



Marine
Management
Organisation

MMO1274: East Marine Plan Spatial Assessment

FINAL REPORT

March 2022



...ambitious for our seas and coasts

MMO1274: East Marine Plan Spatial Assessment

March 2022



**Marine
Management
Organisation**

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Executive Summary

Context and scope

The East Inshore and East Offshore Marine Plans (hereafter referred to as the East Marine Plans) were the first marine plans produced for English seas. The purpose of the plans is to help ensure the sustainable development of the east marine plan areas and that economic growth occurs in a way that benefits society whilst respecting the needs of local communities and protecting the marine ecosystem. Furthermore, marine plans help reduce the net regulatory burden on applicants and users. This is done by acting as an enabling mechanism for those seeking to undertake activities or development in the future and providing more certainty about where activities could best take place.

Since the East Marine Plan publication in 2014, dynamics in the east marine plan areas have evolved. The 2020 East Marine Plans three-year progress report shows that the East Marine Plans have had a significant change in context. Key characteristics and uses that have changed include more marine protected areas, offshore wind developments with potential implications for marine users, and the UK's exit from the European Union. Beyond this, national plans and strategies such as the UK Marine Strategy (2019), the Ten Point Plan for a Green Industrial Revolution (2020), and the Net Zero Strategy (2020), have been enacted and changed national priorities and the regulatory landscape. As a result, marine planners and users need updated clarification on the current and future spatial capacity of the east marine plan areas.

To achieve this, the Marine Management Organisation (MMO) commissioned a spatial analysis of the east marine plan areas to understand suitability of specific locations in the geography to support different sectors, and to visualise potential policy trade-offs.

Our approach

In this study, eleven focus sectors in the inshore and offshore east marine plan areas were analysed. These sectors were selected due to their relevance to national priorities, their spatial specificity and compatibility (or not), with other sectors and their relevance to the east marine plan areas. The sectors are:

- energy production (renewables - with a focus on offshore wind)
- energy production (oil and gas)
- carbon capture, usage and storage (CCUS)
- dredging and disposal
- aggregate
- ports and shipping
- aquaculture
- tourism and recreation
- coastal change and flooding
- fisheries
- environment.

To deliver this study, the following eight workstreams were completed:

1. desktop research to review current and emerging activities for each sector
2. mapping focus sectors to national priorities
3. analysis of spatial constraints and barriers between sectors
4. trade-off implications and opportunities
5. development of spatial mapping
6. stakeholder engagement with team members across the MMO
7. identification of potential policy interventions
8. report writing and recommendations.

This project contributes to a wider work programme that, once complete, will contribute to identifying the carrying capacity of the east marine plan areas and their potential over a 20-year horizon for contributing towards national environmental, social and economic priorities. This project identifies spatial opportunities, barriers, and options for delivering national priorities in the east marine plan areas.

The outputs will be used to facilitate engagement and explore the values and weighting given to national priorities at the east marine plan areas scale. The aim is to support making spatial choices about the location of activities, where appropriate, to inform the development of the vision, objectives and prescriptive policies for an amended East Marine Plan.

Key findings from the spatial assessment are as follows:

Impact of the changing policy landscape on current allocation

The shift to net zero and focus on security and sustainability of energy supply and food stock is creating an impetus for change in the east marine plan areas strategy. This means that significant changes to some sectors can be expected, for example, oil and gas, currently the most prolific sector in the east marine plan areas, will see its activities decrease over the coming years due to national policies and strategies related to achieving net zero emissions by 2050. This decline coincides with the government's plans to transition to more renewable energy production, with large-scale operations of offshore wind farms already underway in the east marine plan areas and significant investment to expand this. With the implementation of the Environment Act 2021, which requires organisations to 'pay regard' to five environmental principles of integration, prevention, precautionary, rectification at the source, and the polluter pays principal, the health of the environment will also remain a critical priority over the coming years. This will be a key consideration for all other sectors and an area where there is likely to be strong government involvement

Competing demands / deconfliction policy needs

There are numerous conflicting demands for natural capital in the east marine plan areas that have been identified in this report. Increasing environmental protection may mean that the Environment sector could take priority over others, to the extent where it could hinder or constrain activities across other sectors particularly through the implementation of Highly Protected Marine Areas (HPMA's). Further investment in offshore wind could also act as a barrier for other sectors, such as fisheries and aquaculture that could compete for the same space. It will therefore be paramount to

explore interventions in which further developments of sectors are not at the expense of adverse environmental impacts and other marine users.

Co-existence opportunities

There are numerous opportunities for greater co-existence of sector activities in the east marine plan areas. Given their finite space, capitalizing on these opportunities could maximise the ability to achieve national priorities. For example, inshore fishing has strong links with many popular coastal resorts and forms an important part of our cultural and heritage assets, which in turn attracts coastal tourism. Development of wind energy projects will also present opportunities for regeneration of ports and shipping as they and their associated supply chains make development possible.

Opportunities to deliver higher yield in one or more sectors from the natural capital assets of the east marine plan areas

There are many instances where increased activity in a sector could facilitate improvements in the natural environment. For example, sustainable tourism and recreation activities can lead to improvements in the quality of the natural environment as users are incentivised to maintain and improve the areas they use. Through offshore platform electrification and sourcing power from offshore renewables, the offshore oil and gas industry could significantly reduce its greenhouse gas emissions, thus also improving the environment.

Uncertainties and areas of further research

There are a number of ways in which the results of this study could be built upon, which will therefore be natural follow-on areas to explore. This includes going beyond the scope of this spatial assessment and exploring the economic outcomes and requirements for successful activities in the east marine plan areas. Understanding the cost of delivering priority activities that support both national economic growth and environmental ambitions is vital to develop a supportive policy and regulatory environment. Similarly, further assessment of infrastructure requirements will determine where appropriate policy measures should be targeted to support spatial conflicts.

Further evidence gathering should also focus on identifying how the potential impacts of activities will be managed, including the cumulative effects on the east marine plan areas. Cumulative and cross boundary impacts of developments also need to be considered and there are currently substantial gaps in our understanding of such impacts.

Next steps

The MMO is responsible for developing marine plans on behalf of the Secretary of State for the Environment. It is the Government's ambition to develop more prescriptive and spatially defined marine plan policies in the future to enable faster decision-making. However, doing so will require more explicit trade-off decisions to determine plan area scale priorities that will, in turn, inform marine plan policy development. The results of this project will be used to inform the development of the second generation of marine plans for English waters.

1. Introduction and overview

1.1 Introduction

To identify the current and future extent of activities in the east marine plan areas, the Marine Management Organisation (MMO) has commissioned a spatial assessment. Spatial analysis allows for complex location-oriented problem solving and enables a better understanding of where and what is occurring in a geographic area. It goes beyond mapping and lets planners study the characteristics of places and the relationships between them. Given the east marine plan areas are finite geographical spaces that have the potential to support many existing and emerging activities, some of which compete for space, this project ultimately aims to inform future decision-making.

Geographically, the east inshore marine plan area includes the coastline stretching from Flamborough Head to Felixstowe, extending from mean high water springs out to 12 nautical miles, including inland areas such as the Broads and other waters subject to tidal influence, and covers an area of 6,000 square kilometres. The east offshore marine plan area covers the marine area from 12 nautical miles out to the maritime borders with the Netherlands, Belgium and France, a total of approximately 49,000 square kilometres of sea.

Figure 1 | East Marine Plan Areas

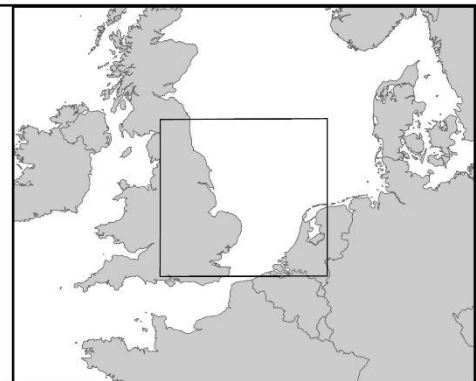


Ports

- Significant Ports within the East Marine Plan

Plan Areas

- East Marine Plan (Inshore Area)
- East Marine Plan (Offshore Area)



In this project, eleven focus sectors in the inshore and offshore east marine plan areas were analysed. These sectors were selected based on their relevance to national priorities, their spatial specificity and compatibility (or not) with other sectors, and their relevance to the east marine plan areas. These sectors are:

- energy production (renewables - with a focus on offshore wind)
- energy production (oil and gas)
- carbon capture, usage and storage (CCUS)
- dredging and disposal
- marine aggregates
- ports and shipping
- aquaculture
- tourism and recreation
- coastal change and flooding
- fisheries
- environment.

An additional set of sectors which could compete with the above focus sectors have also been considered as part of the analysis in this report. These are identified throughout the report as 'further interacting sectors'. These include: telecommunications cabling, defence and national security, heritage, ecological and chemical water quality and resources, surface water management and wastewater, seascape, air quality, nuclear, climate change adaptation and mitigation, and marine ecology and biodiversity.

Some of these sectors overlap with the above focus sectors and this has been factored in appropriately as part of the analysis (e.g. 'marine ecology and biodiversity' overlaps with 'environment'). However, for the majority, considerations in terms of their impact on the eleven focus sectors have been outlined and assessed only at a high-level, as it's anticipated that the majority of activity development and presence in the east marine plan areas over the next 10-20 years, will be seen primarily by the focus sectors.

This report sets out "as is" activities and uses of assets for each sector in the east marine plan areas, potential future use cases (based on national priorities) and the physical attribute requirements for these use cases. It also sets out spatial analysis indicating the current and future extent of activities in the east marine plan areas, recommendations for potential policy interventions to maximise ability to deliver national priorities, and recommendations for further evidence gathering and next steps. The Department for Environment, Food & Rural Affairs (Defra) is undertaking a wider programme focused on Marine Spatial Prioritisation and the outputs of this report, including conclusions and recommendations, will be taken forward and incorporated into future projects being delivered by Defra.

To deliver this study eight workstreams were completed, spanning:

- desktop research to review current and emerging activities for each sector
- mapping to national priorities
- analysis of spatial constraints and barriers
- trade-off implications and opportunities

- spatial mapping development
- stakeholder engagement with team members across the MMO
- identification of potential policy interventions and evidence gaps
- report writing and recommendations.

This report follows the structure of these workstreams.

1.2 Project aims and objectives

Of England's eleven marine plan areas, the east marine inshore and offshore plan areas are two of the most economically significant. For example, as of 2014 the east marine plan areas accounted for 75% of gas production in England and housed nearly 75% of all English oil and gas infrastructure - including 2,485 pieces of gas infrastructure and 6,600km of pipeline.¹ Similarly, the UK Major Ports Group reports that of the forty major ports in the UK, nine are in the inshore east marine plan area, with the ports of Grimsby and Immingham handling 12% of yearly national traffic and 55 million tonnes of goods annually.² The Port of Felixstowe, which is the UK's biggest and busiest container port, and one of the largest in Europe, also sits adjacent to the plan areas southern boundary.

Increasingly, however, there are competing and conflicting demands for space and resources in the east inshore and offshore marine plan areas. For example, from renewable energy and aggregate extraction to fisheries, tourism and marine recreation. This increases the risk of one activity coming into conflict with another, or otherwise compromising the ability of a given activity to maximise its contribution to society, which would inevitably result in a decreased economic value in the future. It also increases pressure on marine ecosystems resulting, potentially, in a decline in their functional status, and the socio-economic value derived from them, and deterioration in the quality of the environment.

This study has been undertaken to identify the current and future extent of activities in the east marine plan areas and their potential over a 20-year horizon for contributing towards national environmental, social, and economic priorities. The overall work will identify spatial opportunities, barriers and options for delivering national priorities in the east marine plan areas. The final outputs will be used to facilitate engagement, exploring values and weighting given to national priorities at the east marine plan areas scale. Ultimately, this has the aim of making spatial choices and, where appropriate, to inform the development of the vision, objectives and prescriptive policies for the east marine plan areas.

¹ Marine Management Organisation (2014), East Inshore and East Offshore Marine Plans, <https://www.gov.uk/government/publications/east-inshore-and-east-offshore-marine-plans>

² Marine Management Organisation (2014), East Inshore and East Offshore Marine Plans, <https://www.gov.uk/government/publications/east-inshore-and-east-offshore-marine-plans>

1.3 Overview of the current policy landscape

Several UK Government policy commitments and strategic objectives have been set in recent years. These are in relation to the development of marine activities, specifically with the aim of increasing economic growth opportunities and increasing sustainable practices (including the reduction of carbon emissions). Key commitments made thus far include:

The Marine Policy Statement (2011):

The Marine Policy Statement (MPS) is the framework for preparing Marine Plans and taking decisions affecting the marine environment. The MPS facilitates and supports the formulation of marine plans, such as the East Marine Plans, ensuring that marine resources are used in a sustainable way in line with the high-level marine objectives and thereby:

- promotes sustainable economic development
- enables the UK to move towards a low-carbon economy, to mitigate the causes of climate change and ocean acidification and adapt to their effects
- ensures a sustainable marine environment which promotes healthy, functioning marine ecosystems and protects marine habitats, species and our heritage assets
- contributes to the societal benefits of the marine area, including the sustainable use of marine resources to address local social and economic issues.

25 Year Environment Plan (2019):

Launched in 2018, the 25 Year Environment Plan sets out government action to help the natural world regain and retain good health. It aims to deliver cleaner air and water in our cities and rural landscapes, protect threatened species and provide richer wildlife habitats. It calls for an approach to agriculture, forestry, land use and fishing that puts the environment first. Specific aims for the oceans include:

- ocean acidification
- coral reef protection and management – particularly in Overseas Territories
- investment in mangroves and natural capital overseas
- continuing to work with others under OSPAR
- commonwealth Blue Charter
- easing impact of human activity on fish stocks and seabed habitats
- the natural capital approach and understanding the value of the marine environment.

UK Marine Strategy (2019):

The UK Marine Strategy provides the framework for delivering marine policy at the UK level and sets out how we will achieve the vision of clean, healthy, safe, productive and biologically diverse oceans and seas. The Strategy consists of a simple 3-stage framework for achieving good environmental status (GES) in our seas. Achieving GES is about protecting the marine environment, preventing its deterioration and restoring it where practical, while allowing sustainable use of

marine resources. The strategy covers 11 elements (known as descriptors) including: biodiversity; non-indigenous species; commercial fish; food webs; eutrophication; sea-floor integrity; hydrographical conditions; contaminants; contaminants in seafood; marine litter and underwater noise.

Resources and Waste Strategy for England (2018):

The Resources and Waste Strategy for England sets out how England plans to double resource productivity and eliminate avoidable waste of all kinds (including plastic waste) by 2050. It combines actions England will take now with firm commitments for the coming years and gives a clear longer-term policy direction in line with the 25 Year Environment Plan. In terms of specific action, the strategy sets out how England will:

- preserve stock of material resources by minimising waste, promoting resource efficiency, and moving towards a circular economy.
- minimise the damage caused to the natural environment by reducing and managing waste safely and carefully
- deal with waste crime.

The Ten Point Plan for a Green Industrial Revolution (2020):

The Ten Point Plan sets out the approach government will take to build back better, support green jobs, and accelerate the UK's path to net zero. The ten points are:

- advancing offshore wind
- driving the growth of low carbon hydrogen
- driving new and advanced nuclear power
- accelerating the shift to net zero emissions
- green public transport, cycling and walking
- net zero and green ships
- greener buildings
- investing in carbon capture, usage and storage
- protecting our natural environment
- green finance and innovation.

All of the above points have some direct impact or relevance to the development of future activities within the east marine plan areas.

Maritime 2050: Navigating the Future (2019):

Maritime 2050: Navigating the Future sets the government's vision and ambitions for the future of the British maritime sector. Key strategic ambitions within this include leading the way in taking action on clean maritime growth enjoying economic benefits from being an early adopter or fast mover and supporting the continued multi-billion pound commercial investment in maritime infrastructure that makes the UK a globally attractive destination for all maritime businesses. These are both ambitions where the east marine plan areas can play a leading role in contributing,

and this study, helps to identify opportunities / areas of activities, through which this can be achieved.

Clean Maritime Plan (2019):

The Clean Maritime Plan is an environment route map of Maritime 2050. It identifies ways to tackle air pollutants and greenhouse gas emissions in parallel while securing clean growth opportunities for the UK. Research undertaken for the government suggests the global market for maritime emission reduction technologies could reach £11 billion per year by 2050, potentially resulting in economic benefits to the UK of £510 million per year.

Net Zero Strategy: Build Back Greener (2021):

In 2021, the Prime Minister set out his 10-point plan for a green industrial revolution, laying the foundations for a green economic recovery from the impact of COVID-19 with the UK at the forefront of the growing global green economy. This strategy builds on that approach to keep us on track for UK carbon budgets, our 2030 Nationally Determined Contribution, and net zero by 2050. It includes:

- our decarbonisation pathways to net zero by 2050, including illustrative scenarios
- policies and proposals to reduce emissions for each sector
- cross-cutting action to support the transition.

The Net Zero Strategy will be submitted to the United Nations Framework Convention on Climate Change (UNFCCC) as the UK's second Long-Term Low Greenhouse Gas Emission Development Strategy under the Paris Agreement.

Clean Growth Strategy (2017):

This strategy sets out our proposals for decarbonising all sectors of the UK economy through the 2020s. It explains how the whole country can benefit from low carbon opportunities, while meeting national and international commitments to tackle climate change. On domestic shipping, the government will continue to work with industry to develop improved fuel efficiency technologies, including new propulsion systems, hull design and aerodynamic structures. The government will also work with ship owners and ports to identify the barriers faced in supplying and using sustainable alternative fuels and cleaner emissions technologies, to explore possible solutions.

National Flood and Coastal Erosion Risk Management Strategy (2020):

The National Flood and Coastal Erosion Risk Management strategy's long-term vision is for: a nation ready for, and resilient to, flooding and coastal change – today, tomorrow and to the year 2100. It has 3 long-term ambitions, underpinned by evidence about future risk and investment needs. These are:

- climate resilient places: working with partners to bolster resilience to flooding and coastal change across the nation, both now and in the face of climate change
- today's growth and infrastructure resilient in tomorrow's climate: making the right investment and planning decisions to secure sustainable growth and environmental improvements, as well as infrastructure resilient to flooding and coastal change

- a nation ready to respond and adapt to flooding and coastal change: ensuring local people understand their risk to flooding and coastal change and know their responsibilities and how to take action.

Levelling Up White Paper (2022):

The Levelling Up White Paper sets out how the UK government will spread opportunity more equally across the UK. In terms of specific action, its stated commitments include but are not limited to:

- eight innovative Freeports bringing jobs, investment and prosperity across England with a commitment to deliver more Freeports in Scotland, Wales and Northern Ireland
- £4.8bn infrastructure investment in towns across the UK via the Levelling Up Fund
- £26bn of public capital investment for the green industrial revolution and transition to Net Zero.

The above identification of relevant national priorities is factored into the later sections of this report, when considering sector activities which contribute most to some of the strategic objectives and policy commitments outlined above. A mapping of sectors to 'national priorities' is presented at the end of Chapter 2.

In short, the policy and strategy commitments above recognise the need to reverse a decline in biodiversity, reduce greenhouse gas (in particular, carbon) emissions, reduce carbon-intensive practices, increase renewables, protect the UK's food supply, and increase clean maritime economic growth opportunities. This inherently has an impact and provides some indication for future prioritisation of sectors. The spatial analysis outlined in Chapter 4 of this report, forms a solid foundation upon which to base future prioritisation activity and exercises. For example, a current hypothesis would be the importance of increasing offshore wind facilities but not at the expense of marine biodiversity, leading to a net loss. A similar hypothesis would be the increased and pressing demand for security of energy supply based on recent events. Prime Minister Boris Johnson has announced that Britain will phase out imports of Russian oil and oil products by the end of 2022, reducing energy dependency on Russia. This could mean two things: 1) there is increased demand placed on existing oil and gas supplies, in the short term, to meet the gap in overseas supply created as a result of this, and 2) there is increased pressure to transition to renewable forms of energy, for long-term security of supply. The outputs of Chapters 3 and 4 explore some of these scenarios and trade-off implications in more detail.

1.4 Methodology

The work underpinning this study covered a multi-workstream approach, comprising a variety of different activities. This approach has sought to identify the current and future extent of activities in the east marine plan areas and their potential over a 10- and 20-year horizon to support national policy priorities / attribute requirements.

The eight multidisciplinary work streams were:

- desktop research to review existing and current activities for each sector

- national priorities mapping
- spatial barriers and opportunities assessment
- trade-off implications and opportunities
- spatial mapping development
- policy intervention identification
- report writing and recommendations
- internal stakeholder engagement with team members across the MMO.

Workstream 1: Desktop research to review existing and current activities for each sector

The first stage involved desk-based research, which included the collation, processing, and analysis of widely available public data with existing data from the MMO. Data was collected on each of the eleven focus sectors in the east marine inshore and offshore plan areas. The eleven focus sectors are:

- energy production (renewables - with a focus on offshore wind)
- energy production (oil and gas)
- carbon capture, usage and storage (CCUS)
- dredging and disposal
- aggregates
- ports and shipping
- aquaculture
- tourism and recreation
- coastal change and flooding
- fisheries
- environment.

For each of these sectors, data was collected on:

- current activities
- emerging activities with a time frame limited to the next 10 years
- potential activities with a time frame limited to the next 20 years.

Once a long list of activities was developed for each sector, data on different attribute requirements and uses of assets were also identified. Attribute data points included:

- seabed conditions, tidal height, water depth, wind speed and direction
- MoD security areas
- marine plan area habitats (wildlife, seabed and essential fish habitat)
- fishing ports and communities
- CCUS licensed areas
- habitats or species that provide flood defence or carbon sequestration
- listed structures, scheduled monuments and registered historic parks on coastlines
- aggregate extraction licensed areas
- special areas of conservation and protection
- sites of recreational / tourist interest
- coastal erosion and flood risk

- oil & gas licensed areas
- offshore wind energy capacity
- shipping and ports traffic.

Workstream 2: National priorities mapping

Based on the outputs of the desktop research, the potential for activities in the east marine inshore and offshore plan areas that contribute to a pre-defined list of national priorities were identified. This involved taking each sector's list of activities and identifying which national priorities they contribute to. This was based on a range of policy documents and plans including:

- Marine Policy Statement
- 25 Year Environment Plan
- UK Marine Strategy
- Resources and Waste Strategy
- The Ten Point Plan for a Green Industrial Revolution
- Maritime 2050: Navigating the Future
- National Flood and Coastal Erosion Risk Management Strategy
- Clean Growth Strategy
- Clean Maritime Plan
- Net Zero Strategy: Build Back Greener.

Workstream 3: Spatial barriers, constraints and enablers assessment

To assess spatial barriers, constraints and enablers for this study, the eleven focus sectors identified (and listed above) were mapped against each other and further interacting sectors (listed below) as found in the Marine Policy Statement. These further interacting sectors are positioned as ones which could present themselves as barriers (difficult to conduct activities for certain sectors) or constraints (difficult to conduct but can potentially co-exist with other activities) or enablers (beneficial when co-existing with other activities). This analysis is covered in detail in Chapter 3 of this report but essentially aims to outline potential restrictions / opportunities in the ability to deliver activities in the eleven focus sectors, based on attributes posing as physical infrastructure/asset challenges. The other sectors, as found in the Marine Policy Statement, include:

- cabling
- defence and national security
- heritage
- ecological and chemical water quality and resources
- surface water management and wastewater
- seascape
- air quality
- nuclear energy
- climate change adaptation and mitigation
- marine ecology and biodiversity.

Workstream 4: Trade off implications and opportunities

Taking the outputs from the earlier workstreams, this section captures potential trade off implications and opportunities for activities in the east marine inshore and offshore areas. This section identifies:

- which priorities can be delivered without spatial constraints
- where priorities may be delivered through co-existence with other priorities
- what priorities may only be achieved if choices are made on which priority takes precedence
- priorities that cannot be accommodated by the east marine plan areas due to significant barriers.

The outputs from this analysis are intended to allow both MMO and Government to facilitate future decision-making on plan area scale priorities for the east inshore and offshore marine plan areas and to support spatial trade-off choices at the marine plan level. This will inform the east marine plan areas vision, objectives, and the development of more prescriptive policies, where appropriate, to provide more steer and clarity for decision-makers and those bringing forward proposals in the marine area.

Workstream 5: Spatial mapping development

The eleven focus sectors facilitate a range of activities of various levels of spatial complexity. These activities can be plotted using geo-spatial software to identify areas of spatial intensity, where it is possible to determine if multiple sectors can co-exist or if there are spatial constraints and such co-existence is not practical. Workstream 5 employed geo-spatial analysis to create a series of maps identifying the principal activities occurring within the confines of the east marine plan areas. Further work will be undertaken in future studies to examine the spatial compatibility of these sectors to assist in facilitating the future decision-making processes regarding the priorities of the inshore and offshore development of the plan area.

ESRI's ArcMap (version 10.6), used by the MMO, was selected as the geo-spatial software to assist in the collection of spatially defined datasets and was used to produce the map layouts for this workstream. The desktop research identified several data repositories which provided a detailed overview of the availability of data for the plan area as well as the diversity of the data in terms of the sectors to which they pertain. The MMO's data repository contains a range of data relating to the 11 focus sectors. This information is contained within a spreadsheet that contains links to the web map service (WMS) layers, as well as download URLs for the shapefiles for each layer. The Defra repository contains information relevant to environmental data, which exists as WMS layers as well as shapefiles. The Crown Estate repository is focused on offshore wind farm sites and agreements, with the data being readily available as shapefiles.

The ArcMap project uses data which is stored in the European Terrestrial Reference System 1989 Lambert Azimuthal Equal Area (ETRS 1989 LAEA) coordinate system, and each of the data shapefiles and layers are contained within a local file geodatabase. Once each of the map layers was created from their relevant

shapefile, they were categorised in group layers in relation to the activity in question. As most of the available data is accessible as shapefiles, this approach enabled an efficient means of creating map layers which allowed greater editorial control over the presentation of the different activities for each of the focus sectors. Although the aim is to make the maps as simple as possible, where there was a risk of overlapping map layers, a separate map was produced for each of the activities affected.

Workstream 6: Policy intervention identification

Having identified potential constraints, barriers and opportunities, this report draws some conclusions as to where national priorities could be facilitated through marine plan policy intervention or where priorities may require other types of management intervention, in order to progress the delivery of certain activities.

Policy interventions will be focused on marine plan policies, but where there is interrelation with wider government policies, these will be outlined at a high-level. They are likely to include or relate to:

- policies that encourage co-location between certain sectors
- spatial policies giving priority to certain sectors in certain areas
- policies that insist on collaboration for environment protection and enhancement.

Workstream 7: Report writing and recommendations

All analysis and findings are presented in the form of this written report, with recommendations for future evidence gathering to enable effective deliberation and decision-making related to priorities in the east marine plan areas. This includes:

- summary and conclusion of findings and analysis
- key initial actions and next steps
- any supporting analysis
- sources and evidence.

Workstream 8: Stakeholder engagement with team members across the MMO

The above workstreams were tested, improved, and agreed with a range of internal MMO project stakeholders throughout this project. Colleagues from across the MMO were also consulted throughout the development of the analysis and drafting phase of this study. A collaborative approach was taken in the initial phases of the study to define the scope of the work to be conducted, followed by regular checkpoints, and sharing of deliverables / outputs with colleagues, for review and comment. An iterative approach to reviewing and incorporating feedback from MMO colleagues has helped to lead to a well-informed set of spatial barriers, constraints, and opportunities, for the development of activities in the east marine plan areas, as well as recommendations and future evidence gathering processes.

2. Industry and sector activities

In total, eleven sectors were chosen as the focus for this report by the MMO. These sectors were chosen for their relevance to national priorities, their spatial specificity and compatibility (or not) with other sectors. The sectors identified are:

- energy production (renewables - with a focus on offshore wind)
- energy production (oil and gas)
- carbon capture, usage and storage (CCUS)
- dredging and disposal
- aggregates
- ports and shipping
- aquaculture
- tourism and recreation
- coastal change and flooding
- fisheries
- environment.

Summarising the output of desk-based research across the focussed list of sectors, this section sets out the current, emerging, and potential activities and use cases for assets across the east marine plan areas. A literature review was also performed to identify the optimal spatial conditions and attributes needed for the success of activities and use cases.

The scope for emerging activities and use cases, defined by existing MMO data such as agreed exploration areas and preferred areas for future projects, are limited to the time frame of the next 10 years. Potential activities and use cases, defined by industry outlooks, direction of travel and future policy trends, are those projected for the next 20 years. To identify emerging and potential scenarios, national priorities for the UK were analysed with a focus on 38 key policy documents and strategies as set out in '2.12 National priorities mapping' at the end of Chapter 2.

Please note that this section is not intended to provide an exhaustive review of each activity in the east marine plan areas but, instead, to provide an overview of each focus sector and the key considerations for future activities and use cases. This section provides the grounding for the spatial assessment conducted in Chapter 3.

2.1 Energy production (offshore wind)

The UK is one of the largest global players in offshore wind and the sector continues to grow in line with net zero ambitions to become a major contributor to the UK's clean energy mix. The Crown Estate indicates that the UK is already meeting 8% of national electricity demand through offshore wind and is on track to meet 33% by 2030.³

³ The Crown Estate (2021), Our Role in Offshore Wind, <https://www.thecrownestate.co.uk/en-gb/what-we-do/on-the-seabed/energy/our-role-in-offshore-wind/>

The Department for International Trade notes that, as of March 2021, 10.4GW of offshore wind farms are operational in the UK, with a further 3.6GW under construction and 12.5GW planned or in the pre-construction phase. Two major leasing rounds are also currently underway, with The Crown Estate's leasing Round 4 offering up to 8GW of seabed rights in England and Wales, and Crown Estate Scotland's Scotwind opportunity offering up to 25GW for fixed and floating projects.⁴

The sector is also seeing large industry players enter the market, including the recent announcement of the joint venture between Shell and Scottish Power aiming to build and operate two of the world's first large-scale floating wind farms in UK waters, developing 5GW of energy.⁵

These developments align with a core objective in the East Marine Plans, published in 2014, *"to realise the potential of renewable energy, particularly offshore wind farms, which is likely to be the most significant transformational economic activity over the next 20 years in the east marine plan areas."*⁶

Current activities and use cases

Due to favourable seabed conditions, the east marine plan areas are currently the most developed plan areas in England for offshore wind.⁷ For the purposes of identifying current activities, the research for this sector focuses on fixed offshore wind farms as there are currently no floating wind farms in the east marine plan areas and none in planning.

Figure 2 reflects the current extent of offshore wind farm activities in the east marine plan areas, along with wind cable sites in Figure 4.

Through reviewing data on leases for the construction and operation of wind turbines, it has been identified that the east marine plan areas currently have six active and in operation offshore wind leases in the inshore area:

- Westermost Rough Wind Farm (210 MW)
- Humber Gateway Offshore Wind Farm (219 MW)
- Lincs Wind Farm (270 MW)
- Inner Dowsing Wind Farm (194 MW)
- Sheringham Shoal Wind Farm (317 MW)
- Scroby Sands Wind Farm (60MW).

⁴ The Crown Estate (2021), Offshore Wind Leasing Round 4, <https://www.thecrownestate.co.uk/round-4/>

⁵ Shell plc (2022), Shell and ScottishPower win bids to develop 5 GW of floating wind power in the UK, <https://www.shell.com/media/news-and-media-releases/2022/shell-and-scottishpower-win-bids.html>

⁶ Marine Management Organisation (2014), East Inshore and East Offshore Marine Plans, <https://www.gov.uk/government/publications/east-inshore-and-east-offshore-marine-plans>

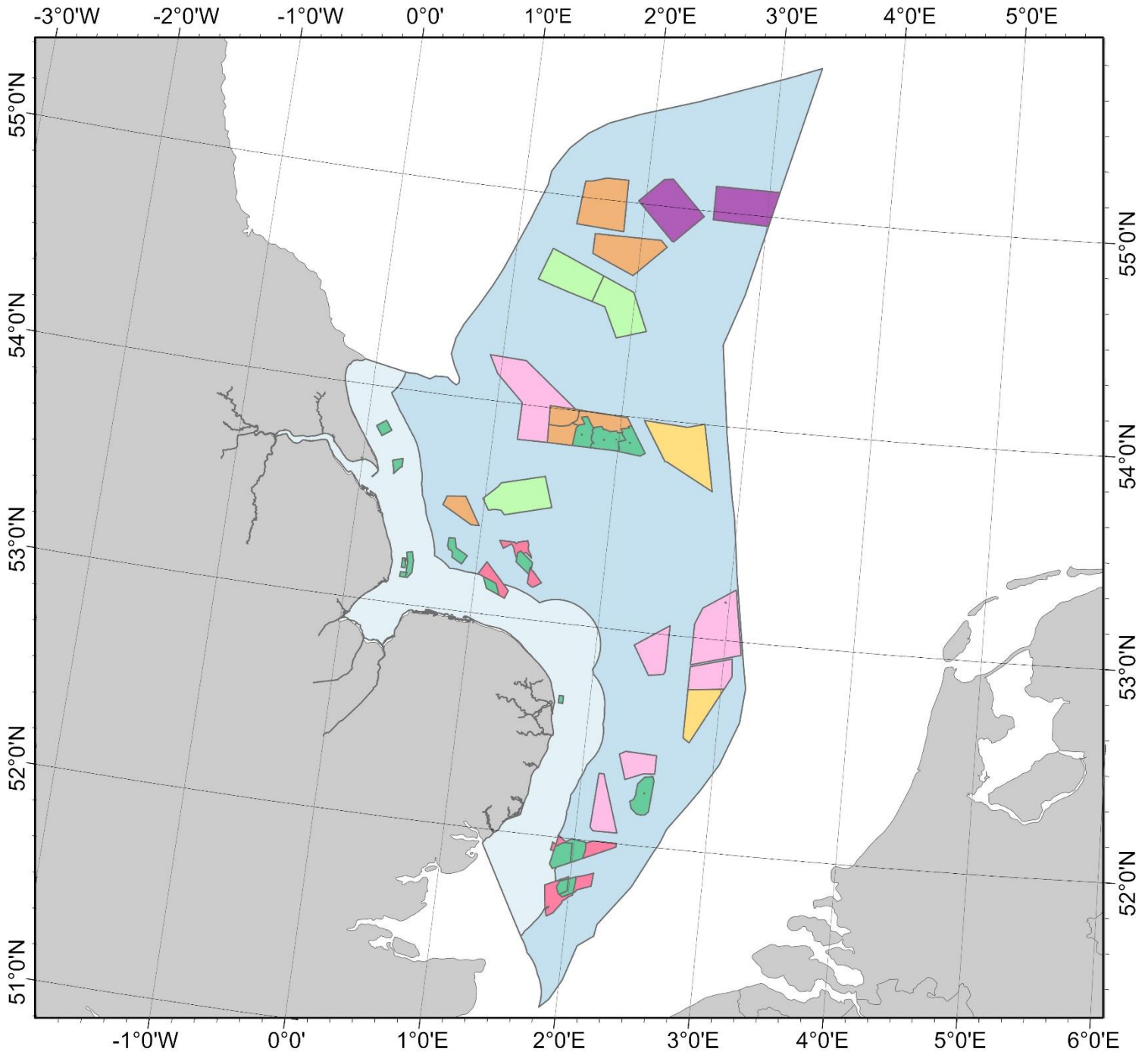
⁷ The Crown Estate (2018), Resources and Constraints Assessment for Offshore Wind: Methodology, <https://www.thecrownestate.co.uk/media/3331/tce-r4-resource-and-constraints-assessment-methodology-report.pdf>

There are also six within the offshore area:

- Hornsea One Wind Farm (1,218 MW)
- Dudgeon Wind Farm (402 MW)
- Race Bank Wind Farm (573 MW)
- East Anglia One Wind Farm (714 MW)
- Galloper Wind Farm (353 MW)
- Greater Gabbard Offshore Wind Farm (500 MW).

In addition, Dogger Bank Wind Farm is an offshore wind farm being developed in three phases – Dogger Bank A, B and C – and is located between 130km and 190km from the north east coast of England at their nearest points. Collectively, these farms will become the world's largest offshore wind farm. Each phase will have an installed generation capacity of 1.2GW and represents a multi-billion pound investment. Combined, Dogger Bank A, B and C will have an installed capacity of 3.6GW and will be capable of powering up to 6 million homes. Similarly, Triton Knoll Wind Farm and Hornsea project 2 are also under construction.

Figure 2 | Offshore Wind Sites in the East Marine Plan Areas

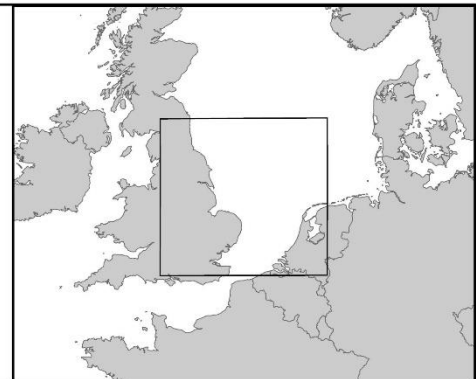


Plan Areas

- East Marine Plan (Inshore Area)
- East Marine Plan (Offshore Area)

Offshore Wind Areas (Crown Estate)

- Active/In Operation
- Consented
- Government Support on Offer
- In Planning
- Pre-planning Application
- Preferred Project – Subject to Habitats Regulations Assessment
- Under Construction

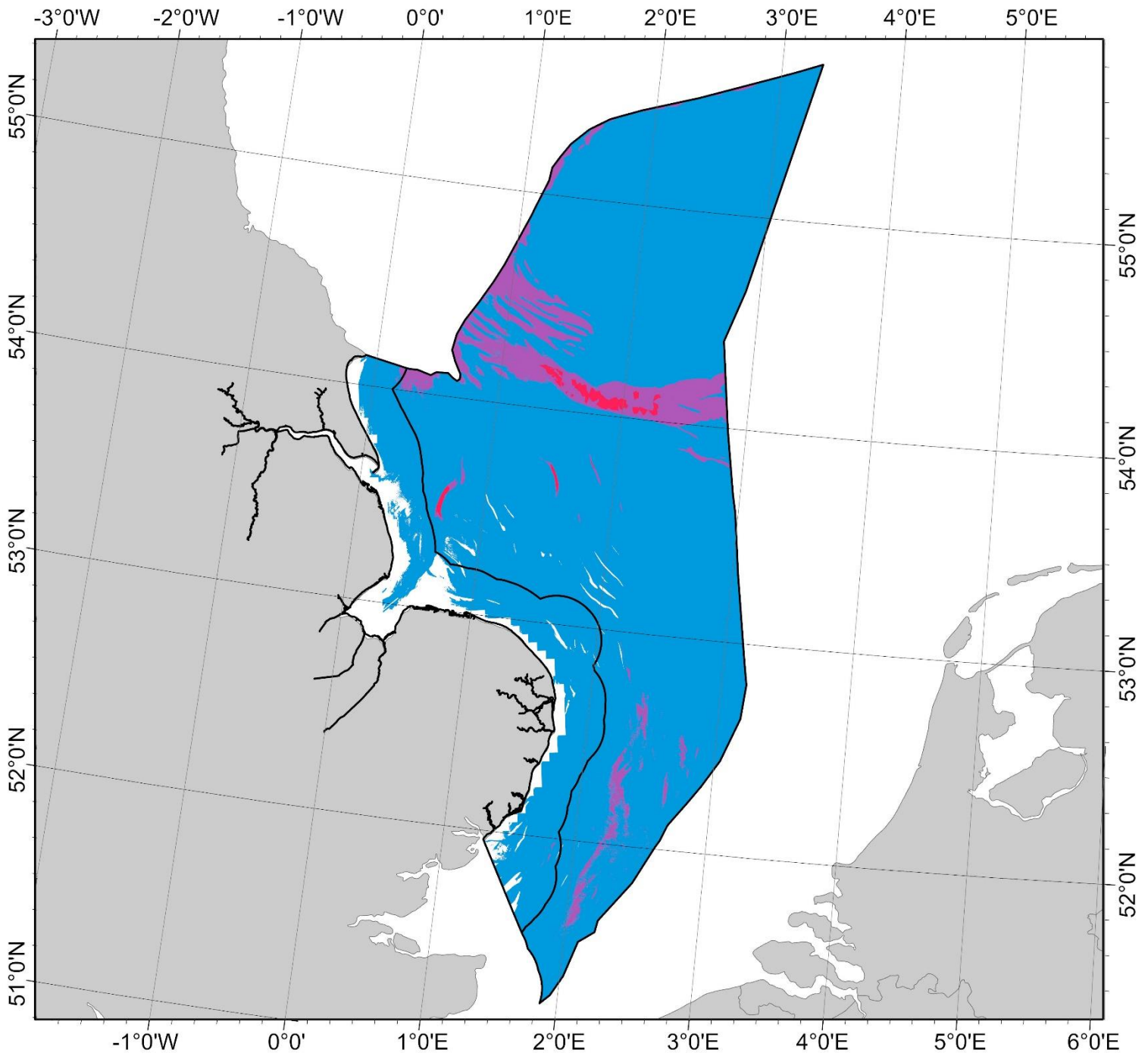


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
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Figure 3 | Fixed and Floating Wind Areas in the East Marine Plan Areas




Plan Areas

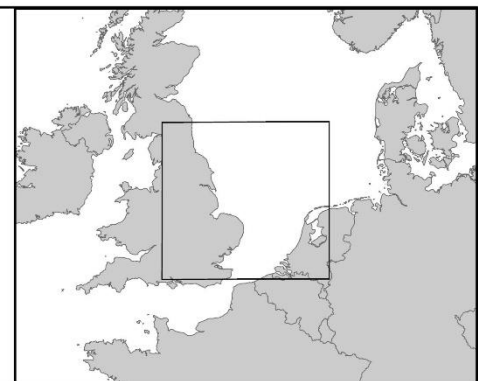
 East Marine Plan (Inshore and Offshore Areas)

Wind Key Resource Areas (Crown Estate)

 Fixed Wind Key Resource Area

 Floating Wind Key Resource Area

 Fixed and Floating Wind Key Resource Area

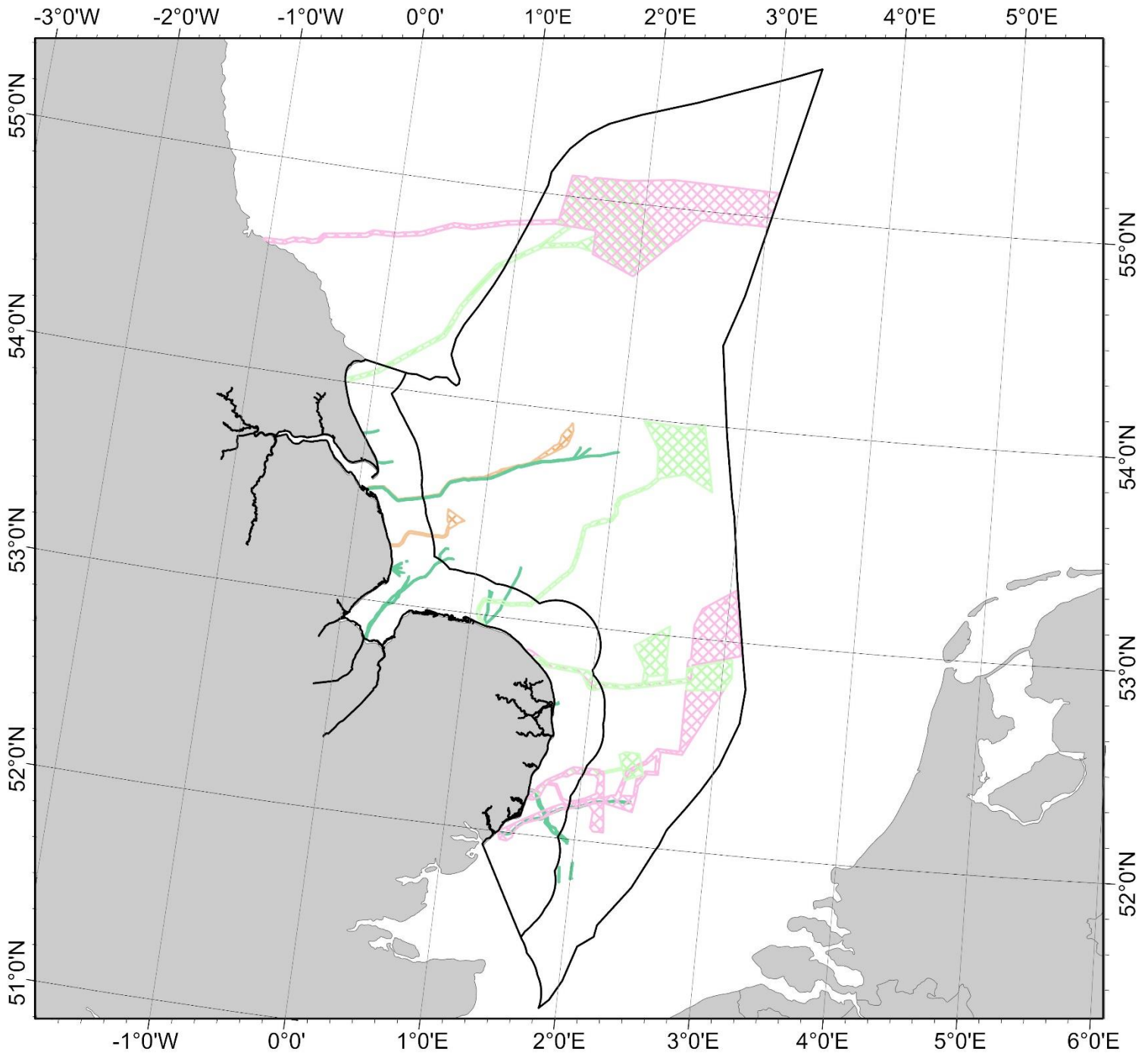


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Figure 4 | Offshore Wind Cable Sites in the East Marine Plan Areas



Offshore Wind Cables Sites (Crown Estate)

-  Active/In Operation
-  Consented
-  In Planning
-  Under Construction

Plan Areas

-  East Marine Plan (Inshore and Offshore Areas)



Emerging activities and use cases (0-10 years)

Several wind farms are expected to be constructed in the east marine plan areas over the next 10 years - Hornsea 3, Norfolk Boreas, Norfolk Vanguard, East Anglia 3, Dogger Bank and Sofia Offshore Wind farm have all received development consent, and there are seven further projects in the area at various stages of planning. Looking further ahead, following the conclusion of the tender process for leasing Round 4, The Crown Estate announced six 'preferred projects' to be taken forwards for assessment. Three of these projects (with a total proposed capacity of 4.5GW) were in the east plan areas.⁸ Figure 5 reflects the potential areas these wind farms could be located in the east marine plan areas and Figure 6 reflects where the preferred Round 4 projects would be best placed.

With clear intent from government to support this sector through the Offshore Wind Sector Deal, there are a number of companies who are continuing their growth and development efforts in the UK over the next few years.⁹ An example of this is the proposed 3.6GW Norfolk offshore wind farms to be located between 47-72km off the coast of Norfolk by developer Vattenfall and turbine manufacturer Siemens Gamesa.¹⁰ The wind farm comprises two 1.8GW 'sister' projects, Norfolk Vanguard and Norfolk Boreas. Both projects have been approved for development and are expected to begin construction in 2023.¹¹

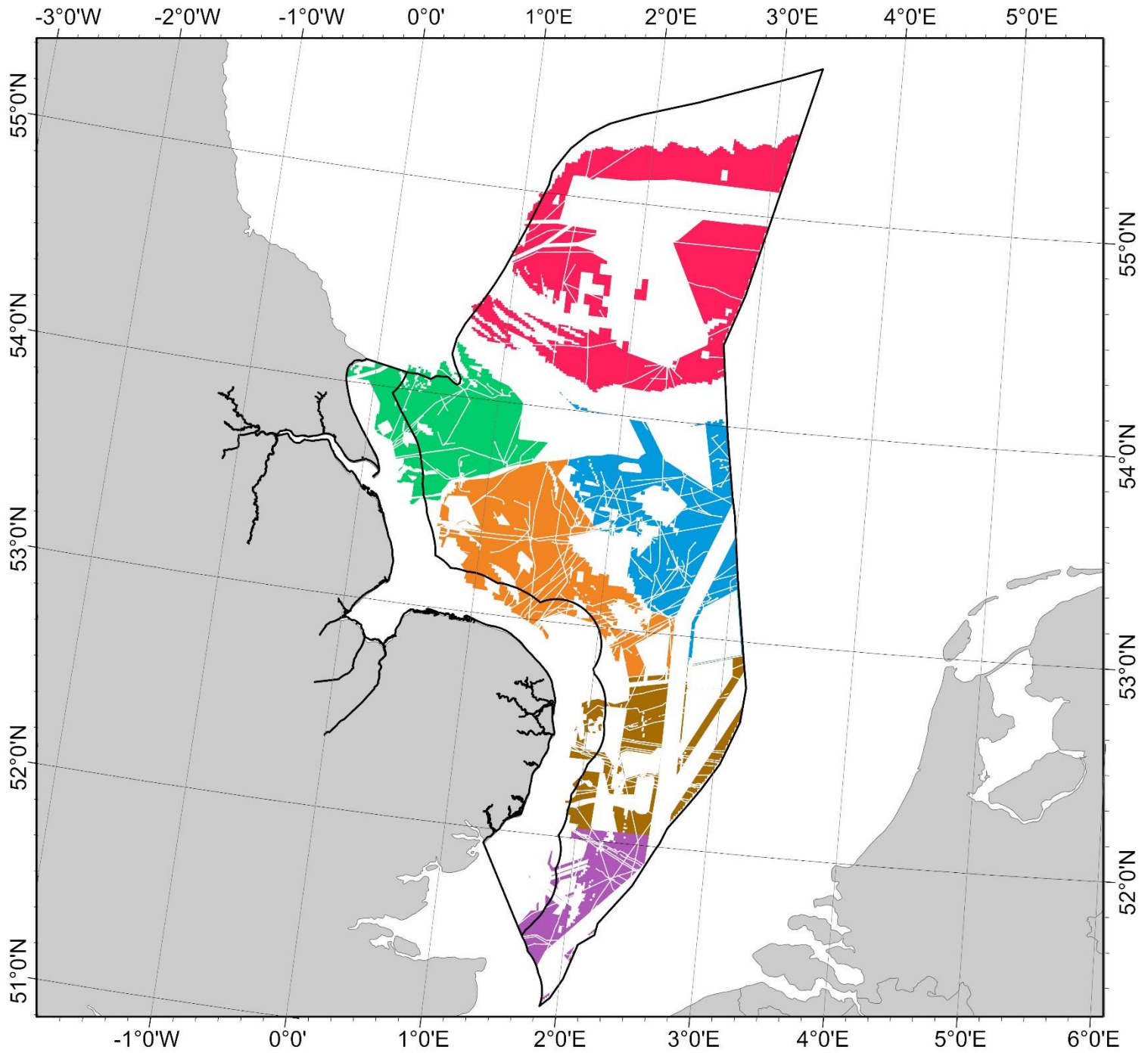
⁸ The Crown Estate (2021), Offshore Wind Leasing Round 4, <https://www.thecrownestate.co.uk/round-4/>

⁹ Department for Business, Energy & Industrial Strategy (2020), Offshore wind Sector Deal, <https://www.gov.uk/government/publications/offshore-wind-sector-deal/offshore-wind-sector-deal>


¹⁰ Siemens Gamesa (2021), 236 metres & 3.6 GW: Siemens Gamesa & Vattenfall to partner using new Siemens Gamesa offshore turbine at massive Norfolk offshore wind projects, <https://www.siemensgamesa.com/en-int/newsroom/2021/11/211108-siemens-gamesa-press-release-vattenfall-norfolk-offshore>

¹¹ Vattenfall (2021), Vattenfall in Norfolk: Norfolk Boreas Offshore Wind, <https://group.vattenfall.com/uk/what-we-do/our-projects/vattenfallinnorfolk/norfolk-boreas>

Figure 5 | Offshore Wind Leasing Round 4 Characterisation Areas in the East Marine Plan Areas

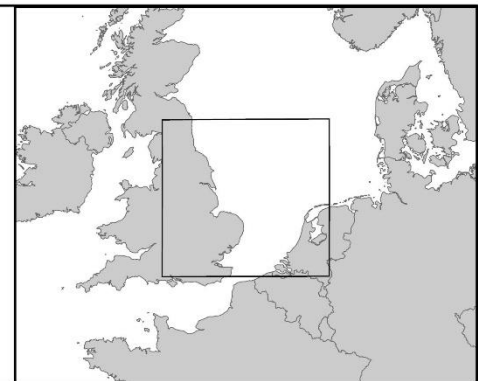


Plan Areas

 East Marine Plan (Inshore and Offshore Areas)

Offshore Wind Leasing Round 4 Areas (Crown Estate)

-  Dogger Bank
-  East Anglia
-  Southern North Sea
-  Thames Approaches
-  The Wash
-  Yorkshire Coast



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Potential activities and use cases (0-20 years)

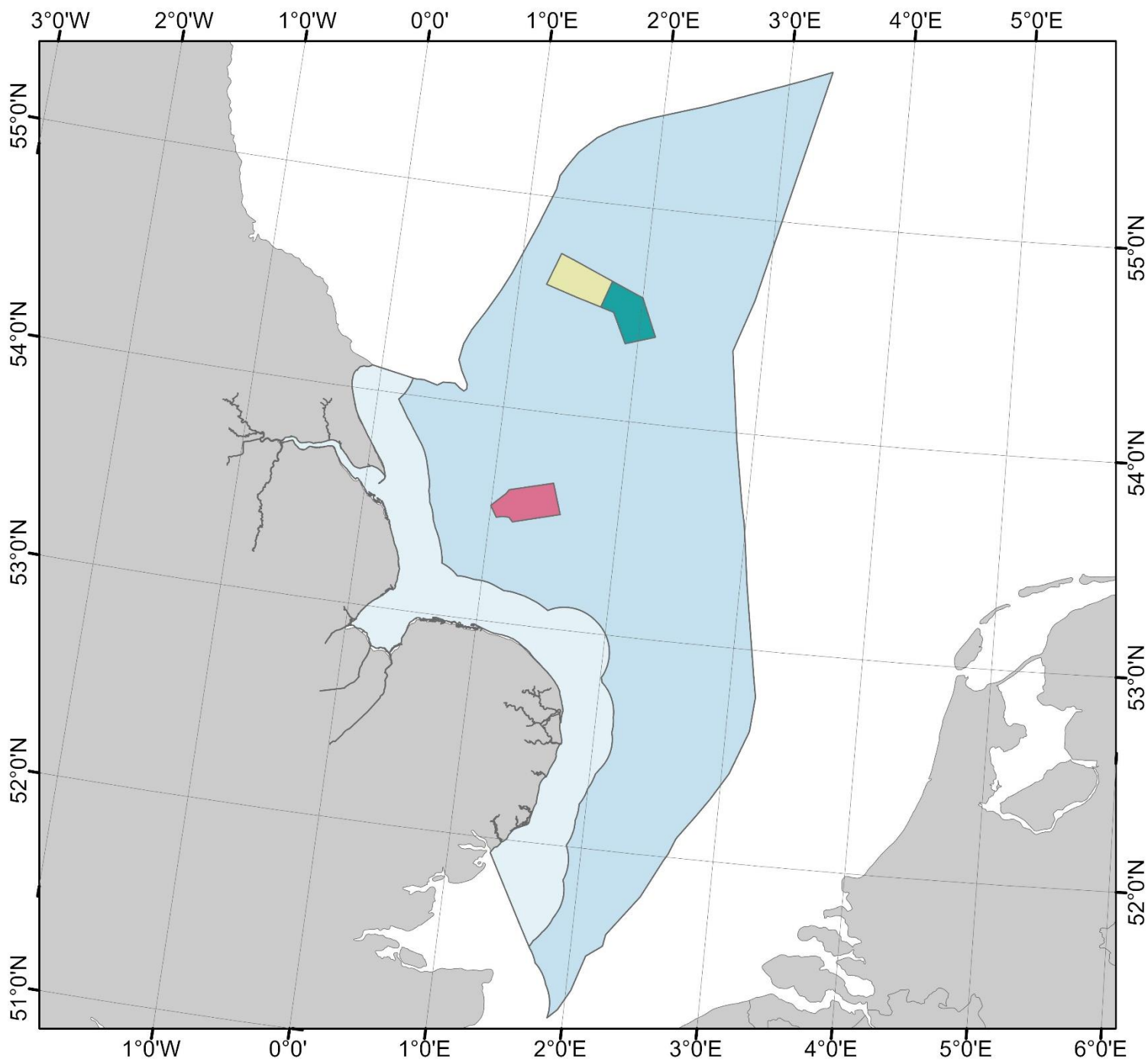
Within the east marine plan areas, there are six key areas of the seabed (Yorkshire Coast, The Wash, Southern North Sea, Dogger Bank, East Anglia and Thames Approaches) with high potential for future fixed-bottom offshore wind developments as identified by The Crown Estate during the leasing process for Round 4.

KPMG's review of the Offshore Wind Sector Deal reflects that success of projects in the UK will be heavily dependent on the pace of development of offshore wind in other countries, including the US, Taiwan and China. With the industry commitment of £250 million through the Offshore Wind Growth Partnership and the remarkable success in reducing costs of wind farms in recent years, future developments may be "*subsidy free*".¹² The International Energy Agency's offshore wind outlook for 2019 also reflected that the UK is set to be the leading European "*offshore wind market to 2030, followed by Germany and the Netherlands.*"¹³

¹² <https://home.kpmg/uk/en/home/insights/2019/03/offshore-wind-deal-march-2019.html>

¹³ IEA (2019), Offshore Wind Outlook 2019, <https://www.iea.org/reports/offshore-wind-outlook-2019>

Figure 6 | Round 4 Preferred Projects in the East Marine Plan Areas

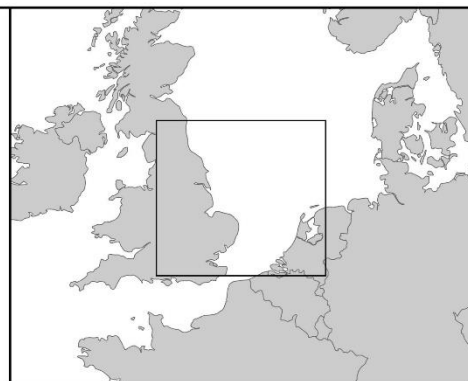


Round 4 Preferred Projects (Crown Estate)

- Dogger Bank South (East)
- Dogger Bank South (West)
- Outer Dowsing

Plan Areas

- East Marine Plan (Inshore Area)
- East Marine Plan (Offshore Area)



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The impacts of priority national policies and strategies

The following are national policies and strategies that could affect the offshore wind sector in the east marine plan areas over the next 20 years:

- with the target of 40GW of offshore wind, including 1GW of floating offshore wind, as committed in The Ten Point Plan for a Green Industrial Revolution, there is potential for expansion, continued development and increased investment in the east marine plan areas.¹⁴ This is also supported by the early-stage funding for offshore electrification committed in the North Sea Transition Deal¹⁵
- the Energy White Paper Powering our Net Zero Future has also committed to deliver four low-carbon clusters by 2030 and at least one fully net zero cluster by 2040. In low carbon and net zero clusters, carbon dioxide and hydrogen pipeline networks connect sites enabling them to capture their carbon dioxide emissions. Whilst it is yet to be determined where these will be located, there may be future potential to expand projects for renewable energy beyond offshore wind¹⁶
- the Industrial Strategy's Offshore Wind Sector Deal builds on the UK's global leadership position in offshore wind and committed to investing £40 billion in a pipeline of new projects to be delivered in the 2020s and 2030s, including new seabed leased in May 2019.¹⁷ This funding could increase demand and support for additional renewables activity in the east marine plan areas
- National Policy Statements EN-1 and EN-3 support offshore wind and set the framework for how environmental impacts will be assessed. This will impact planning and operation of wind developments in the east marine plan areas over the coming years
- the Climate Change Committee's 6th Carbon budget describes scenarios for offshore wind up to 2037. Although not yet an adopted target, these scenarios will be highly influential in planning offshore wind development in the east marine plan areas
- the Offshore Transmission Network Review will re-think the way offshore wind connects to the grid, potentially leading to a more coordinated approach and de-risking one of the main barriers to consent
- the Contract for Defence has been pivotal in driving cost reduction for fixed offshore wind and will be key in facilitating large scale development of floating offshore wind which is essential for achieving net zero
- The National Grids Future Energy Scenarios (FES) provides a range of different, credible ways to decarbonise the UK's energy system as we strive toward the target of net zero emissions by 2050. This will likely increase investment in offshore wind in the east marine plan areas.

¹⁴ UK Government (2020), The ten point plan for a green industrial revolution, <https://www.gov.uk/government/publications/the-ten-point-plan-for-a-green-industrial-revolution>

¹⁵ Department for Business, Energy & Industrial Strategy (2021), North Sea Transition Deal, <https://www.gov.uk/government/publications/north-sea-transition-deal>

¹⁶ Department for Business, Energy & Industrial Strategy (2020), Energy white paper: Powering our net zero future, <https://www.gov.uk/government/publications/energy-white-paper-powering-our-net-zero-future>

¹⁷ Department for Business, Energy & Industrial Strategy (2019), Offshore wind: Sector Deal, <https://www.gov.uk/government/publications/offshore-wind-sector-deal>

Optimal spatial conditions and attributes needed for the success of activities and use cases

The MMO's East Inshore and East Offshore Marine Plan Areas Evidence and Issues Report, published in 2012, reflected on some of the requirements to successfully achieve activities for renewable energy.¹⁸ It highlighted that due to the availability of wind resource and the technical feasibility in relation to water depth, wind speed and size of site, the vast majority of the offshore wind energy potential in England exists in the east offshore area.

Some of the key requirements noted that still apply include:

- defining space and location with certainty for wind energy development to increase business confidence and encourage investment
- continuous development of the offshore electricity network and identification of clear cable routes to enable connection of offshore wind farms to land based grid systems
- understanding of the cumulative effects of all developments in the east marine plan areas and beyond
- consideration of all spatial constraints (see chapter 3) which may impact the extent, location, and type of developments in the east marine plan areas
- as per the National Policy Statement for Renewable Energy Infrastructure, all major wind farm projects must also assess its impact on biodiversity, fish, marine mammals, historic sites, navigation and shipping.¹⁹

A literature review was performed to identify the optimal spatial conditions and attributes needed for the success of activities and use cases for offshore wind farms, primarily focusing on technical requirements. These represent the ideal conditions that would maximise growth of this sector in the UK more broadly.

Infrastructure for offshore wind development

The typical sequence for installation of wind farms includes, establishing an onshore substation, onshore export cables, foundations, offshore substations, array cables, offshore export cables and then a turbine. The installation period for a 1GW wind farm is typically three years from the start of onshore works.²⁰

During construction of an offshore wind farm a 500 metre rolling safety zone is placed around the main installation vessels. Once a wind farm is operational and wind turbines have been installed, a 50 metre safety zones around the wind turbines can be requested.²¹

¹⁸ Marine Management Organisation (2014), East marine plan areas: Evidence and Issues Report, <https://www.gov.uk/government/publications/east-marine-plan-areas-evidence-and-issues-report>

¹⁹ Department for Energy & Climate Change (2011), National policy statement for energy infrastructure, <https://www.gov.uk/government/publications/national-policy-statements-for-energy-infrastructure>

²⁰ The Crown Estate (2019), Guide to an offshore wind farm, <https://www.thecrownestate.co.uk/media/2860/guide-to-offshore-wind-farm-2019.pdf>

²¹ The Crown Estate (2019), Guide to an offshore wind farm, <https://www.thecrownestate.co.uk/media/2860/guide-to-offshore-wind-farm-2019.pdf>

Subsea cable burials and voltage

At the planning and installation phase of a submarine cable project for offshore wind farms, burying the cable with a sea plough protects it from external damage. This burial is very much dependent on suitable seabed conditions and sediments along the cable route. Alternatives would need to be found if suitable conditions were not found. In water depths up to approximately 2,000 metres, the cables may be buried in a narrow (<1 metre wide) trench, however, a much larger corridor (up to 25 metres) will need to be cleared so that the burial vehicle has access, thus increasing the environmental impact of cable laying.²²

For offshore wind, high voltage typically refers to any cable rated higher than 66kV and low voltage anything below 11kV. High voltage cables are generally associated with transmission networks and export cables whereas medium voltage is associated with distribution networks and array cables. Each turbine has of the order of 1 kilometre of array cable on either side associated with it, depending on turbine size and spacing and array cables are now typically rated at 66kV.²³

Seabed profile

An understanding of the seabed profile is key to not only establishing the correct foundations and wind turbines that can be installed offshore, but also avoiding environmental damage from construction.

Wind turbines require a solid rock or soil to build on, although different types of turbine constructions have different requirements. Typical hazards may include areas of soft soil or very hard soil or bedrock that affect foundation placement and installation depths, rapid change in the seabed foundations, surface or buried obstructions and the risk of soil liquefaction.

Water depth

Currently, fixed foundation offshore wind turbines can be installed in up to around 60 metres of sea depth, however, beyond that floating solutions are expected, with the potential for commercial deployment in the mid-2020s.²⁴

There are different types of foundations, according to the depth at which the wind turbine can be installed. For example, at installations of depths below 15 metres, monopiles are used which anchors a thick steel cylinder up to 30 metres under the seabed to support wind turbines. More complex support and anchoring structures are required at depths below 30 to 35 metres.²⁵

²²The Crown Estate (2019), Guide to an offshore wind farm, <https://www.thecrownestate.co.uk/media/2860/guide-to-offshore-wind-farm-2019.pdf>

²³ The Crown Estate (2019), Guide to an offshore wind farm, <https://www.thecrownestate.co.uk/media/2860/guide-to-offshore-wind-farm-2019.pdf>

²⁴ The Crown Estate (2019), Guide to an offshore wind farm, <https://www.thecrownestate.co.uk/media/2860/guide-to-offshore-wind-farm-2019.pdf>

²⁵ Iberdrola (2019), Offshore wind turbine foundations, <https://www.iberdrola.com/sustainability/offshore-wind-turbines-foundations>

Wind speed and direction

Offshore sites are typically able to use more of their available capacity for generation, as wind speed and direction are more consistent offshore. In 2019, the average wind speed in the UK was 8.2 knots, although over the past two decades the average wind speed in the UK has remained stable between 8 and 9 knots (14.9-16.5km hr⁻¹).²⁶

According to the Energy Sector Management Assistance Program, regions with annual average wind speeds at 100-metre height greater than 7 metres/second (which equates to 25km hr⁻¹, faster than the UK average wind speed listed above) are considered as technically viable for the current performance characteristics of offshore wind turbines.²⁷

Impact on demand for the east marine plan areas

Offshore wind is a key energy source the government plans to transition to and, as a result, there are currently large-scale operations in the east marine plan areas and significant investment to expand this. The above findings indicate that operation and development of offshore wind farms is likely to expand across the UK in the next 20 years. The appropriate spatial conditions and implementation of interconnectors that allow energy from wind farms to be exported across Europe, will further support the economic case for expansion.

Offshore wind farms will increase demand for the asset base of the east marine plan areas and therefore, this sectors impact and interactions with other sectors will need to be considered to determine the carrying capacity.

Table 1: Spatial data for offshore wind

Activities	Data Layers	Key Assumptions	Area (km ²)	Percentage Coverage (against total east marine plan area coverage - approx. 58,000 square km)
Current activities	1. Offshore Wind Sites (The Crown Estate)		7618.16	13.00%
	2. Offshore Wind Cable Sites (The Crown Estate)		16101	27.47%

²⁶Statista (2021), average windspeed in the United Kingdom from 2001 to 2021, <https://www.statista.com/statistics/322785/average-wind-speed-in-the-united-kingdom-uk/>

²⁷ Energy Sector Management Assistance Program, Offshore Wind Technical Potential: Analysis and Maps, https://esmap.org/esmap_offshorewind_techpotential_analysis_maps

Emerging and potential activities (10 - 20 year horizon)	1. Round 4 Preferred Project Sites	Offshore wind farms will occupy more space in the future, based on the establishment of	1488.94	2.54%
	2. Safety Zone Buffer of 500m for Round 4 and 5	Round 4 preferred projects, an increased safety zone buffer and	304.57	0.52%
	3. Pre-Planning Phase Offshore Wind Data	pre-planned offshore wind sites.	494.90	0.84%
Percentage change to the area covered in current, emerging and potential activities.	In terms of physical infrastructure, the addition of Round 4 wind sites, along with associated buffer zones and pre-planned wind sites, will increase the current extent of wind farms by 9.65% or 2,288.41km ² . This will require an additional demand of 3.90% of the east marine plan areas to facilitate these constructions.			

2.2 Energy production (oil and gas)

UK activity in this sector mainly focuses on offshore exploration and production of oil and gas (accounting for the majority of the UK's outputs) and refining of oil into petroleum products.²⁸ Oil and gas extraction is currently the largest marine sector in terms of Gross Value Added (GVA) in English waters, with over fifty UK enterprises involved in extraction activities alone with an annual turnover exceeding £5 million in March 2021.²⁹

As of 2019, the offshore oil and gas industry met 45% of the UK's overall energy needs and 59% of oil and gas demand.³⁰ The majority of proved oil reserves in the UK are held offshore within the United Kingdom Continental Shelf (UKCS) but between 1995 and 2020 these reserves have nearly halved. This is the result of

²⁸ Department for Business, Energy & Industrial Strategy (2018), Upstream oil and gas in the UK, <https://www.gov.uk/government/publications/extractive-industries-transparency-initiative-payments-report-2018/upstream-oil-and-gas-in-the-uk#reserves-and-forecasts>

²⁹ Statista (2021), Oil industry in the UK – Statistics & facts, <https://www.statista.com/topics/4861/oil-production-and-consumption-in-the-uk/#dossierKeyfigures>

³⁰ Ofgem (2019), Economic Report 2019, https://www.ofgem.gov.uk/sites/default/files/docs/2020/02/oguk_evidence_economic_report_2019.pdf

reduced exploration activity as well as a push from government to support alternative low carbon fuels to reduce the UK's carbon footprint.³¹

Current activities and use cases

The East Marine Plans cited that, as of 2014, the east marine plan areas accounted for 75% of gas production in England and held nearly 75% of all English oil and gas infrastructure - including 2,485 pieces of gas infrastructure and 6,600km of pipeline.³² At present, there are numerous oil and gas wells, as can be seen in Figure 7 and hydrocarbon fields, hydrocarbon license blocks, and oil and gas safety zone operating within the east marine plan areas.

The sector operates by extracting gas and oil from licensed blocks – designated areas of land (onshore) or seabed (offshore).³³ The Petroleum Act 1998 vests all rights to the nation's petroleum resources in the Crown, but the Oil and Gas Authority (OGA) now called North Sea Transition Authority (March 2022), can grant licences that confer exclusive rights to 'search and bore for and get' petroleum. On 3 September 2020, the OGA offered for award 113 licence areas over 260 blocks or part-blocks to 65 companies in the 32nd Offshore Licensing Round.³⁴ License blocks cover close to 40% of the east offshore marine plan area, as can be seen in Figure 8.³⁵ Over the next decade further license blocks will be explored, however, larger environmental objectives, such as achieving net zero by 2050, will likely impact this number.

The OGA report that the decommissioning of oil and gas infrastructure is also intensifying on the UKCS.³⁶ As stated in the Petroleum Act 1998, decommissioning programmes must identify all the items of equipment, infrastructure and materials that have been installed or drilled, and describe the decommissioning solution for each. In order to enable the government's commitment to reach net zero emissions by 2050 and to maximise the economic recovery of the UK oil and gas industry, much of this decommissioned infrastructure is being re-purposed. For example, several existing oil and gas infrastructure assets are currently being repurposed or have plans to be repurposed for carbon capture, usage and storage (CCUS).

The re-use of oil and gas infrastructure involves repurposing existing oil and gas infrastructure for alternative use. The infrastructure referred to can include wells, trunk pipelines or platforms, which through re-use can facilitate the transport and storage of captured carbon dioxide. If assets are identified as having potential for re-

³¹ Statista (2021), Oil industry in the UK – Statistics & facts, <https://www.statista.com/topics/4861/oil-production-and-consumption-in-the-uk/#dossierKeyfigures>

³² Marine Management Organisation (2014), East Inshore and East Offshore Marine Plans, <https://www.gov.uk/government/publications/east-inshore-and-east-offshore-marine-plans>

³³ UK Parliament (2017), Oil and Fossil Fuel Production (including Gas) Sector Report, <https://www.parliament.uk/globalassets/documents/commons-committees/Exiting-the-European-Union/17-19/Sectoral-Analyses/25-Oil-and-Fossil-Fuel-Production-Report.pdf>

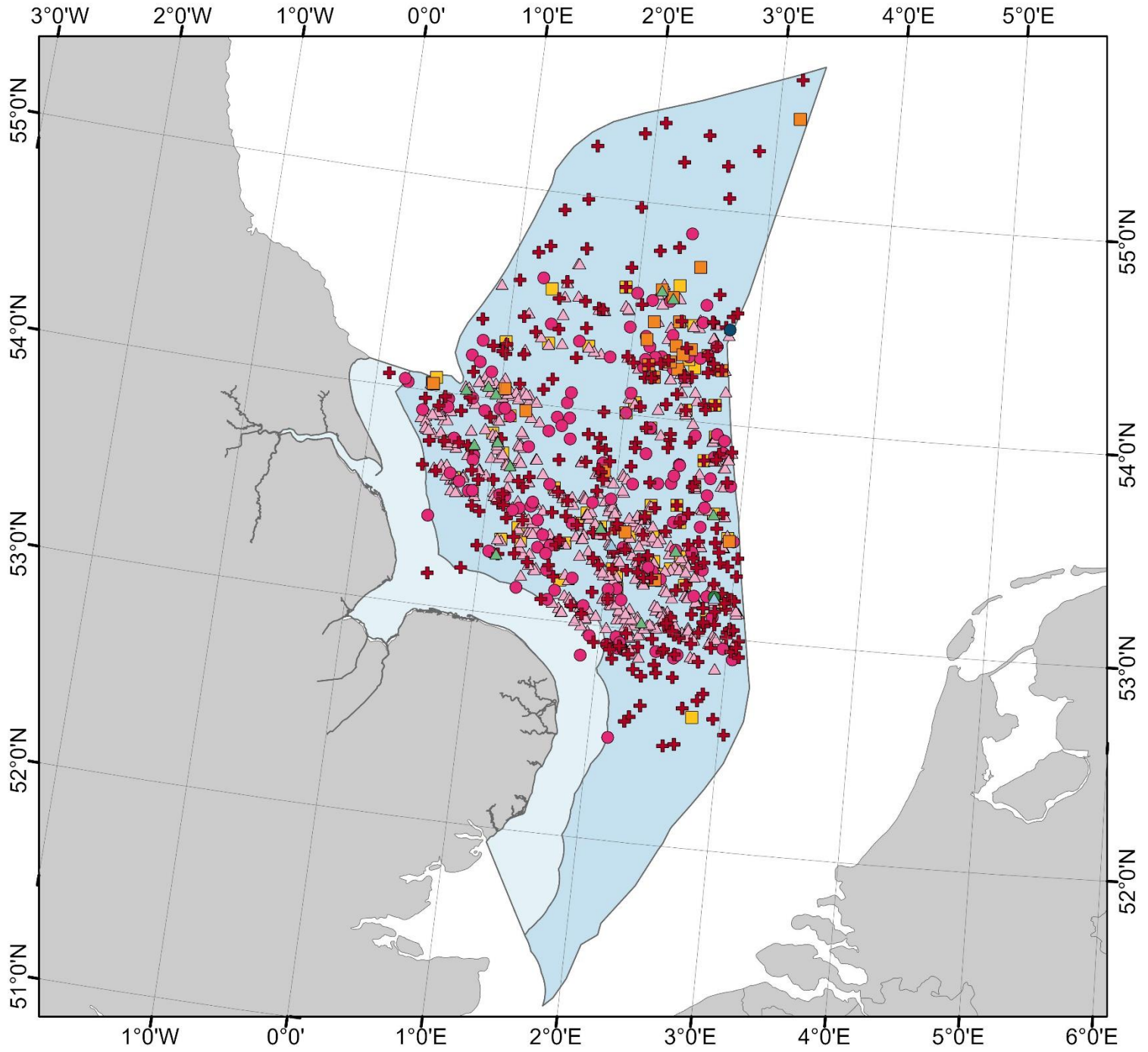
³⁴ Oil & Gas Authority (2020), Licensing rounds, <https://www.ogauthority.co.uk/licensing-consents/licensing-rounds/>

³⁵ Marine Management Organisation (2014), East marine plan areas: Evidence and Issues Report, <https://www.gov.uk/government/publications/east-marine-plan-areas-evidence-and-issues-report>

³⁶ Oil & Gas Authority (2021), Decommissioning Strategy, [decommissioning-strategy-may-2021.pdf](https://www.ogauthority.co.uk/decommissioning-strategy-may-2021.pdf) ([nstaauthority.co.uk](https://www.ogauthority.co.uk))

use (such as for carbon capture, usage and storage), they might need to be maintained or preserved in a state that supports later re-use. These assets would, however, ultimately need to undergo decommissioning in accordance with the Energy Act 2008 and the Petroleum Act 1998.

Figure 7 | Offshore Oil and Gas Wells in the East Marine Plan Areas



- | Oil and Gas Wells Flowclass (NSTA) | Plan Areas |
|------------------------------------|----------------------------------|
| Dry Hole | East Marine Plan (Inshore Area) |
| Gas Show | East Marine Plan (Offshore Area) |
| Gas Well | |
| Gas and Condensate Show | |
| Gas and Condensate Well | |
| Oil Show | |
| Oil Well | |
| Unknown | |
| No data | |



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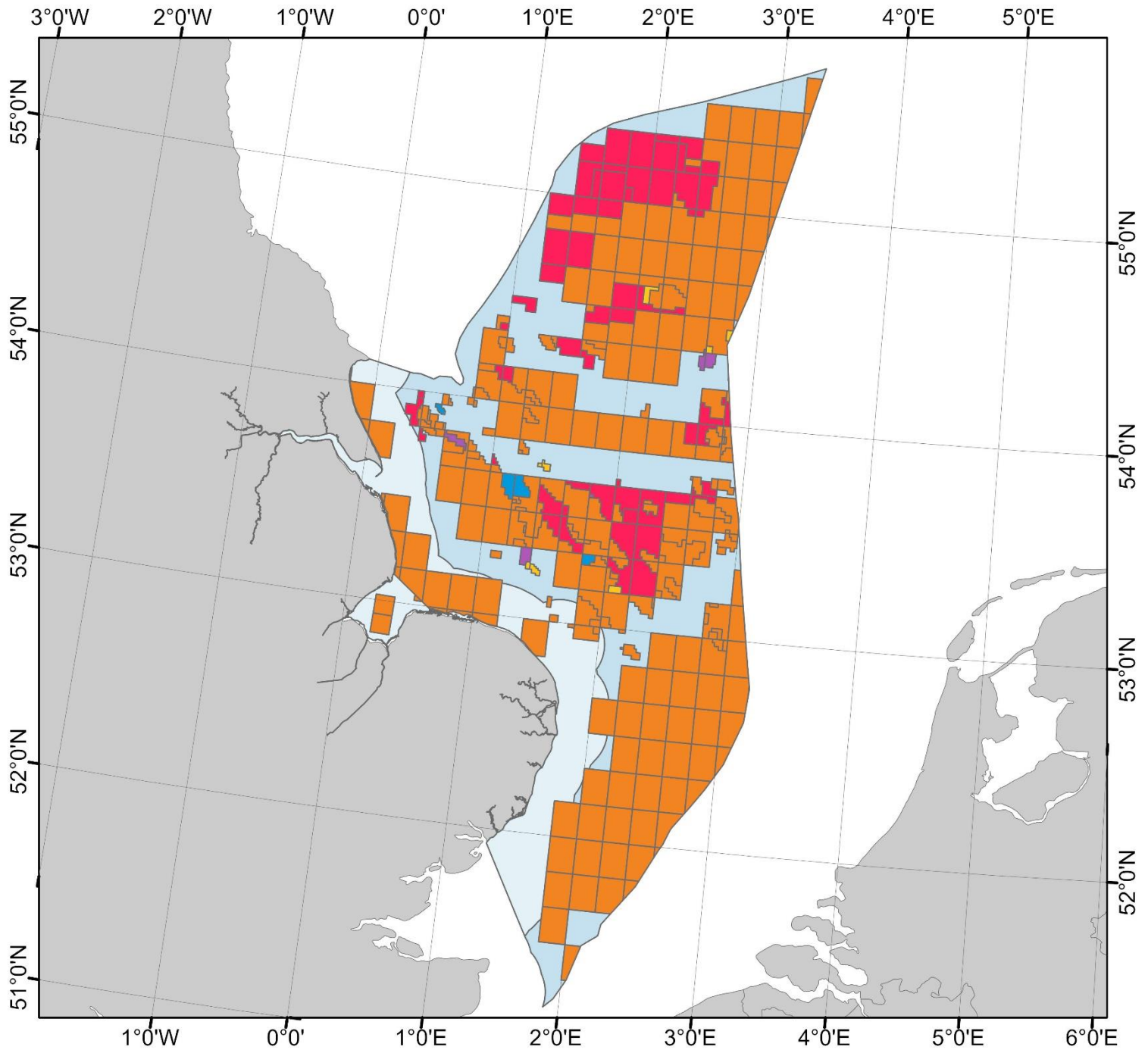
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Figure 8 | Oil and Gas Licence Blocks in the East Marine Plan Areas



Oil and Gas Licence Blocks (NSTA)

- Innovate with either Phase A or Phase B or both
- Innovate with Phase C only
- Promote
- Traditional
- Subtype Unavailable

Plan Areas

- East Marine Plan (Inshore Area)
- East Marine Plan (Offshore Area)



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Emerging activities and use cases (0-10 years)

There are numerous undeveloped gas discoveries in the offshore area. The OGA's 32nd Offshore Licensing Round, as mentioned above, covers the Central North Sea, Northern North Sea, Southern North Sea and the West of Shetlands.³⁷ A 33rd Offshore Licensing Round is currently being planned with timing to be confirmed at a later date.

The OGA's central projection for future production rates in 2019 suggested flat production in 2019 followed by both oil and gas declining at a rate of 5% a year after 2020.³⁸ Although, the path of future production is uncertain and therefore forecasts of future production rates can vary.

Like many other sectors, the oil and gas sector was also severely impacted by the COVID-19 pandemic with offshore activities falling sharply in 2020 and several activities being deferred to 2022 and 2023. According to the Oil and Gas UK (OGUK) 2021 Business Outlook, overall expenditure in the sector was down by more than one-quarter compared to 2019. Similar to OGA forecasts, the OGUK also expects a further 5 to 7% dip in production during 2022.³⁹

Statista's forecast of gas production in the UK from 2016 to 2025 reflects that the UK reached 13.6 billion therms in 2018/19 and over the following six years, this figure is expected to decrease to 10.7 billion therms by 2024/25. This is the result of many oil and gas fields being depleted in the North Sea and with fracking being a contentious practice, the UK is set to become more reliant on energy imports.⁴⁰

Potential activities and use cases (0-20 years)

As noted above, it is difficult to predict or forecast future oil and gas production and extraction activities for the next two decades as this is dependent on several external factors.

The International Energy Agency's Net-Zero Emissions by 2050 Scenario, envisions an energy transition that involves a "*major contraction of oil and gas production with far reaching implications for all the companies that produce these fuels.*" In this scenario oil demand falls from around 90 million barrels per day (mb/d) in 2020 to 24 mb/d in 2050, while natural gas demand falls from 3900 billion cubic metres (bcm) to around 1700 bcm. This scenario also predicts that no fossil fuel exploration is

³⁷ Oil & Gas Authority (2020), Offer of Awards for the UK's 32nd Offshore Licensing Round, <https://www.ogauthority.co.uk/news-publications/news/2020/offer-of-awards-for-the-uk-s-32nd-offshore-licensing-round/>

³⁸ Oil & Gas Authority (2021), Production and expenditure projections, <https://www.ogauthority.co.uk/data-centre/data-downloads-and-publications/production-projections/>

³⁹ OGUK (2021), Business Outlook 2021, <https://oguk.org.uk/wp-content/uploads/2021/01/OGUK-Business-Outlook-2021.pdf>

⁴⁰ Statista (2021), Forecasted gas production in the United Kingdom from 2016/17 to 2024/25 (in billion therms), <https://www.statista.com/statistics/701974/united-kingdom-uk-gas-production-forecast/>

required as no new oil and natural gas fields are required beyond those that have already been approved for development.⁴¹

It is likely that with net zero ambitions, over the next two decades the oil and gas sector will need to heavily diversify and invest in technologies that support reducing emissions including carbon capture, usage and storage, hydrogen, bioenergy and offshore wind. It's also important to note that recent events in Ukraine, could increase the demand for local oil and gas supply in the short term, due to less reliance being placed on Russia.

The impacts of priority national policies and strategies

The following are national policies and strategies that could affect the oil and gas sector in the east marine plan areas over the next 20 years:

- despite the prevalence of oil and gas in this east marine plan areas, the OGA needs to put national and international environmental goals at the heart of its business plans. These notably include achieving net zero emissions by 2050, and embracing the North Sea Transition Deal, which was announced in March 2021, and supports the industry's transition to clean energy and a secure future for high-skilled oil and gas workers.⁴²
- in 2021, the OGA released a lifecycle approach to having all stages of their operations net zero by 2050. Stages of this lifecycle include a new approach to field approvals, emissions reductions, performance improvements, and a final stage of decommissioning much of the UK oil and gas infrastructure.⁴³ Adapting current and emerging activities to meet such objectives will be the focus of the coming years and likely transform the east marine plan areas.

Optimal spatial conditions and attributes needed for the success of activities and use cases

Oil & gas licensed areas

Depth of oil and gas reserves

Natural oil and gas are extracted from different geological resource areas (plays):

- conventional hydrocarbons – those trapped in structures in the rock that are caused by folding and/or faulting of sedimentary layers. These hydrocarbons can be relatively easily recovered and have been extracted for more than 100 years, North Sea gas being an example
- unconventional hydrocarbons – those trapped in impermeable rock that cannot migrate to a trap and form a conventional deposit. For example:

⁴¹ IEA (2021), Net Zero by 2050: A Roadmap for the Global Energy Sector, https://iea.blob.core.windows.net/assets/deebef5d-0c34-4539-9d0c-10b13d840027/NetZeroBy2050-ARoadmapfortheGlobalEnergySector_CORR.pdf

⁴² Department for Business, Energy & Industrial Strategy (2021), North Sea Transition Deal, <https://www.gov.uk/government/publications/north-sea-transition-deal>

⁴³ Oil & Gas Authority (2021), Inaugural emissions monitoring report shows laser focus required to achieve key targets, <https://www.ogauthority.co.uk/news-publications/news/2021/inaugural-emissions-monitoring-report-shows-laser-focus-required-to-achieve-key-targets/>

- shale oil and gas, unlike conventional hydrocarbons, are produced directly from the source shale rock. It is typically found at greater depths than conventional oil and gas. Shale reservoirs are usually 152 metres or more below the surface
- coal bed methane is a form of natural gas found in underground coal seams, methane is adsorbed to the surface of the coal. Coal seams are typically closer to the surface than shale formations, they are at a depth of 600 metres to 1000 metres.⁴⁴

The depletion of the more accessible offshore reserves (<400 metres depth) has pushed the search for hydrocarbons towards 1,500 metres below seabed. According to recent estimates, these deep seabed deposits account for more than 50% of the newly discovered larger offshore fields (i.e. fields with an estimated minimum recoverable reserve of 170 billion barrels). However, the high costs of production at such deep locations, puts the economic viability of these deep seabed reserves at risk.⁴⁵ The majority of hydrocarbon reserves on the United Kingdom Continental Shelf (UKCS) lie between 2,000 and 4,500 metres below seabed although there are shallower and deeper reservoirs.⁴⁶

Oil and gas extraction and exploration sites

The United Kingdom Continental Shelf comprises six geographical and geological oil, gas and condensate regions: Southern North Sea (principally gas fields); Central North Sea (oil, condensate and gas fields); Moray Firth (oil and associated gas fields); Northern North Sea (oil and associated gas fields); West of Shetland (oil and associated gas); and the Irish Sea/Liverpool Bay (oil and gas).

Oil and gas safety zones

A safety zone is an area extending 500 metres from any part of offshore oil and gas installations and is established automatically around all installations which project above the sea at any state of the tide. Vessels of all nations are required to respect them, and it is an offence to enter a safety zone except under the special circumstances.⁴⁷

Impact on demand for the east marine plan areas

The above findings indicate that in the long-term, it is likely that the UK will seek to transition away from oil and gas production to more sustainable and renewable forms of energy production. However, the pace of this change over the next 20 years

⁴⁴ United Kingdom Onshore Operators Group (2013), Onshore Oil and Gas in the UK, <https://www.igasplc.com/media/11155/ukoog-onshore-oil-and-gas-in-the-uk.pdf>

⁴⁵ MARIBE (2016), WP 4: Socio-economic trends and EU policy in offshore economy, https://maritime-spatial-planning.ec.europa.eu/sites/default/files/external-deliverable_oil-and-gas_final-review1.pdf

⁴⁶ Department of Trade and Industry (2001), An Overview of Offshore Oil and Gas Exploration and Production Activities, https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/197799/SD_SEA2EandP.pdf

⁴⁷ Health and Safety Executive (2011), Safety zones around oil and gas installations in waters around the UK, <https://www.hse.gov.uk/pubns/indg189.pdf>

will be determined by recent events in Ukraine with fewer energy supplies being imported from Russia, development of future regulations, advancements in technology, and how and when oil and gas companies diversify their operations and reduce their greenhouse gas emissions in the short-term.

The current offshore extent of oil and gas wells is 36566.94km² which covers approximately 75% of the offshore region. Forecasting the spatial requirements of the oil and gas sector in the more immediate years is difficult given the impacts of external factors. For example, the impacts of Russia's invasion of Ukraine could lead to actions to reduce European reliance on Russia's oil supply, either through transitioning to renewable energy much quicker than expected or continuing operations for oil and gas developments in the interim given pressures on demand.⁴⁸ Therefore, demand for the asset base of the east marine plan areas by oil and gas companies is likely to fluctuate over the next 10 years.

2.3 Carbon capture, usage and storage (CCUS)

Carbon capture, usage and storage (CCUS) is a process in which carbon dioxide (CO₂) from industrial sources is captured, transported via pipelines or shipping, and used or stored in deep offshore geological sites.⁴⁹ In 2019, through its Clean Growth Strategy, the UK government announced its support for CCUS technology, recognising the key role it can play in decarbonising the economy and achieving carbon reduction targets as we transition to renewable energy.⁵⁰

The Marine Policy Statement reflects that "*the UK offshore area is thought to be one of the most promising hub locations in Europe for permanent storage of carbon dioxide.*"⁵¹ Industries such as steel, cement, refining chemicals, glass and ceramics all emit carbon dioxide as part of a chemical process required in production. Currently, CCUS is the only technology option that enables significant decarbonisation for these industries.⁵²

Current activities and use cases

Whilst suitable storage can occur onshore and offshore, given existing oil and gas infrastructure, the focus for developments remains on offshore storage sites with supporting onshore infrastructure.⁵³ CCUS is not yet a commercially viable technology and requires government intervention to overcome market failures such as the presence of negative externalities (CO₂ emissions), coordination failure in the

⁴⁸ IEA (2022), Russia's War on Ukraine, <https://www.iea.org/topics/russia-s-war-on-ukraine>

⁴⁹ Department for Environment, Food & Rural Affairs, UK marine policy statement, <https://www.gov.uk/government/publications/uk-marine-policy-statement>

⁵⁰ Department for Business, Energy & Industrial Strategy, Clean Growth Strategy, <https://www.gov.uk/government/publications/clean-growth-strategy>

⁵¹ Department for Environment, Food & Rural Affairs, UK marine policy statement, <https://www.gov.uk/government/publications/uk-marine-policy-statement>

⁵² UKCCS (2021), CCS Explained, <https://ukccsrc.ac.uk/ccs-explained/>

⁵³ Department for Business, Energy & Industrial Strategy (2020), The UK carbon capture, usage and storage (CCUS) deployment pathway: an action plan, <https://www.gov.uk/government/publications/the-uk-carbon-capture-usage-and-storage-ccus-deployment-pathway-an-action-plan>

transport and storage networks, first mover disadvantage, and lack of private investor incentives.⁵⁴

The UK Government's Ten Point Plan for a Green Industrial Revolution, published in November 2020, established a commitment to deploy CCUS in a minimum of two industrial clusters by the mid-2020s, and four by 2030 at the latest.⁵⁵ In February 2021, the Department for Business, Energy & Industrial Strategy (BEIS) published a consultation seeking input on a potential approach to determine a sequence for locations to deploy CCUS in order to meet this commitment.⁵⁶ Whilst there are currently no fully developed CCUS projects in the UK, as of November 2021 there has been confirmation of two projects as part of the Track-1 clusters for the mid-2020s. These include HyNet in the North West and North Wales and the East Coast Cluster of the Humber and Teesside.⁵⁷ Notably, the Zero Carbon Humber project which is supporting the ambitions of the East Coast Cluster, is a collaboration between Zero Carbon Humber, Net Zero Teesside and Northern Endurance Partnership aiming to build the world's first net zero industrial region that will help position the North of England at the heart of the global energy revolution. This will enable a diverse mix of low carbon projects, including industrial carbon capture, low carbon hydrogen production, negative emissions power, and power with carbon capture.⁵⁸

Emerging activities and use cases (0-10 years)

The fundamental technology which facilitates CCUS is proven and there are many international examples of projects. As the technology improves and the demand for long term carbon storage increases, the UK stands to benefit from a growing worldwide market.⁵⁹

There are significant opportunities for CCUS activities in the offshore east marine plan areas, as can be seen in Figure 9. This is due to the large number of potential storage sites, as well as existing oil and gas infrastructure with the potential for re-use. Bacton, Norfolk, and the Viking storage sites that OGA has received applications for. Alongside this, it also has several industrial facilities emitting CO₂ along England's East coast as reflected in the East Marine Plans.⁶⁰

⁵⁴ Department for Business, Energy & Industrial Strategy (2021), Design of the Carbon Capture and Storage (CCS) Infrastructure Fund, <https://www.gov.uk/government/publications/design-of-the-carbon-capture-and-storage-ccs-infrastructure-fund>

⁵⁵ UK Government (2019), The ten point plan for a green industrial revolution,

<https://www.gov.uk/government/publications/the-ten-point-plan-for-a-green-industrial-revolution>

⁵⁶ Department for Business, Energy & Industrial Strategy (2020), Carbon capture, usage and storage: market engagement on cluster sequencing, <https://www.gov.uk/government/consultations/carbon-capture-usage-and-storage-market-engagement-on-cluster-sequencing>

⁵⁷ Department for Business, Energy & Industrial Strategy (2021), October 2021 update: Track-1 clusters confirmed, <https://www.gov.uk/government/publications/cluster-sequencing-for-carbon-capture-usage-and-storage-ccus-deployment-phase-1-expressions-of-interest/october-2021-update-track-1-clusters-confirmed>

⁵⁸ Zero Carbon Humber, <https://www.zerocarbonhumber.co.uk/east-coast-cluster/>

⁵⁹ Department for Business, Energy & Industrial Strategy (2021), Design of the Carbon Capture and Storage (CCS) Infrastructure Fund, <https://www.gov.uk/government/publications/design-of-the-carbon-capture-and-storage-ccs-infrastructure-fund>

⁶⁰ Marine Management Organisation (2014), East Inshore and East Offshore Marine Plans, <https://www.gov.uk/government/publications/east-inshore-and-east-offshore-marine-plans>

There are also several active and inactive hydrocarbon fields that could be used for storage. CCUS also enables the creation of low-carbon hydrogen supporting the shift to a net zero economy.

As noted above the Ten Point Plan for a Green Industrial Revolution committed to deploy CCUS in a minimum of two clusters by the mid-2020s, and four clusters by 2030 at the latest, with an ambition to capture 10MtCO₂/year by 2030.⁶¹ This was supported by the announcement of the £1 billion Carbon Capture and Storage Infrastructure Fund (CIF).⁶²

With the announcement of the East Coast Clusters, as part of track 1, it is evident that the east marine plan areas provide significant opportunities for this sector from availability of hydrocarbon fields, saline aquifers, industry access and the existing infrastructure.

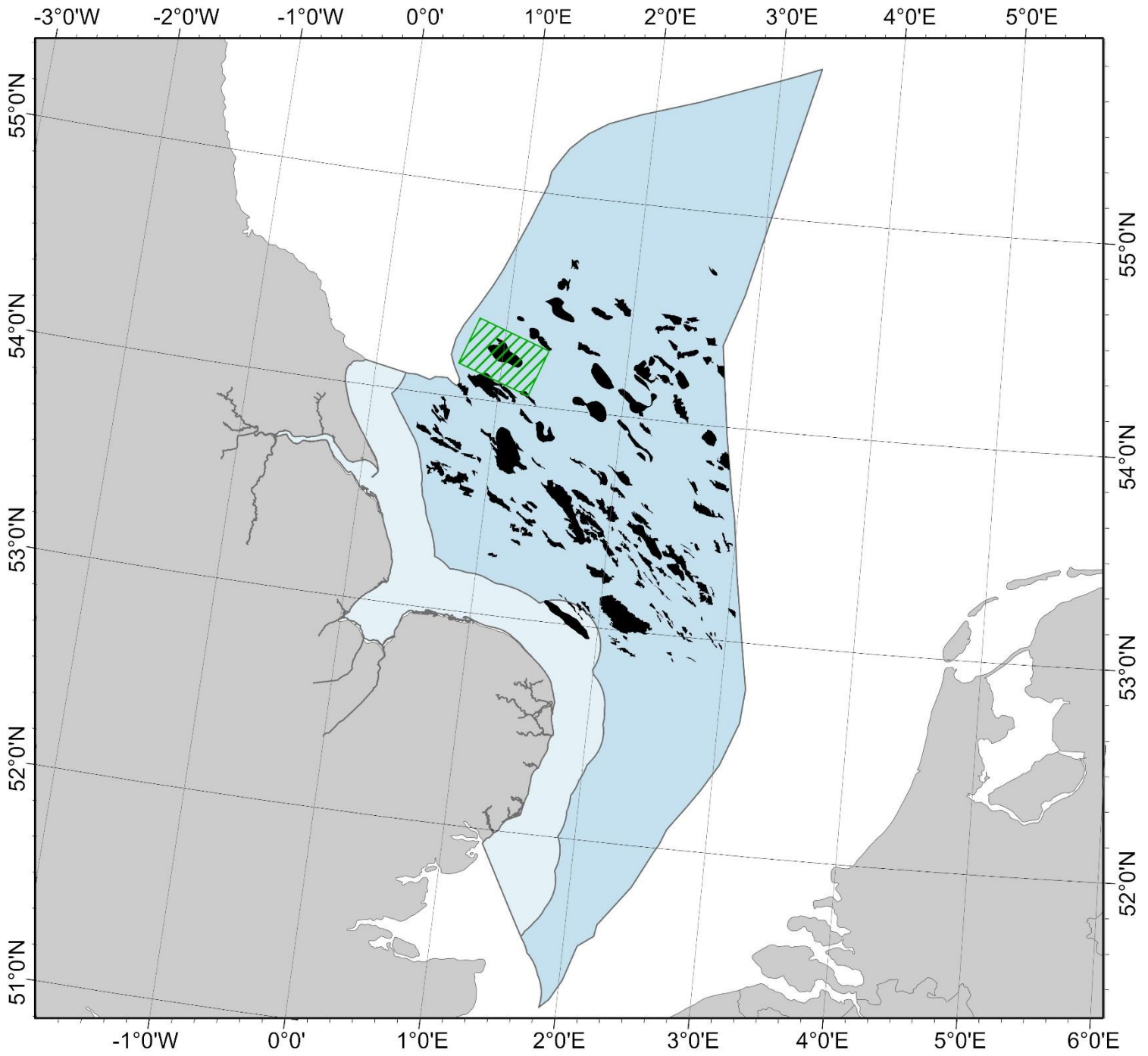
Potential activities and use cases (0-20 years)

Oil and Gas UK's (OGUK) Energy Transition Outlook for 2021 reflects that *“almost 75% of current captured CO₂ emissions are currently linked to oil and gas operations, although in the future it is expected that stand-alone carbon capture industrial clusters will drive investment.”* They also forecast that the oil and gas sector will have a prominent role in the development of CCUS technologies and deployment towards and beyond 2050.

⁶¹ UK Government (2020), The ten point plan for a green industrial revolution, <https://www.gov.uk/government/publications/the-ten-point-plan-for-a-green-industrial-revolution>

⁶² Department for Business, Energy & Industrial Strategy (2021), Design of the Carbon Capture and Storage (CCS) Infrastructure Fund, <https://www.gov.uk/government/publications/design-of-the-carbon-capture-and-storage-ccs-infrastructure-fund>



Figure 9 | Carbon Capture Potential in the East Marine Plan Areas

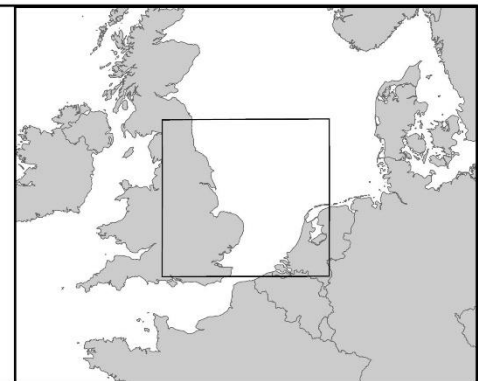


Carbon Capture and Storage

-  BP P.L.C. Carbon Capture and Storage Site Agreement (Crown Estate)
-  Potential Carbon Capture and Storage (MMO)

Plan Areas

-  East Marine Plan (Inshore Area)
-  East Marine Plan (Offshore Area)



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The impacts of priority national policies and strategies

The following are national policies and strategies that could affect the CCUS sector in the east marine plan areas over the next 20 years:

- as reflected in the Ten Point Plan, the UK has set the ambition to capture up to 1 million tonnes of carbon dioxide per year through carbon capture, usage and storage, alongside the £1 billion investment⁶³
- the Energy White Paper Powering our Net Zero Future also commits to the development of CCUS in four industrial clusters including at least one power CCUS project with the aim to be operational by 2030 and put in the commercial framework required to help stimulate the market to deliver a future pipeline of CCUS projects.⁶⁴ This is likely to increase investment and support in CCUS activities in the east marine plan areas, particularly through decommissioning of oil and gas sites for storage utilisation
- as per the Marine Policy Statement, all fossil fuel power stations must now already be constructed “*Carbon Capture-Ready*”, generating considerable volumes of CO₂ to be permanently stored. The expectation is that storage in the UK will take place almost exclusively offshore⁶⁵
- the North East Marine Plan published in 2021 also included two key policy areas for CCUS, which stated that “*decommissioning programmes for oil and gas facilities should demonstrate that they have considered the potential for re-use of infrastructure*” and “*carbon capture, usage and storage proposals incorporating the re-use of existing oil and gas infrastructure will be supported*”. These are policy areas that will likely be considered for the east marine plan areas too⁶⁶
- The UK Hydrogen Strategy aims to have CCUS be a component in developing a thriving low carbon hydrogen sector in the UK by 2030. This will likely lead to investment in CCUS in the east marine plan areas.

Optimal spatial conditions and attributes needed for the success of activities and use cases

The MMO’s East Inshore and East Offshore Marine Plan Areas Evidence and Issues Report, published in 2012, reflected on some of the requirements to successfully achieve activities for CCUS.⁶⁷

Some of the key requirements noted that still apply include:

⁶³ UK Government (2020), The ten point plan for a green industrial revolution,

<https://www.gov.uk/government/publications/the-ten-point-plan-for-a-green-industrial-revolution>

⁶⁴ Department for Business, Energy & Industrial Strategy (2020), Energy white paper: Powering our net zero future, <https://www.gov.uk/government/publications/energy-white-paper-powering-our-net-zero-future>

⁶⁵ Department for Environment, Food & Rural Affairs, UK marine policy statement, <https://www.gov.uk/government/publications/uk-marine-policy-statement>

⁶⁶ Marine Management Organisation (2021), The North East Inshore and North East Offshore Marine Plans, <https://www.gov.uk/government/publications/the-north-east-marine-plans-documents>

⁶⁷ Marine Management Organisation (2014), East marine plan areas: Evidence and Issues Report, <https://www.gov.uk/government/publications/east-marine-plan-areas-evidence-and-issues-report>

- a network of infrastructure for transport (onshore and offshore) and storage for carbon dioxide
- new pipelines will need to be laid and supporting infrastructure, given current inflexibility and location of the majority of existing oil and gas infrastructure
- availability of aquifer structures and the Bunter sandstone formation reservoirs, as well as new infrastructure to support storage facilities within them
- hydrocarbon fields where production has ceased as well as interest areas for enhanced hydrocarbon recovery
- innovation projects will need to be flexible with regards to outputs, access to finance and other support from government given unknown nature of future developments
- the commercial sensitivity of information on the decommissioning programme of oil and gas fields could be limiting to the CCUS sector in identifying suitable project sites. This infrastructure is unlikely to be able to remain dormant for long due to the costs of maintenance and the requirements for operators to decommission such sites.

Geological storage sites

As noted in The Crown Estate's CCUS & Offshore Wind Overlap Study Report, published in April 2021, there are two main types of geological storage sites that are likely to be used for CCUS in the UK:⁶⁸

- saline aquifers – porous and permeable formations that contain saline water
 - a formation depth generally, between circa 1,000 and 2,500 metres below seabed level is required
 - a large volume of reservoir per amount of CO₂ injected is required for saline aquifers due to their storage mechanism and initial reservoir conditions, resulting in a large seabed footprint being required
 - the long history of hydrocarbon exploration drilling in the North Sea means that plugged and abandoned legacy wells may penetrate a saline aquifer formation sitting above a deeper hydrocarbon exploration target. Such wells are generally fairly widely spaced, and it is usually possible to avoid injection into the immediate area. The risk of stored CO₂ leaking from existing well infrastructure is therefore less for a saline aquifer than for depleted hydrocarbon reservoirs
- depleted hydrocarbon reservoirs – formations from which hydrocarbons have previously been produced
 - the reservoirs tend to be deeper than saline aquifers with a typical formation depth of between 2,000 and 3,500 metres below seabed level
 - depleted hydrocarbon reservoirs can store significantly more CO₂ per unit reservoir volume than saline aquifers resulting in a smaller seabed footprint for such stores
 - by their nature, depleted hydrocarbon reservoirs will have a number of existing wells drilled into them. While these wells will have been

⁶⁸ The Crown Estate (2021), CCUS & Offshore Wind Overlap Study Report, <https://www.thecrownestate.co.uk/media/3898/ccus-offshore-wind-overlap-study-report.pdf>

plugged and abandoned after their use in line with the requirements for oil and gas developments, there may be concerns with whether the abandonment measures would be suitable for exposure to CO₂, resulting in a higher potential for leaks from depleted hydrocarbon reservoirs than saline aquifers.

Impact on demand for the east marine plan areas

The above findings indicate that the east marine plan areas have various existing optimal conditions, including available hydrocarbon fields and existing oil and gas infrastructure, to allow for the success of CCUS activities.

However, given the nascent nature of CCUS technologies, this sector is unlikely to develop in the short term without government investment and regulatory support. The early indications of support and commitments by government for the areas of Teesside, the Humber, Merseyside, North Wales and the north east of Scotland potentially reflect a decreased demand for the asset base of the east marine plan areas in the short-term although private investment and industry activities may cause this to change.

Over the 20-year horizon on the other hand, CCUS demand for the asset base of the east marine plan areas can be forecasted to grow as more commercially viable use cases become available.

Table 2: Spatial data for carbon capture, usage and storage (CCUS)

Activities	Data Layers	Key Assumptions	Area (km ²)	Percentage Coverage (against total east marine plan area coverage - approx. 58,000 square km)
Current activities	1. Carbon Capture Site Agreements (The Crown Estate) (Tenant is BP Exploration Operating Company Limited)		1040.57	1.78%
Emerging and potential activities (10 - 20 year horizon)	1. Carbon Capture Potential Sites (MMO)	CCUS infrastructure is now present but occupies minimal "new" space, based on utilisation of existing oil and gas infrastructure and existing hydrocarbon fields.	4047.52	6.91%
Percentage change to the area covered in current, emerging and potential activities.	It is important to note that the current carbon capture site is made up of 146.08km ² or 3.60% of MMO's potential carbon capture sites. This means that 3901.44km ² or 96.40% of the remaining carbon capture potential sites remain un-utilised. Carbon capture sites have the potential to grow by 2860.87km ² or 274.93% beyond their current extent.			

2.4 Dredging and disposal

Dredging is the excavation of materials from a water environment, involving the use of a device to move material (whether or not suspended in water) from one part of the sea or seabed to another part, and/or the total removal of materials from the seabed too.⁶⁹ The purpose of dredging can include improving navigability and existing water features (by removing unwanted material) to facilitate installation of seabed infrastructure and alternative controls for shorelines, and other commercial use (where dredging is used for obtaining desired material – see aggregate dredging below).

Current activities and use cases

Numerous areas are currently under licence for navigational dredging in the east inshore marine plan area. Navigational dredging can be divided into two main types: maintenance and capital. 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.⁷⁰ Likewise, capital dredging enables new activities to proceed by creating new or improved existing navigational channels and berths, often making them deeper and wider.⁷¹

Other types of dredging activity include clearance dredging, which is the removal of silt from outfalls, culverts or inlets. Authorised dredge areas include those that are licensed or those that are exempt from a licence, but which are required to be carried out by, or on behalf of, a harbour authority.

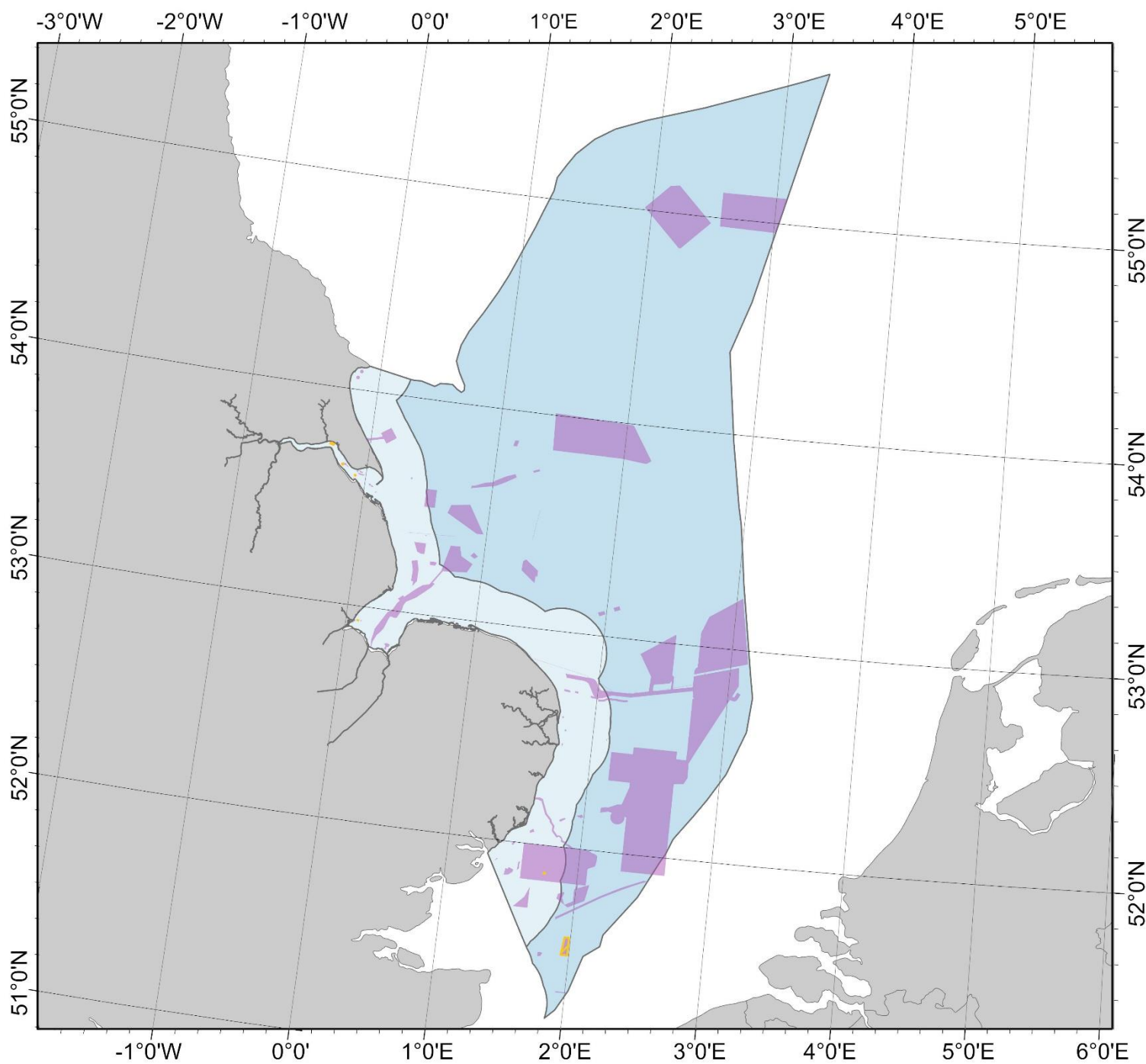
Disposal sites are designated areas in which material, for example from navigational dredging, is deposited. Disposal sites are classified into open, disused, and closed sites. Sites are assessed and classified on a case-by-case basis. Alternative use sites are also currently considered as a category of disposal site. Disposal of dredged material refers to the relocation of dredged material. Dredged material can only be disposed of in identified sites subject to the type of dredged material. Disposing of dredged material means that the material serves no further purpose; however, the exception to this is alternative use sites, which are also classified as disposal sites. Figure 10 reflects the current dredging disposal sites in the east marine plan areas.

⁶⁹ Marine Management Organisation (2019), Dredging, <https://www.gov.uk/guidance/dredging#overview>

⁷⁰ Marine Management Organisation (2021), The North East Marine Plans, [The North East Marine Plans Documents - GOV.UK \(www.gov.uk\)](#)

⁷¹ Marine Management Organisation (2021), The North East Marine Plans, [The North East Marine Plans Documents - GOV.UK \(www.gov.uk\)](#)

Figure 10 | Dredging Disposal Sites and Potential Beneficial Mud Sites in the East Marine Plan Areas



Mud Sites

 Potential Beneficial Mud Sites (MMO)

Dredging Disposal Sites

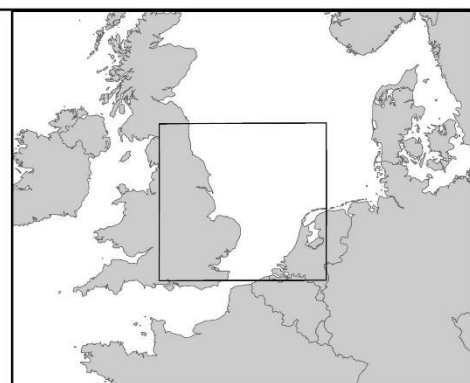
 Dredging Disposal Sites (Cefas)

Plan Areas

 East Marine Plan (Inshore Area)

 East Marine Plan (Offshore Area)

This map shows the locations of dredging disposal sites in the inshore and offshore areas of the East Marine Plan. It also shows the locations of potentially beneficial mud sites as identified by the MMO. These are predominately located in the south of the offshore regions with smaller sites in the Humber.



Emerging activities and use cases (0-10 years)

There may be some further capital dredging for navigation to accommodate changes in vessel size/draught. This may require additional maintenance dredging. For non-navigation projects capital dredging may be required to facilitate installation of infrastructure. If there are more offshore windfarms there may need to be more capital dredging to facilitate these projects.

Potential activities and use cases (0-20 years)

Potential activities for this sector can be derived from the policy position and ambitions noted below.

The impacts of priority national policies and strategies

The following are national policies and strategies that could affect the dredging sector in the east marine plan areas over the next 20 years:

- for many industries such as ports and shipping, dredging acts as a key enabler; however this sector will be required to adapt its operations to meet the national goal of net zero emissions by 2050. Changes to the sector will likely affect the scale and form of future dredging
- the 25 Year Environment Plan requires greater consideration of how factors, such as noise and changes to seabed floor, impact sea life and marine ecology and biodiversity.⁷² As a result, the effect of dredging on the environment and marine life in the east marine plan areas will be subject to updated regulation
- the 25 Year Environment Plan aims to reuse materials wherever possible and meet all existing waste targets. This will likely impact the use case for dredge disposal areas and handling of contaminated sediments⁷³
- the UK Hydrogen Strategy aims to encourage CCUS clusters and the development of offshore wind. Dredging will play a key role in the development of this infrastructure.

Optimal spatial conditions and attributes needed for the success of activities and use cases

The MMO's East Inshore and East Offshore Marine Plan Areas Evidence and Issues Report, published in 2012, reflected on some of the requirements to successfully achieve activities for dredging.⁷⁴

Some of the key requirements noted that still apply include:

⁷² Department for Environment, Food & Rural Affairs, 25 Year Environment, <https://www.gov.uk/government/publications/25-year-environment-plan>

⁷³ Department for Environment, Food & Rural Affairs (2019), 25 Year Environment, <https://www.gov.uk/government/publications/25-year-environment-plan>

⁷⁴ Marine Management Organisation (2014), East marine plan areas: Evidence and Issues Report, <https://www.gov.uk/government/publications/east-marine-plan-areas-evidence-and-issues-report>

- a need to understand the cumulative effects of dredging on all developments, specifically the environment, in the east marine plan areas and beyond
- a need to understand how regulatory changes in industrial dredging will affect future operations and licensing
- a need to understand dredge re-use potential in the east marine plan inshore area as a current evidence project requirement.

Dredging areas

As noted above, there are 3 different purposes for dredging:

- to deepen berths and channels in ports (navigational dredging, which can also be split into maintenance and capital dredging)
- to extract sands and gravels for construction (aggregate dredging)
- to remove material to clear outfalls (clearance dredging)

Dredging disposal areas

There are approximately 155 open sites designated for dredged material disposal around the coast of England, not all of which are used in any one year. While the majority of these are located on the coast of the mainland, generally within a few miles of a major port or estuary entrance, a significant number are positioned within estuaries (e.g. Humber) or on intertidal mudflats. In total, approximately 40 Mt (wet weight) are annually disposed to coastal sites around England, although this can vary from 28 to 57 Mt (wet weight) (data for the period between 1986 and 2010). Individual quantities licensed may range from a few hundred to several million tonnes, and the nature may vary from soft silts to boulders or even crushed rock according to origin, although the majority consists of finer material.⁷⁵

Impact on demand for the east marine plan areas

The current extent of dredging disposal sites covers an area of 7470.15km² or 12.75% of the total east marine plan areas. Dredging and disposal is unlikely to alter demand for the asset base of the east marine plan areas over the next 20 years, however, it can often be utilised as an enabling activity for other sectors which may see increased activities for short periods of time. For example, dredging will be utilised in the expansion of ports and construction of renewable energy sites. Therefore, this sectors impact and interactions with other sectors will need to be considered to determine the carrying capacity of the east marine plan areas.

2.5 Marine Aggregates

Aggregates is a category of materials used in construction, including sand, gravel and crushed stone. Marine aggregate extraction can only occur where commercially viable deposits of sand and gravel occur.

⁷⁵ Centre for Environment, Fisheries and Aquaculture Science (2017), Dredged Material Disposal Site Monitoring Round Coast of England, <https://www.gov.uk/government/publications/dredged-material-disposal-site-monitoring-round-coast-of-england>

Britain has one of the world's most developed marine sourced aggregate industries, extracting 15 to 20 million tonnes from the seabed annually.⁷⁶ Much of this is used for building houses, transport infrastructure, replenishing beaches and improving coastal defences.

The marine aggregate industry meets around 20% of the sand and gravel demand for England and Wales.⁷⁷ Notwithstanding the impacts of the pandemic on the industry in 2020, demand for aggregate dredging has grown steadily with rise in requirements from various infrastructure projects, such as hydro, solar, and other renewable energy sectors, where building material from aggregate activities is needed.⁷⁸

Current activities and use cases

The MMO's East Inshore and East Offshore Marine Plan Areas Evidence and Issues Report, published in 2012, found that the east marine plan areas have historically been the busiest area in England for marine aggregate extraction producing over 50% of tonnage extracted between 2002 and 2012.⁷⁹ Today, almost half of the national commercial extraction licences are also located in the east marine plan areas, as can be seen in Figure 11.⁸⁰

Based on data from The Crown Estate, there are currently nineteen active aggregate production licences in the inshore east marine plan area with licence end dates before 2031.⁸¹ Similarly, in the offshore east marine plan area, there are eight active aggregate production licences, all of which have an end date before 2032.⁸²

Emerging activities and use cases (0-10 years)

The Crown Estate has issued leases for a number of aggregate exploration and option areas within the east marine plan areas. These areas allow for the potential exploration of aggregates and the option to extract them if found.

In the inshore east marine plan area, there are two areas with aggregate exploration and options area licences. These are Inner Dowsing operated by (*Hanson Aggregates Marine Ltd*) (end date - 8/31/2024), and Lowestoft extension operated by (*CEMEX UK Marine Ltd*) (end date - 8/31/2024). In the offshore east marine area,

⁷⁶ The Crown Estate (2021), Capability & Portfolio, <https://www.thecrownestate.co.uk/media/3945/2021-capability-portfolio-report.pdf>

⁷⁷ The Crown Estate (2021), Capability & Portfolio 2021, <https://www.thecrownestate.co.uk/media/3945/2021-capability-portfolio-report.pdf>

⁷⁸ Fact.MR (2022), Global Dredging Market Outlook, <https://www.factmr.com/report/922/dredging-market>

⁷⁹ Marine Management Organisation (2014), East marine plan areas: Evidence and Issues Report, <https://www.gov.uk/government/publications/east-marine-plan-areas-evidence-and-issues-report>

⁸⁰ Marine Management Organisation (2014), East Inshore and East Offshore Marine Plans, <https://www.gov.uk/government/publications/east-inshore-and-east-offshore-marine-plans>

⁸¹ The Crown Estate (2018), Marine Aggregates Report 2018, <https://www.thecrownestate.co.uk/media/2753/2018-the-crown-estate-marine-aggregates-report.pdf>

⁸² The Crown Estate (2018), Marine Aggregates Report 2018, <https://www.thecrownestate.co.uk/media/2753/2018-the-crown-estate-marine-aggregates-report.pdf>

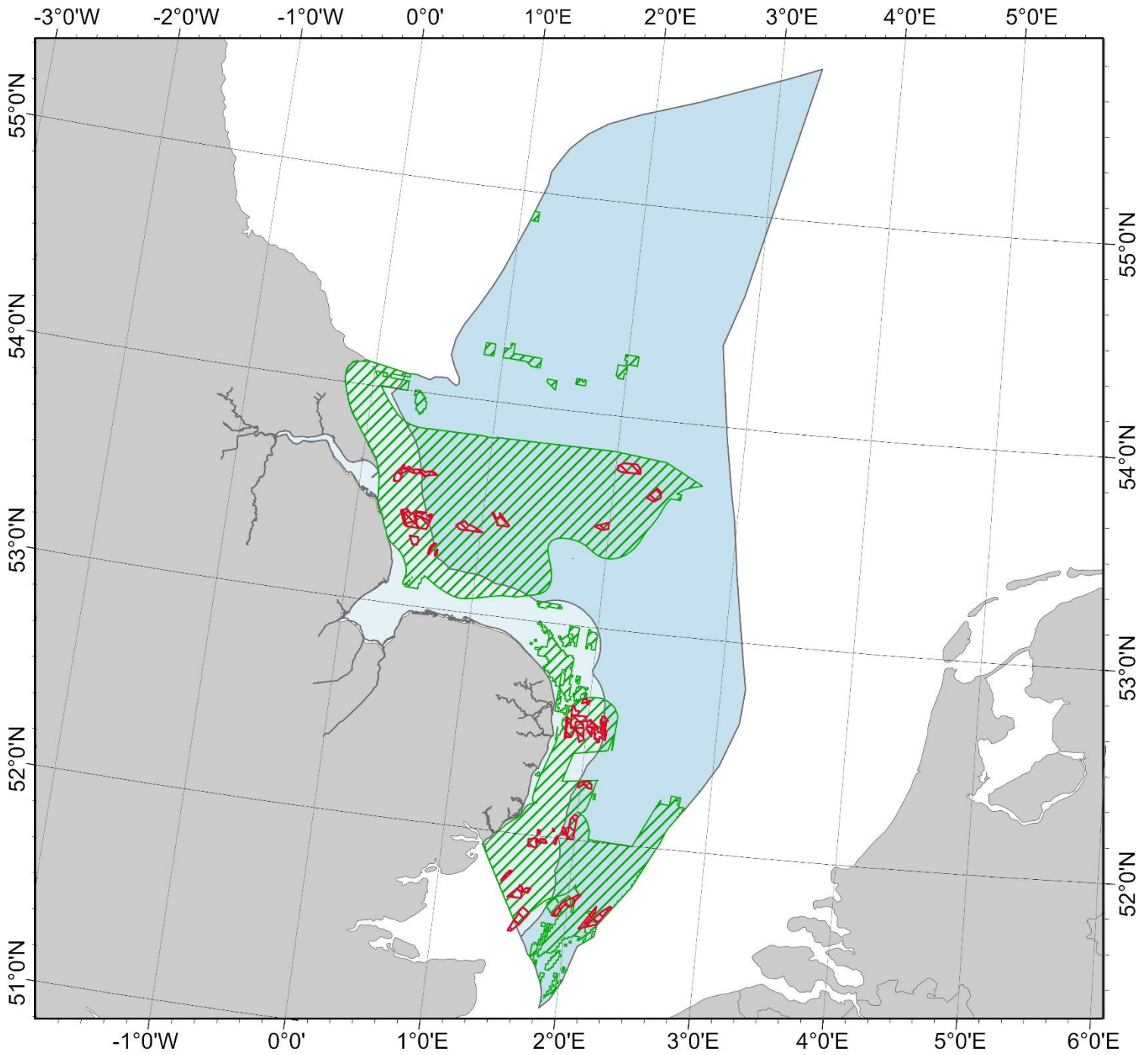
there is one area: East Orford Ness operated by (*Volker Dredging Ltd*) (*End date - 8/31/2024*).

The Crown Estate estimates that potential demand for marine aggregates may increase to 29 million tonnes per year by 2030.⁸³ If this occurs, there could be opportunities for other sectors, specifically ports and shipping, which will need to increase their capacity to transport this material once obtained.

Currently active and emerging aggregate extraction could also face scrutiny as there is unprecedented investment in other sectors, such as renewables, that need to utilise the same seabed for their infrastructure (e.g. wind turbine cables). As a result, over the next decade aggregate licensing and operations could reflect this balance of needs.

⁸³ The Crown Estate (2021), *Capability & Portfolio 2021*, <https://www.thecrownestate.co.uk/media/3945/2021-capability-portfolio-report.pdf>



Figure 11 | Aggregate Sites in the East Marine Plan Areas



Aggregate Areas

-  Aggregate Site Agreements (Crown Estate)
-  Areas of Optimal Aggregate Resource (MMO)

Plan Areas

-  East Marine Plan (Inshore Area)
-  East Marine Plan (Offshore Area)

This map shows all current aggregate site agreements as well as areas of optimal aggregate resource as identified by the MMO.



Potential activities and use cases (0-20 years)

There is currently one aggregate exploration and options area with potential activity in the offshore east marine area. This is the Outer OTE operated by (*Hanson Aggregates Marine Ltd*).

The Crown Estate estimates that as of 2020 there are 14 years left of primary marine aggregate production permitted in the East Coast region, allowing 7.33 million tonnes to be extracted annually.⁸⁴

Marine aggregate extraction can only occur where commercially viable deposits of sand and gravel occur. The British Geological Survey identified areas of high resource potential for future marine aggregate supply within the east marine plan areas beyond existing licensed and exploration areas.

Further, where local sources of aggregates are constrained, either because resources are not geologically present or because existing sources have become depleted, alternative sources of supply have to be found. The importance and increasing demand for aggregate production from the east marine plan areas is expected to continue as onshore resources are becoming increasingly constrained, particularly in the south east of England and London. London and the Thames Estuary are supplied aggregates by the east coast, Thames Estuary & east English Channel and these hold reserves of 7 million tonnes, giving London and the Thames Estuary 12 years of production.⁸⁵ Though these areas are not directly in the east marine plan area, they are in close proximity and therefore have a level of importance and relevance.

The impacts of priority national policies and strategies

The following are national policies and strategies that could affect the aggregates sector in the east marine plan areas over the next 20 years:

- the East Marine Plans have aggregate policies aimed at protecting areas of recognised aggregate resource. A joint initiative between The Crown Estate and members of the British Marine Aggregate Producers Association aims to minimise the area of seabed licensed and area of seabed dredged. This reduces the spatial impact of the activity, and the potential for conflict with others as a result
- the 25 Year Environment Plan states that we should maximise the value and benefits we get from our resources and aims to double resource productivity by 2050
- the Clean Growth Strategy aims to accelerate the pace of decarbonisation, while at the same time enhancing the value and benefits of our resources
- access to markets relies on the availability of suitable infrastructure to support the import of marine aggregates and crushed rock. Without the presence of

⁸⁴ The Crown Estate (2020), Capability & Portfolio 2020, <https://www.thecrownestate.co.uk/media/3634/2020-capability-portfolio-report.pdf>

⁸⁵ The Crown Estate (2020), Capability & Portfolio 2020, <https://www.thecrownestate.co.uk/media/3634/2020-capability-portfolio-report.pdf>

suitable, unconstrained wharf and railhead facilities, the balance of supply cannot be maintained. This is why such sites should be subject to safeguarding policies to protect their use, in accordance with the requirements set out in the National Planning Policy Framework and as set out in the North East Marine Plan INF-2 policy.

Optimal spatial conditions and attributes needed for the success of activities and use cases

The MMO's East Inshore and East Offshore Marine Plan Areas Evidence and Issues Report, published in 2012, reflected on some of the requirements to successfully achieve activities for aggregates.

Some of the key requirements noted that still apply include:

- the need to consider the remaining productive lifespan of existing licensed areas, including in assessing the effect of other issues/sectors, and future opportunities for aggregates extraction
- consideration of demand and use of aggregates for beach nourishment and coastal defence as indicated in Shoreline Management Plans
- a managed aggregate supply system focused on mineral safeguarding, ensuring that non-minerals development does not needlessly prevent the future extraction of mineral resources, of local and national importance.

Aggregate extraction by dredging

Aggregate dredging

The UK's marine aggregate fleet comprises 27 purpose-built marine aggregate extraction vessels, operating 360 days-a-year.⁸⁶ At the heart of the extraction process are powerful electric pumps which, on large vessels, are capable of drawing up to 2,600 tonnes of sand and gravel an hour from water depths of up to 60 metres.⁸⁷

Water depth

Aggregate dredgers in the current UK fleet have dredging depth capabilities ranging from 20 metres to about 55 metres.⁸⁸

Substrate type

London clay or glacial till substrates present difficulties in allocating dredging area, being contaminants in aggregates, compared to sand or solid rock.⁸⁹

⁸⁶ British Marine Aggregate Producers Association (2016), Marine Sand and Gravel Prospecting and Seabed Investigations for Aggregate Extraction,

https://bmapa.org/documents/Marine_sand_and_gravel_prospecting_paper_2016.pdf

⁸⁷ https://bmapa.org/documents/Guideline_19_Marine_Aggregate_Extraction_Proximity_2.pdf

⁸⁸ <https://www.hanson.co.uk/en/products/aggregates/marine-aggregates/fleet>

⁸⁹ British Marine Aggregate Producers Association (2016), Marine Sand and Gravel Prospecting and Seabed Investigations for Aggregate Extraction,

https://bmapa.org/documents/Marine_sand_and_gravel_prospecting_paper_2016.pdf

Overburdens

A seabed overburden of fine-grained sediment greater than a few centimetres thick in a marine aggregate context would sterilise a deposit.⁹⁰ This is due to the cost and virtual impossibility of removing the overburden over the whole extent of the dredging area (covering typically 500,000m² or more of seabed) and subsequently disposing of the sediment in a separate licensed disposal site.⁹¹

Environmental and spatial constraints

Marine Protected Areas (MPAs) designated archaeological sites and other developments such as wind farms and cable routes can preclude marine aggregate extraction. These factors can reduce the area available for aggregate dredging or can cause uncertainty over free access to a given area, with the possibility of seasonal restrictions on aggregate dredging and/or exclusion zones being required, limiting the area of resource available.⁹²

Impact on demand for the east marine plan areas

There is increasing demand for construction materials to maintain and develop transport, energy and water infrastructures and built environment that society relies upon.⁹³ The marine aggregates sector is likely to become increasingly relevant because of the need for new extraction sites to replenish beaches and improve coastal defences.⁹⁴ The increasing scarcity over the supply of raw and non-living material, tends to push some countries out into deeper waters further offshore to look for new material supply zones so there is a significant economic growth opportunity here if the aggregates sector is able to capitalise on it, provided the right conditions are in place.⁹⁵ Therefore, aggregate activities are likely to increase demand for the asset base of the east marine plan areas over the next 20 years.

⁹⁰ British Marine Aggregate Producers Association (2016), Marine Sand and Gravel Prospecting and Seabed Investigations for Aggregate Extraction, https://bmapa.org/documents/Marine_sand_and_gravel_prospecting_paper_2016.pdf

⁹¹ British Marine Aggregate Producers Association (2016), Marine Sand and Gravel Prospecting and Seabed Investigations for Aggregate Extraction, https://bmapa.org/documents/Marine_sand_and_gravel_prospecting_paper_2016.pdf

⁹² British Marine Aggregate Producers Association (2016), Marine Sand and Gravel Prospecting and Seabed Investigations for Aggregate Extraction, https://bmapa.org/documents/Marine_sand_and_gravel_prospecting_paper_2016.pdf

⁹³ European Commission (2021), Marine Aggregates and Marine Mining, <https://maritime-spatial-planning.ec.europa.eu/sector-information/marine-aggregates-and-marine-mining#3>

⁹⁴ European Commission (2021), Marine Aggregates and Marine Mining, <https://maritime-spatial-planning.ec.europa.eu/sector-information/marine-aggregates-and-marine-mining#3>

⁹⁵ European Commission (2021), Marine Aggregates and Marine Mining, <https://maritime-spatial-planning.ec.europa.eu/sector-information/marine-aggregates-and-marine-mining#3>

Table 3: Spatial data for marine aggregates

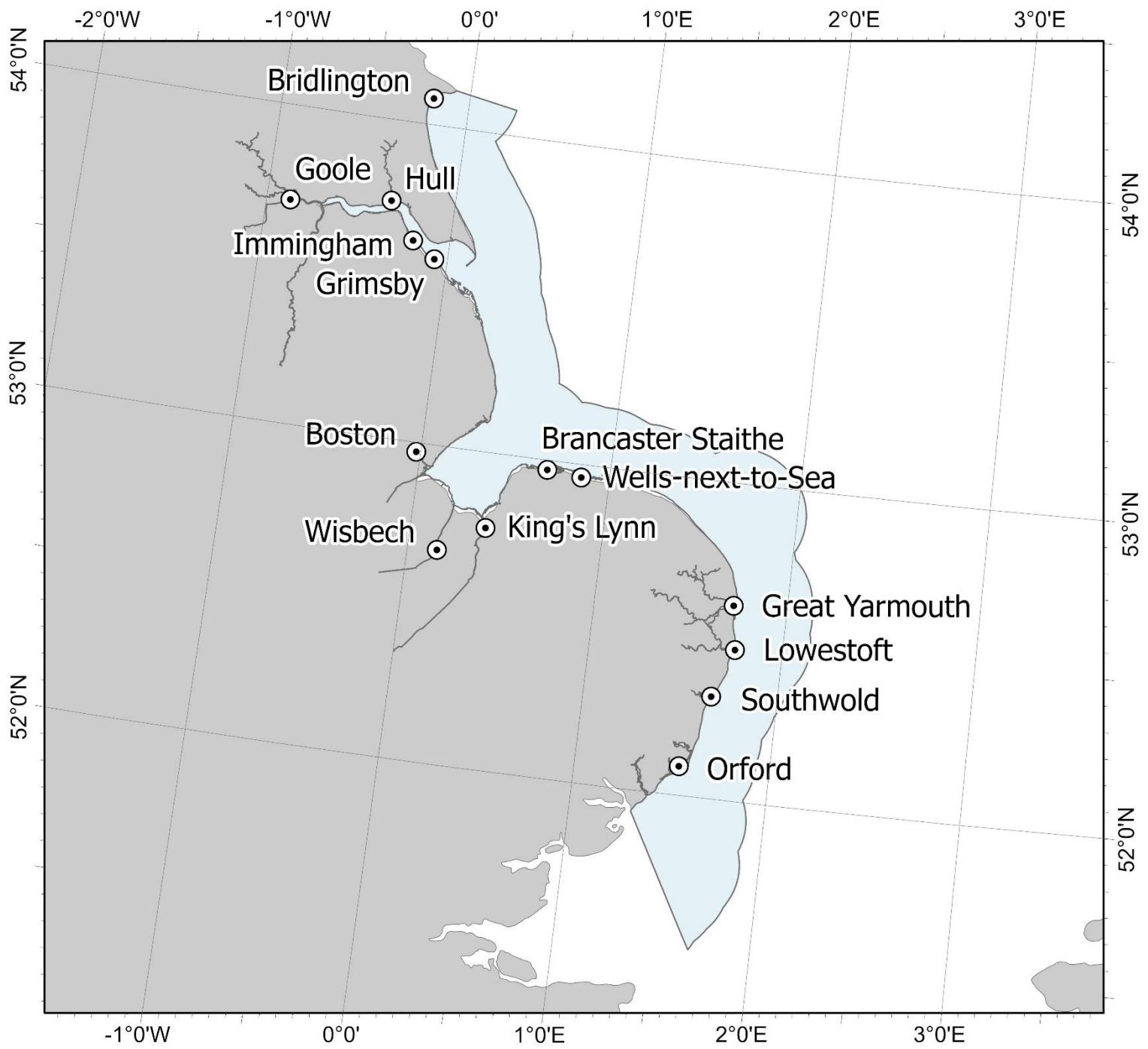
Activities	Data Layers	Key Assumptions	Area (km ²)	Percentage Coverage (against total east marine plan area coverage - approx. 58,000 square km)
Current activities	1. Aggregate Site Agreements (The Crown Estate)		858.26	1.46%
Emerging and potential activities (10 - 20 year horizon)	1. Areas of Optimal Aggregate Resource (MMO)	It is expected that aggregate sites will increase, with some of the expansion being a result of coastal management and flood mitigation schemes	17316.09	29.85%
Percentage change to the area covered in current, emerging and potential activities.	This means there is significant potential for growth for aggregate sites from 858.26km ² to 17316.09km ² , which is a 1917.58% increase from current extent of activities. This will place an additional demand of 29.85% on the east marine plan area, in terms of space.			

2.6 Ports and shipping

Nearly 95% of the UK's international trade arrives or leaves by sea. As gateways to the world, ports and shipping are crucial enablers of strategic supply chains for the UK, allowing British industries to thrive and bring in goods that citizens depend on in their daily lives.⁹⁶

⁹⁶ Department for Transport (2019), Maritime 2050, https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/872194/Maritime_2050_Report.pdf

Figure 12 | Significant Ports within the Inshore East Marine Plan Area

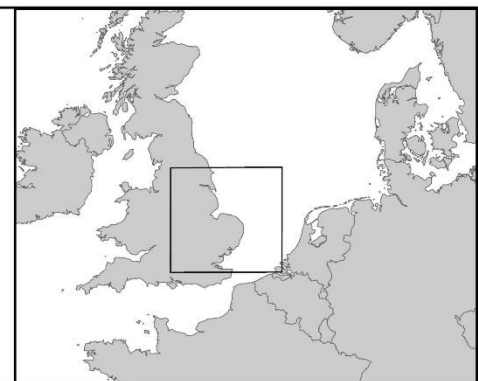


Ports

- Significant Ports within the East Marine Plan

Plan Areas

- East Marine Plan (Inshore Area)



Current activities and use cases

The UK Major Ports Group reports there are currently 40 major ports in the UK of which 22% are in the east marine plan areas with the ports of Grimsby and Immingham handling 12% of yearly national traffic and 55 million tonnes of goods annually, as seen in Figure 12.⁹⁷

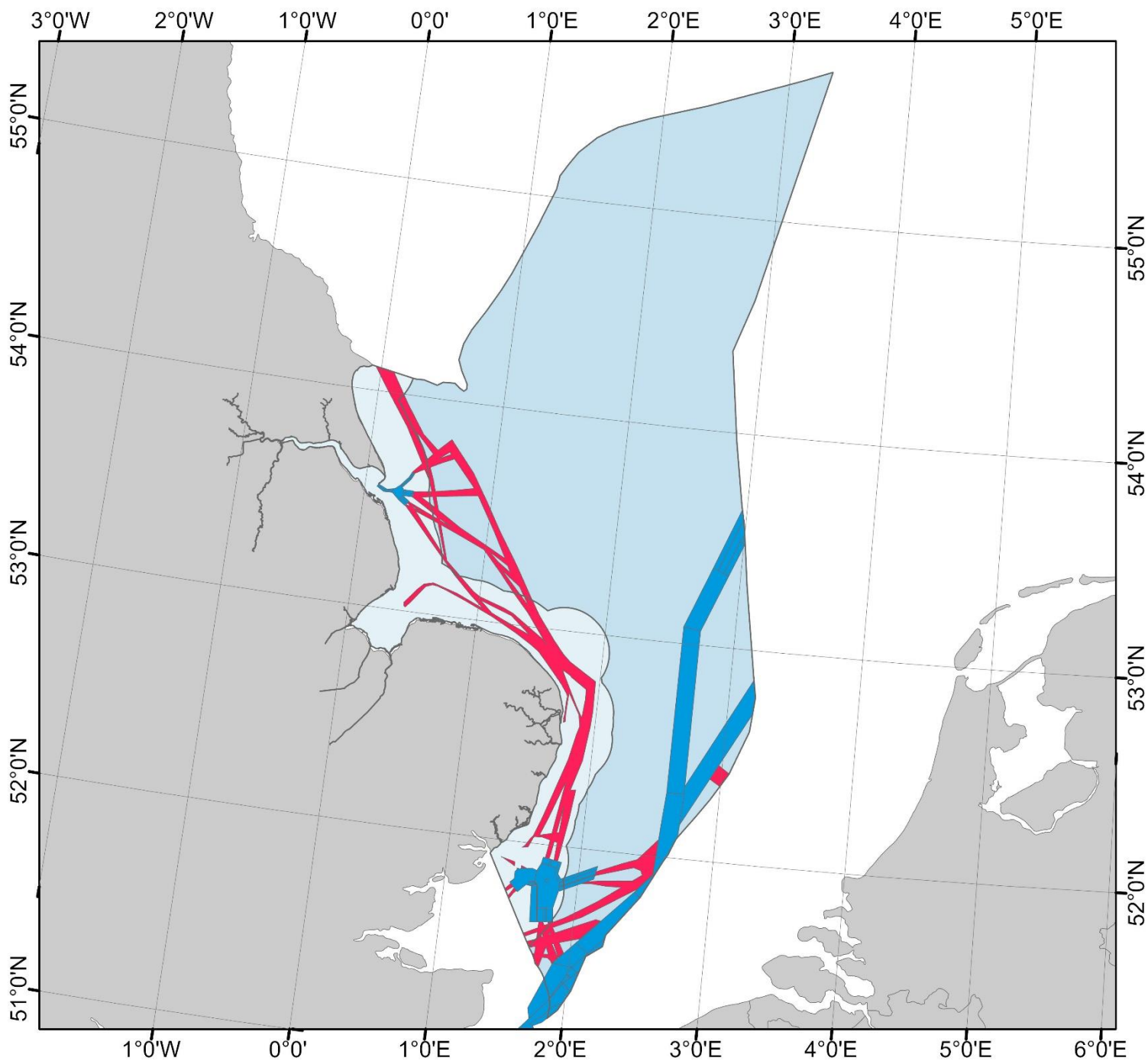
Other relevant ports and shipping activities in the east marine plan areas include an unspecified amount of non-major ports, International Maritime Organization (IMO) routing measures (36 inshore and 21 offshore), the Harwich passenger ferry service, and 6 statutory harbours.

With regards to environmental considerations, shipping is considered one of the most carbon-efficient modes of transport.⁹⁸ Despite this, ports and shipping still currently exert negative pressures on the environment, with their impact commonly including sulphur emissions, nitrogen oxide emissions, airborne and seaborne noise, and unlawful discharges. In an attempt to deal with these issues a draft piece of legislation, The Merchant Shipping (Prevention of Air Pollution from Ships) (Amendment) Regulations 2021, was presented to parliament in 2021.

⁹⁷ UK Major Ports Group (2021), UK ports in 2020 (and into 2021) – What does the data say?, <https://ukmajorports.org.uk/thinking/uk-ports-in-2020-and-into-2021-what-does-the-data-say/>

⁹⁸ IMO (2009), Second IMO GHG Study 2009, <http://www.imo.org/en/OurWork/Environment/PollutionPrevention/AirPollution/Documents/SecondIMOGHGStudy2009.pdf>

Figure 13 | Navigation Routes in the East Marine Plan Areas

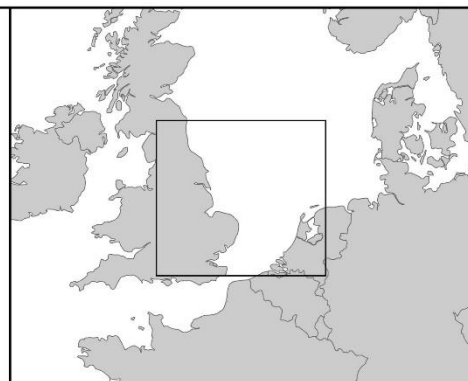


Navigation Routes

- █ Navigation Routes in the EMP Areas
- █ International Maritime Organisation Navigation Routes (UKHO)

Plan Areas

- East Marine Plan (Inshore Area)
- East Marine Plan (Offshore Area)



Date of Publication: 23/03/2023

Coordinate System: ETRS 1989 LAEA

Projection: Lambert Azimuthal Equal Area

MMO Reference: 10715

Not to be used for navigation

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Emerging activities and use cases (0-10 years)

The UK government policy on freeports endeavours to create up to ten freeports around the UK to be national hubs for global trade and investment. These aim to promote regeneration and job creation as part of the government policy to level up coastal communities. Freeports are a special kind of port where normal tax and customs rules do not apply with the aim to specifically encourage businesses that import, process and then re-export goods. These can be land-locked locations (such as airports) as well as seaports⁹⁹. In the 2021 budget, the UK government announced new freeports in Felixstowe and Humberside, would be created in the east inshore marine plan area.

The success of other industries could also increase pressure on shipping and ports in the east marine plan areas. For example, with the predicted rise in marine aggregate extraction by 2030, ports may need to increase their capacity to offload and transit this material. Similarly, with the increased sustainability ambitions of the government and increasing investment in renewable energy it is likely that future ports and shipping activities and their associated supply chains will play a key role. For example, ports may be utilised further for the construction of wind farm infrastructure. Over the next decade, ports and shipping may need to adapt and expand to accommodate such changes.

Potential activities and use cases (0-20 years)

Potential activities for this sector can be derived from the policy position and ambitions noted below.

The impacts of priority national policies and strategies

The following are national policies and strategies that could affect the ports and shipping sector in the east marine plan areas over the next 20 years:

- the Ten Point Plan for a Green Industrial Revolution commits to the development of green ships whilst it aims to increase coastal and short-sea shipping, transporting freight that would otherwise move by road
- in the Maritime 2050 strategy, Government set the ambition to actively drive the transition to zero emission shipping in UK waters, moving faster than competitor countries and international standards to capitalise on the potential economic benefits. Notably, over the course of the next 20 years, the strategy encourages government and industry to work together to achieve the first multimodal autonomous freight movement through a UK port
- this is also supported by the 2019 Clean Maritime Plan that committed to all new vessels being ordered for use in UK waters are designed with zero emission propulsion capability. Whilst the impacts of this are not well known for the east marine plan areas, there is a potential for increased activity and transformation of the sector from ship building, retrofitting and further technological development.

⁹⁹ Institute for Government (2019), Trade: freeports and free zones, <https://www.instituteforgovernment.org.uk/explainers/trade-freeports-free-zones>

Optimal spatial conditions and attributes needed for the success of activities and use cases

The MMO's East Inshore and East Offshore Marine Plan Areas Evidence and Issues Report, published in 2012, reflected on some of the requirements to successfully achieve activities for ports and shipping.¹⁰⁰

Some of the key requirements noted that still apply include:

- there must be due consideration of the interaction of shipping with other users of marine space and vice-versa. Where planning identifies the need to restrict surface navigation or make changes to IMO recognised routing measures, these would need to be agreed through established national and international channels
- there must be awareness of action being taken to realise IMO convention such as protection of freedom of navigation, integrating and supporting measures where appropriate. This is particularly true in the context of marine planning that takes into account a wide range of activities that individually and cumulatively may have significant impact on the use of space in the east marine plan areas
- there must be due consideration of the technological changes being adopted by vessels and ports, with respect to decarbonisation and digitisation, and ensuring that all planned activity in the area, can support these changes, with the necessary regulation, policy, infrastructure, and skills in place.

Impact on demand for the east marine plan areas

The ports and shipping sector both contribute significantly to economic growth through their activities in the east marine plan areas. It can be forecasted that both in the 10-year and 20-year horizon, this sector will increase demand for the asset base of the east marine plan areas due to the growth in activities from increased utilisation of ports for renewable energy infrastructure development, ship building and further technological advancements such as autonomous shipping. It is likely that ports will expand to accommodate these changes and larger shipping channels will be required as a result. Therefore, ports and shipping activity impacts and interactions with other sectors will need to be considered to determine the carrying capacity of the east marine plan areas.

2.7 Aquaculture

The North East Marine Plan defines aquaculture as "*the controlled rearing of aquatic shellfish, finfish and the cultivation of aquatic plants and algae.*" Aquaculture has grown in the last 40 years to be an important component of the UK seafood sector with a production value in excess of £590 million to the UK economy.¹⁰¹

¹⁰⁰ Marine Management Organisation (2014), East marine plan areas: Evidence and Issues Report, <https://www.gov.uk/government/publications/east-marine-plan-areas-evidence-and-issues-report>

¹⁰¹ Government Office for Science (2017), Future of the sea: trends in aquaculture, <https://www.gov.uk/government/publications/future-of-the-sea-trends-in-aquaculture>

Current activities and use cases

In terms of sustainability, the aquaculture sector is often criticised for exerting negative pressures on the environment. This includes transmitting disease and parasites for native fish, genetically altering native fish populations through escape, and impacting nearby marine biodiversity. These impacts, however, are largely confined to finfish aquaculture which, at present, does not occur or have development plans in the east marine plan areas.

By contrast, Shellfish aquaculture is the most common form of aquaculture in the east marine plan areas. Defra cites that the inshore east marine plan area has historically been the most productive area nationally for aquaculture, producing just under 65% of total aquaculture shellfish since 2007.¹⁰² When managed sustainably, shellfish aquaculture has a net positive impact on the environment. For example, as noted in the East Marine Plan, populations of species such as native oysters can provide ecosystem services (water filtering and stabilising shorelines) through the establishment of biogenic reefs.¹⁰³ These reefs can also act as hotspots where biodiversity is greater than that of surrounding sediments and are therefore of high importance to the biodiversity of the surrounding area.¹⁰⁴

At present, shellfish species reared through aquaculture in the east marine plan areas include but are not limited to:

- native oysters (*Ostrea edulis*)
- blue mussels (*Mytilus edulis*)
- pacific oysters (*Magallana gigas*)
- scallops (*Pectinoidea*)
- shellfish including crab and shrimp (*Bivalvia*)

Given the above, the East Marine Plan recognises aquaculture as a key area for development due to its potential to contribute to the sustainability and security of the UK's food supply, 80% of which is currently imported from overseas sources.¹⁰⁵ Recent strategy, such as Seafood 2040, echoes this, and there is currently increased investment and focus on aquaculture production in the east marine plan areas.

Emerging activities and use cases (0-10 years)

In 2019, the MMO carried out suitability modelling of seaweeds (project No. 1184; MMO, 2019), to investigate the suitability of the east and south coasts of England for seaweed farming. Research into the applications of seaweed shows that farms, can have applications in food and livestock feed, biofuels, cosmetics, pharmaceuticals

¹⁰² Department of Environment, Food & Regional Affairs (2011), Marine Policy Statement, <https://www.gov.uk/government/publications/uk-marine-policy-statement>

¹⁰³ Marine Management Organisation (2021), North East Inshore and North East Offshore Marine Plans, <https://www.gov.uk/government/publications/the-north-east-marine-plans-documents>

¹⁰⁴ Marine Management Organisation (2021), North East Inshore and North East Offshore Marine Plans, <https://www.gov.uk/government/publications/the-north-east-marine-plans-documents>

¹⁰⁵ Marine Management Organisation (2021), North East Inshore and North East Offshore Marine Plans, <https://www.gov.uk/government/publications/the-north-east-marine-plans-documents>

and medicines as well as providing carbon sequestration services and acting as fish nursery grounds.¹⁰⁶ Similarly, the MMO reflects that there is an emerging interest in rearing certain types of algae through aquaculture in the east marine plan areas.

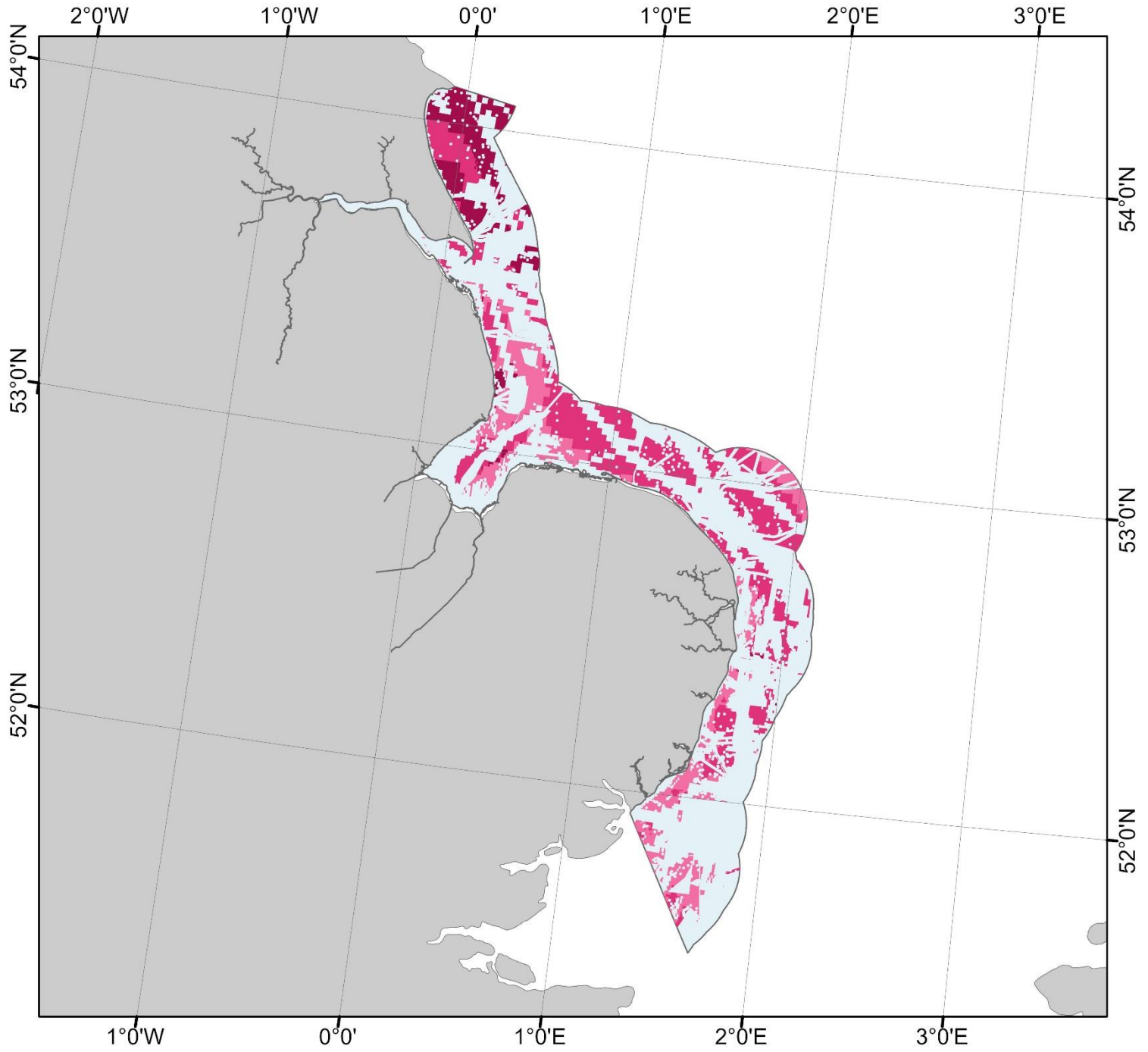
There are also numerous areas of potential strategic sustainable aquaculture production in the inshore east marine plan area. These are areas identified as being most suitable for aquaculture of various key species, while minimising the chance for conflict with other marine users. They were identified based on consideration of environmental conditions that influence growth and physical conditions that act as constraints on siting of aquaculture infrastructure. These were balanced against existing uses of the marine area (such as infrastructure and shipping lanes), with other considerations such as distance from shore (to reflect the costs such as fuel) also considered.

Potential activities and use cases (0-20 years)

Potential activities for this sector can be derived from the policy position and ambitions noted below.

¹⁰⁶ Marine Management Organisation (2021), North East Inshore and North East Offshore Marine Plans, <https://www.gov.uk/government/publications/the-north-east-marine-plans-documents>

Figure 14 | Aquaculture Potential in the East Marine Plan Inshore Area



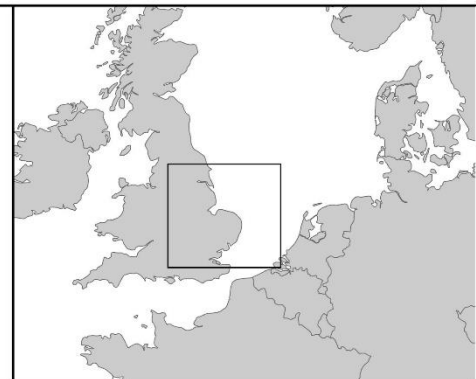
Strategic Areas of Sustainable Aquaculture Potential (MMO)

Suitability Index

- >0.8 to 1 (High Suitability)
- >0.6 to 0.8
- >0.4 to 0.6
- >0.2 to 0.4
- 0 to 0.2 (Low Suitability)

Plan Areas

- East Marine Plan (Inshore Area)



Date of Publication: 23/03/2023

Coordinate System: ETRS 1989 LAEA

Projection: Lambert Azimuthal Equal Area

MMO Reference: 10715

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The impacts of priority national policies and strategies

The following are national policies and strategies that could affect the aquaculture sector in the east marine plan areas over the next 20 years:

- Seafood 2040 aims to enhance the now established Aquaculture Leadership Group in its efforts to more widely represent English aquaculture, to encourage innovation and technology, and to support export and domestic growth. This has the potential to impact future supply and demand of aquaculture farming
- the English Aquaculture Strategy sets out an approach for the sustainable development of English aquaculture over the next twenty years. It aims to see a tenfold increase in production volume to around 90,000 tonnes by 2040, which can be achieved through a combination of expansion, innovation, integration and proportionate regulation. This will likely lead to increased investment in aquaculture in the east marine plan areas.

Optimal spatial conditions and attributes needed for the success of activities and use cases

The MMO's East Inshore and East Offshore Marine Plan Areas Evidence and Issues Report, published in 2012, and the English Aquaculture Strategy reflect on some of the requirements to successfully achieve activities for aquaculture.¹⁰⁷

Some of the key requirements noted that still apply include:

- developing a clear policy framework that promotes sustainable (economic, social and environmental) development whilst balancing the needs of other water space and resource users as well as the ecosystem services that support them
- developing a regional approach to aquaculture development, management and regulation, creating regional hubs that can: lead on regional spatial marine planning, acting as a 'one stop shop' for new and expanding aquaculture businesses; and, providing a forum for co-existence with other marine space users
- development of specific marine licensing guidelines for macroalgae culture that reflects its nature, scale and impact of these extractive, low trophic species
- establish an Aquaculture Innovation Hub and online forum for English aquaculture covering research, knowledge transfer, promotion of best practise, regulatory requirements, consumer information, etc. Where necessary this could be linked to (i) wider UK and EU research, (ii) English regional initiatives and (iii) specific toolboxes, such as the Aquaculture Regulatory Toolbox and the Aquaculture Virtual Hub
- finalise a formal policy for the use of Pacific oysters in English waters balancing the potential harm from further farmed introductions with the socio-economic benefits of producing this now established species.

¹⁰⁷ Marine Management Organisation (2014), East marine plan areas: Evidence and Issues Report, <https://www.gov.uk/government/publications/east-marine-plan-areas-evidence-and-issues-report>

Farming techniques

A study was conducted in 2019 to identify where key aquaculture species might be cultured based on environmental conditions necessary for species growth or constraining culture infrastructure. The findings from the “*Identification of areas of aquaculture potential in English waters (MMO1184)*”¹⁰⁸ report included:

Seaweed farming

In this study, peak wave height, for all seaweed species was considered optimal between 0-4 metres, suboptimal between 4-6 metres, and unsuitable >6 metres.

The optimal current speed range for the following species was:

- *Saccharina latissimi* – 0.1-1.0 (metres/second), not suitable >1.5
- *Laminaria digitata* – 0.25-1.0 (m/s), not suitable >1.5
- *Alaria esculenta* – 0.5-1.5 (m/s), not suitable >1.5
- *Palmaria palmata* - 0.25-1.0 (m/s), not suitable >1.5

Depth requirement for the farm is dependent on the technique adopted for cultivation of seaweeds (e.g. ropes, textiles), the structure of the farm, accessibility via boat etc.

Crustacean aquaculture

Optimal conditions in seabed container culture

- water depth (bathymetry (m)) – 5-50m, not suitable <5, >60
- current speed – 0.05-0.25 (m/s), not suitable <0.25, >0.05
- substrate – Rock and hard, Mixed sediment, Coarse sediment, Seabed.

Bottom culture lobster

The European lobster’s natural habitat is offshore water and shallow sub-littoral regions from depths of 5 to 60 metres, although it has been found on the continental shelf down to depths of 150 metres. Restocking bottom culture methods require existing populations to supplement and therefore the depth requirements will match the natural range.

- water depth (bathymetry (m)) – 5-50m, not suitable <5, >60
- current speed – 0.05-0.25 (m/s), not suitable <0.25, >0.05
- substrate – Rock and hard, Mixed sediment, Coarse sediment, Seabed.

Bivalve mollusc aquaculture and bottom-anchored methods (Pacific oyster, native oyster, mussel, manila clam, king scallop)

Optimal bivalve growth occurs when fully submerged and some species, such as King scallop, do not tolerate air exposure.

¹⁰⁸ Marine Management Organisation (2019), Identification of areas of aquaculture potential in English waters (MMO1184), <https://www.gov.uk/government/publications/identification-of-areas-of-aquaculture-potential-in-english-waters-mmo1184>

- water depth (bathymetry (m)) – 5-40m, not suitable <5, >110
- current speed – 0.5-1.0 (m/s), not suitable <0.25, >1.5
- substrate – coarse sediment sandy mud, muddy sand, fine mud, mixed sediment.

Suspended culture techniques (Pacific oyster, native oyster, mussel, manila clam, king scallop)

- water depth (bathymetry (m)) – 5-20m, not suitable <5, >50
- current speed – 0.5-1.0 (m/s), not suitable >1.

Impact on demand for the east marine plan areas

As indicated in the above research, aquaculture continues to be an important sector for sustainability, security of the food supply and economic growth for the UK. It can be forecasted that both in the 10-year and 20-year horizon, this sector will increase demand for the asset base of the east marine plan areas due its ability to provide various other applications in food and livestock feed, biofuels and pharmaceuticals and increasing government ambitions to reduce reliance on overseas imports and increase aquaculture production tenfold by 2040. Therefore, this sectors impact and interactions with other sectors will need to be considered to determine the carrying capacity of the east marine plan areas.

Table 4: Spatial data for aquaculture

Activities	Data Layers	Key Assumptions	Area (km²)	Percentage Coverage (against total east marine plan area coverage - approx. 58,000 square km)
Current activities	1. Shellfish production sites		164.13	1.6%
Emerging and potential activities (10 - 20 year horizon)	1. Projected area of aquaculture potential	Aquaculture activities occupy more space, based on potential and strategic areas of sustainable aquaculture production	3535.29	34.61%
Percentage change to the area covered in current, emerging and potential activities.	The current extent of inshore aquaculture, namely through shellfish production sites, covers an area of 164.13km ² , which occupies a small portion of the inshore region at 1.6%. The projected area of aquaculture potential as highlighted in Figure 14 is 3535.29km ² or 34.61%, meaning that the current extent has a capacity to grow by 3371.16km ² or 2154%.			

2.8 Tourism and recreation

Prior to COVID-19, roughly 10% of international travellers to the England visited coastal regions, creating 210,000 tourism related jobs and generating £13.7 billion

annually.¹⁰⁹ Coastal Tourism Academy, a private tourism agency, reports that in seaside locations ‘just relaxing’ makes up 51% of tourist activity, followed by visiting a beach and sightseeing on foot at 47%.¹¹⁰

Current activities and use cases

Coastal Tourism Academy reports that visitors to the east of England make up 9% of coastal tourists. In the east marine inshore area, close to 54% of all tourism in Yorkshire and Humberside is done by those who live within the region, and most popular with the elderly who account for 19% of visitors.¹¹¹ Echoing the above, ‘just relaxing’ and sightseeing are combined the most popular activities in this area at 66%.¹¹²

In the Wash and North Norfolk, powerboating and sailing is widespread across all inshore marine protected areas (MPAs) and in the western part of the Inner Dowsing, Race Bank and North Ridge Special Area of Conservation (SAC).¹¹³ Additionally, recreational scuba diving occurs within all MPAs in the east marine inshore area.¹¹⁴

Between Great Yarmouth to Cromer and Skegness to Mablethorpe, portions of the England Coast Path have recently opened. Headed by Natural England, The England Coast Path is an initiative to improve public access to recreation in the coast of England and will likely increase tourism from the UK and abroad in the east marine inshore area.¹¹⁵

There are two areas of outstanding national beauty (AONB) - Norfolk Coast AONB, and Suffolk Coast and Heaths AONB - in the east marine inshore area. An AONB is land protected by the Countryside and Rights of Way Act 2000 and aims to protect, conserve and enhance its natural beauty.¹¹⁶

Similarly, there are four locations in the east inshore marine plan area - Flamborough Head, Spurn, North Norfolk and Suffolk – currently part of the Heritage Coast, a government classification that protects the best stretches of undeveloped coast in England. There is a large overlap between Heritage Coasts and AONBs and, to a lesser extent, National Parks. Heritage Coasts, however, have one purpose that is

¹⁰⁹ National Coastal Tourism Academy (2016), Coastal Tourism,

<https://coastaltourismacademy.co.uk/coastal-tourism>

¹¹⁰ National Coastal Tourism Academy (2021), Business Survey 2021,

https://coastaltourismacademy.co.uk/uploads/Business_Survey_2021_Wave_3_national_results.pdf

¹¹¹ National Coastal Tourism Academy (2021), Business Survey 2021,

https://coastaltourismacademy.co.uk/uploads/Business_Survey_2021_Wave_3_national_results.pdf

¹¹² National Coastal Tourism Academy (2021), Business Survey 2021,

https://coastaltourismacademy.co.uk/uploads/Business_Survey_2021_Wave_3_national_results.pdf

¹¹³ Marine Management Organisation (2021), Non-licensable impacts on priority MPAs (MMO1243), <https://www.gov.uk/government/publications/non-licensable-impacts-on-priority-mpas-mmo1243>

¹¹⁴ Marine Management Organisation (2021), Non-licensable impacts on priority MPAs (MMO1243), <https://www.gov.uk/government/publications/non-licensable-impacts-on-priority-mpas-mmo1243>

¹¹⁵ Natural England (published 2014, updated 2021), England Coast Path in the east of England, <https://www.gov.uk/government/publications/england-coast-path-in-the-east-of-england>

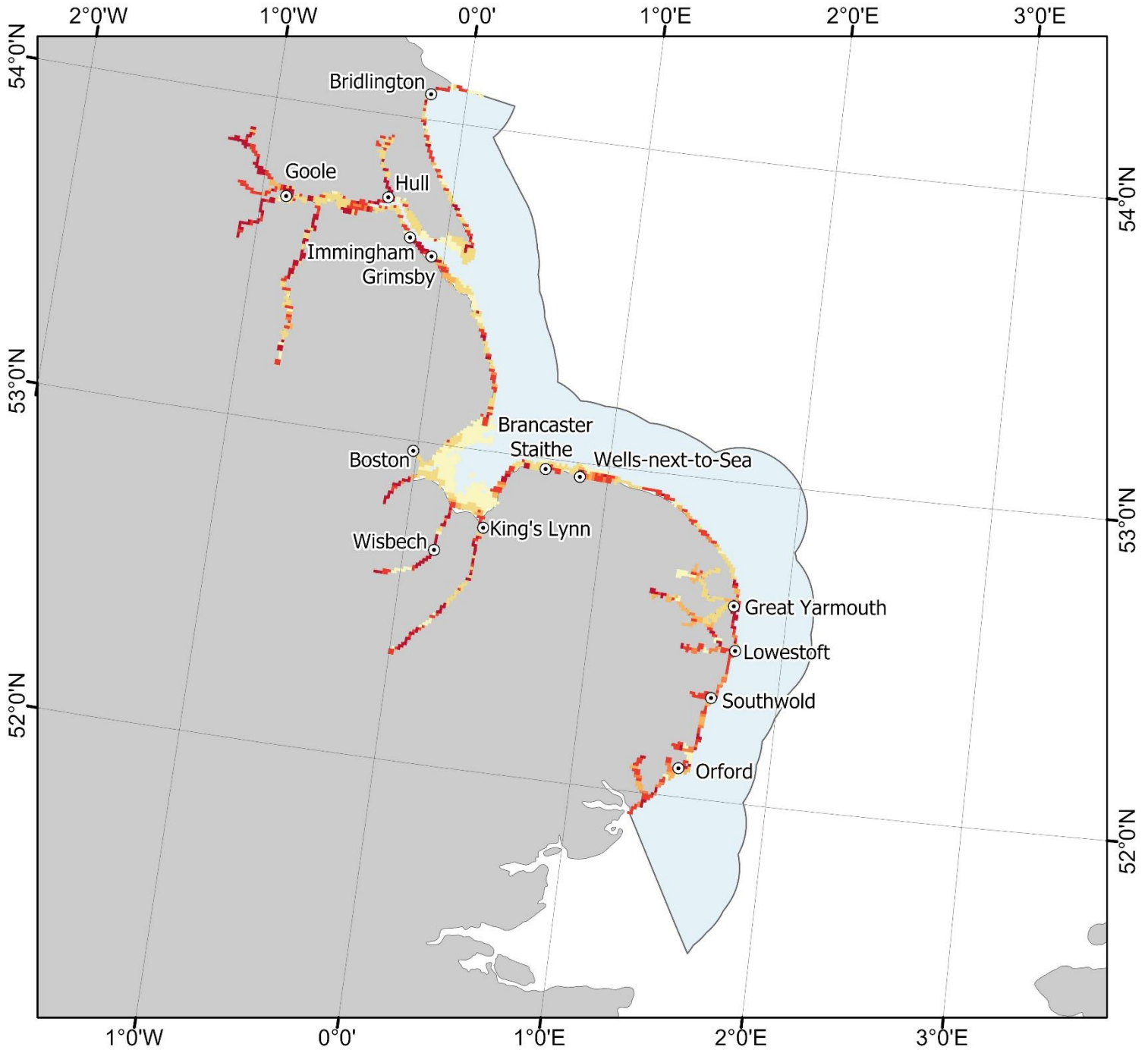
¹¹⁶ Natural England (2017), Areas of outstanding natural beauty (AONBs): designation and management, <https://www.gov.uk/guidance/areas-of-outstanding-natural-beauty-aonbs-designation-and-management>

not covered in AONBs and National Parks - the environmental health of inshore waters. In the east marine plan areas these areas include:

- Flamborough Headland: 19km length, 35km² area
- Spurn: 18km length, 18km² area
- North Norfolk: 64km length, 95km² area
- Suffolk: 57km length, 122km² area.

Since 2011, there have also been 16 beaches in the east inshore marine plan areas with blue flag status, a classification based on stringent environmental (including water quality), educational, safety, and accessibility criteria. Additionally, there are 48 locations classified as designated bathing waters, a marker of high-water quality.

Figure 15 | Modelled Angling Intensity in the East Marine Plan Inshore Area



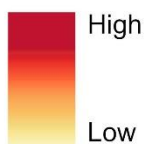
Ports

- Significant Ports within the East Marine Plan

Plan Areas

- East Marine Plan (Inshore Area)

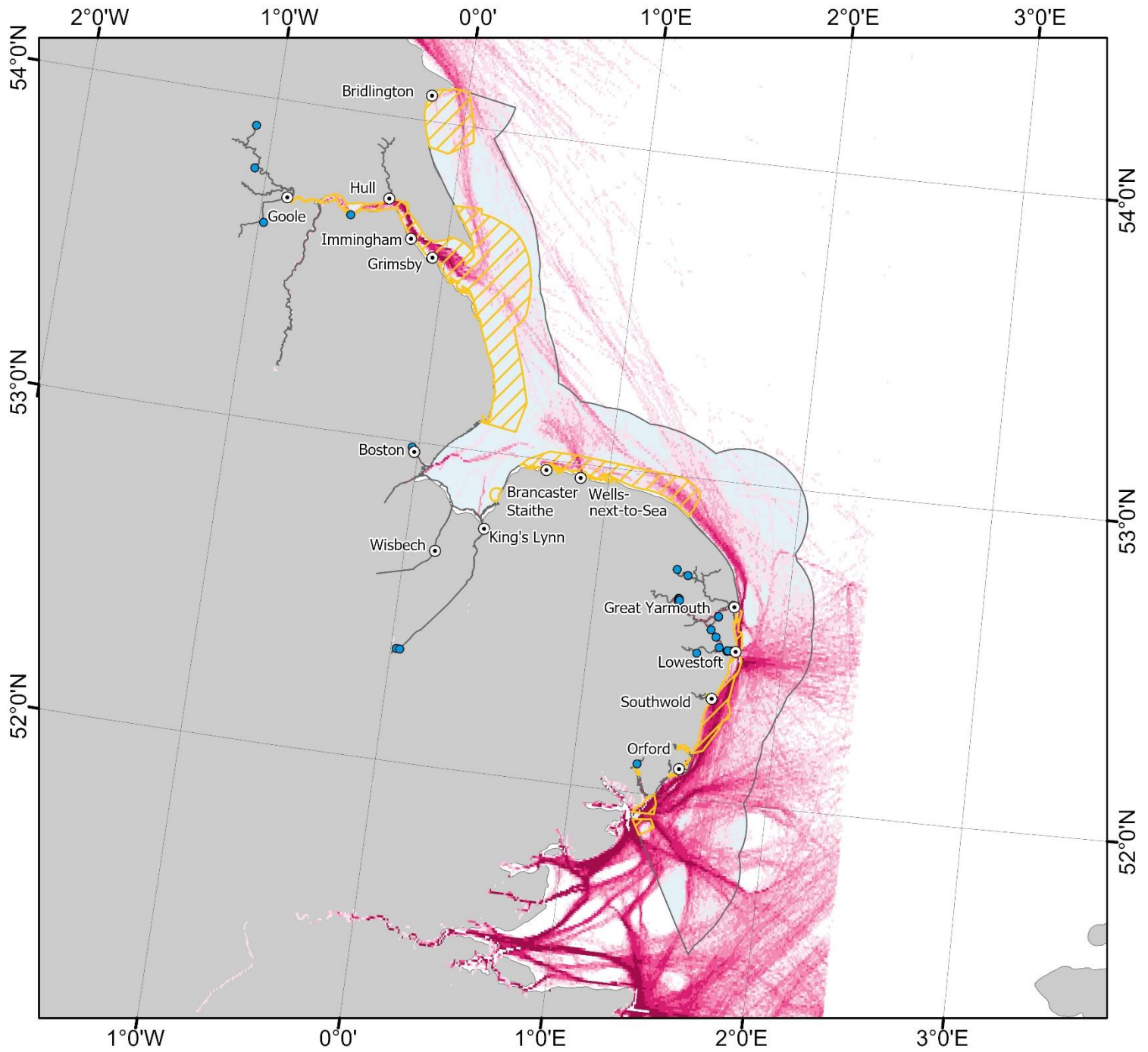
Annual Angling Activity (MMO)



- High
- Low



Figure 16 | Recreational Boating Intensity in the East Marine Plan Inshore Area



Activities

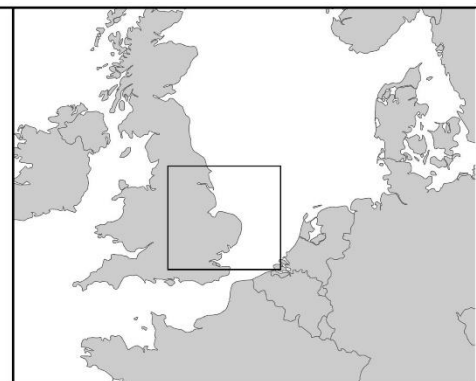
- ⊙ Significant Ports within the East Marine Plan
- Marinas (RYA)
- ▨ General Boating Areas (RYA)

Plan Areas

- East Marine Plan (Inshore Area)

AIS Intensity (RYA)

- High Intensity
-
-
-
- Low Intensity



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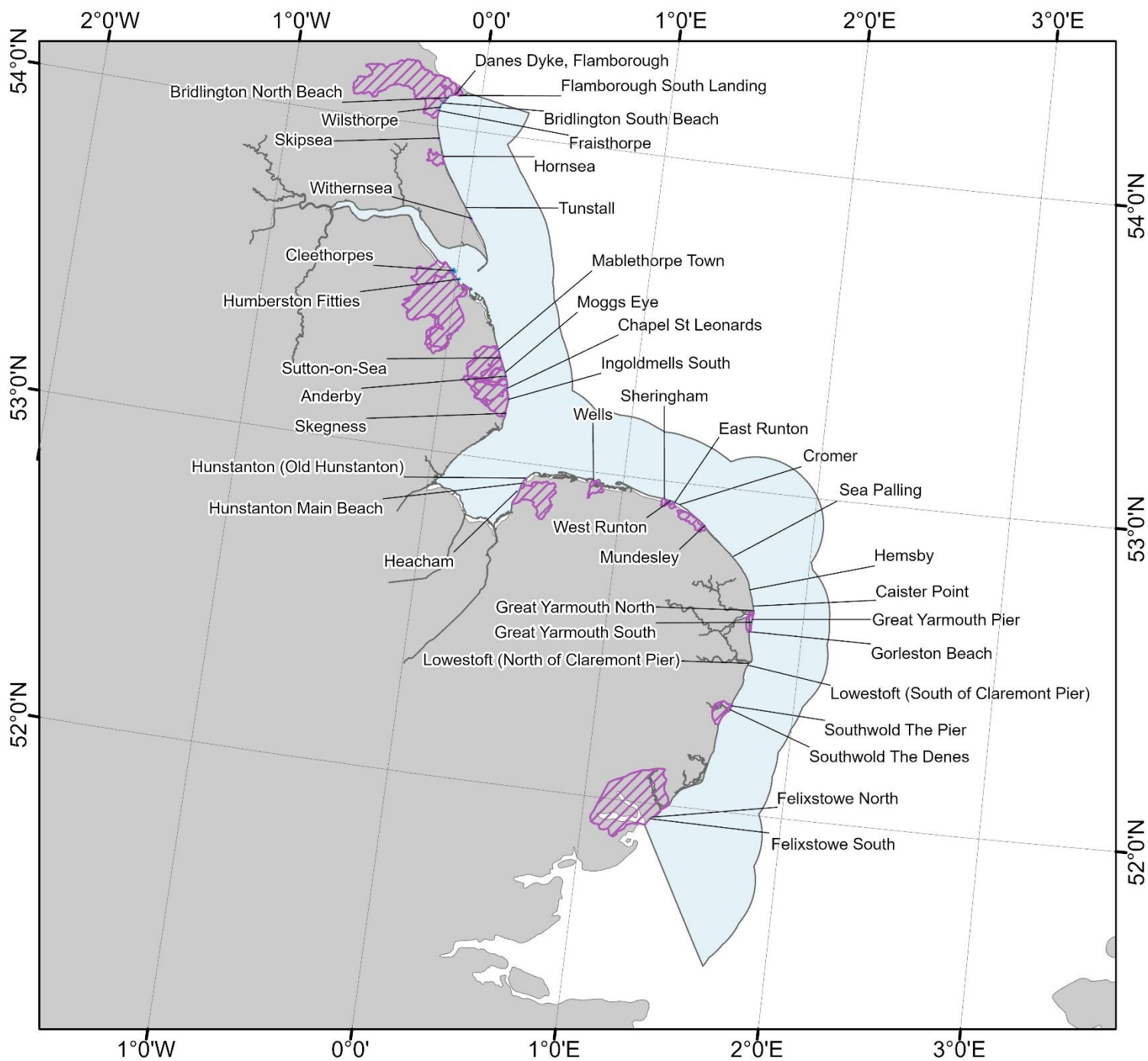
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Figure 17 | Bathing Waters in the East Marine Plan Inshore Area

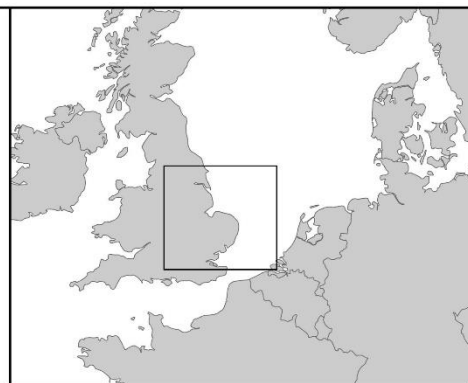


Bathing Waters

- Bathing Waters (Environment Agency)
- Bathing Waters Zones of Influence (Environment Agency)

Plan Areas

- East Marine Plan (Inshore Area)



Emerging activities and use cases (0-10 years)

Globally, Covid-19 has had a significant adverse impact on the tourism and recreation sectors. In coastal England, there has been an estimated loss of £8.7 billion on tourism spend and a further loss of 145,000 tourism related jobs.¹¹⁷ It remains to be seen when or if recovery will occur, however, local communities with a high dependence on tourism may struggle to recover as prior to Covid-19 only 9% of coastal tourists visited the east of England.

The England Coast Path could help rebuild tourism and recreation in the east inshore marine plan area as large portions of the path are set to open in the coming years, of note, however, is that construction is currently behind in the east of England.

Potential activities and use cases (0-20 years)

Potential activities for this sector can be derived from the policy position and ambitions noted below.

The impacts of priority national policies and strategies

The following are national policies and strategies that could affect the tourism sector in the east marine plan areas over the next 20 years:

- the 25 Year Environment Plan aims to conserve and enhance the beauty of the natural environment, and make sure it can be enjoyed, used by and cared for by everyone. This could lead to broad increased investment and preservation of the east inshore marine plan area and its surroundings
- the tourism sector deal aims to develop the visitor economy and places that people want to visit. Additionally, it notes that to do this there needs to be an upgrade of tourism related infrastructure. This could lead to increased investment and job creation in the east inshore area
- the Heritage Coasts and areas of outstanding national beauty (AONB) aim to conserve the best stretches of undeveloped coast in England. This could lead to increased investment and preservation of many locations in the east marine plan areas.

Optimal spatial conditions and attributes needed for the success of activities and use cases

Designated bathing waters

Many designated bathing waters currently meet the minimum and excellent standard in the East. There are approximately 48 beaches in the north east inshore marine plan areas that have designated bathing waters (Bathing Water Quality), as can be seen in Figure 17. Bathing water quality has improved in the UK over the last 30

¹¹⁷ National Coastal Tourism Academy (2016), Coastal Tourism, <https://coastaltourismacademy.co.uk/coastal-tourism>

years, with bathing water quality statistics highlighting that 98% passed minimum standards and 71% met the excellent standard in 2019.

Anchorage and marinas for sailing and power boating

Marinas and designated anchorages are key enablers for recreational sailing and powerboating in the east marine areas. Optimal spatial conditions for each vary dependant on vessel size and, at present, there is an unspecified number in the east marine plan areas.

Impact on demand for the east marine plan areas

Forecasting the spatial requirements and demand of the tourism and recreation sector over a 20-year horizon is difficult given a lack of available data, variations in activities and use cases and the impacts of external factors, such as Covid-19. However, it is likely that demand for the asset base of the east marine plan areas by this sector will remain and therefore this sectors impact and interactions with other sectors, particularly inshore activities, will need to be considered to determine the carrying capacity of the east marine plan areas.

2.9 Coastal change and flooding

Coastal change and flooding are considered one of the highest priority risks in the UK, with over 5.2 million homes at risk in 2020. Over the past decade, close to 28% of coastal England experienced erosion at rates higher than 0.1 metres a year.¹¹⁸ Moving forward, annual damages due to coastal erosion are expected to increase by 3-9 times, costing up to £126 million per year by 2080.¹¹⁹

Current activities and use cases

In 2014, flooding on the east coast of England affected 13,604 properties and caused over £140 million in damages.¹²⁰ Defra reports that 203km of Yorkshire, and Humbers 361km coast currently has significant erosion.

Management of coastal change, particularly erosion and flood risk management, is the responsibility of the Environment Agency, Lead Local Flood authorities and others through Shoreline Management Plans, Flood Risk Management Plans, and Coastal Change Management Areas. At present, there are 6 Shoreline Management Plans in the east marine plan areas. These are:

- SMP 3 Flamborough Head to Gibraltar Point Lead: East Riding Yorkshire Council
- SMP 4 Gibraltar Point to Hunstanton (The Wash) Lead: Environment Agency

¹¹⁸ Climate Change Post (2022), Coastal Erosion United Kingdom, <https://www.climatechange.org.uk/united-kingdom/coastal-erosion/>

¹¹⁹ Climate Change Post (2022), Coastal Erosion United Kingdom, <https://www.climatechange.org.uk/united-kingdom/coastal-erosion/>

¹²⁰ Environment Agency (2020), National Flood and Coastal Erosion Risk Management Strategy for England, <https://www.gov.uk/government/publications/national-flood-and-coastal-erosion-risk-management-strategy-for-england--2>

- SMP 5 Hunstanton to Kelling Hard (North Norfolk) Lead: Environment Agency
- SMP 6 Kelling Hard to Lowestoft (Kelling to Lowestoft) Lead: North Norfolk District Council
- SMP 7 Lowestoft to Felixstowe (Lowestoft Ness to Felixstowe Languard) Lead: Suffolk Coastal District Council
- SMP 8 Essex and South Suffolk Lead: Environment Agency.

Shoreline Management Plans identify a sustainable management approach for each stretch of coastline, such as those in the east marine plan areas, based on 4 policy options that can change across 25-year time horizons:

- *hold the line*: maintaining or upgrading the level of protection provided by defences
- *advance the line*: building new defences seaward of the existing defence line
- *managed realignment*: moving or allowing the retreat of the shoreline and the creation of inter-tidal habitat where appropriate
- *no active intervention*: a decision not to invest in providing or maintaining defences. This requires engagement and adaptation where it affects communities.

In addition, there are 3 Coastal Change Management Areas (CCMA):

- East Suffolk CCMA
- Great Yarmouth CCMA
- North Norfolk CCMA.

The East Suffolk CCMA covers an area of 55.5km in length, Great Yarmouth's CCMA measures 24.56km, and North Norfolk CCMA is 64.15km in length. CCMA's are identified in Local Plans as likely to be affected by coastal change (physical change to the shoreline through erosion, coastal landslip, permanent inundation or coastal accretion). They will only be defined where rates of shoreline change are significant over the next 100 years, taking account of climate change.

Emerging activities and use cases (0-10 years)

Strategic objective 1.4 of the Coastal Erosion Risk Management strategy for England states that between now and 2030 risk management authorities will use nature-based solutions and improve the environment through their investments in flood and coastal resilience.¹²¹ Nature based solutions involve a range of local activities, often undertaken through partnerships between risk management authorities, farmers, landowners, environmental groups and communities. Examples include reconnecting rivers with their natural floodplain, creating new areas where water can be stored, tree planting, creating wetlands and beach nourishment.

One of the most important benefits of nature-based solutions is that they provide other ecosystem services such as carbon sequestration and water quality

¹²¹ Environment Agency (2020), National Flood and Coastal Erosion Risk Management Strategy for England, <https://www.gov.uk/government/publications/national-flood-and-coastal-erosion-risk-management-strategy-for-england--2>

improvements. Planting trees and restoring wetlands, such as peatlands and coastal habitats in the east inshore marine plan area, increases the amount of carbon stored in the natural environment. This helps mitigate climate change and at the same time helps to reduce the risk of flooding and coastal erosion.

Additionally, the Environment Agency reports that between now and 2030 risk management authorities will make greater use of funding and financing from non-public sector sources to contribute to the investment needs of flood and coastal resilience. This could create more funding options for coastal change and flooding initiatives in the east inshore marine plan areas, including nature-based solutions.

Potential activities and use cases (0-20 years)


The Environment Agency estimates that in the long-term as a nation we need to spend an average of over £1 billion a year – which is a minimum of £50 billion in flood and coastal protection over the next 50 years. The long-term investment scenarios show that for every £1 spent on protecting communities, around £5 in property damages will be avoided.¹²²

¹²² Environment Agency (2020), National Flood and Coastal Erosion Risk Management Strategy for England, <https://www.gov.uk/government/publications/national-flood-and-coastal-erosion-risk-management-strategy-for-england--2>

Figure 18 | Flood Risk Areas in the East Inshore Marine Plan Area



Flood Risk Areas

 Flood Risk Areas (Environment Agency)

Plan Areas

 East Marine Plan (Inshore Area)

This map shows the location of flood risk areas (as identified by the Environment Agency) that are located within 1km of the East Marine Plan area.

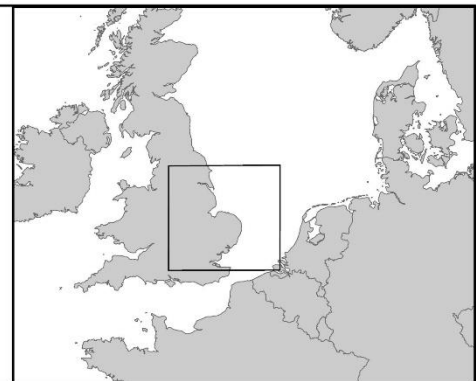
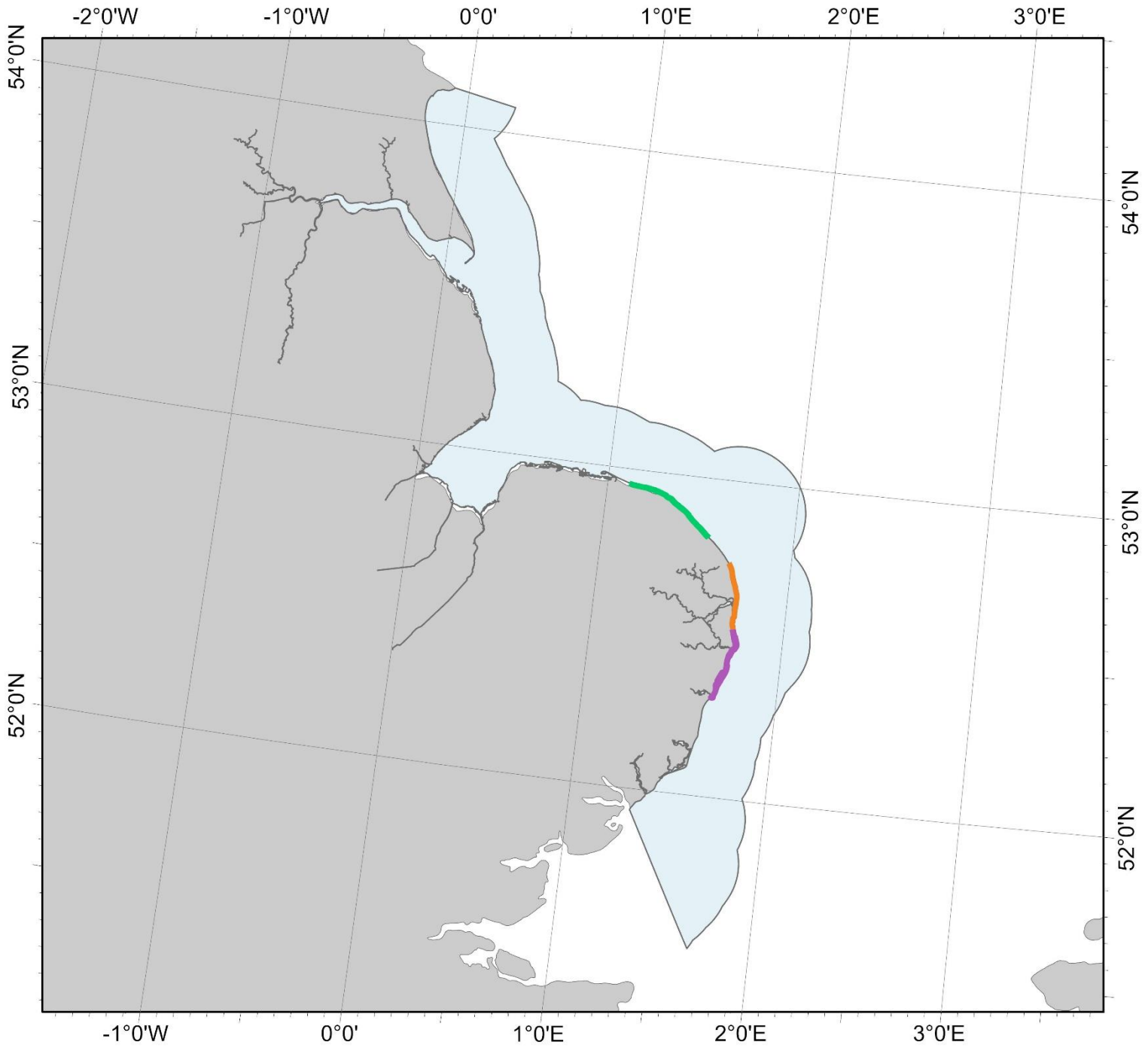





Figure 19 | Coastal Change Management Areas (CCMAs) adjoining the East Marine Plan Inshore Area



Coastal Change Management Areas

-  East Suffolk CCMA (East Suffolk District Council)
-  Great Yarmouth CCMA (Great Yarmouth Borough Council)
-  North Norfolk CCMA (North Norfolk District Council)

Plan Areas

-  East Marine Plan (Inshore Area)

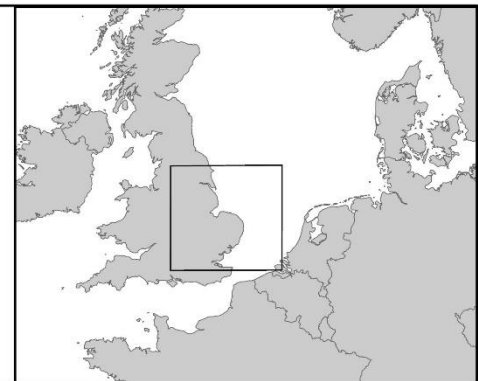
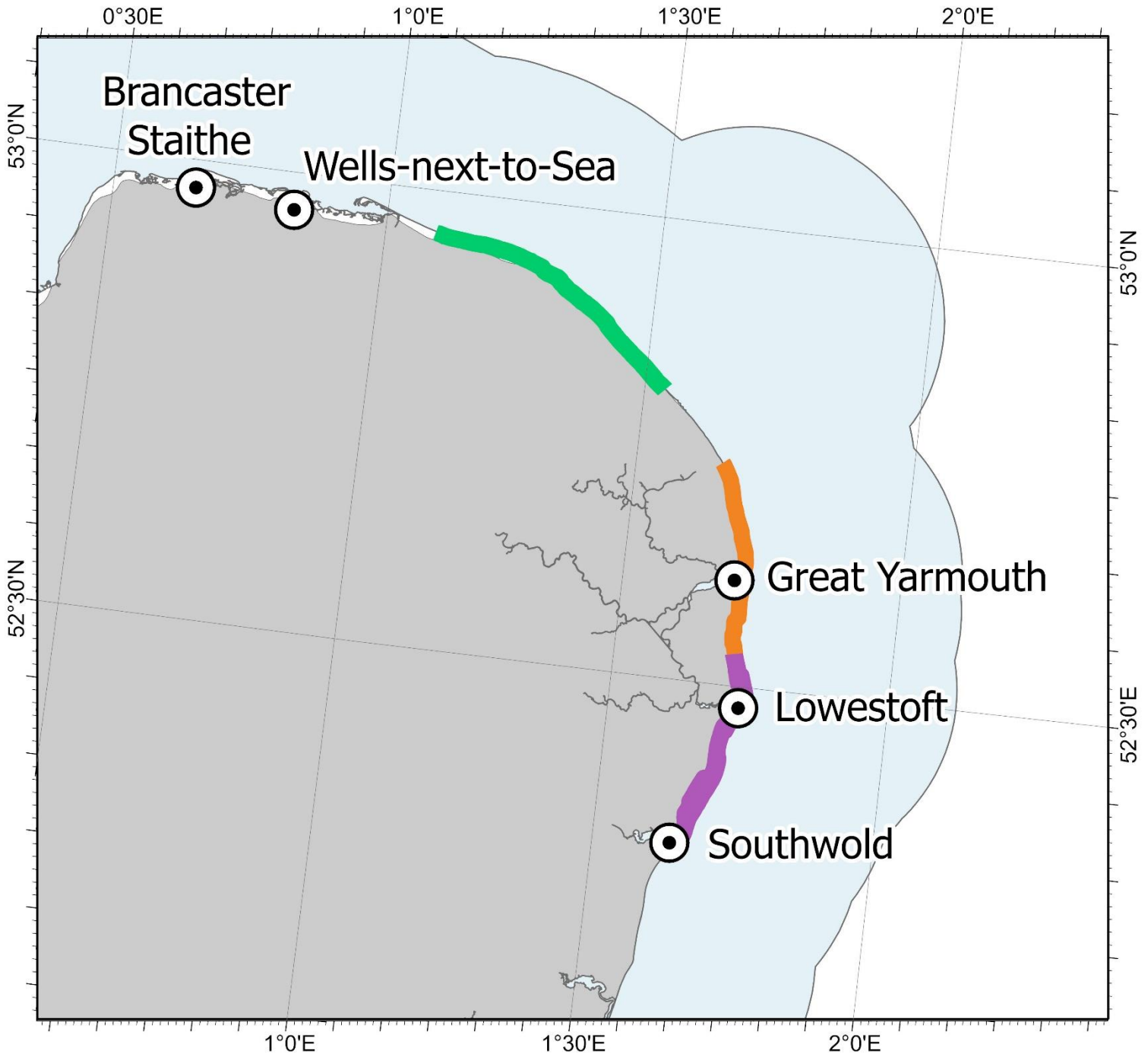


Figure 19a | Focus on Coastal Change Management Areas (CCMAs) within the East Marine Plan Area



Ports

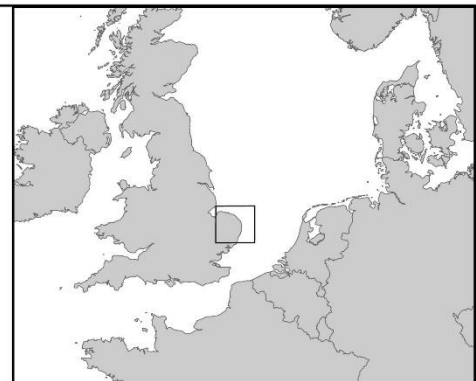
- ⊙ Regionally Significant Ports

Coastal Change Management Areas

- East Suffolk CCMA (East Suffolk District Council)
- Great Yarmouth CCMA (Great Yarmouth Borough Council)
- North Norfolk CCMA (North Norfolk District Council)

Plan Areas

- East Marine Plan (Inshore Area)



The impacts of priority national policies and strategies

The following are national policies and strategies that could affect coastal flooding and change in the east marine plan areas over the next 20 years:

- in 2020, the UK government released the National Flood and Coastal Erosion Risk Management Strategy. This aims to make “*the nation ready for, and resilient to, flooding and coastal change – today, tomorrow and to the year 2100*”.¹²³ This will increase focus on flooding and coastal change in the east marine inshore area
- in the 2020 Budget, the government committed to doubling expenditure on flood and coastal risk management to £5.2 billion between 2021 and 2027. This record-breaking spending aims to protect 336,000 homes and properties as well as avoid £32 billion of wider economic damages to the nation. In addition, the government provided £200 million between 2021 and 2027 for a resilience programme that will support 25 local areas to take forward wider innovative actions that improve their resilience to flooding and coastal erosion. Much of this funding could provide benefit to the east marine plan areas
- Environment Agency: EA2025 endeavours that by 2025 the government will have created more climate resilient places and infrastructure, ensuring the nation is prepared for flooding, coastal change and drought. This will need to be considered when developing other industries in the area and lead to broad investment in more resilient infrastructure
- The 25 Year Environment Plan aims to bring the public, private and third sectors together to work with communities and individuals to reduce the risk of harm. This increased collaboration could benefit all coastal erosion initiatives in the east inshore marine plan area¹²⁴
- The 25 Year Environment Plan aims to reduce the risk of harm to people, the environment and the economy from natural hazards including flooding, drought and coastal erosion. Again, this will need to be considered when developing other industries in the area and lead to broad investment in more resilient infrastructure.¹²⁵

Optimal spatial conditions and attributes needed for the success of activities and use cases

Given the complexity of coastal change and flooding and difference between locations, optimal spatial conditions and attributes are location specific.

Notably, however, saltmarsh creation via managed realignment has the potential to provide social, economic and environmental benefits in the east inshore marine plan area. Managed realignment involves creating new ‘inter-tidal zones’ between the sea

¹²³ Environment Agency (2020), National Flood and Coastal Erosion Risk Management Strategy for England, <https://www.gov.uk/government/publications/national-flood-and-coastal-erosion-risk-management-strategy-for-england--2>

¹²⁴ Department for Environment, Food & Rural Affairs (2019), 25 Year Environment, <https://www.gov.uk/government/publications/25-year-environment-plan>

¹²⁵ Department for Environment, Food & Rural Affairs (2019), 25 Year Environment, <https://www.gov.uk/government/publications/25-year-environment-plan>

and land where the sea is allowed to flood the land and relocating coastal defences to allow for saltmarsh habitat creation. Saltmarshes as a nature-based solution are able to store large quantities of water, thus acting as a buffer for nearby communities by reducing the chances of erosion and flooding and also acts as carbon sinks. Saltmarshes are also popular sites for walking and observing wildlife, which can be beneficial for local communities and businesses through an increase in tourists visiting from surrounding areas.

Impact on demand for the east marine plan areas

The impacts of climate change require both mitigation and adaptation measures to protect local communities and the natural environment. With increasing investment and policy commitments to protect the UK's shorelines, including government funding and financing from non-public sector organisations to contribute to coastal protection, it is likely that demand for the east marine plan areas by this sector will rapidly increase over the next 10 years potentially impacting the ability to meet other priorities. Therefore, this sectors' impacts and interactions with other sectors, particularly inshore activities, will need to be considered to determine the carrying capacity of the east marine plan areas.

2.10 Fisheries

Fishing activity in the UK can be divided into four main categories:

1. commercial fishing at sea and on the foreshore by licensed operators
2. secondary activities including processing and retailing of catch and refined products
3. support activities such as vessel construction and servicing and fishing gear manufacture and repair
4. recreational fishing and angling.

This report focuses primarily on commercial fishing activities at sea as these have the largest interactions with other sectors in the east marine plan areas.

In 2020, UK vessels landed 623 thousand tonnes of fish in the UK and abroad with a value of £831 million. Despite being an island, the UK is a net importer of fish. In 2020, importing 672 thousand tonnes of fish, with a value of £3,206 million, and exporting 423 thousand tonnes of fish, with a value of £1,627 million.¹²⁶

Current activities and use cases

Fisheries in the east marine plan areas utilise both static and towed fishing methods to catch demersal and pelagic fish, and shellfish. These methods include:

- otter trawling: the most common type of trawling. Using this method, a boat drags a net along the seabed with the net held open by large steel boards (called otter boards) which slide apart once the boat begins to move and hold the net open. The size of the mesh dictates which fish can pass through the

¹²⁶ Marine Management Strategy (2021), UK sea fisheries annual statistics report 2020, <https://www.gov.uk/government/statistics/uk-sea-fisheries-annual-statistics-report-2020>

net and avoid capture, with a larger mesh size to allow small species with no commercial value and immature fish a chance of avoiding capture

- beam trawling: includes any towed trawl where the mouth of the trawl is held open by a beam or similar device and typically entails lowering two nets to the seabed from derricks on the side of the boat. This is often used to catch flatfish commercially, particularly lemon sole, Dover sole and plaice as these species are likely to bury themselves underneath sand and sediment
- pots and traps: fish are guided or enticed into stationary funnels that encourage entry but limit escape
- dredging: metal cages are towed across shellfish beds and catch shellfish, such as oysters, mussels and scallops. Metal beams or teeth are used to scrape the shellfish free from the seabed when they then fall back into the cage or into a net or bag attached to the cage.

The ports of Grimsby, Hull and Bridlington are all currently in the top 20 commercial fishing ports in the UK. Using the above methods, data from the 2020 UK Sea Fisheries report reflects that in 2020 vessels in the east marine plan areas landed nearly 19 thousand tonnes of fish.¹²⁷

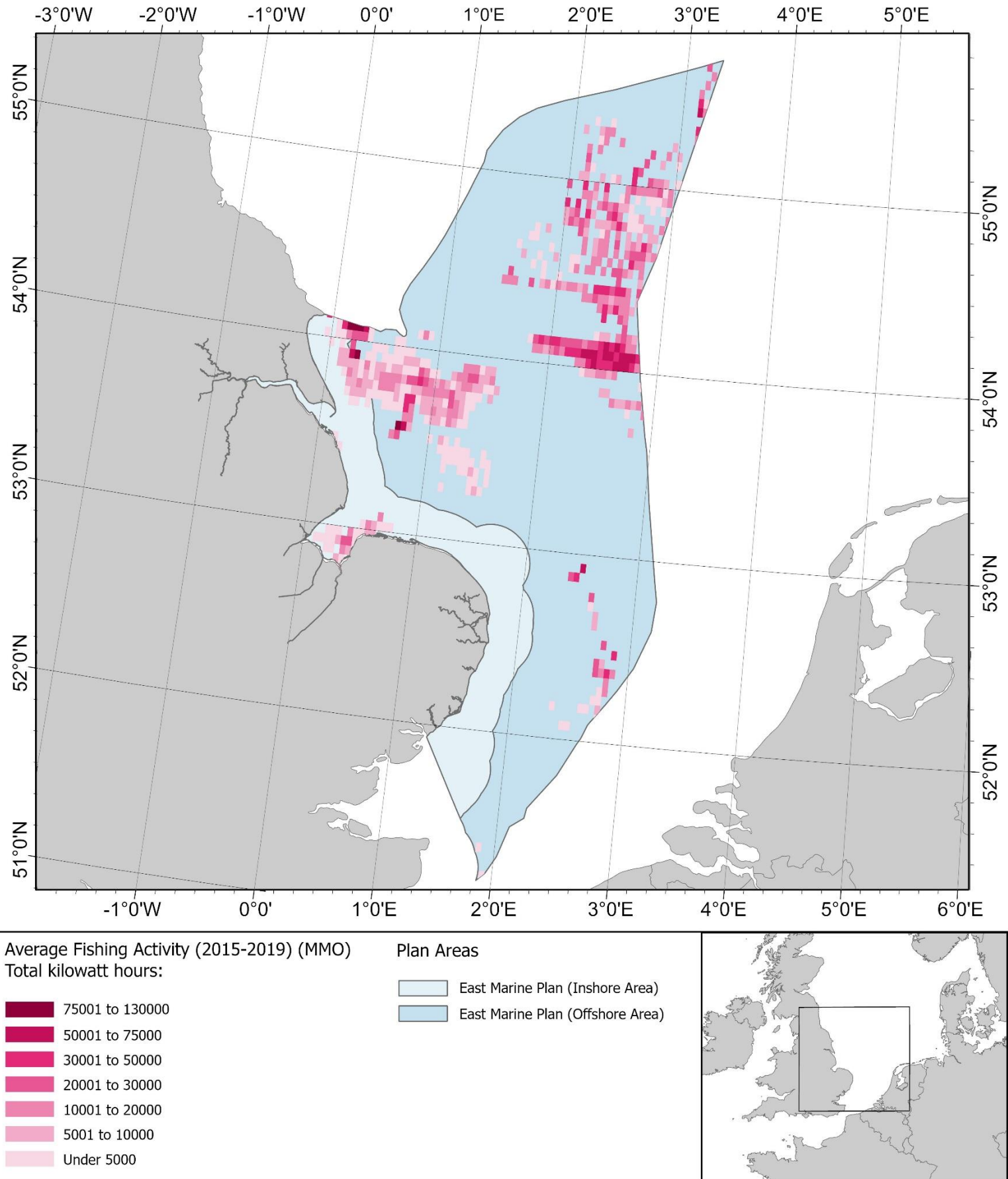
The east inshore marine plan area is currently the third most productive area in the UK for shellfish landings. Since 2012, UK landings of shellfish have increased by over 250%, from 32 thousand tonnes to almost 140 thousand tonnes in 2020.¹²⁸ The COVID-19 pandemic, however, has impacted the shellfish sector as shellfish species tend to be landed and sold fresh for use in the hospitality sector in the UK and abroad.¹²⁹ As a result, despite a rapid increase in landings, fisheries in the east marine plan areas have been some of the most affected by COVID-19.

¹²⁷ UK Parliament (2021), UK Fisheries Statistics, <https://commonslibrary.parliament.uk/research-briefings/sn02788/>

¹²⁸ Marine Management Strategy (2021), UK sea fisheries annual statistics report 2020, <https://www.gov.uk/government/statistics/uk-sea-fisheries-annual-statistics-report-2020>

¹²⁹ Marine Management Strategy (2021), UK sea fisheries annual statistics report 2020, <https://www.gov.uk/government/statistics/uk-sea-fisheries-annual-statistics-report-2020>

Figure 20 | Fishing Activity for Vessels over 15 metres in the East Marine Plan Areas



Emerging activities and use cases (0-10 years)

According to the Marine Climate Change Impacts Partnership, “*the maximum sustainable yield of exploited fishery populations decreased globally by 4.1% from 1930 to 2010, with five ecoregions experiencing losses of 15 to 35%. Notably, populations in the North Sea and Celtic–Biscay shelf (i.e. around the British Isles) were among the most negatively impacted worldwide*”¹³⁰. This would have significant implications for the UK economy and local fishing communities unless action is taken to adapt. Projected oceanic changes already in motion in UK waters means the ability to harvest commercial fish sustainably in the coming decades will be increasingly challenging, particularly if policies are not in place to support it.¹³¹

Similarly, many of the fishing methods used in the east marine plan areas will need to be limited/changed if environmental objectives are to be met. For example, dredging can be a harmful method of commercial fishing, with shellfish beds that have been intensively dredged taking extensive periods of time to recover.¹³² Beam trawling catches a large range of bottom living species and is not a well targeted fishery with often poor selectivity and the potential to catch a wide variety of non-target by-catch. This can include crabs, starfish, other shellfish and many other seabed dwelling organisms.¹³³ As a result, emerging activities in this sector must be considered in the context of encouraging biodiversity and protecting essential marine habitats in the east marine plan areas.

Potential activities and use cases (0-20 years)

Over the next 20 years, developments in other sectors in the east marine plan areas will continue to increasingly compete for space with fisheries. For example, cable transit routes for offshore wind will make fishing methods, such as dredging and beam trawling, no longer viable in many areas. Similarly, Highly Protected Marine Areas (HPMAs), where all human activity with potential to cause damage is banned, means some fishing locations will no longer be accessible. As a result, some fisheries in the east marine plan areas will have no choice but to limit their activity or move to different locations.

The impacts of priority national policies and strategies

The following are national policies and strategies that could affect the fishing sector in the east marine plan areas over the next 20 years:

- the 25 Year Environment Plan aims to ensure that fish stocks are recovered to and maintained at levels that can produce their maximum sustainable yield.

¹³⁰ MCCIP (2020), The impacts of climate change on fisheries, relevant to the coastal and marine environment around the UK, [20_fisheries_2020.pdf \(mccip.org.uk\)](https://mccip.org.uk/20-fisheries-2020.pdf)

¹³¹ Sky Ocean Rescue (2020), The value of Restored UK seas, <https://www.wwf.org.uk/sites/default/files/2021-01/WWF2009-01%20Value%20of%20restored%20UK%20seas%20report%20v6%20%28002%29.pdf>

¹³² British Sea Fishing (2019), Commercial Fishing Methods, <https://britishseafishing.co.uk/commercial-fishing-methods/>

¹³³ British Sea Fishing (2019), Commercial Fishing Methods, <https://britishseafishing.co.uk/commercial-fishing-methods/>

This could increase non shellfish landings quantity and value in the east marine plan areas and as a result create more jobs and food

- Seafood 2040 aims to support England's seafood industry and reduce the UK's dependence on fish imports. This could bring investment to fisheries in the east marine plan areas
- the Benyon Review into HPMA's, published in June 2020, concluded that HPMA's are an essential component of the MPA network, and government should introduce them into Secretary of State waters. The review concluded that HPMA's would complement the existing MPA network, enabling greater recovery of the marine ecosystem and enhancing the government's commitment to a national 'Blue Belt' of marine protection. As previously noted, these will significantly impact fisheries in the east marine plan areas by completely banning the practice in selected locations
- the Fisheries Act 2020 controls who fishes in UK waters through a new foreign vessel licencing regime and ends the current automatic rights for EU vessels (post Brexit) to fish in UK waters
- the Draft Joint Fisheries Statement sets the policy framework for how the UK will work with international partners to ensure the long-term sustainable management of shared fisheries resources post Brexit
- The MMO are undertaking a programme of work to assess the impacts from fishing activity in over 40 offshore MPAs, and to establish management measures where necessary. It is likely that these measures will limit where certain types of fishing can take place.¹³⁴

Optimal spatial conditions and attributes needed for the success of activities and use cases

Based off the Centre for Environment, Fisheries and Aquaculture Science (Cefas) data, there are a number of essential fish habitats and high intensity spawning grounds for plaice, sole and sandeel in the east marine plan areas. The approximate size of the high intensity spawning grounds is 41154.67km² which covers 70.2% of the total east marine plan areas. In order to preserve them, the following conditions need to be accounted for (to note, this is not an exhaustive list but a few examples):

Habitats important to fish in the east plan areas

- plaice: most commonly found on sandy bottoms but can live on gravel or mud. They are active at night and remain stationary during the day, usually buried within the sediment leaving only the eyes protruding. They have been recorded from 0-200m depth, but are mostly between 10-50m and within a temperature range of 2-15°C. Plaice feed on other animals on the seabed including shellfish such as cockles and razor clam, crustaceans, worms, brittle stars and sand eels
- sole: commonly found on sandy and muddy ground and in estuarine habitats where they bury into the sediment. Adults are usually found at a depth range of 10-60m with juveniles staying in shallower water depths of 1-2m. In winter

¹³⁴ Marine Management Organisation (published 2014, updated 2021), Managing fishing in marine protected areas, <https://www.gov.uk/government/collections/managing-fisheries-in-marine-protected-areas>

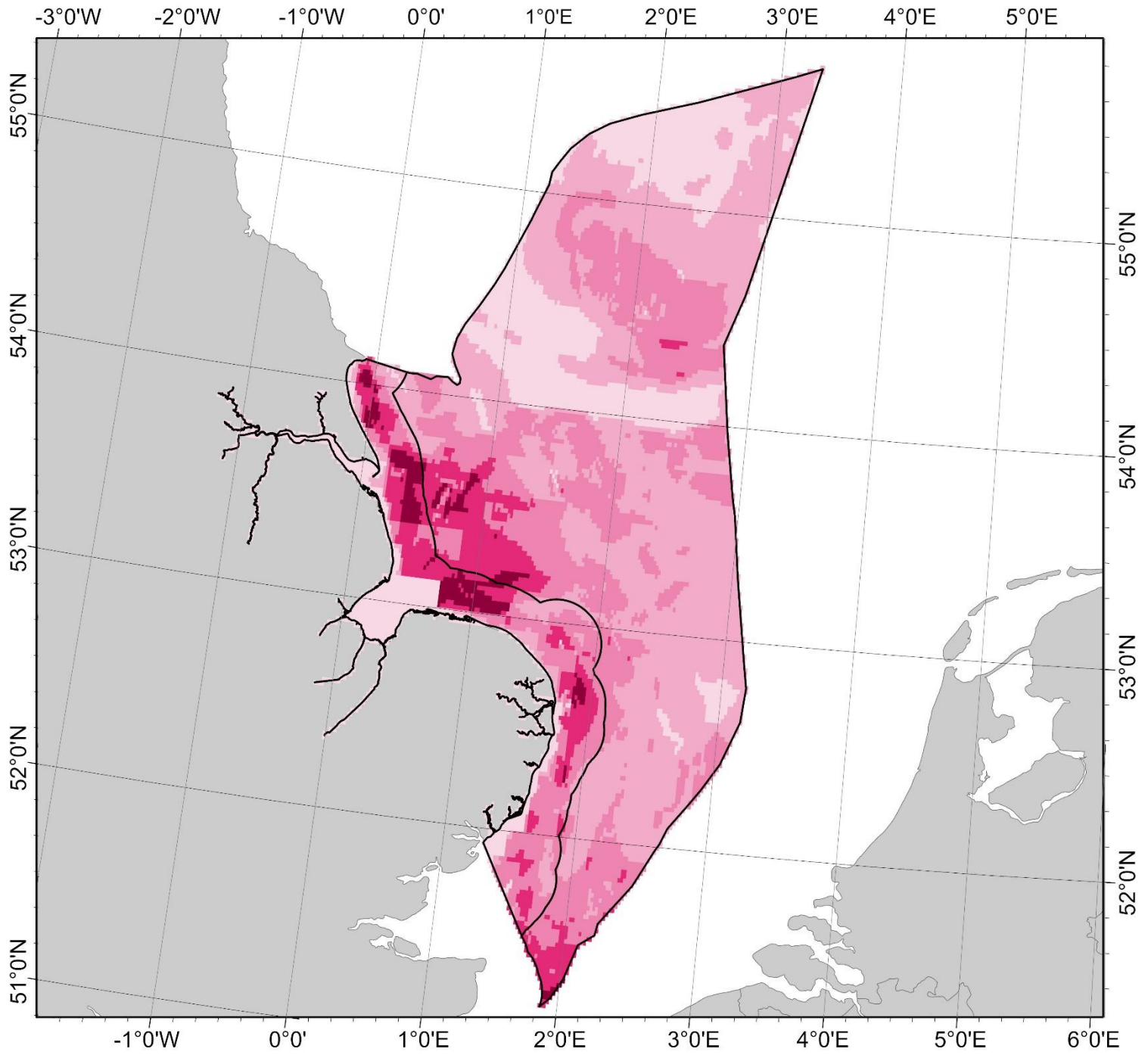
adults move further offshore and can reach depths of 120m. Sole feeds mainly on small crustaceans, worms and small soft shelled bivalves as well as molluscs and other small fish. They are mostly inactive during the day and usually feed at night but can feed during the day in highly turbid conditions

- sandeel: commonly found in shoals. Between April and September, they swim in large shoals close to the seabed and will burrow into the sand to escape predators. In the winter months, they bury themselves up to 50cm in the sand.

High intensity spawning grounds

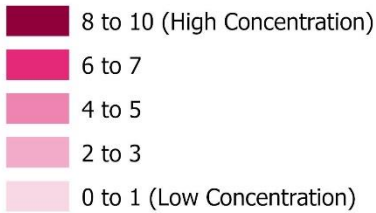
- plaice: between January and March when water temperatures reach 6 degrees Celsius, females lay eggs in shallow water between 20 to 40 metres
- sole: between April and June when water temperatures reach 6 to 12 degrees Celsius, females lay eggs at varying depths dependant on location. This usually occurs when females are between 3 to 5 years of age and, as a result, they need to be allowed to reach this level of maturity
- sandeel: between December and February sandeels emerge from shoals to spawn their demersal eggs onto sand. The larvae hatch between February and April, and the planktonic larvae are transported by currents for 7-10 weeks.

Figure 21 | Modelled Adult Fish Habitats in the East Marine Plan Areas



Essential Fish Habitats (MMO)

Relative concentration of adult fish:



Plan Area

East Marine Plan (Inshore & Offshore Areas)

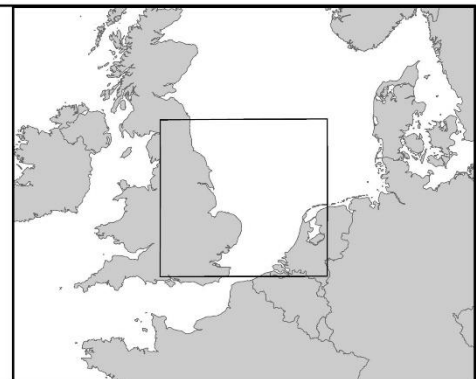
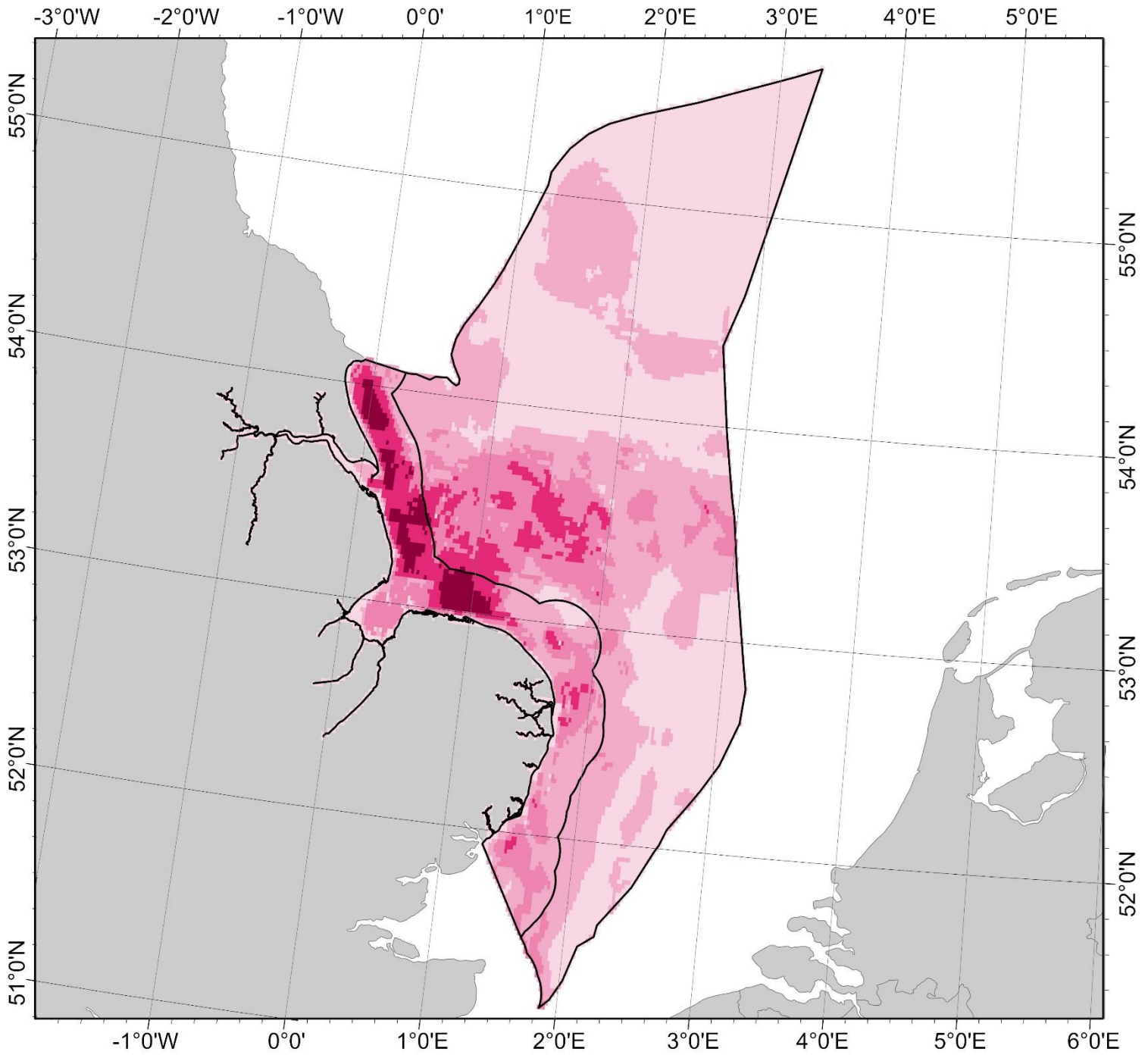
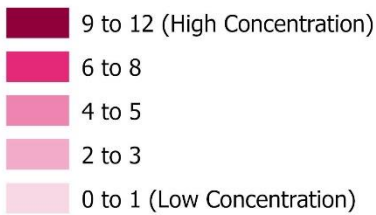


Figure 22 | Modelled Juvenile Fish Habitats in the East Marine Plan Areas




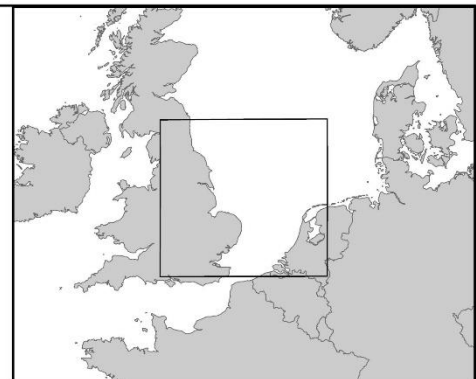
Essential Fish Habitats (MMO)

Relative concentration of juvenile fish:



Plan Area

 East Marine Plan (Inshore & Offshore Areas)



Date of Publication: 30/03/2023

Coordinate System: ETRS 1989 LAEA

Projection: Lambert Azimuthal Equal Area

MMO Reference: 10715

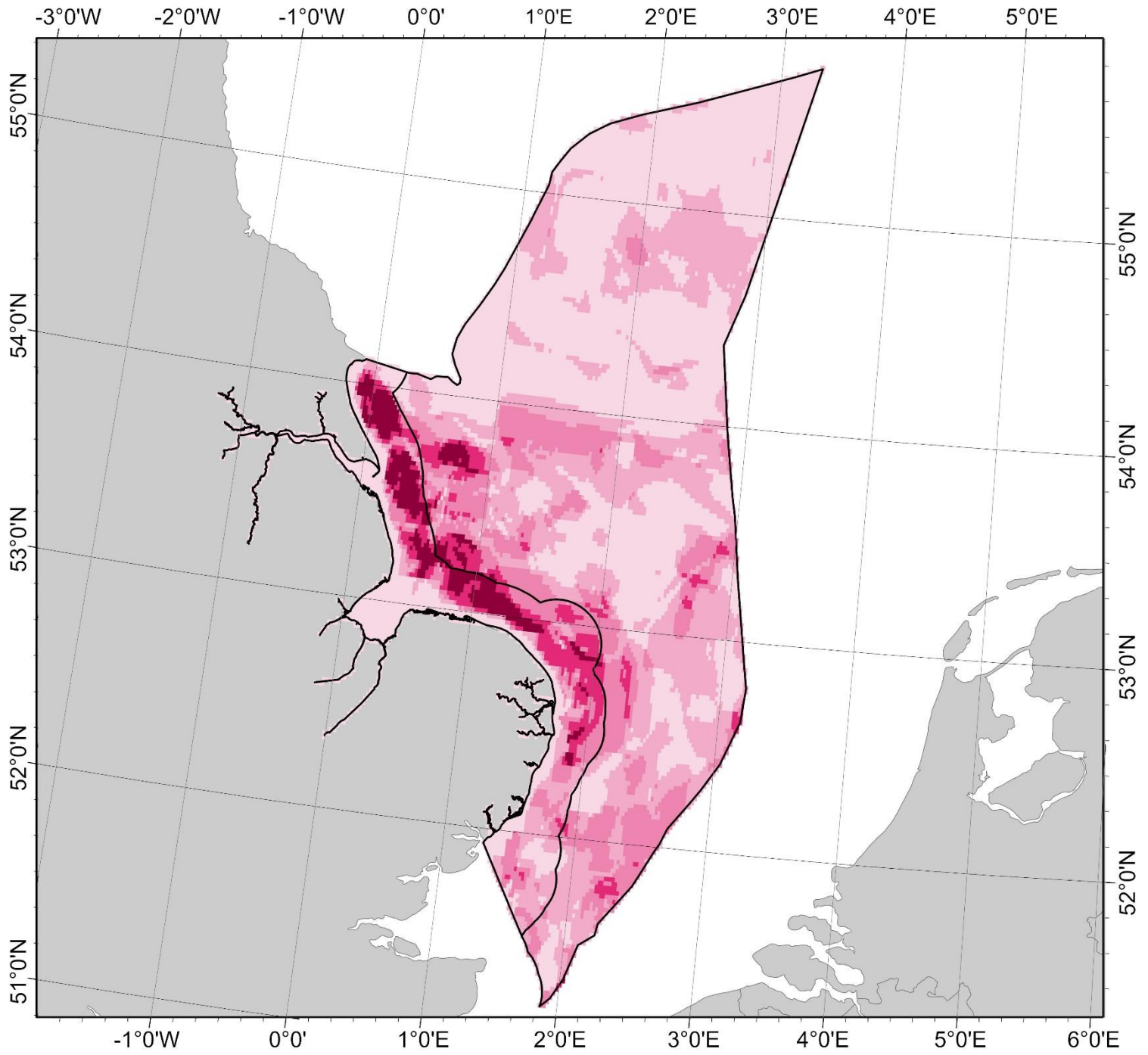
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Figure 23 | Modelled Spawning Fish Habitats in the East Marine Plan Areas



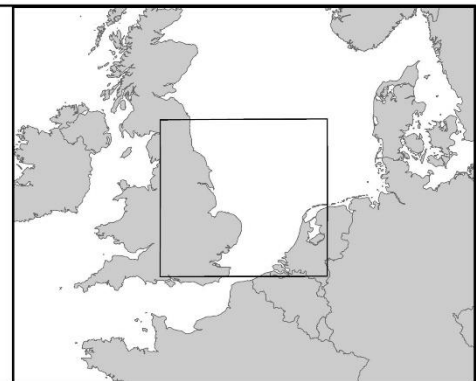
Essential Fish Habitats (MMO)

Relative concentration of spawning fish:

- 5 to 7 (High Concentration)
- 4
- 3
- 2
- 0 to 1 (Low Concentration)

Plan Area

- East Marine Plan (Inshore & Offshore Areas)



Date of Publication: 30/03/2023

Coordinate System: ETRS 1989 LAEA

Projection: Lambert Azimuthal Equal Area

MMO Reference: 10715

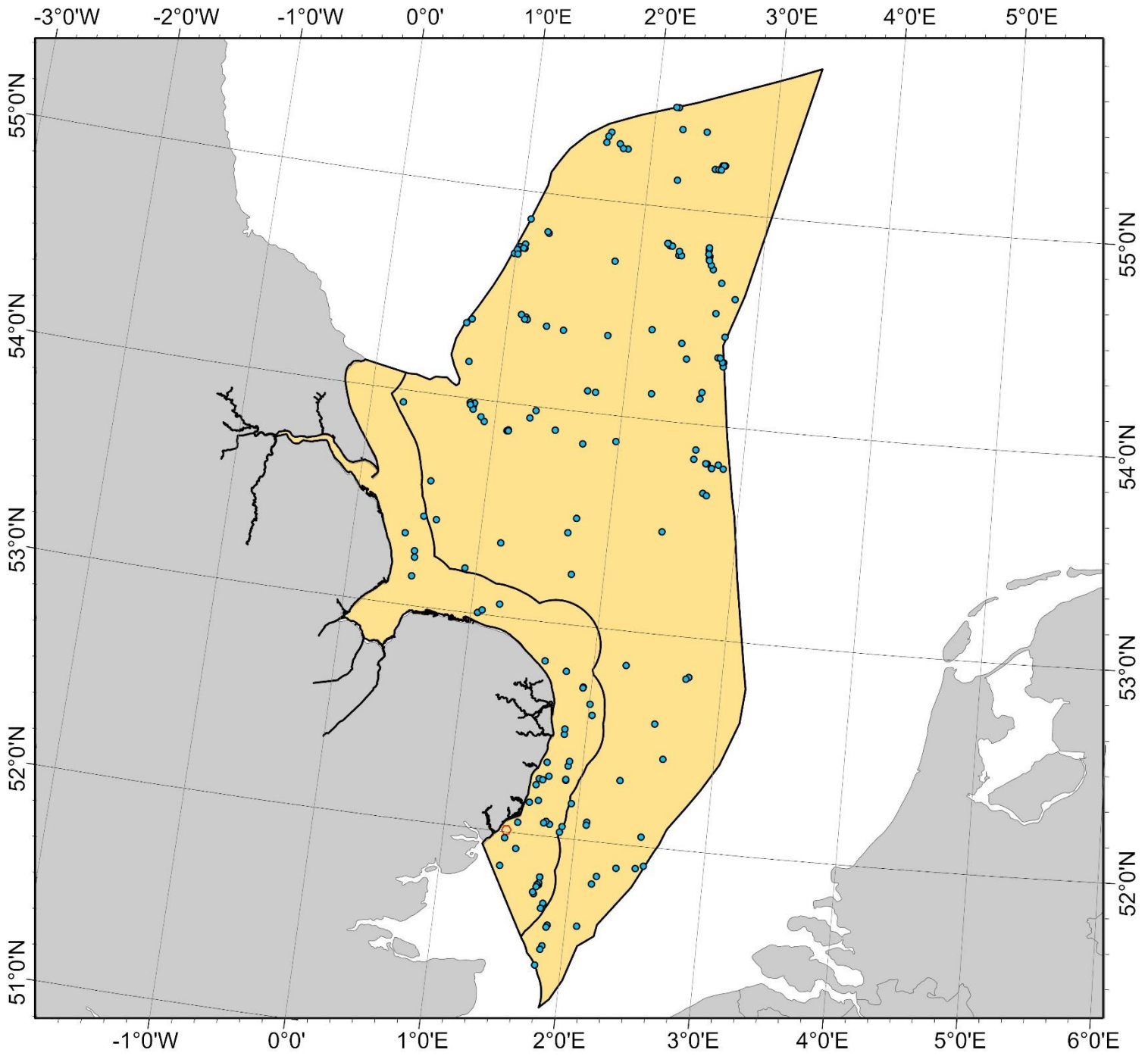
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Figure 24 | Historic Nursery Ground (2010) within the East Marine Plan Area



Plan Areas

 East Marine Plan (Inshore and Offshore Areas)

Identified Nursery Locations from 2010 Study of Sample Data (Cefas):

-  Sole
-  Cod

Nursing Grounds

 Estimated Extent of Nursing Grounds Based on 2010 Sample Data

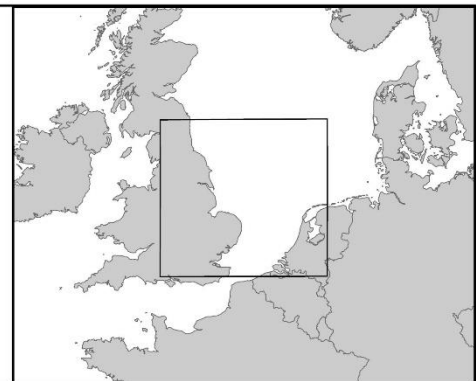
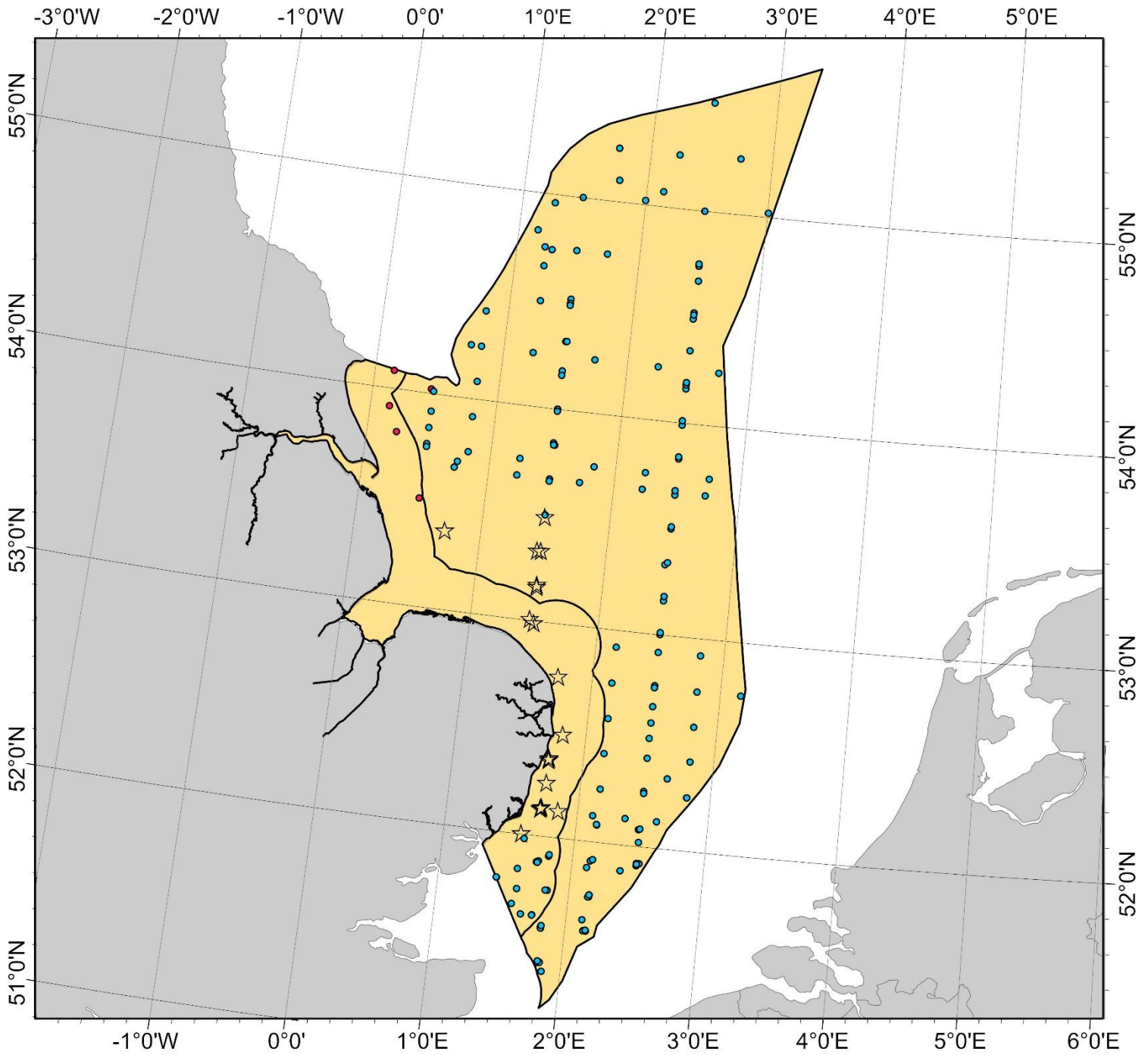



Figure 25 | Historic Spawning Ground (2010) within the East Marine Plan Area



Plan Areas

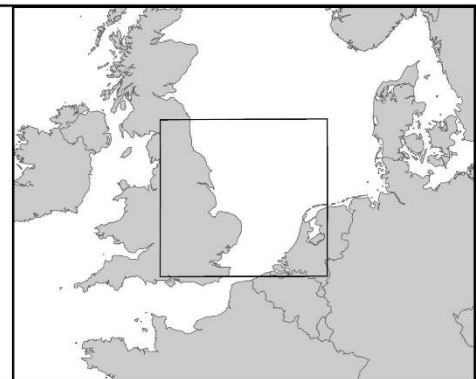
 East Marine Plan (Inshore and Offshore Areas)

Identified Spawning Locations from 2010 Study of Sample Data (Cefas):

-  Cod
-  Plaice
-  Sandeel

Spawning Grounds

 Estimated Extent of Nursing Grounds Based on 2010 Sample Data



Impact on demand for the east marine plan areas

Fisheries are currently competing for space with other marine developments, and whilst the economic impacts of this remain unclear, it is likely that pressures will increase over the next 20 years. If fisheries are displaced and move to a new area, that also increases competition in that area, potentially leading to reduced economic returns, increased environmental damage, and overfishing. Therefore, demand for the asset base of the east marine plan areas from fisheries is likely to fluctuate in the short-to-medium term. This sectors impact and interactions with other sectors will need to be considered to determine the spatial carrying capacity of the east marine plan areas.

2.11 Environment

This report views the environment as a sector in its own right that provides natural capital and ecosystem services that other sectors, including the discussed focus sectors, depend on.

The impacts of climate change are evident, with the UK being on average 0.8 °C warmer than the 1961-1990 average over the past decade. This is largely due to the oceans absorbing approximately a third of excess carbon emitted into the atmosphere, which has also impacted marine life and biodiversity.¹³⁵

In response, the UK Government is attempting to mitigate climate change by shifting to a net zero economy and securing energy through low carbon sources such as offshore wind. This includes it's work with the offshore wind industry to ensure 30% of UK electricity comes from wind by 2030.¹³⁶ Beyond this, environment related legislation, such as the Environment Act 2021 and the Net Zero Strategy, are now at the forefront of the national agenda.

Current activities and use cases

There are numerous Marine Protected Areas (MPAs) and significant legislations related to the environment in the east marine plan areas. These include but are not limited to:

Marine Protected Areas (MPAs) in the east marine plan areas, which include:

- Marine Conservation Zones (MCZ) (including recommended sites) which focus on geological features, habitats and species typical of UK waters
- Ramsar sites which focus on wetlands of international importance
- Sites of Special Scientific Interest (SSSI) which focus on geological features, flora and fauna of special interest
- Special Areas of Conservation (SAC) (including candidate sites and sites of community importance) which focus on habitats and species in need of conservation

¹³⁵ Department for Business, Energy & Industrial Strategy (2014), Climate Change Explained, <https://www.gov.uk/guidance/climate-change-explained>

¹³⁶ BBC (2019), Climate change: Government deal to boost offshore wind, <https://www.bbc.co.uk/news/science-environment-47476006>

- Special Protection Areas (SPA) (including proposed sites) which focus on rare, vulnerable, or threatened birds and for regularly occurring migratory species.

Other protected habitats and species are identified through the:

- UK Biodiversity Action Plan (BAP), with species identified in the 2007 Habitats Review Report as of primary importance to the UK
- Royal Society for the Protection of Birds which funds designated bird reserves
- Defra's identified fish species with significant spawning grounds.

Specific examples of the east marine plan areas MPAs and why they're protected include, but are not limited to:

- Holderness Offshore MCZ: The diverse seabed allows for a wide variety of species which live both in and on the sediment such as, crustaceans (crabs and shrimp), starfish and sponges. This site is also a spawning and nursing ground for a range of fish species for example lemon sole (*Microstomus kitt*), plaice and European sprat (*Sprattus sprattus*). Therefore, the species living both in and on the sediment may benefit from the protection afforded to the habitat features within this site
- the Cromer Shoal Chalk Bed MCZ which encloses important geological features including the best examples of subtidal chalk beds in the North Sea as well as subtidal exposures of clay and peat¹³⁷
- the Wash Ramsar/SSSI: A vast intertidal embayment incorporating one of the largest and most important areas of estuarine mudflats, sandbanks and saltmarsh in Britain. Counts of wintering waterbirds reach 320,673 individuals and include nationally and internationally important numbers of numerous species, notably up to 17,000 passerines (perching songbirds). The site is also of outstanding international importance for passage birds, notable waders, and supports various breeding birds, an important shell fishery, and the largest breeding colony in Europe of the Harbour Seal (*Phoca vitulina*)
- the Southern North Sea SAC which protects key winter and summer habitat for harbour porpoise and covers an area over three times the size of Yorkshire, making it the largest SAC in UK and European waters at the point of designation in 2019¹³⁸
- Dogger Bank SAC which protects extensive sublittoral sandbanks and their related flora and fauna which have been previously impacted by bottom trawling fishing methods¹³⁹
- Flamborough and Filey Coast SPA: home to the only mainland colony of gannets in England and one of the largest population of kittiwakes in the UK. The SPA provides protection to the cliffs which the birds depend on and extends 2km out to sea, affording protection for inshore waters which are important to the seabird's breeding behaviours

¹³⁷ Natural England (2018), Natural England Conservation Advice for Marine Protected Areas, [https://designatedsites.naturalengland.org.uk/Marine/MarineSiteDetail.aspx?SiteCode=UKMCZ0031&HasCA=1&NumMarineSeasonality=0&SiteNameDisplay=Cromer%20Shoal%20Chalk%20Beds%20MCZ#h1colUCN Global Standard for NbS | IUCN](https://designatedsites.naturalengland.org.uk/Marine/MarineSiteDetail.aspx?SiteCode=UKMCZ0031&HasCA=1&NumMarineSeasonality=0&SiteNameDisplay=Cromer%20Shoal%20Chalk%20Beds%20MCZ#h1colUCN%20Global%20Standard%20for%20NbS%20IUCN)

¹³⁸ JNCC (2022), Southern North Sea MPA, <https://jncc.gov.uk/our-work/southern-north-sea-mpa/#:~:text=The%20Southern%20North%20Sea%20SAC%20is%20an%20area,waters%20at%20the%20point%20of%20designation%20in%202019.>

¹³⁹ JNCC (2022), Dogger Bank – SAC, <https://sac.jncc.gov.uk/site/UK0030352>

- Greater Wash SPA which is classified for the protection of red-throated diver (*Gavia stellata*), common scoter (*Melanitta nigra*), and little gull (*Hydrocoloeus minutus*) during the non-breeding season, and for breeding Sandwich tern (*Sterna sandvicensis*), common tern (*Sterna hirundo*) and little tern (*Sternula albifrons*).¹⁴⁰

As noted, there are also currently a significant number of legislations aimed at protecting the environment and mitigating the impacts of climate change. These include:

- Ramsar sites which are designated and protected under the Ramsar Convention on Wetlands of International Importance especially as Waterfowl Habitat
- Special Protection Areas and Special Areas of Conservation which are designated and protected under The Conservation of Habitats and Species Regulations 2017 and the Conservation of Offshore Marine Habitats and Species Regulations 2017
- Marine Conservation Zones which are designated and protected under the Marine and Coastal Access Act 2009
- Sites of Special Scientific Interest which are designated and protected under the Wildlife and Countryside Act 1981 and the Countryside and Rights of Way Act 2000
- Good Environmental Status (GES) assessment which measures progress of projects on our seas and oceans through a defined criterion including biological diversity, sea-floor integrity and contaminants which is required under the UK Marine Strategy Regulations 2010
- Environmental Impact Assessments which ensure local planning authorities assess the effects on the environment of planning applications and development projects prior to funding, required under the Town and Country Planning Regulations 2017
- Strategic Environmental Assessments and Sustainability Appraisals which must be carried out during the preparation of local plans and spatial development strategies through assessing reasonable alternatives, required under Section 19 of the Planning and Compulsory Purchase Act 2004.

Emerging activities and use cases (0-10 years)

Emerging activities related to the environment that will impact the east marine plan areas over the course of the next decade include:

Compensation:

Defra held a recent consultation to seek views on the best practice guidance for developing compensatory measures in relation to Marine Protected Areas. This is a future approach to strategic compensation, and how net gain and compensation can work together to deliver the best outcomes for the marine environment. A potential area where this could occur is by using fisheries management measures to increase seabird prey, thus compensating for the impact offshore wind has on seabird populations.

¹⁴⁰ JNCC (2022) Greater Wash SPA, <https://jncc.gov.uk/our-work/greater-wash-spa/>

MPA Management measures:

The UK Fisheries Act 2020 gave the MMO new powers to manage fishing activities to protect offshore MPAs and this includes management measures for MPAs in the east marine plan areas including Dogger Bank SAC and Inner Dowsing, Race Bank and North Ridge SAC.

In addition to fisheries management there is likely also to be increased management of non-licensable activity such as recreational activities. For example, in 2020 the MMO drafted an assessment on the impacts of marine non-licensable activities, such as anchoring, sailing, powerboating, diving and snorkelling in Studland Bay MCZ. The options identified ranged from the introduction of a monitoring and control plan (no immediate restriction of activities) to full site prohibition. These options were shared with the public during the call for evidence along with the draft assessment, so that people could provide their views and relevant evidence. This has led to The Studland Bay MCZ Habitat Protection Strategy which provides an overview of MMO's management approach for marine non-licensable activities in Studland Bay MCZ¹⁴¹.

Nature Based Solutions:

Over the next decade, there is also a potential for increased activities to find nature-based solutions to mitigate the impacts of climate change. Nature-based Solutions are defined as “*actions to protect, sustainably manage and restore natural or modified ecosystems that address societal challenges effectively and adaptively, simultaneously providing human well-being and biodiversity benefits.*”¹⁴² An example of this is carbon sequestration through living organisms. Living organisms, such as seagrass species, can capture, process and bury carbon. Carbon sequestration in the coastal environment does not just occur in marine habitats, sand dunes and machair can also capture carbon from the air. Coastal habitats, therefore, provide several means of carbon sequestration and burial.¹⁴⁰ Marine habitat restoration activities are likely to prevail as a method of sequestering carbon emissions from the environment. Marine habitats such as saltmarshes, sand dunes, seagrass beds and mudflats provide a natural carbon sequestration service, therefore protection, restoration and or creation of these habitats are considered essential to support the aim of net zero.

At present, nature-based solutions that are being researched and could materialise in the east inshore marine plan areas over the next decade include:

- the Humber Coastal Conservation Project which has the potential to restore seagrass, oysters, saline lagoons, and saltmarshes which could create new habitats and restore existing ones (also creating carbon credits)

¹⁴¹ Managing marine non-licensable activity in Studland Bay Marine Conservation Zone (2019), <https://www.gov.uk/government/publications/managing-marine-non-licensable-activities-studland-bay-next-steps>

¹⁴² ICUN (2021), ICUN Global standards for NbS, <https://www.iucn.org/theme/nature-based-solutions/resources/iucn-global-standard-nbs>

- the Yorkshire Wildlife Trust which aims to improve carbon sequestration through seagrass and saltmarsh restoration in the Humber¹⁴³
- in July 2021, the Lincolnshire Wildlife Trust announced the project ‘Green Investment in Greater Lincolnshire’. In this project, a credit trading model will be developed where nature-based solutions are designed to deliver habitats to meet biodiversity net gain requirements, to capture and store carbon to enable the journey to net zero or to store water during flood or drought events, or cleanse water to improve the quality in our waterways and in the supply change¹⁴⁴
- Humber 2100+, in the Alkborough flats, aims to provide nature-based solutions for the Humber’s resilience to tidal flooding. Three strategic options of managing the tide, adapting to the tide and keeping out the tide are currently being analysed¹⁴⁵
- in July 2021, the Centre for Ecology and Hydrology announced that it is creating a carbon code for saltmarshes in the UK. It is hoped the code will pave the way for at least £1 billion of private investment in restoration projects over 25 years, covering 22,000 hectares of habitat in the UK.¹⁴⁶

ReMeMaRe:

ReMeMaRe is an ambitious initiative lead by the Environment Agency that aims to reverse centuries of decline of our estuarine and coastal habitats by **R**estoring [seagrass] **M**eadows, [salt] **M**arsh and [oyster] **R**eed. Whilst there is limited data specific to the east marine plan areas available, current activities broadly include:

- over 100 catchment-based partnerships across England.¹³⁵ A ‘catchment-based approach’ manages the flow of water from the source of rivers to the sea, across towns, cities, countryside and coasts
- River Basin Management Plans (RBMPs) and Flood Risk Management Plans (FRMPs) encourage and support nature-based solutions as approaches to reduce flooding and mitigate climate change
- Local Nature Recovery Strategies include nature-based solutions.

Highly Protected Marine Areas:

Over the next decade, activities likely to improve the marine environment include the designation of Highly Protected Marine Areas (HPMA). Currently 40% of England’s seas are designated as Marine Protected Areas with the aim of protecting discrete habitats and species which means that “*extractive and depositional activities*

¹⁴³ Yorkshire and Humber Climate Commission (2021), Carbon sequestration – seagrass and saltmarsh, <https://yorksandhumberclimate.org.uk/carbon-sequestration-seagrass-and-saltmarsh>

¹⁴⁴ Lincolnshire Wildlife Trust (2021), Green Investment scheme for Greater Lincolnshire wins Government backing, <https://www.lincstrust.org.uk/news/green-investment-scheme-greater-lincolnshire-wins-government-backing>

¹⁴⁵ Environment Agency (2019), Humber 2100+, <https://consult.environment-agency.gov.uk/humber/strategyreview/>

¹⁴⁶ UK Centre for Ecology & Hydrology (2021), Unlocking £1bn investment in restoration of saltmarshes, <https://www.ceh.ac.uk/news-and-media/news/unlocking-billion-pound-investment-restoration-saltmarshes>

*continue in many such sites, albeit under strict conditions.*¹⁴⁷ According to the Benyon review into HPMA, this does not allow ecosystems to fully recover and HPMA will be more suitable to protect the marine environment. HPMA will prohibit extractive, destructive and depositional uses, allowing only non-damaging levels of other activities.¹⁴⁷ Depending on the placement of HPMA, this is likely to impact a number of activities that can take place in the east marine plan areas over the next decade.

Potential activities and use cases (0-20 years)

Potential activities and use cases related to the environment in the east marine plan areas include:

Marine net gain:

There is unprecedented government action and investment in helping protect and restore the environment and reduce the impacts of climate change. An example of this is national policies that set out that planning should provide biodiversity net gains where possible. Biodiversity net gain delivers measurable improvements for biodiversity by creating or enhancing habitats in association with development. Biodiversity net gain can be achieved on-site, off-site or through a combination of on-site and off-site measures.¹⁴⁸ Work is underway to develop an approach to marine net gain for English waters, with Defra currently developing a consultation on the principles for marine net gain due to be published this year (2022). This will impact future activities across the east marine plan areas.

In a 2018 consultation on biodiversity net gain, recommendations from the industry have included the introduction of a system of natural capital which incorporates capital assets and ecosystem services including flood protection, water quality, carbon storage, air quality, erosion control, access to nature and pollination.¹⁴⁹

Marine Natural Capital Approach and Defra mNCEA projects:

The Defra-led marine Natural Capital Ecosystem Assessment (mNCEA) Programme has released funds to Defra arms-length bodies to develop evidence products that can support the development of a Natural Capital Approach (NCA) for marine decision-making. NCA enables the interdependencies of nature and humans to be shown, such that decision-making can be fully informed by this. It allows for an understanding of how the state of natural capital assets affects the flow of ecosystem services.¹⁵⁰ It should ensure that humans that benefit from the marine environment's natural capital, are benefiting, but doing so in a way that is sustainable and that does not lead to significant disbenefits for others, including through the degradation of NC

¹⁴⁷ Benyon review into Highly Protected marine Areas: final report executive summary (2020), [Benyon review Into Highly Protected Marine Areas: Final report - executive summary - GOV.UK \(www.gov.uk\)](https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/947789/benyon-review-into-highly-protected-marine-areas-final-report-executive-summary.pdf)

¹⁴⁸ Planning Advisory Service – Biodiversity Net Gain (2021), [Biodiversity net gain | Local Government Association](https://www.planningadvisoryservice.gov.uk/biodiversity-net-gain/)

¹⁴⁹ Defra, Biodiversity net gain: updating planning requirements consultation responses (2019), [Biodiversity net gain: updating planning requirements - GOV.UK \(www.gov.uk\)](https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/947789/biodiversity-net-gain-updating-planning-requirements.pdf)

¹⁵⁰ Department for Environment, Food and Rural Affairs (2016), Natural Capital Committee: terms of reference, https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/947789/ncc-terms-of-reference.pdf

overall.¹⁵¹ The outcomes of a NCA assessment can thus indicate whether marine natural capital is being managed sustainably, and so whether marine ecosystem capital (its biotic component) is being renewed as needed to ensure the continued supply of ecosystem services and their associated benefits to society.¹⁵²

The MMO has been successful in receiving funding to work collaboratively with Natural England, the Joint Nature Conservation Committee, the Environment Agency and the Centre for Environment, Fisheries and Aquaculture Science to develop a natural capital evidence base that can support the marine planning process for the East Marine Plan.

The impacts of priority national policies and strategies

The following are national policies and strategies that could affect the environment sector in the east marine plan areas over the next 20 years:

- in the Economics of Biodiversity: In the Dasgupta Review, the government committed to delivering a 'nature positive' future, in which we leave the environment in a better state than we found it, and reverse biodiversity loss globally by 2030. It also committed to ensuring economic and financial decision-making support it's delivery.¹⁵³ This will increase government investment and focus on the environment in the east marine plan areas
- the 25 Year Environment Plan aims to reduce the risk of harm to people, the environment and the economy from natural hazards including flooding, drought and coastal erosion.¹⁵⁴ Additionally, it aims to take all possible action to mitigate climate change, while adapting to reduce its impact and continue to cut greenhouse gas emissions including from land use, land use change, the agriculture and waste sectors and the use of fluorinated gases.¹⁵⁵ As a result, this will increase government investment for related initiatives in the east marine plan areas and need to be reflected in all future planning
- the Ten Point Plan for a Green Industrial Revolution - Point 9: Protecting Our Natural Environment, states that the natural environment is one of the most important and effective solutions we have for capturing and sequestering carbon long-term.¹⁵⁶ Additionally, it endeavours to safeguard landscapes,

¹⁵¹ Department for Environment, Food and Rural Affairs (2016), Natural Capital Committee: terms of reference, https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/947789/ncc-terms-of-reference.pdf

¹⁵² Department for Environment, Food and Rural Affairs (2016), Natural Capital Committee: terms of reference, https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/947789/ncc-terms-of-reference.pdf

¹⁵³ HM Treasury (2021), Final Report - The Economics of Biodiversity: The Dasgupta Review, <https://www.gov.uk/government/publications/final-report-the-economics-of-biodiversity-the-dasgupta-review>

¹⁵⁴ Department for Environment, Food & Rural Affairs (2019), 25 Year Environment, <https://www.gov.uk/government/publications/25-year-environment-plan>

¹⁵⁵ Department for Environment, Food & Rural Affairs (2019), 25 Year Environment, <https://www.gov.uk/government/publications/25-year-environment-plan>

¹⁵⁶ UK Government (2020), The ten point plan for a green industrial revolution, <https://www.gov.uk/government/publications/the-ten-point-plan-for-a-green-industrial-revolution>

restore habitats for wildlife in order to combat biodiversity loss and adapt to climate change, all whilst creating green jobs.¹⁵⁷ This will increase investment and ideally increase employment opportunities related to the environment in the east marine plan areas

- the Net Zero Strategy aims at protecting, restoring, and sustainably managing natural resources such as soils or blue carbon habitats like saltmarsh and seagrass.¹⁵⁸ This can provide benefits for biodiversity and climate adaptation, as well as for carbon sequestration in the east marine plan areas
- the UK Marine Strategy provides the framework for delivering marine policy at the UK level and sets out how we will achieve the vision of clean, healthy, safe, productive and biologically diverse oceans and seas. The Strategy consists of a 3-stage framework for achieving good environmental status (GES) in our seas. Achieving GES is about protecting the marine environment, preventing its deterioration and restoring it where practical, while allowing sustainable use of marine resources. Using this framework, investment and environmental initiatives will ideally increase in the east marine plan areas
- Environment Act 2021 requires organisations to ‘pay regard’ to five environmental principals of integration, prevention, precautionary, rectification at the source, and the polluter pays principal.¹⁵⁹ This will impact future planning and the way industries conduct their operations in the east marine plan areas
- The Environment Act 2021 also includes important legally binding targets, including a 2030 target to halt species decline and a target to tackle air pollution from particulate matter (PM2.5).¹⁶⁰

Optimal spatial conditions and attributes needed for the success of activities and use cases

The MMO’s East Inshore and East Offshore Marine Plan Areas Evidence and Issues Report, published in 2012, reflected on some of the requirements to successfully achieve activities for the environment¹⁶¹

Some of the key requirements noted that still apply include:

- ensuring the maximum sustainable deployment of offshore wind and marine renewable technologies
- safeguarding access to potentially suitable geological storage areas for carbon dioxide

¹⁵⁷ UK Government (2020), The ten point plan for a green industrial revolution,

<https://www.gov.uk/government/publications/the-ten-point-plan-for-a-green-industrial-revolution>

¹⁵⁸ Department for Business, Energy & Industrial Strategy (2020), Energy white paper: Powering our net zero future, <https://www.gov.uk/government/publications/energy-white-paper-powering-our-net-zero-future>

¹⁵⁹ UK Government (2021) Environment Act 2021,

<https://www.legislation.gov.uk/ukpga/2021/30/contents/enacted>

¹⁶⁰ UK Government (2021) Environment Act 2021,

<https://www.legislation.gov.uk/ukpga/2021/30/contents/enacted>

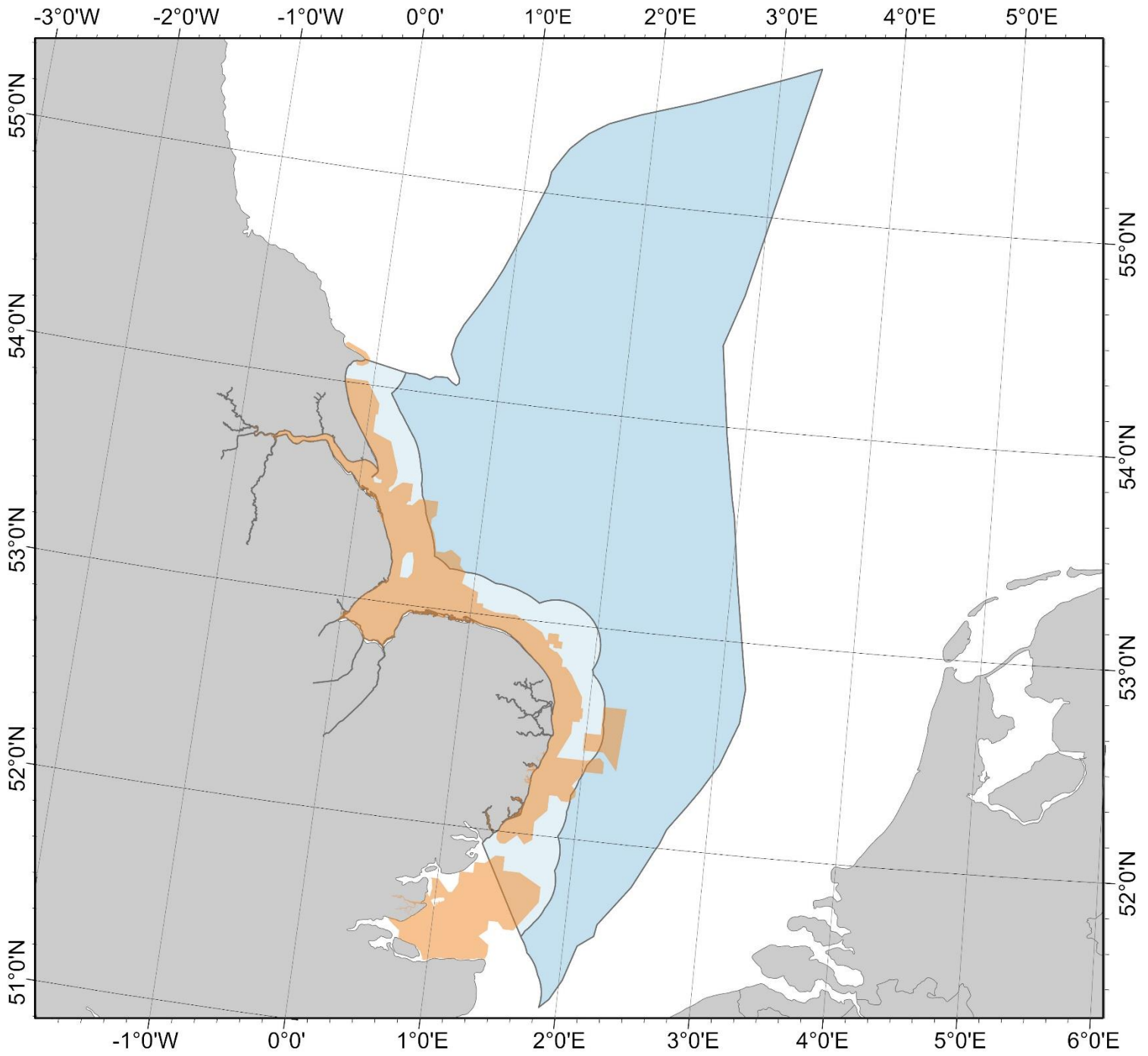
¹⁶¹ Marine Management Organisation (2014), East marine plan areas: Evidence and Issues Report, <https://www.gov.uk/government/publications/east-marine-plan-areas-evidence-and-issues-report>

- minimising air pollution associated with oil and gas exploitation and related industrial activities
- considering how marine planning can contribute to reducing further growth in emissions from the transport sector (shipping, aviation, road, and rail) as a result of the marine plans, and associated activities.

Impact on demand for the east marine plan areas

Marine Protected Areas (MPAs) occupy a substantial portion of the east marine plan areas at 45950.17km² in size. This is equivalent to 78.4% of the current capacity of the total east marine plan areas. Inshore MPA coverage is 8656.32km² or 84.76% of the current extent of the inshore area. Offshore MPA coverage is 37293.85km² or 77.07% of the current extent of the offshore area. Forecasting the spatial requirements and demand of the environment sector over a 20-year horizon is difficult given the variations in activities and use cases. However, given the underlying importance of this sector in marine plans and the continued government ambitions and policies to tackle climate change, it is likely that demand for the asset base of the east marine plan areas for this sector will increase. Therefore, the environment sectors impact and interactions with other sectors will need to be considered to determine the carrying capacity of the east marine plan areas.

Figure 26 | Special Protection Areas (SPAs) within the East Marine Plan Areas



Conservation Area

 Special Protection Areas (JNCC)

Plan Areas

 East Marine Plan (Inshore Area)

 East Marine Plan (Offshore Area)

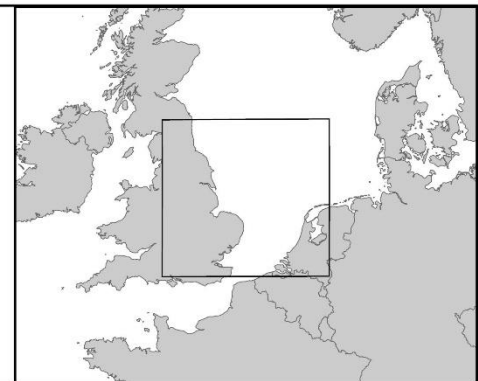
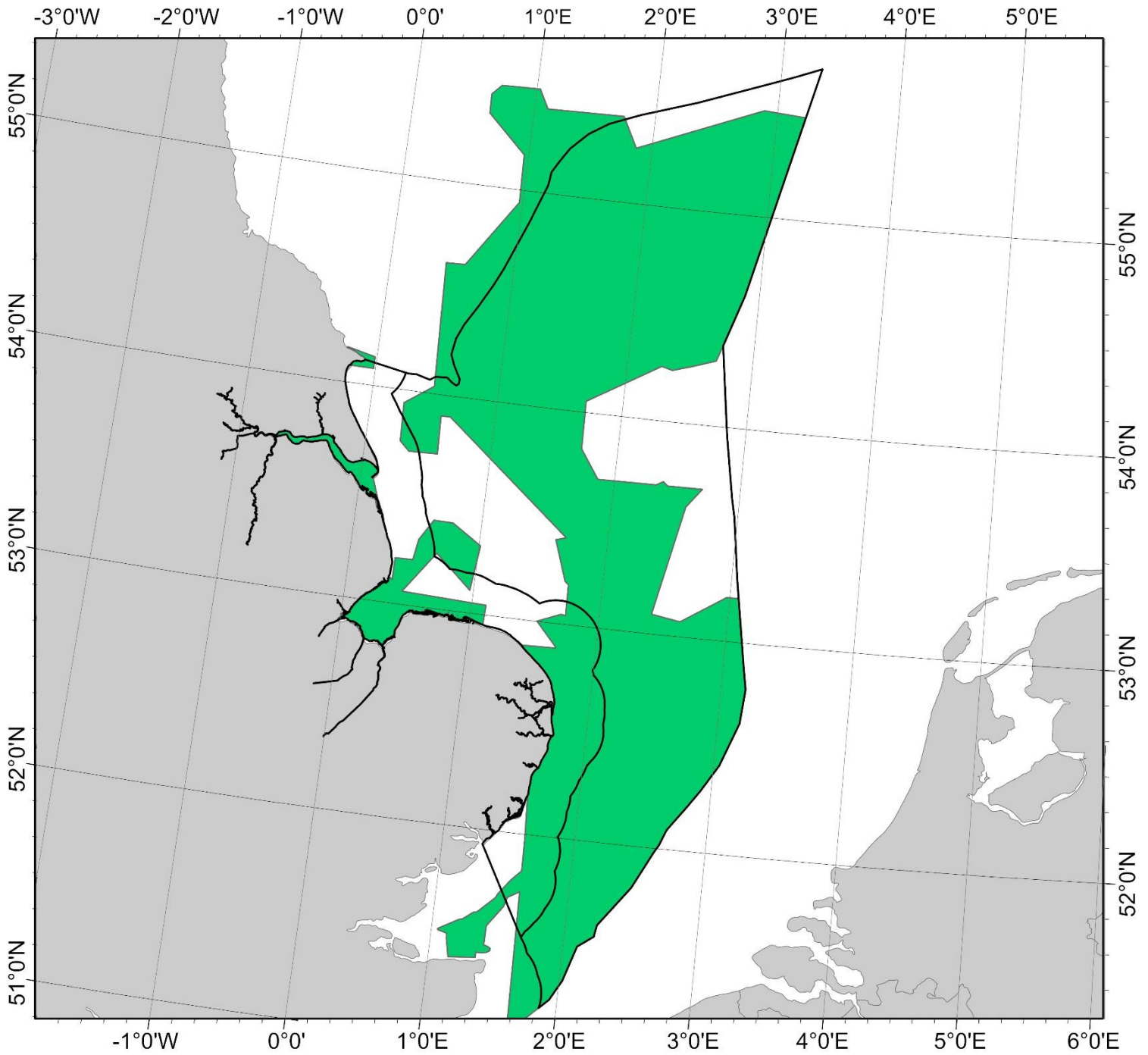



Figure 27 | Special Areas of Conservation (SACs) within the East Marine Plan Areas



Plan Areas

 East Marine Plan (Inshore and Offshore Areas)

Conservation Area

 Special Areas of Conservation (JNCC/Natural England)

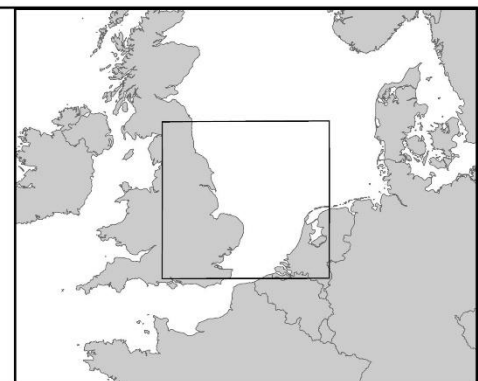




Figure 28 | Marine Conservation Zones (MCZs) and Ramsar Wetlands in the East Marine Plan Areas



Conservation Area

-  Marine Conservation Zones (Natural England)
-  Ramsar Wetlands (Natural England)

Plan Areas



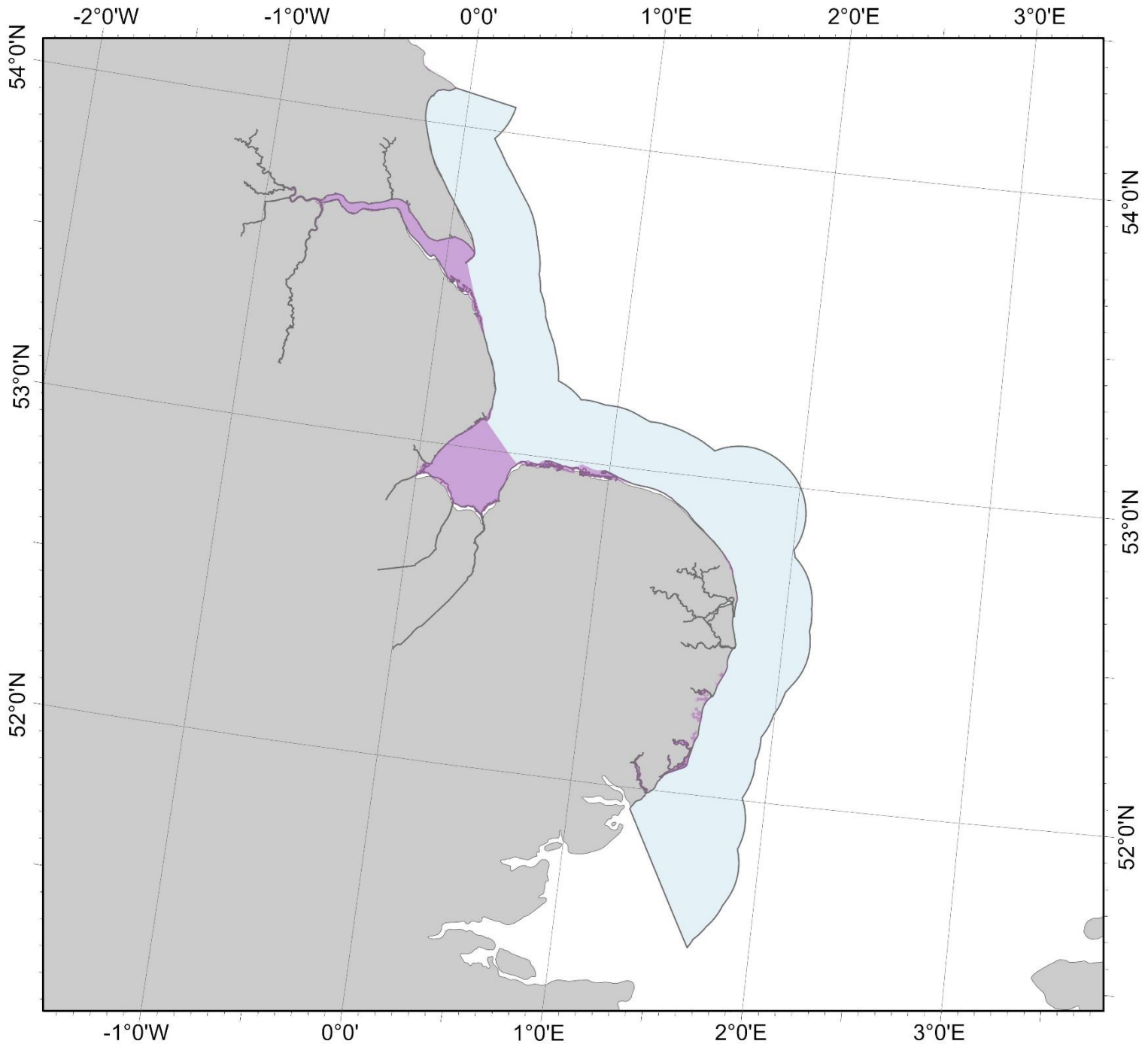
-  East Marine Plan (Inshore Area)
-  East Marine Plan (Offshore Area)



Figure 29 | Sites of Special Scientific Interest (SSSIs) within the East Marine Plan Areas



Conservation Areas

 Sites of Special Scientific Interest (Natural England)

Plan Areas

 East Marine Plan (Inshore Area)

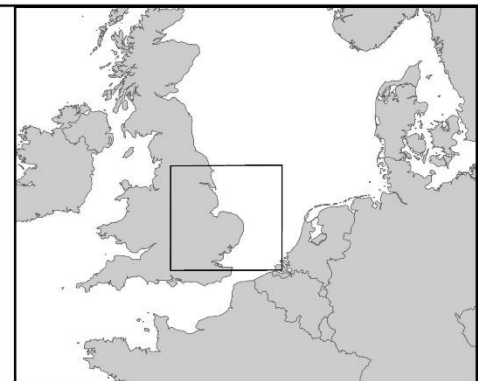


Figure 30 | Saltmarsh and Seagrass Sites within the East Marine Plan Areas

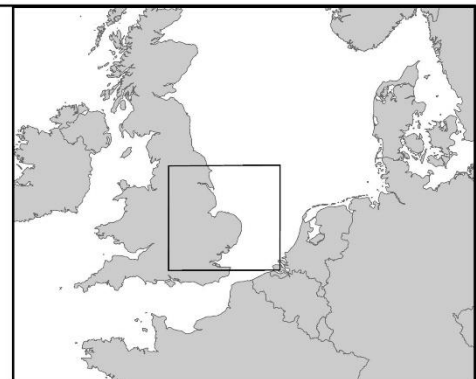


Conservation Sites

- Saltmarsh Species (Environment Agency)
- Seagrass Species (Environment Agency)

Plan Areas

- East Marine Plan (Inshore Area)



2.12 National priorities mapping

Based on the analysis conducted for each of the 11 focus sectors above, a national priorities mapping exercise was conducted to provide a visual summary of which sectors contribute to 38 different marine related UK policy and strategy commitments/objectives, and to what extent.

This exercise considered whether each focus sector has a direct or indirect policy impact, on each of the 38 different UK marine related policy/strategy objectives and commitments.

Direct policy impact indicates that a particular policy/strategy is highly dependent on this sector and development of activities within this sector would be a significant contributor to meeting such policy/strategy commitments. Indirect policy impact indicates that a sector's activities have some relevance to a particular policy/strategy commitment being met but is not a significant contributor.

A separate excel sheet containing the outputs of this exercise is provided along with this report. The outputs feed into chapter 4 of this report and provide a basis for future prioritisation exercises for sector activities i.e. with an informed view of which sectors activities contribute most to national policy/strategy commitments.

3. Spatial barriers, constraints and enablers

The purpose of this section is to identify spatial barriers, constraints and enablers which may restrict or enhance the activities of each sector identified in Chapter 2. In order to identify these, this section evaluates the impact of the 11 focus sectors against each other, in restricting or enabling each sector's respective activities.

The section also evaluates the high-level impact of 11 further interacting sectors from the Marine Policy Statement (MPS) (not covered in Chapter 2). These are:

- existing consenting activities
- cables
- defence and national security
- heritage
- ecological and chemical water quality and resources
- surface water management and wastewater
- seascape
- air quality
- nuclear
- climate change adaptation and mitigation
- marine ecology and biodiversity.

Spatial barriers refer to challenges which make it difficult to conduct activities for certain sectors (i.e. one sector's activities will likely need to be prioritised ahead of the other's) whereas constraints create some difficulty but there is potential for sector activities to co-exist. On the other hand, enablers refer to the opportunities a sector might present for the enhancement of activities in other sectors. Due to the scope of this work, this analysis only factors in physical barriers, constraints and enablers and asset/infrastructure requirements.

Please note that this section is not intended to provide an exhaustive review of all barriers, constraints and enablers for activities in the east marine plan areas but instead provide a high-level spatial assessment of the interactions between each sector. This section provides the grounding for the trade-offs and opportunities analysis conducted in Chapter 4.

3.1 Energy production (offshore wind)

The physical barriers and constraints identified for activities and use cases for renewable energy production, with a focus on offshore wind farms, include:

- **Energy production (oil and gas):**
 - oil and gas infrastructure, together with safety and exclusion zones, excludes other activities. If gas infrastructure increases to exploit new fields, it is likely to compete with where wind energy zones may be located
 - oil and gas pipelines will compete with cables connecting renewable energy sites, although this is not a completely restrictive issue as this

could be managed through developing spatial corridors to align multi-purpose cabling across the seabed

- **Carbon capture, usage and storage:** similar to oil and gas, new infrastructure may compete for space with renewable energy and enabling cable routes
- **Aggregates:** new aggregate extraction areas with potential expansion of activity may conflict with possible grid connection corridors for wind farm developments
- **Ports and shipping:** development of offshore energy installations, particularly large-scale deployments, may compete with shipping particularly impacting the safe operation of installations
- **Tourism and recreation:** there have been some instances where the seascape and visual impacts of turbines and onshore infrastructure, that affect the tourism sector, have led to recent projects being delayed (Norfolk Vanguard) or cancelled altogether (Navitus Bay)
- **Fisheries:** commercial fishing constrains locations for arrays and export cable routes. Transit routes to fishing grounds may also constrain the location of arrays. However, if windfarm developers can liaise with regional fisheries liaison officers on wind farm design there may be more opportunities for co-location
- **Fisheries:** due to space requirements, some types of commercial fishing such as seine netting and pair trawling cannot physically operate among wind farms under current typical turbine layouts. There are examples of static fisheries such as crab and lobster pot fisheries operating among wind farm installations, but there is not yet conclusive evidence of significant levels of towed gear fishing activity taking place
- **Environment:**
 - whilst the placements are yet to be identified, Highly Protected Marine Areas (HPMA) could prohibit extractive, destructive, and depositional uses, allowing only non-damaging levels of other activities. HPMA's are likely to restrict renewable energy production
 - Marine Conservation Zones (MCZ) and Special Areas of Conservation (SAC), are also likely to impact the integration of offshore wind with other sectors. For example, for Marine Protected Areas (MPA), Habitats Regulations Assessments (HRA) and MCZ assessments may restrict where offshore wind developments are sited. However, if developments go down the derogation route, they may still be allowed, but will have to compensate for damage to MPA features, though in some cases 'like for like' compensation may not be achievable
 - cumulative assessments are considered as part of Strategic Environmental Assessments and HRA assessments – if cumulative assessments from other plans or projects are identified this may influence the outcome of the assessments and in turn restrict where offshore wind developments are sited
- **Cables:** further rounds of wind development areas could conflict with interconnectors and transmission network cables, particularly in the construction of wind farms that require submarine cabling. Although, this is not a completely restrictive issue as this could be managed through

developing spatial corridors to align multi-purpose cabling across the seabed or through cable crossing agreements.

The physical enablers identified for activities and use cases for renewable energy production, with a focus on offshore wind farms, include:

- **Energy production (oil and gas):** through platform electrification and sourcing power from offshore renewables, the offshore oil and gas industry could significantly reduce its greenhouse gas emissions. This could also present a commercial opportunity for renewable power developers and co-investing in transmission infrastructure and leveraging oil and gas deep-water technologies could support growth
 - the decommissioning of existing oil and gas infrastructure may lead to increased space for offshore wind
- **Cables:** the Offshore Transmission Network Review is looking to assess the offshore transmission system holistically with the onshore network to deliver a more coordinated approach from the onset and reduce its cumulative impacts, this will reduce constraints from cabling
- **Dredging and disposal:** this is an enabling activity which facilitates the construction of pipelines, outfalls and tunnels supporting the installation of renewable energy infrastructure. However, renewable energy developers that own and operate cables should take note that navigation lanes and deep-water channels should be kept free of cabling to allow for maintenance dredging
- **Ports and shipping:** it should be recognised that ports have a crucial role to play in developing fields of energy production and the associated supply chains.

3.2 Energy production (oil and gas)

The physical barriers and constraints identified for activities and use cases for oil and gas energy production include:

- **Energy production (offshore wind):**
 - potential for adverse effect on ability to develop oil and gas fields due to the requirement for relevant safety zones and overall footprint of wind farm developments
 - there is potential for competition for space between oil and gas pipelines and cables connecting renewable energy sites, although this could be managed through developing spatial corridors to align multi-purpose cabling across the seabed
- **Carbon capture, usage and storage:** there is potential for competition for space between new CCUS pipelines and oil and gas pipelines, as above spatial corridors may resolve this issue in the long term
- **Aggregates:** activities in this sector have the potential to impede exploration of, and potential production from, new sites
- **Environment:**
 - as above, HPMA's would restrict oil and gas production. Although, offshore oil and gas activity is now well established and subject to strict environmental regulations and considerations

- Marine Conservation Zones (MCZ) and Special Areas of Conservation (SAC), are also likely to impact the integration of oil and gas with other sectors as above with offshore wind. For MPAs, Habitats Regulations Assessments (HRA) and MCZ assessments may restrict where developments are sited. However, if developments go down the derogation route, they may still be allowed but will have to compensate for damage to MPA features, though in some cases 'like for like' compensation may not be achievable.

The physical enablers identified for activities and use cases for oil and gas energy production include:

- **Energy production (offshore wind):** through platform electrification and sourcing power from offshore renewables, the offshore oil and gas industry could significantly reduce its greenhouse gas emissions. According to the Oil and Gas Authority (OGA), platform electrification is both essential for cutting oil and gas sector production emissions in the near term and critical to preserving the industry's social licence to operate
- **Carbon capture, usage and storage:** there is the possibility for CCUS and oil and gas to co-locate via enhanced hydrocarbon recovery and for oil and gas infrastructure to be re-purposed to support CCUS activities
- **Dredging and disposal:** this is an enabling activity which facilitates the construction of pipelines, outfalls and tunnels supporting the installation of oil and gas infrastructure
- **Ports and shipping:** it should be recognised that ports have a crucial role to play in developing fields of oil and gas production and the associated supply chains.

3.3 Carbon capture, usage and storage (CCUS)

The physical barriers and constraints identified for activities and use cases for CCUS include:

- **Energy production (offshore wind):** there is potential for competition for space between new CCUS pipelines and cables connecting renewable energy sites, although these could be installed in close proximity to reduce the impact upon other users of the marine area through spatial corridors
- **Energy production (oil and gas):** the MPS reflects that "*Carbon Capture and Storage proposals should demonstrate that consideration has been given to the re-use of existing oil and gas infrastructure rather than the installation of new infrastructure*" however the current inflexibility and location of the majority of existing oil and gas infrastructure means new pipelines will need to be laid
- **Aggregates:** activities in this sector have the potential to impede exploration of and potential production from new sites
- **Environment:** as above, HPMA's would restrict CCUS activities and for MPAs, HRA and MCZ assessments may restrict where developments are sited. Although if developments go down the derogation route, they may still be allowed but will have to compensate for damage to MPA features, though in some cases 'like for like' compensation may not be achievable

- **Cables:** there may potentially be competition for space between new CCUS pipelines and electricity, interconnectors and transmission network cables for distribution networks or connecting to renewable energy sites. Although, as above this is not a completely restrictive issue as this could be managed through developing spatial corridors to align multi-purpose cabling across the seabed.

The physical enablers identified for activities and use cases for CCUS include:

- **Energy production (oil and gas):** there is the possibility for CCUS and oil and gas to co-locate via enhanced hydrocarbon recovery. The deployment of carbon capture and storage technologies will bring significant benefits for the UK in enabling fossil fuel energy generation to be part of the UK's low carbon, secure energy future
- **Dredging and disposal:** this is an enabling activity which facilitates the construction of pipelines, outfalls and tunnels supporting the installation of CCUS infrastructure
- **Ports and shipping:** the transport of captured carbon dioxide is expected to be largely via pipelines; however, it is possible that carbon dioxide may also be transported by ship to storage sites. It should be recognised that ports have a crucial role to play in developing fields of CCUS and the associated supply chains.

3.4 Dredging and disposal

The physical barriers and constraints identified for activities and use cases for dredging include:

- **Energy production (offshore wind):** each turbine has of the order of 1 kilometre of array cable on either side associated with it, renewable energy developers that own and operate cables should take note that navigation lanes and deep-water channels should be kept free of cabling to allow for maintenance dredging
- **Carbon capture, usage and storage:** there is potential for pipelines running to the shoreline and between wells to be severely damaged by dredging activities and could prevent the practise in certain areas
- **Fisheries:** future proposals may consider where species mitigation during certain periods of the year is required to protect fish stock. This could limit dredging activities temporally in certain areas of the east marine plan areas
- **Environment:** capital dredging and the disposal of spoil within 1 nautical mile of the coast may require a full Environmental Impact Assessment
- **Cables:** there is potential for cabling to be severely damaged by dredging activities and could prevent the practise in certain areas.

3.5 Aggregates

The physical barriers and constraints identified for activities and use cases for aggregates include:

- **Energy production (offshore wind):** new wind farm developments may compete for space with aggregate extraction, with potential conflicts linked to cabling, and in some cases renewable energy may exclude aggregate activities happening all together in areas of development
- **Energy production (oil and gas):** oil and gas infrastructure, together with safety and exclusion zones, excludes other activities. This has the potential to impede exploration of and potential production from new sites
- **Fisheries:** evidence of spawning sites can lead to aggregate areas being closed for spawning seasons, restricting temporally when aggregates can be extracted from certain areas
- **Environment:** Marine Protected Areas (MPAs) and designated archaeological sites can preclude marine aggregate extraction. These factors can reduce the area available for dredging or can cause uncertainty over free access to a given area, with the possibility of seasonal restrictions on dredging and/or exclusion zones being required, limiting the area of resource available.

The physical enablers identified for activities and use cases for aggregates include:

- **Coastal change and flooding:** as above, the marine aggregates sector is likely to become increasingly relevant because of the need for new extraction sites to replenish beaches and improve coastal defences
- **Environment:** policies in Shoreline Management Plans for beach nourishment and coastal defences offer opportunities for the aggregate industry. Many beaches have suffered from coastal erosion with beach replenishment schemes introduced to the Lincolnshire and North Norfolk Coast and East Anglia to address erosion and maintain the tourism offer. The marine aggregate industry provides most of the material for these schemes and this relationship needs to be recognised
- **Ports and shipping:** sufficiently sized facilities and infrastructure for landing aggregates allows for onward transportation. This will be particularly important if demand for marine won aggregates increases.

3.6 Ports and shipping

The physical barriers and constraints identified for activities and use cases for ports and shipping include:

- **Energy production (offshore wind):**
 - the protection of navigation routes contributing to delivery of safe shipping, is of paramount concern and a major factor supporting port growth, particularly taking into consideration the predicted increase in both vessel size and frequency of movements, and any growth of offshore renewables must consider this and automated shipping considerations
 - potential competition for space at sea that may arise from development of offshore energy installations, particularly large-scale renewable deployment, may adversely impact upon safe operation and competitiveness of shipping operation, because of re-routing

- **Carbon capture, usage and storage:** potential growth in sub-sea cabling and pipelining in the marine area could lead to an increased need to develop a mechanism to reduce possible impact from anchoring by vessels in emergencies
- **Tourism and recreation:**
 - increase in both commercial shipping and recreational craft activity may increase the risk to safety of navigation as space is squeezed
 - seascape concerns could lead to objections regarding port and harbour expansion proposals
- **Environment:**
 - Marine Protected Areas and designated archaeological sites in close proximity to ports can preclude port expansion
 - air quality considerations must apply with all new port developments to ensure that they do not impact on existing air quality management areas.

The physical enablers identified for activities and use cases for ports and shipping include:

- **Energy production (offshore wind):** energy production and infrastructure development offer opportunities for expansion and diversification in ports through offshore industry growth and support for construction of onshore power plants. Development of wind energy projects in the east marine plan areas will present opportunities for regeneration of port facilities
- **Energy Production (oil and gas):** the decommissioning of oil and gas infrastructure will enable ports and shipping to expand as this material will need to be transported
- **Carbon capture, usage and storage:** if expansion of CCUS meets government policy targets then it could provide significant employment opportunities via construction and maintenance, particularly for the ports and shipping sectors
- **Dredging and disposal:** this is an enabling activity which is essential to the functioning of ports and marinas, positive factors include, safe access and egress to ports and harbours for all users and supporting future port development. Continued navigational access to ports and harbours would not be achieved without maintenance dredging, whilst capital dredging enables new activities to proceed by creating new, deeper and wider channels, and berths
- **Aggregates:** an increase in extraction of marine won aggregates may necessitate suitable port facilities to allow landing and, where necessary, processing. This has the potential to contribute to maintaining or increasing port profitability
- **Tourism and recreation:** particularly with considerations of greener travel and reducing carbon emissions, this sector is seeing an increase in cruise ships and ferry services.

3.7 Aquaculture

The physical barriers and constraints identified for activities and use cases for aquaculture include:

- **Tourism and recreation:** sites where shellfish aquaculture is most likely to develop may also be sites that are popular for other inshore activities such as recreational sailing and boating activity which could produce spatial conflicts
- **Ports and shipping:** shipping lanes take precedent over aquaculture activities and therefore may limit areas for production and aquaculture farming. However, there are some examples of aquaculture existing within statutory harbour areas e.g. Poole harbour
- **Fisheries:** there may be competition for space and objections from commercial fisheries over the space required for aquaculture
- **Environment:** environmental quality issues may be a limiting factor to aquaculture project development where poor water quality in inshore areas occurs.

The physical enablers identified for activities and use cases for aquaculture include:

- **Energy production (offshore wind):** it is possible to co-locate shellfish aquaculture and the fixed structures within wind farm developments
- **Environment:** reduction of pollution of shellfish waters will help provide a sustainable base for development of the inshore aquaculture sector, as well as reducing public health risks.

3.8 Tourism and recreation

The physical barriers and constraints identified for activities and use cases for tourism and recreation include:

- **Energy production (offshore wind):** the tourism and recreation industry may be affected by the location and siting of new substations associated with cabling coming onshore. Seascape of an area and visual impacts of any new coastal substations and converter stations also need careful consideration to ensure both access to the coast and enjoyment of coastal areas and the overall socio-economic benefits of these activities are not undermined by new offshore, and associated onshore developments
- **Coastal change and flooding:** impact upon seascape from coastal flood defences can be negatively received. The visual, cultural, historical, and archaeological impacts are particularly important for all coastal areas. Increased coastal erosion and flooding could also impact on the tourism and recreation opportunities and associated economic benefits for local communities
- **Dredging and disposal:** if not managed effectively, dredging can cause degradation of heritage assets through direct or indirect physical activity
- **Ports and shipping:** increase in both commercial shipping and recreational craft activity may increase the risk to safety of navigation as space is squeezed. Cumulative effects and potential 'squeeze' of other sectors on the navigational needs of tourism and recreation interests should be considered. A reduction in available space for commercial shipping may have a knock-on effect on recreational boating. This can force recreational craft into the same space as commercial shipping thus creating a potential navigation hazard

- **Environment:** tourism and recreation rely heavily on a clean and healthy environment to attract visitors so ensuring surface and wastewater is properly managed so as not to impact upon the quality of coastlines is important.

The physical enablers identified for activities and use cases for tourism and recreation include:

- **Energy production (offshore wind):** anecdotal evidence exists of the deployment of renewable energy devices stimulating tourism related activities such as sightseeing, with boat trips being run from local ports out to renewable energy sites
- **Ports and shipping:** The tourism and recreation sector is supported through berthing of cruise liners and passenger routes to mainland Europe. There is scope for this to increase but a balance needs to be maintained as port expansion may need to be considered alongside onshore tourism on waterfronts. Ports and harbours may also play a role in the diversification of tourism and recreational activities, such as wildlife excursions, fishing trips or visiting offshore wind turbines. They are also important for ferries, yachting and cruising
- **Fisheries:** inshore fishing has strong links with many popular coastal resorts and forms an important part of our cultural and heritage assets, which in turn attracts coastal tourism. Fishing boats and associated activity form a key part of the tourism offer in areas such as Aldeburgh in Suffolk and Cromer in Norfolk
- **Environment:** designations, identified specifically for environmental or conservation characteristics or cultural heritage, are important for tourism and recreation. Visitors are attracted to these areas for a variety of reasons including conservation and wildlife watching, for recreation activities such as diving or walking and to appreciate the uniqueness of the site at the coast, including the Humber and Wash estuaries as well as the Norfolk and Suffolk coasts. A clean and healthy marine environment, including healthy beaches and good water quality, are also important to tourism and recreation.

3.9 Coastal change and flooding

The physical barriers and constraints identified for activities and use cases for coastal change and flooding include:

- **Energy production (offshore wind):** coastal habitats may be affected by the location and siting of new substations associated with cabling coming onshore. Damage to coastal MPAs would need to be compensated for in the creation or enhancement of the damaged coastal habitats
- **Dredging and disposal:** while maintenance dredging and disposal is undertaken by many ports, berth operators and marinas, to maintain safe, navigable channels, it can generate pressures including effects on a coastal landscape and or seascape (for example, maintenance through beach nourishment or disturbance of subsea features at spoil grounds) and changes to natural sedimentary systems via physical changes to contributing structures, such as alteration of channel depths

- **Tourism and recreation:** tourist accommodation, amenities and boat marinas are all built on the coastal margin, increasing the area of hard coastal engineering and interfering with the natural coastal processes of erosion and deposition and may even destroy flood defences.

The physical enablers identified for activities and use cases for coastal change and flooding include:

- **Aggregates:** the marine aggregate industry provides most of the material for beach nourishment and coastal defence schemes and this relationship needs to be recognised
- **Environment:** habitats such as saltmarshes, sand dunes, seagrass beds and mudflats, provide a variety of ecosystem services. Saltmarshes and mudflats play an important natural role in protecting the coast from flood events by reducing wave energy and buffering flood waters. Well-developed sand dune systems act to stabilise sediments, therefore reducing coastal erosion, seagrass beds are shown to support carbon sequestration and sediment stabilisation within the marine environment and saltmarsh ecosystems are a globally significant carbon sink
- **Water management:** sewerage infrastructure and drainage is essential in supporting economic and social development, and for reducing the risk of flooding in rural and urban areas.

3.10 Fisheries

The physical barriers and constraints identified for activities and use cases for fisheries include:

- **Energy production (offshore wind):**
 - deployment of renewable energy devices must be planned sustainably to ensure any effects on fishing activity are minimised, there is possibility of displacement through exclusion and safety zones needed during installation. Early engagement with regional fishers via fisheries liaison through the design stage could enable and support co-location of fisheries with offshore wind farms
 - as well as the noted impacts of exclusion and displacement, there is the potential for impacts on spawning areas, and impacts from noise during construction of wind farms
- **Energy production (oil and gas):** oil and gas infrastructure, together with safety and exclusion zones, excludes other activities. Vessels of all nations are required to respect them, and it is an offence to enter a safety zone except under the special circumstances
- **Cables:** the sector is going through unprecedented growth and generally excludes (some) fishing activity especially pre-construction and construction phases. Interconnectors and transmission network cabling can also prevent bottom towed gear
- **Cables:** there is a possibility of displacement of species from activities in this sector and possible un-viability for certain elements pursuing inshore grounds in smaller vessels through exclusion zones around cabling and cable protection measures such as rock armouring

- **Aquaculture:** where there is competition for space between commercial fishing and aquaculture industry
- **Dredging and disposal:** activities and overflows from dredging vessels could have impacts on fisheries and secondary impacts to marine life and habitat associated with sediment plumes, disturbance of fish spawning, migration routes, nursery and overwintering areas
- **Aggregates:** aggregate extraction sites need to be selected with care, mindful of existing fishing activities with spawning and nursery grounds in particular
- **Environment:** MPA management measures may impact on types of fishing permitted in each MPA. This will be determined by the Inshore Fishing and Conservation Authority (IFCA) or MMO byelaws. Highly Protected Marine Areas (HPMAs) will restrict fishing activities.

The physical enablers identified for activities and use cases for fisheries include:

- **Aquaculture:** aquaculture can reduce the pressure on wild stocks from capture fishing.

3.11 Environment

The physical barriers and constraints identified for activities and use cases for the environment include:

- **Energy production (offshore wind):**
 - there are several potential environmental impacts from wind farm development including, harm or displacement of certain bird, fish and marine mammal species via underwater noise, loss or damage of habitats, cable routes to shore through protected habitats and potential scouring of sediments around the bases of turbines
 - increase in carbon emissions from greater travelling distances of vessels displaced by offshore wind
- **Carbon capture, usage and storage:** the pipelines that connect to the shoreline and between wells can cause damage to the seabed
- **Energy production (oil and gas):** oil and gas structures can have adverse impacts on migratory fish and bird species
- **Cables:** activities in this sector can damage or alter benthic habitats and communities
- **Dredging and disposal:**
 - this sector, alongside shipping and offshore construction, that cause manmade sound is of primary concern with regard to disturbance of marine life. Overflows from dredging vessels could also have impacts to marine life and habitat associated with sediment plumes, disturbance of fish spawning, migration routes, nursery and overwintering areas
 - when sediments are contaminated, dredging has the potential to cause significant environmental and health effects through exposure to contaminants in the dredging plume

- **Aggregates:** activities in this sector can impact spawning and benthic habitats
- **Aquaculture:**
 - the potential impacts of aquaculture can include the genetic alteration of local populations from escapees, changes in biodiversity caused by the escape or release of non-native species which may compete with native species, or cause changes in the natural ecosystem processes and increase potential for exchange of disease between farmed and wild fish although the exchange may be in either direction
 - marine litter caused by aquaculture gear can include environmental problems such as, ingestion by animals, entrapment and entanglement of animals, physical impacts on the benthos, disruption, and potential human exposure to micro-plastics and chemicals through the food chain
- **Tourism and recreation:** an increase in recreation vessels and water-based craft can lead to an increase in wildlife disturbance at the coast. Disturbance can be temporary, permanent and/or cumulative and can affect the ability of individuals to survive, breed, rear or nurture young, which can affect the local distribution or abundance of the species
- **Fisheries:** bottom towed and dredging fishing techniques can cumulatively lead to major environmental impacts including, the decline of target species (overfishing), bycatch, seabed damage and destruction of natural flood defences such as seagrass. Biodiversity impacts from overfishing and illegal fishing and impacts of recreational fishing are not fully understood
- **Energy production (nuclear):** often coastal locations of this activity have many environmental impacts. For example, through the construction of the plants and associated developments and marine off-loading facilities, such as jetties and marinas, for heavy plant items. There are also impacts from abstraction and discharge of cooling water during operation
- **National defence and security:** there are a variety of environmental impacts and risks associated with national defence and national security activities. These include range danger areas, protecting areas of seabed from potentially damaging activities and concerns about noise and disturbance from maritime activities. The Ministry of Defence has well established systems to manage the risks arising from its activities.

The physical enablers identified for activities and use cases for the environment include:

- **Energy production (offshore wind):** while acknowledging that offshore wind farms can result in a loss of habitat, there are some emerging findings that the submerged parts of wind farm structures can act as artificial reefs, providing new habitats. The production of low carbon energy also mitigates the impacts of climate change
- **Carbon capture, usage and storage:** low carbon energy production and storage mitigates climate change impacts
- **Dredging and disposal:** appropriately targeted disposal of dredged sediment can have an ancillary benefit in maintaining sedimentary systems

- **Tourism and recreation:** sustainable tourism and recreation activities can incorporate improvements in the quality of the natural environment and improve people's wellbeing and generate an appreciation and awareness of the marine environment.

Considerations for all marine developments

Heritage:

The historic environment of coastal and offshore zones represents a unique aspect of our cultural heritage. In addition to its cultural value, it is an asset of social, economic and environmental value. It can be a powerful driver for economic growth, attracting investment and tourism and sustaining enjoyable and successful places in which to live and work. However, heritage assets are a finite and often irreplaceable resource and can be vulnerable to a wide range of human activities and natural processes. The view shared by the UK Administrations is that heritage assets should be enjoyed for the quality of life they bring to this and future generations, and that they should be conserved through marine planning in a manner appropriate and proportionate to their significance.

Air quality impacts:

Activities and developments in the marine and coastal area can have adverse effects on air quality at various stages. The construction, operation and decommissioning phases of projects can involve emissions to air which could lead to adverse impacts on human health, biodiversity, or on the wider environment. Other key sources that impact air quality include emissions from shipping, oil and gas platforms at sea, oil and gas importing facilities, vehicle emissions as a result of increased coastal activity, and dust from construction. The generation of energy from renewable sources has an overall beneficial effect on air quality, as compared with fossil fuels.

Water quality:

Developments and other activities at the coast and at sea can have adverse effects on transitional, coastal and marine waters. During the construction, operation and decommissioning phases of developments, there can be increased demand for water, discharges to water and adverse ecological effects resulting from physical modifications to the water environment. There may also be an increased risk of spills and leaks of pollutants into the water environment and the likelihood of transmission of invasive non-native species, for example through construction equipment, and their impacts on ecological water quality need to be considered.

Water management:

Water management is the control and movement of water resources to minimize damage to life and property and to maximize efficient beneficial use. Good water management of dams and levees reduces the risk of harm due to flooding. The objective shared by the UK Administrations is to contribute to sustainable development including the health and wellbeing of the community and the protection of the environment by maintaining and developing a policy and regulatory system which provides modern, high quality management and treatment of surface and wastewater. The collection, treatment and disposal of wastewater from housing and industry, the effective drainage of storm water and runoff to the sea, mitigating the

effects of diffuse pollution from urban areas and agriculture by improved management and improvements to drainage design are key activities to achieve this.

Climate change adaptation and mitigation

Climate change is likely to mean that the UK will experience hotter, drier summers and warmer, wetter winters. There is a likelihood of increased drought, heatwaves, changes in seasonal precipitation and the intensity of weather events such as rainfall leading to flooding. For the UK's marine environment, the impacts of climate change include relative sea level rise, increased seawater temperatures, ocean acidification and changes in ocean circulation. Understanding the impacts and effects of climate change is key to maintaining a healthy environment. This will influence how we use and value our coasts and seas both now and in the future. Adaptation, including in the marine environment, is necessary to deal with the potential impacts of these changes which are already in train. Sea level rises, increased flooding and coastal erosion will lead to increased vulnerability for development and significant change along parts of the UK coast.

Net gain:

The forthcoming requirement for marine net gain will be a transformative change in approach as it will require *every development* to deliver environmental improvements – not just those which impact on protected sites.

National defence and security:

The Ministry of Defence (MoD) has the power to regulate sea areas and restrict their use either temporarily or permanently by making byelaws under the provisions of the Military Lands Acts 1892 and 1900 and the Land Powers Defence Act 1958. Marine activities should not prejudice the interest of defence and national security and the MoD should be consulted accordingly.

As stated in the Evidence and Issues Report¹⁶², nearly half of the combined East marine plan areas' space is indicated as being related to defence activity. Much of this space is dedicated to Air Force air to air training areas, the majority of which do not extend to sea level. There are also two coastal air weapon ranges used for practise bombing in the East marine plan areas and there is a submarine exercise area off Flamborough Head.

Use by the MoD of coastal land for military activities precludes all other activities, limiting development opportunities.

Cables:

Subsea cables are used for many purposes, including connecting offshore infrastructure to the point where the cable comes ashore (known as export cables), connecting different electricity markets known as interconnectors, and ensuring telecommunication between separate landmasses. Subsea cabling is important to the growth and sustainability of telecommunications, offshore energy generation, electricity transmission, and energy security. Other types of subsea cables may also be used for scientific, research and defence purposes.

¹⁶² Marine Management Organisation (2014), East marine plan areas: Evidence and Issues Report, [East marine plan areas: Evidence and Issues Report - GOV.UK \(www.gov.uk\)](http://www.gov.uk)

Subsea cables are subject to different controls in legislation and licensing, depending on the purpose of the cables and where the cables are to be located. All subsea cables are subject to licensing controls within UK territorial waters, although the licensing process for telecommunication and interconnector cables is different from cables used for offshore energy generation. Beyond territorial waters, telecommunications and interconnector cables are exempt from licensing, but cables associated with exploration or exploitation of natural resources (such as offshore wind energy generation) within the UK Exclusive Economic Zone remain subject to licensing control (for example, inter-array cables for wind farms or export cables).

Inter-array and export cables associated with offshore energy generation may fall under the Planning Act 2008 if they are associated with a Nationally Significant Infrastructure Project. Activities associated with cables, including maintenance and protection, are also subject to different licensing controls, depending on the type and location of the cable. Landfall sites are areas on the coast where subsea cables come ashore. Subsea cabling is important to the growth and sustainability of a range of interests including, but not limited to:

- climate change mitigation
- electricity transmission
- energy security
- offshore wind farms
- telecommunications

Subsea telecommunications cable connectivity is a vital part of supplying a high quality superfast broadband experience to users. Lack of telecommunications services can have a significant impact on the financial trading industry and other internet-based businesses, with considerable implications for the economy. Given their support role to the UK, electricity power cables also need similar protection measures to ensure the safety and security of the energy supply network. The UK Marine Policy Statement 3.7.1 and Building Digital UK emphasise the importance of telecommunication and power cabling as vital infrastructure for the domestic and global economy. Cables are also important for the future of electricity transmission, including the mitigation of climate change through greater efficiency, and enhanced cabling and transmission networks.

Subsea cables are generally buried where seabed conditions are suitable, but this is not always practical or possible and therefore not all cables can be buried. Where this is the case, alternative 'protection' measures may be deployed, such as split pipe, grout bags, rock placement, or mattresses, taking account of the circumstances of individual cases including normal depth limitations.

4. Trade-off analysis: opportunities and implications

Using the outputs from the previous chapters, this section captures potential trade off implications and opportunities for activities in the east marine plan areas identifying the current and future extent of these activities.

This section aims to visually represent complex location-oriented pinch points and interactions between sectors under four key scenarios. These scenarios have been developed based on where there are expected shifts and changes over the next 20 years and where sectors interact heavily. These include spatial examples of sectors that have:

- **Scenario 1** – significant barriers and constraints that require further actions to resolve or prioritise activities
- **Scenario 2** – potential to co-exist and contribute towards national priorities
- **Scenario 3** – potential to co-exist and enable other activities
- **Scenario 4** – completely restricted other activities

Spatial data was accumulated in the ArcMap project and comprises 54 unique datasets.

Based on the identification of potential physical barriers, constraints and enablers, a high-level RAG assessment is outlined in this section for the eleven focus sectors. The eleven focus sectors are assessed against each other to determine the possibility of co-existence and provides a high-level summary indicating whether their activities are either: significantly restricted, can co-exist with other activities, or have no significant restrictions. This provides a useful visual guide as to what the anticipated spatial compatibility between each sector would be.

A separate excel sheet containing the outputs of this exercise is provided along with this report. An illustration of this, is shown below. The RAG assessment is based on the ability for each sector in the “*relationship of focus sectors*” axis to enable or restrict activities in the focus sectors. Therefore, RAG ratings are likely to vary across the same sectors.

An additional RAG assessment is included to reflect the interactions with other sectors that haven’t been covered in this report. Most of these sectors do not create significant spatial barriers, but their impact and interactions need to be considered to fully understand the carrying capacity of the east marine plan areas.

Please note that the assessment in this section is not based on an exhaustive review of all barriers, constraints and enablers for activities in the east marine plan areas but instead provides a high-level assessment using the attributes identified in Chapter 3.

Table 5: RAG assessment and relationship between focus sectors

		Relationship of focus sectors												
		Energy production (offshore wind)	Energy production (oil & gas)	Carbon capture and storage	Dredging and disposal	Aggregates	Ports	Shipping	Cables / pipes / connectors	Aquaculture	Tourism and recreation	Coastal change and flooding	Fisheries	Environment
Focus sectors	Energy production (offshore wind)										R		R	R
	Energy production (oil & gas)													
	Carbon capture, usage & storage													
	Dredging and disposal										N/A			
	Aggregates										N/A			
	Ports									R		R		
	Shipping											N/A		
	Cables / pipes / connectors											N/A		
	Aquaculture	R												
	Tourism and recreation								N/A					
	Coastal change and flooding	N/A	N/A	N/A				N/A	R	R				
	Fisheries													
	Environment													
	Environment 2			R										
Environment MPA management measures														

Significantly restricted	
Co-existence possible, with limitations	
No significant restrictions/is an enabler	
No impact/activities don't tend to co-exist	N/A
Requires further assessment	R
Environment 2 includes - good environmental status - water quality, air quality, invasive non-native species and biodiversity.	

Table 6: RAG assessment and relationship with additional sectors

		Sector relationships								
		Telecommunications cabling	Defence	Heritage	Water quality	Water management	Seascape	Air quality	Nuclear	Climate change adaptation and mitigation
Focus Sectors	Energy production (offshore wind)					N/A				
	Energy production (oil & gas)					N/A				
	Carbon capture, usage & storage	R		R		N/A				
	Dredging and disposal					N/A				
	Aggregates					N/A				
	Ports					N/A				
	Shipping					N/A				
	Aquaculture					N/A				
	Tourism and recreation									
	Coastal change and flooding									
	Fisheries					N/A				
	Environment									
	Environment 2									
	Environment MPAs man measures									

Significantly restricted	
Co-existence possible, with limitations	
No significant restrictions/is an enabler	
No impact/activities don't tend to co-exist	N/A
Requires further assessment	R
Environment 2 includes - good environmental status - water quality, air quality, invasive non-native species and biodiversity.	

4.1 Scenario 1: significant barriers and constraints that require further actions to resolve or prioritise activities

Example 1: Impacts on fish species and spawning grounds

Protecting fish species and associated spawning grounds is fundamental for the protection of the marine ecosystem, security of the UK's food supply and economic growth from sustainable fishing. This impacts several sectors including fisheries, ports and environmental activities and use cases.

It is therefore important to understand the impacts of other activities on fish species and spawning grounds to determine where there are significant barriers and constraints that will need to be resolved through policy interventions or prioritisation and how this may change the future extent of activities in the east marine plan areas.

This example focuses on the interactions between essential fish habitats and fish spawning areas, fishing activity and energy production and storage, including offshore wind farms, oil and gas and CCUS activities. Figure 31 highlights the current extent of these activities in the east marine plan areas, except for CCUS (as this is not currently present in the east marine plan areas), and the essential fish habitats and spawning grounds across the region. Spawning grounds occupy the most space in the offshore region at 43610.77km² or 90.1% of the current space of the offshore area. This is followed by oil and gas wells, whose area covers approximately 36566.94km² or 31.71% of the offshore area. Most of the essential fish habitats are situated in the inshore region, with 2427.70km² or 59.41% of the top 25% concentration.

Some of the current spatial challenges are evident from this map – for example, the Dogger Bank region, where there is substantial spatial competition between essential fish habitats, fisheries and wind arrays and cabling. This reiterates our earlier finding that commercial fisheries are consistently competing for space with other marine developments.

Figure 32 highlights what the future extent of activities in the east marine plan areas could look like over a 20-year horizon and how this may impact fish species and spawning grounds, based on the following assumptions:

- fishing activities remains the same
- essential fish habitats and current spawning grounds remain the same
- offshore wind farms occupy more space, based on the establishment of Round 4 preferred projects
- oil and gas infrastructure remain the same and all licensed activities are considered constructed
- CCUS infrastructure is now present but occupies minimal “new” space, based on utilisation of existing oil and gas infrastructure and existing hydrocarbon fields.

The impacts of the forecasted changes in the east marine plan areas indicate an increase in spatial competition between essential fish habitats and fish spawning areas, fisheries and energy production sites. Whilst the introduction of CCUS infrastructure isn't likely to occupy “new” space, it's associated pipelines and the

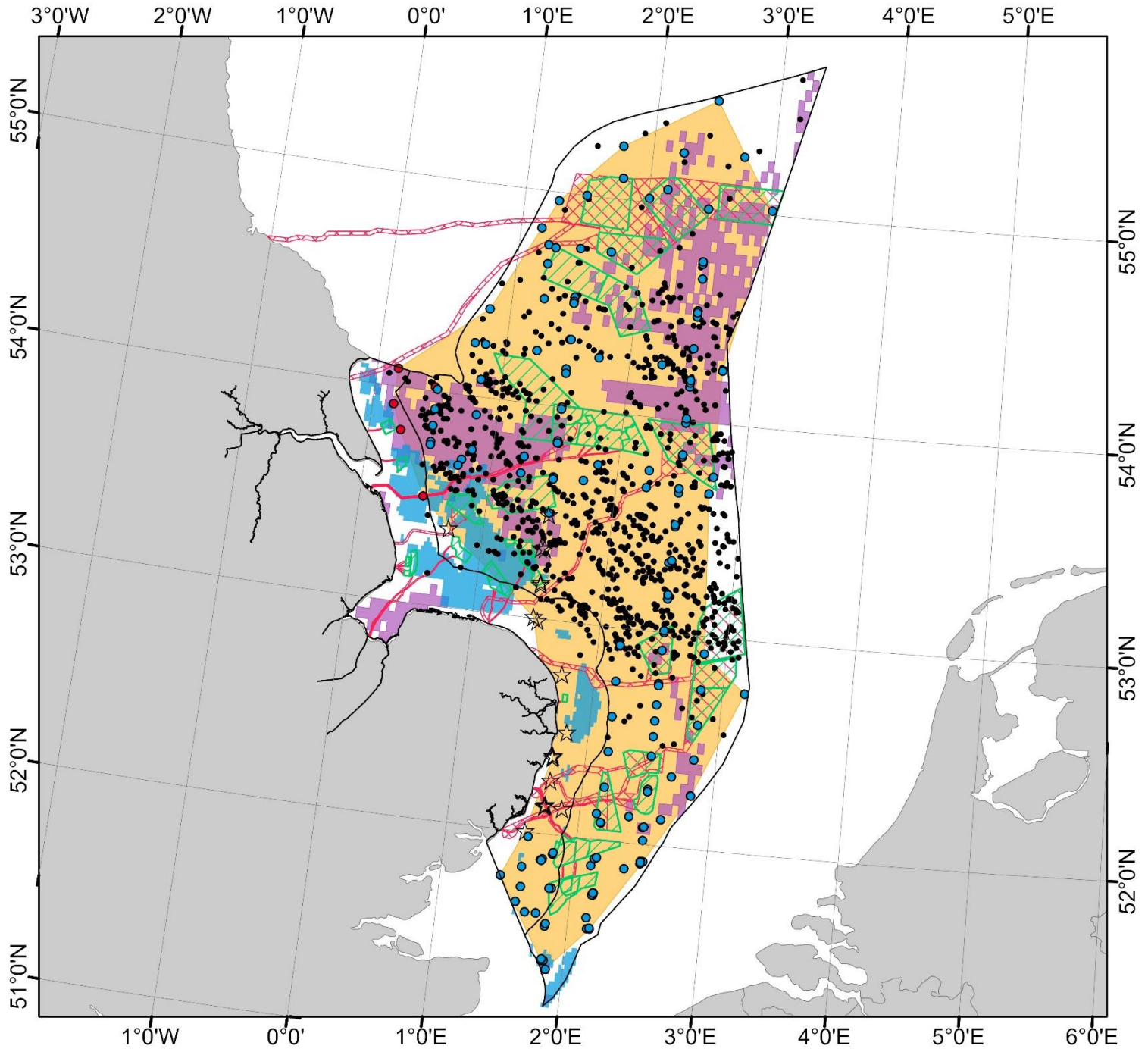
expansion of offshore wind farm sites and associated cabling is likely to conflict with essential fish habitats and fish spawning within the east marine plan areas. The largest pressure on essential fish species and spawning areas can actually come from commercial fishing itself, particularly through trawling or dredging methods that can disturb and damage the marine benthic environment.

The Round 4 preferred project sites occupy an area of 1488.94km² in the offshore area but are situated primarily on spawning grounds and do not directly impact essential fish habitats. However, it should be noted that the severity and nature of the impacts on essential fish habitats and spawning grounds from fisheries or CCUS or offshore wind farm projects depend on the type of project, the type of fishing gear used in that area, the seasonality of fishing activities in the area, and the extent to which the developer has built mitigation measures into their project design. Notwithstanding, the negative externalities that arise from construction of offshore wind farms in the short-term, wind farm arrays could potentially provide better protection to essential fish habitats and spawning grounds by excluding damaging fishing activities in the longer-term.

The expansion of these sectors is likely to increase the demand for the asset base of the east marine plan areas and increase the impacts on the carrying capacity to some extent. However, co-existence is possible through effective management and policy interventions that encourage developers to engage with fisheries pre-development to mitigate any potential negative impacts and protect essential fish habitats and spawning grounds as a priority.

Further research is required to understand the impacts from the expansion of offshore wind farms on essential fish habitats and spawning areas to effectively assess the carrying capacity of the east marine plan areas.

Figure 31 | Current Impacts from Development and Activities on Essential Fish Habitats and Spawning Grounds in the East Marine Plan Areas



- | | |
|--|---|
| Plan Areas | Fish Habitats and Spawning |
| <ul style="list-style-type: none"> □ East Marine Plan (Inshore and Offshore Areas) | <ul style="list-style-type: none"> ● Identified Spawning Locations from 2010 Study of Sample Data (Cefas): ● Cod ● Plaice ☆ Sandeel |
| Activities | <ul style="list-style-type: none"> ■ Essential Fish Habitats (MMO) ■ Spawning Grounds (Cefas) |
| <ul style="list-style-type: none"> ● Oil and Gas Wells Flowclass (NSTA) ▨ Offshore Wind Cable Sites (Crown Estate) ▨ Offshore Wind Sites (Crown Estate) ■ Areas of Fishing Activity (2015 to 2019) (MMO) | |

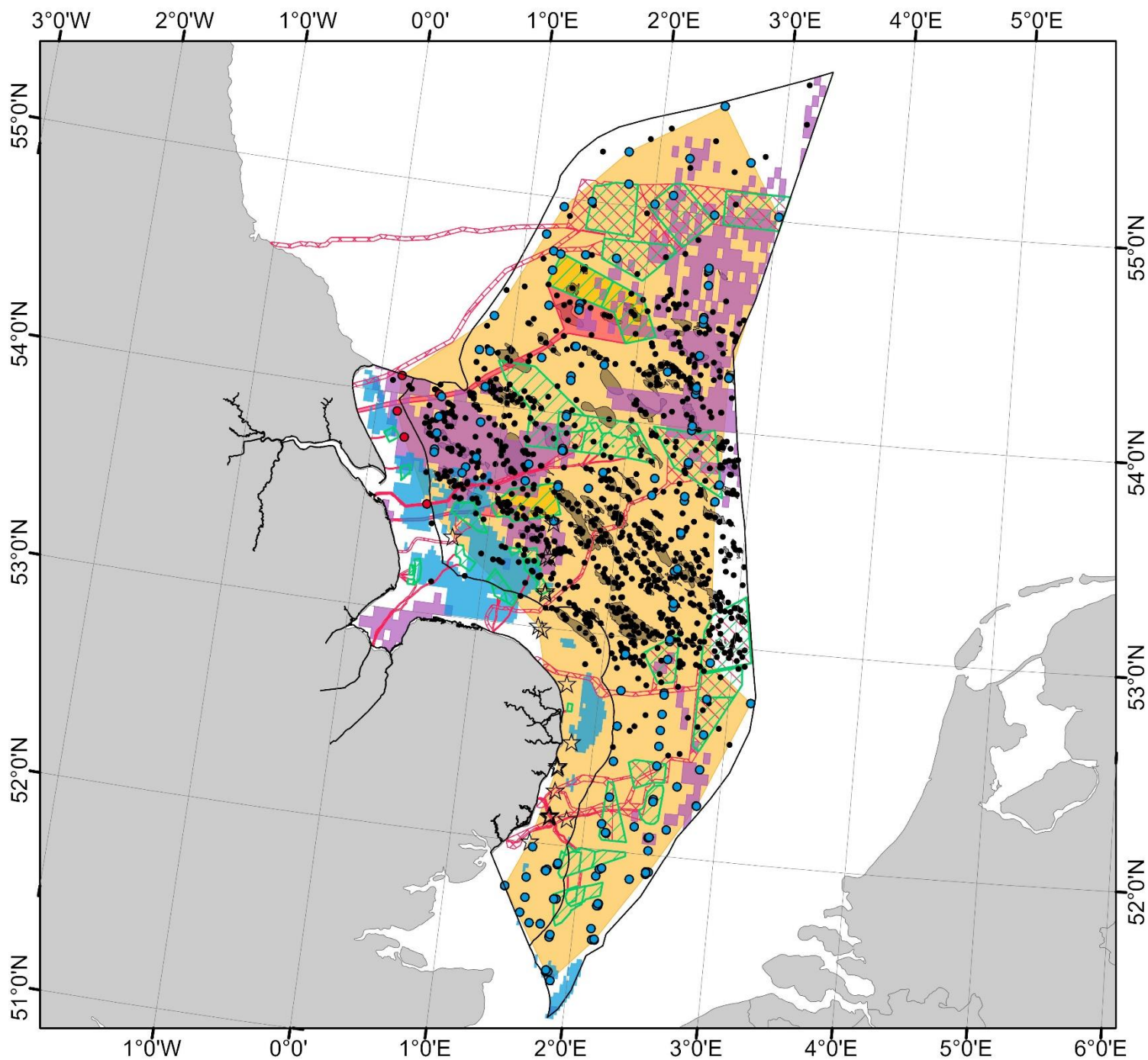


Note: The essential fish habitats data is only displaying areas where there is a concentration of more than seven adults.

Date of Publication: 30/03/2023
 Coordinate System: ETRS 1989 LAEA
 Projection: Lambert Azimuthal Equal Area
 MMO Reference: 10715

Not to be used for navigation
 Contains Collins Bartholomew, Cefas, Crown Estate, MMO, NSTA and UKHO data
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Figure 32 | Potential Future Impacts from Growth in Developments and Activities on Essential Fish Habitats and Spawning Grounds in the East Marine Plan Areas



- Plan Areas**
- East Marine Plan (Inshore and Offshore Areas)
- Activities**
- Oil and Gas Wells Flowclass (NSTA)
 - Offshore Wind Sites (Crown Estate)
 - Offshore Wind Cable Sites (Crown Estate)
 - Round 4 Preferred Projects (Crown Estate)
 - Round 4 Preferred Projects Suggested Cable Routes (Crown Estate)
 - Potential Carbon Capture and Storage (MMO)
 - Areas of Fishing Activity (2015 to 2019) (MMO)

- Fish Habitats and Spawning**
- Identified Spawning Locations from 2010 Study of Sample Data (Cefas):
- Cod
 - Plaice
 - Sandeel
 - Essential Fish Habitats (MMO)
 - Spawning Grounds (Cefas)

Note: The essential fish habitats data is only displaying areas where there is a concentration of more than seven adults.



Example 2: Impacts of inshore activities

The east marine plan areas are home to several inshore activities which can compete for space and need to be managed effectively to ensure that the marine ecosystem isn't overburdened. It is therefore important to balance economically viable activities with adherence to sustainability practices in mind, which may require policy interventions and prioritisation of activities.

This example focuses on interactions between ports, aquaculture, and environmental activities, specifically the protection of saltmarsh and seagrass species and Marine Protected Areas (MPAs), to reflect the competing priorities noted above. Figure 33 highlights the current extent of these activities in the east marine plan areas. Navigation routes represent the largest activity in the inshore area at 1872.82km² or 18.33% of the current capacity of the inshore area. The largest MPAs in the region are Special Protection Areas which covers 5983.65km² or 58% of the current capacity of the inshore area.

The MMO has identified significant potential for aquaculture development in the inshore region, which currently occupy similar spaces as 21 active ports and saltmarsh and seagrass species. There are some existing examples of aquaculture activities operating within statutory harbour areas in other marine plan areas e.g. Poole Harbour.

Figure 34 highlights what the future extent of activities in the east marine plan areas could look like over a 20-year horizon and how this may impact inshore activities, based on the following assumptions:

- MPAs remain the same and no new MPAs are added
- management measures are introduced for certain MPAs
- ports and harbours occupy more space, based on a number of predicted developments including, its crucial role in the developing fields of energy production and technological developments
- aquaculture activities occupy more space, based on potential and strategic areas of sustainable aquaculture production
- saltmarsh and seagrass species remain in the same locations.

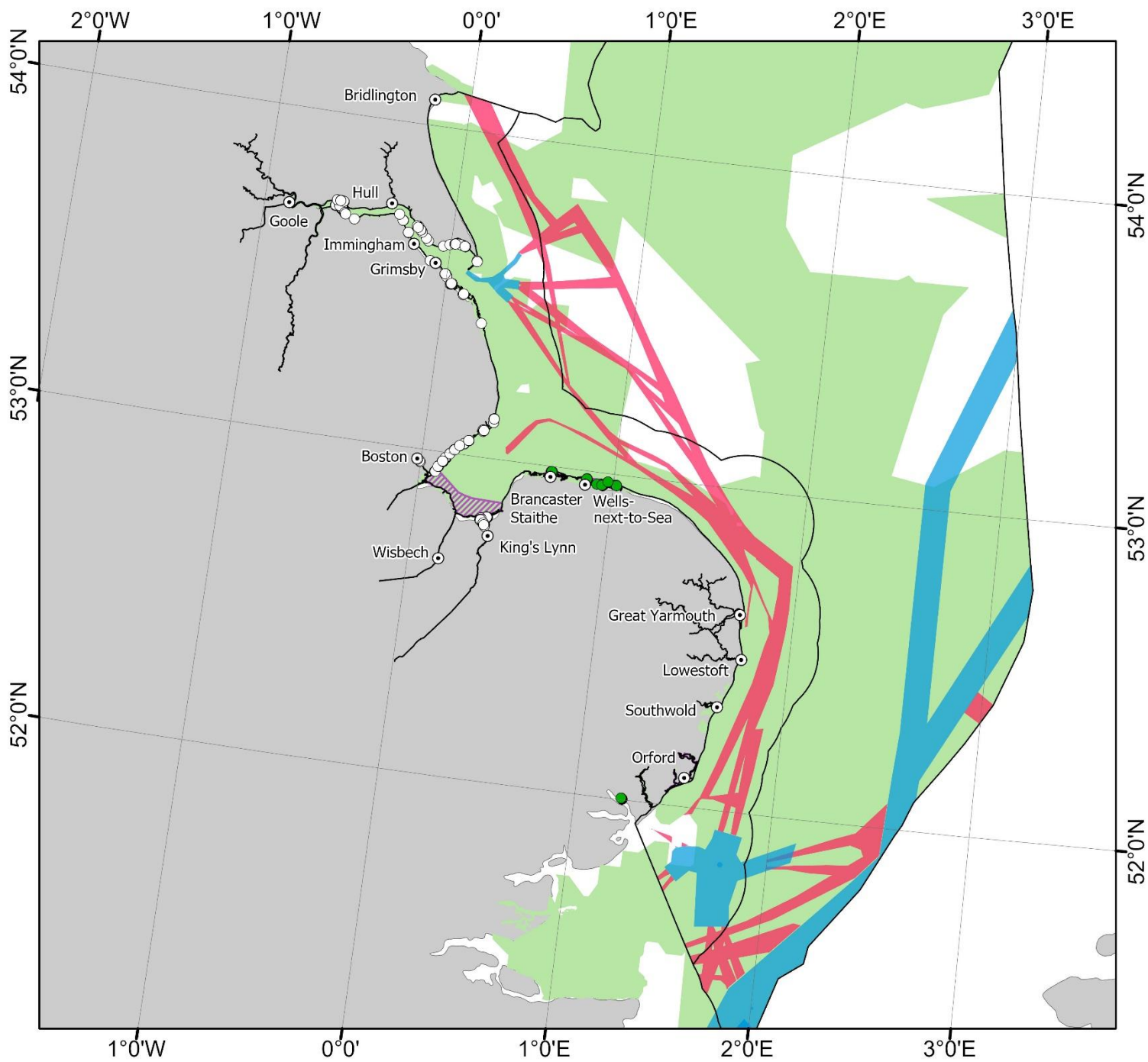
There is a marked difference between the current aquaculture production sites and the strategic areas of sustainable aquaculture, with the former having the capacity to grow by 3371.17km² or by 2154% of its current extent. The impacts of the forecasted changes in the east inshore marine plan areas indicate an increase in spatial competition and conflicts between these sectors that will need to be addressed, particularly presenting barriers for aquaculture activities. It is likely that shipping lanes will continue to take precedent over aquaculture activities and port expansions may further limit areas for aquaculture production and farming. As noted, with examples of the co-existence of aquaculture activities in Poole Harbour, existing mechanisms may be sufficient to manage these interactions. Aquaculture activity that compromises commercial navigation would not be permitted on safety grounds and in some cases the ports sector would support sustainable aquaculture development as it will lead to additional revenues to the port.

The continued focus by the MMO and government to protect the marine environment and biodiversity, including the need to ensure nature-based solutions such as local saltmarsh and seagrass species are protected, will require policy management given the possibilities of port expansion and aquaculture farming methods disrupting the natural environment along the coast. Saltmarsh and seagrass coastal habitats provide several ecosystem services such as flood defence and carbon sequestration and damage to these habitats could exacerbate floods and coastal erosion and impact upon climate change adaptation and mitigation measures. These habitats are also known to provide nursery habitats for fish species and so also remain important for protection to maintain fish stocks.

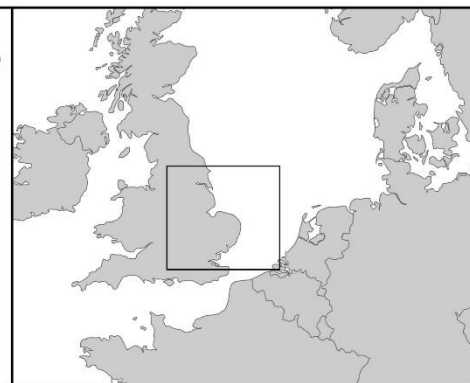
Adversely, seascape concerns may lead to objections regarding port and harbour expansion proposals. This could have a knock-on impact on other sectors that rely on port expansion such as, future offshore wind farm developments that may utilise ports to construct supporting parts for turbines or the development of zero emission and autonomous ships that may need additional port space for charging infrastructure.

The expansion of these sectors is likely to increase the demand for the asset base of the east marine plan areas and increase the impacts on the carrying capacity to some extent. However, co-existence is possible through existing management and policy mechanisms that allow ports and aquaculture farmers to engage and continue to prioritise the protection of coastal habitats and the marine environment.

Figure 33 | Current Restrictive Interactions between Inshore Activities in the Inshore East Marine Plan Area



- | | |
|---|--|
| <p>Plan Area</p> <ul style="list-style-type: none"> East Marine Plan (Inshore and Offshore Areas) <p>Activities</p> <ul style="list-style-type: none"> Significant Ports within the East Marine Plan Current Aquaculture Production Sites (Cefas) <p>Conservation Areas</p> <ul style="list-style-type: none"> Saltmarsh Species (Environment Agency) Seagrass Species (Environment Agency) Marine Protected Areas (MPAs) (JNCC and Natural England) | <p>Navigation Routes</p> <ul style="list-style-type: none"> International Maritime Organisation Navigation Routes (UKHO) Navigation Routes in the EMP Areas |
|---|--|

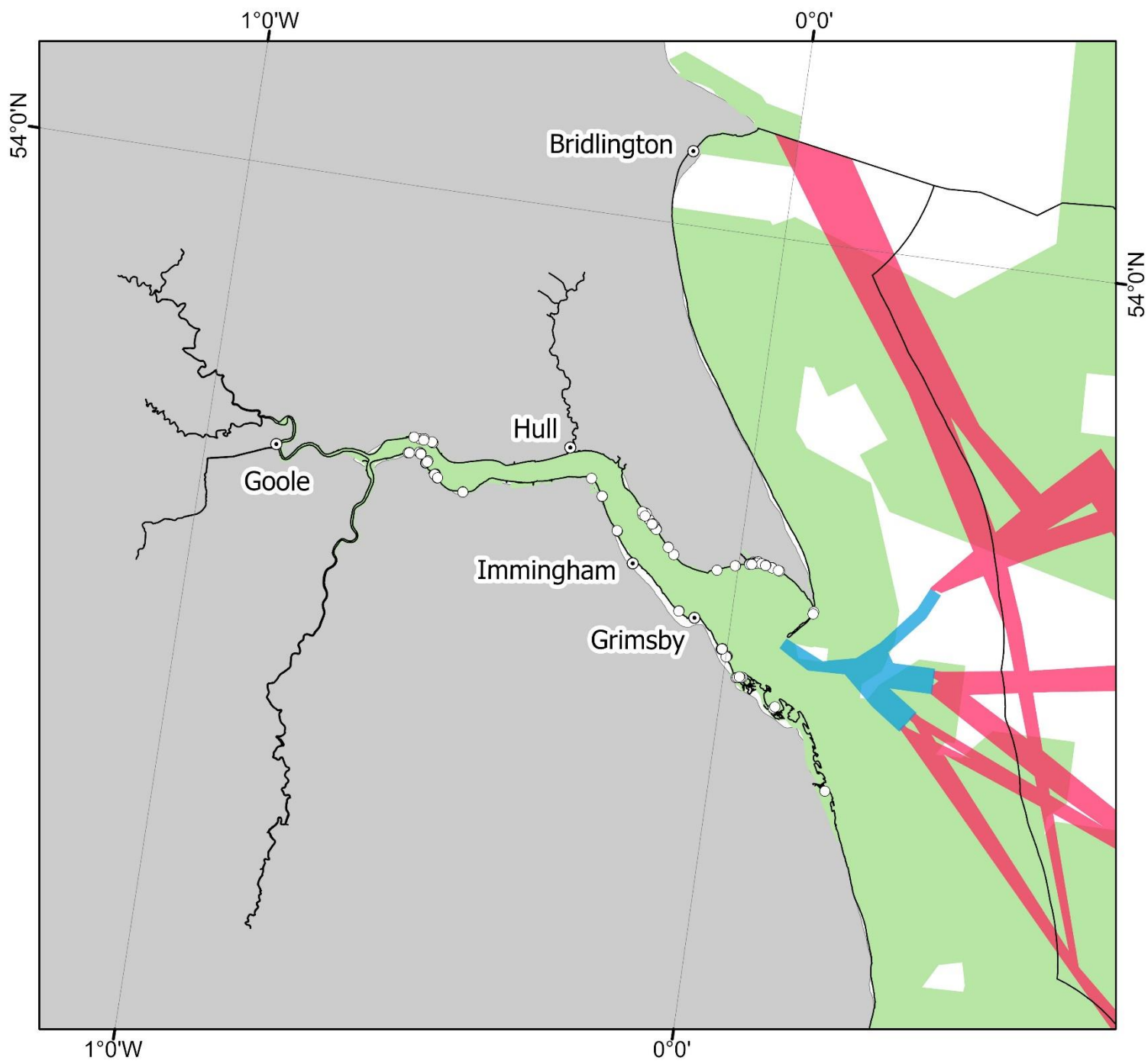


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Figure 33a | Current Restrictive Interactions between Inshore Activities (Focus on the Humberside Region)



- Plan Area**
- East Marine Plan (Inshore and Offshore Areas)
- Activities**
- Significant Ports within the East Marine Plan
 - Current Aquaculture Production Sites (Cefas)
- Conservation Areas**
- Saltmarsh Species (Environment Agency)
 - Seagrass Species (Environment Agency)
 - Marine Protected Areas (MPAs) (JNCC and Natural England)

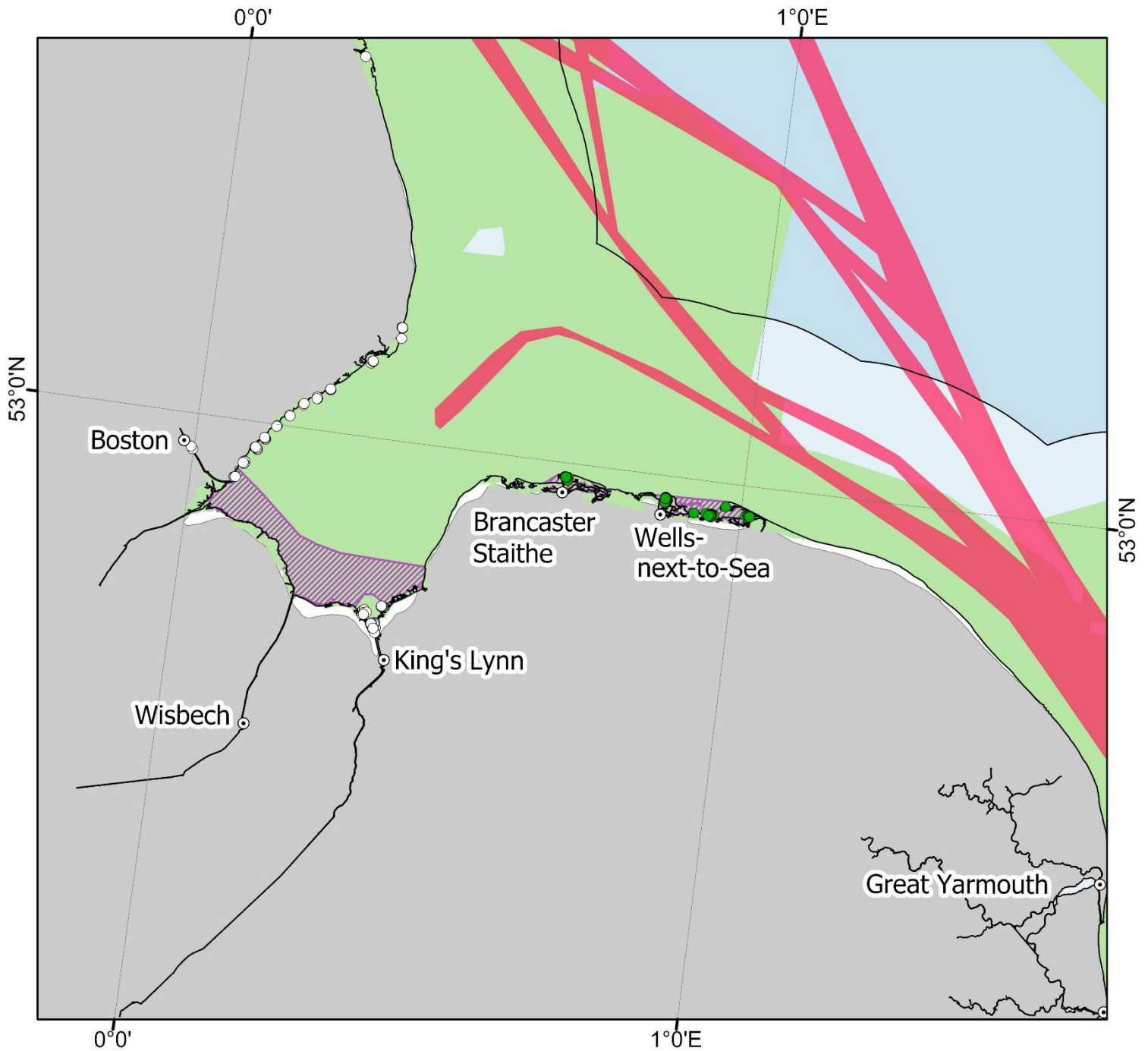
- Navigation Routes**
- International Maritime Organisation Navigation Routes (UKHO)
 - Navigation Routes in the EMP Areas



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Figure 33b | Current Restrictive Interactions between Inshore Activities (Focus on the Wash Region)



- Plan Area**
- East Marine Plan (Inshore and Offshore Areas)
- Activities**
- Significant Ports within the East Marine Plan
 - Current Aquaculture Production Sites (Cefas)
- Conservation Areas**
- Saltmarsh Species (Environment Agency)
 - Seagrass Species (Environment Agency)
 - Marine Protected Areas (MPAs) (JNCC and Natural England)

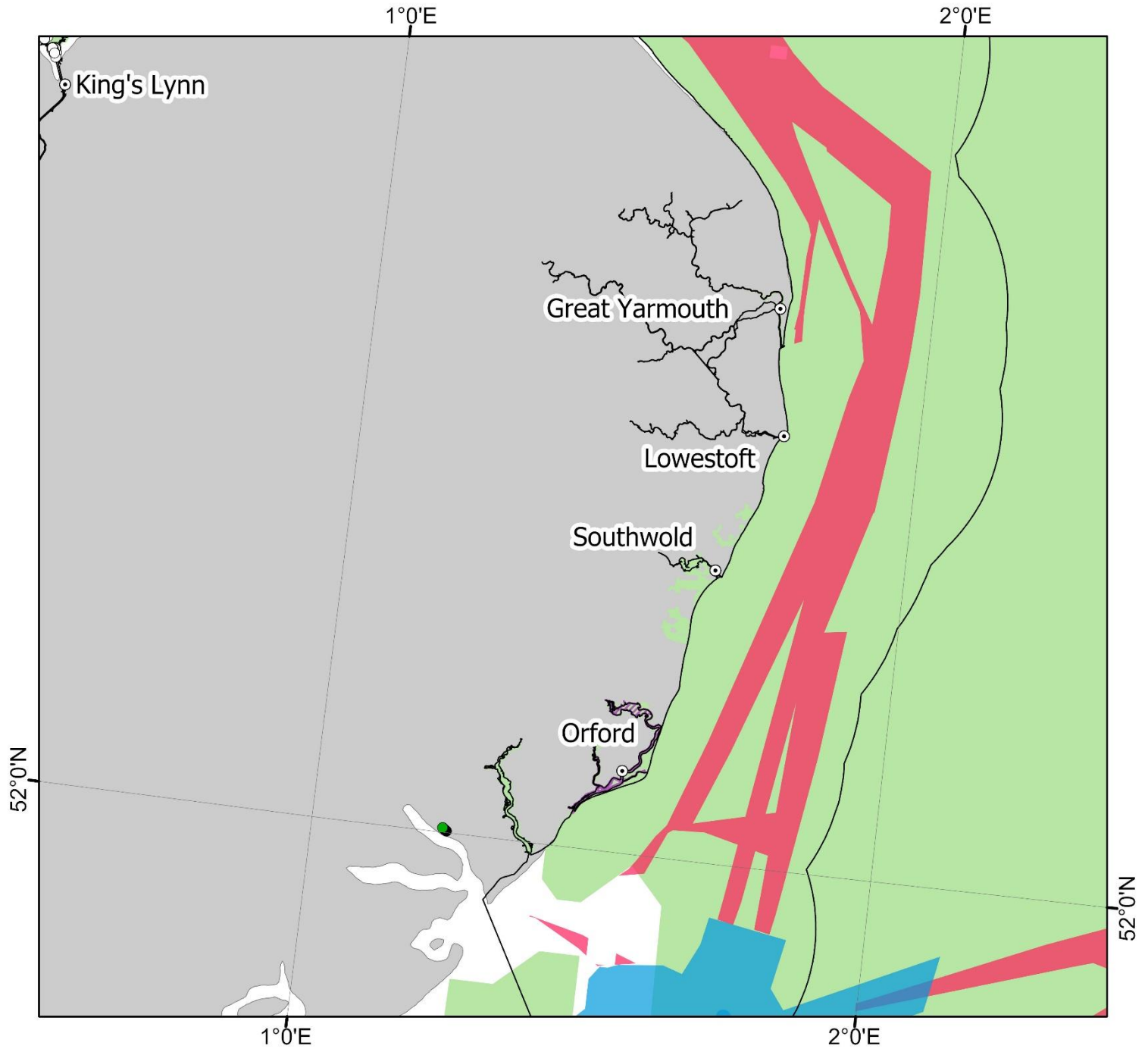
- Navigation Routes**
- International Maritime Organisation Navigation Routes (UKHO)
 - Navigation Routes in the EMP Areas



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Figure 33c | Current Restrictive Interactions between Inshore Activities (Focus on Coastal Norfolk and Suffolk)



- Plan Area**
- East Marine Plan (Inshore and Offshore Areas)
- Activities**
- Significant Ports within the East Marine Plan
 - Current Aquaculture Production Sites (Cefas)
- Conservation Areas**
- Saltmarsh Species (Environment Agency)
 - Seagrass Species (Environment Agency)
 - Marine Protected Areas (MPAs) (JNCC and Natural England)

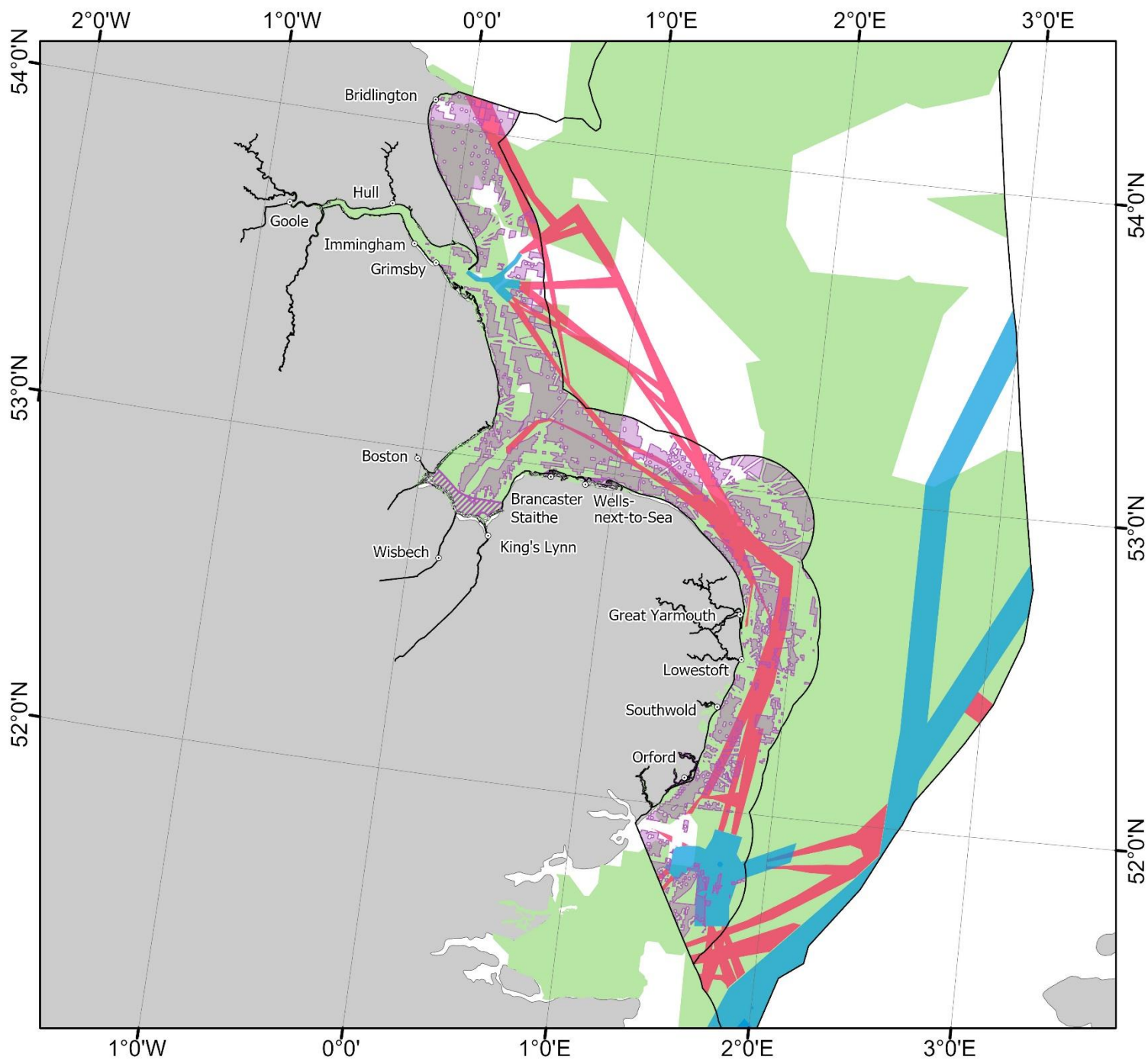
- Navigation Routes**
- International Maritime Organisation Navigation Routes (UKHO)
 - Navigation Routes in the EMP Areas



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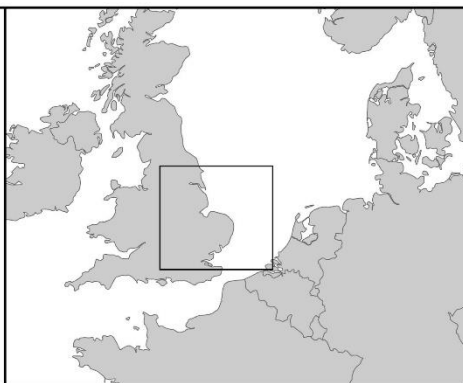
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Figure 34 | Potential Future Impacts and Restrictive Interactions between Inshore Activities in the Inshore East Marine Plan Area



- Plan Areas**
- East Marine Plan (Inshore and Offshore Areas)
- Activities**
- Significant Ports within the East Marine Plan 1km Buffer
 - Current Aquaculture Production Sites (Cefas)
 - Strategic Areas of Sustainable Aquaculture Potential
- Protection Areas**
- Saltmarsh Extents and Zonation (Environment Agency)
 - Seagrass Potential (Environment Agency)
 - Marine Protected Areas (MPAs) (JNCC and Natural England)

- Navigation Routes**
- International Maritime Organisation Navigation Routes (UKHO)
 - Navigation Routes in the EMP Areas

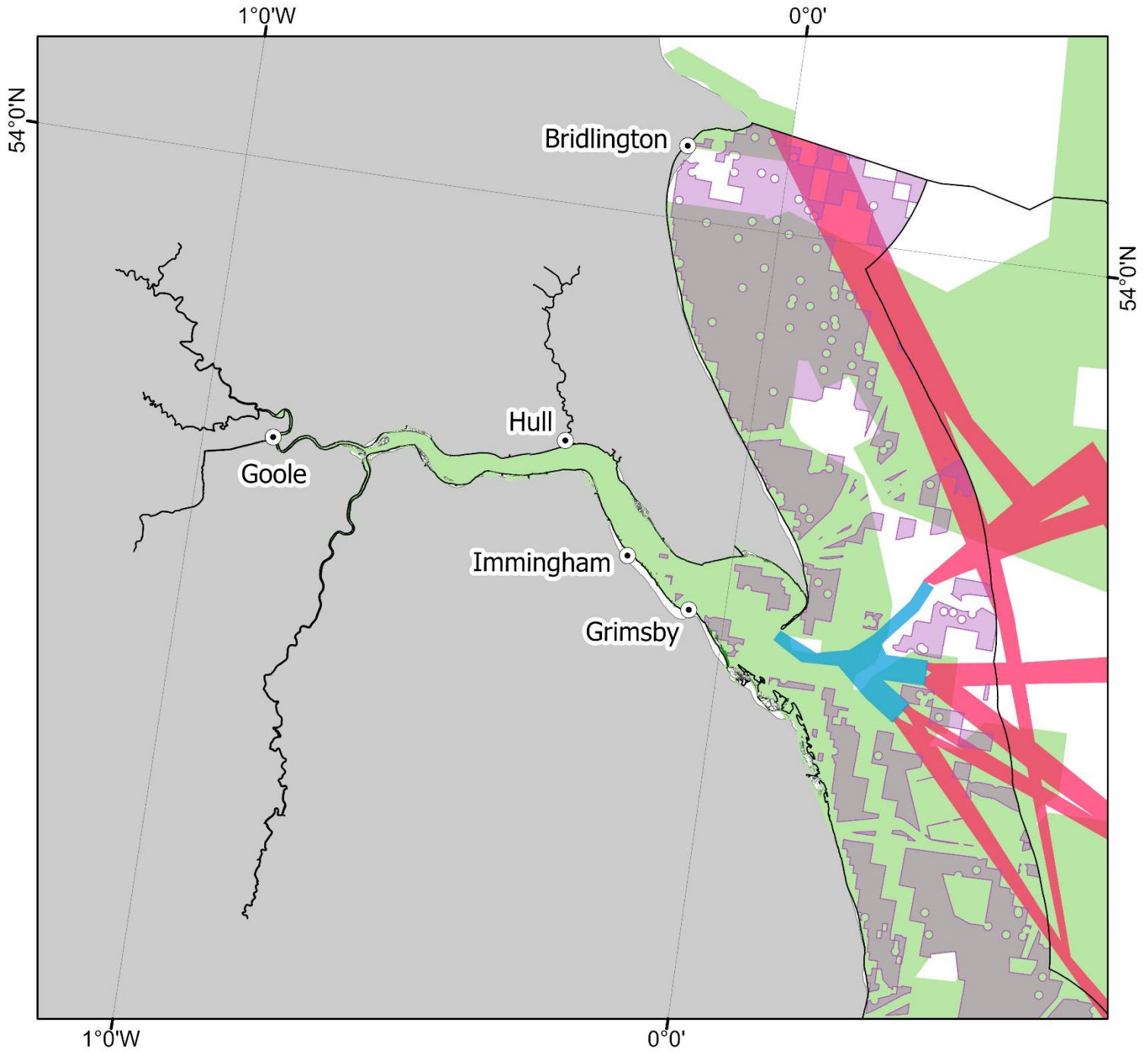


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Figure 34a | Potential Future Impacts and Restrictive Interactions between Inshore Activities (Focus on the Humberside Region)



- Plan Areas**
- East Marine Plan (Inshore and Offshore Areas)
- Activities**
- Significant Ports within the East Marine Plan 1km Buffer
 - Current Aquaculture Production Sites (Cefas)
 - Strategic Areas of Sustainable Aquaculture Potential
- Protection Areas**
- Saltmarsh Extents and Zonation (Environment Agency)
 - Seagrass Potential (Environment Agency)
 - Marine Protected Areas (MPAs) (JNCC and Natural England)

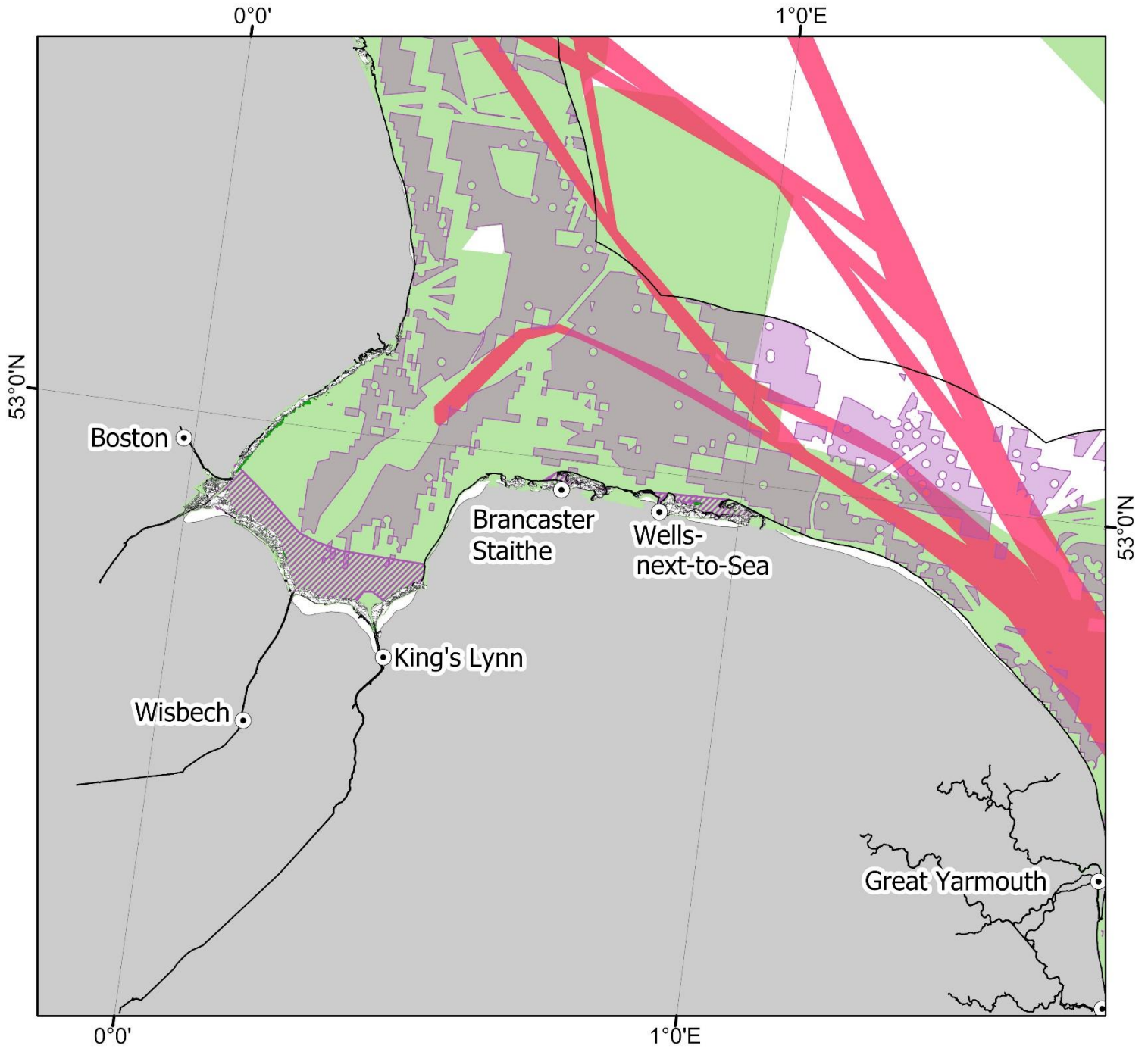
- Navigation Routes**
- International Maritime Organisation Navigation Routes (UKHO)
 - Navigation Routes in the EMP Areas



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Figure 34b | Potential Future Impacts and Restrictive Interactions between Inshore Activities (Focus on the Wash Region)



Plan Areas

East Marine Plan (Inshore and Offshore Areas)

Activities

- ⊙ Significant Ports within the East Marine Plan 1km Buffer
- ▨ Current Aquaculture Production Sites (Cefas)
- ▨ Strategic Areas of Sustainable Aquaculture Potential

Protection Areas

- ▨ Saltmarsh Extents and Zonation (Environment Agency)
- ▨ Seagrass Potential (Environment Agency)
- ▨ Marine Protected Areas (MPAs) (JNCC and Natural England)

Navigation Routes

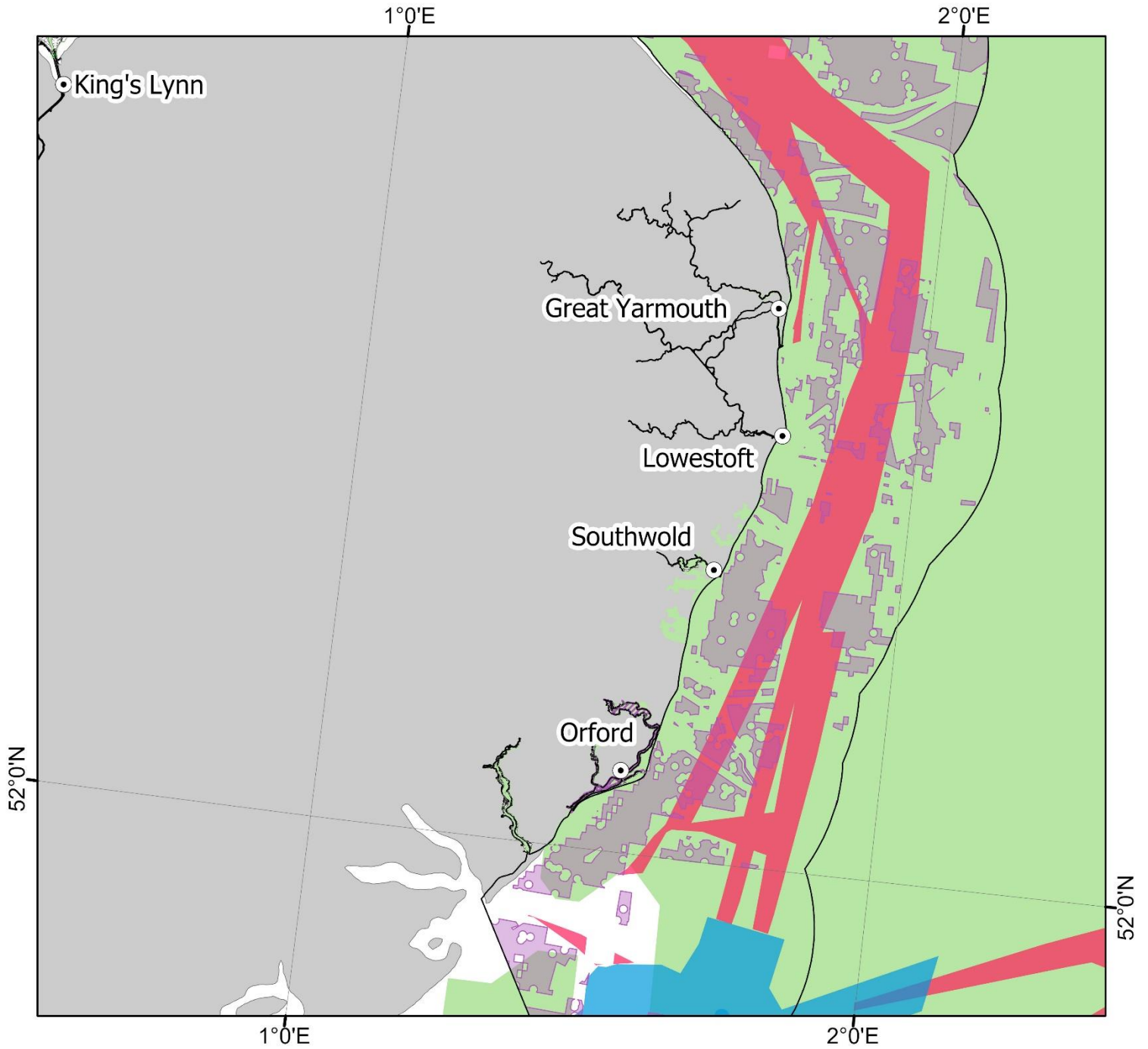
- ▨ International Maritime Organisation Navigation Routes (UKHO)
- ▨ Navigation Routes in the EMP Areas



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Figure 34c | Potential Future Impacts and Restrictive Interactions between Inshore Activities (Focus on Coastal Norfolk and Suffolk)



- Plan Areas**
- East Marine Plan (Inshore and Offshore Areas)
- Activities**
- Significant Ports within the East Marine Plan 1km Buffer
 - Current Aquaculture Production Sites (Cefas)
 - Strategic Areas of Sustainable Aquaculture Potential
- Protection Areas**
- Saltmarsh Extents and Zonation (Environment Agency)
 - Seagrass Potential (Environment Agency)
 - Marine Protected Areas (MPAs) (JNCC and Natural England)

- Navigation Routes**
- International Maritime Organisation Navigation Routes (UKHO)
 - Navigation Routes in the EMP Areas



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4.2 Scenario 2: potential to co-exist and contribute towards national priorities

Example 1: Supporting national priorities

This report identifies the national priorities that need to be considered in all future decision-making for the prioritisation of activities in the east marine plan areas. These centre around supporting activities that reverse the decline in biodiversity, reduce greenhouse gas emission (particularly carbon), reduce carbon-intensive practises, increase utilisation for renewable energy, protect the UK's food supply and increase clean maritime economic growth opportunities. Therefore, there must be due consideration for the interactions between co-existing sectors that contribute towards these national priorities.

This example focuses on the interactions between offshore wind farms, tourism and recreational activities, specifically recreational boating, sailing and marinas, and aquaculture. Figure 35 highlights the current extent of these existing activities in the east marine plan areas.

This shows that the intensity of interactions between these sectors is primarily inshore. Boating areas occupy 1436.79km² or 14.06% of the current capacity of the inshore area whereas recreational boating has a high concentration of 4271.73km² or 41.83% of the current capacity of the inshore area. Offshore wind farms do not currently pose any significant barriers or constraints to tourism and recreational activities, although further research is required to understand their long-term interactions and impacts on aquaculture.

Figure 36 highlights what the future extent of activities in the east marine plan areas could look like over a 20-year horizon, based on the following assumptions:

- offshore wind farms occupy more space, based on the establishment of Round 4 preferred projects
- tourism and recreation activities, specifically boating, sailing and marinas remain the same but may increase in density
- aquaculture activities occupy more space, based on potential and strategic areas of sustainable aquaculture production.

The addition of the strategic aquaculture layer, which occupies 32.41% of the inshore region in Figure 36, lowers the proportional representation of boating areas within the inshore region to 13.17%. The impacts of the forecasted changes in the east marine plan areas indicate an increase in intensity of activities in these sectors and therefore further interactions and similar spaces occupied. These sectors can co-exist given the distance of offshore wind farms to inshore tourism and recreation activities and inshore aquaculture production. Some anecdotal evidence exists of the deployment of renewable energy devices stimulating tourism related activities such as sightseeing, with boat trips being run from local ports out to renewable energy sites. However, seascape of an area and visual impacts of any new coastal substations and converter stations will need careful consideration to ensure both access to the coast and enjoyment of coastal areas and the overall socio-economic benefits of these activities are not undermined by new offshore and associated onshore developments. For example, a proposed wind farm off the south coast of

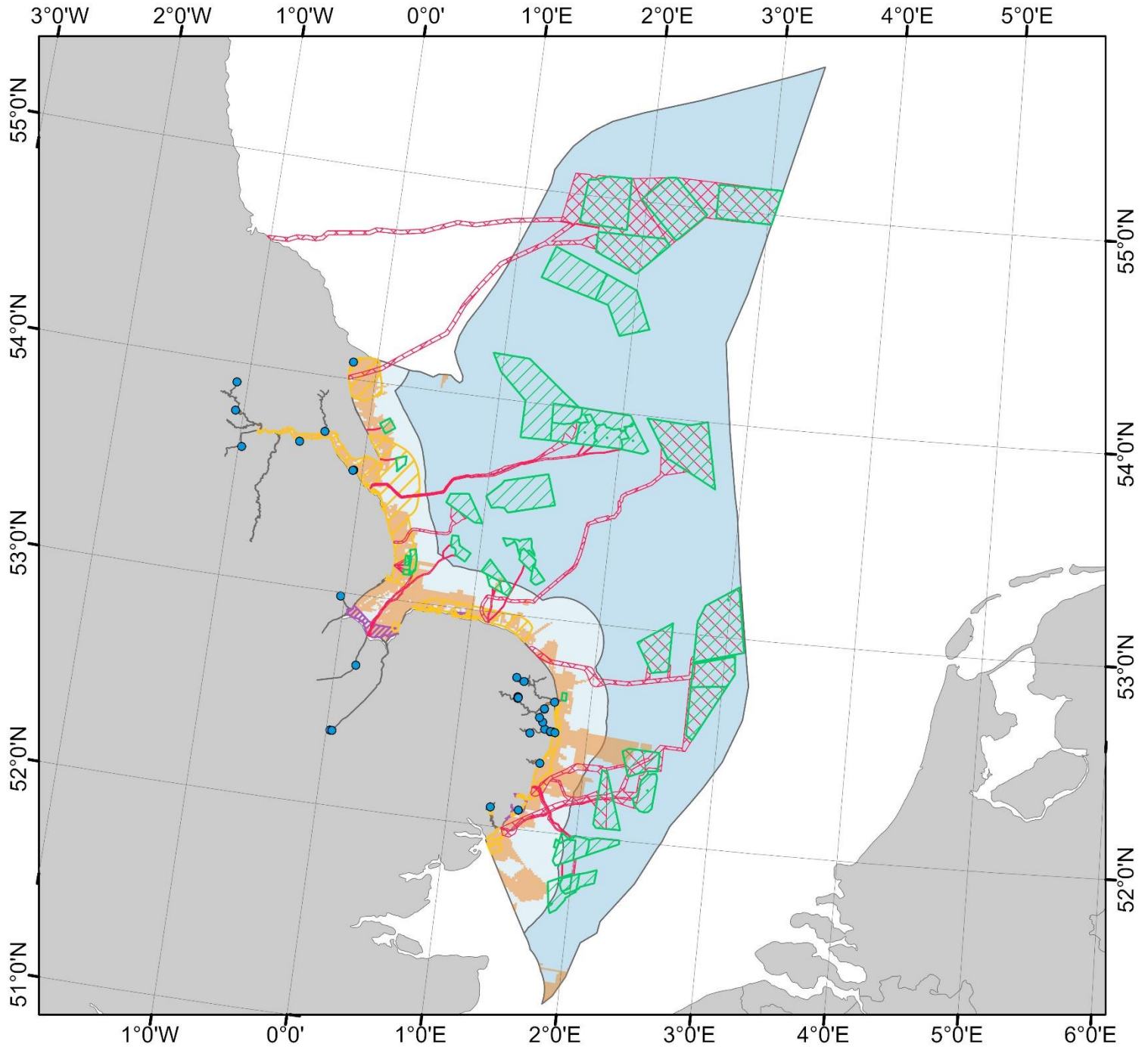
England was refused consent by the government in 2015, given its impact on the seascape and opposition from local communities.¹⁶³

There is also some emerging evidence of the potential for co-location between shellfish aquaculture and the fixed structures within wind farm developments, although additional evidence is required to determine whether this co-existence could be enabled further.

The expansion of these sectors is likely to increase the demand for the asset base of the east marine plan areas, however the potential for co-existence between some sectors will reduce the impacts on the carrying capacity. Further evidence and research gathering will enable optimal policy interventions to enable this co-existence, including understanding the impacts from the expansion of offshore wind farms on the aquaculture and tourism sectors.

¹⁶³ UK Government (2015), Planning decision for Navitus Bay offshore wind park, <https://www.gov.uk/government/news/planning-decision-for-navitus-bay-offshore-wind-park>

Figure 35 | Current Interactions between Offshore Wind, Tourism, Recreation and Aquaculture Activities in the East Marine Plan Areas



Activities

- Marinas (Royal Yachting Association)
- Offshore Wind Sites (Crown Estate)
- Offshore Wind Cable Sites (Crown Estate)
- Current Aquaculture Production Sites (Cefas)
- General Boating Areas (Royal Yachting Association)
- Recreational Sailing Model (MMO)

Plan Areas

- East Marine Plan (Inshore Area)
- East Marine Plan (Offshore Area)

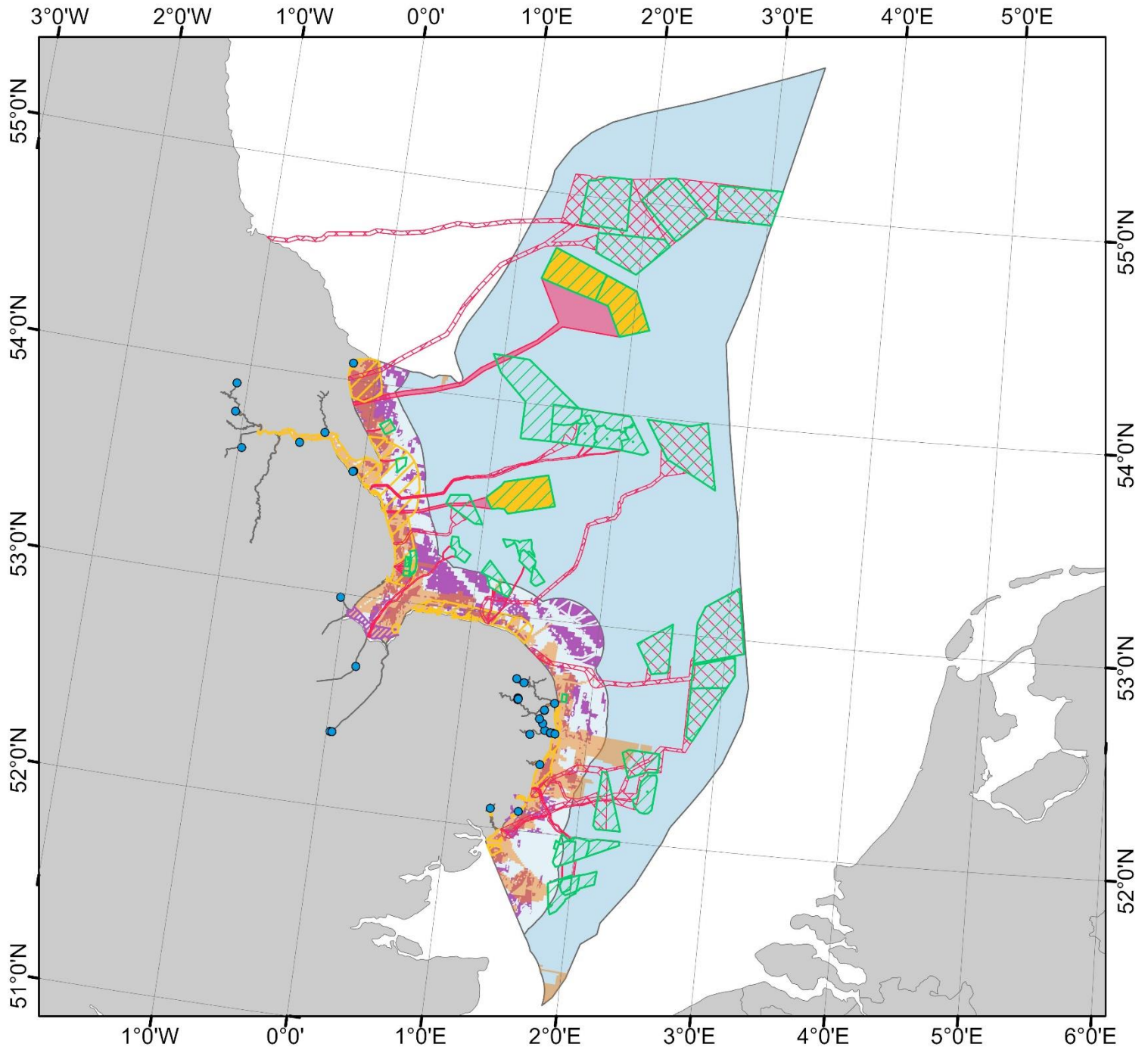


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Figure 36 | Potential Future Interactions between Offshore Wind, Tourism, Recreation and Aquaculture Activities in the East Marine Plan Areas



- Activities**
- Marinas (Royal Yachting Association)
 - ▨ Offshore Wind Sites (Crown Estate)
 - ▨ Offshore Wind Cable Sites (Crown Estate)
 - Round 4 Preferred Projects (Crown Estate)
 - Round 4 Preferred Projects Suggested Cable Routes (Crown Estate)
 - ▨ Current Aquaculture Production Sites (Cefas)
 - Strategic Areas of Sustainable Aquaculture Potential (MMO)
 - ▨ General Boating Areas (Royal Yachting Association)
 - Recreational Sailing Model (MMO)

- Plan Areas**
- East Marine Plan (Inshore Area)
 - East Marine Plan (Offshore Area)



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Example 2: Inshore activities to protect the coastline and biodiversity

As noted in the example above, there are a number of national priorities that underpin decision-making for policy interventions and prioritisation of activities in the east marine plan areas, including reversing the decline in biodiversity and protecting our coastal communities from erosion and floods.

This example focuses on the interactions between coastal change and flooding, areas of environmental importance specifically of saltmarsh and seagrass species and aggregate activities. Figure 37 highlights the current extent of these activities and species in the east marine plan areas.

Most of the existing aggregate sites are in the north and south regions of the plan areas, with a particularly high concentration east of Great Yarmouth. Aggregates provide resources for use in construction and so can play a vital role in providing material for coastal defence schemes.

Given the significant network of rivers and estuaries along the east inshore marine plan areas coastline, the potential for flooding is significant. There are also significant Coastal Change Management Areas defined in the National Planning Policy Framework as ‘an area identified in plans as likely to be affected by physical change to the shoreline through erosion, coastal landslip, permanent inundation or coastal accretion’. Both man-made flood and coastal defences require construction materials and therefore benefit from the aggregates sector.

Saltmarsh and seagrass species can provide natural flood defence protection and count towards climate change resilience and adaptation measures, whilst providing a number of other ecosystem services.

Figure 38 highlights what the future extent of activities in the east marine plan areas could look like over a 20-year horizon and the impacts on coastal erosion and flooding, based on the following assumptions:

- MPAs remain the same and no new MPAs are added
- management measures are introduced for certain MPAs
- coastal change and flooding areas remain the same
- saltmarsh and seagrass species remain in the same locations
- aggregate activities occupy more space, based on potential aggregate opportunities.

The impacts of the forecasted changes in the east marine plan areas indicate that whilst these sectors can co-exist and contribute to the national priorities of protecting the environment, preventing coastal erosion and supporting the economic growth that arises from the aggregates industry, there is a significant interaction between flood defences and saltmarsh with flood defences limiting the landward extent of saltmarsh and contributing to coastal squeeze. Managed realignment, of the existing flood defences provides opportunities to allow seawater to flood the land, re-creating saltmarsh and providing space for nature.

The marine aggregate industry can provide material for coastal defence schemes and in some cases for beach nourishment and this relationship needs to be

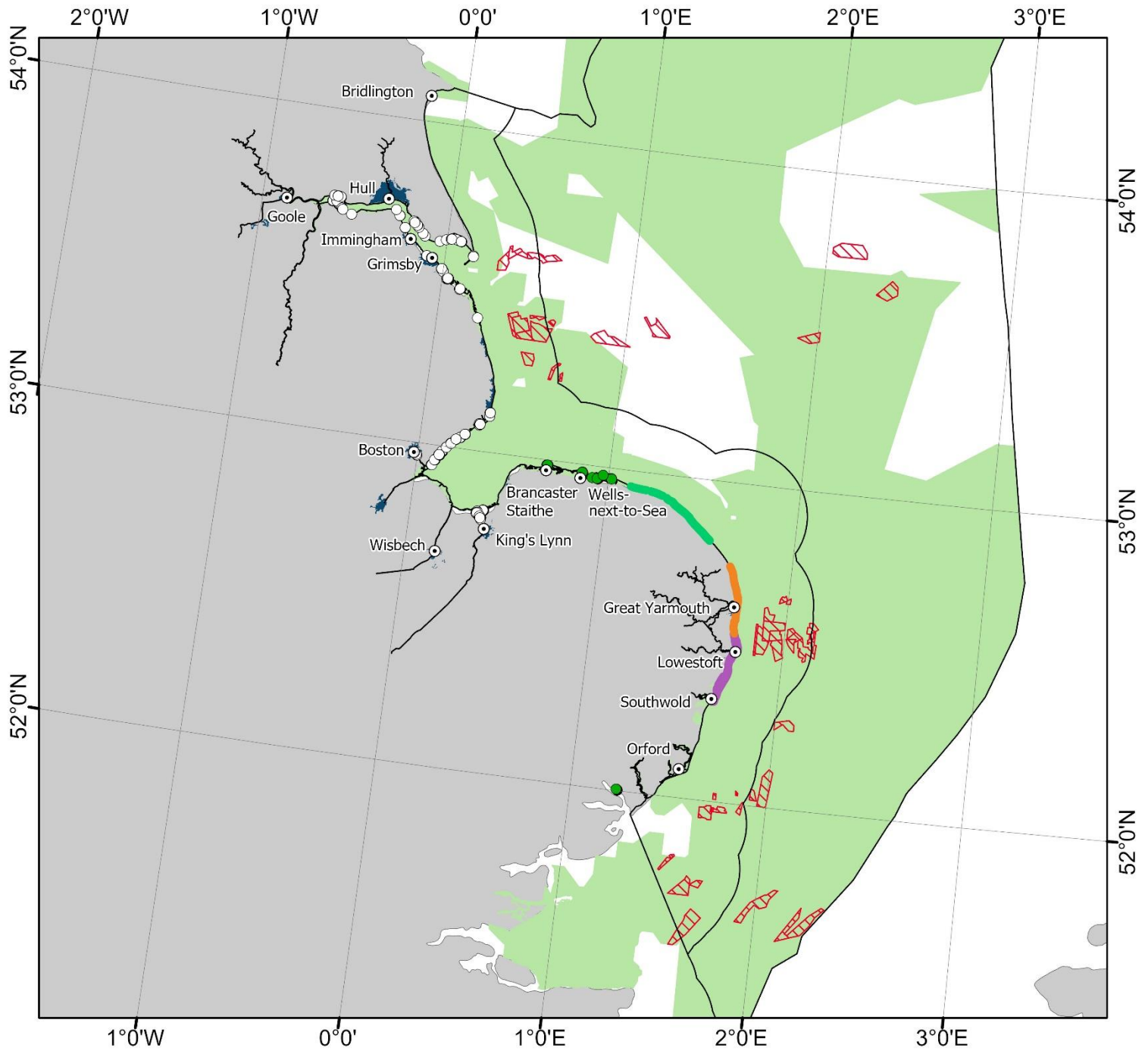
recognised in any future decisions regarding the carrying capacity of the east marine plan areas. Similarly, continued support for environmental activities that protect or enhance habitats such as saltmarshes, sand dunes, seagrass beds and mudflats, will support a variety of ecosystem services. Well-developed sand dune and salt marsh systems act to stabilise sediments, therefore reducing coastal erosion, saltmarsh and seagrass beds are also shown to be important carbon sinks and sediment stabilising habitats within the marine environment.

There are also potential areas of habitat creation in the east marine plan inshore area. For example, currently defended floodplain areas in the Humber and the Wash could be suitable for managed realignment or Regulated Tidal Exchange¹⁶⁴ to create mudflats and saltmarshes. As above, these habitats provide ecosystem services that include support for fish nursery habitats which help to improve marine biodiversity.

The expansion and co-existence of these sectors is unlikely to increase the demand for the asset base of the east marine plan areas, and in turn the overall carrying capacity.

¹⁶⁴ Regulated Tidal Exchange is the regulated exchange of seawater to an area behind fixed sea defences, through engineered structures such as sluices, tide-gates or pipes, to create saline or brackish habitats.

Figure 37 | Current Interactions of Inshore Activities for Coastal and Environmental Protection in the Inshore East Marine Plan Area



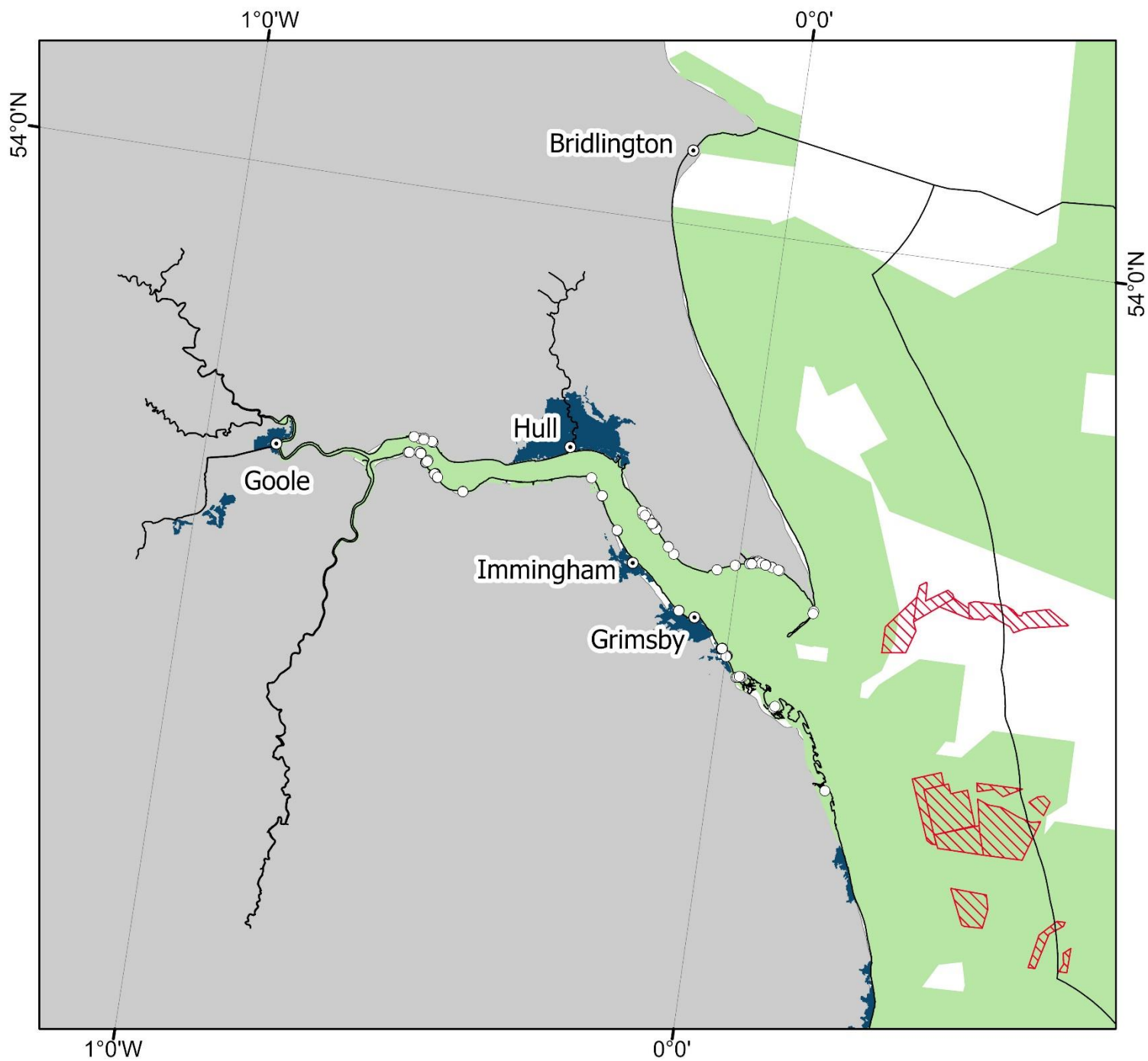
- | | |
|--|--|
| <p>Plan Areas</p> <ul style="list-style-type: none"> □ East Marine Plan (Inshore and Offshore Areas) <p>Activities</p> <ul style="list-style-type: none"> ○ Significant Ports within the East Marine Plan ■ East Suffolk CCMA (East Suffolk District Council) ■ Great Yarmouth CCMA (Great Yarmouth Borough Council) ■ North Norfolk CCMA (North Norfolk District Council) ▨ Aggregate Site Agreements (Crown Estate) ■ Flood Risk Areas (Environment Agency) | <p>Protection Areas</p> <ul style="list-style-type: none"> ○ Saltmarsh Species (Environment Agency) ● Seagrass Species (Environment Agency) ■ Marine Protected Areas (MPAs) (JNCC and Natural England) |
|--|--|



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Figure 37a | Current Interactions of Inshore Activities for Coastal and Environmental Protection (Focus on the Humberside Region)



Plan Areas

□ East Marine Plan (Inshore and Offshore Areas)

Activities

⊙ Significant Ports within the East Marine Plan

■ East Suffolk CCMA (East Suffolk District Council)

■ Great Yarmouth CCMA (Great Yarmouth Borough Council)

■ North Norfolk CCMA (North Norfolk District Council)

▨ Aggregate Site Agreements (Crown Estate)

■ Flood Risk Areas (Environment Agency)

Protection Areas

○ Saltmarsh Species (Environment Agency)

● Seagrass Species (Environment Agency)

■ Marine Protected Areas (MPAs) (JNCC and Natural England)



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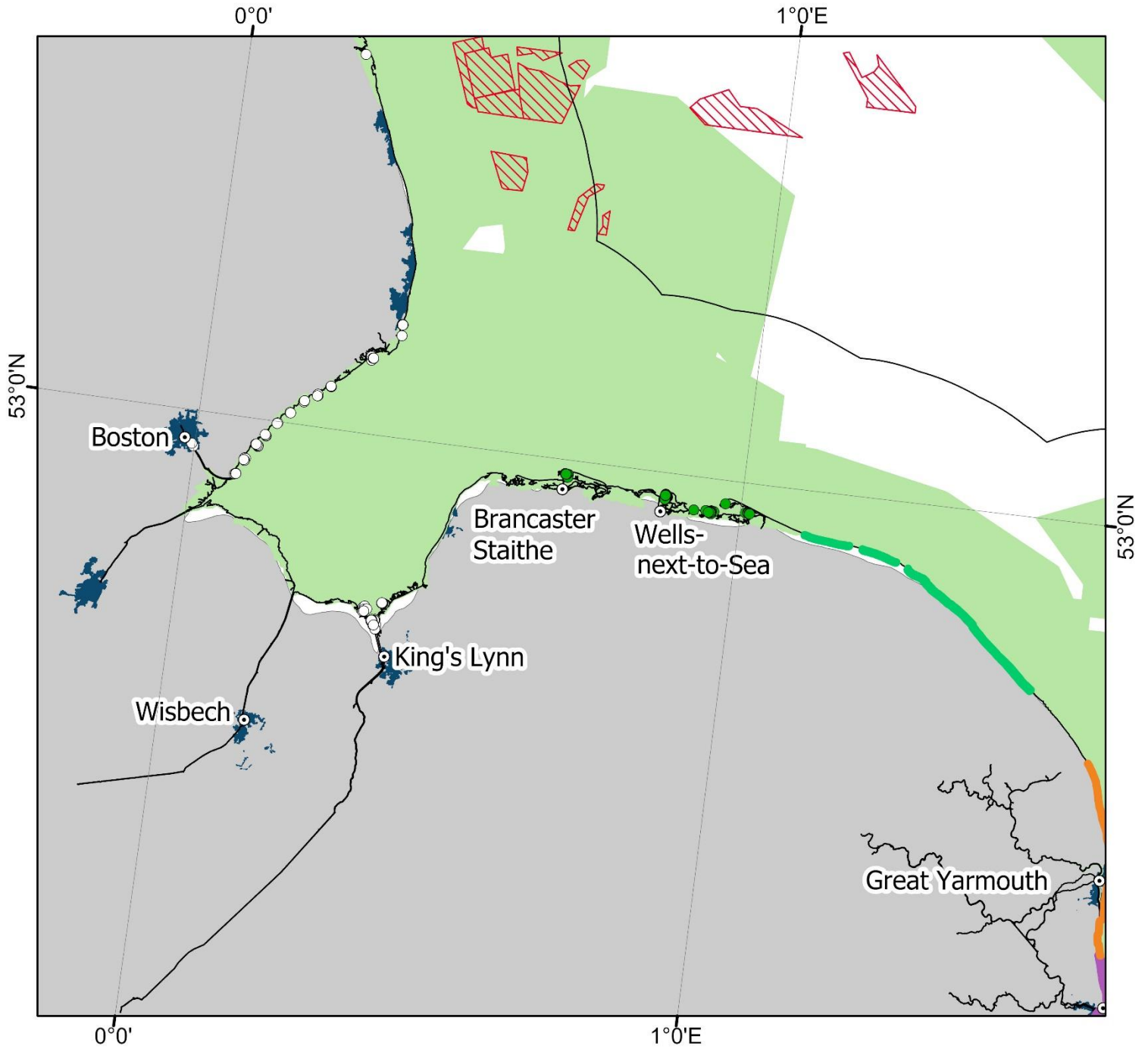
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Figure 37b | Current Interactions of Inshore Activities for Coastal and Environmental Protection (Focus on the Wash Region)






Plan Areas

 East Marine Plan (Inshore and Offshore Areas)

Activities

-  Significant Ports within the East Marine Plan
-  East Suffolk CCMA (East Suffolk District Council)
-  Great Yarmouth CCMA (Great Yarmouth Borough Council)
-  North Norfolk CCMA (North Norfolk District Council)
-  Aggregate Site Agreements (Crown Estate)
-  Flood Risk Areas (Environment Agency)

Protection Areas

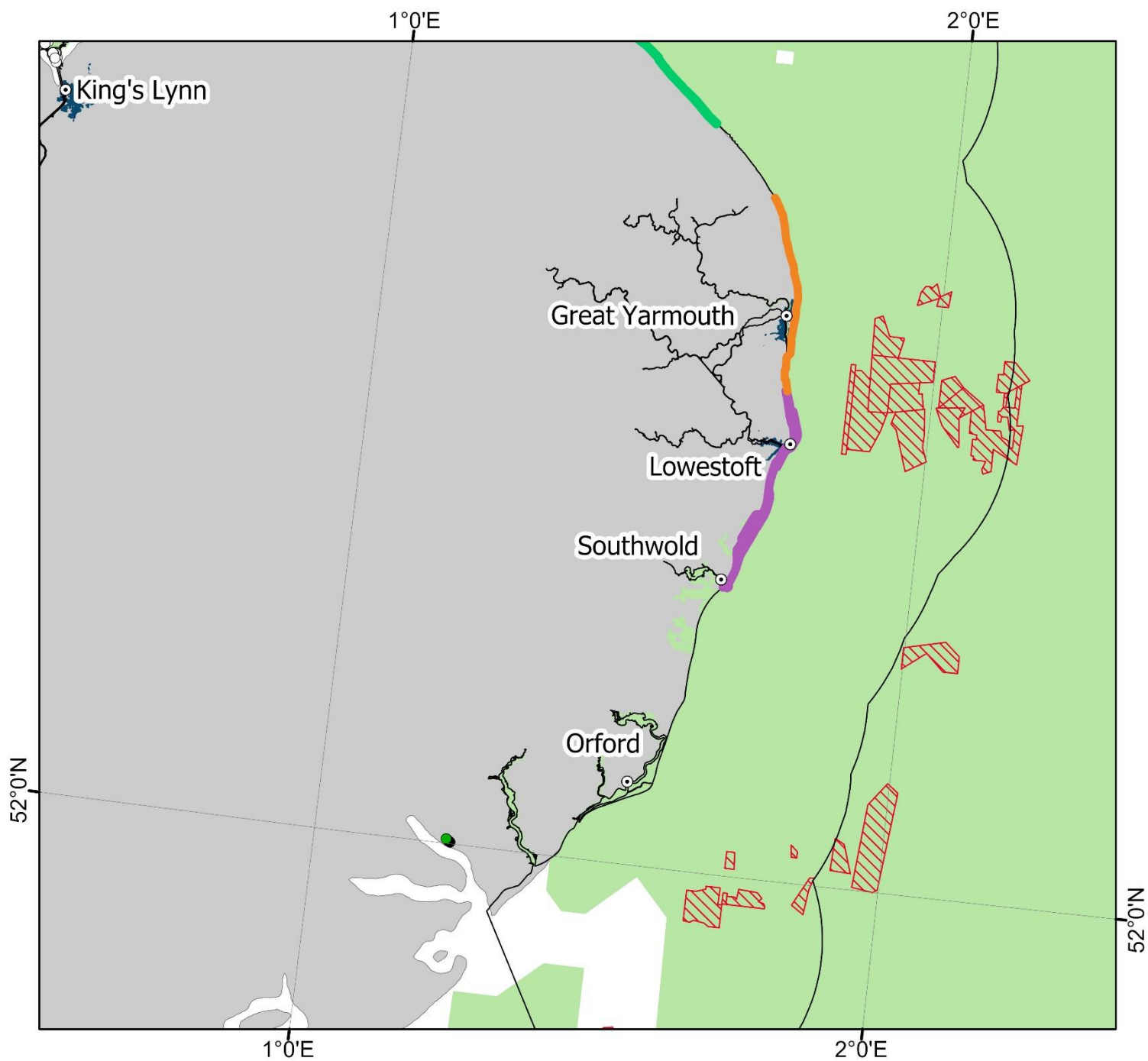
-  Saltmarsh Species (Environment Agency)
-  Seagrass Species (Environment Agency)
-  Marine Protected Areas (MPAs) (JNCC and Natural England)



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Figure 37c | Current Interactions of Inshore Activities for Coastal and Environmental Protection (Focus on Coastal Norfolk and Suffolk)



- Plan Areas**
- East Marine Plan (Inshore and Offshore Areas)
- Activities**
- Significant Ports within the East Marine Plan
 - East Suffolk CCMA (East Suffolk District Council)
 - Great Yarmouth CCMA (Great Yarmouth Borough Council)
 - North Norfolk CCMA (North Norfolk District Council)
 - Aggregate Site Agreements (Crown Estate)
 - Flood Risk Areas (Environment Agency)

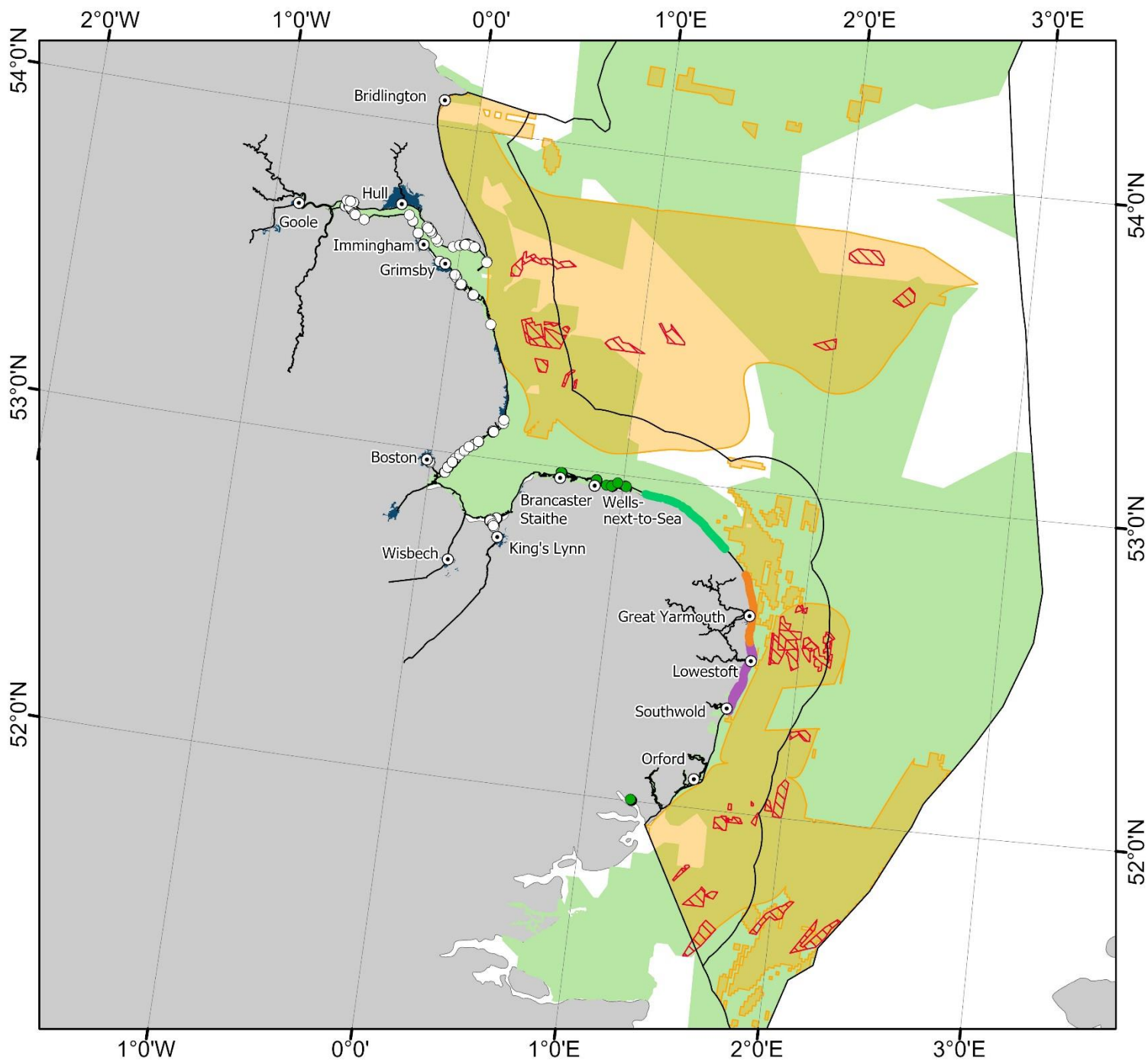
- Protection Areas**
- Saltmarsh Species (Environment Agency)
 - Seagrass Species (Environment Agency)
 - Marine Protected Areas (MPAs) (JNCC and Natural England)



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Figure 38 | Potential Future Impacts and Interactions of Inshore Activities for Coastal and Environmental Protection in the Inshore East Marine Plan Area



- Plan Areas**
- East Marine Plan (Inshore and Offshore Areas)
- Activities**
- Significant Ports within the East Marine Plan
 - East Suffolk CCMA (East Suffolk District Council)
 - Great Yarmouth CCMA (Great Yarmouth Borough Council)
 - North Norfolk CCMA (North Norfolk District Council)
 - Aggregate Site Agreements (Crown Estate)
 - Areas of Optimal Aggregate Resource (MMO)
 - Flood Risk Areas (Environment Agency)

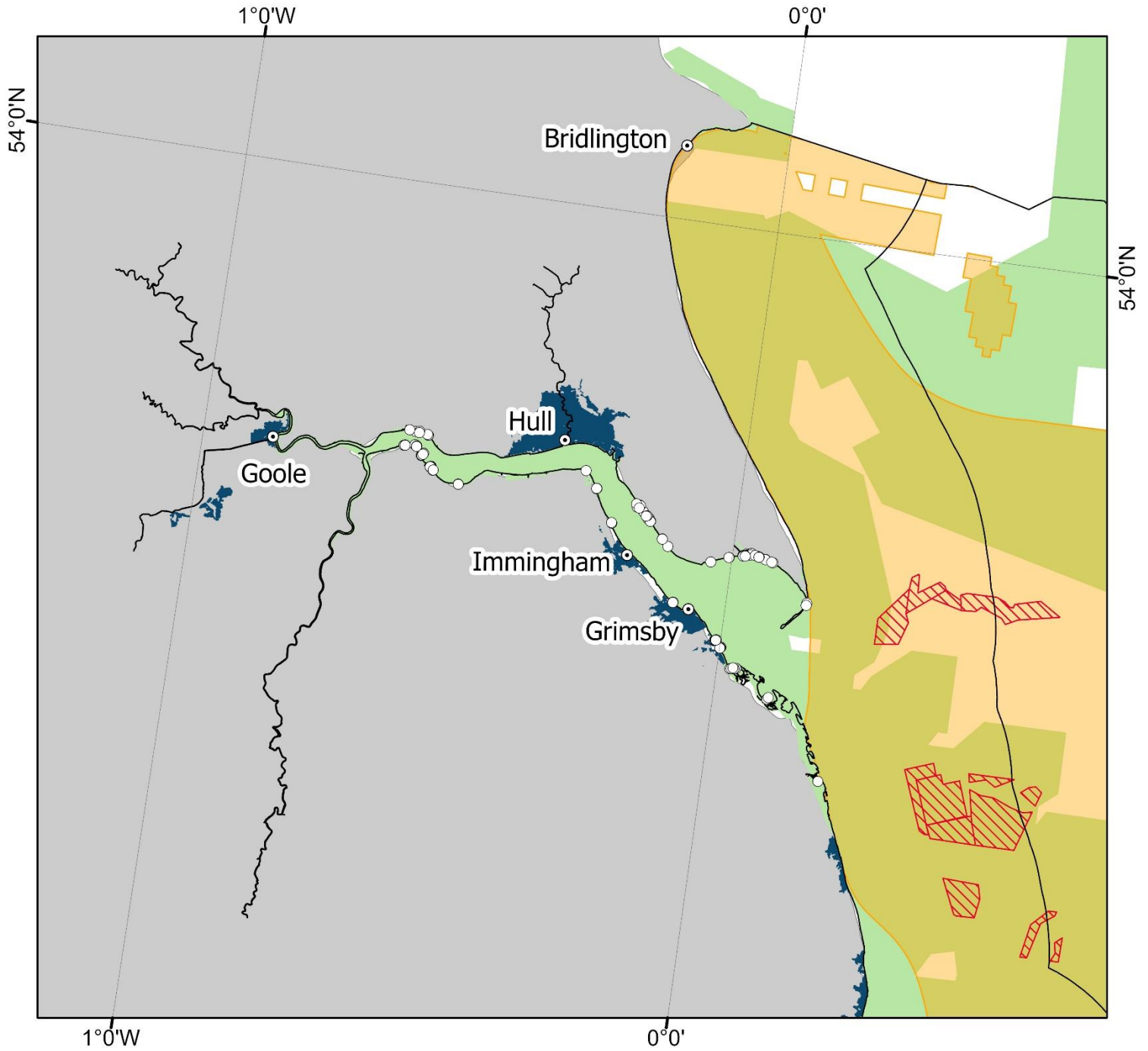
- Protection Areas**
- Saltmarsh Species (Environment Agency)
 - Seagrass Species (Environment Agency)
 - Marine Protected Areas (MPAs) (JNCC and Natural England)



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Figure 38a | Potential Future Impacts and Interactions of Inshore Activities for Coastal and Environmental Protection (Focus on the Humberside Region)



- Plan Areas**
- East Marine Plan (Inshore and Offshore Areas)
- Activities**
- Significant Ports within the East Marine Plan
 - East Suffolk CCMA (East Suffolk District Council)
 - Great Yarmouth CCMA (Great Yarmouth Borough Council)
 - North Norfolk CCMA (North Norfolk District Council)
 - Aggregate Site Agreements (Crown Estate)
 - Areas of Optimal Aggregate Resource (MMO)
 - Flood Risk Areas (Environment Agency)

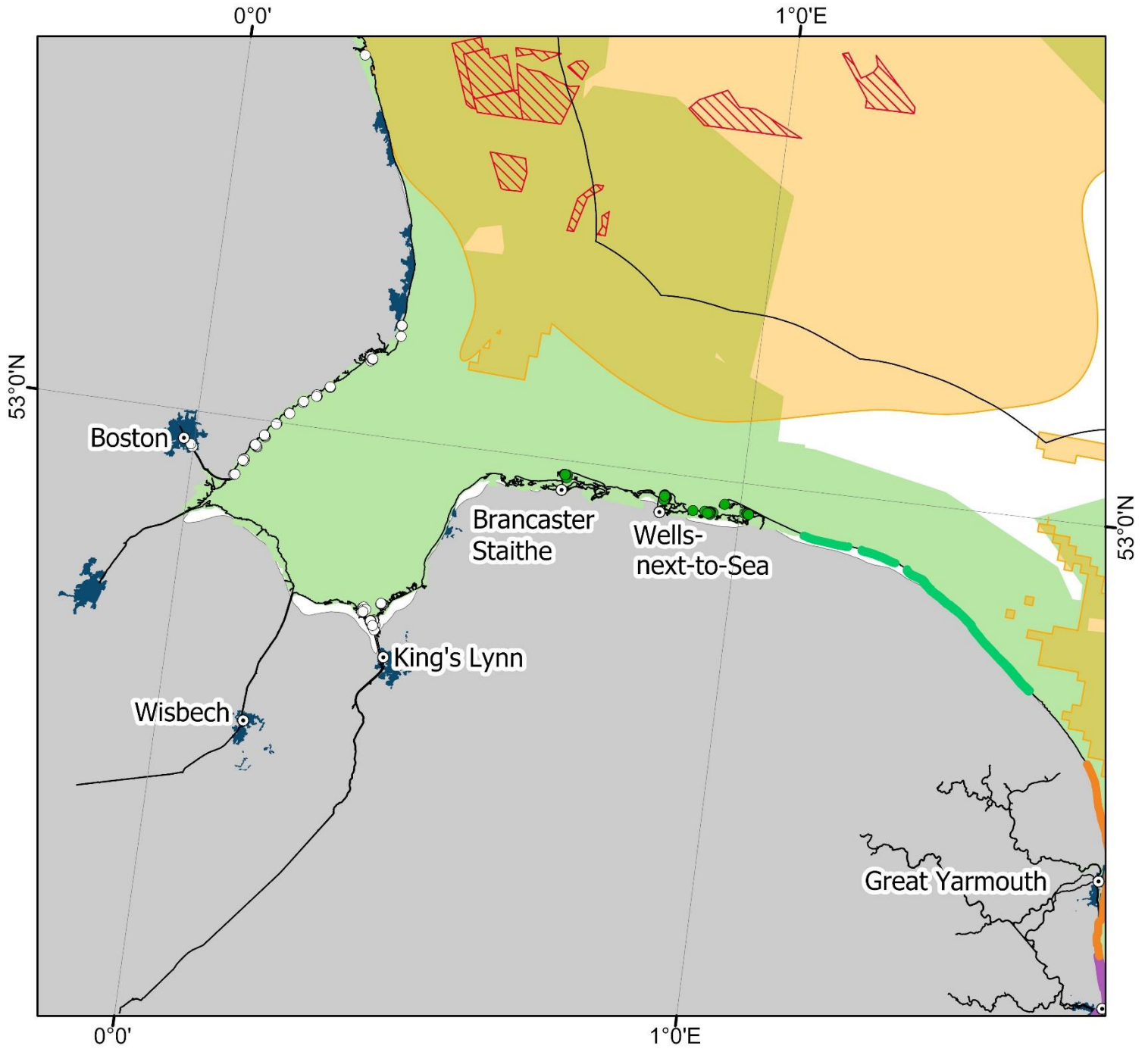
- Protection Areas**
- Saltmarsh Species (Environment Agency)
 - Seagrass Species (Environment Agency)
 - Marine Protected Areas (MPAs) (JNCC and Natural England)



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Figure 38b | Potential Future Impacts and Interactions of Inshore Activities for Coastal and Environmental Protection (Focus on the Wash Region)



- Plan Areas**
- East Marine Plan (Inshore and Offshore Areas)
- Activities**
- Significant Ports within the East Marine Plan
 - East Suffolk CCMA (East Suffolk District Council)
 - Great Yarmouth CCMA (Great Yarmouth Borough Council)
 - North Norfolk CCMA (North Norfolk District Council)
 - Aggregate Site Agreements (Crown Estate)
 - Areas of Optimal Aggregate Resource (MMO)
 - Flood Risk Areas (Environment Agency)

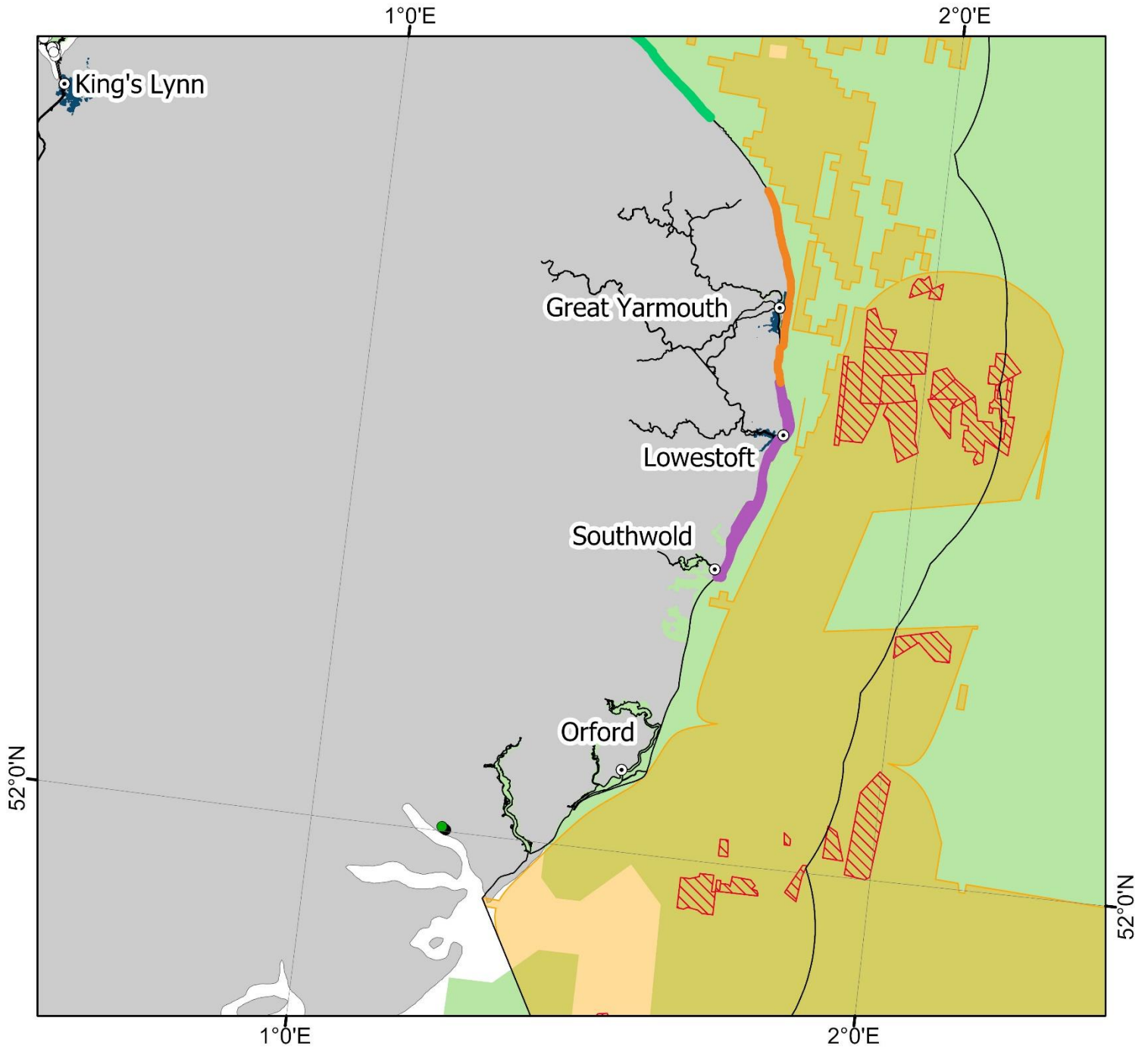
- Protection Areas**
- Saltmarsh Species (Environment Agency)
 - Seagrass Species (Environment Agency)
 - Marine Protected Areas (MPAs) (JNCC and Natural England)



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Figure 38c | Potential Future Impacts and Interactions of Inshore Activities for Coastal and Environmental Protection (Focus on Coastal Norfolk and Suffolk)



Plan Areas

□ East Marine Plan (Inshore and Offshore Areas)

Activities

⊙ Significant Ports within the East Marine Plan

■ East Suffolk CCMA (East Suffolk District Council)

■ Great Yarmouth CCMA (Great Yarmouth Borough Council)

■ North Norfolk CCMA (North Norfolk District Council)

▨ Aggregate Site Agreements (Crown Estate)

■ Areas of Optimal Aggregate Resource (MMO)

■ Flood Risk Areas (Environment Agency)

Protection Areas

○ Saltmarsh Species (Environment Agency)

● Seagrass Species (Environment Agency)

■ Marine Protected Areas (MPAs) (JNCC and Natural England)



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4.3 Scenario 3: potential to co-exist and enable other activities

Example 1: enabling inshore activities

The east marine plan areas are home to several inshore activities which can compete for space but can also enable activities across other sectors. These interactions should be recognised to support future decision-making with regards to the prioritisation of activities.

This example focuses on the interactions between ports, shipping, tourism and recreation activities, specifically recreational boating, marinas, angling and RYA yachting activities and fishing activity. Figure 39 highlights the current extent of these activities in the east marine plan areas.

Fishing activities currently occupy a significant portion of the inshore area, whilst tourism and recreation activities such as angling occupy a spatially sparse area of the inshore region. The main areas of fishing activity account for 1116.76km² or 11% of the total inshore area. Recreational activities have the capacity to develop in the inshore region without significantly impacting the distribution of nursery and spawning sites. Similarly, ports and shipping activities have the capacity to continue operations alongside tourism and recreation and fishing activities without substantial barriers or constraints.

Figure 40 highlights what the future extent of activities in the east marine plan areas could look like over a 20-year horizon, based on the following assumptions:

- fishing activities remains the same
- ports and harbours occupy more space, based on several predicted developments including, its crucial role in the developing fields of energy production and technological developments
- shipping traffic remains unchanged, although intensity is likely to increase overtime
- tourism and recreation activities, specifically angling and RYA yachting areas remain the same but may increase in density.

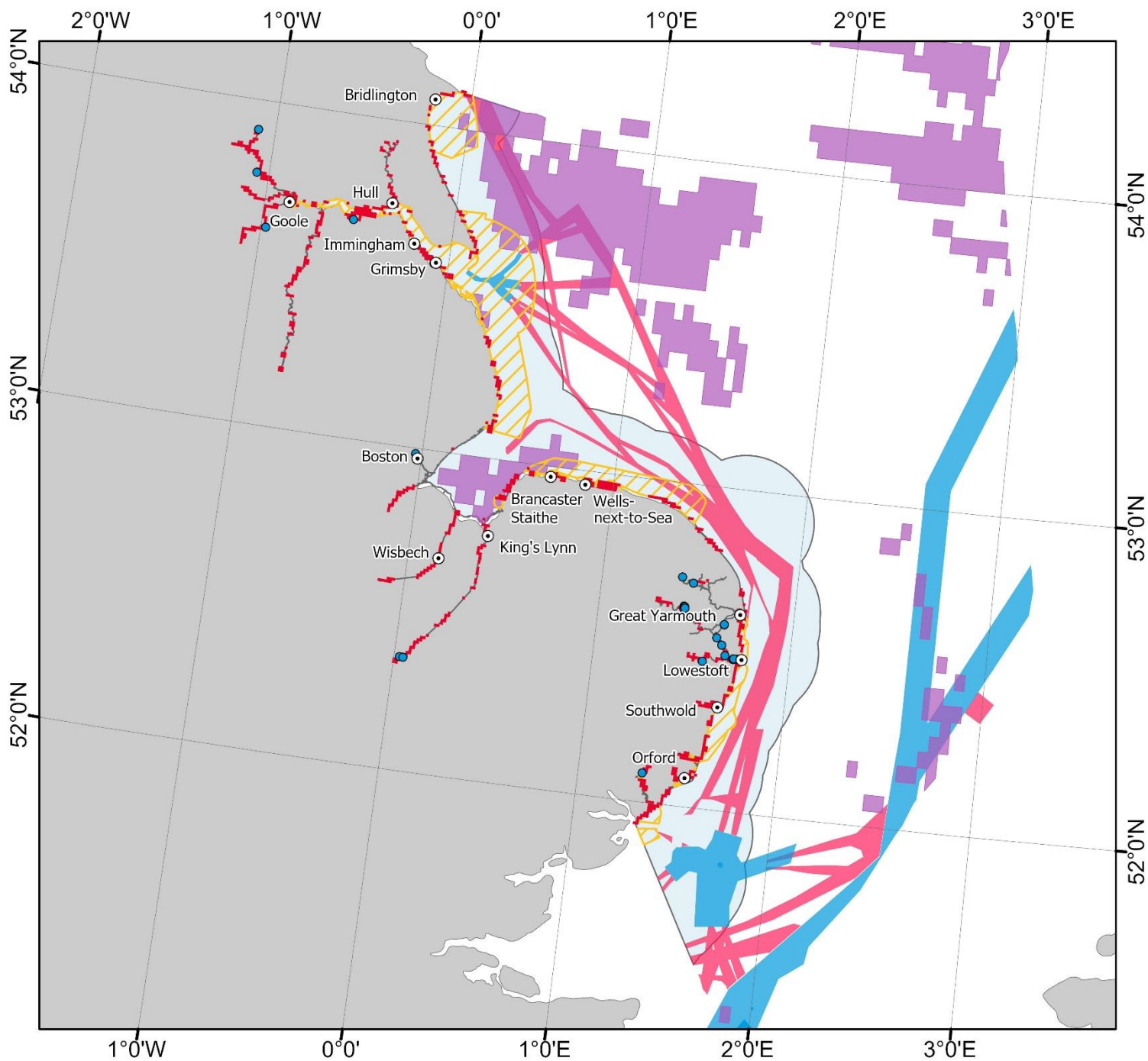
The impacts of the forecasted changes in the east marine plan areas indicate that there are minimal changes and increased opportunities for these sectors to continue occupying similar spaces given their ability to co-exist and enable each other. The tourism and recreation sector is supported through berthing of cruise liners and passenger routes to mainland Europe and there is scope for this to increase but a balance needs to be maintained as port expansion may need to be considered alongside onshore tourism on waterfronts. Ports and harbours may also play a role in the diversification of tourism and recreational activities, such as wildlife excursions, fishing trips or visiting offshore wind turbines and will continue to remain important for ferries, yachting and cruising. The combined conservation layer occupies a significant portion of the inshore area at 8656.317km² or 85% of the current capacity of the inshore area.

Inshore fishing also has strong links with many popular coastal resorts and forms an important part of our cultural and heritage assets, which in turn attracts coastal

tourism. Fishing boats and associated activity form a key part of the tourism offer in areas such as Aldeburgh in Suffolk and Cromer in Norfolk.

Whilst the co-existence of these sectors may increase the demand for the asset base of the east marine plan areas, it is unlikely to increase the impacts on the carrying capacity given the enabling capabilities of these sectors. However, it should be noted that tourism and recreation activities may lead to an increase in wildlife disturbance if not managed correctly and that a policy intervention response may be required to address disturbance issues as the marine space gets busier.

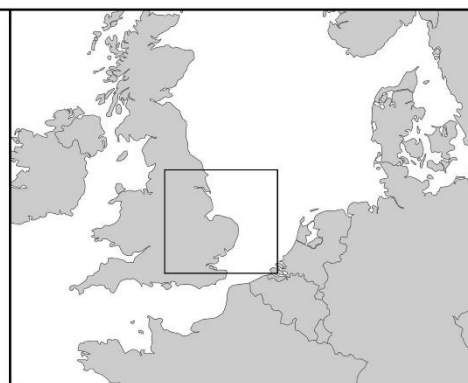
Figure 39 | Current Enabling Interactions between Fishing, Ports and Shipping and Tourism and Recreation Activities in the East Marine Plan Inshore Area



- Activities**
- ⊙ Significant Ports within the East Marine Plan
 - Marinas (Royal Yachting Association)
 - High Annual Angling Activity (MMO)
 - Areas of Fishing Activity (2015 to 2019) (MMO)
 - ▨ General Boating Areas (Royal Yachting Association)

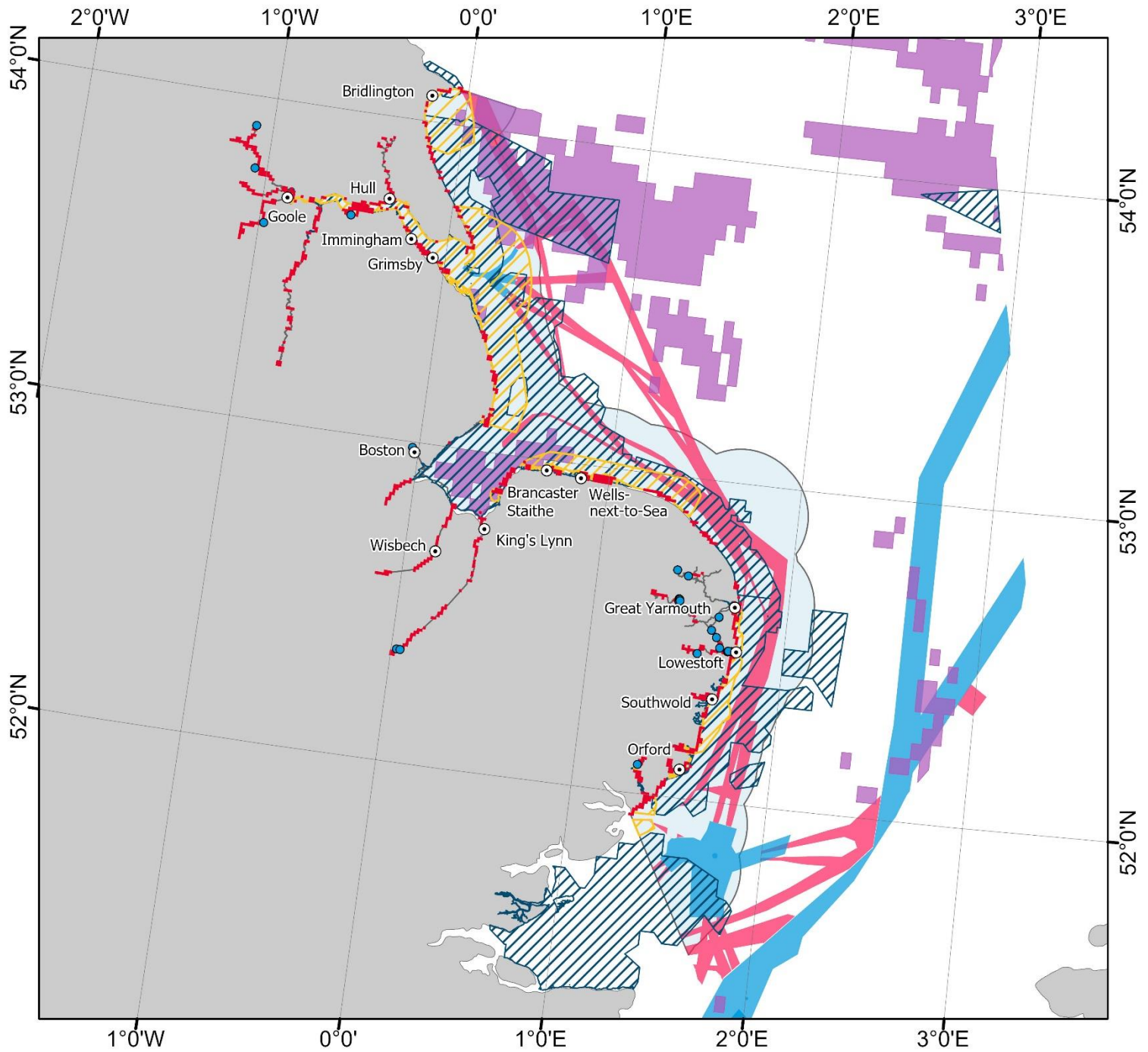
- Navigation Routes**
- International Maritime Organisation Navigation Routes (UKHO)
 - Navigation Routes in the EMP Areas

- Plan Areas**
- East Marine Plan (Inshore Area)



Note: The high annual angling activity data is only displaying the top 50% of areas of angling intensity.

Figure 40 | Potential Future Impacts and Enabling Interactions between Fishing, Ports and Shipping and Tourism and Recreation Activities in the East Marine Plan Inshore Area



- Activities**
- ⊙ Significant Ports within the East Marine Plan
 - Marinas (Royal Yachting Association)
 - High Annual Angling Activity (MMO)
 - Areas of Fishing Activity (2015 to 2019) (MMO)
 - ▨ Inshore Conservation Areas (JNCC and NE)
 - ▨ General Boating Areas (Royal Yachting Association)

- Navigation Routes**
- International Maritime Organisation Navigation Routes (UKHO)
 - Navigation Routes in the EMP Areas
- Plan Areas**
- East Marine Plan (Inshore Area)



Note: The high annual angling activity data is only displaying the top 50% areas of angling intensity. The inshore conservation areas data is a merged layer consisting of Marine Conservation Zones (NE), Ramsar Sites/SAC/SPA/SSSI (NE), and Special Protection Areas (JNCC).

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4.4 Scenario 4: completely restricted other activities

Example 1: impacts of Marine Protected Areas (MPAs)

Protecting the marine environment and wildlife is a key national priority and this is currently enforced through the development of a strong and well managed network of Marine Protected Areas (MPAs) that is well understood and supported by all sea users. These are geographically defined areas of the marine environment, that enforce prioritisation of activities that protect the environment through various means including legislation.

This example focuses on the interactions between MPAs, dredging and disposal, and ports and cables associated with energy production. Figure 41 highlights the current extent of these activities in the east marine plan areas.

MCZs, Ramsar sites, SSSI's and SPAs occupy a majority of the east inshore marine plan areas with a combined total of 8325.04km² or 81.51% of the inshore area, whereas SAC's cover 42409.29km² or 54.44% of the overall east marine plan areas. The Dogger Bank Special Area of Conservation, has the largest shallow sandbank in British waters and supports commercial fish species such as cod and plaice, as well as sand eels that provide an important food source for kittiwakes, puffins and porpoises.

Whilst not necessarily spatially restrictive, the regulations and legislations associated with these marine protected areas can preclude other activities. These factors can reduce the area available for development including but not limited to; dredging, port expansion and cable installations or can cause uncertainty over free access to a given area, with the possibility of management measures only allowing certain activities, for example limiting the area of resource available for certain fisheries.

Figure 42 highlights what the future extent of activities in the east marine plan areas could look like over a 20-year horizon, based on the following assumptions:

- MPAs remain the same and no new MPAs are added
- management measures are introduced for certain MPAs
- Highly Protected Marine Areas (HPMAs) are introduced and (for the sake of this report - located within existing MPAs), and exclude all depositional and extractive activities (these are not informed by Defra)
- dredging and disposal occupy more space, based on potential future sites for dredging activity
- ports and harbours occupy more space, based on a number of predicted developments including, its crucial role in the developing fields of energy production and technological developments
- cabling routes occupy more space with growth in offshore wind farm developments.

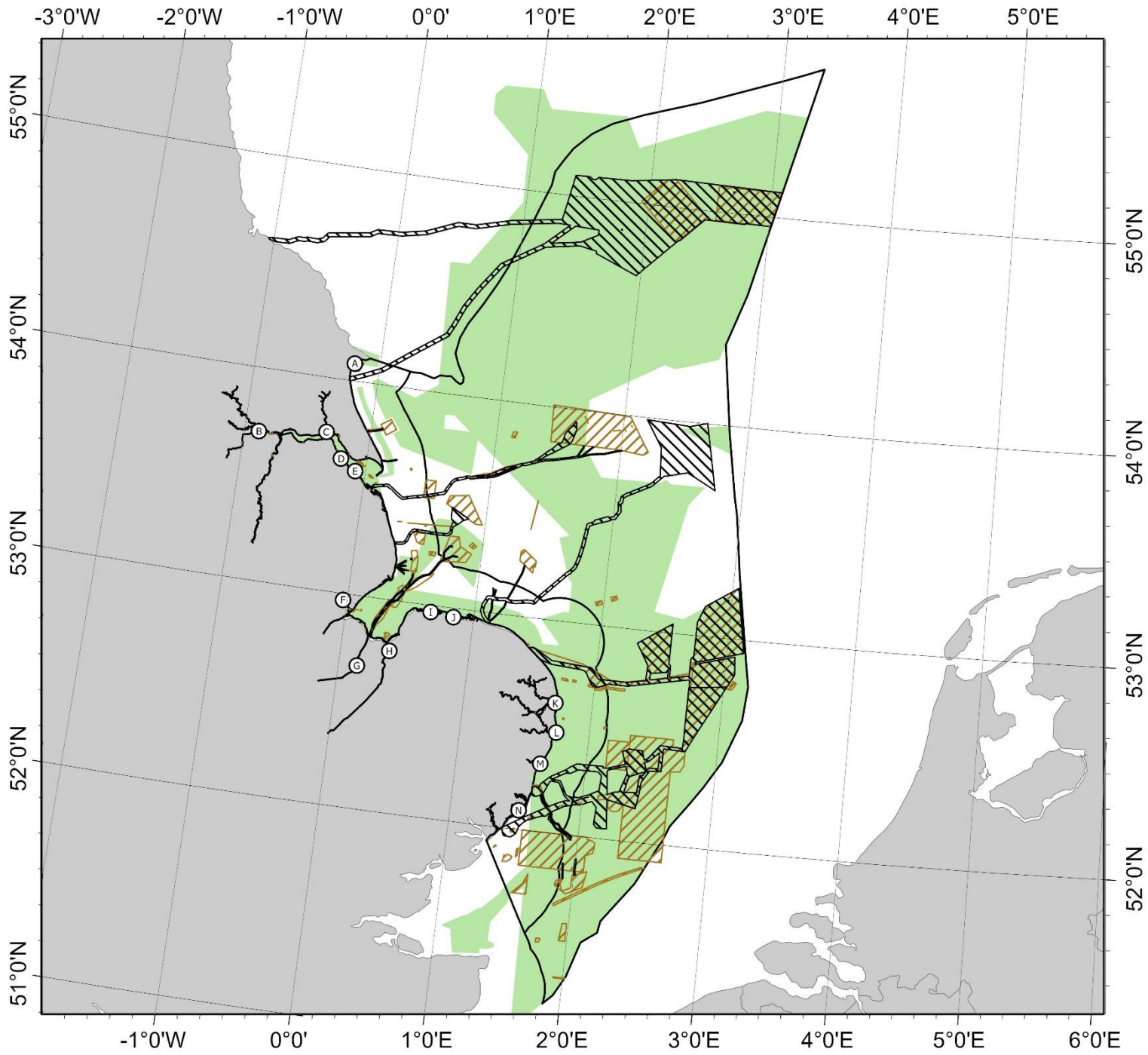
The most significant impacts of the forecasted changes in the east marine plan areas are the potential introduction of HPMAs. HPMAs could prohibit extractive, destructive and depositional uses, allowing only non-damaging levels of other activities. Depending on the placement of HPMAs, this is likely to impact a number of activities that can take place in the east marine plan areas over the next decade. The suggested HPMAs in Figure 42 were based on the areas where most of the

various inshore MPA areas converge and is an example for demonstration purposes of this report only. These represent two distinct regions off the coast of Cromer and Hornsea and cover an area of 2100.45km² or 20.56% of the inshore area.


MPAs in close proximity to ports can preclude port expansion and may cause significant restrictions to cable routes given their damaging impacts on benthic habitats and communities. Similarly, dredging is considered a significantly destructive sector that could be excluded from certain areas of the east marine plan areas due to pollution and potential for overflows that could impact fish spawning and migrations routes.

The designation of HPAs and introduction of management measures in MPAs is likely to reduce the demand for the asset base of the east marine plan areas and the overall carrying capacity of the east marine plan areas to support other sectors due to the restriction of certain activities and lack of opportunities to co-exist.

Figure 41 | Current Impacts of Marine Protected Areas on Dredging and Disposal, Ports and Offshore Winds Activities



Plan Areas

 East Marine Plan (Inshore and Offshore Areas)


Offshore Wind Farms

 Offshore Wind Farms

Dredging Disposal Sites

 Dredging Disposal Sites (Cefas)

Conservation Areas

 Marine Protected Areas (MPAs) (JNCC/Natural England)

Ports

 Significant Ports:

- | | |
|----------------|-----------------------|
| A: Bridlington | I: Brancaster Staithe |
| B: Goole | J: Wells-next-to-Sea |
| C: Hull | K: Great Yarmouth |
| D: Immingham | L: Lowestoft |
| E: Grimsby | M: Southwold |
| F: Boston | N: Orford |
| G: Wisbech | |
| H: King's Lynn | |

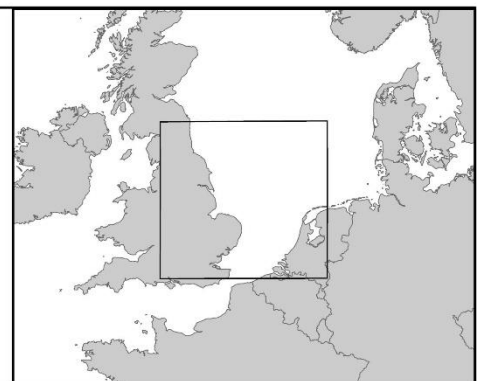
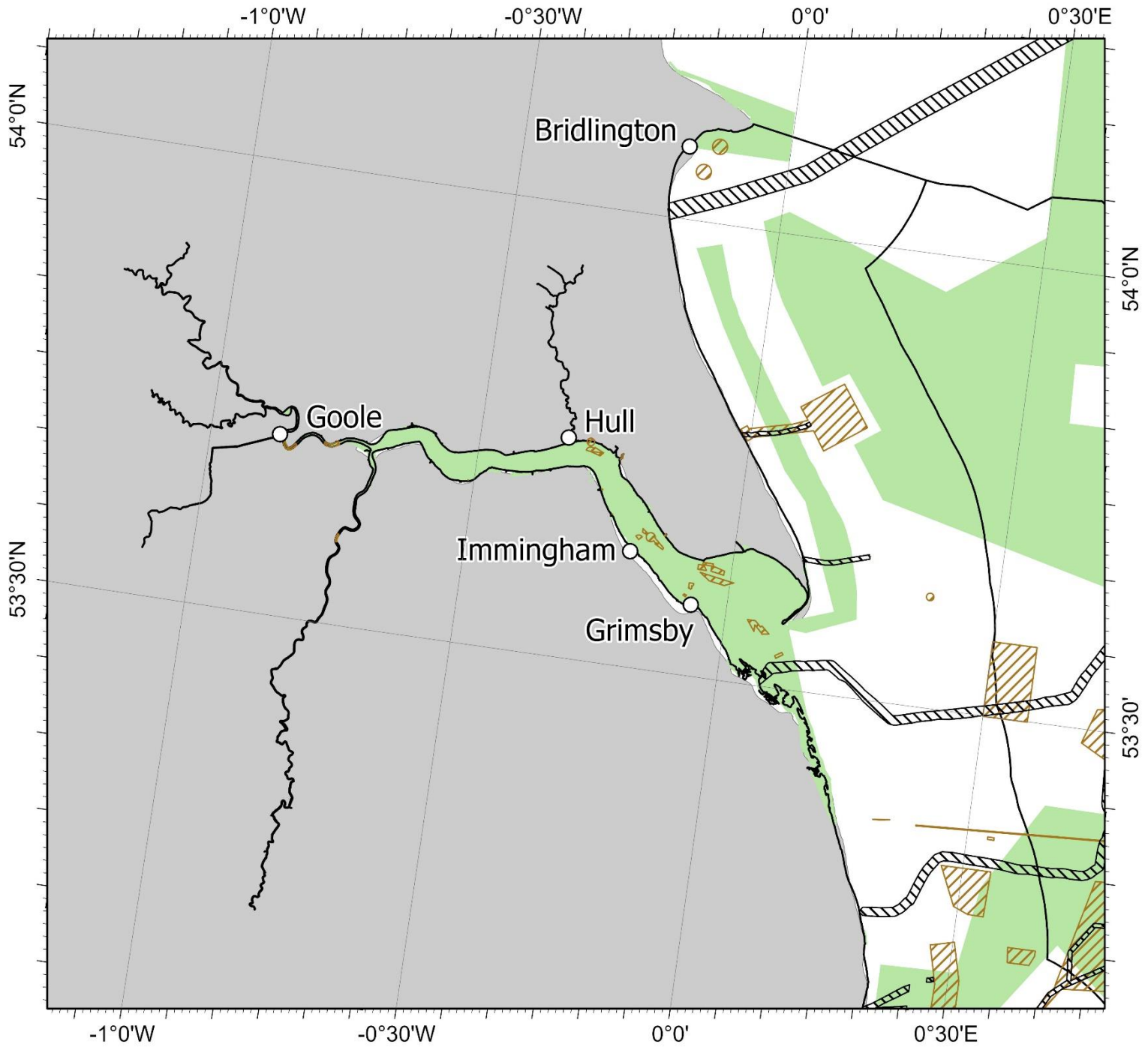



Figure 41a | Current Impacts of Marine Protected Areas on Dredging and Disposal, Ports and Offshore Winds Activities (Focus on the Humberside Region)



Plan Areas

 East Marine Plan (Inshore and Offshore Areas)

Ports

 Significant Ports


Offshore Wind Farms

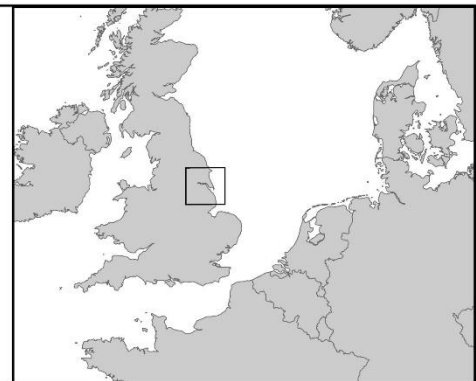
 Offshore Wind Farms

Dredging Disposal Sites

 Dredging Disposal Sites (Cefas)

Conservation Areas

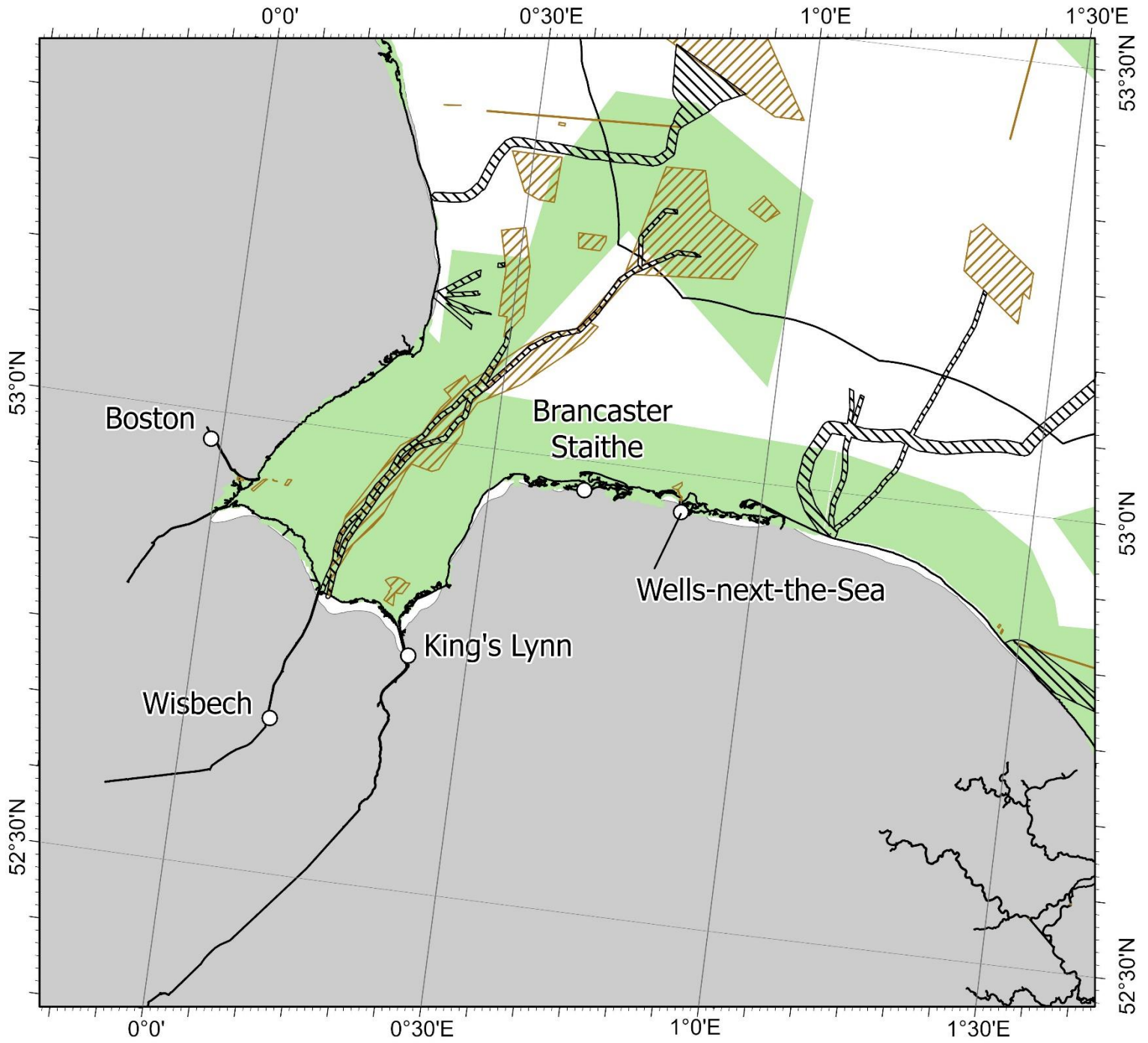
 Marine Protected Areas (MPAs) (JNCC/Natural England)




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Figure 41b | Current Impacts of Marine Protected Areas on Dredging and Disposal, Ports and Offshore Winds Activities (Focus on the Wash Region)




Plan Areas

 East Marine Plan (Inshore and Offshore Areas)

Ports

 Significant Ports


Offshore Wind Farms

 Offshore Wind Farms

Dredging Disposal Sites

 Dredging Disposal Sites (Cefas)

Conservation Areas

 Marine Protected Areas (MPAs) (JNCC/Natural England)

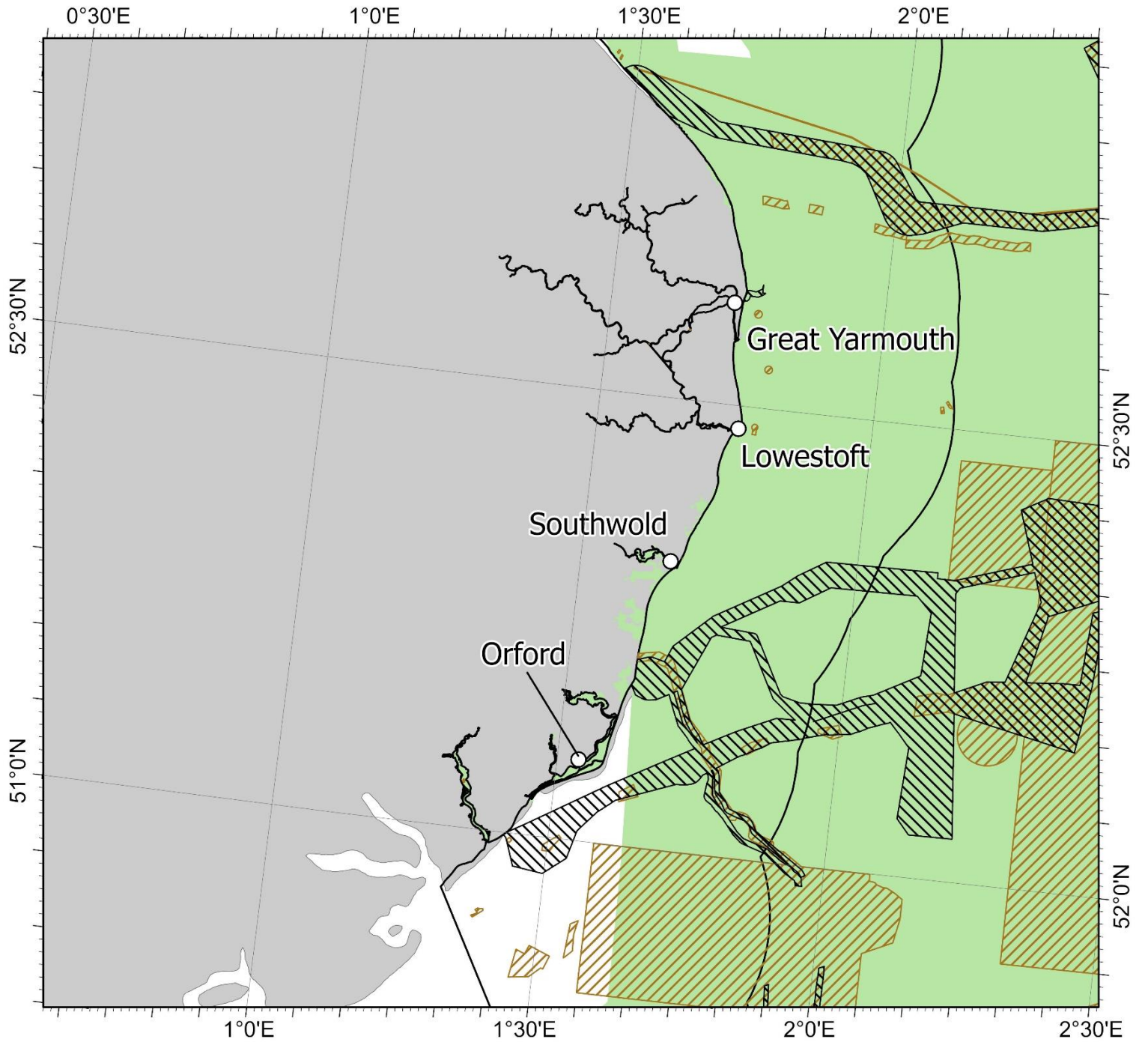


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Figure 41c | Current Impacts of Marine Protected Areas on Dredging and Disposal, Ports and Offshore Winds Activities (Focus on Coastal Norfolk and Suffolk)




Plan Areas

 East Marine Plan (Inshore and Offshore Areas)

Ports

 Significant Ports


Offshore Wind Farms

 Offshore Wind Farms

Dredging Disposal Sites

 Dredging Disposal Sites (Cefas)

Conservation Areas

 Marine Protected Areas (MPAs) (JNCC/Natural England)



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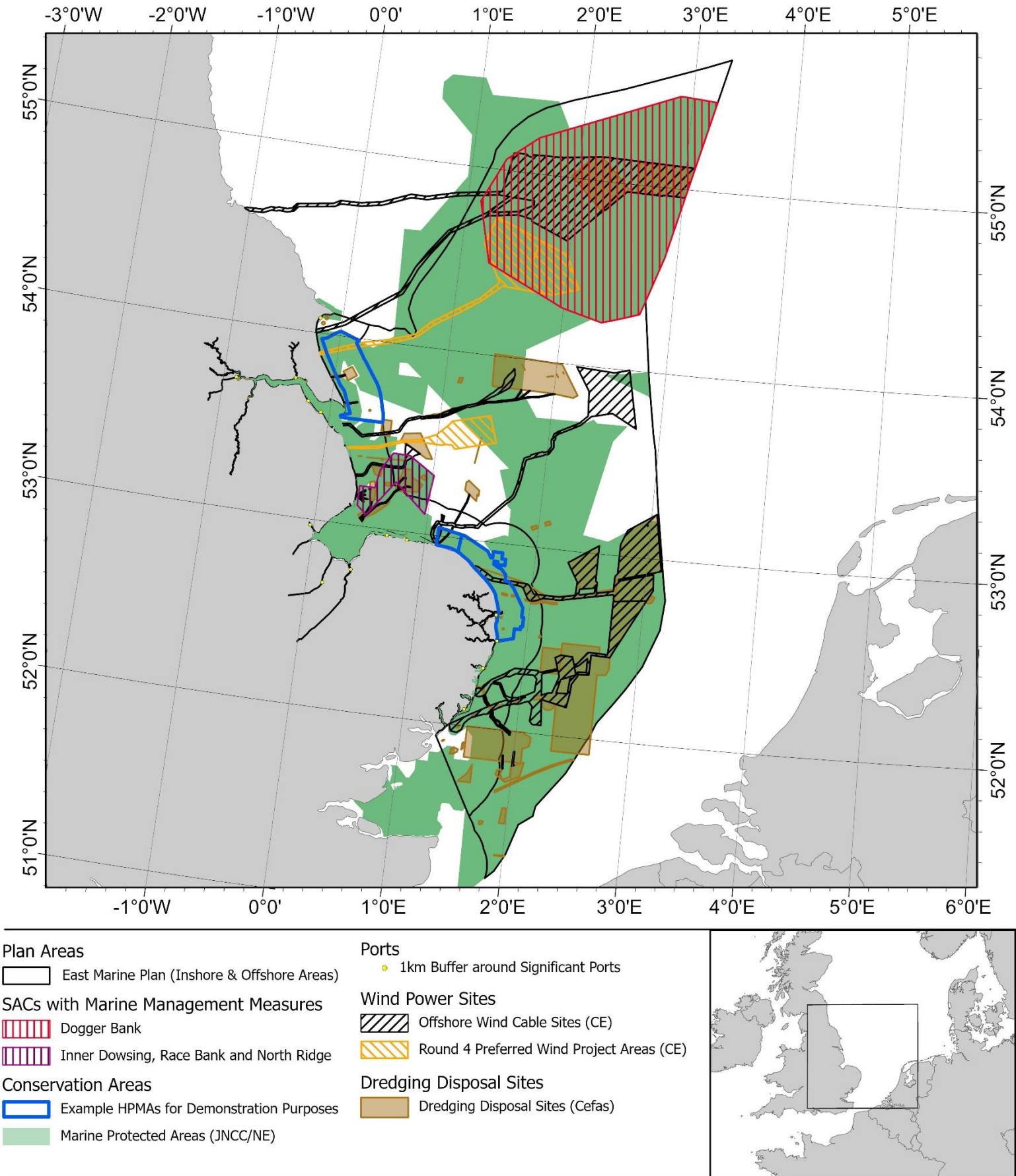
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Figure 42 | Potential Future Impacts of the Introduction of SACs with Management Measures and Proposed Inshore HMPAs Areas



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Example 2: Restrictive impacts of offshore wind farms

As previously noted, the UK is one of the largest global players in offshore wind and the sector continues to grow in line with net zero ambitions to become a major contributor to the UK's clean energy mix. Given the favourable seabed conditions, the east marine plan areas are currently the most developed plan areas in England for offshore wind.¹⁶⁵ However, the construction of wind farms can cause significant restrictive impacts on other sector activities in the marine environment and has long-term restrictions for some sectors during operation.

This example focuses on the interactions between offshore wind farms, oil and gas infrastructure, CCUS infrastructure, shipping traffic, dredging and disposal and aggregates activities. Figure 43 highlights the current extent of activities in the east marine plan areas including, existing offshore wind farm infrastructure, oil and gas infrastructure, shipping traffic, dredging and disposal and aggregate activities. The inshore navigation routes account for the largest portion of inshore activity in Figure 43 with 1872.82km² or 13.52% of the current capacity. Offshore wind cables have the largest offshore presence with 15021.81 km² or 20.65% of the current capacity.

Figure 44 highlights what the future extent of activities in the east marine plan areas could look like over a 20-year horizon, based on the following assumptions:

- offshore wind farms occupy more space, based on Round 4 preferred projects and potential future growth of the sector
- oil and gas infrastructure remain the same and all licensed activities are constructed
- CCUS infrastructure expand but occupy minimal “new” space, based on utilisation of existing oil and gas infrastructure and existing hydrocarbon fields
- shipping traffic remains unchanged, although intensity is likely to increase overtime
- dredging and disposal occupy more space, based on potential future sites for dredging activity
- aggregate activities occupy more space, based on potential aggregate opportunities.

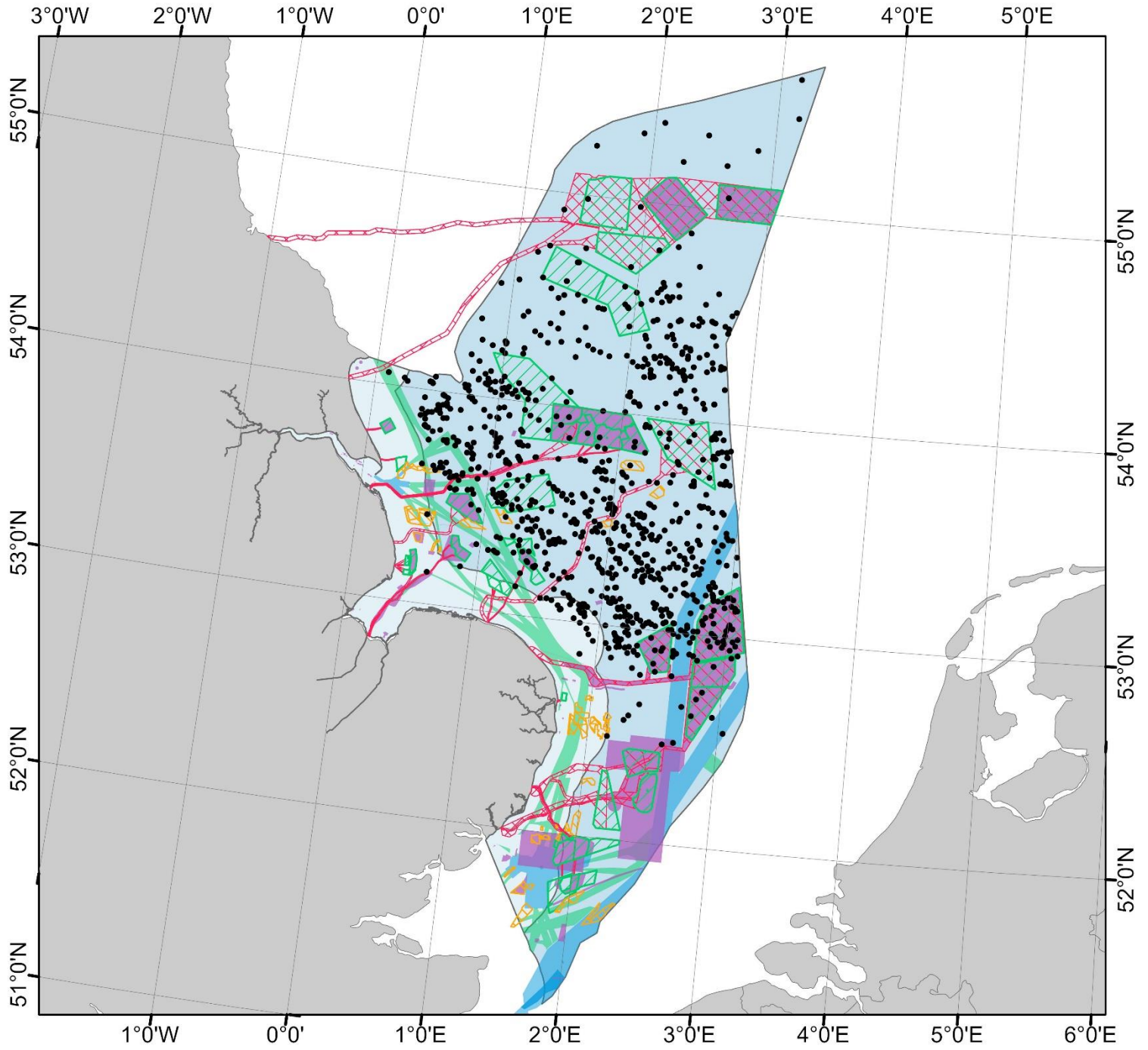
The impacts of the forecasted changes in the east marine plan areas, if there is a focus on renewable energy and offshore wind farms, indicate an increase in spatial competition and conflicts between these sectors and further adverse impacts as displayed. The addition of the Round 4 preferred projects in Figure 44 increases the pressure on the east marine plan area with a combined total (both landing sites and suggested cable routes) of 11032.48km² or 18.83% additional usage. With the overall footprint of wind farm developments, it's associated safety zones and associated cabling, these activities can restrict further development of oil and gas infrastructure and new CCUS pipelines that may be required. Offshore wind may also exclude aggregate activities from areas of development and impact upon the safe navigation of shipping operations, because of re-routing or restricting navigation routes.

¹⁶⁵ The Crown Estate (2018), Resources and Constraints Assessment for Offshore Wind: Methodology, <https://www.thecrownestate.co.uk/media/3331/tce-r4-resource-and-constraints-assessment-methodology-report.pdf>

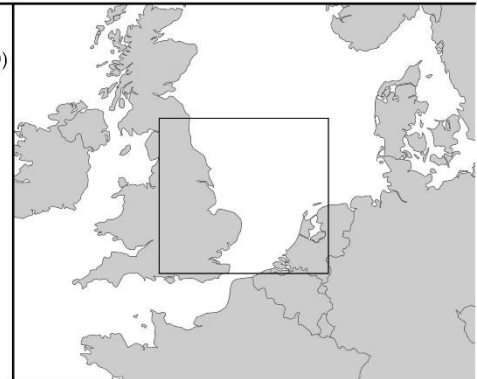
Whilst the expansion of offshore wind farms is likely to align with national priorities and may not restrict all activities, there are restrictive aspects for the sectors noted above and these will need to be addressed in any future policy decisions for the east marine plan areas. Offshore wind farms are likely to increase demand for the asset base of the east marine plan areas and increase the impacts on the overall carrying capacity for other sectors activities especially fisheries. There is little evidence to date of co-existence between offshore wind and fisheries, though it is considered that following early consultation between the fisheries sector and offshore wind developers, there could be more scope for co-existence.

Offshore wind development is also likely to have impacts on shipping, navigation and the environment, not covered in this scenario.

Figure 43 | Current Restrictive Impacts of Offshore Wind Farms on Dredging and Disposal, Aggregate and Other Energy Production Activities in the East Marine Plan Areas



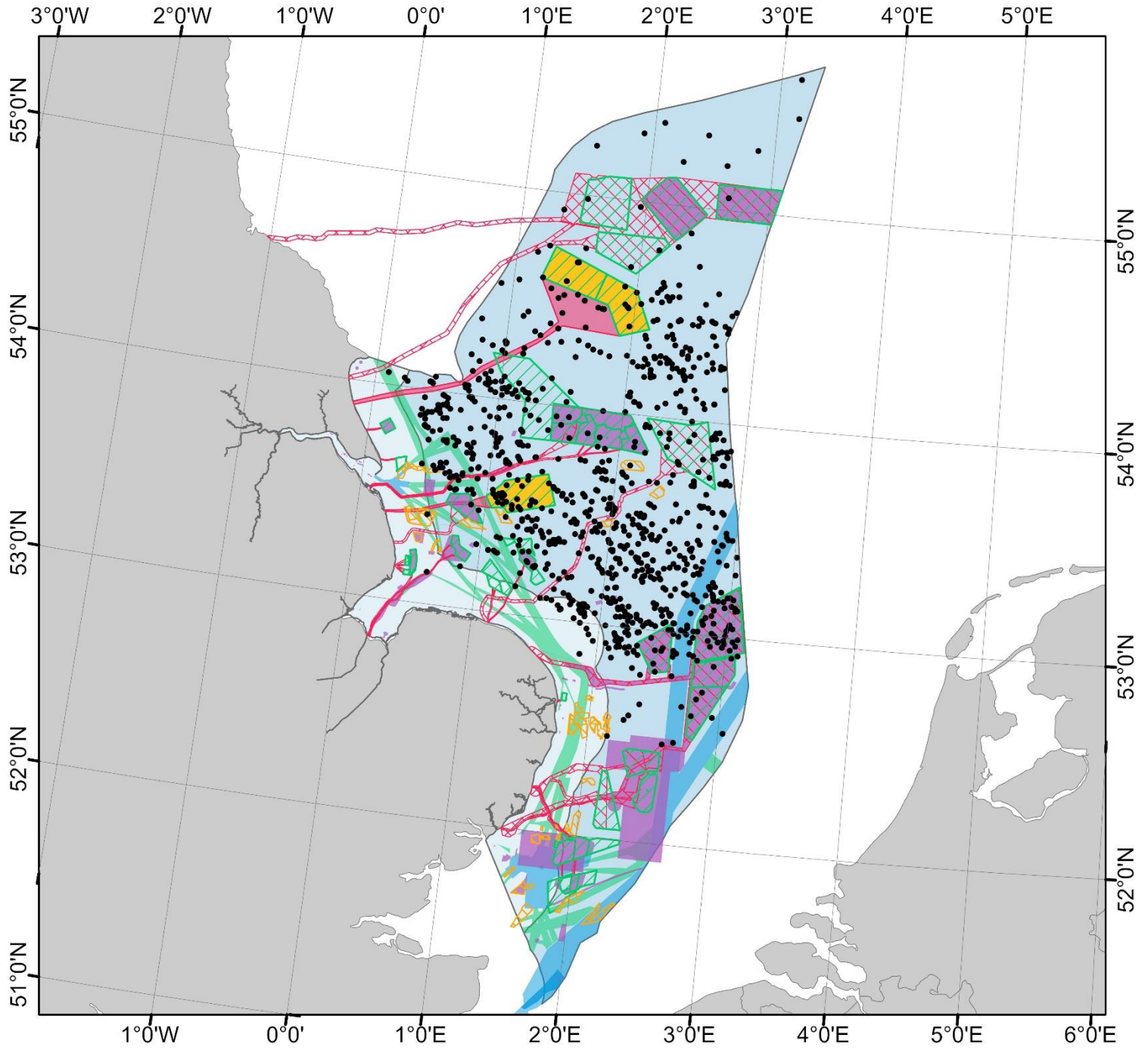
- | | |
|--|---|
| <p>Activities</p> <ul style="list-style-type: none"> • Oil and Gas Wells Flowclass (NSTA)  Aggregate Site Agreements (Crown Estate)  Offshore Wind Sites (Crown Estate)  Offshore Wind Cable Sites (Crown Estate)  Dredging Disposal Sites (Cefas) | <p>Navigation Routes</p> <ul style="list-style-type: none">  International Maritime Organisation Navigation Routes (UKHO)  Navigation Routes in the EMP Areas <p>Plan Areas</p> <ul style="list-style-type: none">  East Marine Plan (Inshore Area)  East Marine Plan (Offshore Area) |
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Figure 44 | Potential Future Impacts of Offshore Wind Farms on Dredging and Disposal, Aggregate and Other Energy Production Activities in the East Marine Plan Areas



<p>Activities</p> <ul style="list-style-type: none"> • Oil and Gas Wells Flowclass (NSTA)  Aggregate Site Agreements (Crown Estate)  Offshore Wind Sites (Crown Estate)  Offshore Wind Cable Sites (Crown Estate)  Round 4 Preferred Projects (Crown Estate)  Round 4 Preferred Projects Suggested Cable Routes (Crown Estate)  Dredging Disposal Sites (Cefas) 	<p>Navigation Routes</p> <ul style="list-style-type: none">  International Maritime Organisation Navigation Routes (UKHO)  Navigation Routes in the EMP Areas <p>Plan Areas</p> <ul style="list-style-type: none">  East Marine Plan (Inshore Area)  East Marine Plan (Offshore Area)
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5. Conclusion and summary

This chapter summarises the findings of this report and outlines future evidence gathering priorities, to enable effective deliberation and decision-making related to priorities in the east marine plan areas.

5.1 Summary and analysis of key findings

Key findings from the spatial assessment are as follows:

Impact of the changing policy landscape on the current allocation

The shift to net zero and focus on security and sustainability of energy supply and food stock is creating an impetus for change in the east marine plan areas. This means that:

- oil and gas, currently the most prolific sector in the east marine plan areas, will see its activities decrease over the coming years due to national policies and strategies related to achieving net zero emissions by 2050 (though it's worth noting that recent events in Ukraine could impact this in the short-term – further explanation is provided in Chapter 1)
- due to the decline of oil and gas, offshore wind is a key energy source the government plans to transition to and, as a result, there are currently large-scale operations in the east marine plan areas and significant investment to expand this
- the fisheries sector remains impacted by any further development in the east marine plan areas and the outcomes of displacement and or a reduction in fishing area is yet unknown on the sector
- an increased demand for space is also likely to emerge from the aquaculture sector, given the expanding innovations and investment in these sectors to secure the UK's food supply and increase exports and domestic growth
- the health of the environment remains a critical priority over the coming years and, as a result, will be a key consideration for all other sectors and an area where there is likely to be strong government involvement. This is reflected in policy and legislation - including the Environment Act 2021, which will introduce mandatory biodiversity net gain for terrestrial developments down to mean low water springs.

Competing demands / deconfliction policy needs

There are conflicting demands for natural capital in the east marine plan areas.

These include:

- increasing environmental protection may mean that the environment sector could take priority over others, to the extent where it could hinder or constrain activities across other sectors
- further investment in offshore wind could act as a barrier for other sectors, such as fisheries which competes for space - the rapid growth of offshore wind has also not allowed for a complete understanding of the environmental impacts and further development will likely impact upon the objectives of marine protected areas in the east marine plan areas. The growth of inshore activities including tourism and port expansion could also adversely impact other sectors and inshore marine ecosystems in light of the above, it will

therefore be paramount to explore methods/interventions in which further development of sectors such as renewable energy is not at the expense of adverse environmental impacts (e.g. net biodiversity loss).

Co-existence opportunities

There are numerous opportunities for greater co-existence of sector activities in the east marine plan areas. Given their finite space, capitalizing on these opportunities could maximise the ability to achieve national priorities. For example:

- inshore fishing has strong links with many popular coastal resorts and forms an important part of our cultural and heritage assets, which in turn attracts coastal tourism
- ports and harbours will continue to remain important for ferries, yachting and cruising and may support diversification of tourism and recreational activities
- there are some early findings that it could be possible to co-locate shellfish aquaculture and the fixed structures within wind farm developments
- development of wind energy projects will present opportunities for regeneration of ports and shipping as they and their associated supply chains make development possible
- the oil and gas sector has the ability to support CCUS in the east marine plan areas as its infrastructure can be repurposed.

Opportunities to deliver higher yield in one or more sectors from the natural capital assets of the east marine plan areas

There are many instances where increased activity in a sector could facilitate improvements in the natural environment. For example:

- sustainable tourism and recreation activities can lead to improvements in the quality of the natural environment as users are incentivised to maintain and improve the areas they use
- through platform electrification and sourcing power from offshore renewables, the offshore oil and gas industry could significantly reduce its greenhouse gas emissions, thus also improving the environment
- there are opportunities to utilise dredge disposal in beach nourishment providing protection from coastal erosion and flooding
- the marine aggregates industry can supply resources for construction materials which can include for coastal defence schemes.

Uncertainties and areas of further research

There are several ways in which the results of this study could be built upon, which will therefore be natural follow-on areas to explore. These include:

- identifying the potential constraints of offshore wind farm expansion on other sectors, given that the greatest uncertainty arises from the potential requirement for space for offshore wind farms (floating and fixed)
- identifying the potential for some fisheries to collocate with offshore wind farms
- the environmental benefits and constraints of offshore wind, including recent research that suggests that the submerged parts of their structures act as artificial reefs, providing new habitats and likely affecting fisheries resources

- exploring the co-location potential for carbon capture, usage and storage and the outputs of the 'Offshore Wind and CCUS Co-location Forum' established by The Crown Estate in July 2021
- identifying the environmental impacts of carbon capture, usage and storage
- identifying further methods that ports are utilising to reduce emissions from shipping and transport links ashore and its impact on marine activities
- understanding the co-existence ability of aquaculture activities and the commercial fishing sector
- exploring recent research that suggest offshore wind farm installations may enable offshore aquaculture through providing shared platforms for co-existence
- exploring the co-location potential of tourism and recreation activities with offshore wind farms
- understanding the long-term demand for tourism and recreation and dredging and disposal sectors in the east marine plan areas.

5.2 Potential policy interventions and recommendations

The results of the analysis conducted in this report reflect that the east marine plan areas are a finite geographical space, and it is inevitable that activities will compete for these areas. However, areas of constraints and opportunities, can be managed and prioritised to align with marine plan policies and national policy objectives.

These policies will be derived on the basis of actions taken by key stakeholders including, the MMO itself, the Government, and the private sector. The potential interventions and levers that could be utilised by these stakeholders include:

- creating an effective platform for engagement and facilitating dialogue between sectors that compete for space, e.g. early engagement between fisheries and offshore wind farm developers could enable more opportunities for co-location understanding where further collaboration and engagement is required by the MMO with key government departments to manage spatial constraints for the east marine plan areas
- decision-making will be reliant on more than spatial assessments and therefore the MMO should look to develop an understanding of the cumulative impacts on the east marine plan areas including, economic impacts and wider environmental, social and governance considerations
- identifying further spatial mapping exercises across all marine plan areas to get a true picture of trade-offs as national priorities will apply to all locations and will help identify the national carrying capacity to determine how best to meet priorities. As above, this could be done with key government departments such as Defra and the Environment Agency across all of the UK's natural capital assets
- with the rapid pace of technological developments, it is likely that investments and key activity decisions for the east marine plan areas will need to be future proofed e.g. port expansion decisions today will need to factor the impacts of autonomous shipping. Therefore, horizon-scanning and identifying future

trends that could impact the seabed and marine plan areas will be a significant tool for decision makers.

Work already underway

This spatial assessment contributes to a wider work programme and the outputs of this report will be driven forward and incorporated into future projects delivered by Defra and the MMO. The final outputs will be used to facilitate engagement, exploring values and weighting given to national priorities at the east marine plan areas scale. Ultimately this has the aim of making spatial choices and, where appropriate, to inform the development of the vision, objectives and prescriptive policies for the east marine plan areas.

Some examples of work already underway include:

- **Cross-UK Marine Spatial Prioritisation (MSP) Programme:** The Department for Environment, Food & Rural Affairs (Defra) is undertaking this programme to set a future vision of our seas in 2050 and encourage opportunities for co-existence between marine activities. MSP will facilitate how the different policies across all of the marine space can better co-exist, and also provide the best tools to help prioritise which activity should occur where. In 2022, Defra will carry out an evidence review to bring together all the existing research and development and modelling that has been carried out on MSP.
- **Marine Natural Capital Ecosystem Assessment (mNCEA) Programme:** The Defra-led mNCEA Programme has also released funds to Defra's arms-length bodies to develop evidence products that can support the development of a Natural Capital Approach (NCA) for marine decision-making. Natural capital (NC) is a broad term that includes many different components of the living and non-living natural environment, as well as the processes and functions that link these components and sustain life. The NCA involves understanding the 'value' of components of the natural environment in terms of their wider contribution to social and economic interests, in addition to their value for environmental interests. The MMO was successful in receiving funding to work collaboratively with Natural England, the Joint Nature Conservation Committee, the Environment Agency and the Centre for Environment, Fisheries and Aquaculture Science to develop a natural capital evidence base that can support the marine planning process for the East Marine Plan.
- **Future Offshore Wind Project:** The Department for Business, Energy and Industrial Strategy, The Crown Estate, and Crown Estate Scotland have commissioned research to explore the potential interactions with other marine industries and the marine environment associated with future offshore wind expansion in UK waters, taking account of the influence on levelised cost of energy of different future decisions, and the role of floating wind in the UK's future offshore wind portfolio. The study was commissioned under the

Offshore Wind Evidence and Change Programme (OWEC). The outcomes of the research present multiple outputs that demonstrate within the agreed bounding model parameters what impact different decisions or system changes have on the geo-spatial spread and cost of the future offshore wind portfolio required to deliver net zero by 2050. Changing assumptions on a broad range of factors saw significant diversity in the potential spatial distribution of offshore wind in UK waters.

5.3 Potential next steps

While the spatial analysis in this report provides key insights, moving forward, it is suggested that other dynamics that will impact the ability to achieve priorities should also be explored. These could include:

- further study of a focus sector's current contribution to gross domestic product, and its estimated contribution in the future
- an analysis of trade-offs between sectors at an economic gross value-added level
- comparing the time and investment needed to optimise a focus sector's contribution toward priorities
- engaging with stakeholders to further understand the operational challenges of each sector, particularly where they likely change in response to distribution of activity
- engaging with stakeholders to further understand, in instances where two sectors can complement each other (e.g. offshore wind and aquaculture), what are the potential operational and legal challenges
- comparison of which sectors are most likely to be negatively impacted by climate change
- a detailed prioritisation exercise and engagement with stakeholders which looks to determine a set criteria (e.g. economic output, socioeconomic benefits, cost of delivery, complexity of delivery etc.) against which to assess the preference/order of sectors to develop in the next 10-20 years.

The MMO will soon embark on updating the East Marine Plan. It is the MMO's and the Government's ambition to develop more prescriptive and spatially defined marine plan policies in the future to enable faster decision-making. However, doing so will require more explicit trade-off decisions at scales from local to national to determine plan area priorities that will, in turn, inform marine plan policy development.