Offshore Wind **Leasing Round 4**

THE CROWN ESTATE

Resource and Constraints Assessment for Offshore Wind

Characterisation Area Report
Southern North Sea

5

38255-TCE-REP-010

Characterisation Area Report: 5 - Southern North Sea

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1.1	Draft	July 2018
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The information included in this report should be read in conjunction with the *Resource and Constraints Assessment for Offshore Wind: Methodology Report* and the *Summary Stakeholder Feedback Report*. The trigger distance for constraints to be included in the constraints analysis section of this report is 1 nautical mile (NM).

The Crown Estate has undertaken the analysis in this report using the evidence available to it, internal expertise and support from external advisers where appropriate. The analysis does not obviate any potential need for any Habitat Regulations Assessment (HRA) or any project level consideration of the potential impact of development. The analysis does not supersede any statutory policies or marine plans. The analysis, including the data and information contained in this document, presents a point in time assessment with changes likely to both the presence and nature of constraints.

This report is provided for information purposes only and no party may rely on the accuracy, completeness or fitness of its content for any particular purpose. The Crown Estate makes no representation, assurance, undertaking or warranty in respect of the analysis in the report including all data and information contained in it

Receptor rating		Area rating	
Receptor assessed but no interaction noted		Receptor assessed but no interaction noted	
Interaction acceptable with best practice/accepted mitigation		The constraint will present the need to implement best practice/accepted mitigation measures to enable acceptable development within the whole area	
Interaction acceptable with moderate mitigation		The constraint will present the need to implement moderate mitigation measures to enable acceptable development within the whole area	
Interaction acceptable with significant mitigation		The constraint will present the need to implement significant and/or strategic level mitigation measures to enable acceptable development within the whole area	
Significant/insurmountable issue that would be challenging to mitigate within the area of influence of a receptor		Significant/insurmountable issue that would be challenging to mitigate for any development within the whole area	
No data coverage across the area		No data coverage across the area	

Constraints analysis

Note that in addition to The Crown Estate leases/licences within this table, The Crown Estate has also identified key resource areas (KRAs) which may be suitable for the future development of different marine sectors. Information about overlapping KRAs that overlap this characterisation area is described in a latter section of this document.

Exclusions model — Hard constraints			Receptor rating	Area rating
	Present	Commentary		
The Crown Estate agreements	Pipelines into Bacton: there are numerous active and inactive pipelines intersecting the characterisation area as they head into Bacton terminal, particularly in the south of the characterisation area.	The pipelines have been removed from the characterisation area and will need to be avoided; this should be possible with best practice/accepted mitigation. However, the large number of pipelines, particularly in the south of the characterisation area may be a constraint on the available area for new arrays.		
	Hornsea Project One Wind Farm – Heron East: adjacent to the northern edge of the characterisation area.	The cumulative impact of offshore wind farm (OWF) developments and associated cable infrastructure will need to be considered in this area as there may be concerns around wind resource and proximity to the existing site. The existing site has been designed to consider navigational requirements therefore there may be adjacent areas e.g. to the east that are deemed undevelopable. There will need to be a 5 km buffer around existing offshore wind projects – any new wind developments within 5 km will need the permission of the incumbent party.		
	Hornsea Project Two Wind Farm: adjacent to the north west edge of the characterisation area.	The cumulative impact of OWF developments and associated cable infrastructure will need to be considered in this area as there may be concerns around wind resource and proximity to the existing site. The existing site has been designed to consider navigation requirements therefore there may be adjacent areas that are deemed undevelopable. There will need to be a 5 km buffer around existing offshore wind projects – any new wind developments within 5 km will need the permission of the incumbent party.		
	Hornsea Project Three Wind Farm: surrounded on three sides by the northeast corner of the characterisation area.	The cumulative impact of OWF developments and associated cable infrastructure will need to be considered in this area as there may be concerns around wind resource and proximity to the existing site. The existing site has been designed to consider navigational requirements therefore there may be adjacent areas e.g. to the west that are deemed undevelopable. There will need to be a 5 km buffer around existing offshore wind projects – any new wind developments within 5 km will need the permission of the incumbent party.		
	Hornsea Project Four Wind Farm: adjacent to a small part of the northwest corner of the characterisation area.	Less of a concern although there may still be concerns around wind resource and proximity to the existing site. There will need to be a 5 km buffer around existing offshore wind projects – any new wind developments within 5 km will need the permission of the incumbent party.		
	East Anglia North Tranche One East (Norfolk Vanguard East): approximately 713 m to the south.	Less of a concern although there may still be concerns around wind resource and proximity to the existing site. There will need to be a 5 km buffer around existing offshore wind projects – any new wind developments within 5 km will need the permission of the incumbent party.		
	East Anglia North Tranche One West (Norfolk Vanguard West): surrounded on three sides by the southern part of the characterisation area.	The cumulative impact of OWF developments and associated cable infrastructure will need to be considered in this area as there may be concerns around wind resource and proximity to the existing site. The existing site has been designed to consider navigational requirements, therefore there may be adjacent areas e.g. to the east that are deemed undevelopable. There will need to be a 5 km buffer around existing offshore wind projects – any new wind developments within 5 km will need the permission of the incumbent party.		
	East Anglia North Tranche Two (Norfolk Boreas): this	The cumulative impact of OWF developments and associated cable infrastructure will need to be considered in this area as there may be concerns around wind resource and proximity to the existing site.		

	is surrounded on three sides by the south-eastern characterisation area.	The existing site has been designed to consider navigational requirements therefore there may be adjacent areas e.g. to the east and west that are deemed undevelopable. There will need to be a 5 km buffer around existing offshore wind projects – any new wind developments within 5 km will need the permission of the incumbent party.		
	Numerous Offshore Transmission Owners (OFTOs): Hornsea Project One to the north and East Anglia North Tranche One West (Norfolk Vanguard West): to the south.	Best proactive/established mitigation should remove any impacts. The coverage of these OFTO's over the area is minimal. New projects may look to use similar landing locations which may cause significant cumulative impacts issues especially if connection options transited through The Wash or North Norfolk coast where there is already significant cumulative pressure over sensitive habitats. Since cable crossings require cable protection (which may have adverse environmental effects), crossings should be minimised where practicable.		
	Aggregates area 506: active dredge site within the north-western part of the characterisation area.	Active dredge site within the characterisation area – would require a 2 km buffer around it and negotiations with the customer.		
	Aggregates area 483: application area within the north-western part of the characterisation area.	Application area that was granted in 2018 – would require a 2 km buffer around it and negotiations with the customer.		
	Aggregates area 484: active dredge site within the north-western part of the characterisation area.	Active dredge site within the characterisation area – would require a 2 km buffer around it and negotiations with the customer.		
Other energy infrastructure	There are 63 operational platforms, two manifolds and nine wellheads intersecting and within 1 NM of the area. These are situated across the area.	The significant amount of oil and gas activity in the area presents a significant constraint to development. The 0-3 and 3-6 NM helicopter consultation buffers around platforms cover 87% of the characterisation area. The 0-3 NM buffer, which appears to have been a hard constraint for previous wind farm projects, covers 57% of the area.		
Navigation	There is a traffic separation scheme that transects the area denoting a deep-water channel.	The schemes have meant that traffic is concentrated into defined routes due to volume and navigation and safety reasons. Any impact on the traffic separation scheme should be avoided where possible. There is significant opportunity in the rest of the area.		
Social	None within the trigger distance.			

Restrictions model — Soft constraints			Receptor rating	Area rating
Economic tier				
Navigation	Aside from the traffic separation scheme, the only other strong traffic signal runs from the north-west to the south-east through the area, which may be traffic heading	There are other significant opportunities in the area to allow mitigation/avoidance of this interaction. Cumulative impact issues will be a significant concern in this area due to significant existing developments.		

	from ports in north-east England to Europe.			
Subsurface	None within the trigger distance.			
Fishing	See fisheries commentary below.		N/A	

Environmental tier							
The assessment of the sensitivity of Marine Protected Areas (MPAs) to pressures caused by offshore wind development and operation is assessed in a separate spreadsheet which will be made available as part of the Round 4 evidence base. Commentary has been noted in the relevant characterisation document where MPAs either overlap or are within 1 NM of the characterisation area and have been assessed as a yellow rating or above. For more information on the methodology for this assessment, please refer to the methodology report. Assessments of Annex II species have not been made as part of the characterisation process. Such assessments will need to be undertaken at project level for individual developments within the characterisation area.							
Type of designation		Name of designation	Designated features/species	Conservation objectives	Commentary	Receptor rating	Area rating
European marine designations	Special Areas of Conservation (SAC)	North Norfolk Sandbanks and Saturn Reef	Subtidal sandbanks Reefs	Currently in unfavourable condition. Conservation objective: Subject to natural change, restore the sandbanks and reefs to favourable condition (maintain feature extent and supporting natural processes, and restore physical structure and biological communities).	The sandbank and reef features are both considered sensitive to pressures exerted by offshore wind development and operation (including cabling) and an assessment of impact will need to be made at project level. The area will be sensitive to significant changes in sediment dynamics as well as direct impacts on the features. The Wildlife Trusts (TWT) consider that this site should be avoided for both array and cabling since it is in unfavourable condition and needs to recover. Cable impacts are considered possible from development in any of the North Sea characterisation areas. Consideration should also be given to the SNCB's report on cable sensitivity entitled 'Natural England and JNCC advice on key sensitivities of habitats and Marine Protected Areas in English Waters to offshore wind farm cabling within Proposed Round 4 leasing areas'.		
	SAC (Netherlands)	Klaverbank (adjacent)	Grey Seal Harbour Seal Harbour Porpoise Reefs	Seal and porpoise features have conservation objectives to maintain at favourable condition. The reef features have a conservation objective to maintain the area of reef and improve the quality.	The site is a gravelly/stony reef alternating with coarse sand and shell – a unique site in the Dutch North Sea. It has high biodiversity owing to the mosaic of habitats and the surprisingly clear water also allows red algae to grow. The average depth is 43 m but a 60 m deep silt-rich trench (the Botney Cut) crosses the south-west side. Klaverbank supports some indigenous invertebrate species as well as more common North Sea sandbank invertebrates and fish. The site may be important for ray and herring spawning (on hard substrates) and it supports large quantities of seabirds and harbour porpoise. The location of the site seaward of the characterisation area means that it is improbable that cabling would run through it and it is therefore unlikely that the reef features would be affected. Impacts of noise on seal and porpoise would need to be taken into consideration for developments within		

					the characterisation area. Seal and porpoise using the area are likely to forage throughout the North Sea (and the area is obviously not a seal haul-out site) so impacts are likely to be manageable with appropriate mitigation. It is noted that adverse effects on integrity at this site have not been identified in UK North Sea offshore wind HRAs to date.		
	Harbour porpoise SAC	Southern North Sea	Harbour porpoise	To ensure that the integrity of the site is maintained and that it makes the best possible contribution to maintaining Favourable Conservation Status (FCS) for Harbour Porpoise in UK waters In the context of natural change, this will be achieved by ensuring that: 1. Harbour porpoise is a viable component of the site; 2. There is no significant disturbance of the species; and 3. The condition of supporting habitats and processes, and the availability of prey is maintained. This is similar to the protection afforded to harbour porpoise throughout their range by the European Protected Species (EPS) regulations in the UK. However, the Natura 2000 principles and HRA tests set the bar higher than EPS protection for impacts on the site as the protection is no longer solely considering effects on the population as a whole but making sure that the site is contributing positively to the species' Favourable Conservation Status	This site was fully designated in February 2019. Harbour porpoise could be affected by offshore wind development in the area, mainly through acoustic impacts (disturbance and hearing damage) from pile driving, UXO clearance and possibly some geotechnical surveys. Disturbance and barrier effects arising from vessel movements and presence of turbines may also occur. The noise disturbance during wind farm construction is likely to be significant if using pile-driving to install the turbine foundations, and there is also a risk from UXO clearance. There will be a need to consider population level effects of disturbance (mainly during construction), and there may be some additional requirements to investigate potential impacts on prey species. The designation of harbour porpoise SACs will undoubtedly have consequences as to how some activities operate, and measures may need to be put in place to reduce disturbance. Implementation of any disturbance management is likely to be challenging given the complexity of marine activities, regulatory arrangements and scientific uncertainty surrounding the significance of noise impacts on harbour porpoise. The approach recommended by SNCBs is that developers should ensure that there is sufficient time between the assessment and the start of construction for them to effectively implement mitigation/management, which could include: 1. Careful spatial planning and phasing of noisy activities. 2. Use of alternative foundations that do not require pile driving (e.g. suction buckets, gravity bases), noting that these may have other impacts. 3. Use of alternative methods of installation (e.g. vibropiling) to reduce the noise footprint. 4. Use of technology to reduce the sound levels at source or to minimise sound propagation and reduce the noise footprint. Harbour porpoise occur in elevated densities in some parts of the site compared to others during summer and winter. This may make mitigation slightly easier since summer is likely to be the most important construction season. The SNCBs and The Wildlife Trusts have concerns over the potential cumulative impacts on harbour porpoise within this SAC, and note that currently there is no mechanism to ensure that a strategic approach to the management of impacts is taken. They consider that this could be a significant consenting risk for offshore wind development in the North Sea characterisation areas. In parallel to new offshore wind leasing, The Crown Estate has committed to fund a collaborative programme of strategic enabling		

					actions to increase the evidence base and support sustainable and coordinated expansion of offshore wind. Underwater noise and its management, assessment of impacts on sensitive receptors, and approaches to modelling and assessment, are all likely to form a key priority area for further work, and we anticipate collaborating with stakeholders on new work streams under the programme to help address outstanding evidence gaps.		
	Sites of Community Importance (SCIs)	None within the trigger distance					
	Ramsar	None within the trigger distance					
	Special Protection Areas (SPAs)	None within the trigger distance					
	Potential Special Protection Area (pSPA)	None within the trigger distance					
Marine Conservation Zones (MCZs)		Markham's Triangle	Subtidal coarse sediment Subtidal sand Subtidal mud Subtidal mixed sediments	Conservation objectives for all features are to recover to favourable condition.	This MCZ was designated in May 2019. The MCZ is already overlapped by the Hornsea 3 array area, and the section of the MCZ which is overlapped by the characterisation area is directly adjacent to the international boundary (i.e. to the east of Hornsea 3). It is therefore unlikely that any cables would be running through the site, since cables are likely to run westwards towards the UK. Assuming consent is granted for Hornsea 3 the MCZ will already be affected by offshore wind development and it is likely that cumulative effects will make consenting further capacity within the MCZ more complex (although none of the features within it are very sensitive to offshore wind development). Consideration should also be given to the SNCB's report on cable sensitivity entitled 'Natural England and JNCC advice on key sensitivities of habitats and Marine Protected Areas in English Waters to offshore wind farm cabling within Proposed Round 4 leasing areas'.		
Sites of Special Scientific Interest (SSSIs)		None within the trigger distance					
Spawning and nursery grounds		There are few overlaps of high-intensity nursery and spawning grounds in the area (maximum is three). The most species overlaps occur to the north of the area. The characterisation overlaps portions of herring spawning grounds to the north and west. Cod spawning areas cover the eastern portion of the area with another in close proximity to the south-east.			This data does not show this area to be of significant sensitivity so viewed as a minimal constraint. Noise disturbance has the potential to be an issue with the potential for seasonal restrictions on piling during breeding. It will depend on the precise location of the spawning grounds and whether they are still active (which may need to be determined by surveys). Cod is especially sensitive to noise impacts.		

Social tier			Receptor rating	Area rating
Royal Yachting Association (RYA) Automatic Identification System (AIS) Intensity	None triggered in the area as data does not extend this far offshore			
Marinas	None within the trigger distance			
Bathing beaches	None within the trigger distance			
Visibility from sensitive receptors	See visibility analysis below			

Review layers

Visibility from landscape designations and from the coast

The bands of significant visual impact are taken from the OSEA3[1] environmental report. It should be noted that these bands were challenged through the statutory stakeholder engagement by the Statutory Nature Conservation Bodies (SNCBs) so further analysis and engagement should be conducted to understand the visual constraint in potential development areas more fully.

The visibility from landscape designations analysis has been conducted using designations which include protections for landscapes and settings namely: National Parks, Areas of Outstanding Natural Beauty (AONBs), Heritage Coasts and World Heritage sites. For more information on these, please consult the methodology report. The analysis draws on visibility from these designations but not the sensitivity of them to offshore wind developments. Proposals should draw on the relevant management plans or local policies to fully understand the level of constraint that exists in the vicinity of these landscape designations. As such, more analysis is required to fully understand the potential constraint.

	Band of significant visual impact	% of overlap with the characterisation area	Commentary	Area rating
Medium sensitivity receptors	0-13 km (3.6 MW turbines)	0%	No visibility this far from shore.	
	13-20 km (4-8 MW turbines)	0%		
	20-30 km (10-15 MW turbines)	0%		
High sensitivity receptors	0-30 km	0%		

Visibility of sea surface from landscape designations		Receptor rating	Area rating
None triggered	No visibility this far from shore.		

Ornithology outside of Special Protection Areas (SPAs) for high-risk species

Joint Nature Conservation Committee (JNCC), Natural England and Royal Society for the Protection of Birds (RSPB) advise that there are a number of information sources which should be taken into consideration in the assessment of potential impacts from offshore wind development in this characterisation area. These are:

- Site Information Centres on the JNCC website (http://jncc.defra.gov.uk/page-6895) which provide up-to-date information on protected areas, their features and status.
- Marine Ecosystems Research Programme (MERP) seabird distribution maps (https://marine-ecosystems.org.uk/Research_outcomes/Top_predators)
- Future of the Atlantic Marine Environment (FAME) and Seabird Tracking and Research (STAR) tracking data from the RSBP (https://rspb.maps.arcgis.com/apps/Cascade/index.html?appid=d6c3aa1ec7184a2895a01cebf451c7b3)
- Wakefield, E., Owen, E., Baer, J., Carroll, M., Daunt, F., Dodd, S., Green, J., Guilford, T., Mavor, R., Miller, P., Newell, M., Newton, S., Robertson, G., Shoji, A., Soanes, L., Votier, S., Wanless, S. & Bolton, M. (2017) Breeding density, fine-scale tracking, and large-scale modeling reveal the regional distribution of four seabird species. Ecological Applications https://doi.org/10.1002/eap.1591
- Cleasby, I.R., Owen, E., Wilson, L.J., Bolton, M. (2018) Combining habitat modelling and hotspot analysis to reveal the location of high density seabird areas across the UK: Technical Report. RSPB Research Report no. 63
- Kober, K., Webb, A., Win, I., Lewis, M., O'Brien, S, Wilson, L.J, Reid, J.B. (2010) An analysis of the numbers and distribution of seabirds within the British Fishery Limit aimed at identifying areas that qualify as possible marine SPAs. JNCC Report 431 (and the distribution maps therein) (http://jncc.defra.gov.uk/page-5622)
- Sansom, A., Wilson, L.J., Caldow, R.W.G. & Bolton, M. 2018. Comparing marine distributions maps for seabirds during the breeding season derived from different survey and analysis methods. PLOS ONE https://doi.org/10.1371/journal.pone.0201797

[1] BEIS (2016), OESEA3 Environmental Report. Crown copyright 2016, p 291. URN 16D/033.

- Bradbury, G., Trinder, M., Furness, B., Banks, A.N., Caldow, R.W.G. & Hume, D. 2014. Mapping Seabird Sensitivity to Offshore Wind Farms. PLoS ONE 9(9): e106366. doi:10.1371/journal.pone.0106366
- Thaxter, C.B., Ross-Smith, V., Bouten, W., Clark, N., Conway, G., Rehfisch, M. & Burton, N. (2015) Seabird–wind farm interactions during the breeding season vary within and between years: A case study of lesser black-backed gull Larus fuscus in the UK. Biological Conservation 186: 347-358

Species	Site	Commentary on coverage	Area rating
Gannet	Flamborough and Filey Coast (FFC) SPA	The gannet mean maximum seaward foraging range extends 229 km from the source colony at the FFC SPA. This range encompasses five other characterisation areas in addition to encompassing the majority of the southern North Sea area, which lies in the south-east of the foraging radius. As a result, cumulative collision risk effects should be considered if development is taken forward in more than one characterisation area. This cumulative effects constraint will also be affected by current pre-application developments within the foraging range e.g. Hornsea Project Three, Norfolk Boreas and Norfolk Vanguard West developments. Summer density decreases further offshore and to the east and south of the FFC SPA. The Southern North Sea area lies in an area of relatively low gannet density, with a slightly increased density in the southern part of the characterisation area. However, cumulative impacts on gannet will be a key HRA consideration for development in the Southern North Sea area given the existing wind farm development within the FFC SPA gannet foraging range and wider North Sea. Data from the FAME/STAR databases (available from the RSPB and analysed in Cleasby *et al.* 2018) and from the Hornsea strategic monitoring tracking data should be used to inform future assessment of cumulative impact to the FFC SPA. Natural England also recommends the use of Sansom *et al.* 2018, Bradbury *et al.* 2014 and the modelled MERP seabird distribution maps. When taking into consideration the cumulative impact of existing and planned offshore wind projects in this area and nearby, Natural England considers that there is a significant consenting risk to future projects in this area, and that it may not be possible to conclude no adverse effects on site integrity.	
Kittiwake	Flamborough and Filey Coast (FFC) SPA	The kittiwake mean maximum seaward foraging range extends 60 km from the source colony. While the Southern North Sea area is located outside this FFC SPA foraging range there is a slight overlap with the maximum foraging range of kittiwake (120 km). Four other characterisation areas lie within this maximum range and, given concerns over the cumulative impacts of other North Sea offshore wind developments on the FFC kittiwake population, the species is likely to represent a consent consideration for any development within the portion of the Southern North Sea area that overlaps this range. However, given the distance of the Southern North Sea area from the FFC colony, and the minimal overlap with the maximum foraging range, any kittiwake impacts attributed to this FFC are likely to be manageable. Summer density of kittiwake increases east of the FFC colony, with an area of higher density continuing beyond the 60 km mean maximum foraging range which the northern part of the Southern North Sea area overlaps with. Locating any development south of this higher density area and beyond the maximum foraging range (i.e. > 120 km) would help further reduce impacts on this species. Data from the FAME/STAR databases (available from the RSPB and analysed in Cleasby *et al.* 2018) and from the Hornsea strategic monitoring tracking data should be used to inform future assessment of cumulative impact to the FFC SPA. Natural England also recommends the use of Sansom *et al.* 2018, Bradbury *et al.* 2014 and the modelled MERP seabird distribution maps. When taking into consideration the cumulative impact of existing and planned offshore wind projects in this area and nearby, Natural England considers that there is a significant consenting risk to future projects in this area, and that it may not be possible to conclude no adverse effects on site integrity. RSPB do not consider that impacts to kittiwake from FFC SPA can be considered *de minimis*.	
Lesser black-backed gull	Alde-Ore Estuary SPA	The lesser black-backed gull mean maximum seaward foraging range extends 141 km from the Alde-Ore Estuary SPA, with the southern end of the Southern North Sea characterisation area encompassed within this foraging range. Given the high level of existing offshore wind development within this foraging range, cumulative impacts of development within the Southern North Sea area with other offshore wind development are likely to be a consent consideration. Summer density of lesser black-backed gull is relatively high, with patches of highest density concentrated along the coast extending either side of the colony. Given that only the southern end of the Southern North Sea area overlaps the foraging range, locating any development in the north and beyond the Alde-Ore Estuary mean maximum range (i.e. > 141 km) would help reduce any impacts on this SPA colony.	

Ministry of Defence (MoD) activity

	Issues when using 250 m tip heights	Issues when using 350 m tip heights	Receptor rating
Air traffic control (ATC)	No ATC concerns.	No ATC concerns.	
Air defence radar (ADR)	Trimingham ADR concerns in the south-western part of the Southern North Sea area.	Trimingham ADR concerns in the south-western part of the Southern North Sea area.	
Threat radar	No threat radar concerns.	No threat radar concerns.	
Low flying	No low flying concerns, however, there will be a lighting requirement.	No low flying concerns, however, there will be a lighting requirement.	
Ranges, danger and exercise areas	UXO should be taken into account. The MoD would need to review cable routes to ensure highly surveyed routes are not obstructed by cables or turbines.	UXO should be taken into account. The MoD would need to review cable routes to ensure highly surveyed routes are not obstructed by cables or turbines.	

Area commentary	Area rating
ADR concerns at both tip height scenarios although mainly over the south-western section of the characterisation area. There will be a lighting requirement and consideration of UXO as per standard industry practice.	

Fishing activity

Gear type	Location and comments
Mobile gear	▪ This area is mainly fished by Dutch Beam Trawlers, Belgium Beam Trawlers and French Trawlers, with occasional UK vessels present and some Dutch seine netters. ▪ The Cleaver Bank to the north-east of the area would be very difficult to develop from a fisheries perspective due to the importance of the area. It is fished by vessels from many EU countries and Norway. ▪ To the north of the area there are the Outer Silver Pits which provide a profitable Nephrops fishery that services Scottish and Belgian fishermen. There appears to be other Nephrops fishing throughout the area as well ▪ The National Federation of Fishermen's Organisation (NFFO) advise that in-combination impacts, principally from existing wind farm and fisheries management measures associated with MPAs are a concern for fisheries operating in this area and elsewhere in the southern North Sea.

Area Commentary	Area rating
Some important fisheries in the area, however, there are gaps that can provide opportunities for development.	

Future oil and gas

Licensing round	Commentary	Receptor rating	Area rating
28th and 29th rounds - central of the area	Four new licence blocks (Blocks 49/29c, 49/4d, 49/3, 49/9d) awarded through 28th licensing round. The new licence blocks overlap with the existing 0-6 NM helicopter buffers, however, would need to work together to design mitigation.		
30th round - southern tip of the area	In the 30th offshore licensing round there are two licence applications which overlap with the Southern North Sea characterisation area. They are located in the southern tip of the characterisation area and may present some additional constraint. However, the overlap is very small and the sites may not progress and may not require platforms. We will continue to work with the Oil and Gas Authority (OGA) to monitor the progress of these applications.		

Marine plans

East Marine Plan	Spatially explicit policies	Issues	Area rating
Aggregates	AGG3: within defined areas of high potential aggregate resource, proposals should demonstrate in order of preference: a) that they will not prevent aggregate extraction; b) how, if there are adverse impacts on aggregate extraction, they will minimise these; c) how if the adverse impacts cannot be minimised, they will be mitigated; and, d) the case for proceeding with the application if it is not possible to minimise or mitigate the adverse impacts.	The characterisation area, particularly the northern extent, overlaps with the area of optimal aggregate resource area identified in the East Marine Plan. Any new offshore wind development would need to consider impacts to the aggregates industry negotiation with the sector would be required. Whilst The Crown Estate leases/licences seabed for offshore wind and aggregate extraction it should be noted that aggregates tendering rounds currently run every two years, and so the requirement for liaison between industries will be ongoing.	
Tidal energy	TIDE1: in defined areas of identified tidal stream resource proposals should demonstrate, in order of preference: a) that they will not compromise potential future development of a tidal stream project; b) how, if there are any adverse impacts on potential tidal stream deployment, they will minimise them; c) how, if the adverse impacts cannot be minimised, they will be mitigated; and, d) the case for proceeding with the proposal if it is not possible to minimise or mitigate the adverse impacts.	There is no overlap of the characterisation area with the area of identified tidal stream resource in the East Marine Plan.	
Aquaculture	AQ1: within sustainable aquaculture development sites, proposals should demonstrate in order of preference: a) that they will avoid adverse impacts on future aquaculture development by altering the seabed or water column in ways which would cause adverse impacts to aquaculture productivity or potential; b) how, if there are adverse impacts on aquaculture development, they can be minimised; c) how, if the adverse impacts cannot be minimised, they will be mitigated; and, d) the case for proceeding with the proposal if it is not possible to minimise or mitigate the adverse impacts.	There is no overlap of the characterisation area with the optimum sites of aquaculture potential identified in the East Marine Plan.	
Carbon Capture Storage (CCS)	CCS1: within defined areas of potential carbon dioxide storage, proposals should demonstrate in order of preference: a) that they will not prevent carbon dioxide storage; b) how, if there are adverse impacts on carbon dioxide storage, they will minimise them; c) how, if the adverse impacts cannot be minimised, they will be mitigated; and, d) the case for proceeding with the proposal if it is not possible to minimise or mitigate the adverse impacts.	There is some overlap of the characterisation area with the areas of potential opportunity for CCS identified in the East Marine Plan. The overlap would need to be considered as part of any plans for future offshore wind development negotiation with the sector would be required.	
Ports and shipping	PS2: proposals that require static sea surface infrastructure that encroaches upon important navigation routes should not be authorised unless there are exceptional circumstances. Proposals should: a) be compatible with the need to maintain space for safe navigation, avoiding adverse economic impact; b) anticipate and provide for future safe navigational requirements where evidence and/or stakeholder input allows; and,	There is no overlap of the characterisation area with the important navigation routes identified in the East Marine Plan. However, the characterisation area is adjacent to an International Maritime Organisation (IMO) shipping route where the policy in the plan is that no static sea surface infrastructure should be authorised. Any new offshore wind development would need to account for navigation routes, and appropriate buffer distances, when locating the project area.	

	c) account for impacts upon navigation in-combination within other existing and proposed activities.		

The Crown Estate key resource areas (KRAs) for other sectors

KRA category	Where?	Commentary	Receptor rating	Area rating
Cables	No interaction.			
Carbon Capture Storage (CCS) stores	Overlaps with the Bunter 36 and Viking Fields, both of which have been economically appraised through the Energy Technologies Institute strategic site appraisal (SSA) work. The area intersects a number of moderate, marginal and limited rated stores. These are distributed across the area.	This site has been identified as a commercially viable storage option and as such, is a sensitive receptor that should be considered in development plans. However, the constraint is relatively limited in terms of coverage of the characterisation area, therefore there is significant potential development in the rest of the area.		
CCS infrastructure	Wide coverage across the area.	This KRA is significant in size however there is significant opportunity for potential deployment of CCS infrastructure from industrial hubs on the east coast and Europe, transporting captured CO2 through the characterisation areas to potential stores in the Southern North Sea. Proposals should consider potential impacts on these potential infrastructure corridors that may be developed in the near to medium term.		
Minerals	No interaction.			
Pipelines	No interaction.			
Sandscaping	No interaction.			
Tidal range	No interaction.			
Tidal stream	No interaction.			
Wave	No interaction.			

National Air Traffic Services (NATs) radar overlap

% Overlap with Primary Surveillance Radar (PSR) assessment buffer (200 m turbines)	Commentary	Area rating
69.38%	Radar coverage further assessment buffer intersects with a large proportion of the area with some non-coverage to the north-east of the area. There is some scope for mitigation through siting, but this is limited.	

Water Framework Directive (WFD)

% of the area covered	Spatial overlap with the area	Commentary	Area rating
No intersect.			

Marine cultural heritage

Heritage asset type	Where?	Commentary on sensitivity from offshore wind development	Receptor rating
Maritime archaeology and wrecks	There is potential throughout the characterisation area, particularly in the north of the area in association with shipping routes leading into the Humber estuary. Preservation potential will be greatest where sandier sediments most conducive to preservation are present.	Maritime archaeology including known wrecks represented by a physical asset on the seabed, historic losses of vessels where precise location is uncertain, and associated cultural material such as isolated finds, all have potential to be affected by OWF development in the Southern North Sea characterisation area. The area contains a significant number of wrecks and obstructions although it is notable that this is lower in concentration compared with those areas closer to the coast. There is potential for the recovery of remains from the earliest seafaring in the prehistoric period through to the present day, although the potential for seafaring craft from periods of prehistory at this distance offshore is somewhat limited (although not zero) due to the capabilities of vessels at this time. There is a particular dominance of steel and metal vessels from the 19th and 20th centuries due to their survivability in the historic record, and there are also a significant number of wrecks associated with 20th century military activity and trade. Established procedures exist to ensure that any historic wrecks, both known and unknown, and associated remains, are identified as part of any proposed OWF development and impacts are mitigated and minimised.	
Aviation archaeology	Moderate potential for recovery of aviation archaeological remains throughout the characterisation area.	There is potential within the Southern North Sea characterisation area for the discovery of remains from crashed aircraft and associated cultural material from the birth of aviation at the start of the 20th Century to the present. The greatest potential is associated with losses from the Second World War, the numerous airborne battles and defence of strategic locations around the Lincolnshire and north Norfolk coast, as well as vital shipping routes and targets within the area that took place there at this time. Several Royal Air Force (RAF) bases were located in proximity to the characterisation area and the historic records indicate a significant number of aircraft losses from this period in this area. While existing standard mitigation measures could be utilised for specific projects in the area, further site-specific mitigation including excavation and recovery of significant remains that are encountered, and where impacts are unavoidable, may be required. It should however, be noted that this is an extreme example and would only be undertaken following significant discussion with advisors and in rare cases where preservation *in situ* was not a feasible option.	
Submerged prehistoric landscapes	Potential across characterisation area with enhanced potential in the north and coastal areas, and particularly near to geomorphological features such as the palaeochannels being worked in the area by the aggregate industry, as well as gravel terraces, lagoons, lakes etc. that were favourable hunting locations during the Pleistocene and early Holocene.	During periods of lower sea level caused by three major glaciations (the Anglian, Wolstonian and Devensian) the majority of the characterisation area would have been covered by ice sheets. If present, any remains would be expected to be associated with geomorphological features such as palaeochannels and valleys, and the geological deposits from these periods. There is some potential for the survival of sediments and secondary context artefactual material in areas where glacial activity has not eroded earlier sedimentary deposits. The areas to the south of the Dogger Bank within the characterisation area have been studied extensively through research and other OWF development projects. Following the retreat of the Devensian ice sheet (c. 13,000 BP) much of the area would have provided accessible and attractive habitat for humans and animals. In particular, this area contained geomorphological features that may have been utilised as favourable locations by human ancestors during the Mesolithic. Significant deposits and possible finds may therefore be anticipated in association with the early Mesolithic channel systems and other geomorphological features that were present and exposed prior to marine transgression. As such, there is potential for remains from this period to be present and impacted by OWF development in the characterisation area. Established procedures exist to ensure that any submerged prehistoric landscapes, associated geographical and geomorphological features, and associated deposits, features and finds are identified as part of any proposed OWF development so impacts can be mitigated and minimised.	

Area commentary	Area rating
There are extensive heritage assets and potential for recovery of further remains across the area, although concentrations of known wrecks and obstructions are lower here than for areas closer to the coast. The main issue for this area lies in the consideration of the cumulative impact of further wind development on the submerged prehistoric resources. Consideration therefore needs to be given to cumulative effects on this resource on a strategic level across the area. Strategic mitigation may include exclusion of certain parts of the characterisation area to minimise the cumulative effects of further wind farm development on submerged prehistoric resources, however, further research may be required to better understand the cumulative impacts of development on this receptor class.	

Glossary of acronyms and abbreviations

ADR	Air Defence Radar
AONB	Area of Outstanding Natural Beauty
ATC	Air Traffic Control
CCS	Carbon Capture Storage
EPS	European Protected Species
FAME	Future of the Atlantic Marine Environment
FFC	Flamborough and Filey coast
HRA	Habitat Regulations Assessment
IMO	International Maritime Organisation
JNCC	Joint Nature Conservation Committee
km	Kilometre
KRA	Key Resource Area
m	Metre
MCZ	Marine Conservation Zone
MERP	Marine Ecosystems Research Programme
MoD	Ministry of Defence
MPA	Marine Protected Area
MW	Mega watt
NATS	National Air Traffic Services
NFFO	National Federation of Fishermen's Organisation
NM	Nautical Mile
OESEA3	Offshore Energy Strategic Environmental Assessment 3
OFTO	Offshore Transmission Owners
OGA	Oil and Gas Authority
OWF	Offshore Wind Farm
pSPA	Potential Special Protection Area
PSR	Primary Surveillance Radar
Ramsar	Ramsar Convention on wetlands of international Importance especially as waterfowl habitat, also known as the 'Convention on Wetlands'.
RAF	Royal Air Force
RSPB	Royal Society for the Protection of Birds
RYA AIS	Royal Yachting Association (RYA) Automatic Identification System (AIS)
SAC	Special Area of Conservation
SCI	Site of Community Importance
SNCB	Statutory Nature Conservation Body
SPA	Special Protection Area
SSA	Strategic Site Appraisal
SSSI	Site of Special Scientific Interest
STAR	Seabird Tracking and Research
TWT	The Wildlife Trusts
UXO	Unexploded Ordnance
WFD	Water Framework Directive