Change in employment (downstream construction chain) **[L,M]** Reduction in future income and employment **[L,L]**
	Obstruction of routes to current licensed aggregates extraction sites	Increased steaming distances/time, leading to increased costs and reduced revenue.	Reduction in income **[L,L]**	Change in employment (downstream construction chain) **[L,M]** Reduction in future income and employment **[L,L]**
	Constraint on marine aggregates prospecting (to assess potential of new areas)	Future extraction constrained (loss of mineral asset) – increased cost per tonnage	Reduction in income **[L,L];** Environmental impacts associated with increased costs/reduced amounts of aggregates for flood and coastal defences **[L,M]**	Change in employment (downstream construction chain) **[L,M]**
Increased vessel traffic	Increased vessel traffic (coinciding when and where dredging operations are taking place)	Increased collision risk (vessel to vessel) Reduced efficiency due to lost time/effort or relocating to alternative locations (potential increases in operational costs)	Increased safety fears and health impacts **[L,L]** Environmental impacts associated with increased costs/reduced amounts of aggregates for flood and coastal defences **[L,M]**	Loss of community and cultural stability **[L,L]** Change in employment (downstream construction chain) **[L,M]** Reduction in future income and employment **[L,L]**

Issue	Interaction	Consequence	Social Impact	
			Primary	**Secondary**
Competition for space – change in port/wharf facilities	Less suitable facilities / better facilities (for landing, processing and distribution)	Changes in turnaround times, changes in efficiency of handling and distribution, affecting profitability of activity	Reduction/increase in local income **[L,L]** Changes in employment **[L,L]** Environmental impacts **[L,L]**	Changes in income and employment (downstream construction chain) **[L,M]** Changes in future income and employment **[L,L]** Environmental impacts **[L,L]**
Infrastructure	Presence of infrastructure	Increased collision risk (vessel to infrastructure) – reduced operational efficiency (potential increases in operational costs)	Increased safety fears and health impacts **[L,L]**	Reduction in community and cultural stability **[L,L]** Change in employment (downstream construction chain) **[L,M]** Reduction in future income and employment **[L,L]**
	Interference with navigational equipment	Increased collision risk	Increased safety fears and health impacts **[L,L]**	Reduction in community and cultural stability **[L,L]**
	Development of other sectors	Increased demand for marine aggregates (which industry is able to meet)	Increased income and employment opportunities **[L,M]**	Change in employment (downstream construction chain) **[L,M]** Increase in future income and employment **[L,M]**

Potential social impacts of interactions– supporting literature review
The following review identifies evidence of the occurrence of these interactions and the social impacts that may arise as a consequence where such evidence was available. Where specific evidence of primary and/or secondary social impacts arising from changes in employment levels within this sector were found, they are described below. However, it can be noted that, in general, unemployment can be detrimental to individual identity and social status, physical and mental health, as well as a key cause of deprivation, weak social capital and community cohesion (see Section 1).

Competition for space - Spatial Restrictions
A number of marine sectors may potentially restrict or exclude marine aggregates extraction. These are generally related to the physical presence of structures within the licenced aggregates site or due to management measures restricting activities within the site. For example, exclusion zones are applied to in-service cables or pipelines typically preventing dredging occurring within 500 m either side of an existing structure (leading to a 1 km wide exclusion zone) (Tillin *et al*., 2011). Similarly, an area used by renewable energy infrastructure would no longer be available for aggregates extraction in the medium term, i.e. 50 years because of the presence of turbines and cables within offshore energy arrays (eftec, 2011).

However, aggregates extraction and many other marine sectors are planned spatially at a strategic level through respective processes for licensing. The Crown Estate leases the seabed to spatially accommodate both renewable energy and aggregate needs. For example, the Round 3 Zone 5 wind farm development zone off the East Anglian coastline was shaped to not overlap with licensed aggregates areas, allowing enough space for both sectors to develop in the medium term. Similarly, following the selection of a landfall site for Hornsea Offshore Wind Farm at Horseshoe Point, the export cable route corridor was optimised to take account of seabed features and routed around licensed dredging areas (Smart Wind, 2013). In contrast, the eastern portion of the Gwynt y Môr wind farm project area was previously licensed to United Marine Dredging Ltd and Norwest Sand and Ballast Company, for the extraction of sand and gravel. The licensed area was amended to accommodate the wind farm and is now adjacent to the eastern boundary of the Gwynt y Môr site (npower renewables, 2005).

Dredging for aggregates also interacts with a range of recreational activities including recreational angling, scuba diving and sailing. Angling occasionally targets similar areas to aggregates dredging. An example of this includes the Overfalls area that coincided with licence application area 372-2. This area of offshore gravel was recognised as providing a niche environment that was very important for a range of fish species including bass and blonde ray. Following consultation, Hanson, the original applicant surrendered the application and The Crown Estate decided not to licence extraction of minerals from the area for a period of 21 years pending designation of the Overfalls as a Marine Conservation Zone (Wildlife and Countryside Link, 2006; Tillin *et al*., 2011).

During the MCZ review process The Crown Estate raised particular issues about the Goodwin Sands rMCZ on a strategic aggregates resource. This is because as well as offering features of important conservation value, the Goodwin Sands bank system is a dynamic highly mobile system which contains highly significant volumes of aggregates resource of various gradings. Within the boundary of the rMCZ there is an important block of potential aggregates resource which contains a strategic resource, both in volume and location terms, for coastal defence, coastal development and construction to supply a range of markets and projects. The Crown Estate indicated that closure of the resource block to aggregates extraction would have significant economic impacts on the aggregates industry and potential knock on effects on construction, beach recharge and coastal protection operations. To safeguard this strategically important resource for the forthcoming leasing round, The Crown Estate suggested that the Goodwin Sands rMCZ be designated using a zonal approach that would allow aggregates extraction from the potential resource block for essential mineral resource supply (The Crown Estate, feedback on draft IA material, 2011; cited in Finding Sanctuary, Irish Seas Conservation Zones, Net Gain and Balanced Seas, 2012).

Although it is evident that there are a range of activities which have the potential to interact with the marine aggregates sector, there is limited evidence of significant social impacts associated with these interactions. This is largely because income and employment associated with aggregates are limited and spread over a large number of sites and the interactions with MPS activities (e.g. MPAs or offshore renewables) are well managed through the leasing and Environmental Impact Assessment (EIA) processes.

The main social impacts are likely to occur where aggregate licences are modified or revoked in circumstances where another MPS activity is given priority, but this is only likely to happen in a very limited number of cases and even where this occurs, it is possible that production will simply be switched to other licensed areas. Following consultation with BMAPA it was recognised that a reduction in the resource available to be extracted may lead to a loss of capital asset and increases in operational costs (including costs associated with sourcing an alternative licence site), thus resulting in increased cost per tonne of aggregates. These costs may potentially have knock on effects associated with increased costs for coastal defences, sequentially affecting coastal communities. Whilst reduction in employment could occur as a result of spatial restrictions or exclusions from licence sites, this outcome is unlikely to occur from a single licence being compromised as the dredge vessel would simply relocate elsewhere. Any employment impacts are, therefore, more likely to occur at the wharf and added value facilities or end users that depend on marine aggregates (Mark Russell, BMAPA, pers. comm. 2014).

Competition for space - Obstruction of routes

Offshore developments are likely to preclude passage of dredge vessels through areas occupied by infrastructure (e.g. renewable energy arrays). Displacement of dredge vessels may result in the potential for increased steaming distances and times on some routes and therefore increase costs to the sector. Similarly, displacement of vessels from renewable energy areas also has the potential to increase vessel density within a licence area and/or reduce navigable sea room for dredge vessels which may lead to increased risk of collision and delays/restrictions on the duration of dredging activity.

The proposed Burbo Bank extension offshore wind farm intersects with the transiting route of a Tarmac aggregates dredger. It is proposed that the wind farm extension will result in this dredging vessel having to re-route slightly north and/or west of the offshore wind farm site once operational. Discussions between Dong Energy and Tarmac over the likely extra fuel costs of extra steaming to reach dredging areas are ongoing (Dong Energy, 2013a).

However, in response to the Impact Assessment process for Special Area of Conservation designations, BMAPA prepared a marine aggregates case study in 2009 to quantify the business costs of changes to production operations. The scenario considered the unforeseen loss of an existing production licence area and the need to replace this tonnage with production from a more distant licence area. The key operational costs considered were: (1) Additional fuel consumed (tonnes and cost); (2) Additional carbon emissions (tonnes); and (3) Additional time in vessels cycle, resulting in loss of vessel productivity (time and loss of revenue associated with that time). It is important to note that the calculations do not include the financial consequences resulting from the loss of an existing production licence area – either in terms of investment to date (prospecting data and application studies) or loss of asset value, nor the additional costs per cargo arising from the increased wear and tear on vessels from the additional steaming distance.

Assuming an existing production licence area producing 500,000 tonnes per annum was lost and replaced with a similar licence located 40km away (80km total distance per cycle) the maximum annual cost to business was estimated to be approximately £1.7 million (BMAPA, 2009).

Whilst there is clear evidence of increased costs associated with the obstruction of shipping routes on the aggregates sector, no specific evidence on social impacts could be found.

Competition for space - Constraints on prospecting
In common with mineral extraction onshore, legal permission is required for marine aggregates prospecting and extraction. Prospecting licences provide developers with an exclusive option on an area of sea bed to carry out the necessary geological and geophysical investigations to establish whether a viable aggregates resource is present (Highley *et al.*, 2007). Designation of potential marine aggregates licence sites as MPAs may mean that dredge activities are excluded from the site and/or that marine aggregates extraction (prospecting and production) are subject to higher levels of assessment with greater costs being incurred by dredge companies in assessing impacts on MCZ features of conservation interest in future licence applications for aggregates extraction. In BMAPA's view (pers. comm. 2011), additional costs will be incurred because of the need to demonstrate the impact pathways and sensitivity of any features that are at risk of direct or indirect pressure from the proposed extraction activity. Given the paucity of information surrounding the distribution of features on many rMCZ sites, and based on experiences with other MPA designations, BMAPA also anticipates that it is highly likely that operators will have to acquire additional survey data for marine aggregates sites that are in relatively close proximity to rMCZs. These data will be required to ensure that licensing decisions are based on sound evidence relating to feature distribution and relative exposure to pressure, rather than simply deferring to a precautionary

position (BMAPA pers. comm., 2011, cited in Finding Sanctuary, Irish Seas Conservation Zones, Net Gain and Balanced Seas, 2012).

Whilst it is likely that designations of MPAs may increase the cost of prospecting and leasing licences for the aggregates sector, no specific evidence on social impacts could be found. The stakeholder response from BMAPA confirmed that whilst it was unlikely that this interaction would lead to unemployment the increased costs incurred may have knock on effects for the downstream construction sector (Mark Russell, BMAPA, pers. comm. 2014).

Increased vessel traffic
Due to the commercial navigation intensity combined with other water users such as fishing and recreational users, the potential for vessel to vessel encounters exists. This does not however translate to vessel to vessel collision risk. Instead, the collision risk and frequency would depend on a wide range of factors including conditions, visibility, vessel characteristics and vessel speed (Marine Scotland, 2013). In particular, a number of UK aggregates licence areas are located within and adjacent to busy shipping lanes. Many of these shipping routes, particularly those close to Northwest Europe, are firmly established and require due consideration during the licensing of marine aggregates deposits. Collisions between dredging vessels and commercial shipping and/ or grounding incidents are prevented through communication with the shipping industry at all stages of licensing and prosecution of activities (Tillin *et al*., 2011).

No specific evidence could be found on the social impacts of increased vessel traffic on the marine aggregates sector.

Changes in port/wharf facilities
The ability of the industry to deliver more aggregates relates to the capacity of the dredging fleet and wharf facilities to allow landing, processing and distribution (MMO, 2013). Adequate wharf facilities at appropriate locations to allow the landing, processing, storage and distribution of marine aggregates are an integral and crucial part of the supply chain. Many wharves are also integrated with value added manufacturing facilities in the form of ready-mixed concrete and concrete block plants. The social importance of these is noted in the fact that activities related to ready-mixed concrete and concrete products collectively employ over 30,000 staff, and generate an annual turnover of £4,281 million and a GVA of £1,685 million (Highley *et al.*, 2007). Consequently, a significant part of these sectors, and their associated employment, infrastructure and turnover are entirely dependent upon the continued supply of marine aggregates materials – particularly in London and the Southeast (Mark Russell, BMAPA, pers. comm. 2014).

However, the waterfront location of these facilities means that marine aggregates wharves could potentially be under pressure from other industrial activities which may be considered more profitable in the short term. Aggregates are a low value product and there is the potential for them to get out-competed by other cargo types (Mark Russell, BMAPA, pers. comm., 2014). Landing points for aggregates are the first stage in the supply chain for a range of added value end users. Therefore, if wharf facilities were to disappear the cost to the wider community/society, in terms of the price of construction aggregates and associated increases in road traffic movements, noise, emissions and quality of life, would be considerable as alternative resources would have to be resourced from elsewhere (Mark Russell, BMAPA, pers. comm., 2014). The strategic importance of wharves to the future supply of marine aggregates imports has thus prompted wharf safeguarding strategies under the National Planning Policy Framework (Department for Communities and Local Government, 2012). Conversely, aggregate wharves may provide secondary social impacts on the local community through increased traffic movements and potential adverse air quality from increased dust particles. However, the impacts of these secondary impacts should have been mitigated for during any Environmental Impact Assessment required for extraction of marine aggregates.

Whilst there is clear evidence of the importance of wharf facilities to the marine aggregates sector, no specific evidence on social impacts associated with the change of use of port facilities could be found.

Infrastructure: Presence of infrastructure and increased collision risk
The presence of structures above, on or below the sea surface poses a risk to all vessels through collision or snagging of vessel lines with structures and their moving parts while the vessel is either underway or anchoring (Marine Scotland, 2013). For offshore renewable developments (wind, wave or tidal), the outer structures are most exposed to shipping collision and relate to vessels navigating in restricted visibility, or those with inadequate bridge watch keeping, or vessels adrift and/or not under command. Any development would be identified on a chart and appropriately marked with buoyage as an exclusion zone. The effectiveness of these controls relies on vessels monitoring up to date charting information and maintaining an effective watch whilst at sea (Marine Scotland, 2013).

The proposed Walney extension offshore renewable site lies close to the southernmost corner of an active dredge area. This area is mostly dredged for coarse sand in the central part and is served by ships coming from Heysham, Barrow and Liverpool which cross the Walney extension site. Issues over the proximity of the wind turbines to the actively dredged site were raised by Tarmac Ltd particularly in relation to the safety of vessels if they lose power and drift. It has been proposed that an acceptable turbine layout would ensure a sufficient safety zone between the dredge area and the wind turbines. This approach has also previously been used for an active dredge area close to the London Array offshore wind farm in the Thames Estuary (Dong Energy, 2013b).

No specific evidence could be found on the social impacts of increased collision risk on the marine aggregates sector.

Infrastructure: Interference with navigational equipment
Radar interference from offshore wind installations is a known factor with respect to marine safety. Trials on the impact of offshore wind farms on marine radar systems have been carried out at North Hoyle (QinetiQ and MCA, 2004) and Kentish Flats (Marico Marine, 2007) and highlighted a risk to the use of both ship-borne and shore-based radar as an effective aid to both vessel and mark detection and, consequently, for ship-to-ship collision avoidance in the proximity of wind farms. The presence of wind farm structures can produce false (multiple and reflected) radar echoes, due to the vertical extent of the wind turbine generators. At the same time the turbines can

introduce interference and cause shadowing round the structures or development. The potential for radar induced collision is greater with commercial vessel and smaller craft interaction, as smaller craft provide a limited radar return potential, which could potentially be 'lost' if wind farm radar effects are significant. The concern is that due to the interference on radar systems from wind farm developments, dredging vessels will reduce the gain of their radar sets and as a result lose smaller recreational craft (Marine Scotland, 2013). These effects can be mitigated by vessels keeping well clear of wind farms in open water or, where navigation is restricted, keeping the wind farm boundaries at suitable distances from established traffic routes and aggregates dredge areas (Qinetiq and MCA, 2004).

The electromagnetic fields (EMF) associated with live power cables and offshore substations also have potential to interfere with navigational equipment (Red Penguin Associated Ltd, 2012; potential impact described, no specific evidence cited).

No specific evidence could be found on the social impacts of the interference with navigational equipment on the marine aggregates sector.

Infrastructure: Development of other MPS activities

Activity within the marine aggregates sector is driven by the demand for construction material and the availability of land-won aggregates in comparison with marine aggregates. Demand for construction material is in turn driven by government policies on energy security and climate change and large-scale infrastructure projects such as nuclear new builds, renewable energy developments and coastal defence programmes (UKMMAS, 2010). Major contract fill projects include the Cardiff Bay Barrage (constructed using 2.5 million tonnes of dredged sand) and Sizewell B nuclear power station in Suffolk (constructed using 1.5 million tonnes of marine sand and gravel) (Highley *et al*., 2007).

As the construction of offshore windfarms moves into deeper waters, gravity base foundations may become increasingly used and the associated demand for marine aggregates could be significant (Quarry Management, 2010, cited in MMO, 2013). The future contribution of tidal power to the UK's energy mix could also influence the demand for marine aggregates as tidal barrage or lagoon schemes could require large volumes of aggregates for both fill purposes and for construction. Given the coastal locations of such developments and the scale of supply required, marine dredged sand and gravel would represent an obvious source (Highley *et al.*, 2007). Similarly, the increasing need to protect existing coastal assets will create a continuing demand for marine sand and gravel for construction and material for coastal defences and beach replenishment (UKMMAS, 2010).

Although no specific evidence could be found on the social impacts of the development of other MPA activities on the marine aggregates sector, the increased demand for marine aggregates may have positive benefits for employment opportunities within the marine aggregates sector.

Establishing Significance

Due to the limited evidence identified on the social impacts of interactions between MPS activities and the marine aggregates sector there has subsequently been little evidence identified of the significance of social impacts. This is largely because income and employment associated with aggregates are limited and spread over a large number of sites and the interactions with MPS activities (e.g. MPAs or offshore renewables) are well managed through the leasing and Environmental Impact Assessment (EIA) processes. Therefore, the significance of social impacts are likely to be site specific and related to the socio-economic context, including the community dependence on the industry within a given location.

Following consultation with BMAPA it was concluded that in fact the most significant social impacts of interactions resulting in restrictions or increased operational costs within the marine aggregates sector are likely to be felt at the added value facilities or end users that depend on marine aggregates (for example wharf facilities and large scale construction projects, including coastal defences) rather than the marine aggregates sector itself (Mark Russell, BMAPA, pers. comm. 2014). Therefore, the significance of changes in employment in downstream construction chains has been assessed as Medium. Similarly, the significance of environmental impacts as a result of increased costs/reduced amounts of marine aggregates for coastal defences has been assessed as Medium.

The increased demand for marine aggregates as a result of growth in MPS activities may have positive benefits for employment opportunities within both the marine aggregates sector and at the added value facilities. Employment is recognised as the most important means by which to fulfil material wellbeing, as being central to individual identity and social status, and being an important contributor to physical and mental health (see Section 1). Therefore, the significance of these changes in employment has been assessed as Medium.

4.7.3 Marine Aggregates References

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4.8. Marine Protected Areas

4.8.1 Social impacts of Marine Protected Areas

This section provides a short overview of the key social impacts relating to Marine Protected Areas (MPAs), in the absence of any specific interaction. MPAs within England cover EU specific areas of conservation such as those identified as Special Areas of Conservation (SACs) and Special Protection Areas (SPAs) as well as additional areas of conservation such as Marine Conservation Zones (MCZs). They are areas which are legally protected and could mean that certain activities may be restricted in these areas of sea in order to protect marine biodiversity (MMO, 2013).

There are already a number of established MPAs in UK waters which aim to conserve and preserve different marine environments. MPAs are human creations the purpose of which is to manage the behaviour of people in their use of coastal and marine resources in order to protect the marine environment (Bromley, 1991). In this way MPAs inherently have social impacts. However, the relative youth of MPAs, lack of management definition and difficulty in measuring 'non-use values' all make it challenging to empirically measure the social impact of MPAs (Tom Hooper, RSPB, pers. comm. 2014). Pike *et al.* (2010), in a paper called 'Social Value of Marine and Coastal Protected Areas in England and Wales', identified nine key themes of social value in Marine and Coastal Protected Areas (MCPAs): Management; the natural environment; spirituality; activities; community involvement; research, education and interpretation; built infrastructure; access; and marketing and promotion (Pike *et al*., 2010).

Income and employment

MPAs have been shown to increase fish stock abundance, biodiversity and recovery of habitats. As a result, MPAs can be highly attractive to non-extractive users who value the biological and cultural resources for their tourism and recreational opportunities. New visitors can lead to diversification of the local economy through new businesses, jobs and income and tax revenues for the local community (Pomeroy *et al.*, 2006). It is even possible that potential increases in revenue from tourism and recreation could offset potential losses due to lower commercial or recreational catches because of the closure (Sanchirico *et al.*, 2002). For example, Kenter *et al.* (2013) provide evidence of the potential recreational use and non-use benefits of 25 Scottish, 119 English and 7 Welsh existing or potential MPAs for recreational angling and diving. The English MCZ impact assessment estimated aggregate costs at present value over a 20 year time scale for all 127 rMCZs at £227 - 821 million including costs to the renewable energy sector, the fisheries sector, oil and gas, commercial shipping, recreation, and implementation, management and enforcement costs. In contrast, the baseline, one-off non-use value of protecting the sites to divers and anglers alone was assessed to be worth £730 – 1,310 million (Kenter *et al*., 2013). The RSPB report "Natural Foundations: conservation and local employment in the UK" also highlights the direct benefits of conservation in terms of jobs and GVA to local communities. The report notes that in England alone, there were 299,000 jobs and £7.6 billion worth of GVA supported by environment linked activity in the year 2007 (MMO, 2013).

Excessive visitation of MPAs, and the development that can accompany tourism and recreational activities, can, however, be damaging to the environment and reduce the biological, cultural and economic benefits obtained from the closure (Pomeroy *et al.*, 2006). Obviously, the location and setting of a particular MPA will play a critical role in the magnitude of these benefits and costs. For example, a protected area offshore that is mainly occupied by bottom-dwelling species will most likely not have a significant tourism or recreational potential, while a coral-reef closure might. However, in general a MPA can offer protection and provide the possibility for economic returns to sectors of the economy not directly tied to commercial fishing (Sanchirico *et al.*, 2002).

Community and culture

MPA establishment generally induces shifts in resource access and use that vary within and among social groups. Often these shifts involve changes from extractive activities (e.g. fishing) to non-extractive activities (e.g. ecotourism) and/or local resource users moving to exclude "outsiders" (users from outside the immediate community) from accessing nearby marine resources. MPA establishment has often resulted in increases in income, food security, and material assets for those gaining preferential resource access, while those losing access may suffer corresponding losses or adopt mitigation strategies by shifting resource use patterns or livelihoods strategies (Pomeroy *et al.*, 2006).

MPAs can also provide "undisturbed" areas creating new opportunities for scientific research and offering a safeguard against management errors. Scientists argue that these areas can be used as controls to monitor and study the recovery of fish populations that will improve estimates of population parameters (e.g. more reliable estimates of growth and natural mortality rates) and stock assessments (Sanchirico *et al.*, 2002). MPAs can also provide centres for research and education, for example Wembury and Polzeath both have seashore centres which are used by many school groups during the summer (Tom Hooper, RSPB, pers. comm. 2014).

Environment

In addition to the job and GVA valuations of MPAs, there is also the added value of the preservation of habitat and species by instating MPAs. Research shows that MPAs can increase biodiversity and allow a marine ecosystem to return to its "natural" state (e.g. Boersma and Parrish, 1999). Non-extractive users, such as divers and photographers, may value these changes to the marine ecosystem (Sanchirico *et al.*, 2002).

Improving the health of the ocean may also appeal to individuals who might never intend to use the area, but who value its existence nonetheless. Ressurreição *et al*. (2012) undertook research to investigate the willingness of people to pay (WTP) a one-off payment to stop the reduction of different taxa from a 10% decrease in the Azores, Isles of Scilly and Gdansk. For the Isles of Scilly the WTP for the conservation of algae was £46 for residents (£41 for visitors), for mammals residents were willing to pay £43 (visitors £38), for birds £39 (£34), fish £37 (£33) and invertebrates £36 (£32) (reviewed in MMO, 2013).

The conservation focus of MPAs controls for perceptions of ideal (or special) attributes to which humans are attracted; these attributes include values such as beautiful, untouched wilderness or resources that offer vast economic, social or cultural wealth (Campbell and Hewitt, 2013). Kenter *et al*., 2013 also indicate that the most important benefits to divers and anglers of marine sites were engagement and interaction with nature (including feeling connected, getting to know nature, and appreciating its beauty), transformative values (including memorable experiences) and the sites' social bonding value.

It is also important to note that social value of an MPA is likely to change over time and would be influenced by factors such as ecological changes (which might bring more visitors, catches for commercial fishermen) or increased visitor numbers (which might bring more revenue, but tensions with local community as well) (Tom Hooper, RSPB, pers. comm. 2014).

4.8.2 Social impacts of changes in Marine Protected Areas arising from marine sector interactions

Interactions and impacts – summary table

The MMO has a legal obligation to ensure conservation objectives and the MPA network are not negatively affected by marine licensable activities, or activities which could be regulated through an MMO byelaw (e.g. fishing or recreational activities). Therefore, marine activities which would hinder the likelihood of achieving those objectives for MPAs are unlikely to be licensed. Thus interactions with the MPA sector are likely to arise through unmanaged activities such as the spread of non-natives or accidental pollution/contamination events (see below).

The potential interactions between MPS activities and MPAs are shown in Table 21. This table was compiled based on a review of key studies in which potential interactions between marine sectors have been proposed or described (e.g. MMO, 2013), an additional grey and peer-reviewed literature search and through consultation with stakeholders. Any available evidence detailing the occurrence of these potential marine sector interactions, consequences and subsequent social impacts are described after the table.

Table 21: Marine Protected Areas interaction-impact table.
Key: H/M/L = High Medium Low - Representing: **[strength of the evidence that the impact can occur**; **judgement on the significance of the impact as presented in the literature]**

Issue	Interaction	Consequence	Social Impact	
			Primary	Secondary
Non-native species	Facilitation of spread of non-native species through vessel traffic (ballast water, vessel hulls, equipment, etc.) or introduction of infrastructure into marine habitat	Possible impact on conservation status of site	Potential impact on environment (e.g. biodiversity, ecosystem services, cultural heritage) **[M,M]** Reduced enjoyment of recreational activities (e.g. diving) **[L,L]**	Reduction in health **[L,L]**
Water quality	Accidental release of contaminants from vessels/infrastructure	Reduction in water quality, potential impact on designated features on conservation status of site	Potential impact on environment (e.g. biodiversity, ecosystem services) **[M,M]**; Reduced enjoyment of recreational activities (e.g. diving) **[L,L]**	Reduction in health **[L,L]**

Potential social impacts of interactions– supporting literature review
The following review identifies evidence of the occurrence of these interactions and the social impacts that may arise from them, where such evidence was available.

Spread of non-native species affecting the conservation status of a site
MPAs are areas set aside to preserve and protect their biodiversity and resources. MPAs are often chosen because they include important marine resources and habitats that the surrounding environment or humans depend upon. They are often located near ports and are therefore in close proximity to introduction points for marine invasive non-native species (INNS). Due to their high environmental values and the management efforts required to set up and maintain MPA's, the impacts posed by marine INNS can be highly detrimental to them. Intentional introductions of species (e.g. fisheries and aquaculture stocking) are relatively simple to manage and can be controlled via quarantine measures (e.g. import health standards) and/or containment (i.e., maintained in a quarantine facility) though once released into the environment, unanticipated impacts may occur. Unintentional introductions of species are more problematic and need to be managed at the level of the vector (transport mechanism), the pathway (route of transfer) and the species by understanding the anticipated risk (Campbell and Hewitt, 2013).

The designation of a site as a protected area can increase the risks of invasion by alien species. MPAs are, for instance, points of significant attraction for marine tourism, including recreational boating, yachting, the diving and snorkelling industry, and, where allowed, recreational and artisanal fishing. All these activities are likely to lead to increased risks of introducing INNS, associated with hull fouling, ballast water, or on wetsuits and bait material (Méliane, 2004).

INNS can cause changes in ecosystems through displacing native organisms (through predation or by competing for resources), altering the genetic pool through hybridisation and introducing exotic pathogens and parasites (Eno *et al*. 1997). The impact of INNS is generally irreversible, particularly in the marine environment where INNS can be very difficult to eradicate once established (Cefas, 2012; Williams, 2010). The number of interest features where invasive species has been reported as being implicated in unfavourable condition status is 191 for Natura 2000 features and 527 for SSSI features (Williams, 2006). However, it should be noted that these invasive species include terrestrial features such as bracken or scrub.

INNS directly or indirectly impact on livelihoods through affecting ecosystem services or sustainable use of biodiversity or through impinging on cultural and heritage values. The Millennium Assessment confirms that INNS have been one of the main drivers of biodiversity loss over the last 50 to 100 years, and assesses that the trend in the impact (at global level) will continue or increase in all biomes (UNEP 2005a; 2005b). The cost includes the loss of native species, biodiversity and ecosystem functioning, ecosystem services and livelihoods (GISP, 2007).

If marine INNS damage the abundance of native species and the ecosystem, the aesthetic quality of the environment will be affected. This may impact the tourism industry, which for example in the Seychelles, accounts for a large proportion of income. An indirect effect of INNS can also be the perceived devaluation of the natural environment when INNS are present. The resources spent on control of these INNS are driven by people's fear of losing an attractive or rare species. INNS are very expensive to get rid of once they are established. They cost some countries millions and sometimes billions of dollars in damages and eradication efforts. These significant financial costs have implications for local authority budgets and consequential knock on effects (Duncan Vaughan, Natural England, pers. comm. 2014). The main control costs that can be entirely attributed to biodiversity are those related to control of INNS for conservation purposes in protected areas and landscapes (Williams, 2010). Conservation is aimed at retaining native species or ecosystem functions in order to limit damage. This can be done, for example, by localised eradications or limiting of the spread of INNS. Costs will include the time and money spent by conservation organisations, non-governmental organisations and local authorities on the removal of INNS from the natural environment. Without management to prevent and address invasive alien species, MPAs, including ecosystem services and biodiversity, will inevitably be eroded (GISP, 2007).

In addition to possibly affecting people's livelihoods and jobs, marine invasive species can cause serious health problems. For example the bacteria that cause cholera can be carried in ships ballast water, which killed more than 10,000 people in South America (IUCN website).

Reductions in water quality affecting the conservation status of a site
Potential contamination to MPAs can arise through a number of sources, namely oil tanker accidents; rupture or leakage of marine pipelines; loading and unloading of oil in port or at offshore facilities; and operational spills from vessels engaged in construction work, or while anchored. Pollution originating from diffuse and point sources may impact negatively on marine environments, including MPAs. Oil, for example, may impact on the environment by one or more of the following mechanisms: physical smothering; chemical toxicity; ecological changes; and the loss of habitat or shelter (ITOPF website). This can have undesirable economic consequences for use and non-use values, including recreational activities, both within and outside the MPA (CARE, 2011).

The physical disturbance to MPAs and recreational pursuits from a single pollution event is usually comparatively short lived. Once the area is clean, normal trade and activity would be expected to resume, although media attention may cause disproportionate damage to the image of the MPA, aggravating economic losses by contributing to a public perception of a prolonged and wide scale pollution event. In contrast, long term and historic pollution activities can have detrimental environmental affects, affecting MPA site designation. Approximately 11% of SSSIs are in an adverse condition due to water pollution issues including agriculture/run-off and discharges (Natural England, 2014). Furthermore, the number of interest features where water quality (including siltation, water pollution (direct or diffuse), run-off, nutrient enrichment, eutrophication) has been implicated in unfavourable condition status is 145 for Natura 2000 features and 314 for SSSI features (Williams, 2006).

Establishing Significance
The review has found little evidence of significance levels of social impacts of interactions between MPAs and other MPS activities. The significance of social impacts is likely to be site specific and related to the socio-economic context. The

most significant social impact are likely to arise from direct effects on the environment within MPAs and the associated costs of implementing management measures to protect the environment, for example controlling or eradicating INNS. However, the resources spent on managing MPAs are likely to vary by location and be driven directly by the concerns of local communities and users.

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4.9 Nuclear Energy

4.9.1 Social impact of nuclear energy

This section provides a short overview of the key social impacts produced by the nuclear sector, in the absence of any specific interaction but in light of general industry trends. For the purposes of this review, the sector refers to the operation of nuclear power stations.

Income and employment

Estimates indicate that the British nuclear industry currently employs between 44,000 and 60,000 people (24,000 direct, 20,000 indirect in wider supply chain) (Horizon, 2013; EDF Energy, 2012). Nuclear new build also offers the potential employment of around 1,000 permanent jobs and a peak of 6,000 during construction (Horizon, 2013), totalling 32,500 new jobs under current generation plans (EDF Energy, 2011). In terms of the wider economy, estimates indicate that UK nuclear industries account for 0.1% of GDP (DECC, 2013) and generate exports in the region of £700m per year (Horizon, 2013). New nuclear builds could raise UK GDP by £5bn and increase exports by up to £900m (EDF Energy, 2011).

Average income levels for nuclear employees (£39,560) are higher than UK average (£25,532) and provide a higher level of skilled occupations (EDF Energy, 2011). EDF Energy (2012) indicates that wider benefits to UK industry will occur due to a steady stream of work, contracts in the future due to new power station development and would enable the supply chain to invest in capability and capacity to support the sector. In addition the literature indicates that investment in nuclear energy will have benefits in contributing to both wider economic growth and job creation and has the potential to give Britain a greater share in the export market. Given the relatively high multipliers associated with the nuclear industry, investment could boost GDP by between 0.04 and 0.34 per cent per year (equivalent to £5.1 billion in 2011) for 15 years and if capacity reached 18GW, nuclear power would account for 0.4 per cent of GDP in the operational phase.

Environment - climate change

The World Nuclear Association (2014) indicates that in 2012 a total of 363 billion TWh of electricity was produced in the UK, of this 70 TWh (19%) was generated by nuclear power sources. The literature highlights the UK Government commitment to affordable, secure and low-carbon electricity and an associated major capital investment programme to expand the UK's nuclear energy production, including 18GW by 2025 (EDF Energy, 2012).

Nuclear CBA (unknown date) estimates the annual carbon emissions reduction from investing in a GW of nuclear power is 2.5 million tonnes of CO2 (700,000 tonnes of carbon) / GW compared to investment in gas fired plant. Valuing emissions savings at a CO2 price of €36 [£25] / tonne gives a present value benefit of around £1.4 billion/ GW over forty years from nuclear new build. Investment in new nuclear power capacity will provide additional energy security compared with importing gas.
A 2013 study (Poortinga *et al.,* 2013) indicates that a significant proportion of the British population is willing to accept the building of new nuclear power stations if it would help to tackle climate change (47%) or if it would help to improve energy security (52%).

Community and fears/ aspirations

Publication by DECC (2013) indicates that the scale and duration of the impact of new nuclear power stations on their localities must be recognised and that communities benefit from the role they play as hosts. In line with recent guidance from Government 8 communities in England & Wales identified for new build could receive benefits worth up to £1000/MW over 40 years from when the stations begin operating. In the case of Hinkley Point C (Somerset) which has Government approval, could generate £128m to the area. In addition local communities can benefit from retention of up to 50% of business rates.

Research by SCARR (2008) indicates that communities close to power stations experience a degree of co-dependence in terms of employment and wider economic and community benefits (e.g. service provision) in what are often highly marginalised and peripheral areas.

In terms of public and community acceptance of nuclear power, research indicates that proximity to a power station results in increased levels of acceptability (SCARR 2008) and that this is a key issue in the feasibility and developability of new build power stations. While there is reasonable detail as to the attitudes and acceptability of nuclear power at a national level (and the level of opposition has been reducing in recent years) there is less detail as to how attitudes from host communities are changing. Research by Poortinga *et al.* (2013) indicated that a similar proportion of people supported (32%) or opposed (29%) nuclear power. The research indicated that overall support for nuclear power has increased to 32% from 26% in 2005) and levels of opposition decreased to 29% (from 35% in 2005). Perception of benefits outweighing risks of nuclear power has also shifted slightly, in support of benefits and 30% of respondents in the study felt existing stations should be replaced, although 27% indicated current stations should not be replaced.

As well as employment benefits research by EDF Energy (2011) indicated that the provision of support for local communities (through CSR and local engagement schemes) was active at all sites, operating, decommissioning and new build.

Health

While radioactive waste and discharge is highly regulated and subject to strict limits (DECC, 2009) there is discussion in the literature around the perception of areas hosting nuclear power as ‘contaminated’ even where discharge/ accidents have not occurred (SCARR, 2008). This perception can lead to wider social implications such perception of social deprivation, loss of sense of place and ill-health.

The release of radioactive material, even at levels safe to humans and the environment, is noted as undesirable in UK policy (DECC, 2009). Data however indicates that rates of total radioactive discharge into water have been falling since 2002.

4.9.2 Social impacts of changes in the nuclear energy sector arising from marine sector interactions

Interactions and impacts – summary table

The potential interactions between MPS marine sectors and the nuclear power sector are shown in Table 22. This table was compiled based on an in initial review of key studies in which potential interactions between marine sectors have been proposed or described an additional grey and peer-reviewed literature search and through consultation with stakeholders. Any available evidence detailing the occurrence of these potential marine sector interactions, consequences and subsequent social impacts are described after the table.

Establishing significance

Given the issues of energy security and impacts of climate change on social welfare the likely social impacts from nuclear power, as a result of interactions with other marine sectors, are likely to result in ‘all or nothing’ scenarios. Due to the scale of infrastructure investment in new nuclear build and the associated safety requirements, negative interactions will be identified either before a new power station is built thus preventing the development proceeding or the interaction is mitigated and therefore not allowed to occur as the costs and implications would be too significant.

Table 22: Nuclear energy interaction-impact table.
Key: H/M/L = High Medium Low - Representing: **[strength of the evidence that the impact can occur**; **judgement on the significance of the impact as presented in the literature]**

Issue	Interaction	Consequence	Social Impact	
			Primary	Secondary
Competition for space	Restrictions on water abstraction activities	Termination of nuclear power generation	Reduction in future employment opportunities **[L,H]**	Reduction in future employment opportunities in downstream sectors **[M,H]**
			Increase in net carbon emissions and the social costs of climate change **[L,H]**	
	Restrictions on cooling water discharge activities (e.g. restrictions on use of certain antifouling agents, corrosion inhibitors)	Increased operating costs	Reduction in income and employment **[L,H]**	
		Termination of nuclear power generation	Reduction in future employment opportunities **[L,H]**	Reduction in future employment opportunities in downstream sectors **[L,H]**
			Increase in net carbon emissions and the social costs of climate change **[L,H]**	

4.9.3 Nuclear Energy References

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4.10 Offshore Renewables

4.10.1 Social impact of offshore renewables

This section provides a short overview of the key social impacts produced by the offshore renewable energy sector, in the absence of any specific interaction but in light of general industry trends. For the purposes of this review the sector includes consideration of offshore wind, wave and tidal energy production as well as offshore electricity networks.

A review has highlighted a limited base of literature relating to social implications of offshore renewable energy generation and associated electricity networks. Certainly social science research relating to marine energy has not to date been a key priority of researchers or the sector in general (Kerr *et al.*, 2013). Emphasis is more often placed on social acceptance, technological development and environmental impacts of the sector on other sectors/users (Wind Energy the Facts, date unknown).

Income and employment and community

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 (EWEA, 2007 and 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.*, 2013). Impacts of employment (split between manufacturing, installation and operation/ maintenance phases) are also anticipated to be experienced on-shore (Johnson *et al.*, 2013). In addition, it is estimated that £8.8bn of investment is required to facilitate the reinforcement of transmission networks to support offshore connections (ENSG, 2012; National Audit Office, 2012).

Benefits of economic development and revitalisation of declining communities is also noted in the literature. Johnson, *et al.* (2013) note 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/peripheral locations (Cowell *et al.*, 2012; Johnson *et al.*, 2013).

Environment - climate change and energy security

The contribution of offshore renewable energy to support wider social benefits of both improved energy security and reduced greenhouse gas emissions from energy generation are clearly set out in literature (e.g. Johnson *et al.*, 2013; Ison, date unknown). Linked to this is the provision of and connection to the electricity network which provides security of supply (Offshore Grid, 2011). The social cost of carbon can be captured and a monetary value applied using techniques as set out by Government guidance (HM Treasury, 2011), therefore the value of a reduction in carbon emissions can be presented and shown as a social benefit. A social benefit in terms of increased consumer choice for household energy supply is also highlighted, with particular benefit to low income and disadvantaged households (Mowatt, 2013).

A key requirement of developing and utilising offshore renewable energy is connection and access to the transmission network to enable lower carbon energy generation to take place (EAEA, 2010; ENSG, 2012; National Audit Office, 2012). Research by OECD/ IEA (2013) highlights the importance of transmission networks in terms of their impact on cost efficiency and reliability of energy generation and the subsequent impact on extent of decarbonisation of energy generation.

Community – services

The limited extent of social research is reflected in that positive and negative impacts for communities close to marine renewable are still poorly understood (Kerr *et al.*, 2013). However available discussions do also note that there is growing interest in the analysis of public reactions and perceptions associated with offshore wind power, though empirical evidence is limited (Wind Energy The Facts, date unknown). Competition between users of space (access to coast/ sea space) also has the potential for social impact, creating negative social relations between users and restricting community benefits generally due to limited access (EWEA, 2007; Kerr *et al.*, 2013). The provision of community facilities have been outlined as a potential social benefit resulting from new renewable energy developments. Developers have in the past been willing to provide community facilities to counter the issue of using a public good (e.g. wind and sea access) to generate private profit (Johnson *et al.* 2013). However discussion by Johnson *et al.* (2013) and Cowell *et al.* (2012) both note the difficulties capturing this type of scheme benefit for communities due to the specialist complexities of installation, operation and maintenance of offshore development. The provision of direct payments are more easily captured; however due to the offshore and remote nature of the installations, developers often see less incentive to support such schemes. Community benefit schemes are however noted as an important tool to help address social injustice in disadvantaged areas (Cowell *et al.*, 2012).

Development of a critical mass of economic activity associated with marine renewables in remote rural/ peripheral areas provides an opportunity for improved service provision, thus allowing local people to benefit from additional services. This can be supported by in-migration to take up employment and a reduction in youth out-migration, as demonstrated by the development of the oil and gas sector in the Scottish Islands during the 1970s (Johnson *et al.*, 2013).

4.10.2 Social impacts of changes in the Offshore Renewables sector arising from marine sector interactions

Interactions and impacts – summary table

The potential interactions between MPS marine sectors and the offshore renewable/ electricity networks sectors are shown in Table 23. This table was compiled based on an in initial review of key studies in which potential interactions between marine sectors have been proposed or described (e.g. Marine Scotland, 2013a; Marine Scotland, 2013b; MMO, in prep), an additional grey and peer-reviewed literature search and through consultation with stakeholders. Any available evidence detailing the occurrence of these potential marine sector interactions, consequences and subsequent social impacts are described after the table.

The table illustrates how different types of interaction may affect the goods and services associated with that sector's activity and in turn the primary and secondary social impacts that it creates. The interaction table focus on the activity being affected rather than the intricacies of how different activities create the interactions; that is a 'generic typology. The table include an indication of social impacts, included where the 'interaction' literature review has identified them.

Potential social impacts – supporting literature review

As with social impacts of offshore renewables, the literature discussion setting out interactions with other sectors is also limited. It is focused on interactions with other sectors restricting or constraining development (potential or actual) of new renewable energy offshore installations.

Activity of offshore renewable energy developments and other marine sectors primarily generate issues that are the result of completion for space, land or resources. Interactions with other sectors such as competition for land or sea area result in constraining new offshore renewable development which in turn results in social impacts in the form of loss of potential future employment. By constraining development (potential reasons outlined in table below the resulting limit to investment and reduced operational capacity are issues raised in the literature reviewed, although in limited detail as to the size/significance of the impact on future employment (EWEA, 2007; Natural Power, 2011). Literature surrounding electricity networks/ transmission connection also picks up on the critical issue of lost capacity due to insufficient network connections, with grid connections required to enable the UK to meet 15% renewable generation targets by 2020 (National Audit Office, 2012; ENSG, 2012). Social impact of employment due to the interactions with other sectors, as noted in the table, must also be considered in the context of wider issues such as politics, policy, licensing, business decisions, etc. As Kerr *et al.* (2013) noted there is a shortfall in reliable employment data relating to marine renewable energy development.

Table 23: **Offshore renewable energy interaction-impact table.**
Key: H/M/L = High Medium Low - Representing: **[strength of the evidence that the impact can occur**; **judgement on the significance of the impact as presented in the literature]**

Issue	Interaction	Consequence	Social Impact	
			Primary	Secondary
Competition for space	Exclusion from sea area / restriction on size of developments	Development constrained (reduced renewable energy capacity)	Reduction in future employment opportunities **[M,H]**	
			Potential negative impact in relation to climate change **[M,H]**, and social costs of climate change **[L,H]**	
		Lack of investment in sector	Reduction in future employment opportunities **[M,H]**	
			Reduction in future community projects funded by developers **[M,M]**	
	Delays to operation or maintenance through the presence of other sector vessels	Reduced operational efficiency	Increased social tension **[L,L]**	
	Damage to infrastructure (impact to devices – primarily more of an issue for wave and tidal stream technologies)	Increased costs to sector – may deter investment in sector or make future developments unviable (as a result of increased costs)	Reduction in future employment opportunities **[L,H]**	
	Competition for transmission capacity	Reduced renewable energy capacity (or reduced energy output from other energy sources due to displacement by renewables)	Reduction in future employment opportunities **[M,H]**	

Issue	Interaction	Consequence	Social Impact	
			Primary	Secondary
	Obstruction of potential cable routes	Increased cost as a result of cable crossings or re-routing cables leading to a decrease in profitability	Reduction in future employment opportunities **[L,H]**	Reduction in future income **[L,H]**
	Increased difficulty of access at crossing points	Increased maintenance costs leading to a decrease in profitability	Reduction in employment **[L,H]**	Reduction in income **[L,H]**
		Increased maintenance costs leading to a lack of investment in sector	Reduction in future employment opportunities **[L,H]**	Reduction in future employment opportunities in downstream sectors **[L,H]**
Increase in vessel traffic	Increased vessel traffic	Increased collision risk of maintenance vessels (vessel to vessel)	Increased risk to safety **[L,L]**	Increased risk of environmental pollution (e.g. oil spill) **[L,M]**
Infrastructure	Interference with navigational equipment	Increased collision risk of maintenance vessels	Increased risk to safety **[L,L]**	Increased risk of environmental pollution (e.g. oil spill) **[L,M]**
	Presence of infrastructure	Increased collision risk of maintenance vessels (vessel to infrastructure)	Increased risk to safety **[L,L]**	Increased risk of environmental pollution (e.g. oil spill) **[L,M]**
		Increased steaming distances/time, leading to increased maintenance costs	Reduction in future employment opportunities **[L,H]**	Reduction in future income **[L,L]**
Competition	Competition with other	Development constrained	Reduction in future employment	

Issue	Interaction	Consequence	Social Impact	
			Primary	Secondary
for resources	industrial sectors for equipment and materials to develop new assets (e.g. copper, cables, skills)	(reduced capacity)	opportunities/ potential**[L,H]**	
			Potential negative impact in relation to climate change and social costs of climate change **[L,H]**	
Competition for land & access	Competition for suitably located land to assemble assets close to port/ access to ports of suitable size	Development constrained (reduced capacity)	Reduction in future employment opportunities/ potential **[L,H]**	
			Potential negative impact in relation to climate change and social costs of climate change **[L,H]**	

Environment – climate change
Interactions with other sectors as a result of: new development being excluded from sea areas, or competition for land and materials which results in new development being constrained or limited in capacity/ size, can have social impacts in relation to loss of carbon reduction. Evidence suggests that offshore wind can save 536g of carbon dioxide per kWh of electricity generated (E.ON Climate and Renewables, 2010).

Establishing significance
Evidence relating to offshore renewables in Scotland highlights the importance of distributional effects (variation by location and groups in society) in determining the significance level of impacts (Scottish Government, 2013; Cowell *et al.,* 2012). Research indicates that social impacts at a regional would not be noticeable by the majority of groups and at a national level impacts are not anticipated.

A review has found little tangible evidence of significance levels of social impacts relating to offshore renewable/ networks. The majority of research is still concerned with scoping and researching the nature of social implications of the sector (as discussed previously). However the inference taken from the available literature indicates the key factors that will determine the significant:

1. Location/spatial: the significance of impacts will vary depending upon the spatially-specific nature of development. If location is a driving factor (e.g. tidal power) whereby conflict and completion for space with other sectors (e.g. shipping) is strong then implications for social impacts are likely to be stronger. In areas where development is far less constrained/ driven by locational need, then significance would be expected to be lower.
2. Context: the socio-economic context in which development takes place will be a key factor determining significance of impacts. That is development potential in areas of high deprivation, out-migration and unemployment will have more significance than in prosperous areas. In addition, wider political and public context (in the form of support) will have a bearing on significance levels.
3. Network connection: the capacity and accessibility of offshore sites to the electricity network is a key issue in terms of social impacts in relation to constraining development thus reducing all social benefits including employment and carbon reduction.

In the future, as more evidence is available, the understanding of the relative significance of some interactions may change.

4.10.3 Offshore Renewables References

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4.11 Oil and Gas

4.11.1 Social impact of oil and gas

Income and employment

The contribution of the oil and gas sector to the UK economy is a central reference in the majority of the literature. The level and value of employment and ongoing growth/ demand for skilled employees are key social benefits noted throughout the literature (Aberdeen & Grampian Chamber of Commerce, 2012; UNBC, 2005; Oil & Gas UK, 2013). Employment is estimated to be in the region of 450,000 employees including 36,000 direct jobs (12,500 offshore), 200,000 in the supply chain, a further 100,000 induced jobs and 100,000 in relation to exporting products (Oil & Gas UK 2013).

The salary levels and value of the employment in the oil and gas sector is a key social impact identified in the literature (AGCoC, 2012). Average salaries in the Aberdeen area are noted as being significantly higher (at £64,000pa) than the national average (c£25,000pa) and this above average trend is also reflected in higher levels of pay rises (c5-12% for the industry compared to 1.5% nationally). Demand for employment remains high, supporting above average salaries and higher levels of pay increases as the sector competes, internally and externally, for suitably skilled employees. The higher grade and higher paid nature of oil and gas employment is noted as a key wider social benefit for a locality (UNBC, 2005).

Evidence comparing population and unemployment levels in Shetland from 1970 to the present day (around 2% unemployment rate) indicates a strong rate of retention of permanent employment and jobs created (Johnson *et al.,* 2013).

Some of the literature (UNBC, 2005; DECC, 2013) points to wider social benefits arising from oil and gas sector operation in the form of economic diversification and supply chain development. The operational needs of the sector enable the development of upstream and downstream industry to support the sector. This provides additional employment (as noted above) as well as broadening the employment base in a locality. The expectation of benefits to local enterprise from new drilling sites is noted in the literature as a key social benefit anticipated by local communities (Cairn Energy, 2010).

Another key social impact arising from oil and gas sector is the contribution to the UK's Balance of Payments (c£32bn in 2012) and the largest contributor to GVA of all industrial sectors (Oil and Gas, 2013). Significantly the literature highlights that the sector generated £6.5bn of tax in 2012/13, with a further £5bn generated through related supply chain industries which support and facilitate the operation of the oil and gas sector (Oil and Gas, 2013).

Environment - energy security

The contribution of the oil and gas sector to ensure energy security for the UK is clearly set out as a social benefit in the literature (Defra, 2010; Oil and Gas, 2013). Defra indicated that in 2008 the sector covered two thirds of the UK primary power demand and by 2020 will still cover 50% of this demand.

Community – services

Literature makes reference to an absence of a systematic review or assessment of the community and wider social impacts of North Sea extraction in recent years (UNBC, 2005). Consideration was given to community impacts at the early stages of exploration but subsequent follow up and research has been lacking.

At the outset of oil and gas exploration in the Scottish Islands steps were taken by the local council to control and mitigate possible social impacts (such as loss of sense of place, in-migration, maintenance of traditional industries, etc.). Powers were granted by Westminster (Orkney County Council Act 1974 and Zetland County Council Act 1974) to enable the local area to share in the new exploration developments, and subsequent benefits (e.g. share of revenue, investment in new infrastructure). The local community, through the Council, gained powers to control oil and gas development, generate revenues from rents/rates to reinvest back into the local area. As of 2012 the established Council 'Oil Reserve Fund' amounted to £200m, earmarked for grants and loans to support infrastructure, good and service provision for the benefit of the local community (Johnson *et al.* 2013). As a result of the fund the Council has taken a sustainable view to ensure social impacts are positive for the community in the medium-term though provision of new business development.

Development of a critical mass of economic activity associated with offshore oil and gas extraction in remote rural/ peripheral areas provided an opportunity for improved service provision, thus allowing local people to benefit from additional services. This is supported by in-migration to take up employment and reduction in youth out-migration, as demonstrated by the development of oil and gas sector in the Scottish Islands during the 1970s (Johnson *et al.,* 2013).

4.11.2 Social impacts of changes in the oil and gas sector arising from marine sector interactions

Interactions and impacts – summary table

The potential interactions between MPS marine sectors and the oil and gas sector are shown in Table 24. This table was compiled based on an in initial review of key studies in which potential interactions between marine sectors have been proposed or described (e.g. Marine Scotland, 2013a; Marine Scotland, 2013b; MMO, in prep), an additional grey and peer-reviewed literature search and through consultation with stakeholders. Any available evidence detailing the occurrence of these potential marine sector interactions, consequences and subsequent social impacts are described after the table.

The table illustrates how different types of interaction may affect the goods and services associated with that sector's activity and in turn the primary and secondary social impacts that it creates. The interaction tables focus on the activity being affected rather than the intricacies of how different activities create the interactions; that is a 'generic typology. The table include an indication of social impacts, included where the 'interaction' literature review has identified them.

Table 24: Oil and gas interaction-impact table.
Key: H/M/L = High Medium Low - Representing: **[strength of the evidence that the impact can occur**; **judgement on the significance of the impact as presented in the literature]**

Issue	Interaction	Consequence	Social Impact	
			Primary	Secondary
Competition for space	Obstruction of potential pipeline routes	Increased cost as a result of re-routing pipelines or cable/pipeline crossings leading to a decrease in profitability	Reduction in future employment opportunities **[L,M]**	Reduction in future income **[L,M]**
			Potential positive impact in relation to natural resources and climate change **[L,H]**	
		Increased cost as a result of re-routing pipelines or cable/pipeline crossings leading to a lack of investment in sector	Change in future employment opportunities **[L,H]**	Reduction in future employment opportunities in downstream sectors **[L,H]**
	Increased difficulty of access at crossing points	Increased maintenance costs leading to a decrease in profitability	Reduction in future employment opportunities **[L,H]**	
		Increased maintenance costs leading to a lack of investment in sector	Reduction in future employment opportunities **[L,H]**	Reduction in future employment opportunities in downstream sectors **[L,H]**
	Obstruction/delays of oil tanker routes	Increased steaming distances/time, leading to increased costs and reduced revenue	Reduction in future employment opportunities **[L,H]**	Reduction in income **[L,M]**
	Restricted access to seafloor	Increased cost as a result of restrictions on platform construction leading to a decrease in profitability	Reduction in future employment opportunities **[L,H]**	Reduction in income **[L,M]**
			Potential positive impact in	

Issue	Interaction	Consequence	Social Impact	
			Primary	**Secondary**
			relation to natural resources and climate change **[L,H]**	
		Increased cost as a result of restrictions on platform construction leading to a lack of investment in sector	Reduction in future employment opportunities **[L,H]**	Reduction in future employment opportunities in downstream sectors **[L,M]**
	Restriction on exploration activities	Decrease in new oil and gas discoveries	Reduction in future employment opportunities **[L,H]**	Reduction in income; Reduction in future employment opportunities in downstream sectors **[L,H]**
			Potential positive impact in relation to natural resources and climate change **[L,H]**	
Increase in vessel traffic	Increased vessel traffic	Increased collision risk of maintenance vessels (vessel to vessel)	Increased safety fears and health impacts **[L,L]**	Increased risk of environmental pollution (e.g. oil spill); **[L,M]** Increased social tension **[L,L]**
Infrastructure	Interference with navigational equipment	Increased collision risk of maintenance vessels	Increased safety fears and health impacts**[L,L]**	Increased risk of environmental pollution (e.g. oil spill); **[L,M]** Increased social tension **[L,L]**
	Presence of infrastructure	Increased collision risk of maintenance vessels (vessel to infrastructure)	Increased safety fears and health impacts**[L,L]**	Increased risk of environmental pollution (e.g. oil spill); **[L,M]** Increased social tension **[L,L]**
		Increased steaming distances/time, leading to increased maintenance	Reduction in future employment opportunities **[L,M]**	Reduction in income; Reduction in future employment opportunities in

Issue	Interaction	Consequence	Social Impact	
			Primary	Secondary
		costs		downstream sectors **[L,M]**
Competition for resources	Competition with other industrial sectors for skilled staff/ equipment and materials to develop/ maintain assets.	Production and future exploration constrained (reduced capacity)	Reduction in future employment opportunities/ potential **[M,M]**	
			Potential negative impact in relation to climate change **[L,M]**	Social cost of climate change **[L,H]**
Competition for land & access	Competition for suitably located land to support the offshore activity and port/air access to facilitate offshore operation.	Production and future exploration constrained (reduced capacity)	Reduction in future employment opportunities/ potential **[M,M]**	
			Potential negative impact in relation to climate change (Environmental impact) **[L,M]**	Social cost of climate change **[L,H]**

Potential social impacts – supporting literature review
The literature discussion setting out interactions between oil and gas with other sectors is rather limited. It is focused on interactions with other sectors restricting or constraining development due to limited resources or completion for space. Details relating to interactions as a result and for operational activity appear to be limited.

Income and employment
Competition for resources to support and facilitate oil and gas operations is a key issue for the sector in its interactions with other sectors, most specifically in terms of availability of skilled employees. Interactions with other manufacturing/ industrial sectors requiring similar skill sets (project management, engineering, etc.) could result in reduced production capacity or constrain new exploration and development which in turn would result in social impacts in the form of loss of employment/ economic productivity (AGCoC, 2012).

Access to infrastructure (e.g. pipelines) is a constraining factor due to interactions with other sectors and within the sector. DECC (2013) has outlined a clear process for accessing infrastructure to unlock reserves and an associated dispute resolution function to facilitate the process if required to ensure access to up/ downstream infrastructure.

Establishing significance
A review has found little tangible evidence of significance levels of social impacts relating to oil and gas. However the inference taken from what literature is available indicates that management of resources/ operation mechanisms to facilitate the capture and distribution of benefits in a locality will contribute to the determination of the significance of social impacts.

In the future, as more evidence is available, the understanding of the relative significance of some interactions may change.

4.11.3 Oil and Gas References

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4.12 Ports, Dredging and Disposal

4.12.1 Social impacts of ports, dredging and disposal

This section provides a short overview of the key social impacts generated by the ports, dredging and disposal sector, in the absence of any specific interaction. 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 in and are often commensurate with port areas (Marine Scotland, 2013). Ports and harbours may support additional sector activity, for example, the fishing industry, provision of facilities for the offshore Oil and Gas industry, maintenance of ferry links and provision of the recreational sector with support services. For the purposes of this study, all port and harbour installations have been considered, irrespective of whether they are part of a formal Harbour Area, established and defined under a Special Act of Parliament, or a pier/slipway in public or private ownership. There is an intrinsic link between ports, harbours and commercial shipping, however the interactions and issues in relation to shipping are often distinctly different and hence these interactions have been considered within a separate interaction table (Section 4).

The operation of ports and marinas requires dredging and the disposal of the marine sediment. Applications for dredge licences are overseen by the MMO who also licence specific disposal sites using scientific advice provided by the Centre for Environment, Fisheries and Aquaculture Science (Cefas). In relation to port and harbour activities, there are two types of (non-aggregate) dredging licensed by the MMO; capital dredging and maintenance dredging. Capital dredging is the removal of material to create a greater water depth than had previously existed. Maintenance dredging is required to maintain water depths in areas where sedimentation occurs and is a routine activity required for the preservation of navigable depths (MMO, 2011).

This sector also includes the disposal of material, dredged from ports, harbours and marinas, into the marine environment (this type of waste disposal is only allowed where the material cannot be used beneficially, for example to replenish beaches or in construction projects) (Marine Scotland, 2013).

Income and employment

Around 95% of international goods to and from the UK go by sea, so ports play a vital role in the UK economy (DfT, 2005). In total there are more than 650 ports in the UK for which statutory harbour authorities have been granted, of which 120 are commercially active (DfT, 2005). The sector is diverse ranging from major ports such as London and Liverpool, which carry out a number of functions, to specialised ports such as Dover which is a ferry port, specialised container ports such as Felixstowe and smaller ports catering for local traffic or for particular sectors such as fishing (e.g. Brixham) and leisure (e.g. Cowes).

Ports are substantial employers themselves and generate and facilitate economic activity in trade related sectors. A report prepared by Oxford Economics (2009) estimated that UK ports contributed £7.7 billion GVA in 2007, whilst the number of people directly employed by ports in 2007 was 132,000 (Oxford Economics, 2009). By 2011, these values equated to £7.9 billion GVA and 117,200 people directly employed in the ports sector (Oxford Economics, 2013). About half of these jobs were in transport or transport related activities with another 15% employed in cargo handling and storage and 10% in maritime insurance and related activities. Those indirectly employed in 2011 were 166,800 people in port supply chains and 107,800 jobs owed to the consumer spending of port staff and those directly employed in the supply chain. Therefore, in total the UK ports sector was estimated, in 2011, to have supported 391,800 jobs which is 1.3% of all employment in the UK (Oxford Economics, 2013). The equivalent statistics for England alone in 2011 equated to £4.8 billion direct GVA and 75,800 directly employed, £7.0 billion indirect GVA and 144,000 indirectly employed and £4.4 billion induced GVA and 91,100 employed due to consumer spending. Therefore, in total the English ports sector was estimated, in 2011, to have provided £16.2 billion GVA and supported 310,800 total jobs (Oxford Economics, 2013).

Ports enable a range of industries to function, including the UK marine aggregate dredging fleet, the cruise industry and the offshore oil and gas industry which is supplied through ports. In 2007 there were 6,670 fishing vessels working out of UK ports. Some recreation facilities are also provided by ports for watersports and in addition nearly 3,000 people were employed in museums in ports in 2007 (Oxford Economics, 2009). Large numbers of these are employed in Liverpool and Portsmouth, which have a number of museums and historical ships. Other employees include an estimated 2,175 staff of the UK Border Agency, employed in border control and migration (UKMMAS, 2010). Ports are also essential to facilitate emerging industries such as renewable energy development. Such developments create business for installation and maintenance vessels and supply chain bases at ports (DfT, 2012; DECC, 2009).

The impacts of the ports sector vary across countries and regions. The East and the Southeast of England have the greatest contribution to GVA and employment in the ports sector, with the distribution of employment displaying a similar pattern to the distribution of total freight handled in the UK (Oxford Economics, 2013). Ports are often located in deprived areas and thus the provision of job opportunities is of particular importance (ABP pers. comm., 2014).

Many port and harbour authorities operate under Local Acts which empower them to undertake dredging works within the limits of their jurisdiction. This means that centralised statistics that reflect the extent of dredging in the UK are not available. However, the disposal of 43 million tonnes of dredged material (wet weight) was licensed in 2007. The majority of this relates to maintenance dredging (UKMMAS, 2010). Without the ability to undertake maintenance dredging and disposal activities, it is very likely that ports, harbours and marinas would be unable to operate (ABP, pers. comm., 2014).

Community and culture

The distribution of commercial ports in the UK (and hence value) reflects the historical importance of certain areas for trade, which would have been based on prosperity, population and the presence of inland trade networks supporting demand. For example, London has been an important trading city for centuries. In addition, the northeast of the UK is close to Scandinavian shipping routes and as part of the previous industrial heartland of the UK has significant port activity, which has been sustained to date (UKMMAS, 2010).

Within each region there are non-commercial ports which may also contribute significantly to the local economy and have historical importance. Of the non-commercial ports, Devonport is the largest Naval Base in Western Europe. It covers over 650 acres and has 15 dry docks, four miles of waterfront, 25 tidal berths and five basins (UKMMAS, 2010).

Environment

Port operations emit currently unquantified amounts of greenhouse gases, which contribute to climate change. One important contributor is ships' running generators while in port (UKMMAS, 2010).

4.12.2 Social impacts of changes in the Ports, Dredging and Disposal sector arising from marine sector interactions

Interactions and impacts – summary table

The potential interactions between MPS activities and the ports, dredging and disposal sector are shown in Table 25. This table was compiled based on a review of key studies in which potential interactions between marine sectors have been proposed or described (e.g. Marine Scotland, 2012), an additional grey and peer-reviewed literature search, and through consultation with Associated British Ports. Any available evidence detailing the occurrence of these potential marine sector interactions, consequences and subsequent social impacts are described after the table.

Table 25: Ports, dredging and disposal interactions-impact table.
Key: H/M/L = High Medium Low - Representing: **[strength of the evidence that the impact can occur**; **judgement on the significance of the impact as presented in the literature]**

Issue	Interaction	Consequence	Social Impact	
			Primary	Secondary
Competition for space	Obstruction or displacement of maintained navigation channel(s) or approaches	Loss of customers (trade) and revenue (reduction in commercial competitiveness); Increased costs to sector associated with maintaining alternative routes.	Reduction in income **[L,M]**	Change in employment **[L,M]** Reduction in health **[L,L]**
	Obstruction to navigation routes	Loss of customers (trade) and revenue (reduction commercial competitiveness).	Reduction in income **[L,M]**	Change in employment **[L,M]**
	Reduced development opportunities	Loss of customers and revenue (long term); Increased costs to sector associated with development	Reduction in future income and employment opportunities **[L,L]**	
	Loss or reduced use of dredge material disposal sites	Increased costs of disposal	Reduction in income **[L,L]**	Change in employment **[L,L]**
Expansion of sector (wind farm, oil and gas, leisure - moorings, tourism – cruise terminal, shipping – larger vessels)	Increase demand for port capacity	Expansion of ports and associated navigation channels	Increase in employment **[M,H]** Change in culture (e.g. from fishing port to servicing wind farms) **[L,L]** Disturbance to natural environment (increased	

Issue	Interaction	Consequence	Social Impact	
			Primary	Secondary
			vessel traffic and dredge/disposal activity) **[L,L]** Increased community tension (increased noise/traffic movement) **[L,L]**	
Increased vessel traffic	Increased vessel interactions	Increased collision risk (vessel to vessel)	Increased safety fears and health impacts **[L,L]**	Impact on community and cultural stability **[L,L]**

Potential social impacts of interactions – supporting literature review
The following review identifies evidence of the occurrence of these interactions and the social impacts that may arise as a consequence where such evidence was available. Where specific evidence of primary and/or secondary social impacts arising from changes in employment level within this sector were found, they are described below. However, it can be noted that unemployment can be detrimental to individual identity and social status, physical and mental health, as well as a key cause of deprivation, weak social capital and community cohesion (see Section 1).

Competition for space - Restrictions on maintained navigation channels
Developments (for example wind, wave and tidal arrays plus their associated cable corridors) may cause obstruction to maintained navigation channels and approaches leading to port and harbour facilities. This may result in increased steaming time or the use of alternative routes with the potential that port and harbour facilities may become unattractive and/or affect commercial competitiveness. This could occur where port and harbour maintained navigation channels and proposed development areas / cable routes spatially overlap. Cable and pipeline corridors affect maintained navigation channels during the process of laying cables/pipelines, with a temporary increase in collision risk and/or a requirement to avoid areas of work to reduce the risk of marine incidents (Marine Scotland, 2013). They may also affect the ability of port authorities to deepen navigation channels. For example, ABP Southampton had to amend their capital dredging works within Southampton Water to exclude any dredging (deepening or widening) within 150m of a pipeline which crosses Southampton Water between the ExxonMobil Marine Oil Terminal at Fawley and BP in Hamble (ABPmer, 2008).

Constraints on navigational channels and the inability to dredge has clear and critical implications for the future development of the Ports sector. For example, the failure to accommodate deep-sea shipping at the Port of Southampton may have potential knock-on effects on the Port's strategic locational advantage. In the short term, ports which are unable to offer sufficiently deep water or a tidal access window may experience increased vessel delays and congestion, incurring additional costs to the shipping lines. Cargo owners and shipping companies which find marine access constrained at a port for any sustained length of time may seek alternative ports, not only within the UK but possibly also mainland Europe that can accommodate their current and future needs (ABP, pers. comm., 2014).

In 2011, ABP commissioned Drewry Shipping Consultants to consider the market scenario that would face the Port of Southampton should two major capital projects be refused consent. Although the report relates to the Port of Southampton, the consequences are predicted to be similar for other ports, harbours and marinas. The report concluded that by not maintaining the current maintenance dredge regime (or indeed restricting future development opportunities) the commercial reality is that customers would seek an alternative port where no such restrictions applied. Ports which cannot adapt to the requirements of customers who are operating within the global market place, and cannot, therefore, provide the required levels of service, may cease to be commercially cost effective ports of call. Ultimately, the inability of a port to be able to properly service the needs of its customers may lead to a decline in the commercial attractiveness of that port with the consequent loss of trade. This may lead to stagnation of a port and affect direct and indirect employment and commerce in the local community and the wider region. The potential for future private investment (both within the port and port related organisations such as terminal operators, rail freight operators, transport companies and the general marine supplies sector) may also reduce as investors are no longer prepared to invest in the port or locality. In addition, the port would increasingly only be able to accommodate the smaller ageing vessels, with less efficient propulsion systems and generally higher emissions than newer vessels, thus reducing the general environmental quality of the port and local environment (ABP, pers. comm., 2014).

Competition for space – Obstruction to navigation routes
The impacts on the shipping sector from the obstruction or displacement of navigation routes is discussed in detail in Section 4. However, due to the consequential impacts of the obstruction of navigation routes on ports this interaction is also noted here.

Peel Ports, for example, are concerned about the increasing constraints on navigation routes, as a result of continued offshore windfarm development and cable laying, with the potential to undermine the commercial viability of the Port of Heysham. Concerns from Peel Ports include fears that the extension of the Walney wind farm will prejudice navigational safety arising through shipping diversions (IPC, 2010).

No specific evidence could be found on the social impacts of the obstruction to navigation routes on the port, dredging and disposal sector. However, as mentioned above, the inability of a port to be able to properly service the needs of its customers, by providing safe navigation channels, may lead to a decline in the commercial attractiveness of that port with the consequent loss of trade.

Competition for space: Reduced development opportunities
Designation of Marine Protected Areas (MPAs) may potentially restrict new or existing port developments due to the additional costs of management measures to support achievement of conservation objectives (JNCC and Natural England, 2011a; c cited in Finding Sanctuary, Irish Seas Conservation Zones, Net Gain and Balanced Seas, 2012).

During the Marine Conservation Zone (MCZ) review process a number of port and harbour operators were also concerned that the presence of an MCZ in proximity to planned port activity may deter commercial investment (Portland Port, pers. comm., 2012). Costs to the economy could be incurred through lost commercial opportunity and therefore in increased efforts to try and attract commercial investment (cited in Finding Sanctuary, Irish Seas Conservation Zones, Net Gain and Balanced Seas, 2012).

No specific evidence could be found on the social impacts of reduced development opportunities on the port, dredging and disposal sector.

Competition for space: Loss or reduced use of dredge material disposal sites
Potential negative impacts on waste disposal may occur through the loss or reduced use of dredge material disposal sites causing increased disposal costs as a direct result of displacement by developments such as wind farm arrays. Potential negative

impacts on waste disposal may also occur through arrays increasing the cost of disposal through the disruption of access to disposal sites (increasing fuel and staff costs). These displacements would have knock-on effects on nearby ports, harbours and marinas should a nearby disposal site be closed (Marine Scotland, 2013). However, it is also noted that not all disposal sites are in use in any one year, and thus the most optimal disposal sites may simply receive a higher volume of dredged material (Defra and Marine Scotland, 2012).

No specific evidence could be found on the social impacts of the loss or reduced use of dredge disposal sites on the port, dredging and disposal sector.

Increased demand for port capacity:
A number of MPS activities have the potential to impact positively on the ports sector by allowing the opportunity for increased business and expansion. The interactions of specific sectors on ports, dredging and disposal are discussed below.

Offshore renewables

Harbour Authorities responding to consultation [for project 4126 – interactions with offshore renewable energy] (Orkney Harbour Authority, Shetland Islands Council Harbour Authority, Scrabster Harbour Authority, etc.) expressed interest in seeking to offer port services to the renewable industry (Marine Scotland, 2013). They saw the development of marine renewables in a positive light by providing an opportunity for increased business developments (Marine Scotland, 2013).

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 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 (Marine Scotland, 2012).

The relationship with offshore energy is mainly a synergistic one. The offshore energy industries depend on ports and shipping for the import and export of energy supplies, and for servicing the offshore installations. Traditionally this has been oil and gas, but more recently importing biomass for new power stations constructed on or near port sites has increased significantly. The offshore wind industry requires port facilities and nearby construction areas for the manufacture of turbines and associated structures if the industry is to be home grown. This would in some cases require extra capacity and deeper berths so this is likely to drive port expansion plans in some locations (MMO, 2011).

A few examples of recent granted and proposed port expansions in relation to offshore wind farm developments are listed below.

Associated British Ports (ABP) and Siemens plc (“Siemens”) received consents in 2012 for the construction of a new terminal and facility for use by Siemens at the Port of Hull known as Green Port Hull (GPH). The facility will be used for the manufacture, assembly, testing and shipment of wind turbines for the offshore wind power industry (URS Scott Wilson, 2011). The construction of GPH is estimated to directly create approximately 345 – 445 jobs, whilst upon opening the proposed development will create approximately 700 - 800 jobs. Approximately 1,020 -1,230 jobs are estimated to be generated during the operation of GPH. In addition indirect employment opportunities are expected to be generated in a range of occupations (URS Scott Wilson, 2011).

Able UK Ltd (Able) is proposing to construct the Able Marine Energy Park (AMEP) which will incorporate a new quay together with manufacturing facilities for offshore wind turbines on the south bank of the Humber Estuary. The MEP comprises a harbour development on the south bank of the Humber, with associated land development, to serve the renewable energy sector. In the short to medium term, the facility will primarily serve the emerging renewable energy sector by providing a base for the pre-assembly and construction of wind farm components, and for installation vessels. Once construction of the offshore wind farms is complete, the harbour will provide a facility from which to operate, monitor and maintain offshore wind farms. The harbour will be designed with sufficient flexibility so that it is well placed to respond to market demands in the long term, after wind farm development is complete, providing continuing benefit to the UK economy (ERM, 2011). It is estimated that the construction of the AMEP will create approximately 260 full time equivalent (FTE) jobs whilst the completed project will create around 4,100 direct FTE jobs on the site related to manufacturing of marine energy components and 5,000 direct FTE jobs in the Yorkshire and Humber region and elsewhere in the UK. This totals 9,100 direct FTE jobs related to the manufacturing facilities. In addition it is predicted an estimated 3,200 direct FTE jobs in total (i.e. locally, in the rest of the region, and the rest of the UK) will be created in relation to the installation of the wind turbines. Indirect jobs include a number of goods and services required to run premises, equip the workforce, and run the business (e.g. professional services such as accounting and legal). It is estimated that AMEP will create 1,080 FTE supplier jobs in the Yorkshire and Humber region. Further jobs are expected to be created through the spending of workers employed in direct and indirect jobs, within the local economy (e.g. retail and leisure) supporting existing businesses and creating an estimated 920 FTE jobs in the wider local area (North and Northeast Lincolnshire) and 720 FTE jobs in the rest of the region (ERM, 2011).

Marine development works have also been proposed at the Port of Mostyn, situated adjacent to the existing Port operational land and within the boundary of the Mostyn Statutory Harbour Area (SHA). The development works will comprise a Marine Energy Park (MEP) and will complement the existing operational land in order to establish a facility designed to service the Round 3 offshore wind energy programme and future renewable energy projects. It is proposed that the facility will be used initially for the construction of Offshore Wind Turbines (OWT) required for the Round 3 Celtic Array offshore wind farm. Following the completion of the OWT construction works, a part of the MEP will be required for a long term servicing of the wind farms, with the remainder being used for further Rounds of offshore windfarms and other renewable energy projects (Port of Mostyn, 2013). It is estimated that the MEP will create 30 jobs for the MEP infrastructure construction period; 300 jobs for the offshore windfarm construction stage; and 370 FTE jobs for the operation and maintenance stage (Port of Mostyn, 2013).

Shipping

The National Policy Statement for Ports (England and Wales) (Department for Transport (DfT), 2012) describes the need for new port infrastructure and forecasts the following increase in demand for port capacity up to 2030 compared to the 2005 baseline: 182% increase in containers, 101% increase in Ro-Ro traffic 4% increase in non-unitised traffic (based on MDS Transmodal, 2007). In time, this growth will require a substantial additional port capacity over the next 20-30 years to be met by a combination of development already consented and development for which applications have yet to be received. To accommodate predicted increases in international trade there would be a major expansion of port facilities and infrastructure, with shipping routes becoming markedly busier and vessels larger. With projected increases in shipping traffic, pressures associated with traffic, ports and maintenance of navigation routes are also forecast to increase. It is assumed that there will be further demand for capital navigational dredging to deepen existing ports, allowing use by larger vessels (Defra and Marine Scotland, 2012). Consultation with ABP confirmed that the principle driver for capital dredges in relation to commercial ports is due to the trend of shipping lines commissioning larger vessels to achieve greater economies of scale, especially as marine fuel will dramatically rise in price as the greater air quality restrictions come into force (ABP, pers. comm., 2014).

The Port of Southampton, for example, is currently undergoing works to deepen and widen the main navigational channel to the Port. The rationale for this is to enable the Port to handle larger vessels from both the cruise and container market of up to 15.5m draught and to further enhance navigational safety in the approaches to the Port. ABP’s proposal has been optimised to avoid the relocation of various pipelines that cross beneath Southampton Water as well as minimising the extent of the widening while maintaining high navigational standards and requirements. The proposed changes to the channel design will increase the ability of the Port to accommodate the 24-hour nature of international shipping companies with their larger cargo and passenger carrying capacity vessels. This will reduce the costs resulting from delay and congestion, and increase the efficiency and competitiveness of the Port and its customers (ABPmer, 2008; 2012). As part of these works the dredged pocket for Berths 201 and 202 within the Port of Southampton have also been deepened and the quay walls to both berths have been reconstructed in order for the Port to accommodate the latest generation of large container ships currently being brought into service by the world’s major shipping lines. The project comprised the deepening of Berths 201 and 202 to 16m below Chart Datum (CD), which, in turn, required the construction of a new quay wall immediately in front of the existing quay wall. The improved berth facilities will merge naturally with the existing port infrastructure at Southampton’s container terminal thereby avoiding the need to have to identify and bring into use suitable alternative land within the Port estate. A failure to carry out the works to Berths 201 and 202, would have jeopardised Southampton’s position as the UK’s ‘port of choice’ for Far Eastern shipping lines, placing a serious risk to current and future employment at the container terminal (ABP, 2011).

Oil and gas

It is estimated that Oil and Gas production in the UK currently supports about 207,000 jobs in the supply chain. Using turnover figures relating to exports, it is estimated that direct export activity from the supply chain could be supporting a further 100,000 UK jobs (Marine Scotland, 2012). The centre of excellence and expertise established in Northeast Scottish Ports has generated global trade in Oil and Gas equipment manufactured or services. Aberdeen Harbour is Europe's main support centre for the offshore oil and gas industry and is a global hub for the traffic of oil field equipment (Aberdeen City Council, 2010). Aberdeen Harbour already has three scheduled services to West African Oil and Gas producing countries and regularly handles other energy related cargoes to and from many other worldwide destinations (BPA, 2008).

Tourism

A number of Ports are also important cruise destinations from within the UK and Europe. Smaller scale local ferry services can also provide an important life-line for residents. These services also provide a gateway for tourists to visit areas that might otherwise be inaccessible by car or train. This gives considerable economic and social benefits to both the port and harbour operators as well as the surrounding area, allowing for the movement of commercial traffic, local passenger traffic and growing numbers of tourists and visitors (BPA, 2008). The impact of the cruise industry on the Port of Southampton is also discussed above under shipping.

Military

There is a requirement for Her Majesty's Naval Base (HMNB) Portsmouth to accommodate larger vessels than present at Portsmouth, and a major expansion has been planned to improve the Portsmouth naval base facilities. The project includes navigational improvements including channel deepening, realignment and widening within Portsmouth Harbour and disposal of material at the Nab deposit ground. In addition to the navigation channel, deepening of vessel berths could also be required to enhance the accessibility for the new aircraft carriers due to enter service in 2014 (MMO, 2012).

Summary

Whilst there is clear evidence of MPS activities providing development opportunities for ports, the only social impact for which evidence was found was the creation of jobs, specifically in association to wind farm support. Employment is recognised as the most important means by which to fulfil material wellbeing, as being central to individual identity and social status, and being an important contributor to physical and mental health (MMO, 2013) (see Section 1). Limited evidence could be found of any other social impacts associated with these interactions. Whilst there will be opportunities for employment, a shift in port use (e.g. from a fishing port to an OWF provider) may also cause increased social tensions amongst the community. The Environmental Impact Assessments necessary for large scale port developments should ensure that any environmental or community impacts associated with port developments are minimised.

Increased vessel traffic
Due to the commercial navigation intensity combined with other water users such as fishing and recreational users, the potential for vessel to vessel encounters exists. This does not however translate to vessel to vessel collision risk. Instead, the collision risk and frequency would depend on a wide range of factors including conditions, visibility, vessel characteristics and vessel speed (Marine Scotland, 2013). In particular, ports and dredge and deposit areas are inherently located adjacent to busy shipping lanes. Collisions between vessels are prevented through communication between vessels and reference to up to date charts.

No specific evidence could be found on the social impacts of increased vessel traffic on the port, dredging and disposal sector.

Establishing Significance
The review has found little tangible evidence of significance levels of social impacts relating to the ports sector or of the significance of social impacts of interactions between ports and other MPS activities. The significance of social impacts are likely to be site specific and related to the socio-economic context, including the community dependence on the industry within a given location. The most significant social impact as a result of interactions with MPS activities is likely to relate to changes in employment opportunities, both positively and negatively. Employment affects individual identity, health, and social capital and cohesion (see Employment Section 1).

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4.13 Recreation

4.13.1 Social impact of recreation

This section provides a short overview of the key social impacts produced by the recreation sector, in the absence of any specific interaction. For the purposes of this review recreation is considered as: all coastal and watersport outdoor activity e.g. boating, walking and surfing. Recreation can provide a range of social impacts, in part depending on the activity being undertaken and the individual's reason for undertaking that activity.

Health

There is an extensive literature base on the health benefits of recreation, which typically identifies two types of health benefit: physical health and mental health. A review by C3 Collaborating for Health (2011) provides a summary based on the most widely cited evidence-based studies.

Physically active recreation can help reduce the risk factors for non-communicable diseases (NCDs) e.g. reducing blood pressure, improving blood cholesterol levels and lowering body mass index (BMI) (C3 Collaborating for Health, 2011). A positive relationship has been found between physical activity and NCDs including coronary heart disease, type 2 diabetes mellitus, Alzheimer's disease and dementia (Reiner *et al.*, 2013). Further, there is demonstrable dose-response relationship. That is, the physical health benefits of physical recreation increase as the amount and intensity of activity increases (C3 Collaborating for Health, 2011). The health benefits of physical recreation are more pronounced for high risk individuals e.g. those who are obese or have high blood pressure (C3 Collaborating for Health, 2011). There is evidence that living near or visiting coastal areas can encourage increased physical exercise (Cox, 2005; Roe and Brown, 2012; Ashbullby *et al.*, 2013).

Physical recreation activity is also shown to have benefits for people's mental health. There is good evidence of such benefits, although it is not so well documented as for physical health. These include: improved mood, reducing symptoms of stress, anger and depression, alleviating anxiety and slowing cognitive decline. There is evidence of benefits specifically in young people (improving memory function and accelerating learning) and old people (general cognition, verbal memory and attention) (C3 Collaborating for Health, 2011). Other potential benefits relate to enhancing self-worth and spiritual ideals (State of California Resources Agency, 2005)

Particularly in relation to mental health, the setting in which recreation takes place can be an important variable in determining the magnitude and nature of the benefit. There are an increasing number of studies which demonstrate a positive relation between being outdoors and in the natural environment and subjective measures of health. For example, MacKerrona and Mourato (2013) demonstrate that individuals are happiest when in the natural environment. White *et al.* (2013) found that visits to the coast were associated with the perceived higher levels of emotional and cognitive restoration than visits to other natural areas whilst Ashbullby *et al.* (2013) found that psychological benefits (e.g. experiencing fun, stress relief and engagement with nature) were key motivators for visiting a beach. Annual statistics produced by Natural England (2013) provide subjective measures of the health effects of visits to natural environment locations e.g. coastline or beach.

There is limited evidence of the health benefits of specific activities (Reiner *et al.*, 2013) and of how mental health benefits differ between different activities (White *et al.*, 2013). de Moor (2012) provides a review of evidence of the health benefits of being active, with a particular focus on walking. For recreation angling, Brown *et al.* (2013) found that ‘being outdoors and active’ and to ‘relax and get away from things’ were the two most common motivations for angling.

It should be noted that marine and coastal recreation also carries potential health risks, for example, through exposure to water pollution, physical injury or drowning. See WHO (2003) for examples of the types of health effects of different forms of water pollution.

Community and culture
Recreation can encourage social participation and opportunities for volunteering (Coalter, 2005), can help to combat social exclusion (Donnelly and Coakley, 2002) and build social networks and community cohesion (Cox *et al.*, 2004), including interaction within a family unit (Ashbullby *et al.*, 2013). Research by Brown *et al.* (2013) found that sea angling was a route for socialising with 38% of respondents saying that they had made friends through sea angling.

Notably the way in which recreation is provided and carried out can influence the significance and direction of impact, with an obvious focus on group activities. Some recreation may foster social exclusion through, for example, imposed codes of conduct (Donnelly and Coakley, 2002).

Both the built and natural environment can hold cultural value. Recreation activity can provide access to these cultural values; for example recreational visits to cultural heritage sites, such as wrecks and heritage coastlines. Some recreation events celebrate or help to retain local and international culture and tradition; for example, Tall Ships regattas e.g. at Greenwich and Falmouth, and racing of traditional oyster dredge boats near Falmouth (Falmouth Working Boats Association, 2013). These can provide cultural identity and sense of place both for participants and the broader local community.

Visits to cultural sites can provide opportunities for education (Heritage Lottery Fund Policy & Strategic Development Dept, 2009). Interpretation of the marine environment can provide education benefits to visitors. Education benefits can include visitor learning and knowledge from information presented about marine species and environments (Zeppel and Muloin, 2008). Annual statistics produced by Natural England (2013) provide subjective measures of whether people learnt anything about the natural environment during visits to outdoor locations e.g. coastline or beach.

Income and employment
Recreation activity can generate income and employment directly through the participants purchasing recreation services from providers e.g. anglers hiring an angling charter boat, and indirectly through the participants purchasing other goods and services associated with their recreation visit e.g. food and drink.

A number of studies have made estimates of the economic impact of marine and coastal recreation activities (e.g. Ruiz-Frau, 2013; RSPB, 2010; Rees *et al.*, 2010; MPC *et al.*, 2013). These typically provide estimates of total expenditure from recreation visits and sometimes data on the number of jobs supported by recreation activity and Gross Value Added (GVA) generated.

There is no single comprehensive source of data on recreation expenditure, jobs, GVA or income. Expenditure data is provided by three national surveys: Natural England's Monitor of Engagement with the Natural Environment (MENE) and VisitEngland's Day Visit Survey (DVS) and Overnight Tourism Survey. All provide expenditure data broken down by location type and reasonably detailed activity type.

Non-market values of recreation benefits

Many recreation activities do not involve marketable goods or services. As such non-market valuation techniques, typically revealed preference or stated preference, are often used to provide monetary and non-monetary estimates of the benefits of recreation. Studies can seek to estimate the total value of a recreation trip, or estimate the value to recreational users of a change in certain characteristics of their trip e.g. environmental quality[11].

There are a growing number of valuation studies which seek to estimate the non-market value of recreation trips. For example, Sen *et al.* (2011) identified 297 values from 106 studies which they used to estimate the location-specific mean per person per trip value for each 1km grid square cell in Britain as part of an estimate of the value of recreation trips in the UK, including coastal habitats. Notably the value of a recreation trip can vary significantly depending on ecosystem type and location (Bateman *et al.*, 2011), as well as by recreation activity type.

For specific marine and coastal activities the evidence base on the total value of a recreation trip is relatively limited. Examples include research by Drew Associates (2004) and by Lawrence (2005) to estimate consumer surplus values for a day sea angling. Rees *et al.* (2010) carry out a non-monetary valuation of recreation using the frequency of visit as a proxy. Pett (2006) and Chae *et al*. (2012) both estimate the consumer surplus of recreation trips to Lundy Island, Devon. There is also a potentially useful US literature base[12].

4.13.2 Social impacts of changes in the recreation sector arising from marine sector interactions

Interactions and impacts – summary table

The potential interactions between MPS marine sectors and the recreation sector are shown in Table 26. The types of interaction that can potentially impact on recreation activities can vary significantly, depending on the recreation activity in question and the participants' characteristics although many of the social impacts from interactions

[11] This section purposely does not present unit values, functions or aggregate values from studies, and it is outside of the scope of this project to provide a full review of the available valuation literature. When utilising values in benefits transfer care should be taken that the values are appropriate for the assessment in question. For guidance on benefit transfer see: https://www.gov.uk/ecosystems-services

[12] http://www.oceaneconomics.org/nonmarket/valEstim.asp

fall into similar categories. As such, the interactions table presented represents all relevant marine and coastal recreation activities. In general, common sense dictates which types of recreation activity a given interaction is likely to affect.

The tables were compiled based on a review of key studies in which potential interactions between marine sectors have been proposed or described (e.g. Marine Scotland, 2013a; Marine Scotland, 2013b; MMO, in prep; MMO, 2013), an additional grey and peer-reviewed literature search and through consultation with stakeholders. Any available evidence detailing the occurrence of these potential marine sector interactions, consequences and subsequent social impacts are described after the table.

Table 26: Recreation interaction-impact table.
Key: H/M/L = High Medium Low - Representing: **[strength of the evidence that the impact can occur**; **judgement on the significance of the impact as presented in the literature]**

Issue	Interaction	Consequence	Social Impact	
			Primary	Secondary
Competition for space	Exclusion/displacement from sea or coastal area	Reduction in available area, or relocation of activity to another area, may lead to overcrowding and increased conflict between recreation participants or other users	Increase/decrease in social tension and impacts on community cohesion **[H,M]**	
		Reduction in activity levels	Reduction in health, community and cultural benefits **[M,M]**	Reduction in income and employment (via recreation and related businesses) **[L,L]**
Change in use of marina	Loss of access to the sea from marinas	Reduction in available area, or relocation of activity to another area, may lead to overcrowding and increased conflict between recreation participants or other users	Increase/decrease in social tension and impacts on community cohesion **[L,L]**	
		Reduction in activity levels	Reduction in health, community and cultural benefits **[L,L]**	Reduction in income and employment (via recreation and related businesses) **[L,L]**
	Less/more suitable facilities/better facilities	Change in time taken to access services resulting in reduced recreation activity	Change in health, community and cultural benefits **[L,L]**	Change in income and employment (via recreation and related businesses) **[L,L]**
	Higher/ lower cost for	Relocation of activity to another	Increase/decrease in	

Issue	Interaction	Consequence	Social Impact	
			Primary	Secondary
	using facilities	area, may lead to overcrowding and increased conflict between recreation participants or other users	social tension and impacts on community cohesion **[L,L]**	
		Change in activity levels	Change in health, community and cultural benefits **[M,M]**	Change in income and employment (via recreation and related businesses) **[L,L]**
		Change in total cost of undertaking recreation activity	Change in available disposable income **[L,L]**	Change in ability to access a variety of market goods and services **[L,L]**
Changes to seascape/setting	Visual impact on recreation users	Change in activity levels and/or Change in quality of experience	Change in health, community and cultural benefits **[M,L]**	Change in income and employment (via recreation and related businesses) **[L,L]**
	Noise impact on recreation users	Change in activity levels and/or Change in quality of experience	Change in health, community and cultural benefits **[M,M]**	Change in income and employment (via recreation and related businesses) **[L,L]**
			Increase/decrease in social tension and impacts on community cohesion **[M,M]**	
	Reduction in wave quality	Change in activity levels and/or Change in quality of experience	Change in health, community and cultural benefits **[M,L]**	Change in income and employment (via recreation and related businesses) **[L,L]**
	Reduction in wind	Change in activity levels and/or	Change in health,	Change in income

Issue	Interaction	Consequence	Social Impact	
			Primary	Secondary
	quality	Change in quality of experience	community and cultural benefits **[M,L]**	and employment (via recreation and related businesses) **[L,L]**
Environmental quality	Change in quality of surrounding environment	Change in activity levels and/or Change in quality of experience	Change in health, community and cultural benefits **[H,M]**	Change in income and employment (via recreation and related businesses) **[L,L]**
Increase in vessel traffic	Increase in vessel-vessel interactions	Increased collision risk	Increased safety fears and health impacts **[L,L]**	
Non-recreation infrastructure	Increased recreation-infrastructure interaction			
Recreation infrastructure, facilities or management	Better recreation infrastructure, facilities or management	Improved access, activity levels and visit quality for a variety of societal groups	Improved social inclusion and cohesion **[M,H]**	
			Improved health, community and cultural benefits of activity **H,H]**	Increased income and employment (via recreation and related businesses **[L,L]**

Potential social impacts – supporting literature review
The following review identifies potential impacts and their pathways and connections, as identified in recent recreation literature. It does not set the review against any particular locality or set of characteristics and therefore says nothing about the potential significance of any impact, or extent to which all potential impacts of an interaction may occur. It should not be assumed that any particular impact identified in the review can be readily generalised to all recreation types, users or locations. As such, it should not be assumed that any particular impact (or chain of impacts) identified in the review will occur in all interaction situations in practice.

Amount of time to access areas
An increase in time to access recreation activity areas will result in a reduction in either time spent undertaking the particular recreation activity, or decrease in available time to spend on other recreation or non-recreation activities. No specific research has been identified on the social impacts of increased travel time in relation to changes in recreation site access. However a lack of time is sometimes cited as a reason for not undertaking more recreation activity (e.g. Mangi *et al.*, 2011; Henley Centre, 2005), and one may therefore assume that increased time for access holds the potential to affect recreation activity levels, and therefore the delivery of the social benefits of recreation activity e.g. health.

There is evidence on the 'value' that people place on their leisure time. For example, the Department for Transport (DfT) (2011) note that there is evidence that individuals implicitly value their leisure time, and that their 'willingness to pay' for different transport options will vary considerably, depending on such factors as the income of the individual traveller, the value of the journey purpose and its urgency, and the comfort and attractiveness of the journey itself. DfT (2011) provide a range of values for use in impact assessment. Other values for leisure time can be found in the recreation Travel Cost Method (TCM) literature.

Marinas - change in cost
The effect on usage of changes in cost will depend on the characteristics of the user (e.g. their ability to pay higher fees) and the availability of substitutes. No relevant research on the impacts of such marina cost changes was found. This may or may not be a reflection of the significance/insignificance of social impacts that arise from such price changes.

More generally (i.e. not exclusively in relation to marinas), cost/price is often identified as a barrier to undertaking recreation activities, particularly for your people and families (Henley Centre, 2005) as well as people with a disability, from an ethnic minority and people living within disadvantages areas (DOENI, 2008). Changes in cost may therefore affect the ability of certain groups of society to carry out recreation activity, and therefore affect the flow of recreation-derived benefits (e.g. health) that they receive. Further, charges can be seen as a mechanism by which recreation can contribute to social exclusion.

Exclusion/loss of access
Infrastructure, other activities or marine and coastal management plans may result in the exclusion of a particular recreation activity from a given area. The extent to which the exclusion will change how the recreation activity is undertaken, and result in

social impacts on participants, will depend on a number of factors, such as the spatial and temporal extent of the exclusion zone in comparison to the required recreation area and the availability of substitutes. Notably, whether an infrastructure development is inshore or offshore will dictate to a large degree the range of activities that it will potentially affect (RYA, 2012).

Marine and coastal management plans may seek to alter access for certain recreation activities for environmental protection purposes. However in many instances (e.g. North East Kent European marine sites Management Group, 2007) altering how activities are undertaken may be a preferred solution to reducing environmental impacts, thereby allowing access to continue. Where new management arrangements are expected in an area, but the management is not known (as has been the case for Marine Conservation Zones), recreation participants may, correctly or incorrectly, be concerned that their activity may be constrained, with associate effects on their ability to undertake their activity recreational experience (McAuliffe, 2010).

There is evidence that participants of many marine and coastal recreation activities prefer less crowded locations. For example, beach users (Tratalos *et al.*, 2013) and surfers (Hugues-Dit-Ciles *et al.*, 2003 cited in Surfers Against Sewage, 2009). For most recreation activities, whether they have a preference for less crowded locations or not, there is likely to be a point at which overcrowding of recreational facilities can cause conflict between users, and detract from the experience and social benefits of the activities (MMO, 2013). There are number of international studies on the social impacts of overcrowding at beaches including valuations (for example Lankford *et al.,* 2005). Potential impacts include conflict between recreation participants and recreation participant and local residents. Further, overcrowding can deter individuals from carrying out a recreation activity. For example, King (2001) finds that beach users in Southern California will reduce their usage by an average 25% as beaches become more crowded. It can also detract from the quality of the experience. For example, Mangi *et al.* (2011) found that some anglers identified an increase in commercial fishing nets set in the Lyme Bay MPA detracted from the quality of fishing.

It can be concluded that overcrowding can affect both the quantity and quality of recreation visits undertaken. As such, social impacts can occur in relation to a reduction in the mental and physical health, community and cultural benefits of individual recreation trips and aggregate visits per person/society. Reductions in the number of visits may have direct economic consequences on local recreation (and related service) providers, resulting in income and employment impacts.

It should be noted that there are likely to be markedly different carrying capacities across recreation activity types, and differences in the preferences of different users groups for any given activity. For example, Roca *et al.* (2009) found (through case study at Spanish beaches) that short stay visitors are less concerned about overcrowding than loyal and local users.

Seascape/environmental quality

Infrastructure development may affect activities indirectly if it affects the resource upon which the activity depends i.e. wind or wave quality. Research by Ecofys

(2013) estimates that wind speed declines compared to the free flow wind speed directly behind a wind farm are likely to be significant, compared to around 10% up to a few kilometres away and 15km away (e.g. at the shoreline) losses are of just 1-2%. Maximum effects on turbulence are expected around 500 meters from the wind farm. The effects of wind farms on nearshore wind-powered activities e.g. windsurfers and kiteboarders is therefore likely to be negligible. For activities occurring further offshore, such as cruiser sailing effects will be more noticeable. For activities such as surfing, effects of infrastructure on wave quality will affect the quality of the surfing experience. Wave quality is identified as one of the two most important factors determining the quality of surf experience (ASR Ltd, 2007 and Hugues-Dit-Ciles *et al.*, 2003 cited in Surfers Against Sewage, 2009).

There is a growing literature on the perceived incompatibility of personal water craft (PWCs) and certain other recreation activities e.g. Whitfield and Roche (2007); McAuliffe (2010). Due to their unpopularity, and capacity for disturbance of other activity participants, PWC may result in a perception of overcrowding. Even where there is not a physical constriction on available space caused by PWC use, conflict can arise due to noise disturbance and perceived threat to safety. The particular tonal note of PWCs means that they are considered to be more of a disturbance than other vessels (Whitfield and Roche, 2007). PWC usage also raises safety concerns for other users. Whilst PWC not necessarily any more inherently dangerous than many other motorised activities, there can be concerns relating to the high speeds that they can attain (Whitfield and Roche, 2007). This may be heightened by a view of PWC usage occurring with a ‘disregard’ for the safety of others (McAuliffe, 2010)

In research on the River Hamble (Hampshire) McAuliffe (2010) found that 86% of survey respondents selected PWCs as detracting from their boating experience. Motorboats and fishing boats were the second and third most identified sources of perceived conflict. Sailboats, human-powered boats, scuba divers and anglers prompted comparatively few negative responses, although it should be noted that 96% of respondents used sailboats as their primary vessel and so the survey results cannot be considered to be representative of all recreation user types.

In relation to changes in the marine and coastal natural environment, those recreation activities most likely to be affected are those which are most directly related to it, i.e. angling, recreational diving, and wildlife watching (Murry *et al.*, 2007). As a result of the Lyme Bay MPA, both recreational anglers and divers reported an improved recreational experience (Rees *et al.*, 2013). Brown *et al.* (2013) found that better fish stocks was most commonly identified by anglers as the factor that would increase participation in sea angling, with declining fish stocks the most commonly cited factor that would decrease participation.

Improvements in water quality can affect recreation participants including those using water bodies indirectly (e.g. as a backdrop to walking). The activities most likely to benefit from a reduction in pollution include: bathing, swimming, scuba diving, sea fishing, surfing and other activities where there is direct contact with the water. All studies identified by Ravenscroft and Church (2008) claim a causal relationship between pollution and levels of recreation activity, although the determining factor is often people’s perceptions of water quality, rather than actual water quality.

A small but increasing number of economic valuation studies have been carried out to ascertain the willingness to pay (WTP) of recreation participants for an improved marine environment e.g. Kenter *et al.* (2013): anglers and divers WTP for MCZs; Drew Associates (2004) and Lawrence (2005): anglers WTP for increase catch (quantity and/or quality). Pett (2006) and Chae *et al.* (2012) looked at consumer surplus of visits to Lundy Island Marine Nature Reserve (now MCZ), although no baseline is available for the 'without designation' scenario from which to ascertain the net impact. There are also valuation studies on, for example, improvements to coastal water quality and shoreline management and erosion control – see TEEB (2013) for a database of valuation studies.

A visitor's decision to use a particular recreational site is influenced by the individual's taste as well as the characteristics of the site (Krishna *et al.*, 2011) and recreation activity being undertaken (Coombes *et al.*, 2011). For example, a contrast was suggested between those wishing to enjoy the 'natural characteristics' of a beach (e.g. scenery, absence of pollution in various guises, fauna), and others who preferred traditional "beach resort" qualities (hot, sunny weather, safe bathing, convenient facilities and ease of access (Morgan, 1999).

With regards the seascape impacts from windfarms and other marine and coastal infrastructure, there has been little post-development evaluation research. Vattenfall (2013) identifies three relevant studies, two for onshore wind farms (Roger Tyms, 2006a; University of West of England, 2007) and one for an offshore interconnector (Roger Tyms, 2006b). Figures from these studies include: a 2-3% adverse impact on tourism businesses in Ayrshire as a result of the interconnector; 3% of survey respondents stating that the Artfield Fell Wind farm had had a negative impact on tourism business; 87% of tourists to North Devon stated that the presence of a wind farm would neither encourage nor discourage them from visiting, which over half of the remaining 13% said that they would be encouraged to visit.

A UK-based omnibus survey of 2,000 people for VisitScotland (2012) found that 80% stated their decision on where to visit or stay on a short UK-based holiday would not be affected by wind farms were present there, with 20% claiming that it would be affected. Earlier research by the Scottish Government (2008), found that 'under all circumstances, the vast majority (93-99%) of those who had seen a wind farm suggested that the experience would not have any effect'. Walkers were found to be the least opposed to wind farms - 19% had a negative attitude to wind farms compared to an average for all activities of 25%. Wildlife watchers had an above average score (33%), anglers matched the average (25%) and watersport participants a below average score (20%).

Recreation infrastructure, facilities and management
In relation to the basic ability to access parts of the coast, a programme of research conducted by Natural England (2007) identified a series of benefits of improved access. These included: different standards of access and associated area management can result in different social impacts of recreation visits – good access/management allows visitors a good sense of freedom which poor access/management can leave people feeling unpleasantly constrained or unsafe. Where people have a choice, they tend to use sections of coast where they are

confident that the experience will be positive and enjoyable, rather than negative or frustrating.

Many management bodies actively seek to improve access to cultural and recreational sites, including through the provision of recreation infrastructure e.g. Durham Heritage Coast Partnership improved access by providing facilities that enabled people to use the coast for informal recreation, including 20km of coastal path and 47km of cycle route (Durham Heritage Coast Partnership, 2013).

Recreation activities can help to foster social inclusion (MMO, 2014). Notably, infrastructure can be used to overcome barriers to recreation activity for particular groups of society, such as the elderly, young, disabled or ill. For example: physical difficulty of access; lack of confidence and negative perceptions of a poorly managed environment; lack of user support, such as access information, interpretative information, signage, and publicity (The Countryside Agency, 2004)

Interpretation of the marine environment can provide education benefits to visitors. In marine and coastal areas interpretation activities or education programmes typically involve talks by tour guides, interpreters and rangers onboard boats or at shorelines and also visitor centres, displays, signs and brochures (Zeppel and Muloin, 2008).

Nature designations, of other forms of designation e.g. UNESCO Word Heritage Site, can help to attract funding for the purpose of increased interpretation (Defra, 2013), and their associated management plans can be used to develop coherent education strategies, although the strength of such strategies can vary (PriceWaterhouseCoopers LLP, 2007). Using a choice experiment at the Jurassic Coast World Heritage Site in Dorset, Webber *et al.* (2004) estimated that people were willing to pay £23.69 per household per year to gain access to the coast with some explanation of the geology, and £62.35 per household per year to gain access with extensive interpretive material.

Collision risk

Collision risk can change as a result of any new or altered developments of activity operations. Where impacts materialise, there will clearly be potential detrimental effects on physical and mental health. No literature discussing the social impacts of recreational collision risk was identified.

Income and employment

Changes in the volume or type of recreation occurring in a given area can have knock on impacts on the performance of the businesses serving those activities. Any changes in recreation activity levels can therefore have impacts on employment and income.

Employment is recognised as the most important means by which to fulfil material wellbeing, as well as being central to individual identity and social status and an important contributor to physical and mental health, and social capital and community cohesion. Conversely unemployment can be detrimental to individual identity and social status, physical and mental health, as well as a key cause of deprivation, weak social capital and community cohesion.

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4.14 Surface Water and Waste Water Management

4.14.1 Social impacts of surface water and waste water management

This section provides a short overview of the key social impacts generated by the surface water and waste water management sector, in the absence of any specific interaction. Disposal of waste at sea is regulated for environmental protection purposes. Disposal of waste material into the marine environment includes the regulated discharge of wastewater and unregulated surface water runoff (MMO, 2013). Discharges arise from water and sewage companies (and associated waste water treatment plants). There has also been increasing control with time over the disposal of effluents into the marine environment and since the 1980s disposal at sea of radioactive wastes, industrial wastes, colliery minestone and sewage sludge have progressively been prohibited. Note the disposal of dredged material from capital and maintenance dredging is discussed in Section 11. Similarly discharges of cooling water from coastal power stations are discussed Section 8 although it is noted that there will be some overlap between these sectors.

Income and employment

Control of waste water discharges is fundamental to sustaining certain key economic activities, such as shellfisheries, tourism and recreation, as well as the industries which rely on making discharges to the marine environment, e.g. power stations and water and sewage companies (MMO, 2013). However, waste water discharges do not generate a measurable economic value by themselves. It is therefore not possible to measure the contribution of waste water to the marine environment in terms of GVA or employee jobs (MMO, 2013; Baxter *et al*., 2011).

Income is raised, however, via the licensing of discharge activities through the 'polluter pays' principle. In England and Wales income is raised via 'Charging for Discharges' (CfD) which recovers the costs of issuing discharge consents and monitoring discharges and their impacts on receiving waters (Environment Agency, 2008b cited in UKMMAS, 2010). Licensing these discharges to coastal waters provides an estimated CfD income in England and Wales for 2007/08 of £3.26 million with a GVA of £2.34 million (UKMMAS, 2010).

Community and environment

The provision of effective surface and waste water treatment systems also contributes more widely to ecosystem services; including flood prevention through surface water drainage; community benefits through infrastructure for waste water collection; and avoidance of damage to sensitive coastal and estuarine habitats due to the control of pollution through sewage treatment works (MMO, 2013). Beaumont *et al.* (2006) estimated a pollution avoidance value of £1billion for water management companies based on the amount of money saved from not having to implement tertiary treatment to all coastal sewage works. This cost is currently avoided by utilising the marine environment's capacity to accept waste (Beaumont *et al*., 2006). Control of waste water discharges also provides clean seas for other tourism and recreation related activities (UKMMAS, 2010).

4.14.2 Social impacts of changes in the surface water and waste water management sector arising from marine sector interactions

Interactions and impacts – summary table

All treatment works are required to have a permit to discharge to the environment in the form of a consent from the environmental regulator, the Environment Agency in England and Wales, the Scottish Environment Protection Agency and Northern Ireland Environment and Heritage Service. The consent has conditions that are designed to protect the receiving watercourse. The larger the discharge and the smaller the watercourse the more stringent the conditions are likely to be. In addition, a number of European Directives require certain water standards to be met. These include the European Urban Waste Water Treatment Directive; which requires a minimum of secondary treatment (to biologically break down and reduce residual organic matter) for all works serving a population above 2000 people (MMO, 2013; Water UK, 2006), and the Water Framework Directive (WFD); which sets targets for obtaining 'good ecological and chemical status' in watercourses. This WFD identifies priority substances, which must be progressively reduced in consented discharges; or must cease altogether in the case of priority hazardous substances (Water UK, 2006). The revised Bathing Waters Directive also includes stringent water quality standards for bathing waters (South West Water website).

Continuous investments are, therefore, already being made by the water industry to ensure that wastewater discharged from Waste Water treatment works are well within required standards. It is, therefore, unlikely that any of the MPS activities will additionally interact with this waste water and surface water management sector over and above the requirements as set out by the above Directives. However, a number of activities may put added pressure on water resources and discharges and these are discussed below.

The potential interactions between MPS activities and the surface water and waste water management sector are shown in Table 27. This table was compiled based on a review of key studies in which potential interactions between marine sectors have been proposed or described (e.g. MMO, 2013) and an additional grey and peer-reviewed literature search. Any available evidence detailing the occurrence of these potential marine sector interactions, consequences and subsequent social impacts are described after the table.

Table 27: Surface water and waste management interaction-impact table.
Key: H/M/L = High Medium Low - Representing: **[strength of the evidence that the impact can occur**; **judgement on the significance of the impact as presented in the literature]**

Issue	Interaction	Consequence	Social Impact	
			Primary	Secondary
Competition for space	Restrictions on water discharge activities	Increased costs to sector (e.g. through requirement for additional infrastructure, increased costs for licence to discharge)	Increase/decrease in social tension and impacts on community cohesion **[H,M]**	
Increased pressure on surface water and waste water infrastructure	Unlicensed release to marine environment	Increased costs to sector (e.g. fines, increased costs for licence to discharge)	Reduction in income **[L,L]** Environmental Impacts **[L,L]**	

Potential social impacts of interactions– supporting literature review
The following review identifies evidence of the occurrence of these interactions and the social impacts that may arise as a consequence where such evidence was available.

Competition for space
It is possible that water discharge activities may be restricted due to the presence of other MPS activities. For example, an existing long sea outfall from the Swansea Bay Waste Water Treatment Works (WWTW) terminates within a proposed tidal lagoon area within Swansea Bay. The outfall discharges a high quality tertiary treated UV disinfected final effluent, which should not preclude the use of the lagoon for water contact sports. However, after heavy rainfall, the occasional discharge of screened storm water from the long sea outfall into the lagoon is capable of causing localised, temporary deterioration in water quality. In order to maintain an appropriate standard of water quality all year round for water contact sports within the lagoon in the case of heavy rainfall, additional treatment of the storm water is being considered. These options include i) ultraviolet (UV) disinfection of the storm water; and ii) extension of the existing long sea outfall beyond the seawall of the lagoon (TLSB, 2014).

Although the costs of interactions of this nature will largely be borne by the proposed developer large scale construction projects may have future impacts on the surface and waste water management sector by restricting potential upgrades to infrastructure or through increasing licence costs for discharge. However, no specific evidence could be found on the social impacts of competition for space on the surface water and waste water management sector.

Increased pressure on infrastructure
The tourism industry is likely to put added pressure on water resources and discharges during peak months (i.e. summer holidays). The tourism industry generally over uses water resources for hotels, swimming pools, golf courses and personal use of water by tourists. This can result in water shortages and degradation of water supplies, as well as generating a greater volume of waste water. At such times treatment processes may need to be optimised to deal with variations in organic load concentrations associated with seasonal population changes (Defra, 2012).

Water companies may receive fines if poorly treated effluent is discharged into the sea which can occur during periods of adverse weather or peak tourist numbers. One example, of many, is the fine received by Anglian Water Services Ltd for discharging greater volumes of poorly treated sewage effluent into the North Sea than their permit from the Environment Agency allowed. They were fined a total of £28,000, ordered to pay full costs of £3,375.39 and a victim surcharge of £120 (Environment Agency, 2013).

Although this can lead to short-term impacts on the environment and bad publicity and reduced profits for the surface and waste water management sector, no specific evidence could be found on the social impacts of the increased pressure on infrastructure on the surface water and waste water management sector.

Establishing Significance
The review has found little evidence of significance levels of negative impacts of interactions between the surface and waste water management sector and other MPS activities. The significance of social impacts is likely to be site specific and related to the socio-economic context. The most significant pressure on the surface water and waste water management sector is likely to arise from the tourism sector.

4.14.3 Surface and Waste Water Management References

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4.15 Tourism

4.15.1 Social impacts of tourism

This section provides a short overview of the key social impacts produced by the tourism sector, in the absence of any specific interaction. For the purposes of this review tourism relates to 'the activities of persons travelling to and staying in places outside their usual environment for not more than one consecutive year for leisure, business and other purposes not related to the exercise of an activity remunerated from within the place visited' (World Tourism Organisation, 2004; Kalaydjian, 2012). This section focuses specifically on coastal tourism.

Coastal tourism encompasses a wide variety of businesses and economic activities. MMO (2013a) lists the key aspects of the sector to include: hotels and similar accommodation; holiday and other short stay accommodation; camping grounds; recreational vehicle parks and trailer parks; restaurants and mobile food service activities; beverage serving activities; libraries, archives; museums and other cultural activities; sports activities and amusement; and recreation activities.

As noted above, tourism is often associated with other specific leisure activities including marine ecotourism, tourism associated with coastal cultural heritage and marine recreation (including water sports). Recreational activities (including recreational boating) are described separately in Section 12 as the interactions and issues are often distinctly different. This raises the possibility of a degree of replication or double counting with regard to the evidence base using this approach but not to the extent that it materially affects the results of this study.

Tourism can offer a number of benefits and costs to individuals and local communities specifically in terms of development, town characteristics and well-being effects (MMO, 2013b). The evidence for this is briefly reviewed below.

Income and employment

Tourism is a large part of the economy for many coastal areas in the UK (e.g. see MMO, 2013b, MMO, 2013c; Marine Scotland, 2013a). However, tourism jobs are often low wage, part-time and seasonal (Roger Tym and Partners and OSCI, 2011). Employment in the seaside tourist economy peaks in the summer months and declines during the winter, which represents a significant problem in providing a sustainable basis for employment in the sector (Roger Tym and Partners and OSCI, 2011) and creates an element of instability in the community (Farr and Rogers, 1994 cited in MMO, 2013b). In general, employment is recognised as the most important means by which to fulfil material wellbeing, as well as being central to individual identity and social status and an important contributor to physical and mental health (see Section 1).

Low pay in the tourism sector is low partly because many of the jobs are part-time, and partly because many are low wage. In 2007 the national average GVA per job in hotels and restaurants (which account for around half of all seaside tourism jobs) was just £11,000 a year, compared to a national average of £36,500 a year across all sectors (Beatty *et al*. 2010 cited in Roger Tym and Partners and OSCI, 2011).

Tourism labour market catchments are relatively local as research has suggested that lower paid individuals are less likely to be able to travel long distances to work (Smith, 1999 cited in Roger Tym and Partners and OSCI, 2011). However, tourism labour markets are becoming increasingly global, and there is anecdotal evidence that tourism jobs are increasingly being filled by national and international migration (Roger Tym and Partners and OSCI, 2011).

Tourism activity is likely to have a series of complex effects on deprivation. Tourism has the potential to create jobs at the lower end of the labour market which are accessible to deprived people. This could have a positive effect on deprivation (as research indicates that the state of labour demand drives social exclusion more than any other factor; ODPM-SEU, 2004 cited in Roger Tym and Partners and OSCI, 2011). However, as noted above, because many tourism jobs are low wage, part time and seasonal in nature, this reduces the long-term positive impact of the tourism industry on deprivation (Roger Tym and Partners and OSCI, 2011).

The following information on the value of tourism to the UK economy has been taken from Charting Progress 2 (UKMMAS, 2010). The estimated income for coastal towns from tourism in the UK is calculated at £4.8 billion. The proportion of turnover contributing to gross value added has been estimated at 0.47 for the hotel, catering and licensed premises section. Using this conversion factor for tourism would suggest a GVA of £2.26 billion from UK seaside tourism as a whole (Pugh, 2008). A problem with seaside tourism values is that it is very difficult to separate which tourist activities are specifically related to the utilisation of the coastal and marine environment and which are more general ‘seaside holiday’ expenditure values.

Health

Research by White *et al.* (2013) suggests that there are health benefits from coastal tourism and ‘enjoying nature’ (described in MMO, 2013b). Research has indicated that benefits of tourism for disadvantaged members of society include significant increases in certain elements of individual happiness and social wellbeing and that the tourist experience contributes positively to family bonding, increased functioning and participation of individuals in society (McCabe and Johnson, 2013 cited in MMO, 2013b).

Community and culture

Tourism can be closely related to the identity of coastal communities. For example, The MMO draft East Inshore and Offshore Marine Plans describe how several seaside towns in the plan areas, such as Southwold and Cromer, are considered traditional seaside resorts. These resorts promote intangible aesthetic characteristics such as unique histories and a traditional ambience as selling points to potential and regular visitors rather than the large amusement areas, bars, clubs and restaurants present in the larger coastal resorts (e.g. Brighton and Blackpool).

Furthermore, tourism and the infrastructure associated with it can create valuable year-round amenities for local residents that improve the quality of life offered by an area (e.g. roads, updated sewage works and water facilities, Williams *et al*. 1989; Roger Tym and Partners and OSCI, 2011). Heritage and environmental assets can be upgraded for tourist use, and then be used by local communities. For example, investment in cultural and community facilities in Hastings has taken place to improve the tourism offer, with positive consequences for local communities. Where this takes place, there is evidence of the benefits from cultural activity (Hastings Borough Council, 2005 cited in Roger Tym and Partners and OSCI, 2011).

However, tourism may also have negative social impacts on a community, for example, a 'faster pace of life' due to the increased demands of tourists. In addition, some areas may be seen as a 'retirement spot' hence over time reducing the number of working people, resulting in a change in the demographics of the population and the identity of the area (Williams *et al.,* 1989 cited in MMO, 2013b). Farr and Rogers (1994) reported negative impacts of tourism in the Scilly Isles on the community included local people believing that second homes and timeshares (bought by 'outsiders') were fragmenting the community and increasing house prices beyond the means of local people. Tourism may also have a negative social impact on communities if an increase in tourist numbers put strains on local infrastructure/assets (e.g. beaches) with this turning into resentment for some locals having to share public spaces (Andereck *et al*., 2005; Fredline, 2002; Woosnam *et al.,* 2009 cited in MMO, 2013b). Furthermore, as noted above, the seasonal nature of employment within the tourism sector also generates instability in the community.

It should be noted that employment is recognised as an important contributor to social capital and community cohesion (see Section 1).

Environment

Whilst growth in visitor numbers may impact positively on the economy of an area, local environments can be damaged by the weight of tourism numbers. For example an increase in footfall in rural areas, may adversely affect the environment by changing the landscape and character of an area and potentially harming or disturbing species and habitats (MMO, 2013d; no specific evidence cited). The environmental impacts of tourism can be classified under three main types (summarised in MMO, 2013e):

- Depletion/use of resources e.g. depletion of water resources through water intensive tourism, and infrastructure e.g. golf courses and swimming pools
- Pollution e.g. discharge of sewage to coastal waters, general beach/tourism related pollution (e.g. litter), and transport emissions
- Physical impacts e.g. trampling, disturbance of marine wildlife, and land use change and degradation.

4.15.2 Social impacts of changes in the tourism sector arising from marine sector interactions

Interactions and impacts – summary table

The potential interactions between MPS activities and the tourism sector are shown in Table 28. This table was compiled based on a review of key studies in which potential interactions between marine sectors have been proposed or described (e.g. Marine Scotland, 2013a; Marine Scotland, 2013b; MMO, in prep; MMO, 2013b) and an additional grey and peer-reviewed literature search and through consultation with stakeholders. Any available evidence detailing the occurrence of these potential marine sector interactions, consequences and subsequent social impacts are described after the table.

Table 28: Tourism interaction-impact table.
Key: H/M/L = High Medium Low - Representing: **[strength of the evidence that the impact can occur**; **judgement on the significance of the impact as presented in the literature]**

Issue	Interaction	Consequence	Social Impact	
			Primary	Secondary
Competition for space – foreshore and marine area	Competition for space	Potential conflicts e.g. between tourism and recreation such as multiple beach users and demand for space	Increase in social tension **[M,L]**	
Change in use	Creation of new visitor attraction (e.g. recreational facilities/opportunities; MPA designation; renewable energy visitor centre)	Increase in visitor numbers, revenue and investment	Impact on way of life (in relation to income, employment and identity) **[L,L]**	
			Increase in social tension **[L,L]** Decrease in quality of environment **[L,L]** Decrease in quality of visits **[L,L]**	
Change to landscape or seascape	Visual impact (change in the perceived attractiveness or quality of the landscape/seascape)	Change in visitor numbers and value/expenditure; Change in investment	Impact on way of life (in relation to income and employment) **[L,L]**	Increase in social tension **[L,L]** Effects of unemployment on individual identity, health, and social capital and cohesion **[L,L]**
Change to environment/pollutio n	Change in noise levels	Decrease in visitor numbers and revenue	Impact on way of life (in relation to income and employment)	Increase in social tension **[L,L]** Effects of unemployment on

Issue	Interaction	Consequence	Social Impact	
			Primary	Secondary
			[L,L]	individual identity, health, and social capital and cohesion **[L,L]**
	Change in bathing water quality	Decrease in visitor numbers and revenue; Decrease in investment	Impact on way of life (in relation to income and employment) **[L,L]**	Increase in social tension **[L,L]** Effects of unemployment on individual identity, health, and social capital and cohesion **[L,L]**
	Change in light levels	Decrease in visitor numbers and revenue	Impact on way of life (in relation to income and employment) **[L,L]**	Increase in social tension **[L,L]** Effects of unemployment on individual identity, health, and social capital and cohesion **[L,L]**
Disturbance	Disturbance or injury to coastal or marine wildlife (e.g. through construction or increased vessel traffic)	Decrease in visitor numbers and revenue; Decrease in investment	Decrease in employment **[L,L]** Increased social tension **[L,L]**	
	Disturbance or damage to heritage assets	Decrease in visitor numbers and revenue; Decrease in investment	Decrease in employment **[L,L]** Increased social tension **[L,L]**	

Potential social impacts – supporting literature review
The following review identifies evidence of the occurrence of these interactions and the social impacts that may arise as a consequence where such evidence was available. Where specific evidence of primary and/or secondary social impacts arising from changes in employment level within this sector was found, they are described below. However, it can be noted that, in general, unemployment can be detrimental to individual identity and social status, physical and mental health, as well as a key cause of deprivation, weak social capital and community cohesion (see Section 1).

Competition for space
A number of reports suggest that there may be potential conflicts between tourism and recreation such as multiple beach users and demand for space (e.g. MMO, 2013d, MMO, 2013b). For example, as already noted above, an increase in tourist numbers may put strains on local infrastructure/ assets (e.g. beaches) with this turning into resentment for some locals having to share public spaces (Andereck *et al*., 2005; Fredline, 2002; Woosnam *et al*., 2009 cited in MMO, 2013b).

Change in use – creation of new visitor attraction
Developments associated with other MPS activities (e.g. recreational activities including boating, aquaculture, offshore renewables and also designations of MPAs) may provide new tourism opportunities through the creation of a new visitor attraction. Evidence was sought in relation to the impact of other MPS sector activities on tourism rather than investment in new tourism facilities or updating of existing coastal tourism facilities, assets or resorts which would be expected to encourage tourism.

A study investigating the impact of aquaculture on tourism in Scotland showed that in contrast to an assumed conflict between wildlife watching and aquaculture, there were examples of business linkages having been developed. For example, visits to salmon cages had proved to be a popular additional interest on wildlife watching boat tours and the salmon cages were useful as a constant fixed feature on a boat operator's itinerary (Nimmo *et al*., 2011). Furthermore, a survey of 65 tourism-related businesses in the areas studied (Mull and Oban, Outer Hebrides and Shetland) showed a generally positive contribution was made by aquaculture towards tourism as it provided a point of interest and also locally sourced food for tourists. For accommodation providers, aquaculture also provided additional business with visitors requiring lodgings throughout the year. There was no suggestion from any of the tourism dependent businesses interviewed that aquaculture was having a negative impact on tourism in Scotland although there were some negative aspects in relation to the angling sector's perception of aquaculture (see Section 12).

The positive link between inshore fisheries and tourism should also be highlighted although the interaction may not necessarily be categorised as a 'change in use' or 'creation of a new visitor attraction'. CCRI (2011) states that "fishing and the ambience it creates plays a central role in the major industry of most coastal communities – tourism". Furthermore, events such as fish festivals (e.g. Newlyn, Clovelly (North Devon)) and fishery-related visitor attractions (e.g. the lobster hatchery at Padstow, Cornwall) can attract large numbers of visitors.

Some studies have suggested that offshore wind farms could bring economic benefits to the local tourism industry. A report by BWEA (2006) reviewed numerous studies and surveys assessing the impacts of wind farms on tourism in the UK, including two operational OWFs in England and Wales. The report stated that E.ON UK's Scroby Sands Information Centre welcomed 30,000 people in the first six months (from May 2004), and in 2009, 42,000 people visited (based on a pers. comm. cited in ABPmer *et al.,* 2011). The Great Yarmouth tourism website states that Scroby Sands OWF has become a popular landmark and tourist attraction (see also evidence relating to changes to seascape/landscape below). Boat trips/cruises to view offshore wind arrays have also been promoted both in Europe (e.g. the shipping company FRS Helgoline offering tourist boat trips to the Meerwind Sud/Ost wind farm in the German North Sea and the ferry company Stena Line offering commercial cruises to the Anholt wind farm off North Denmark) and the UK (e.g. boat operators out of Ramsgate Harbour to Thanet OWF and the London Array). A study in Delaware USA, investigated the effect of offshore wind farms on coastal tourism by showing tourists photo-simulations of OWFs and enquiring about the effect it would have on visitation to the beach. The study found that the percentage of tourists who would be attracted to a beach with offshore wind turbines (66%) and the proportion stating they would pay to take a boat tour of the wind farm (44%) were greater than the percentage of tourists (26%) who stated that they would switch beaches (i.e. avoid that beach) if there was an OWF 10km offshore (Blades Lilley *et al*., 2010).

In general, the designation of a marine protected area may enhance eco-tourism through protection of biodiversity which may benefit recreational diving, sea angling and other forms of eco-tourism such as bird watching (see Section 12). The economic gain would be reflected in increased willingness to pay for the enhanced recreation/amenity experience and increases in participation rates (MMO1010). With regards to specific effects of MPAs on tourism, examples from the UK, Europe and Australia are provided below.

The research of Pike *et al*. (2010) showed that Marine and Coastal Protected Areas (MCPAs) are of great importance economically and to the tourism industry as well as in terms of conservation. A cost benefit analysis of MPAs in Lyme Bay, Dorset showed that one of the perceived economic benefits of MPAs by stakeholders was the potential for increased tourism. For example a stakeholder response provided to a questionnaire to collect data on the perception and levels of support of stakeholders for the MPA was “more people will come to the area because of the MPA” (Rees *et al*., 2013).

A study in Southern Europe estimated the benefits of MPAs in Southern Europe, by undertaking a field survey of expenditure by recreational visitors (e.g. recreational fishing and scuba diving) and used this to estimate the number of tourism jobs and expenditure generated by the MPA. The results estimated that on average 15 jobs and €639,000 of added value was generated per MPA (Roncin *et al*., 2008).

In a global review of the conservation and socio economic improvements arising from coral reef management in MPAs, 85% of coral reef MPA managers surveyed reported that they had seen tourist visits to the MPA increase (Hargreaves-Allen, 2011).

Changes in seascape or landscape – visual impacts and potential indirect effects on tourism

Changes in seascape or landscape associated with MPS activity infrastructure (e.g. offshore renewable arrays, port developments, aquaculture installations) may change the perceived attractiveness or quality of a landscape/seascape for a visitor (tourist). It is possible that such a change in landscape or seascape setting may indirectly impact on tourism performance (the number of tourists and tourism expenditure) if the change in the landscape or seascape deters visitors from returning to that area in the future.

Potential Impacts of OWFs

There are numerous studies which have assessed people's perceptions of developments such as offshore windfarms (OWFs). However, despite the existence of OWFs in the UK, there is very little/no evidence of the indirect effect of OWFs on tourism.

Numerous studies have assessed the attitude and reactions of visitors to wind farms (mainly onshore) in the UK, Europe and reviews of these studies are provided by Riddington *et al*. (2008), The Tourism Company (2012) and Aitchison (2012). In general, studies show that the majority of visitors would not be deterred from visiting or returning to an area by the presence or expansion of onshore wind farms (75-99% would not be deterred, results from multiple studies cited in The Tourism Company, 2012 and Aitchison, 2012). General observations from these studies included (The Tourism Company, 2012):

- Only a minority of tourists appear to be negative about wind turbines and believe that they spoil the landscape. However, this is a significant minority.
- In general, tourists prefer to see wind farms in the distance and preferably offshore.
- Wind turbines are not seen as negatively as some other structures in the countryside, notably pylons.
- Evidence is mixed on the proportion of tourists who may choose to stay away from areas with wind turbines in future. While this may be a relatively small minority it could be quite damaging to markets in certain locations.

There is less evidence relating specifically to the potential impacts of offshore wind farms on tourism.

A study in Delaware USA, showed that 74% of tourists reported they would visit the same beach if a wind farm existed 10km from shore, while 26% said they would switch beaches (i.e. avoid that beach) (it should be noted that the number of tourists who would visit the same beach if a wind farm existed 0.9 miles offshore was 55% and 45% stated they would switch beaches or not go to a Delaware beach at all) (Blades Lilley *et al*., 2010). As already described above, the number of tourists that stated they would avoid that beach was smaller than the percentage of tourists who stated that would be attracted to a beach with offshore wind turbines (66%) and take a boat tour of the wind farm (44%) (see also creation of new tourist attraction above).

In Denmark, Kuehn (2003) found neither a decrease in the community's tourism levels nor any reduction in the price of summer house rentals one year following construction of the Horn Rev offshore wind farm (summarised in Blades Lilley *et al*., 2010).

In the UK, a public attitude survey towards the operational North Hoyle OWF in North Wales reported that two thirds of residents (67%) stated the presence of the OWF had no effect on the number of people visiting or using the area, with people more likely to state there had been an increase rather than a decrease in numbers (11% stated increase compared with 4% who stated decrease). 82% of visitors did not see any effect on visitor numbers. From reviewing the literature The Tourism Company (2012) concluded that "The negative effect on tourism performance where wind farms have already been established may not be as great as some people fear. However, far too little firm longitudinal evidence on this is available."

The most recent analysis of the impacts of OWFs (construction and operational phases) on the tourism sector was undertaken by Navitus Bay Development Ltd (2013), as part of a preliminary assessment of potential environmental impacts of Navitus Bay OWF. The review used information from eight existing OWFs in the UK (Robin Rigg, Barrow, Burbo Bank, Rhyl Flats, Kentish Flats, Lynn, Inner Dowsing and Scroby Sands). Assessment of standard VisitBritain data in areas where there are existing Round 1 OWFs indicated that people were not being discouraged from visiting areas with OWFs as there was no pattern of adverse impacts on tourism trips and nights by domestic tourists from OWF projects. This conclusion was supported from anecdotal evidence from consultation with authorities within whose jurisdiction the OWFs lay. These results were generally consistent with people's and communities expectations of the impacts of the Navitus Bay project on tourism assessed by Navitus Bay Development Ltd (2013) through a visitor survey. For example, about 30% of visitors stated that they were likely or very likely to visit somewhere else during the OWF construction phase with reasons mainly linked to concerns over disruption to beach activity, pollution in the sea caused by construction activity and noise. However, the comments suggested that changes in behaviour would be conditional on the project causing disturbance or pollution, with the implication that should this not occur then behaviour would not change. A tourism business survey was also conducted to assess whether the businesses anticipated any effects of the OWF. The majority of businesses (54%) considered the development of the OWF would have no impact on their business, while a further 12% expected it to have a low or minimal impact; 7% of businesses expected the project to have beneficial impacts on trading (through increased custom for accommodation providers for OWF workers and/or because the OWF would act as a new visitor attraction and bring additional visitors to the area). However, 28% considered that impacts would either be medium or high adverse citing reasons including visual impacts on the coastal views, noise impacts and light pollution at night.

There is also the potential for offshore wind farm development to adversely affect investment in new resort development in circumstances, where such development is promoted on the basis of a rural location and uncluttered seascapes, for example, golfing or water sports resorts. The Tourism Company (2012) stated that while few tourism enterprises are opposed to wind energy generation in principle, many have concerns about the future effect of wind turbines on their business. However, evidence relating to impacts from offshore wind farms specifically on visitors to coastal/links courses are unknown (summarised in Marine Scotland, 2013a).

Overall, research from the UK has demonstrated that wind farms are very unlikely to have any adverse impact on tourist numbers (volume), tourist expenditure (value) or tourism experience (satisfaction) (Riddington *et al*., 2008; Aitchison, 2004). Moreover, to date, there is no evidence to demonstrate that any wind farm development in the UK or overseas has resulted in any adverse impact on tourism (Aitchison, 2012; Navitus Bay development Ltd, 2013).

Potential impacts of aquaculture

A survey of tourists in Scotland (Mull and Oban, Outer Hebrides and Shetland) showed that when tourists were asked to focus on the effect of specific aspects of fish farming, including perception of the area, impact on scenery, natural environment, recreational activities and willingness to re-visit, 91% of respondents stated the current level of fish farming would have no effect (positive or negative) on their willingness to re-visit. Although 48% of respondents believed that expansion of fish farming would negatively impact the scenery and 46% believed that it would negatively impact the natural environment, respondents stated that further development or expansion of fish farming would not affect their willingness to re-visit (Nimmo *et al*., 2011).

Water quality – reduction in bathing water quality

Healthy beaches and clean waters attract people to the coast and enable participation in water-based recreation in a safe manner (MMO, 2013d). For example, any activity that resulted in oil in the water or on the shore (e.g. due to an accidental spillage or maritime incident) may potentially disrupt traditional coastal activities (e.g. bathing, boating, angling, diving), which in turn may affect local tourism businesses (hotels, restaurants, accommodation providers, etc.). Food service related businesses may also be impacted if the supply of local seafood is reduced (ITOPF, undated).

As noted above, a visitor survey undertaken by Navitus Bay development Ltd (2013) showed that about 30% of visitors surveyed stated that they would be likely or very likely to visit another destination during the construction phase of Navitus Bay windfarm related to concerns about pollution, including pollution in the sea caused by construction activity. However, the comments suggested that the visitor behaviour was conditional on the project causing such pollution effects implying that their behaviour would not change if the impact did not occur.

Disturbance to wildlife or heritage assets

Commercial wildlife boat trips such as whale watching trips have the potential to be impacted directly by the physical presence of offshore infrastructure (e.g. OWFs) by making access difficult to routes often used by the boats or by interrupting lines of sight while scanning for wildlife. In addition, changes to the abundance or distribution of target species in an area arising from potential environmental impacts (e.g. disturbance from construction and/or operational noise arising from any development or maintenance vessels) could cause ‘knock-on’ effects to the marine wildlife tourism sector. Although there is some uncertainty concerning actual environmental impacts, such risks are generally considered to be low. In particular, most of the species of interest to marine ecotourism such as cetaceans, seals and seabirds are protected under the EC Birds and Habitats Directives. This places a legal obligation to ensure that adverse effects on the integrity of designated sites are protected and also gives wider provisions to avoid or minimise disturbance of protected species (ABPmer *et al*., 2011).

There is the potential for MPS activities to damage known and currently undiscovered heritage assets. However, such activities would be licensed with an MPS focus on effective management of such activities to ensure that the significance of heritage assets is accounted for in terms of current and future value. As such, it was not considered likely that there would be any interaction that would lead to an indirect impact on the tourism sector (and no evidence was found to suggest otherwise).

Establishing significance

The review has found little evidence of significance levels of impacts of interactions between tourism and other MPS activities. The significance of social impacts are likely to be site specific and related to the socio-economic context, including the community dependence on the tourism industry within a given location.

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5. Spatial Representation of Social Impacts

5.1 Introduction

An important component of this study has been to explore approaches for representing beneficial social impacts and interactions spatially on maps. Understanding how spatial data sets can be created and utilised for investigating social impacts is particularly important for marine planning, given the importance of spatial interactions between activities in determining planning policies. However it is rare to find spatial representations of social impacts, with the majority of maps and discussions focussed on economic and environmental impacts. This is largely a product of the available data. Quantitative, spatially explicit data on social issues is very limited in comparison to that for economic and environmental issues. Typically social data is of a qualitative nature making it difficult to use in a traditional spatial mapping processes. Furthermore, there are important context and distributional issues which make generalisation of social impacts difficult. There is not a plan to operationalise the following exploration at this time. It is expected that further development and stakeholder validation will be carried out before any attempts to pilot such an approach.

This section of the current study sought to explore how both quantitative and qualitative social data/information could be spatialised to enable consideration of social benefits, and areas where overlapping activities may act to diminish the flow of social benefits, within the marine planning process. The method and its outputs are illustrative of what could be done to better account for social issues in spatial representation outputs for marine planning. A method has been designed that is consistent in its coverage of the MPS sectors, thereby allowing the spatial data layers of different sectors to be overlaid and contrasted.

The methodology is applied to a case study for the South Inshore and Offshore Marine Plan Areas (hereafter 'South marine plan areas'). It makes use of available spatial data on MPS sectors collated to inform development of the South Marine Plans, together with information on the indicative social impacts and interactions between MPS activities collated within this study.

The approach identifies a short-list of the most relevant beneficial social impact types to this project based on the outputs detailed in section 4 (see Table 3 for the classification of social impact 'types' adopted for this exercise). It uses the information identified in this project to spatialise each of the potentially significant social benefits associated with each of the MPS sectors/sub-sectors identified in Section 4, where possible. By combining these data layers it is then possible to identify areas of high social value that may be at risk as a result of spatial interactions between MPS sectors.

5.2 Methodology

The spatialisation exercise for the South marine plan areas was undertaken through completion of the following steps:

- Step 1 – Identify and collate available spatial data on the distribution and intensity of current and potential future MPS sectors.
- Step 2 – Identify the potentially significant social impacts for each MPS sector.
- Step 3 – Collate information to quantify significant social benefits for each MPS sector.
- Step 4 – Define decision rules to spatialise each social benefit.
- Step 5 – Apply rules to spatialise social benefits for each MPS sector.
- Step 6 – Combine resulting data layers within each MPS sector to create a single social benefit layer (referred to as a social 'heat' map) for each MPS sector.
- Step 7 – Identify locations where interactions between sectors may diminish the flow of social benefits (e.g. where one activity may result in the reduction of social benefits from another).

Step 1 - Collation of spatial data on MPS activities
Spatial data on the current and potential future distribution and intensity of MPS activities was obtained from a number of sources including:

- MMO Master Data Register[13].
- MMO 1039 South marine plan areas futures analysis (MMO, 2013b).
- MMO 1040 Spatial trends in aquaculture potential in the South and East Inshore and Offshore Marine Plan Areas (MMO, 2013c).
- MMO 1051 Future trends in fishing and aquaculture in the South Inshore and Offshore Marine Plan Areas (MMO, 2013d).
- South Inshore and South Offshore Marine Plan Areas: South Plans Analytical Report (SPAR) (MMO, 2013e).

The information collated was held within a geodatabase (ArcGIS v9.3.1) and a list of data layers used within the case study is presented in Annex 1.

It should be noted that the primary aim of this aspect of the study was to devise a methodology for spatially representing social data and not an exhaustive spatial data collation exercise. As such, the MMO Master Data Register, which contains a large amount of MPS activity data, and the reports listed above, which contain information on both current and projected activity levels, were considered to provide a sufficiently comprehensive data set on which to propose such a methodology, using the South marine plan areas as a case study. Where data limitations or gaps were identified, these are highlighted in the 'Issues and Limitations' section (5.4) and recommendations made for future development of the spatial analysis of social impacts within and between sectors.

It should also be noted that a lack of quantitative social data for a number of sectors (carbon capture and storage, offshore electricity works and telecommunications) prevented spatial assessment of these sectors (see Step 3 below). The oil and gas sector was also omitted from the analysis as there are no oil or gas fields in the case study marine plans areas (although there are supporting downstream activities).

Step 2 - Identification of potentially significant social benefits

[13] http://www.marinemanagement.org.uk/evidence/mdr.htm

Table 29 provides a summary of the most 'significant' social benefits judged to be provided by each sector activity and being taken forward in the spatial analysis. These were identified based on the review outputs presented in section 4 and relate to a sub-set of the full list of social impact types (see Table 3). For those represented only by qualitative data this is necessarily a difficult judgement.

The rationale is that if a given sector (e.g. fisheries) provides a significant social benefit, then any other sector development or activity which excludes or restricts fishing activity is likely to diminish the flow of social benefits from the fishing industry. The social benefits of income and employment were considered to be significant for all sectors included in the analysis (except MPAs).

Due to the methodology employed, sectors for which no income or employment indicator data was available were not included in the analysis. The types and sources of quantitative data and qualitative information used within the spatialisation of social benefits are described in Step 3.

Table 29: Potentially significant social benefits associated with MPS sectors.

MPS activity	Income	Employment	Social Cohesion	Culture	Environment
Aquaculture	✔	✔			
Carbon Capture and Storage (CCS)	No data	No data	-	-	-
Commercial Fishing	✔	✔	✔	✔	
Commercial Shipping	✔	✔	✔		
Defence	✔	✔	✔		
Marine Aggregates	✔	✔			
Marine Protected Areas (MPAs)	Not relevant	Not relevant			✔
Nuclear Energy	✔	✔			
Offshore Renewables	✔	✔			✔
Offshore Electricity Works	No data	No data	-	-	-
Oil and Gas	No data	No data	-	-	-
Ports, Dredging and Disposal	✔	✔			
Recreation	✔	✔		✔	
Recreational Boating	✔	✔		✔	
Surface Water and Waste Water Management	✔	✔			
Tourism	✔	✔		✔	
Telecom Cables	No data	No data	-	-	-

Step 3 - Collation of quantitative information on social impacts
Information on key potential social benefits of MPS activities within the South marine plan areas identified in Step 2 was collated primarily from the following sources:

- MMO 1039 South marine plan areas futures analysis (MMO, 2013b).

- MMO 1050 Economic baseline assessment of the South Coast (MMO, 2013f).

The following types of information were used to quantify specific social impacts:

- Income – estimates of Gross Value Added (GVA) are available for most MPS sectors and were therefore used as a substitute for income as there is a lack of available data on average incomes for individual MPS sectors.
- Employment – estimates of employment are available for most MPS activities.
- Social cohesion – there is no direct quantitative information on how specific MPS sectors contribute to social cohesion (a 'community' related social benefit). The three sectors for which current evidence suggests that this impact is particularly relevant in the South marine plan areas are commercial fishing, defence (particularly HMNB Portsmouth) and shipping (life-line ferry services):
    - Commercial fishing - information on the 'fishing dependency' (% of population employed within the marine fishing catch sector) of wards within the South marine plan areas was used to indicate the potential contribution to social cohesion.
    - Defence – information on employment at HMNB Portsmouth was used to indicate the potential contribution to social cohesion; and
    - Shipping – information on local ferry services (Automatic Identification System (AIS) density) in the South marine plan areas was used to indicate the potential contribution to social cohesion.
- Culture – there is no direct quantitative information on how specific MPS sectors contribute to cultural benefits. Different information has been used for different MPS sectors:
    - Commercial fisheries – information on the number of under 10m vessels at fishing ports within the South marine plan areas was used to indicate the potential contribution to culture.
    - Recreation, recreational boating and tourism – information on the number of individuals engaged in the activity has been used to support quantification of social impacts.
- Environment – different information has been used for different MPS sectors:
    - Offshore renewables – estimate of gross carbon savings based on electricity generation (see Annex 2).
    - Marine Protected Areas – estimated non-market benefits from the conservation of ecosystem goods and services (using the transfer value methodology of McVittie and Moran, 2010).

As noted above, no GVA or employment data were available for the following sectors in the South marine plan areas and as such it was not possible to include them in the spatial analysis of social impacts:

- Carbon capture and storage
- Offshore electricity works
- Oil and Gas
- Telecommunication cables.

Step 4 - Define spatialisation 'rules'

Based on the available spatial data and information to inform the quantification of impacts, a series of rules were developed to spatialise each potentially significant social benefit relating to each MPS sector (see Annex 1). It is noted that the methods used to spatialise social benefits are particularly dependent on available data and are subject to the inherent limitations of these data sets. The rule definitions inevitably involve an element of judgement and this is acknowledged as a limitation of the work.

For example, for income and employment, the rules essentially sought to spatialise overall South marine plan areas values based on the relative spatial intensity of the activity. Thus, for commercial fishing, GVA (a proxy for income) and employment were distributed over the plan areas in proportion to the landings values per 1/200th ICES rectangle. It is recognised that this approach adopts a number of simplifying assumptions, for example that there is a relationship between effort (employment) and landings, and that profitability (GVA) is constant across all gear types and species.

The limitations of the data sets used to spatialise social benefits, the 'spatialisation rules' applied to the data for each MPS sector to enable it to be spatially represented, and the assumptions underlying these rules, are described in Annex 1.

Step 5 - Application of spatialisation 'rules'
The rules were applied to the existing spatial data to create a series of social impact data layers for each MPS sector for which potentially significant social benefits were identified. These data layers were created and stored within Arc GIS 9.3.1. Figures showing the spatialisation of GVA (as a proxy for income) and employment for each MPS sector are shown in Annex 1 and represent the spatial distribution of the societal benefits relating to income and employment in the marine environment from each sector. These layers were combined with the spatialised qualitative social benefits (social cohesion, culture and/or environmental social benefits) provided by each sector as described in Step 6 below (and in further detail in Annex 1), to produce combined social benefit 'heat maps' for each sector and for all sectors combined.

Step 6 - Combining social impacts within and across MPS sectors
In order to ensure consistency across different MPS sectors and across different types of social benefit, a weighting and scoring system was applied to the different social benefits. This allowed different types of social benefit for a given MPS sector to be combined to produce a single social benefit heat map, which could be compared to other MPS sectors on a consistent basis. The social benefits included for each sector are tabulated in annex 1. The following weighting and scoring criteria were applied:

- The intensity of income/km^2 (using GVA as a proxy) across different MPS sectors was converted to a common scale ranging from 0 to 100.
- The intensity of employment/km^2 across different MPS sectors was converted to a common scale ranging from 0 to 100.
- For fisheries, quantitative social cohesion values were obtained by multiplying the intensity of employment value by a social cohesion factor ranging from 0 to 5, depending on the number of under 10m vessels associated with

individual home ports, to account for the importance of commercial fisheries employment in contributing to social cohesion.

- For defence, quantitative social cohesion values were obtained by multiplying the employment value associated with HMNB Portsmouth by a social cohesion factor of 5, to account for the importance of defence employment in contributing to social cohesion in the Portsmouth area.
- For shipping, quantitative social cohesion values were obtained by multiplying the intensity of GVA/km^2 by a factor of 10 in those shipping density grid cells that were intersected by life-line local ferry services, to account for the importance of these services in contributing to social cohesion.
- For fisheries, quantitative cultural values were obtained by multiplying the employment values by a factor ranging from 0 to 5, to account for the importance of commercial fisheries employment in contributing to culture.
- For recreation (including recreational boating) and tourism, quantitative cultural values were obtained by multiplying the employment values by a factor of 1, to account for the importance of these activities in contributing to culture.
- For offshore renewables, quantitative cultural values were obtained by multiplying the intensity of GVA value by an environmental factor of 3.27, to account for the benefit associated with carbon savings (see Annex 2). This factor was derived by multiplying the gross carbon savings per annum by the non-traded carbon price to derive a notional economic value for the carbon savings which could be compared with the GVA value.
- For MPAs, the estimated ecosystem services benefit/km^2 was scaled on a common basis to the GVA intensity.

Using these rules a series of MPS sector specific social benefit maps were created in Arc GIS 9.3.1 (see Annex 1). A combined social benefit ‘heat map’, showing the indicative distribution of the combined social benefits from each MPS sector in the South marine plan areas was then created, together with an overall social benefit ‘heat map’ showing the indicative distribution of the combined social benefits from all MPS activities within the South marine plan areas. These social benefit ‘heat maps’ are shown in Figures 3 to 14 and described further in Section 5.3.

Step 7 - Identifying locations where interactions may give rise to significant social impacts

Each social benefit heat map was overlain with spatial data for the other MPS sectors to determine where spatial interactions (overlaps) may occur. The significance of any interaction was determined from the following factors:

- The nature of the overlapping activities and the likelihood that any spatial overlap had the potential to give rise to a significant interaction or social impact.
- The size of the area of overlap with other sector activities (i.e. the scale of the interaction) – for example if a marine area of high social benefit for commercial fisheries is intersected by a relatively small section of an OWF exclusion zone, this will be less significant than if a large OWF exclusion zones completely encompasses the important social area for commercial fisheries.

- 'Intensity' of the activity (captured within the social benefits 'heat maps'; see Steps 3 to 5 above) – for example, if interactions occur in an area in which another MPS sector activity is low this will be less significant than if the interaction occurs in an activity 'hotspot'.
- The level of dependency on the sector or area containing the resource – (captured within the social benefits 'heat maps'; see Steps 3 to 5 above) – for example, interactions occurring in an area of high social importance (a combination of the activities contribution to income, employment, social cohesion, culture and environment) will be more significant than an interaction occurring in an area of relatively lower social importance. Alternatively, the level of dependency may be high if the resource (e.g. important commercial fish species, shellfish brood stock or seed, specific aggregate type, essential military Practice and Exercise Areas [PEXA]) is spatially confined to that area.

5.3 Results

Social impacts within and across MPS sectors
The social benefit 'heat maps' for each MPS sector are shown in Figures A3.1 to A3.17 (Annex 3). These maps show the potential spatial distribution of all combined social benefits (i.e. related to income, employment, social cohesion, culture and environment) across the South marine plan areas for each MPS sector. In these figures, the higher the 'social benefit index', the greater the overall social benefit derived from that area of sea by that sector activity.

It is of note that in spatialising social impacts, the study has also necessarily had to spatialise key economic impacts such as employment and GVA and that the work therefore has wider utility within impact assessments.

In general, MPS sectors that have a large economic impact also have a high social benefit 'index'. This reflects the importance attached to income and employment as social benefits, which is consistent with the evidence reviewed. Due to the methods utilised in this project there is a direct correlation of the income and employment benefits with the economic impact of the sector in terms of GVA and employment; although this is also a function of the spatial intensity of the activity. The sectors highlighted include marine aggregates, shipping, military defence, offshore renewables and ports, dredging and disposal (Figures A3.1, A3.4, A3.5, A3.8 and A3.9 respectively).

However, the methodology has sought to emphasize beneficial social impacts such as social cohesion and culture in addition to the benefits of income and employment. Therefore sectors which provide such social benefits also demonstrate a relatively high social benefit index. For example, for the commercial fishing sector, the highest social benefits are identified in inshore waters (Figure 5), reflecting the social importance of the inshore fishing fleet to social cohesion and culture in the coastal communities where these fleets are based. Similarly, due to the relatively high value that society places on the protection of marine biodiversity, the methodology has highlighted a relatively high social benefit index associated with MPAs (Figure A3.6).

Nuclear energy has a relatively high social benefit index despite GVA and employment being lower compared to many of the other sectors. This is because these social benefits are generated in and assigned to a small marine area.

While the social benefits of recreation are large, within the spatial model used in this study, the social value of recreational activity has been distributed evenly over the inshore waters (Figure A3.10). This results in a relatively low intensity of social benefit across the marine plan areas. Improved spatial data on locations of particular value to recreational activities and further methodological development would improve future analysis of social benefits for this sector. For example, in relation to recreational boating it is likely that a significant proportion of social value is associated with marinas, local harbours and major estuaries, and methods could be developed in the future to assign a larger proportion of social value to these areas.

Similarly, for aquaculture, in the absence of information on the location of shellfish aquaculture installations (for reasons of commercial confidentiality), the social benefit of shellfish aquaculture has been distributed over existing shellfish harvesting areas (Figure A3.2). This has resulted in a low intensity of social benefit over these areas. The use of data on the location of shellfish farms and species production tonnage per farm would enable the social benefits of this sector to be better represented

Particular difficulty was encountered in trying to spatially assign social benefits associated with tourism in this analysis, as the aim was to map social benefits in the marine area. While information is available on the economic value of tourism to seaside towns it is difficult to apportion this value spatially, particularly to the marine area. Within this study a proportion of the social value has been assigned to intertidal areas fronting seaside towns (Figure A3.12), but further methodological development is required if such values are to be mapped more reliably. The separation of recreation from tourism is a notable issue making representation of tourism activity over marine areas particularly problematic.

The combined social benefits ‘heat map’ for all activities is shown in Figure A3.13. This figure shows the indicative distribution of social benefits from all MPS sectors in the South marine plan areas. As such it highlights the relative importance of marine areas with respect to their ‘social value’. The map indicates the higher social value of inshore areas, particularly on account of sectors such as ports, defence, tourism and fishing. Further offshore, higher social value areas are associated with the more intensive economic development sectors such as marine aggregate extraction and, potentially in the future, offshore renewables development.

Ultimately the relative distribution and scale of social benefits of each sector are affected by the choice of spatial attribute, social impact type and benefit weighting. A significant level of further analysis could be carried out for each sector to generate more detailed and comprehensive spatial data layers, and research and/or stakeholder input could usefully help to formulate appropriate weights.

Identifying locations where interactions may give rise to significant social impacts

As described above, each MPS sector social benefit map was overlain with spatial data for the other MPS sectors to determine where spatial interactions (overlaps) may occur in relation to areas of current and potential future activity. Where an area that had a relatively 'high' social benefit index overlapped with another sector activity, judgement was used, with reference to the review outputs presented in section 4, to determine whether:

i. The two activities already co-exist, or could co-exist, without significant effects on each sector's beneficial social value.
ii. If it was determined that activities could not co-exist without significant effects on their social value, the magnitude of this impact was considered based on the scale of the overlap, intensity of the activities and social dependency on the activity (as described in Step 7 above).

From the overlaps that occurred, the following sector interactions were identified as having potentially significant negative impacts on one or both of the sectors' social benefits:

- Offshore renewables and commercial fishing
- Offshore renewables and commercial shipping
- MPAs and ports
- MPAs and fishing.

Figures A3.14 and A3.15 show the location of offshore renewable lease areas in relation to areas of social importance to the fishing industry and the shipping industry respectively. These figures suggest that the location of offshore renewable lease areas do not coincide with the areas of highest social benefit for commercial fishing and shipping. Thus the interactions may potentially give rise to some reduction in social benefits from the fishing and shipping sectors. This is in line with the findings of an impact assessment of draft plans for offshore wind, wave and tidal development in Scottish waters (Marine Scotland, 2013b).

Figure A3.16 shows the location of MPAs in relation to areas of social importance to the ports sectors. The figure suggests that MPAs around the Isle of Wight overlap with areas of high social value around Portsmouth and Southampton. In responding to consultations on proposals for MCZs, the ports sector has highlighted concerns about the potential operational impacts of designating some of the recommended MCZs.

Figure A3.17 shows the location of MPAs in relation to areas of social importance to the fishing industry. The figure suggests that MPAs along the coastline overlap with some of the areas of highest social value for fisheries. If these fishing activities are incompatible, depending on the management imposed upon them, this interaction may result in significant (negative) impacts on the social benefits derived from fishing. Again, this is in line with the findings of an impact assessment for Scottish Nature Conservation MPAs (Marine Scotland, 2013a) which identified some potential for negative social impacts within the fishing sector associated with the displacement of fishermen from inshore fishing grounds.

5.4 Issues and limitations

A number of significant limitations have been encountered in seeking to spatialise social values in the marine environment. These include:

- A general lack of qualitative data on the social impacts of MPS activities, the mechanisms to quantify and spatially map it.
- A limited understanding of the factors that drive the contribution of MPS sectors to social cohesion, culture and environment-related social benefits (as well as those impact types not utilised in this spatial mapping exercise), thus requiring the use of simplistic assumptions based on this limited understanding.
- A general absence of information on income relating to individual sectors (GVA has been used as a proxy).
- Incomplete information on GVA and employment across MPS activities;
- Challenges in seeking to present different dimensions of social impact on a common basis. This has required the use of a weighting and scoring system as part of a multi-criteria analysis, necessitating judgements to be made about relative weightings to be applied to different types of social impact within and across MPS sectors.
- A lack of spatially resolved data on the distribution and intensity of marine activities. This has particularly been the case for aquaculture, categories of recreational activity and tourism, but limitations also exist for many other activities. This limits the extent to which it is possible to spatially resolve social impacts and leads to averaging of values over large spatial areas or the use of simplistic assumptions.
- Uncertainty concerning how the distribution and intensity of MPS sectors may change in the future.
- Beyond a sectoral split, no meaningful depiction of the distribution of social benefits across society was possible.

6. Conclusions and Recommendations

Evidence on the social impacts of marine sectors, and in particular on the social impacts of their interaction, is limited. There are a growing number of research projects linked to the social impacts of marine sectors and their interactions, particularly linked to the ecosystem services paradigm. However this is largely through economic-ecology research, with a particular focus on economic valuation; although even here it is still early days. There appears to be less research using more qualitative methods.

However in many instances non-marine based evidence is appropriately transferable; for example on the social benefits of employment and social costs of unemployment, and on the health benefits of active recreation and engagement with the natural environment. Research on these issues in a marine and coastal context is limited, but developing.

The growing evidence base is useful for understanding the nature of social impacts that can occur as a result of sector interactions, however in reality the social impact of any given interaction will always be context specific and as such it is very difficult to generalise on the significance of any given interaction. The growing evidence base can also be used to start to understand an individual's, community's and sector's social characteristics. In addition to the fundamental interaction, the significance of any social impact of an interaction will depend on the characteristics of the individual / community / sector affected, including their /its vulnerability, adaptability and preferences.

A broad number of potential social impacts of marine sectors and their interactions were identified and explained and in this project. Notable points include:

- Employment is recognised as the most important means by which to fulfil material wellbeing, as well as being central to individual identity and social status and an important contributor to physical and mental health. Some marine sectors e.g. oil & gas and ports, help to generate nationally significant quantities of jobs and can therefore be thought of as significant generators of social benefit. For other sectors, most notably commercial fishing, which are less significant employers, social benefits linked to way of life and personal and community identity can be particularly significant.
- Where a certain activity has taken place in an area for a long time, it can become a strong feature of that community's and location's identity and sense of place. The social networks that are generated between long-term workers and residents can help to build community cohesion. Whilst economic restructuring often offers economic, and in turn employment and income, benefits, it can also erode the traditional identity or sense of place of a community or location.
- Degradation and enhancement of the natural environment can affect a number of sectors, most notably the commercial fishing, recreation and tourism sectors. The development of offshore infrastructure (most notably offshore wind farms) is often perceived to have a negative impact on the experience of recreation participants and tourists, although this does not necessarily hold true once the infrastructure is in place. MPAs are currently

seen as a key tool for enhancing the quality of the UK marine environment. There is some evidence of potential benefits to commercial fishing, recreation and tourism, although the UK evidence base is very limited.

As a result of the evidence base review and manipulation of information to create social interaction-impact tables, a number of recommendations for future research were made. These are:

R1: Primary research to establish a broad set of marine-specific social indicators
Primary research could be usefully carried out to develop both a better understanding of the most policy-relevant social issues for marine planning; and to development quantitative indicators which can be meaningfully analysed and interpreted to understand social impact and social change.

R2: How MPS sectors contribute to costal community social cohesion and culture
There is a general lack of MPS sector-specific research on issues around social cohesion and culture. Research to better understand how MPS sectors contribute to these issues in coastal communities will provide a better baseline position from which to develop understandings of how changes in those sectors (via interactions or otherwise) will affect coastal communities.

R3: Improved mapping of marine sector activities to Standard Industrial Classification (SIC) codes
Employment is recognised as the most important means by which to fulfil material wellbeing, as well as being central to individual identity and social status and an important contributor to physical and mental health and community cohesion. As such it can act as a good high level indicator of the social impact of marine sector activity. Whilst some marine activities can be readily mapped using 4-digit SICs, others, such as offshore renewable energy cannot. It is understood that exploratory work of this nature may be undertaken via research project MMO1075[14].

R4: Commercial fishing non-market economic valuation
Including economic valuation of the non-market benefits of local fishing fleets[15] may help to demonstrate the social value of the sector; for example the role of local fleets in providing sense of place to local communities and for tourists. Enabling monetisation of such social values will allow it to be represented in economic decision-making tools such as cost benefit analysis (CBA).

R5: Commercial fishing / fishing community social indicators and profiles
Readily available social indicators for commercial fishing are predominantly economic and socio-economic (Delaney, 2008 and MRAG *et al.*, 2013). Truly social indicators are not generally available. In part this is because many social impact concepts, such as social capital, may be best measured using subjective indicators

[14] This evidence project is published simultaneously with this one despite being not being available at the time of writing and is available from https://www.gov.uk/government/collections/evidence-register-and-reports
[15] An economic valuation of this nature is being undertaken as part of the GIFS project, which is expected to report in September 2014.

(Rolfe, 2006). Research by MRAG *et al.* (2013) to devise a set of social and socio-economic indicators concluded that 'subjective measures and perceptions of individual and collective status were often viewed as being at least as important as income', particularly if the aim is to understand the overall wellbeing of fishers and their communities. Research using qualitative geographic information systems (GIS), may help to uncover and map insights into the social and cultural contribution of fisheries to coastal communities (Urquhart *et al.*, 2011) and what constitutes 'sense of place'. In relation to specific marine plan policies, or as part of early evidence gathering for marine plan areas, there may be the opportunity for the MMO to develop fishing community profiles through targeted research to develop social information and indicators to input to both the planning process and monitoring as well as impact assessments.

R6: *Ex-post* evaluation of social impacts in England:
Offshore windfarms: there is very little post-development evaluation evidence on the actual social impacts of OWFs through their effect on the seascape. Ex-post evaluation research could usefully be carried out to assess impacts on the tourism sector and on the subjective health-related benefits of recreation users affected by altered seascapes.

Marine Protected Areas: there is very little ex-post evaluation evidence on the social impacts of UK MPAs. Further research could usefully be carried out in relation to recently designated MPAs on (i) the negative impacts of displacement on commercial fishing, and the positive impacts of spillover effects; and (ii) how recreation participant usage and experience changes with changes in the quality of different environmental features. Methodologies have been developed to explore spatial mapping of estimated social benefits of marine sector activities and to highlight areas where interactions between marine sectors may result in significant impacts to the social benefits provided by each sector.

Commercial fishing: Much of the UK literature on the social impacts resulting from impacts to the fishing industry is focussed on the effects of general decline of the sector in fishing dependent communities in Scotland. Further research is needed to understand the role of fishing in different types of English communities. In particular there is limited literature evaluating the ex-post social impacts of specific sector interaction events that have had an effect on the English commercial fishing sector. The advent of marine plans and designation of a number of European Marine Sites (EMS) and marine conservation zones (MCZ) provides numerous opportunities for evaluations of specific social impacts of interactions of the commercial fishing sector with other sectors and management tools.

Spatialisation of marine social impacts

The methodologies used to spatialise social impacts for each sector are subject to the limitations of the underlying spatial data. A large number of assumptions need to be made to enable social impacts to be spatialised, including assumptions on weighting and scoring of different types of social impact in order that combined social impact layers can be presented on a consistent basis across the different MPS sectors. In particular, judgements need to be made about the relative importance of impacts such as social cohesion, culture and environment relative to income and employment impacts. In this study, we have deliberately sought to highlight the non-economy-derived social impacts by weighting them by a factor of up to 10. However, this was exploratory work and would need to be developed, refined and peer reviewed prior to use.

The analysis of interactions between MPS sectors based on currently available information identified four inter-sector interactions that hold the greatest potential for significant social impacts:

- Offshore renewables and commercial fishing
- Offshore renewables and shipping
- MPAs and commercial fishing
- MPAs and ports.

Of these four, the interactions between MPAs and inshore commercial fishing are considered to have the greatest potential for social impact, although it remains unclear whether such impacts might be significant at the scale of a marine plan.

Overall, it is important to stress that the primary aim of this exercise was to explore potential ways in which to spatialise the social impacts within and between marine sectors and due to the significant limitations of the data sets used and assumptions made within this methodology, the outputs of this exercise are only indicative. Improved spatial data and quantitative social impact data will enable greater consideration of social issues in the marine spatial planning process.

The spatial framework developed within this study has clear linkages to a number of other MMO research projects including on co-existence (MMO, 2014b), implementation of an ecosystem approach within marine planning (MMO, in prep a) and the development of a strategic cumulative effects framework (MMO, in prep b). The identification of potential social interactions within section 4 and the spatialisation of those interactions is directly relevant to the consideration of the potential for co-existence between different MPS sectors. The outputs also feed directly into the suggested framework for implementing an ecosystem approach within marine planning by providing spatial information on the potentially significant social interactions that may occur between different MPS sectors. The mapping of social impacts and interactions could also support cumulative effects assessment of social impacts. In particular, the maps help to relate social impacts spatially (and the creation of time series maps could present such information temporally) so that the potential cumulative effects of interactions can be understood. While detailed cumulative effects assessment would also need to better understand the relative dependency of MPS sectors on particular resources, the mapping does at least provides a starting point for exploring cumulative effects issues.

Recommendations for future development of social impact maps
Improvements in data availability over time (including data layers on potential future activity) should provide for better characterisation and spatial resolution of social benefits. Whilst fundamental improvements could be made by developing a comprehensive understanding of the temporal, spatial and general distribution of social benefits and how each MPS sector contributes to each social benefit type,

some key areas where improvements could be made in relation to the spatialisation approach set out in this document include:

- Income: it will be challenging to obtain information on employee income for each relevant MPS activity. GVA is considered to be an adequate proxy. Better and more location specific information on GVA will help to better spatially resolve this social benefit. It is likely to continue to be challenging to estimate GVA for MPS activities such as telecom cables or pipelines. Replacement value for these assets may be an alternative measure.
- Employment: better and more location specific information on employment will help to better resolve this benefit. This is only likely to occur in the long-term, if ONS data collection is better able to record marine related employment across all MPS activities which is being explored by MMO. Employment data for MPS activities such as cables and pipelines will continue to be difficult to collect.
- Social cohesion: further research is required to understand how MPS activities contribute to social cohesion and how this can be quantified and spatialised. Suggestions on possible options for improving upon the methods used in this study include:
    - Commercial fisheries – information on community dependency on fishing activities (proportion of population engaged in commercial fishing activity) is likely to be a better measure of its contribution to social cohesion than the simple metric of under 10m vessels. Dependency could be estimated based on local ward data around each home port from ONS Business Register and Employment Survey (BRES). The use of a relative index would help to get round the under-reporting currently experienced in ONS BRES data. It may be useful for this to be combined with new MMO fisheries statistics analysis that establishes employment by home port rather than administration port.
    - Defence – dependency of local wards on naval base employment.
- Culture: further research is required to understand how MPS activities contribute to culture and how this can be quantified and spatialised. Suggestions on possible options for improving upon the methods used in this study include:
    - Commercial fisheries – could link to seascape assessments, identifying fishing ports which contribute to local character, potentially using a ratio of number of vessels to scale of port/town area.
    - Recreation – limitations of current information on distribution and intensity of recreational activities. Relative cultural value of activity - simply based as a factor of employment or other supply side factors e.g. facilities/clubs.
    - Tourism – an improved method for spatialising tourism in the marine environment, as coastal tourism is not wholly dependent on the coastline/beach.
- Environment:
    - Carbon savings – an agreed and standardised method is required for estimating gross carbon savings. It is likely to be better to work out the net present value of gross carbon savings over the lifetime of the asset and then present this as an annualised value. Challenges are likely to remain in seeking to estimate net carbon savings because of the methodological difficulties in taking account of embedded carbon within what are

effectively global supply chains, and in agreeing a suitable counterfactual against which to assess such changes.

- MPAs – better information on ecosystem service values of MPAs and their contribution to an overall network of MPAs – this may help to facilitate better spatial definition within individual MPAs.
- Pollution avoidance – developing a better understanding of the social benefits of pollution avoidance.

Coastal defence – information to help spatially attribute the benefits associated with beach replenishment to the marine aggregates sector.

7. References

This section includes the set of references cited in the main report. A full set of references for each sector interaction-impact table and evidence base can be found in section 4.

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Annex 1: Spatial Representation of Social Impacts

A1.1 List of spatial data sources
Table A1 shows the data sets used for each MPS activity for the spatial representation of social impacts. It should be noted that because there was no GVA or employment data for the carbon capture and storage sector, offshore electricity works, telecommunication cable or oil and gas sectors (the latter as no oil or gas fields are located in the case study area), these activities were excluded from the spatial analysis. Due to the spatial analysis focussing on the South marine plan areas as a case study, the spatial data representing the distribution of current and potential future activity was sourced from recent MMO evidence reports on the South marine plan areas. The table indicates whether the spatial data sources were used to represent current and/or potential future areas of activity.

Table A1: Spatial data sources.

MPS activity	Datasets for current and future activity	Source
Aquaculture	Shellfish harvesting areas (current)	MMO 2013 (Data in figure 31 from Report MMO1051)
	Current and future and future potential areas	MMO 2013 (Data in figures 41, 42, 44, 46, 48, 50, 51; from Report MMO1040)
Carbon capture and storage	No data layers used	
Commercial fishing	Total Value for all UK vessels (MCZ & VMS) (current)	MMO 2013 (Data in figure 24 from Report MMO1051)
Commercial shipping	Total vessel density (current)	MMO 2013 (Data in figure 25, MMO1039)
Defence	Harbour Administrative Areas (UKHO) – Only Portsmouth Naval Base Area (current)	MMO S-57 data layer, February 2014
Marine aggregates	Aggregates Licence Areas (current and potential future)	The Crown Estate, 2014 accessed via http://www.thecrownestate.co.uk/energy-infrastructure/downloads/maps-and-gis-data/ on the 04/02/14
	Aggregates Option Areas & Aggregates Application Areas (potential future)	The Crown Estate, 2014 accessed via http://www.thecrownestate.co.uk/energy-infrastructure/downloads/maps-and-gis-data/ on the 04/02/14
Marine	Marine	Natural England, 2014 accessed via

MPS activity	Datasets for current and future activity	Source
protected areas	Conservation Zones (current and potential future)	http://www.gis.naturalengland.org.uk/pubs/gis/GIS_register.asp on the 04/02/14
	Ramsar Sites (current)	The Joint Nature Conservation Committee, 2014 accessed via http://jncc.defra.gov.uk/protectedsites/SACselection/gis_data/terms_conditions.asp on the 04/02/14
	Special Protection Areas (current)	The Joint Nature Conservation Committee, 2014 accessed via http://jncc.defra.gov.uk/protectedsites/SACselection/gis_data/terms_conditions.asp on the 04/02/14
	Special Areas of Conservation (current)	The Joint Nature Conservation Committee, 2014 accessed via http://jncc.defra.gov.uk/protectedsites/SACselection/gis_data/terms_conditions.asp on the 04/02/14
Nuclear energy	Nuclear power stations (current)	MMO 2013 (Data in figure 12, from Report MMO1039)
Offshore renewables	Tidal sites (future)	The Crown Estate, 2014 accessed via http://www.thecrownestate.co.uk/energy-infrastructure/downloads/maps-and-gis-data/ on the 04/02/14
	Offshore Windfarm lease areas (future)	The Crown Estate, 2014 accessed via http://www.thecrownestate.co.uk/energy-infrastructure/downloads/maps-and-gis-data/ on the 04/02/14
Offshore electricity works	No data layers used	
Ports, dredging and disposal	Port Locations (current)	MMO 2013 (Data in figure 20 from MMO Report 1039)
	Harbour Administrative Areas (UKHO) (current)	MMO S-57 data layer, February 2014
Recreation	Number of divers carried on charter boats (current)	MMO 2013 (Data in figure 31 from MMO Report 1039)
	Annual board based activity (current)	MMO 2013 (Data in figure 34 from MMO Report 1039)

MPS activity	Datasets for current and future activity	Source
	Number of people paddle boarding annually (current)	MMO 2013 (Data in figure 35 from MMO Report 1039)
	Number of sea anglers carried on charter boats (current)	MMO 2013 (Data in figure 36 from MMO Report 1039)
Recreational boating	RYA racing areas & RYA sailing areas (current)	RYA data from MMO (data in figure 30 from Report MMO1039)
Surface and waste water management	River Basin Districts (current)	European Environment Agency accessed via http://www.eea.europa.eu/themes/water/interactive/soe-wfd/wfd-river-basin-district-info-viewer on the 11/02/14
Tourism	Principle seaside towns (current)	MMO 2013 (Data in figure 44 from Report MMO1039)
Telecommunication cables	No data layers used	

A1.2 List of social data sources

Table A2 lists the source of quantitative social data (in the form of GVA and employment) used within the spatial analysis. The original source of the data is available in the references cited.

Table A2: Sources of quantitative social benefit information.

MPS Activity	GVA (£m, 2013/14)	Direct employment (FTEs)	Source
Aquaculture	0.74	42	MMO. 2013a
Carbon capture and storage	No information	No information	MMO, 2013a
Commercial fishing	52	1084	MMO, 2013a
Commercial shipping	831	21,460	MMO, 2013a
Defence	1680	19,800	MMO, 2013a
Marine aggregates	143	178	MMO, 2013a
Nuclear energy (Operation Dungeness B)	29	554	MMO, 2013b
Offshore electricity networks	No information	No information	No information
Offshore renewables – operation Rampion OWF (future)	10.8	75	MMO, 2013a

MPS Activity	GVA (£m, 2013/14)	Direct employment (FTEs)	Source
Offshore renewables – operation Navitus Bay OWF (future)	17	100	MMO, 2013a
Offshore renewables – operation tidal power lease site (future)	No information	No information	No information
Ports, dredging and disposal	1165.61	17,286	MMO, 2013a
Recreation	195	6,581	MMO, 2013a
Tourism	1508	77,287	MMO, 2013a
Telecommunication cables	No information	No information	No information

A1.3 Spatialisation rules and data limitations

Based on the available spatial data and information to inform the quantification of spatial impacts, a series of rules were developed to spatialise each potentially significant social benefit relating to each MPS activity and these are described in Tables A3 to A13 below. A summary of which 'significant' social benefits were considered to be associated with each MPS activity for inclusion in the spatial analysis is provided in Table 29. It should be noted that the methods that have been used to spatialise social impacts are particularly dependent on the available data and are subject to the inherent limitations of these data sets. These limitations are also noted in the table below. The rule definitions inevitably involve an element of judgement and this is acknowledged as a limitation of the work. Where no spatialisation rule has been applied (indicated by 'n/a' in the tables) following the review of evidence, this indicates that the activity was not considered to contribute significantly to that 'type' of social benefit.

Table A3: Spatialisation rules and data limitations for Aquaculture.

Social Criteria	Data and spatialisation rules	Data limitations
Income (GVA)	Social data: total GVA for aquaculture in the South marine plan areas; Spatial area applied to: Shellfish harvesting areas for each species (km^2); Spatial rule: GVA was distributed over shellfish harvesting areas (for each species cultivated) in proportion to the 'value'* of the species farmed (see below). Where shellfish harvesting areas overlapped the sum of the GVA value was calculated. * For each shellfish species (mussels, Pacific oysters, native oysters and clams) 'value' was calculated as: market prices x total production tonnage of species in the south marine plan areas.	Shellfish harvesting areas are not specific to aquaculture (wild harvesting may occur) and may not contain the aquaculture production businesses responsible for the shellfish produced (aquaculture installations may be located outside of these areas due to depuration re-laying arrangements); Information on the location of aquaculture production businesses and tonnage of each species per farm would improve social impact mapping but are not publicly available; No market value for cockles was available.
Employment	Social data: total employment for aquaculture in the South marine plan areas; Spatial area applied to: Shellfish harvesting areas for each species (km^2); Spatial rule: employment was distributed over shellfish harvesting areas (for each species cultivated) in proportion to the total production tonnage of the species farmed. Where shellfish harvesting areas	As no information on employment per farm was available, production tonnages were used to spatialise this social benefit; Shellfish harvesting areas are not specific to aquaculture (wild harvesting may occur) and may not contain the aquaculture production businesses responsible for the shellfish produced (aquaculture installations may be located outside of these areas due to depuration re-laying arrangements);

Social Criteria	Data and spatialisation rules	Data limitations
	overlapped the sum of the GVA value was calculated.	Information on the location of aquaculture production businesses and tonnage of each species per farm would improve social impact mapping but are not publicly available.
Social Cohesion	n/a	
Culture	n/a	
Environment	n/a	

Table A4: Spatialisation rules and data limitations for Commercial Fishing.

Social Criteria	Spatialisation Rule	Data limitations
Income (GVA)	Social data: Total GVA for fisheries in the South marine plan areas; Spatial area applied to: 1/200th ICES rectangles in south plan areas; Spatial rule: GVA was distributed over the plan areas in proportion to the landings values per 1/200th ICES rectangle.	Assumption that profitability (GVA) is constant across all gear types and species; The ‘landings value’ data layer used to assign distribution of GVA and employment under represents the <15m fishing sector.
Employment	Social data: Total employment for fisheries in the South plan areas; Spatial area applied to: 1/200th ICES rectangles in south plan areas; Spatial rule: Employment was distributed over the	Assumption that there is a relationship between effort (employment) and landings value; The ‘landings value’ data layer used to assign distribution of GVA and employment under represents the <15m fishing sector.

Social Criteria	Spatialisation Rule	Data limitations
	plan areas in proportion to the landings values per 1/200th ICES rectangle.	
Social Cohesion	Social data: 'Fishing dependency' (% of population employed within the marine fishing catch sector) of wards within the South marine plan areas; Spatial area applied to: 6nm circular buffer zone around each fishing port with >5% fishing dependency in the South marine plan areas; Spatial rule: The number of <10m fishing vessels for the port closest to a ward with >5% fishing dependency had a 'social cohesion' weighting factor added. Where social cohesion buffer zones overlapped the sum of the social cohesion indicator (number of vessels) was calculated. The six fishing ports identified using this method were: Exmouth, Portland, Weymouth, Dartmouth, Paignton and Brixham.	Individual fishing ports on the Isle of Wight are not shown spatially; Exact locations of some ports not provided by data sets used.
Culture	Social data: The number of <10m fishing vessels per fishing port in the South marine plan areas was used as an indicator of cultural value; Spatial area applied to: 6nm circular buffer zone around each fishing port; Spatial rule: The number of <10m fishing vessels for each port was used to apply a 'cultural' weighting factor to the buffer zones. Where buffer zones overlapped the sum of the culture indicator (number	Individual fishing ports on the Isle of Wight are not shown spatially; Exact locations of some ports not provided by data sets used.

Social Criteria	Spatialisation Rule	Data limitations
	of vessels) was calculated.	
Environment	n/a	

Table A5: Spatialisation rules and data limitations for Commercial Shipping.

Social Criteria	Spatialisation Rule	Data limitations
Income (GVA)	Social data: Total GVA for commercial shipping in the South marine plan areas; Spatial area applied to: 0.5km x 0.5km grid cells; Spatial rule: GVA was distributed across the grid cells in proportion to shipping density (calculated from AIS data).	
Employment	Social data: Total employment for commercial shipping in the South marine plan areas; Spatial area applied to: 0.5km x 0.5km grid cells; Spatial rule: Employment was distributed across the grid cells in proportion to shipping density (calculated from AIS data).	
Social Cohesion	Social data: Life line ferry services was used as an indicator of social cohesion value; Spatial area applied to: Grid cells in which >1 small draught passenger vessel was identified; Spatial rule: The GVA value of grid cells identified as	The method used to identify 'life-line ferry services' under represents ferry routes.

Social Criteria	Spatialisation Rule	Data limitations
	containing a 'life-line ferry service' were multiplied by a factor of 10 to provide a social cohesion value.	
Culture	n/a	
Environment	n/a	

Table A4: Spatialisation rules and data limitations for Military Defence.

Social Criteria	Spatialisation Rule	Data Limitations
Income (GVA)	Social data: Total GVA for military defence in the South marine plan areas; Spatial area applied to: The Harbour Authority area for Portsmouth Naval Base as marked on the UKHO Admiralty charts; Spatial Rule: GVA was applied to HMNB Portsmouth.	The total area and GVA for military defence is underestimated as data was only available for HMNB Portsmouth.
Employment	Social data: Total employment for military defence in the South marine plan areas; Spatial area applied to: The Harbour Authority area for Portsmouth Naval Base as marked on the UKHO Admiralty charts; Spatial rule: Employment was applied to HMNB Portsmouth.	The total area and employment for military defence is underestimated as data was only available for HMNB Portsmouth.
Social Cohesion	Social data: No suitable indicator or proxy indicator was available to quantify the value to social cohesion. As such, the total employment value was multiplied	No suitable indicator or proxy indicator to quantify social cohesion.

Social Criteria	Spatialisation Rule	Data Limitations
	by a factor of 5 to generate the value of social cohesion value; Spatial area applied to: The Harbour Authority area for Portsmouth Naval Base as marked on the UKHO Admiralty charts; Spatial rule: The social cohesion value was applied to the HMNB Portsmouth.	
Culture	n/a	
Environment	n/a	

Table A7: Spatialisation rules and data limitations for Marine Aggregates.

Social Criteria	Spatialisation Rule	Data Limitations
Income (GVA) - current	Social data: Total GVA for marine aggregate sector in the South marine plan areas; Spatial area applied to: Current aggregate licence areas; Spatial rule: GVA was distributed evenly across the current aggregate licence areas.	Due to lack of detailed spatial information on current active dredge zones, GVA was applied across the whole aggregate licence area.

Social Criteria	Spatialisation Rule	Data Limitations
Employment - current	Social data: Total employment for marine aggregate sector in the South marine plan areas; Spatial area applied to: Current aggregate licence areas; Spatial rule: Employment was distributed evenly across the current aggregate licence areas.	Due to lack of detailed spatial information on current active dredge zones, GVA was applied across the whole aggregate licence area.
Income (GVA) - future	Social data: GVA value inflated by 2% per year over 20 years; Spatial area applied to: All marine aggregate licence, option, and application areas; Spatial rule: Inflated GVA distributed evenly over areas described above.	Due to lack of detailed spatial information on future aggregate dredging areas it was assumed that all aggregate licence, application and option areas will be used.
Employment - future	Social data: Employment value inflated by 2% per year over 20 years; Spatial area applied to: All marine aggregate licence, option, and application areas; Spatial rule: Inflated employment distributed evenly over areas described above.	Due to lack of detailed spatial information on future aggregate dredging areas it was assumed that all aggregate licence, application and option areas will be used.
Social Cohesion	n/a	
Culture	n/a	
Environment	n/a	

Table A8: Spatialisation rules and data limitations for Marine Protected Areas.

Social Criteria	Spatialisation Rule	Data Limitations
Income (GVA)	n/a	
Employment	n/a	
Social Cohesion	n/a	
Culture	n/a	
Environment	Social data: The proportion of the non-market benefits from the conservation of ecosystem goods and services in UK seas (using the transfer value methodology of McVittie and Moran, 2010) attributable to the South marine plan areas (estimated at £29m); Spatial area applied to: All designated sites in the South plan areas (SPAs, SACs, Ramsar, MCZs, rMCZs); Spatial rule: Value of the non-market benefits from the conservation of ecosystem good and services distributed evenly across the MPAs.	Assumption that all types of nature conservation designation contribute equally to conservation of ecosystem services and goods; Ramsar sites were omitted from analysis as they generally overlay the same areas as SPAs but would not result in the area making twice the contribution to the conservation of ecosystem goods and services.

Table A9: Spatialisation rules and data limitations for Nuclear Energy.

Social Criteria	Spatialisation Rule	Data Limitations
Income (GVA)	Social data: GVA associated with operation of Dungeness B; Spatial area applied to: 1nm buffer around the intake and outfalls for Dungeness B Nuclear Power Station; Spatial rule: GVA applied to buffer zone around Dungeness B.	
Employment	Social data: Direct employment associated with operation of Dungeness B; Spatial area applied to: 1nm buffer around the intake and outfalls for Dungeness B Nuclear Power Station; Spatial rule: Employment value applied to buffer zone around Dungeness B.	
Social Cohesion	n/a	
Culture	n/a	
Environment	n/a	

Table A10: Spatialisation rules and data limitations for Offshore Renewables.

Social Criteria	Spatialisation Rule	Data Limitations
Future income (GVA) – Rampion OWF	Social data: Estimated future GVA from operation of Rampion OWF (based on £15,430/1MW (MMO, 2013a);	Distribution of benefit - assumes wind turbines are installed over the whole lease area.

Social Criteria	Spatialisation Rule	Data Limitations
	Spatial area applied to: Lease area; Spatial rule: Estimated future GVA distributed across the whole wind farm lease area.	
Future income (GVA) – Navitus Bay	Social data: Estimated future GVA from operation of Navitus Bay OWF (based on £15,430/1MW (MMO, 2013a); Spatial area applied to: Lease area; Spatial rule: Estimated future GVA distributed across the whole wind farm lease area.	Distribution of benefit - assumes wind turbines are installed over the whole lease area.
Future income (GVA) – Tidal site OWF	Social data: Average GVA/km2 predicted to be generated by Rampion and Navitus Bay OWFs; Spatial area applied to: Tidal power lease site; Spatial rule: Estimated future GVA distributed across the whole tidal power lease area.	No future projections of GVA for the tidal power lease site were available - assumed GVA would be the equivalent to that generated by offshore wind.
Future employment - Rampion	Social data: Estimated future direct employment from operation of Rampion OWF (MMO, 2013a); Spatial area applied to: Lease area; Spatial rule: Estimated future direct employment distributed across the whole wind farm lease area.	Distribution of benefit - assumes wind turbines are installed over the whole lease area.
Future employment – Navitus Bay	Social data: Estimated future direct employment from operation of Navitus Bay OWF (MMO, 2013a); Spatial area applied to: Lease area;	Distribution of benefit - assumes wind turbines are installed over the whole lease area.

Social Criteria	Spatialisation Rule	Data Limitations
	Spatial rule: Estimated future direct employment distributed across the whole wind farm lease area.	
Future employment – Tidal Site	Social data: Average GVA/km2 predicted to be generated by Rampion and Navitus Bay OWFs; Spatial area applied to: Tidal power lease site; Spatial rule: Estimated future employment distributed across the whole tidal power lease area.	No future projections of employment for the tidal power lease site were available - assumed employment would be the equivalent to that generated by offshore wind.
Social Cohesion	n/a	
Culture	n/a	
Future environment – Rampion OWF	Social data: The Carbon multiplier (3.27; see Annex 2); Spatial area applied to: lease area; Spatial rule: The carbon multiplier factor was applied to the GVA values for the Rampion wind farm lease area to calculate the environmental value.	Distribution of benefit - assumes wind turbines are installed over the whole lease area.
Future environment – Navitus Bay OWF	Social data: The Carbon multiplier (3.27; see Annex 2); Spatial area applied to: lease area; Spatial rule: The carbon multiplier factor was applied to the GVA values for the Navitus wind farm lease area to calculate the environmental value.	Distribution of benefit - assumes wind turbines are installed over the whole lease area.
Future environment –	Social data: The Carbon multiplier (3.27; see Annex 2);	Distribution of benefit - assumes wind turbines are installed over the whole lease area.

Social Criteria	Spatialisation Rule	Data Limitations
Tidal Site	Spatial area applied to: lease area; Spatial rule: The carbon multiplier factor was applied to the GVA values for the tidal power lease to calculate the environmental value.	

Table A11: Spatialisation rules and data limitations for Ports, Dredging and Disposal.

Social Criteria	Spatialisation Rule	Data Limitations
Income (GVA)	Social data: Total GVA for ports and associated dredging activities; Spatial area applied to: Port Statutory Harbour Authority Areas; Spatial rule: GVA was distributed across the ports in proportion to freight tonnage handled by each port.	Statutory Harbour Authority Areas were only readily available for ten ports in the South marine plan areas; Three of these ports (Torbay, Hamble and Dartmouth) had no associated freight tonnage handling value and were therefore excluded from the analysis
Employment	Social data: Total direct employment for ports; Spatial area applied to: Port Statutory Harbour Authority Areas; Spatial rule: Employment value was distributed across the ports in proportion to freight tonnage handled by each port.	No employment figures for port-related dredging were readily available; Statutory Harbour Authority Areas were only readily available for ten ports in the South marine plan areas; Three of these ports (Torbay, Hamble and Dartmouth) had no associated freight tonnage handling value and were therefore excluded from the analysis.
Social Cohesion	n/a	
Culture	n/a	

Social Criteria	Spatialisation Rule	Data Limitations
Environment	n/a	

Table A12: Spatialisation rules and data limitations for Recreation (including recreational boating).

Social Criteria	Spatialisation Rule	Data Limitations
Income (GVA)	Social data: Total GVA for all recreational activities; Spatial area applied to: Marine areas used for SCUBA diving, board activities, paddle board activities, sea angling and recreational boating (including racing and sailing areas); Spatial rule: GVA was distributed across the recreational activity areas in proportion to the number of participants in each group of activities.	Lack of comprehensive data sets including spatial information on where activity occurs and intensity/participation numbers for each type of recreational activity; Used spatial information on SCUBA diving locations from data detailing SCUBA diving activity from chartered boats as this included intensity (participation) information – however, this data set underrepresents the spatial area in which diving activities take place; Sea angling from the shore is also under-represented.
Employment	Social data: Direct employment numbers for all recreational activities; Spatial area applied to: Marine areas used for SCUBA diving, board activities, paddle board activities, sea angling and recreational boating (including racing and sailing areas); Spatial rule: Employment value was distributed across the recreational activity areas in proportion to the number of participants in each group of activities.	As above

Social Criteria	Spatialisation Rule	Data Limitations
Social Cohesion	n/a	
Culture	Social data: No suitable indicator or proxy indicator was available to quantify the value to culture. As such culture was given the same weighting as employment; Spatial area applied to: Marine areas used for SCUBA diving, board activities, paddle board activities, sea angling and recreational boating (including racing and sailing areas); Spatial rule: The cultural weighting factor was applied to the recreational activity marine spatial areas.	No suitable indicator was available to quantify the social 'cultural' value of recreation – as such the cultural benefits of recreation were assumed to be equivalent in magnitude as those from employment in this sector (i.e. the 'employment value' (employment/km2) was applied as the 'cultural weighting factor).
Environment	n/a	

Table A13: Spatialisation rules and data limitations for Tourism.

Social Criteria	Spatialisation Rule	Data Limitations
Income (GVA)	Social data: GVA attributable to the tourist industry in each principle seaside towns; Spatial area applied to: Foreshore of principle seaside towns;	Assigning GVA just to the foreshore of principle seaside towns over estimates the GVA/km^2 'social' value of tourism as the GVA represents land aspects of tourism not just the foreshore area.

Social Criteria	Spatialisation Rule	Data Limitations
	Spatial rule: GVA was applied to the foreshore area of each principle seaside town. Due to the small area of foreshore and the relatively high value of GVA for each principle seaside town the GVA was then reduced by a factor of 50 to allow realistic comparison with other activity sectors.	
Employment	Social data: Estimated average annual employment attributable to the tourist industry in each principle seaside towns; Spatial area applied to: Foreshore of principle seaside towns; Spatial Rule: GVA was applied to the foreshore area of each principle seaside town. Due to the small area of foreshore and the relatively high value of employment for each principle seaside town the employment value was then reduced by a factor of 50 to allow realistic comparison with other activity sectors.	Assigning employment just to the foreshore of principle seaside towns over estimates the employment/km^2 'social' value of tourism as the employment numbers represents land aspects of tourism not just the foreshore area.
Social Cohesion	n/a	
Culture	Social data: No suitable indicator or proxy indicator was available to quantify the value to culture – as such culture was given the same weighting as employment; Spatial area applied to: Foreshore of principle seaside towns;	No suitable indicator was available to quantify the social 'cultural' value of – as such the cultural benefits of tourism were assumed to be equivalent in magnitude as those from employment in this sector (i.e. the 'employment value' (employment/km^2) was applied as the 'cultural weighting factor).

Social Criteria	**Spatialisation Rule**	**Data Limitations**
	Spatial rule: the cultural weighting factor was applied to the foreshore of principle seaside towns.	
Environment	n/a	

A1.4 Spatial representation of GVA and employment
After the spatialisation rules were applied to the data available, GVA/km^2 and employment/km^2 were plotted for each MPS activity to enable the spatial distribution of these benefits to be visualised. The resulting spatial representation of GVA and employment for each sector is shown in Figures A1 to A20 below. Note figures showing the spatial distribution of 'social cohesion', 'culture' and 'environment' are not shown because they were largely derived based on a multiple of either the GVA or employment maps, although fishing social cohesion and culture were derived on a different basis (see the 'Spatialisation rules' above and Section 5.2 in the main report). However, data layers for social cohesion, culture and environment were generated to enable the combined social benefit heat maps (described in Section 5.3 of the main report) to be created.

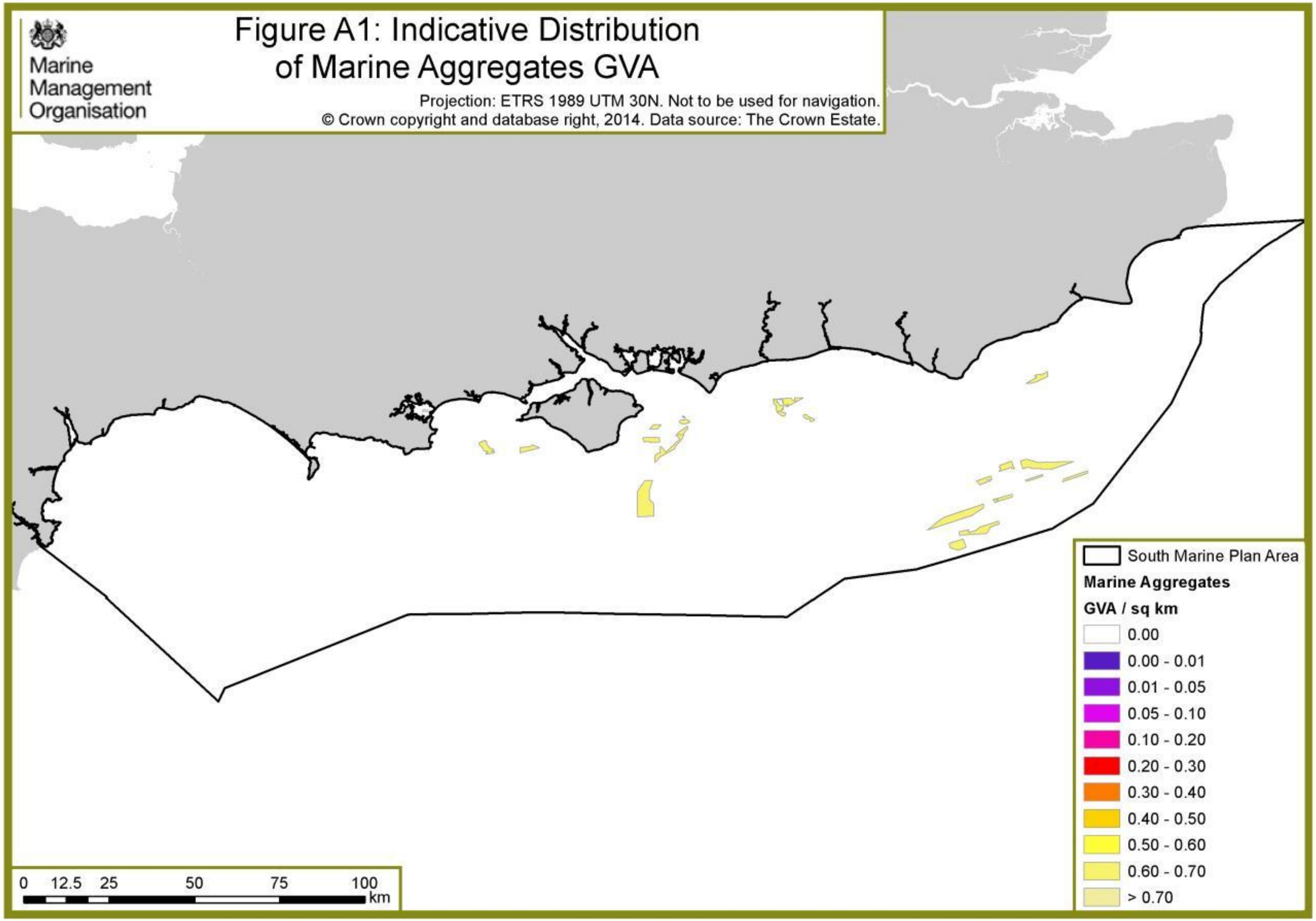
A1.4 Weighting and scoring of social impacts to create social heat maps
In order to ensure consistency across different MPS activities and across different types of social benefit, a weighting and scoring system was applied to the income, employment, social cohesion, and culture related social benefits. This allowed the different types of social benefit of an MPS sector to be combined to produce a single social benefit heat map for each MPS sector, which could be compared to other MPS sectors on a consistent basis. The following weighting and scoring criteria were applied:

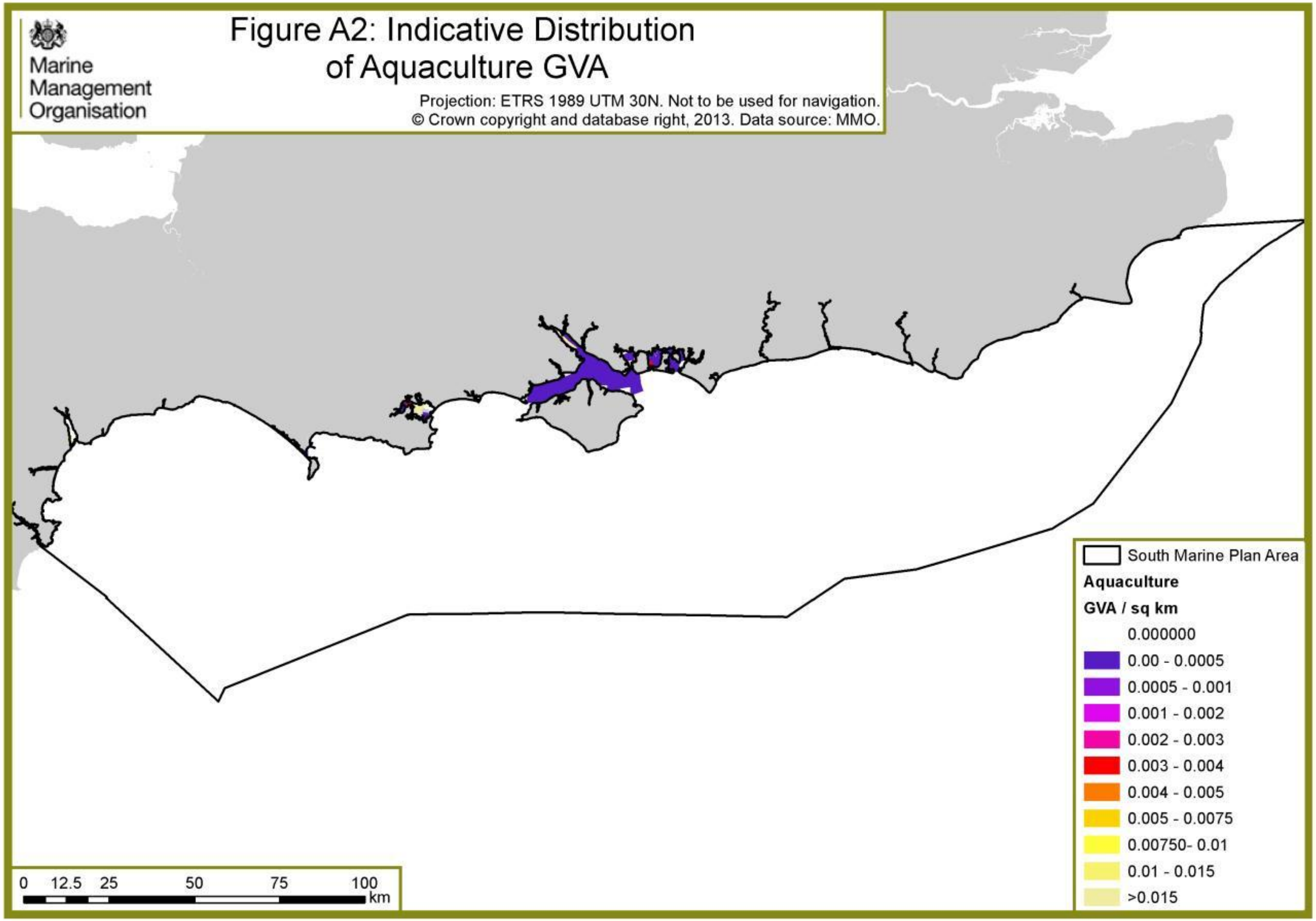
- Intensity of income/km^2 (using GVA as a proxy indicator) across different MPS sectors was converted to a common scale ranging from 0 to 100.
- The intensity of employment/km^2 across different MPS sectors was converted to a common scale ranging from 0 to 100.
- For fisheries, quantitative social cohesion values were obtained by multiplying the intensity of employment value by a social cohesion factor ranging from 0 to 5, to account for the importance of commercial fisheries employment in contributing to social cohesion.
- For defence, quantitative social cohesion values were obtained by multiplying the employment value associated with HMNB Portsmouth by a social cohesion factor of 5, to account for the importance of defence employment in contributing to social cohesion in the Portsmouth area.
- For shipping, quantitative social cohesion values were obtained by multiplying the intensity of GVA/km^2 by a factor of 10 in those shipping density grid cells that were intersected by life-line local ferry services, to account for the importance of these services in contributing to social cohesion.
- For fisheries, quantitative cultural values were obtained by multiplying the employment values by a factor ranging from 0 to 5, to account for the importance of commercial fisheries employment in contributing to culture.
- For recreation (including recreational boating) and tourism, quantitative cultural values were obtained by multiplying the employment values by a factor of 1, to account for the importance of these activities in contributing to culture.
- For offshore renewables, quantitative cultural values were obtained by multiplying the intensity of GVA value by an environmental factor of 3.27, to account for the benefit associated with carbon savings (see Annex 2). This factor was derived by multiplying the gross carbon savings per annum by the

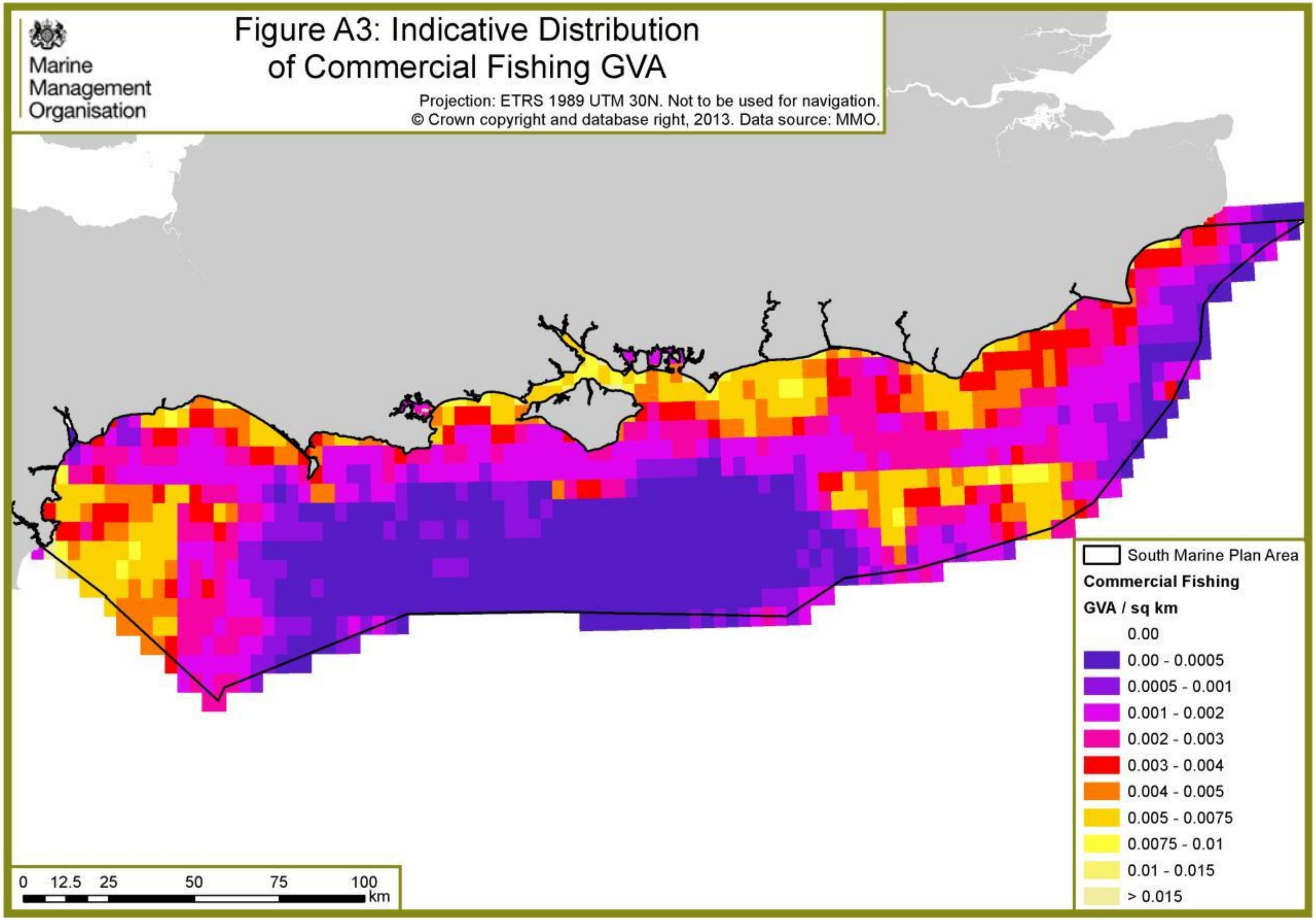
non-traded carbon price to derive a notional economic value for the carbon savings which could be compared with the GVA value.
- For MPAs, the estimated ecosystem services benefit/km^2 was scaled on a common basis to the GVA intensity.

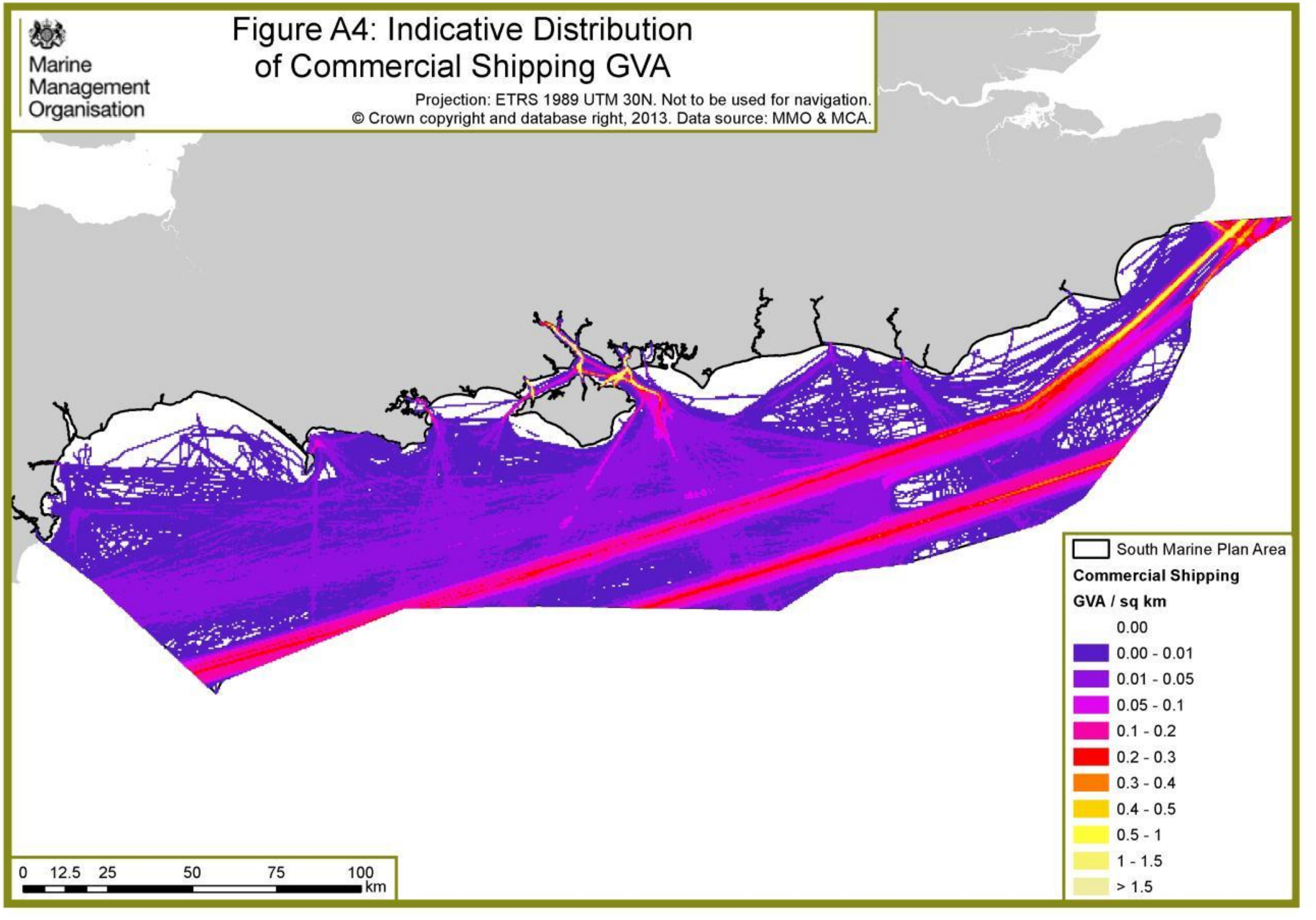
Once all social indicators were indexed (i.e. given a value between 0 and 100), all indicators per sector were merged into a single layer to create a social benefit ‘heat map’ for each MPS sector. It should be noted that where multiple social benefits occurred within a given spatial area, the social values were summed. These heat maps are shown in the main report (Figures 3 to 14).

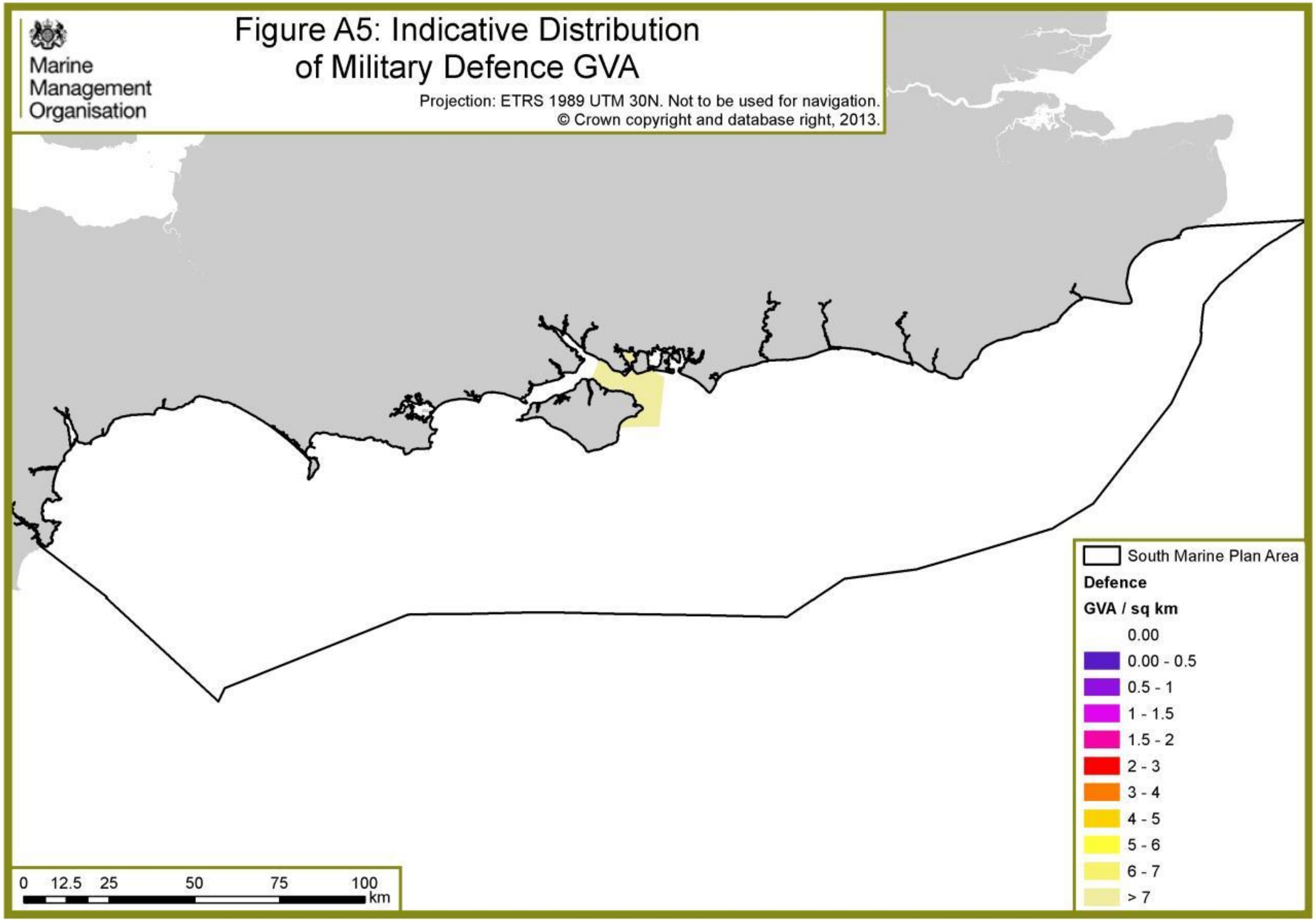
A final combined social benefit ‘heat map’ for all MPS sectors was created by merging the individual sector heat maps. Where multiple social benefits occurred within a given spatial area, the social values were summed. This combined social benefit heat map is shown in Figure 15 in the main report.

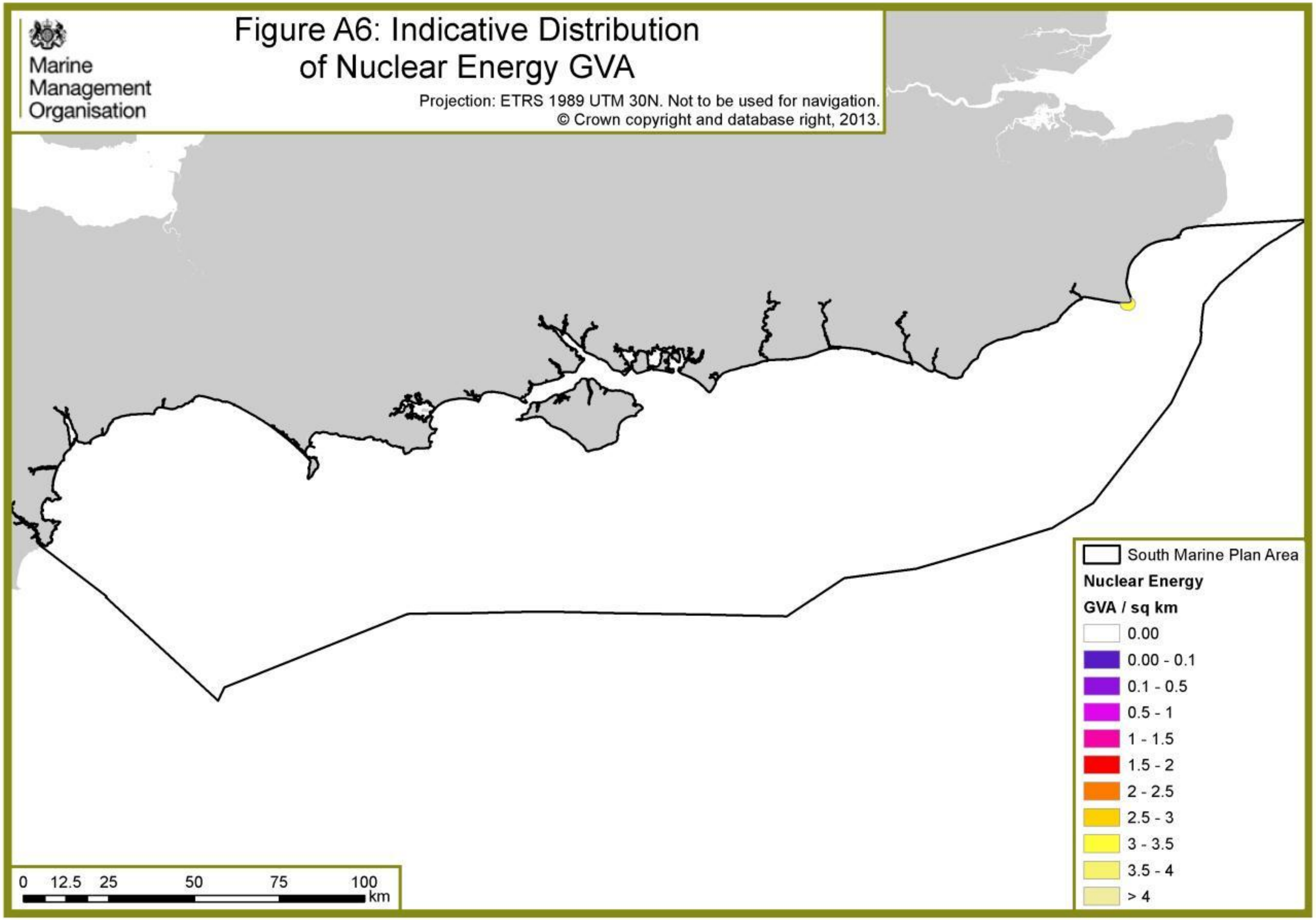

Marine
Management
Organisation
Figure A1: Indicative Distribution
of Marine Aggregates GVA
Projection: ETRS 1989 UTM 30N. Not to be used for navigation.
© Crown copyright and database right, 2014. Data source: The Crown Estate.
South Marine Plan Area
Marine Aggregates
GVA / sq km
0.00
0.00 - 0.01
0.01 - 0.05
0.05 - 0.10
0.10 - 0.20
0.20 - 0.30
0.30 - 0.40
0.40 - 0.50
0.50 - 0.60
0.60 - 0.70
> 0.70
0
12.5
25
50
75
100
km

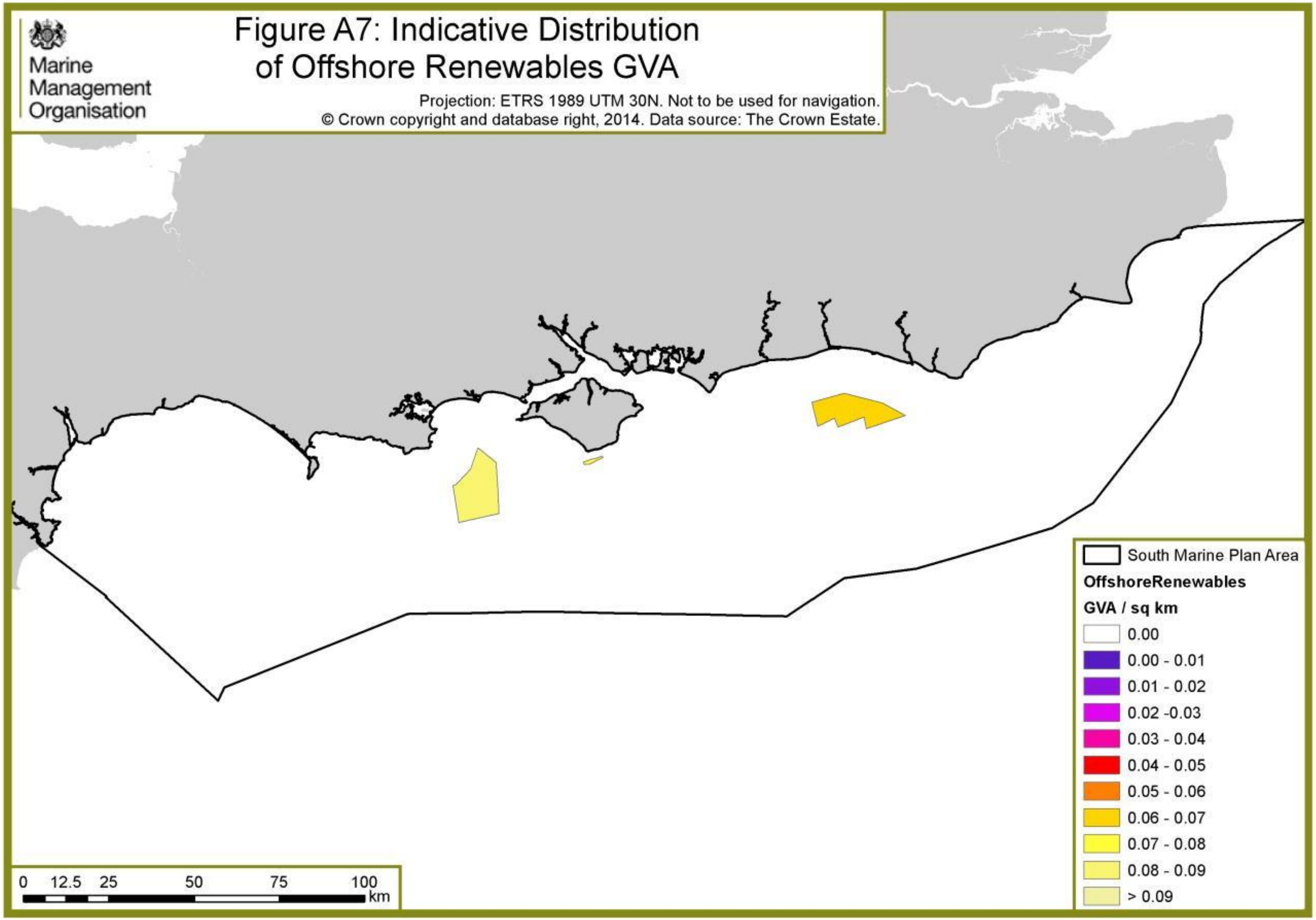

Marine Management Organisation
Figure A2: Indicative Distribution of Aquaculture GVA
Projection: ETRS 1989 UTM 30N. Not to be used for navigation.
© Crown copyright and database right, 2013. Data source: MMO.
South Marine Plan Area
Aquaculture
GVA / sq km
0.000000
0.00 - 0.0005
0.0005 - 0.001
0.001 - 0.002
0.002 - 0.003
0.003 - 0.004
0.004 - 0.005
0.005 - 0.0075
0.00750- 0.01
0.01 - 0.015
>0.015
0 12.5 25 50 75 100
km

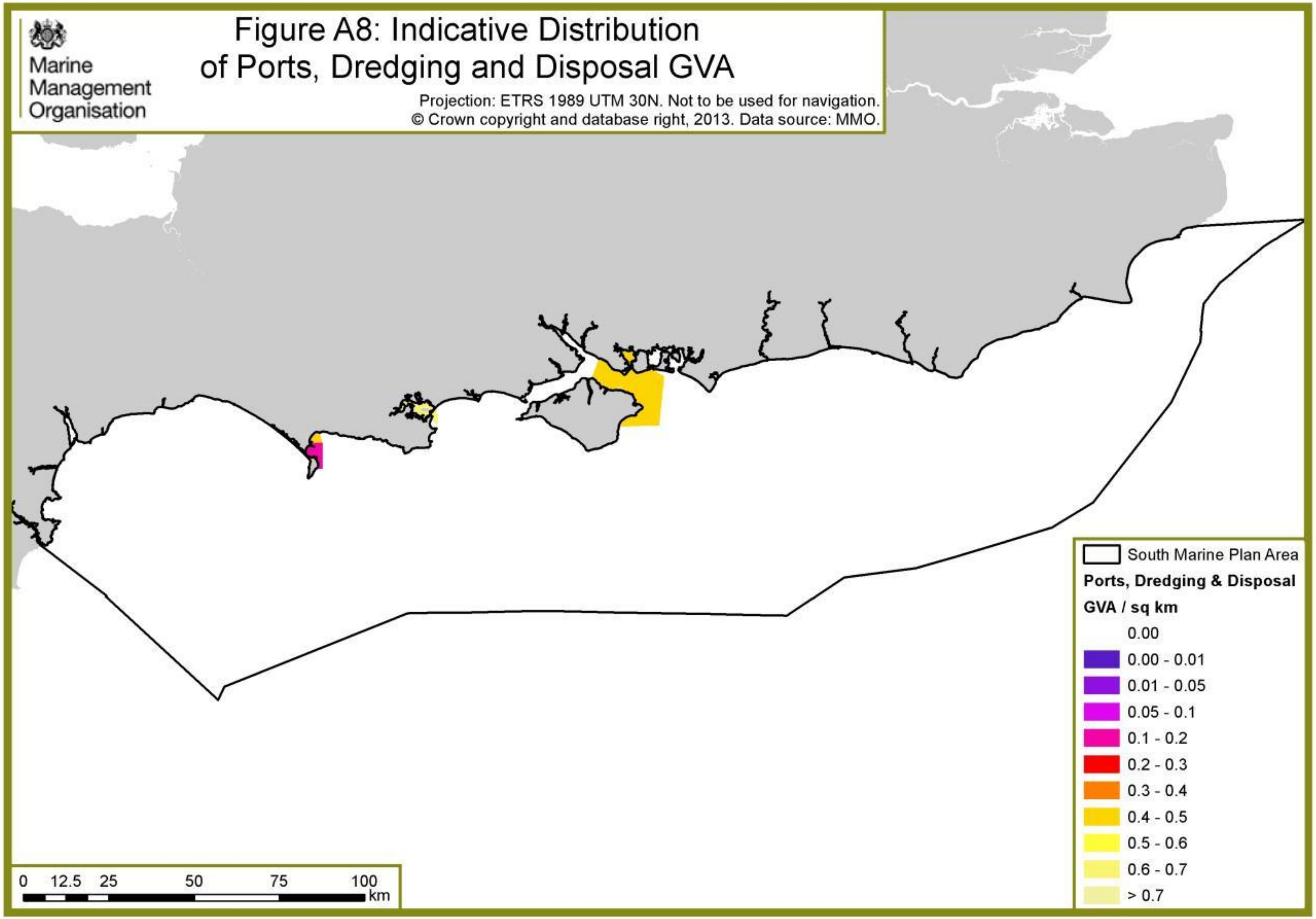

Marine
Management
Organisation
Figure A3: Indicative Distribution of Commercial Fishing GVA
Projection: ETRS 1989 UTM 30N. Not to be used for navigation.
© Crown copyright and database right, 2013. Data source: MMO.
South Marine Plan Area
Commercial Fishing
GVA / sq km
0.00
0.00 - 0.0005
0.0005 - 0.001
0.001 - 0.002
0.002 - 0.003
0.003 - 0.004
0.004 - 0.005
0.005 - 0.0075
0.0075 - 0.01
0.01 - 0.015
> 0.015
0 12.5 25 50 75 100
km

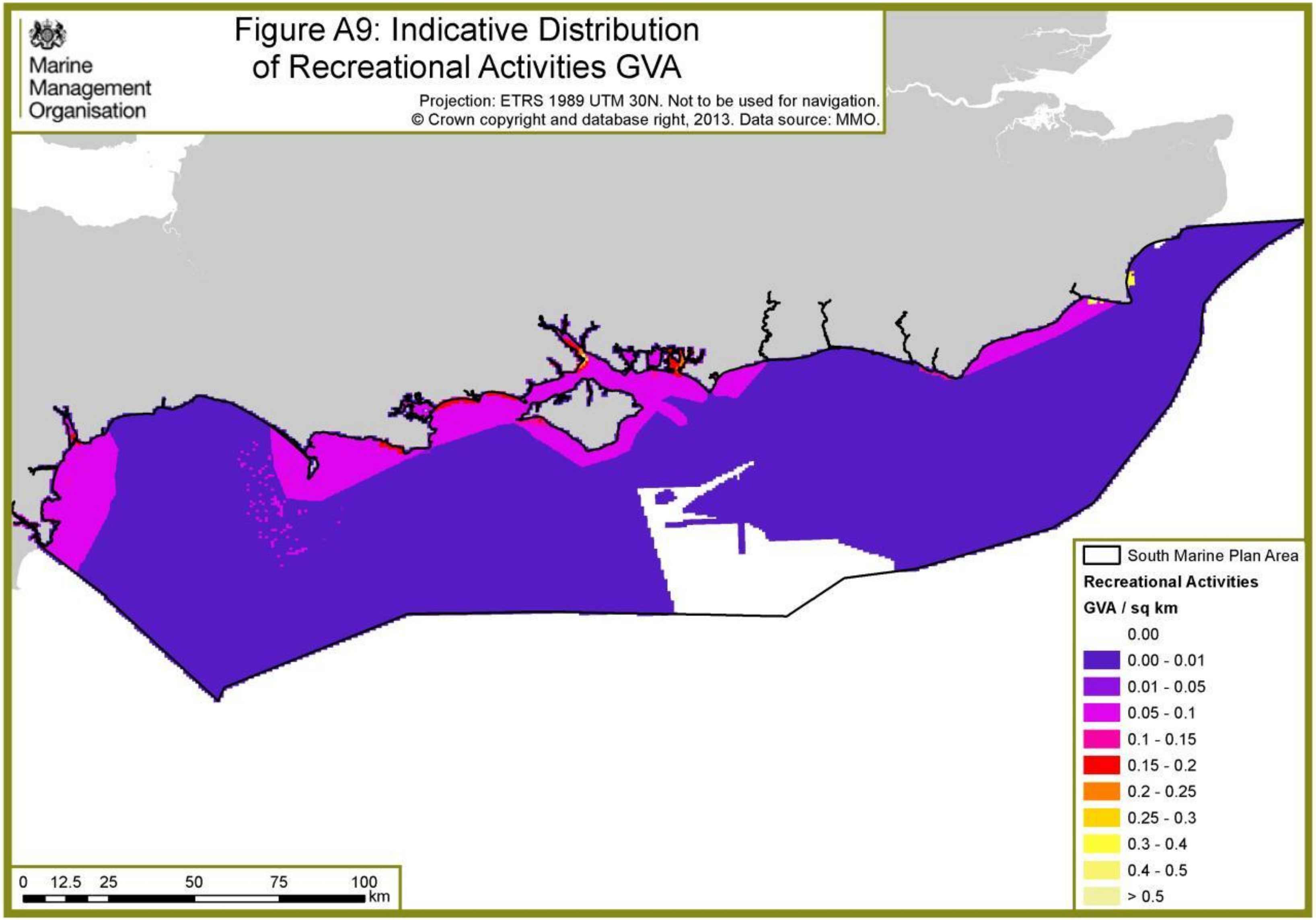

Marine
Management
Organisation
Figure A4: Indicative Distribution of Commercial Shipping GVA
Projection: ETRS 1989 UTM 30N. Not to be used for navigation.
© Crown copyright and database right, 2013. Data source: MMO & MCA.
South Marine Plan Area
Commercial Shipping
GVA / sq km
0.00
0.00 - 0.01
0.01 - 0.05
0.05 - 0.1
0.1 - 0.2
0.2 - 0.3
0.3 - 0.4
0.4 - 0.5
0.5 - 1
1 - 1.5
> 1.5
0 12.5 25 50 75 100
km

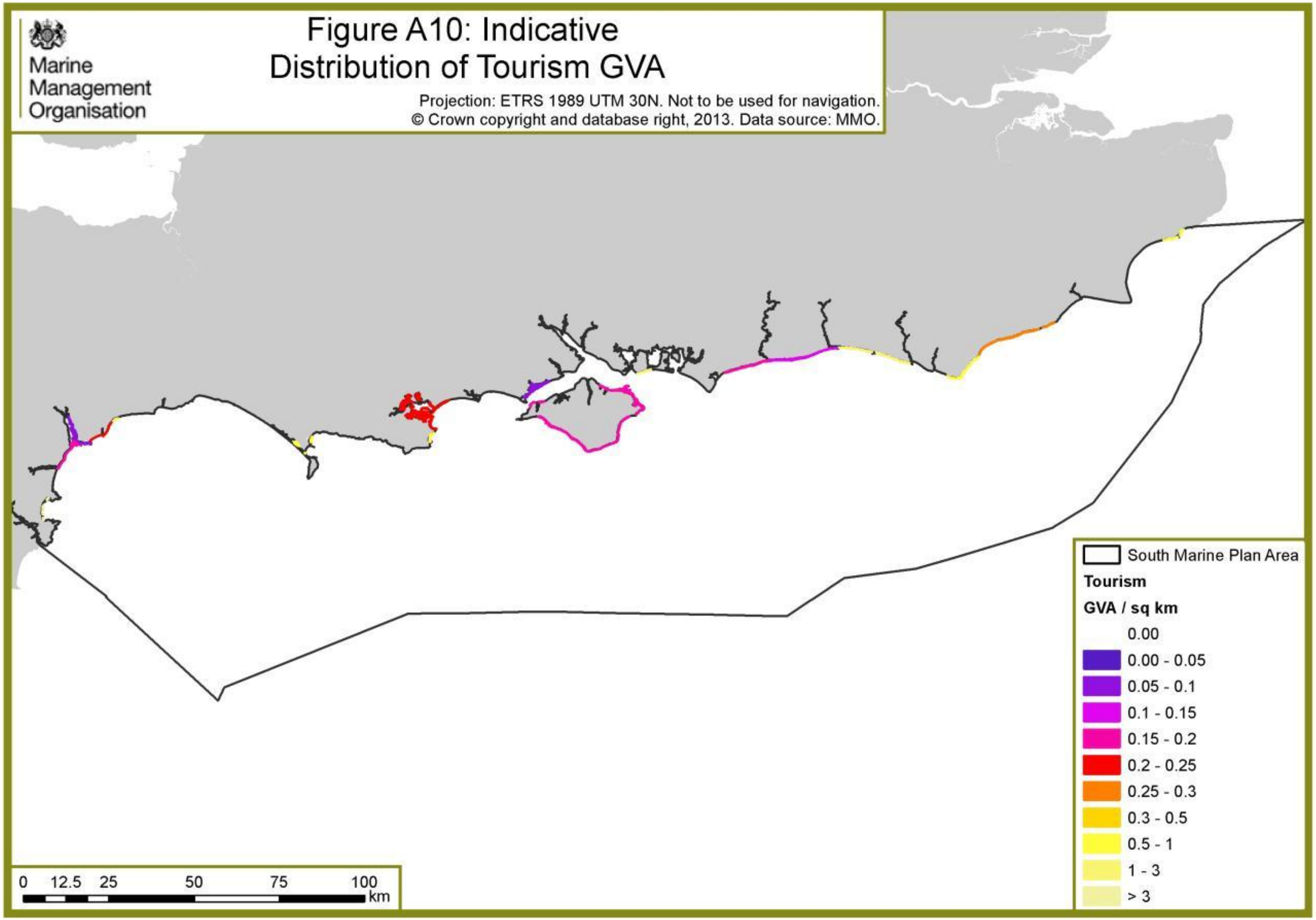

Marine
Management
Organisation
Figure A5: Indicative Distribution
of Military Defence GVA
Projection: ETRS 1989 UTM 30N. Not to be used for navigation.
© Crown copyright and database right, 2013.
South Marine Plan Area
Defence
GVA / sq km
0.00
0.00 - 0.5
0.5 - 1
1 - 1.5
1.5 - 2
2 - 3
3 - 4
4 - 5
5 - 6
6 - 7
> 7
0 12.5 25 50 75 100
km

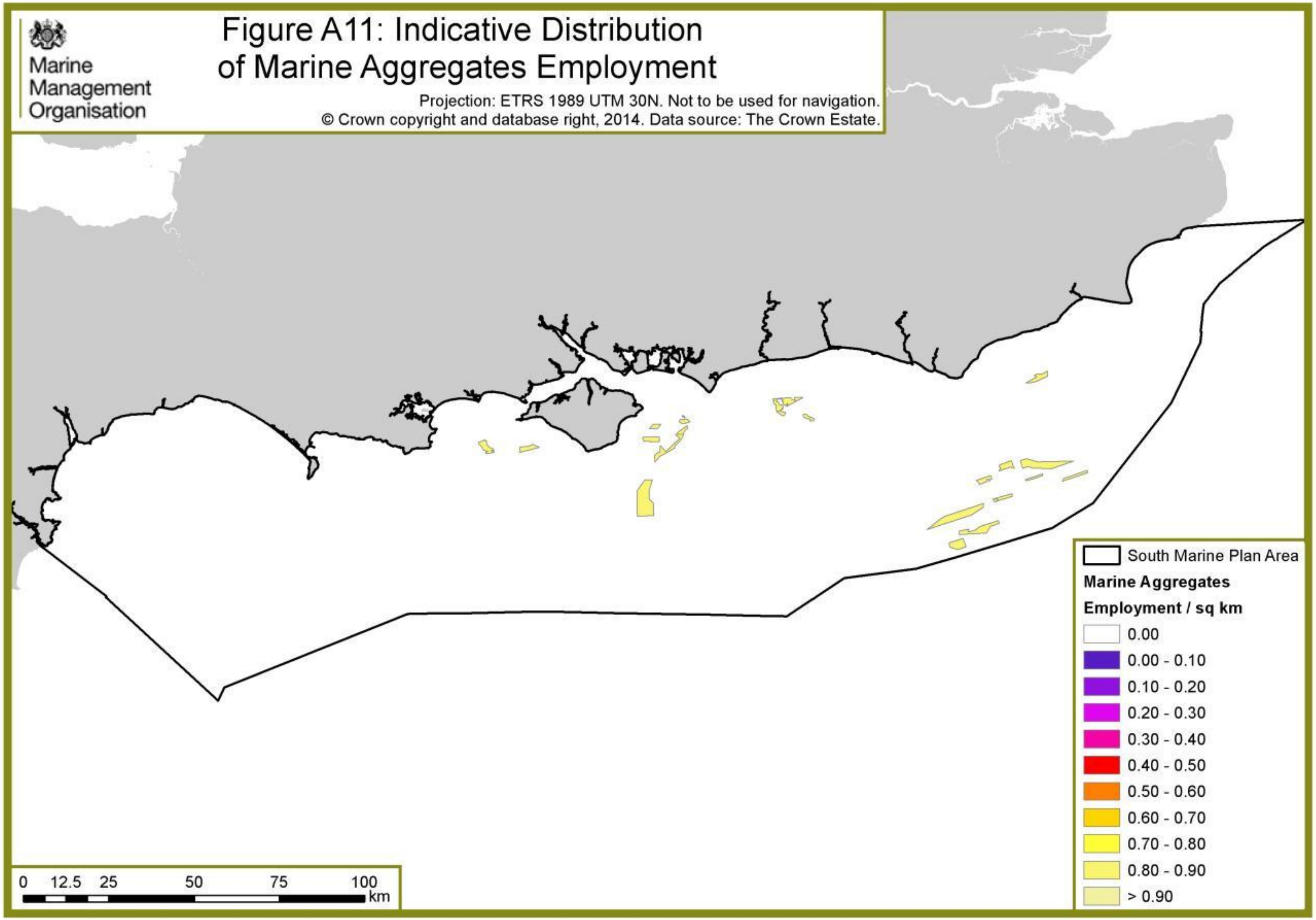

Marine
Management
Organisation
Figure A6: Indicative Distribution
of Nuclear Energy GVA
Projection: ETRS 1989 UTM 30N. Not to be used for navigation.
© Crown copyright and database right, 2013.
South Marine Plan Area
Nuclear Energy
GVA / sq km
0.00
0.00 - 0.1
0.1 - 0.5
0.5 - 1
1 - 1.5
1.5 - 2
2 - 2.5
2.5 - 3
3 - 3.5
3.5 - 4
> 4
0 12.5 25 50 75 100
km

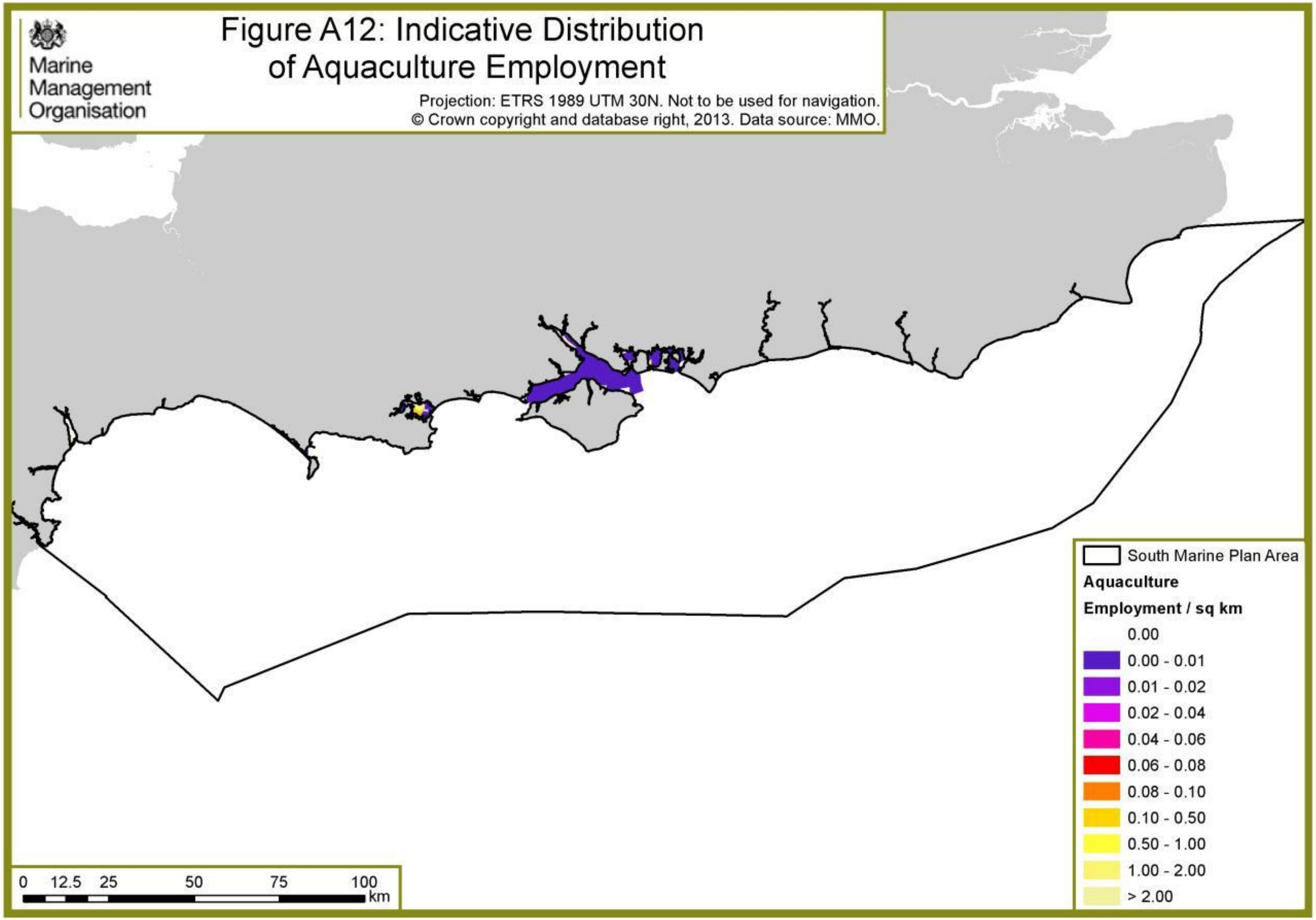

Marine
Management
Organisation
Figure A7: Indicative Distribution
of Offshore Renewables GVA
Projection: ETRS 1989 UTM 30N. Not to be used for navigation.
© Crown copyright and database right, 2014. Data source: The Crown Estate.
South Marine Plan Area
OffshoreRenewables
GVA / sq km
0.00
0.00 - 0.01
0.01 - 0.02
0.02 -0.03
0.03 - 0.04
0.04 - 0.05
0.05 - 0.06
0.06 - 0.07
0.07 - 0.08
0.08 - 0.09
> 0.09
0 12.5 25 50 75 100
km

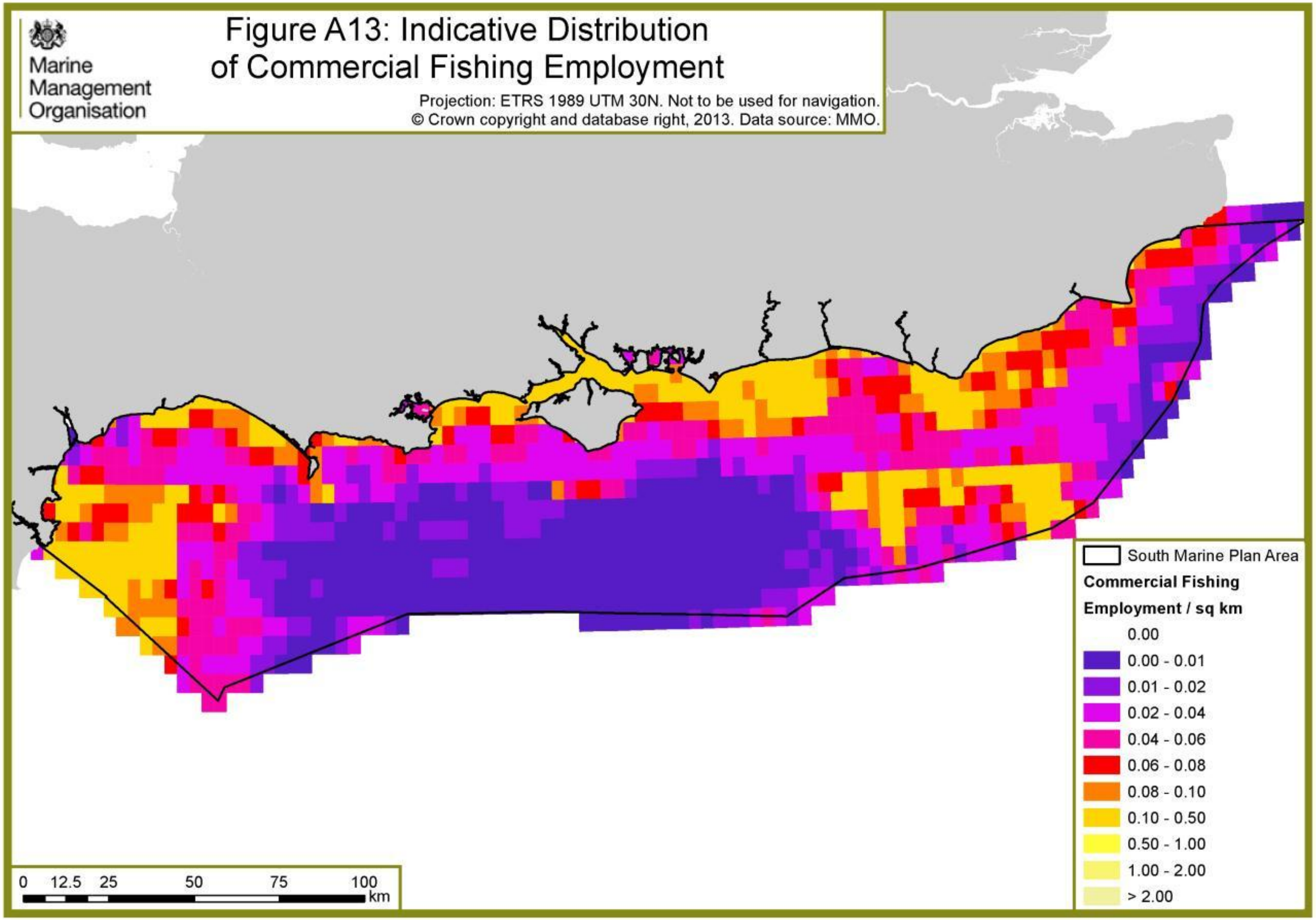

Marine
Management
Organisation
Figure A8: Indicative Distribution
of Ports, Dredging and Disposal GVA
Projection: ETRS 1989 UTM 30N. Not to be used for navigation.
© Crown copyright and database right, 2013. Data source: MMO.
South Marine Plan Area
Ports, Dredging & Disposal
GVA / sq km
0.00
0.00 - 0.01
0.01 - 0.05
0.05 - 0.1
0.1 - 0.2
0.2 - 0.3
0.3 - 0.4
0.4 - 0.5
0.5 - 0.6
0.6 - 0.7
> 0.7
0 12.5 25 50 75 100
km

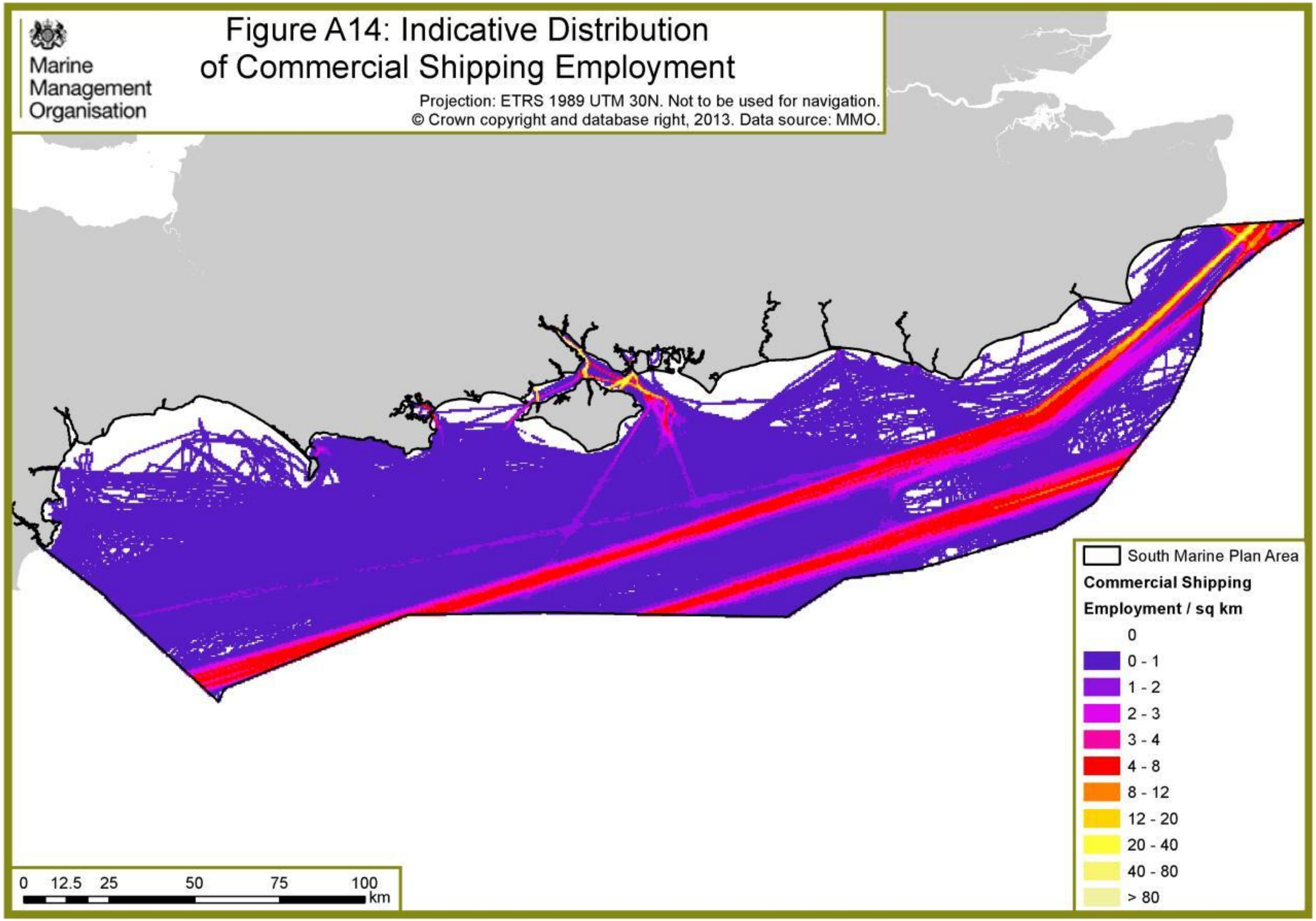

Marine
Management
Organisation
Figure A9: Indicative Distribution of Recreational Activities GVA
Projection: ETRS 1989 UTM 30N. Not to be used for navigation.
© Crown copyright and database right, 2013. Data source: MMO.
South Marine Plan Area
Recreational Activities
GVA / sq km
0.00
0.00 - 0.01
0.01 - 0.05
0.05 - 0.1
0.1 - 0.15
0.15 - 0.2
0.2 - 0.25
0.25 - 0.3
0.3 - 0.4
0.4 - 0.5
> 0.5
0 12.5 25 50 75 100
km

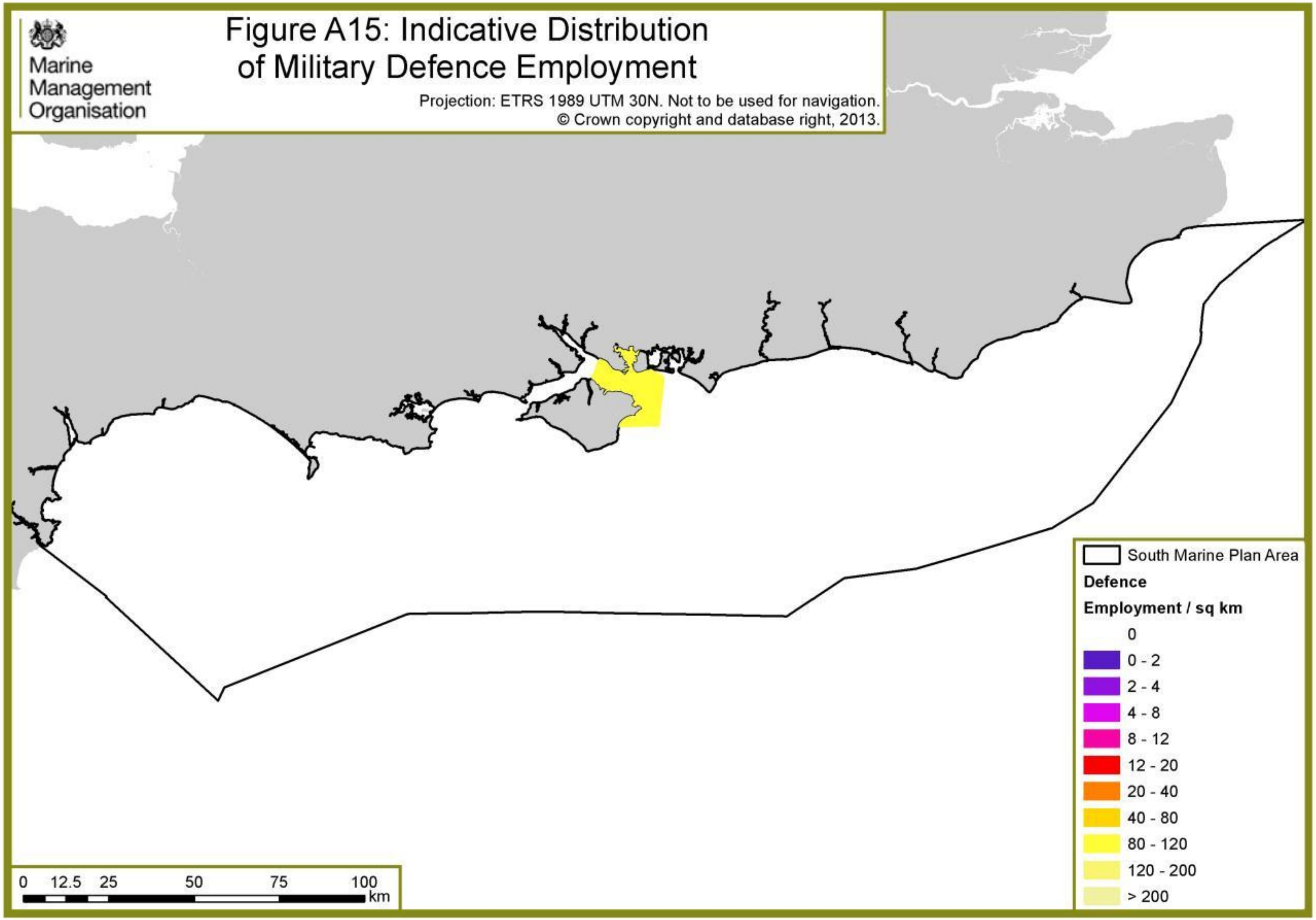

Marine
Management
Organisation
Figure A10: Indicative Distribution of Tourism GVA
Projection: ETRS 1989 UTM 30N. Not to be used for navigation.
© Crown copyright and database right, 2013. Data source: MMO.
South Marine Plan Area
Tourism
GVA / sq km
0.00
0.00 - 0.05
0.05 - 0.1
0.1 - 0.15
0.15 - 0.2
0.2 - 0.25
0.25 - 0.3
0.3 - 0.5
0.5 - 1
1 - 3
> 3
0
12.5
25
50
75
100
km

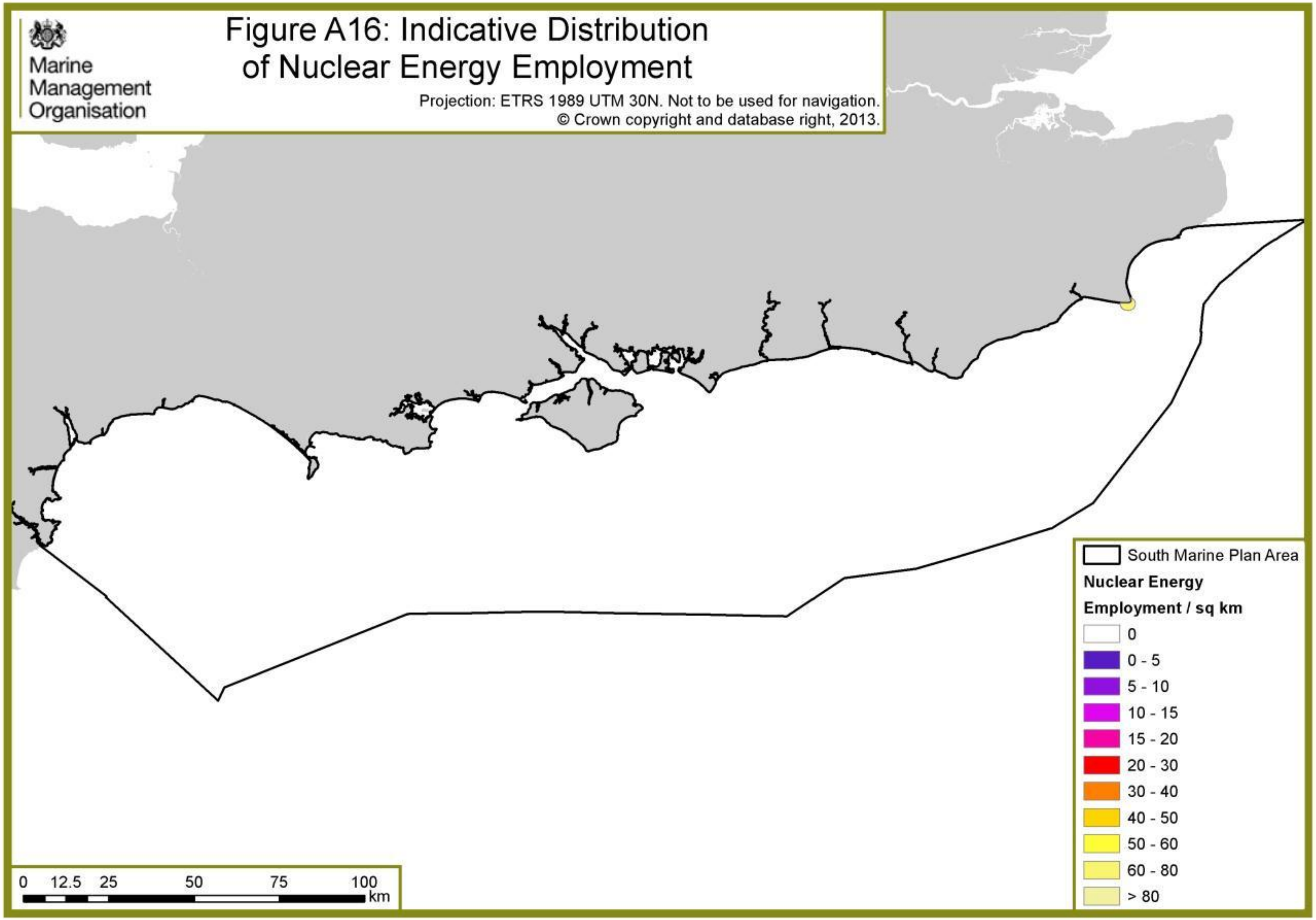

Marine
Management
Organisation
Figure A11: Indicative Distribution
of Marine Aggregates Employment
Projection: ETRS 1989 UTM 30N. Not to be used for navigation.
© Crown copyright and database right, 2014. Data source: The Crown Estate.
South Marine Plan Area
Marine Aggregates
Employment / sq km
0.00
0.00 - 0.10
0.10 - 0.20
0.20 - 0.30
0.30 - 0.40
0.40 - 0.50
0.50 - 0.60
0.60 - 0.70
0.70 - 0.80
0.80 - 0.90
> 0.90
0 12.5 25 50 75 100
km


Marine
Management
Organisation
Figure A12: Indicative Distribution of Aquaculture Employment
Projection: ETRS 1989 UTM 30N. Not to be used for navigation.
© Crown copyright and database right, 2013. Data source: MMO.
South Marine Plan Area
Aquaculture
Employment / sq km
0.00
0.00 - 0.01
0.01 - 0.02
0.02 - 0.04
0.04 - 0.06
0.06 - 0.08
0.08 - 0.10
0.10 - 0.50
0.50 - 1.00
1.00 - 2.00
> 2.00
0
12.5
25
50
75
100
km

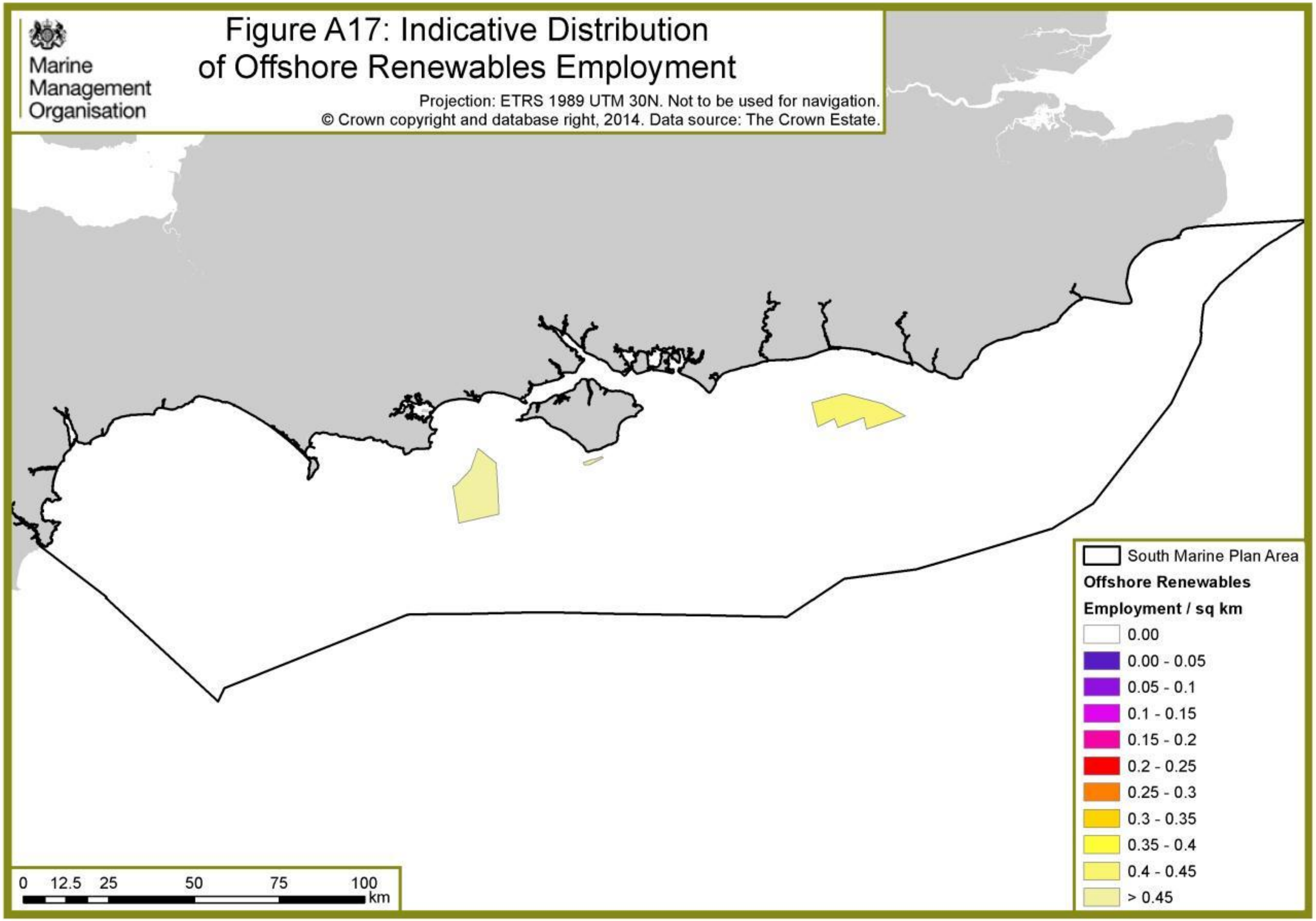

Marine Management Organisation
Figure A13: Indicative Distribution of Commercial Fishing Employment
Projection: ETRS 1989 UTM 30N. Not to be used for navigation.
© Crown copyright and database right, 2013. Data source: MMO.
South Marine Plan Area
Commercial Fishing Employment / sq km
0.00
0.00 - 0.01
0.01 - 0.02
0.02 - 0.04
0.04 - 0.06
0.06 - 0.08
0.08 - 0.10
0.10 - 0.50
0.50 - 1.00
1.00 - 2.00
> 2.00
0 12.5 25 50 75 100 km


Marine
Management
Organisation
Figure A14: Indicative Distribution
of Commercial Shipping Employment
Projection: ETRS 1989 UTM 30N. Not to be used for navigation.
© Crown copyright and database right, 2013. Data source: MMO.
South Marine Plan Area
Commercial Shipping
Employment / sq km
0
0 - 1
1 - 2
2 - 3
3 - 4
4 - 8
8 - 12
12 - 20
20 - 40
40 - 80
> 80
0 12.5 25 50 75 100
km

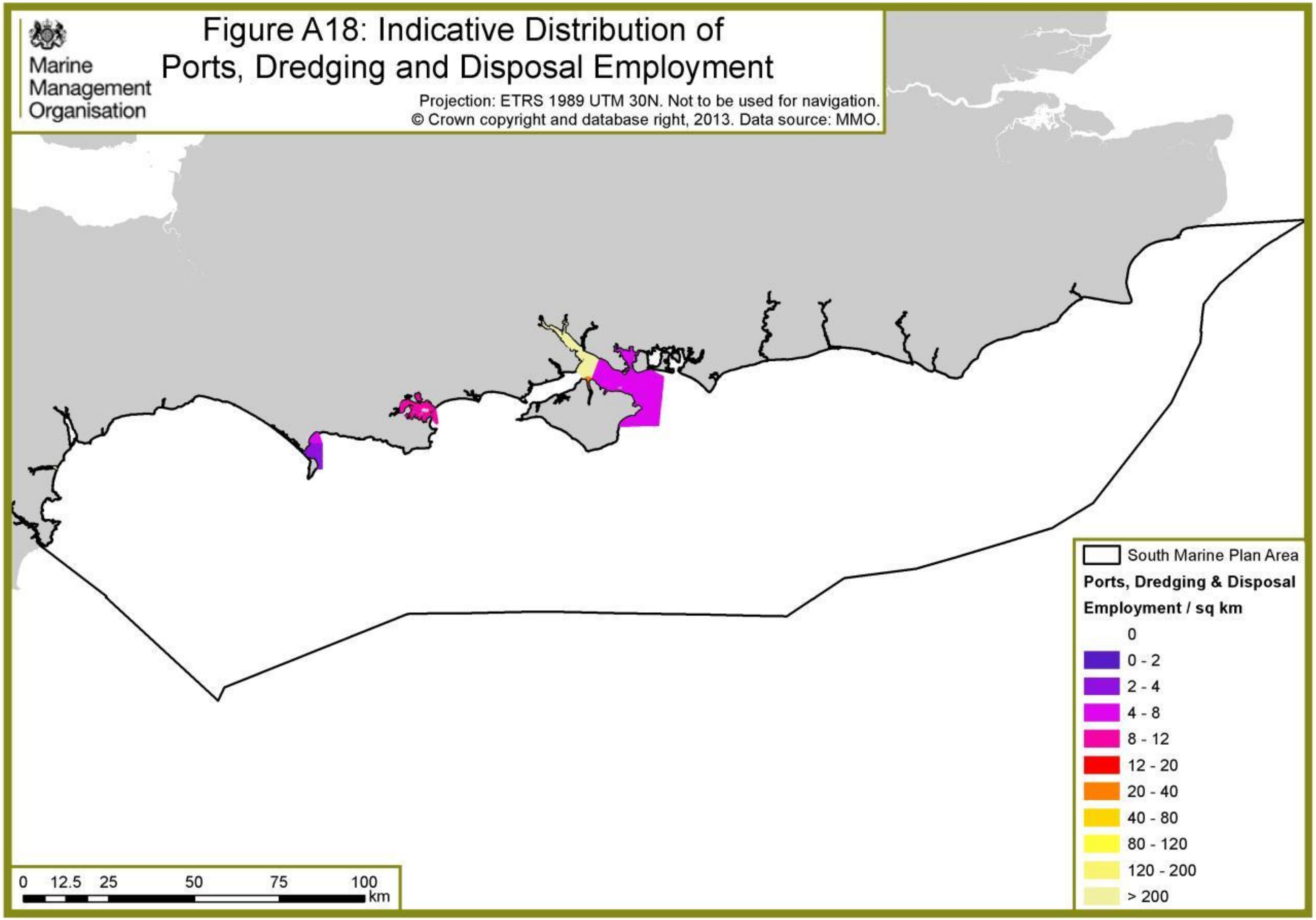

Marine
Management
Organisation
Figure A15: Indicative Distribution
of Military Defence Employment
Projection: ETRS 1989 UTM 30N. Not to be used for navigation.
© Crown copyright and database right, 2013.
South Marine Plan Area
Defence
Employment / sq km
0
0 - 2
2 - 4
4 - 8
8 - 12
12 - 20
20 - 40
40 - 80
80 - 120
120 - 200
> 200
0 12.5 25 50 75 100
km

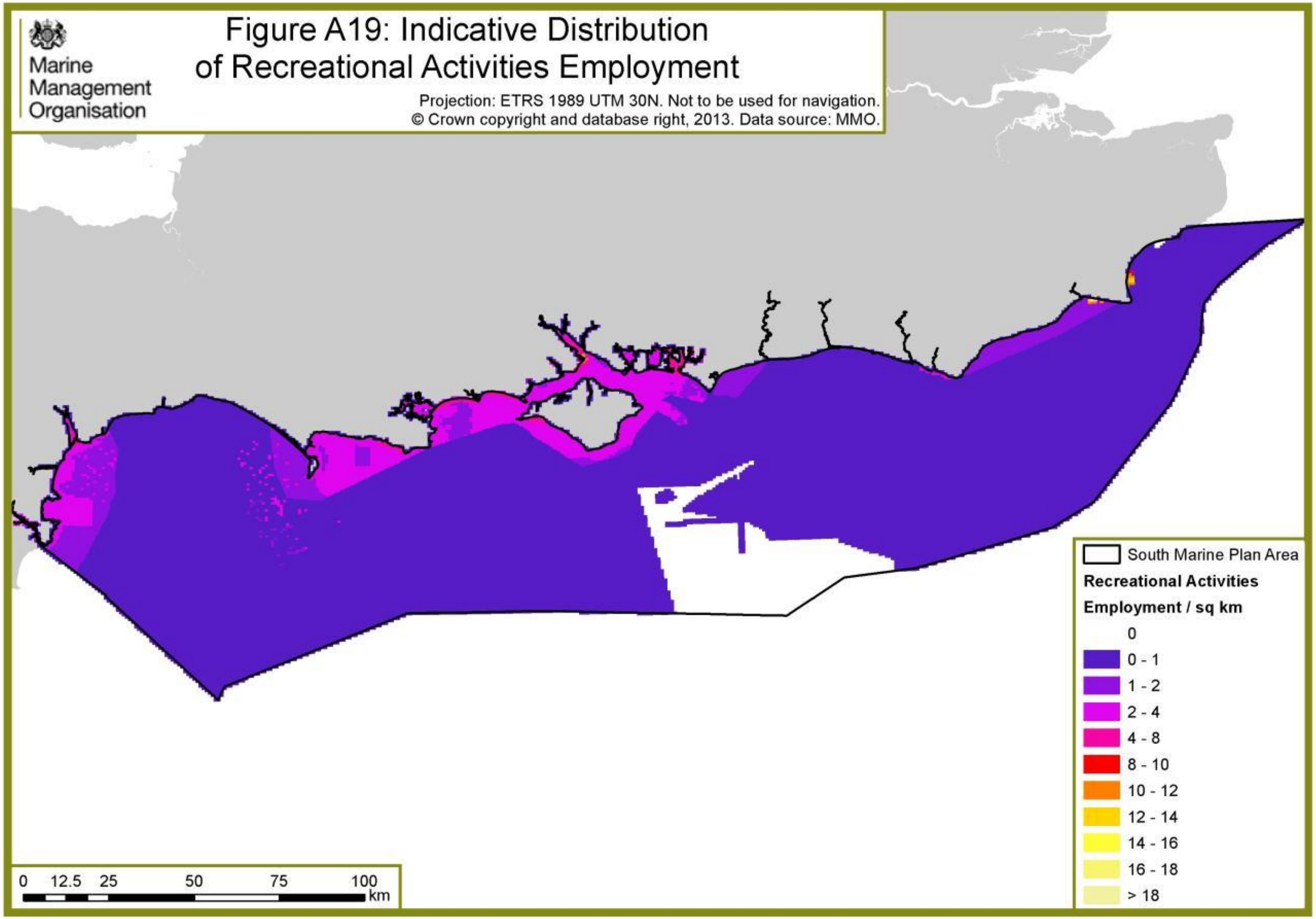


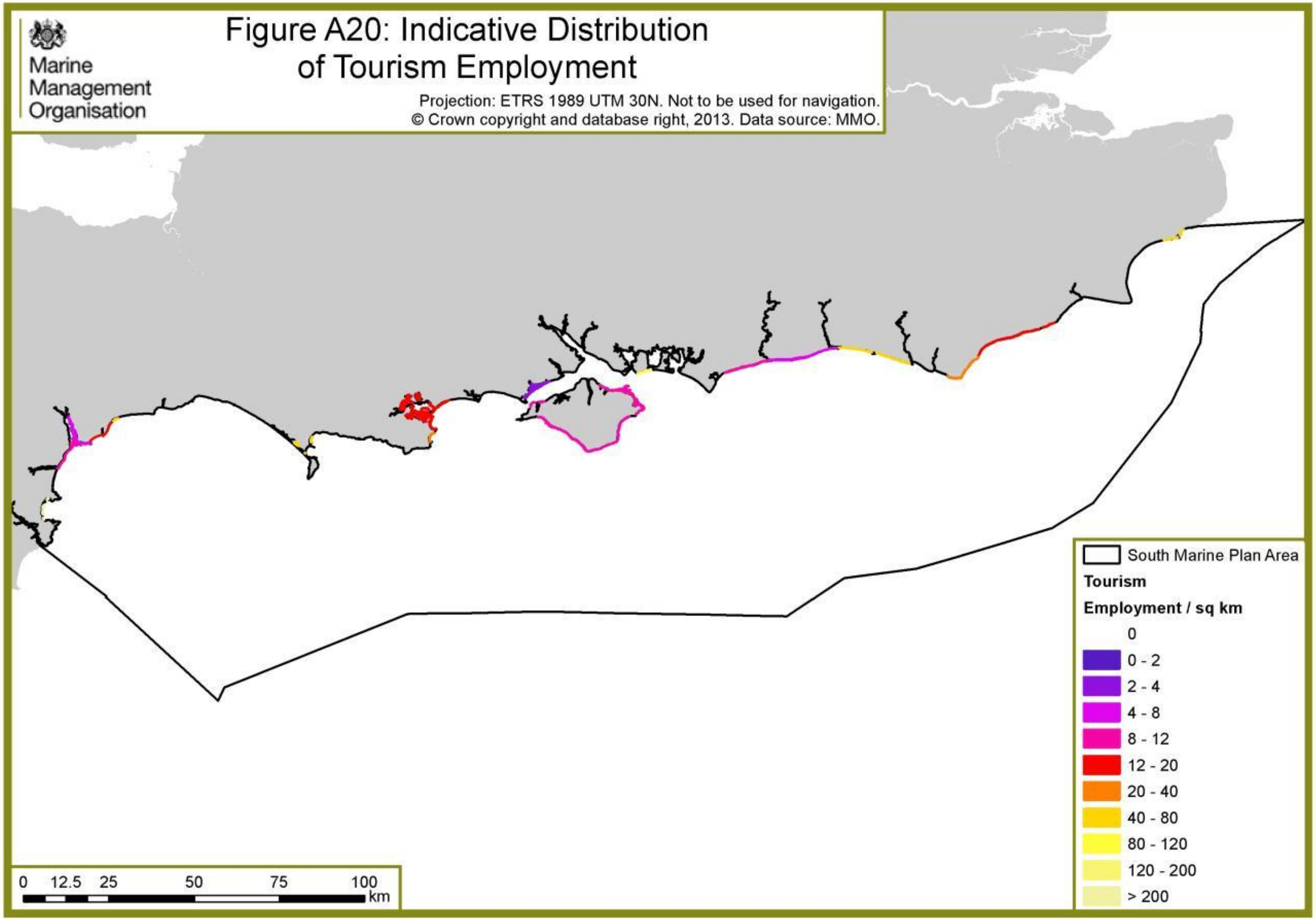
Marine Management Organisation
Figure A16: Indicative Distribution of Nuclear Energy Employment
Projection: ETRS 1989 UTM 30N. Not to be used for navigation.
© Crown copyright and database right, 2013.
South Marine Plan Area
Nuclear Energy Employment / sq km
0
0 - 5
5 - 10
10 - 15
15 - 20
20 - 30
30 - 40
40 - 50
50 - 60
60 - 80
> 80
0 12.5 25 50 75 100 km



Marine
Management
Organisation
Figure A17: Indicative Distribution of Offshore Renewables Employment
Projection: ETRS 1989 UTM 30N. Not to be used for navigation.
© Crown copyright and database right, 2014. Data source: The Crown Estate.
South Marine Plan Area
Offshore Renewables
Employment / sq km
0.00
0.00 - 0.05
0.05 - 0.1
0.1 - 0.15
0.15 - 0.2
0.2 - 0.25
0.25 - 0.3
0.3 - 0.35
0.35 - 0.4
0.4 - 0.45
> 0.45
0 12.5 25 50 75 100
km


Marine Management Organisation
Figure A18: Indicative Distribution of
Ports, Dredging and Disposal Employment
Projection: ETRS 1989 UTM 30N. Not to be used for navigation.
© Crown copyright and database right, 2013. Data source: MMO.
South Marine Plan Area
Ports, Dredging & Disposal
Employment / sq km
0
0 - 2
2 - 4
4 - 8
8 - 12
12 - 20
20 - 40
40 - 80
80 - 120
120 - 200
> 200
0 12.5 25 50 75 100
km


Marine
Management
Organisation
Figure A19: Indicative Distribution
of Recreational Activities Employment
Projection: ETRS 1989 UTM 30N. Not to be used for navigation.
© Crown copyright and database right, 2013. Data source: MMO.
South Marine Plan Area
Recreational Activities
Employment / sq km
0
0 - 1
1 - 2
2 - 4
4 - 8
8 - 10
10 - 12
12 - 14
14 - 16
16 - 18
> 18
0
12.5
25
50
75
100
km


Marine
Management
Organisation
Figure A20: Indicative Distribution
of Tourism Employment
Projection: ETRS 1989 UTM 30N. Not to be used for navigation.
© Crown copyright and database right, 2013. Data source: MMO.
South Marine Plan Area
Tourism
Employment / sq km
0
0 - 2
2 - 4
4 - 8
8 - 12
12 - 20
20 - 40
40 - 80
80 - 120
120 - 200
> 200
0
12.5
25
50
75
100
km

A1.5 References

McVittie and Moran (2010). Determining monetary values for use and non-use goods and services: Marine Biodiversity – primary valuation. Final Report, July, 2008.

MMO (2013a) Economic baseline assessment of the South Coast. A report produced for the Marine Management Organisation by Eunomia Research & Consulting Ltd, pp 125. MMO Project No: 1050. ISBN: 978-1-909452-13-8.

MMO (2013b) South marine plan areas futures analysis. A report produced for the Marine Management Organisation by ABP Marine Environmental Research Ltd, 241pp. MMO Project No: 1039. ISBN: 978-1-909452-14-5

Annex 2: Estimating Gross Carbon Savings from Offshore Wind Development and Relative Significance of Carbon Savings Relative to GVA

A2.1 Method

Step 1: Calculate total potential output of the development in MWh

The total potential output is based on the total installed power of the development (in MW) and the number of hours in a year during which it can operate. This is then multiplied by a capacity factor to take into account the periods when the devices may be operating at below peak output.

Total potential output in MWh = Power of development (in MW) x 8,760 hours per year

Output capacity per year in MWh = Total potential output (MWh) x Capacity factor

The capacity factor has been taken to be 0.3 (Lynn, 2011).

Based on an installed capacity of 700MW for Rampion and 1100MW for Navitus Bay, this would indicate electricity production of 1839600MWh and 2890800MWh respectively.

Step 2: Assign output capacity to years of operation and calculate carbon savings per year

The annual gross carbon savings per year are calculated based on the amount of CO_2 that a combined cycle gas turbine power plant would produce to generate the same amount of energy, as equivalent tonnes of carbon dioxide (tCO_2e). Typical combined cycle gas turbine CO_2 emissions are around 400 g/kWh, or 0.4 t/MWh (AEA Technology, 2005).

Gross C-savings per year (tCO_2e) = Output capacity per year (MWh) x 0.4 tCO_2/MWh

On this basis, the gross carbon savings for Rampion and Navitus Bay would be 735840 and 1156320 tonnes respectively.

Step 3: Calculate value of carbon savings based on DECC traded and non-traded carbon prices, per year of operation

DECC provides projections of carbon prices (DECC, 2013). These can be used to calculate the value of the potential gross CO_2 emissions displaced by offshore renewables development. The projected prices are regularly updated.

UK carbon emissions projections are split into ‘traded’ and ‘non-traded’ sectors. Emissions from installations within the EU Emissions Trading Scheme (ETS) are referred to as ‘traded sector’ emissions. The traded sector comprises energy industries including power stations, refineries, offshore oil and gas, some combined heat and power (CHP) installations, energy intensive industries and a small number of service sector participants (DECC, 2013). Therefore, the traded carbon price is used in this analysis.

The value of CO_2 displaced in each year of operation can be calculated based on the gross carbon savings per year multiplied by the traded carbon price in that year. These values are then summed over the lifetime of the development, and divided by 1 million to obtain the total value of carbon savings in £ million. Given the simple nature of the analysis being undertaken here a single value for traded carbon has been used of £33.41 per tonne based on the central value for 2024 from DECC (2013). It is recognised that the relative importance of carbon savings is very dependent on the choice of carbon price.

On this basis the estimated gross carbon savings for Rampion and Navitus would be £24.6m and £38.6m per year respectively.

Step 4: Relative significance of carbon savings compared to GVA

European Offshore Wind Deployment Centre (2011) estimates a total of £15,430 GVA per 1MW operational wind power. For Rampion and Navitus Bay this therefore represents an annual GVA of £10.8m and £17.0m respectively.

To take account of these potential savings within the social impact model, the GVA values are therefore multiplied by 1+ (annual estimated carbon savings value/annual estimated GVA) = 3.27.

A2.2 References

AEA Technology (2005). Environmental Product Declaration of Electricity from Torness Nuclear Power Station. Summary of Results. A study for British Energy. May 2005. Available at http://www.britishenergy.com/documents/EPD_Exec_Summary.pdf .

DECC (2013). Updated short-term traded carbon values for UK public policy appraisal, September 2013. https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/240095/shortterm_traded_carbon_values_used_for_UK_policy_appraisal_2013_FINAL_URN.pdf

European Offshore Wind Deployment Centre (2011). Environmental Statement - Aberdeen Offshore Wind Farm Limited. www.vattenfall.co.uk/en/file/EOWDC-consent-vol2.pdf_18477873.pdf.

Lynn, P.A. (2011). Introduction in Onshore and Offshore Wind Energy: An Introduction, John Wiley & Sons, Ltd, Chichester, UK. doi: 10.1002/9781119954613.ch1

Annex 3: Figures of Indicative distribution of potential combined social benefits

Figure A3.1: Indicative distribution of potential combined social benefits from marine aggregates.

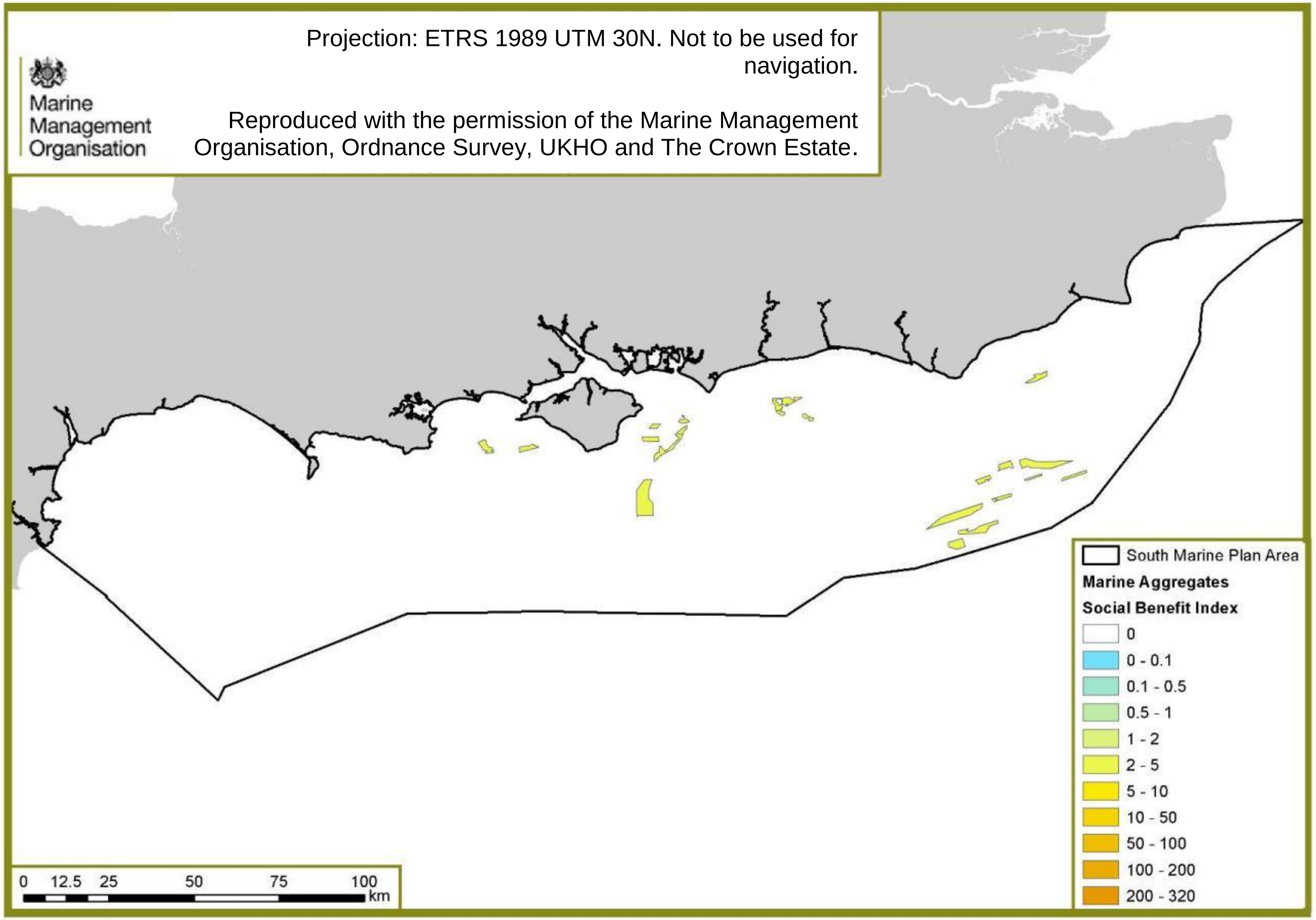


Figure A3.2: Indicative distribution of potential combined social benefits from aquaculture.

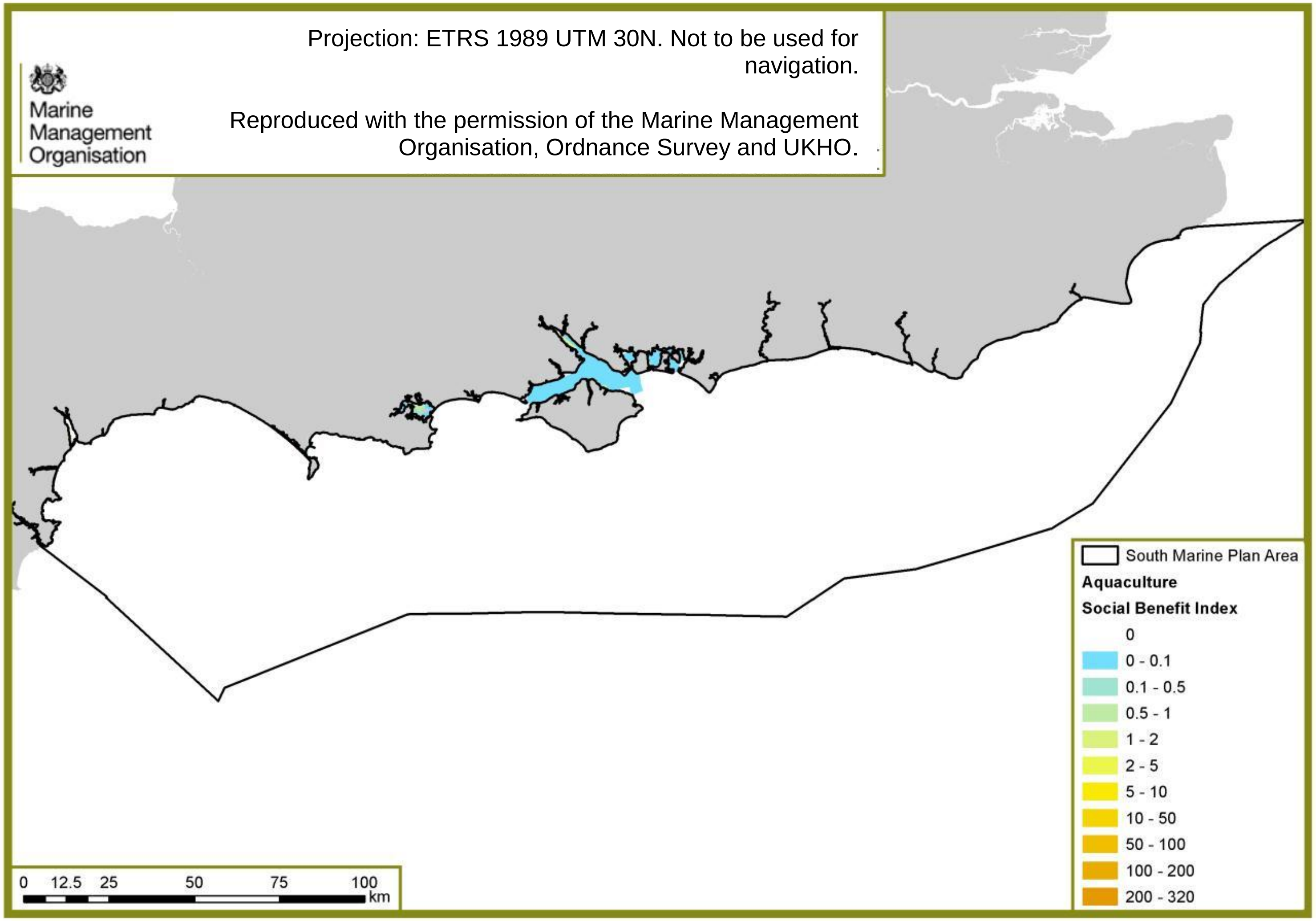


Figure A3.3: Indicative distribution of potential combined social benefits from commercial fishing.

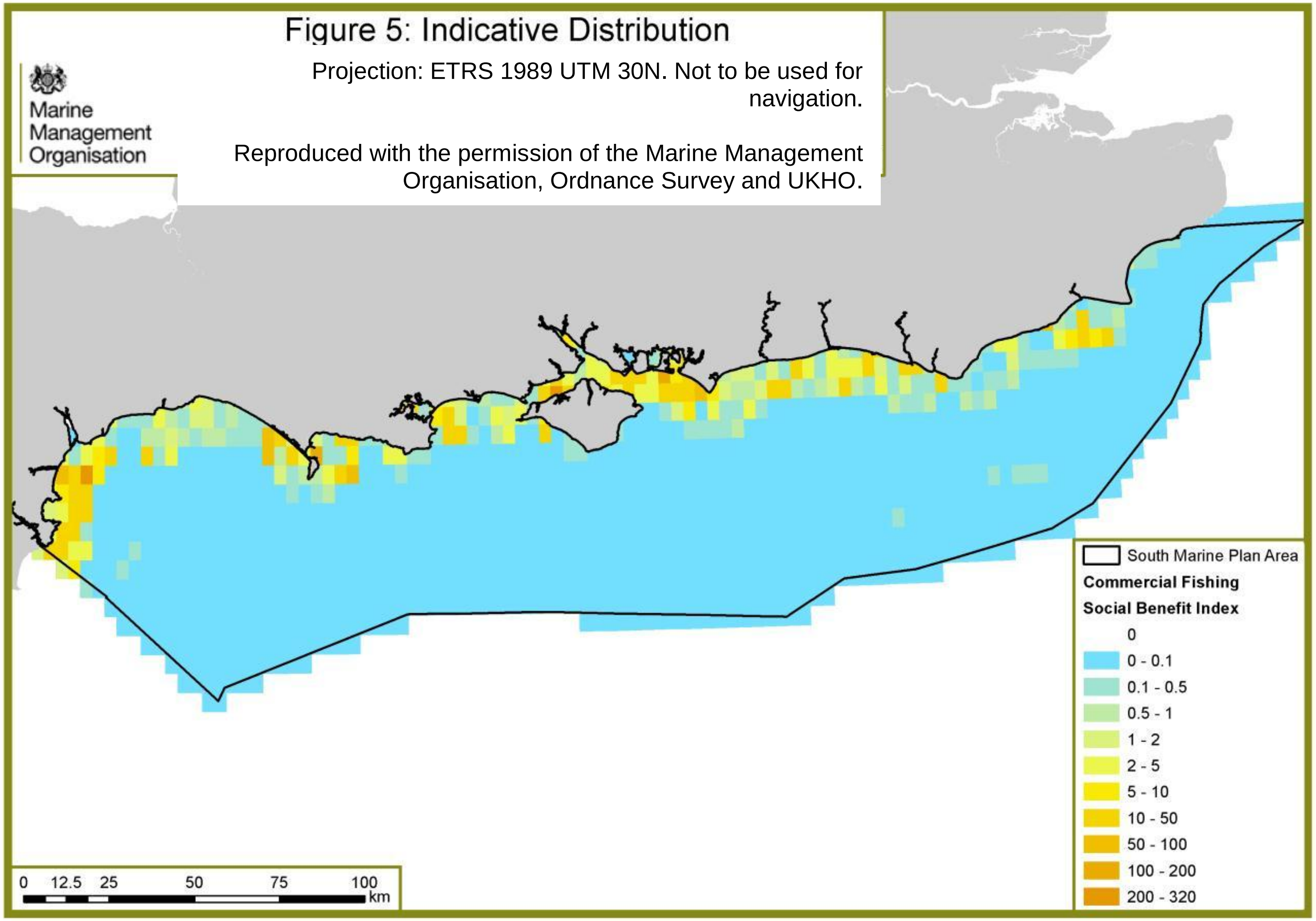


Figure A3.4: Indicative distribution of potential combined social benefits from commercial shipping.

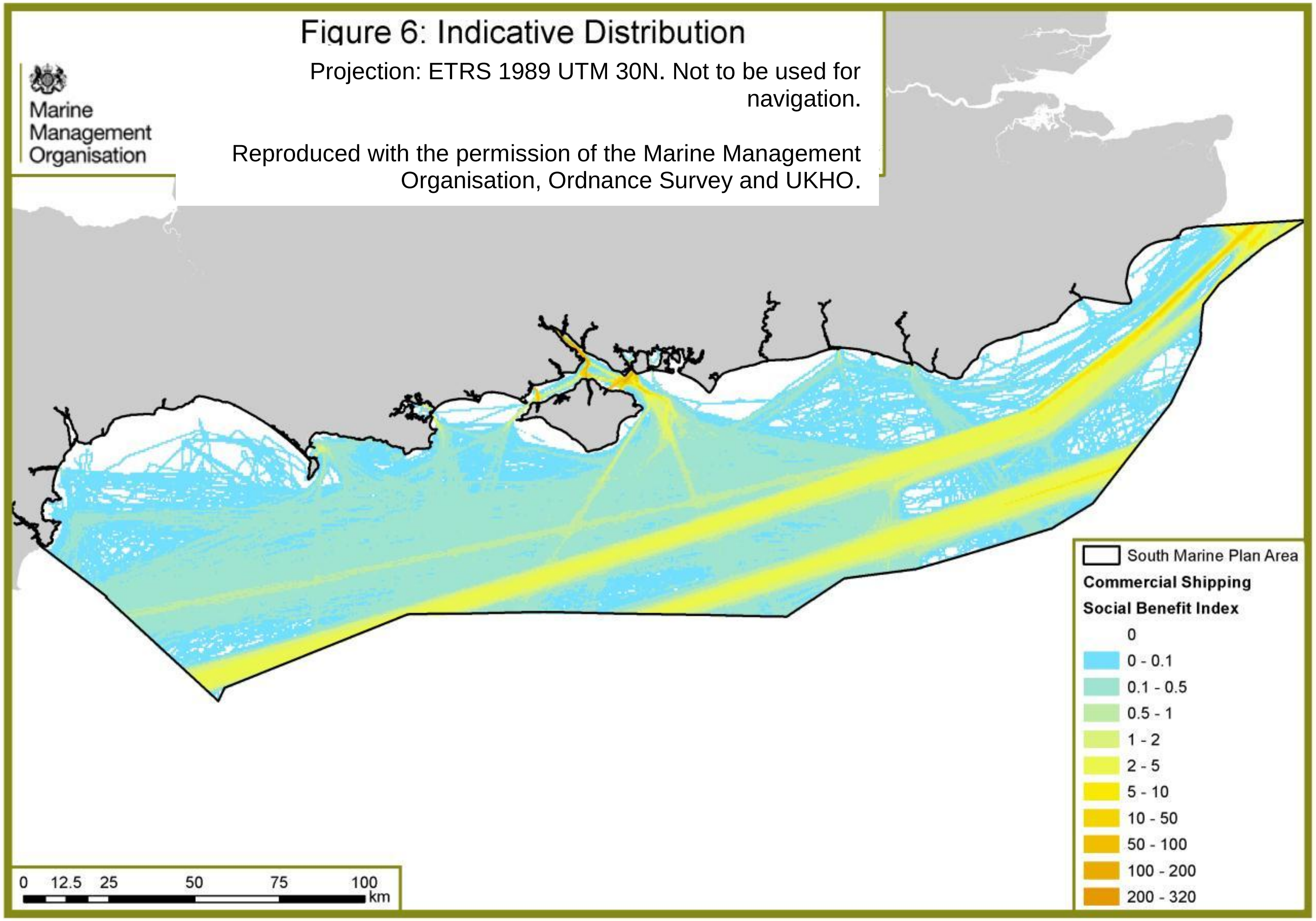


Figure A3.5: Indicative distribution of potential combined social benefits from defence.

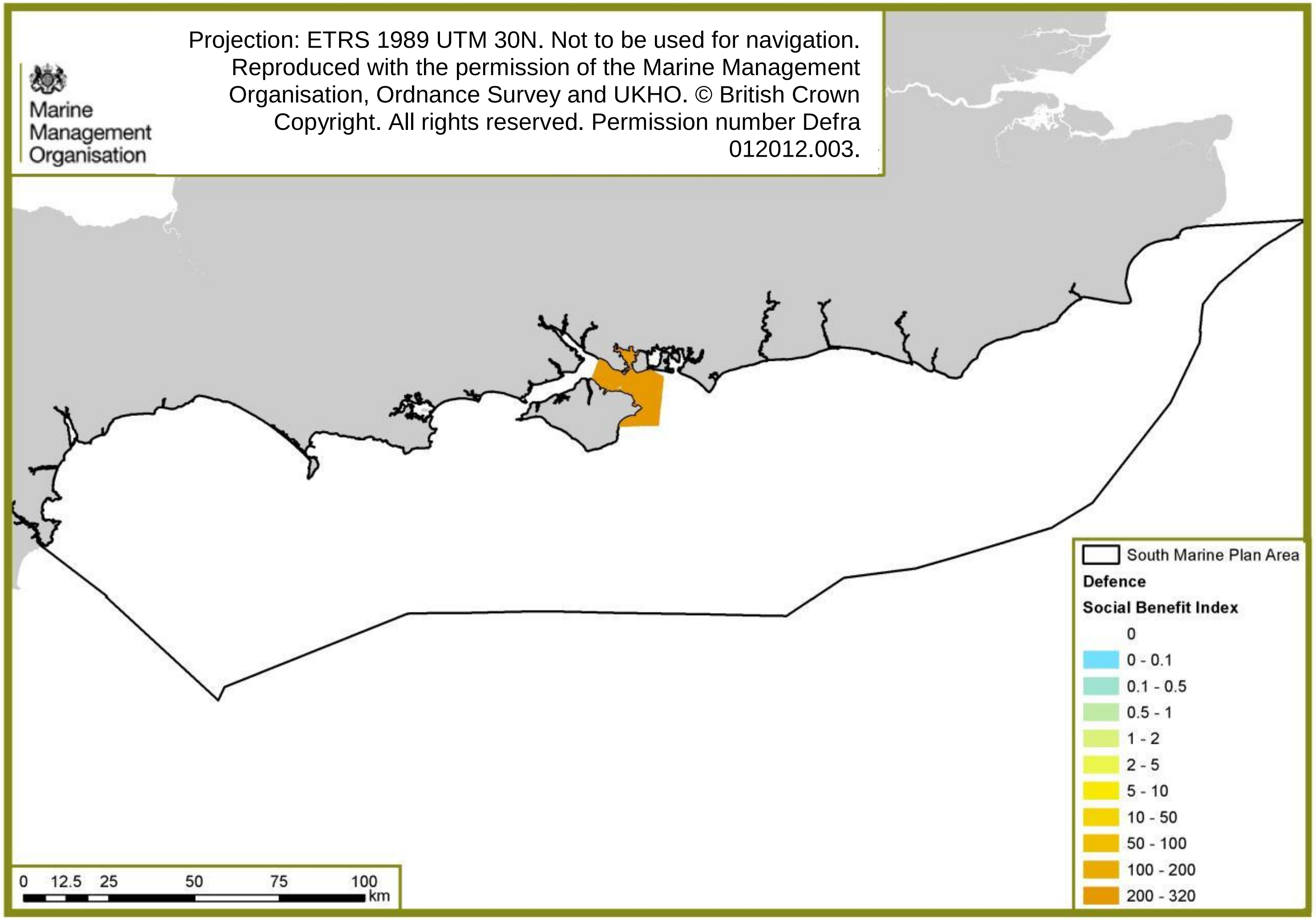


Figure A3.6: Indicative distribution of potential combined social benefits from Marine Protected Areas.

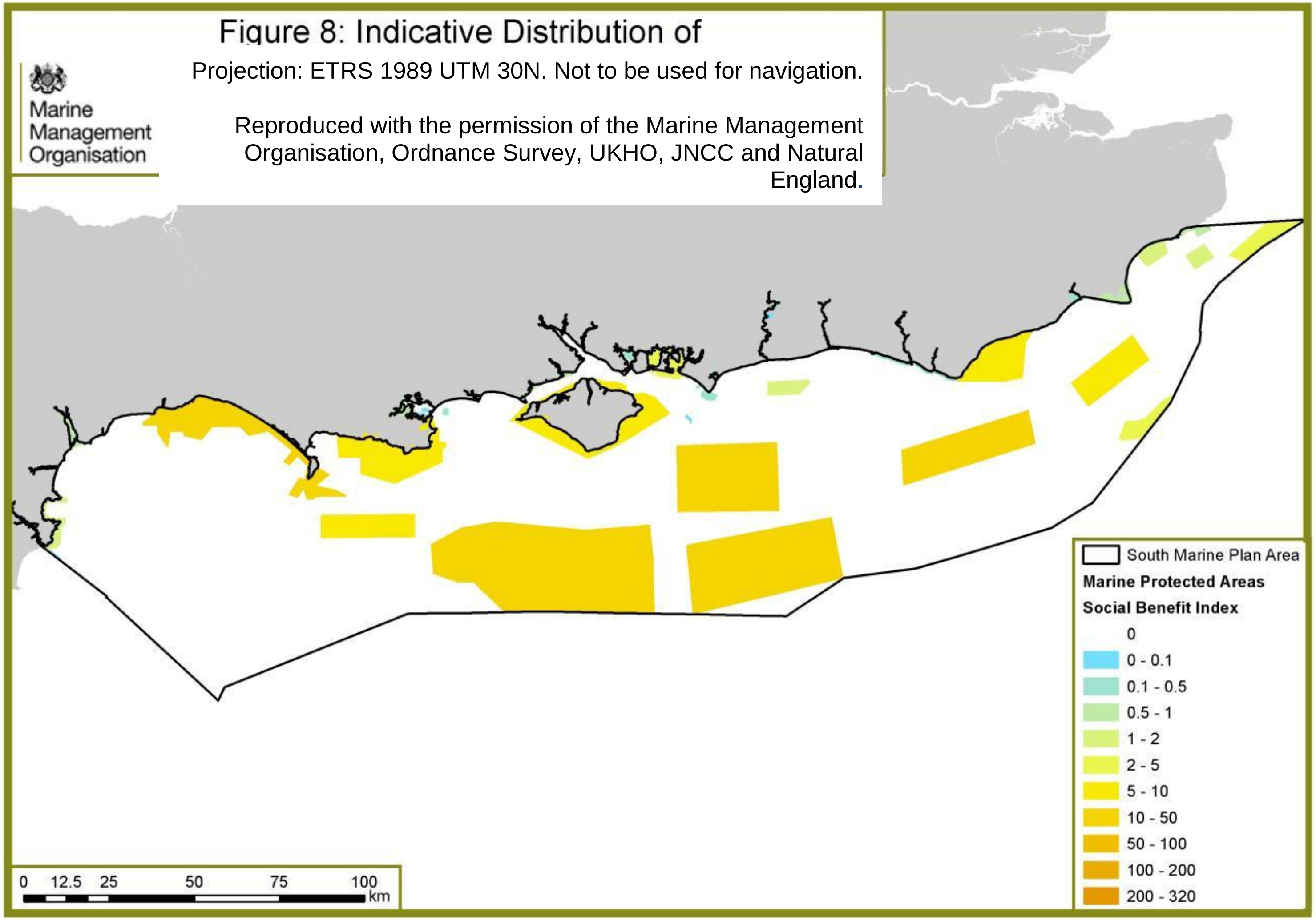


Figure A3.7: Indicative distribution of potential combined social benefits from nuclear energy.

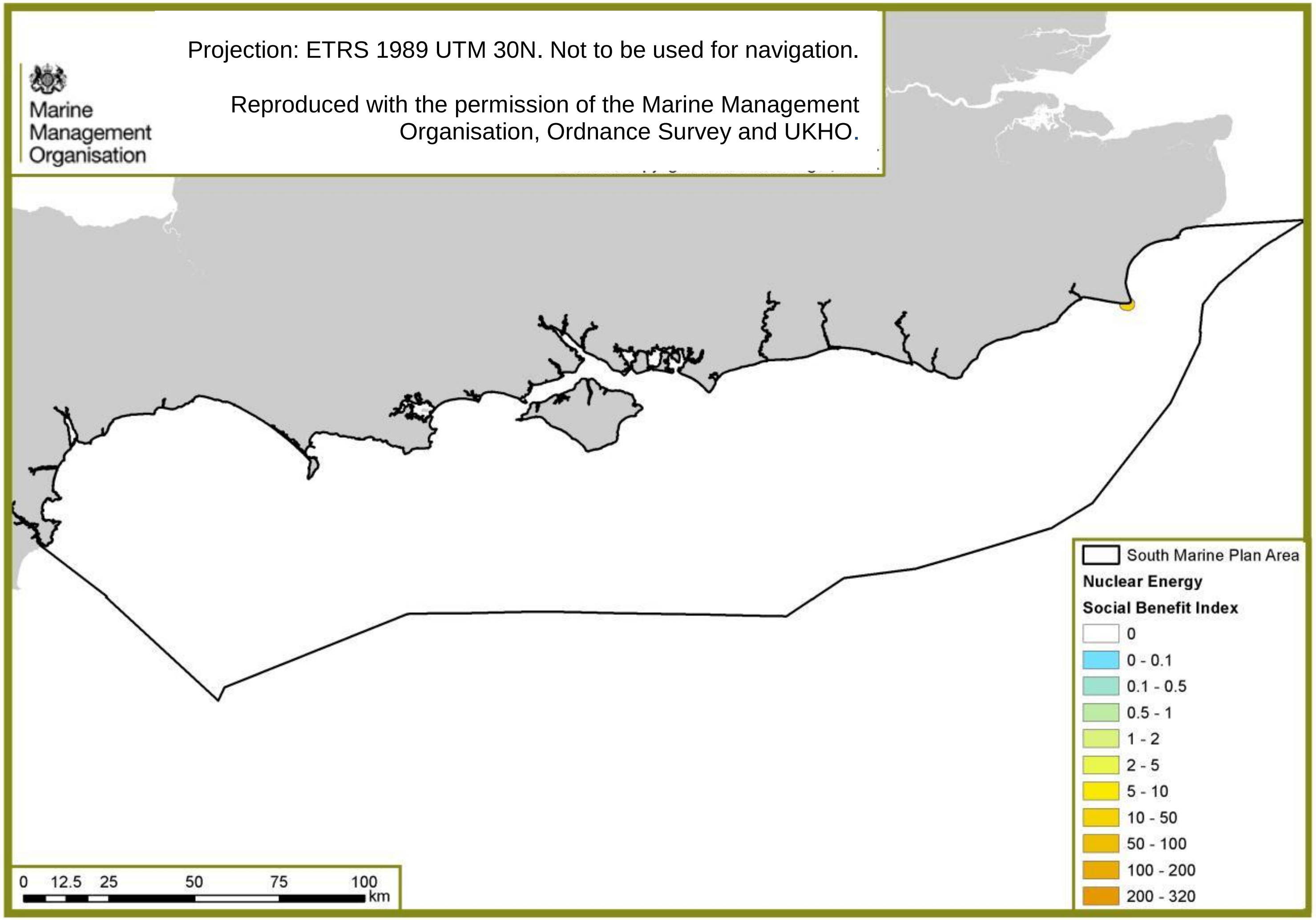


Figure A3.8: Indicative distribution of potential combined social benefits from offshore renewables.

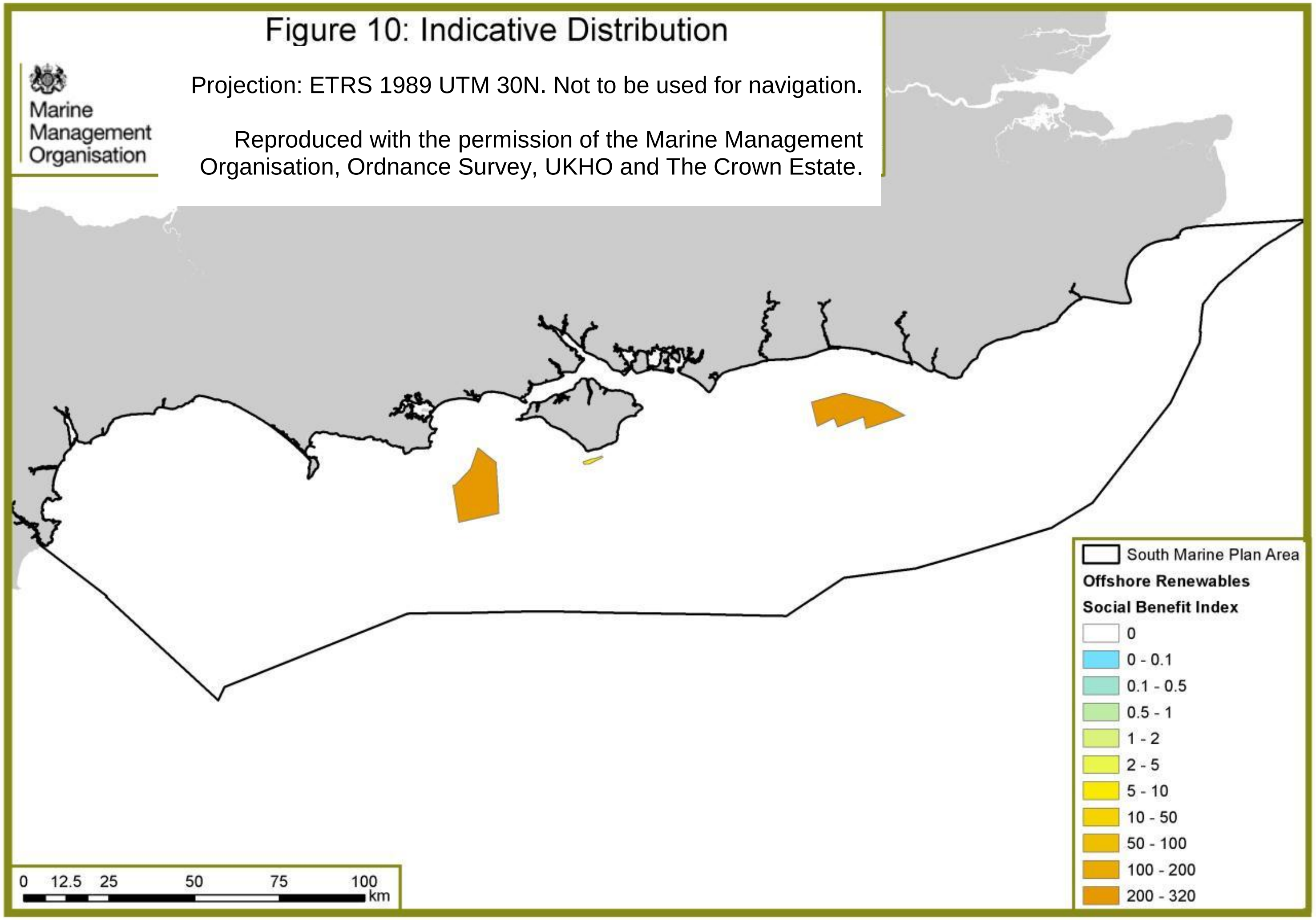


Figure A3.9: indicative distribution of potential combined social benefits from ports, dredging and disposal.

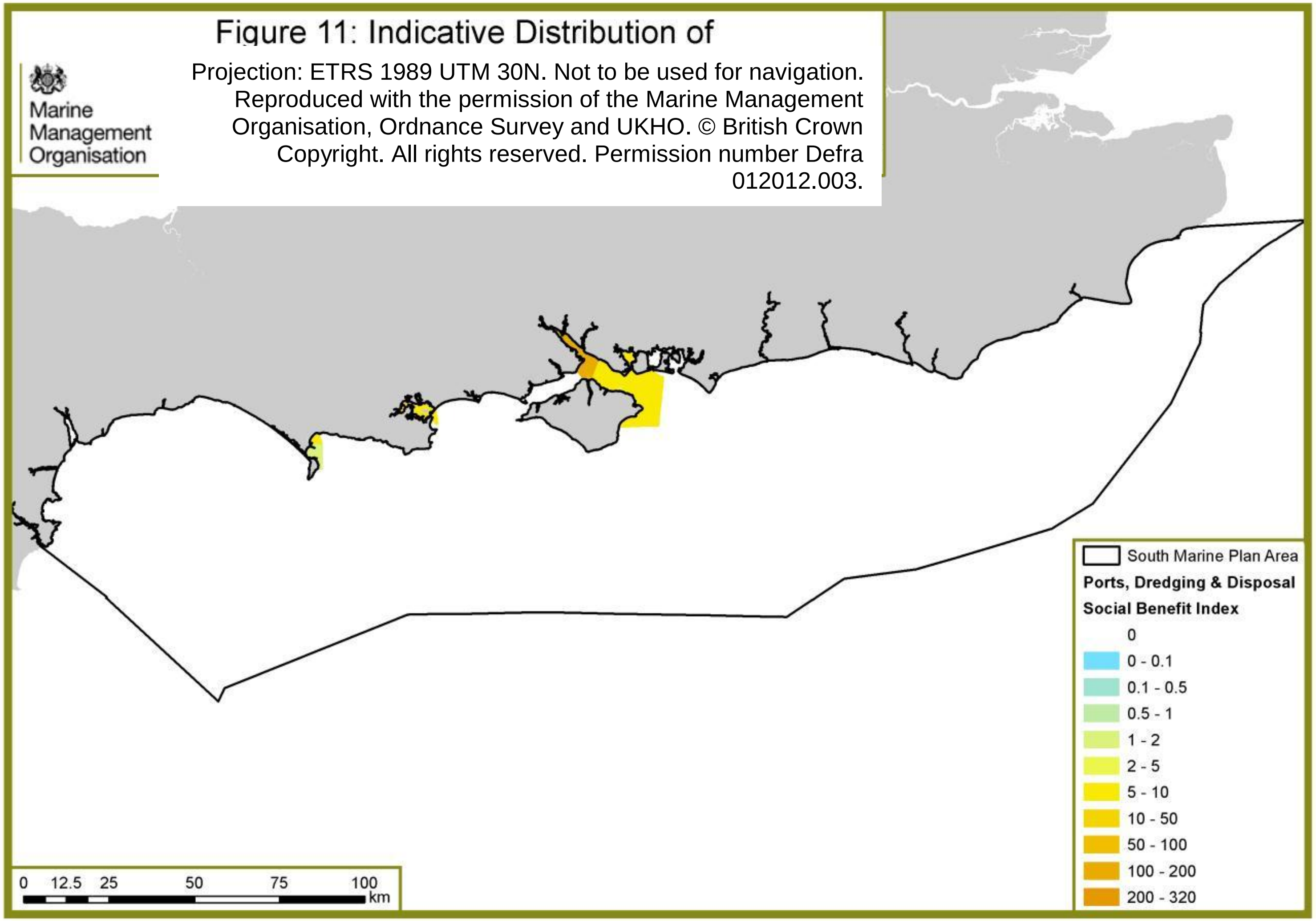


Figure A3.10: indicative distribution of potential combined social benefits from recreational activities.

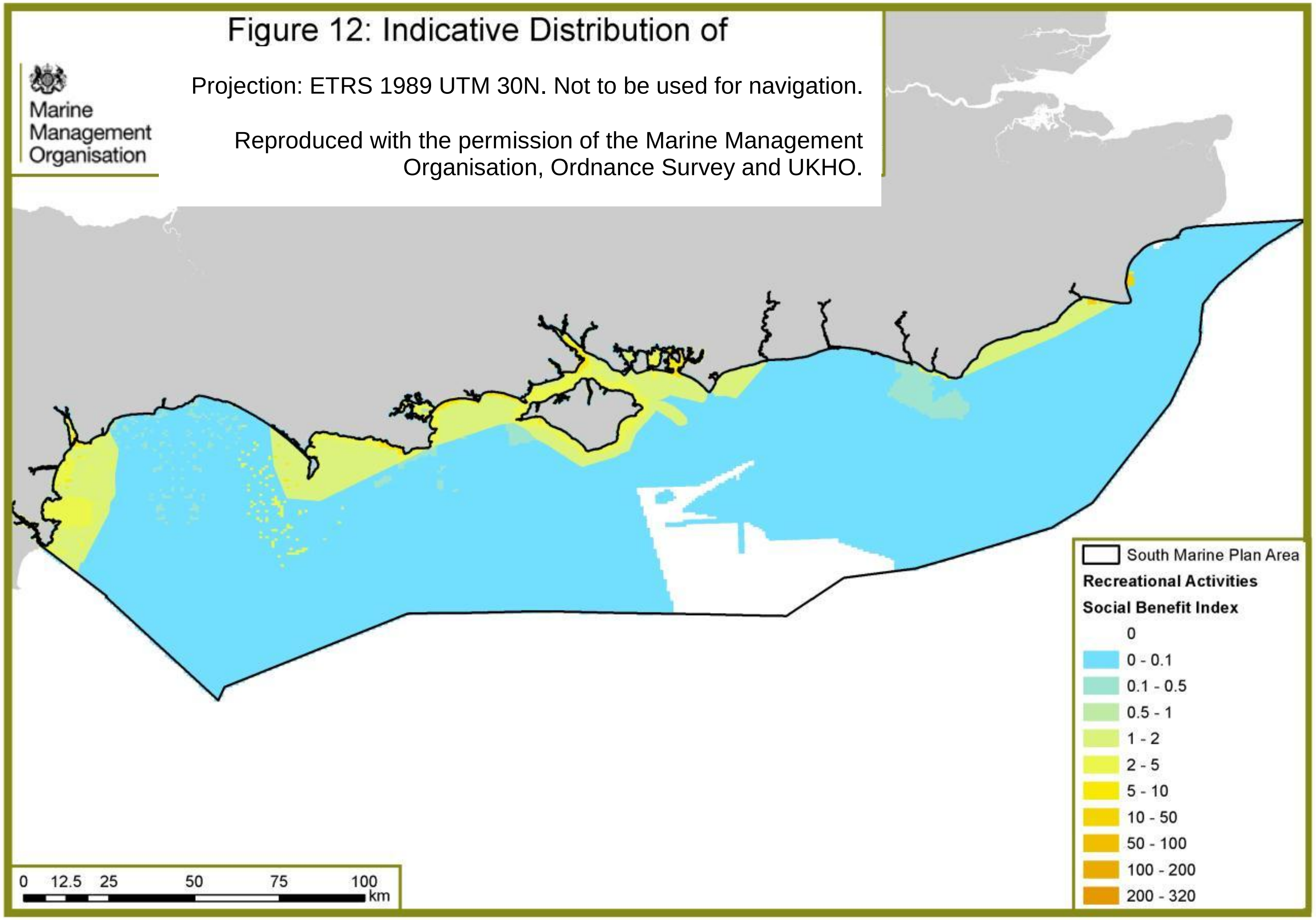


Figure A3.11: indicative distribution of potential combined social benefits from surface water and waste water management.

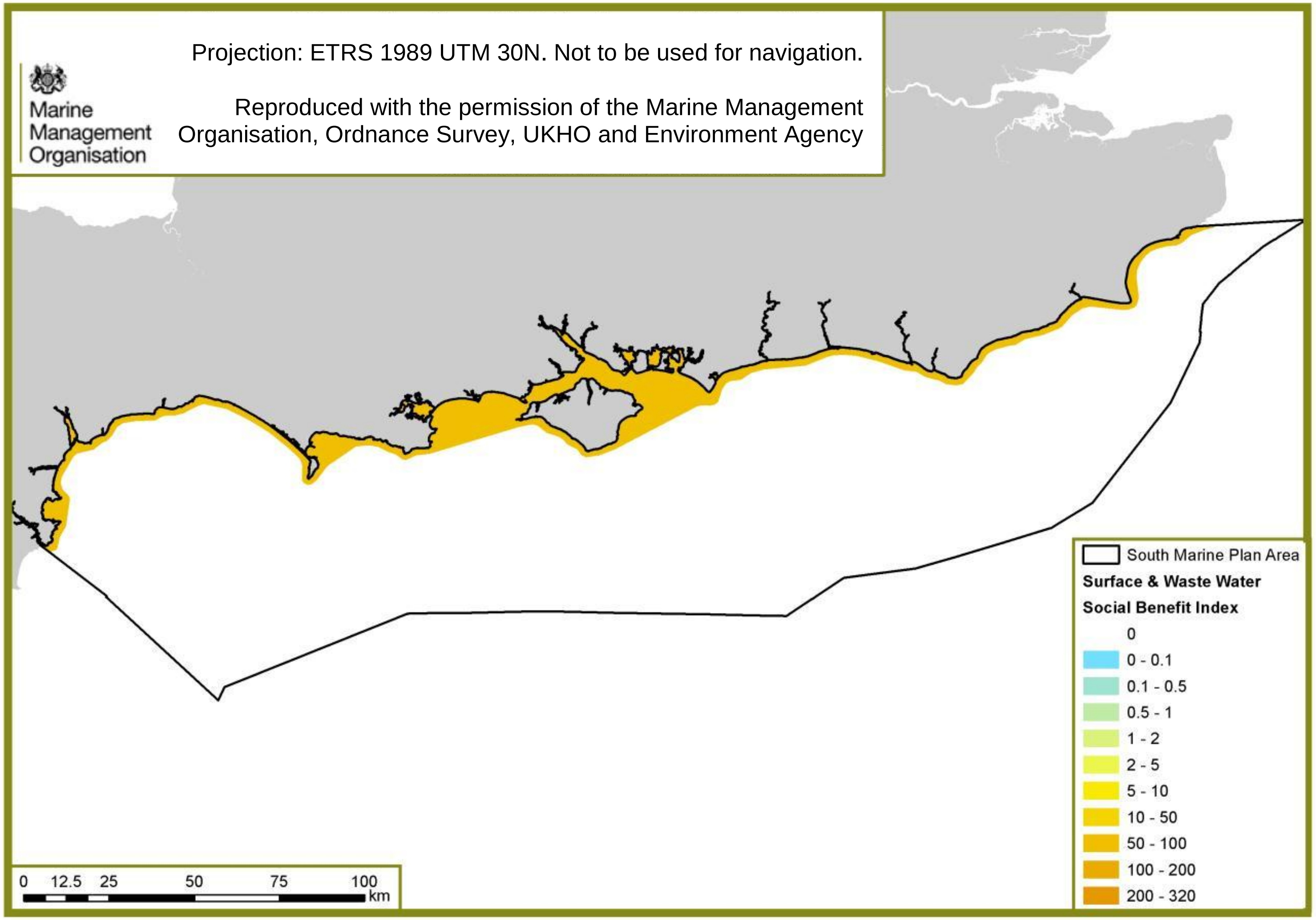


Figure A3.12: Indicative distribution of potential combined social benefits from tourism.

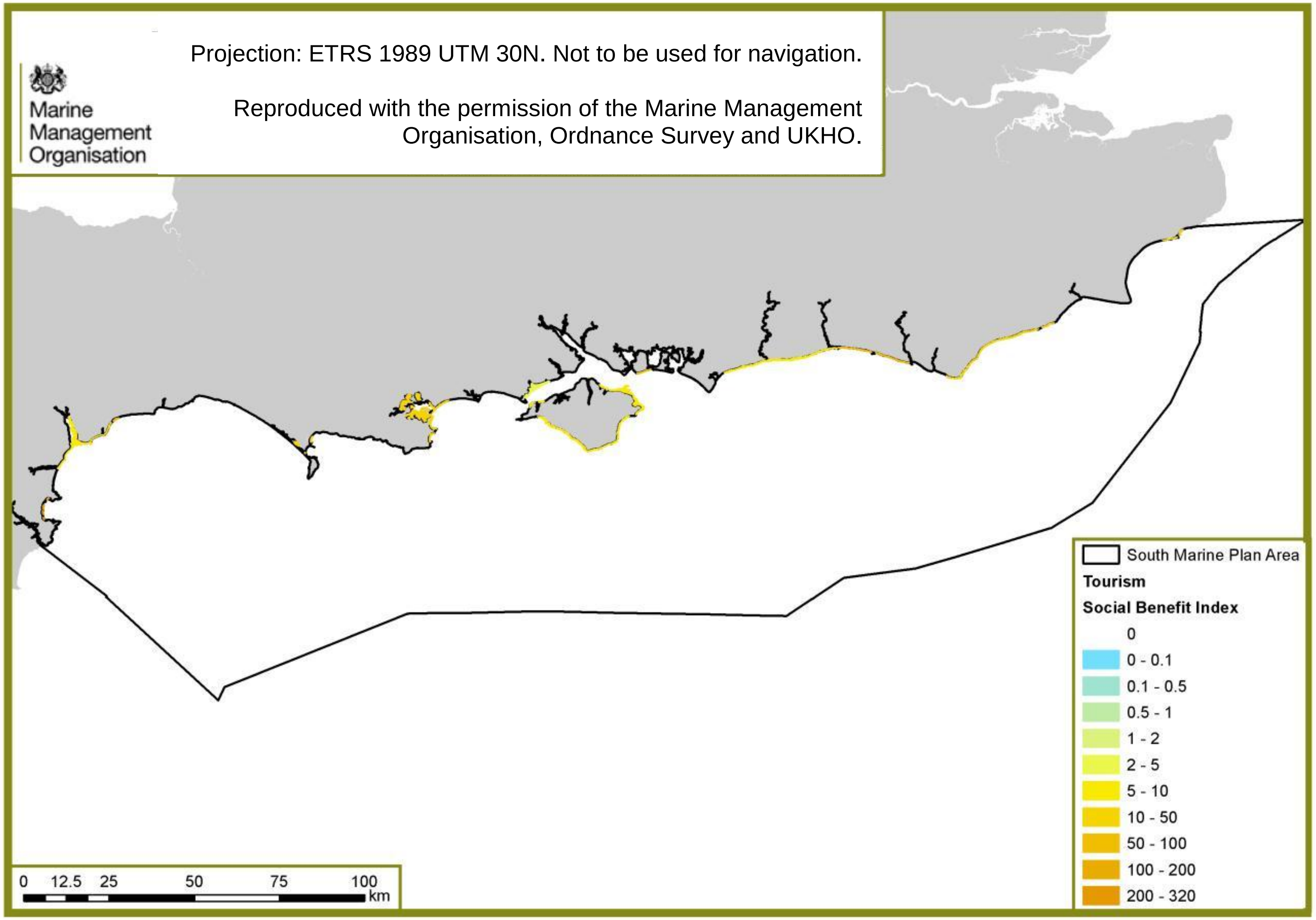


Figure A3.13: indicative distribution of potential combined social benefits from all MPS activities.

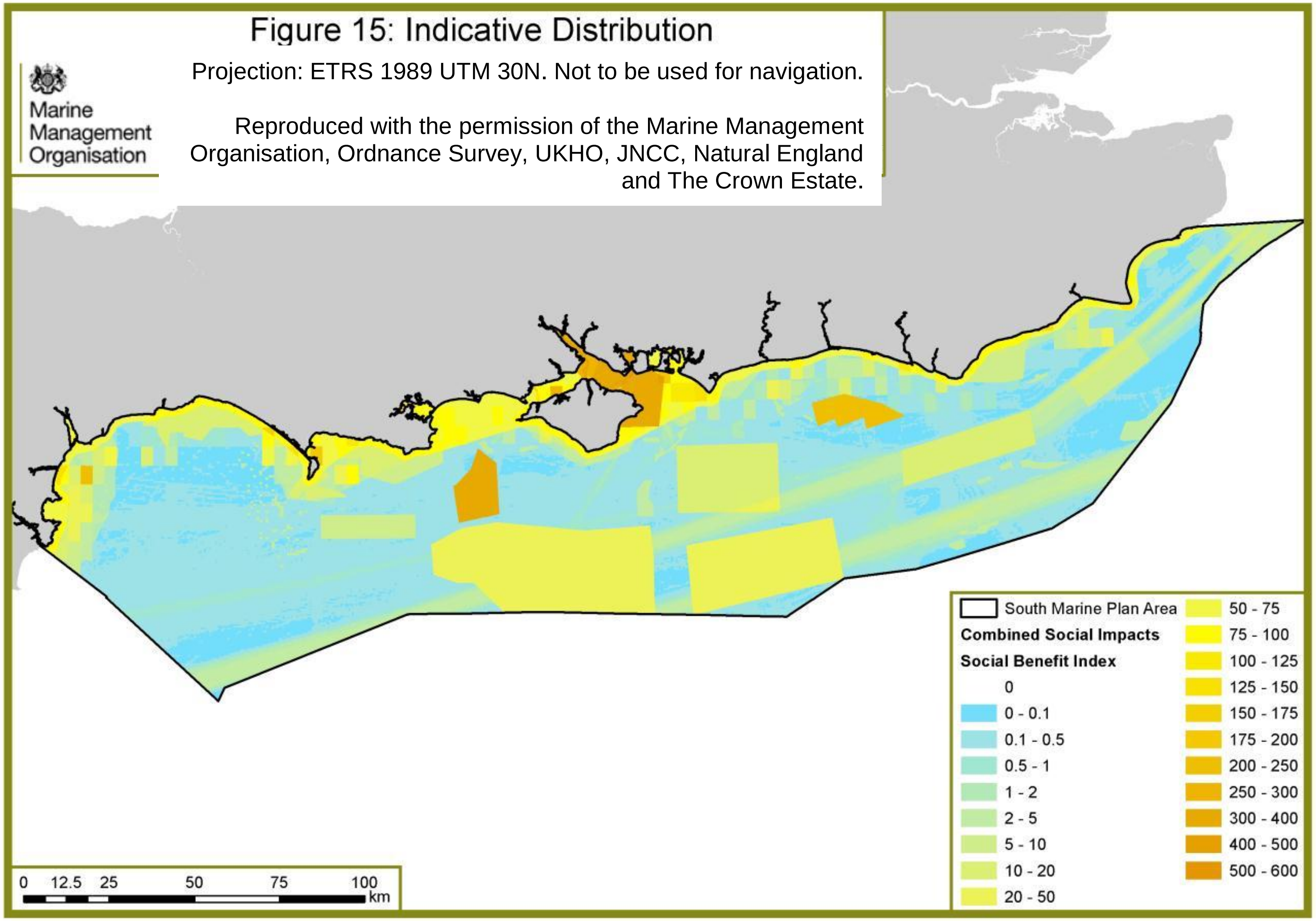


Figure A3.14: Potential areas of interaction between offshore renewables and areas of social benefit to the commercial fishing sector.

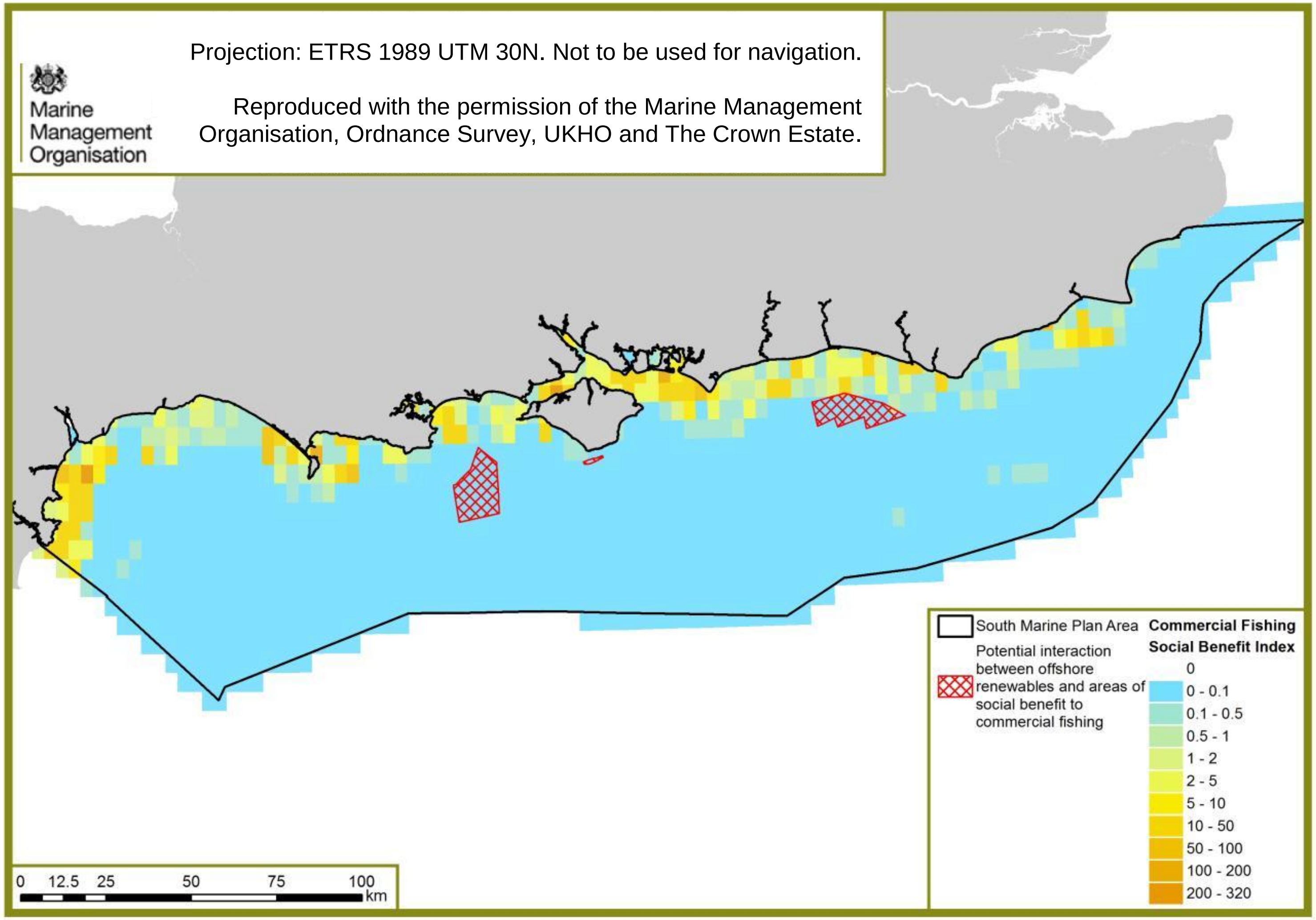


Figure A3.15: Potential areas of interaction between offshore renewables and areas of social benefit to the ports, dredging and disposal sector.

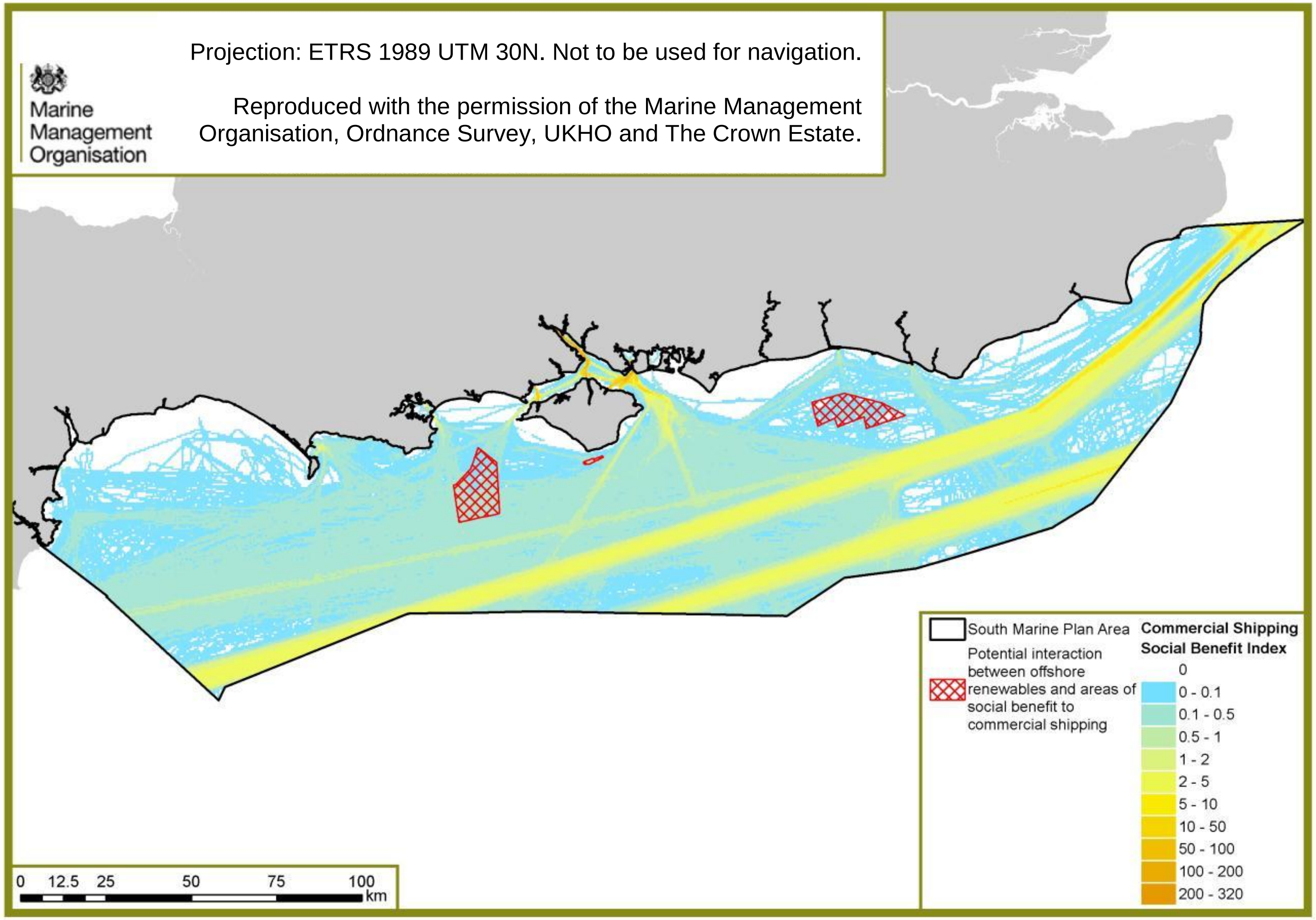


Figure A3.16: Potential areas of interaction between MPAs and areas of social benefit to the ports, dredging and disposal sector.

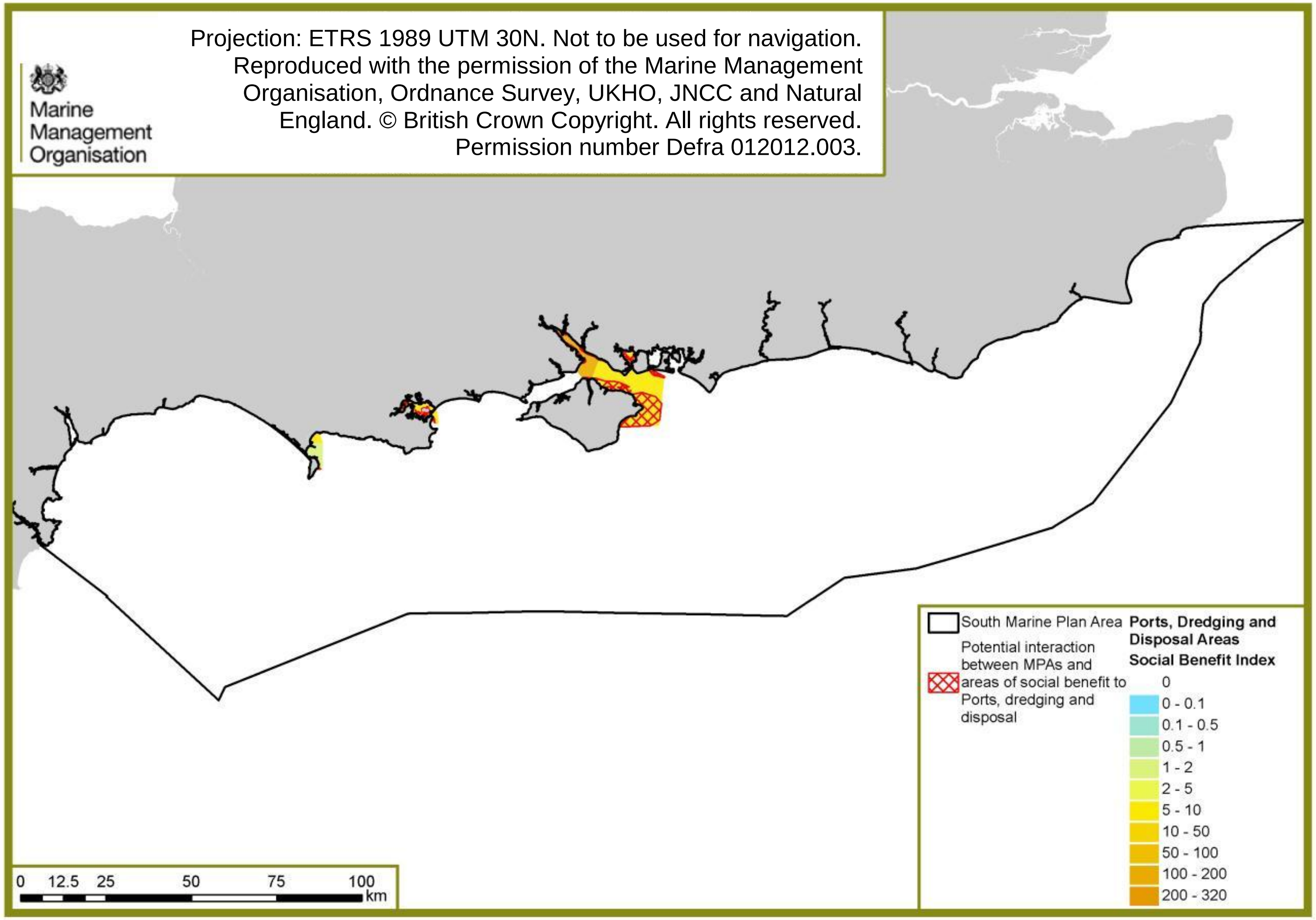


Figure A3.17: Potential areas of interaction between MPAs and areas of social benefit to the commercial fishing sector.