

Hornsea Project Three
Offshore Wind Farm



Hornsea Three Offshore Wind Farm

Habitats Regulations Assessment
Report to Inform Appropriate Assessment

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Offshore Wind Farm



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Report to Inform Appropriate Assessment

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Ørsted

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Front cover picture: Kite surfer near a UK offshore wind farm © Orsted Hornsea Project Three (UK) Ltd., 2018.

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Appendix A Effects on benthic ecology in relation to the specific attributes of the Conservation Objectives

Table Error! No text of specified style in document..1: The Wash and North Norfolk Coast SAC Assessment Matrix – Construction/Decommissioning

Potential Impact: Temporary habitat loss/disturbance during construction/decommissioning								
Potential Impact: Temporary increases in suspended sediments/smothering during construction/decommissioning								
Potential Impact: Accidental pollution during construction/decommissioning								
					Alternative route		Original route	
European Site	Qualifying Feature	Conservation Objective	Attributes	Conservation Objective target	Assessment overview/justification	Conclusion of effect on site integrity	Assessment overview/justification	Conclusion of effect on site integrity
The Wash and North Norfolk Coast SAC	Sandbanks which are slightly covered by sea water all the time	To ensure that, subject to natural change, the extent and distribution of qualifying natural habitats are maintained or restored	Presence and spatial distribution of biological communities	Maintain the presence and spatial distribution of subtidal sandbank communities	The proposed cable route is located near the eastern edge of the site. Sediment transport in the region is in an easterly direction. Analysis of historic and site specific data does not indicate the presence of Annex I Sandbanks which are slightly covered by sea water all the time coinciding with the cable corridor within the boundary of the site. The biotopes identified within the section of the cable corridor occurring within The Wash and North Norfolk Coast SAC are not characteristic of sandbank communities with the exception of the NcirBat biotope, however; the occurrence of this biotope in this location is not indicative of this feature in this instance.	No effect on site integrity anticipated	The proposed cable route is located near the eastern edge of the site. Sediment transport in the region is in an easterly direction. Analysis of historic and site specific data does not indicate the presence of Annex I Sandbanks which are slightly covered by sea water all the time coinciding with the cable corridor within the boundary of the site. The biotopes identified within the section of the cable corridor occurring within The Wash and North Norfolk Coast SAC are not characteristic of sandbank communities with the exception of the NcirBat biotope, however; the occurrence of this biotope in this location is not indicative of this feature in this instance.	No effect on site integrity anticipated

Potential Impact: Temporary habitat loss/disturbance during construction/decommissioning								
Potential Impact: Temporary increases in suspended sediments/smothering during construction/decommissioning								
Potential Impact: Accidental pollution during construction/decommissioning								
			Extent and distribution	Maintain the total extent and spatial distribution of subtidal sandbanks to ensure no loss of integrity, while allowing for natural change and succession.	<p>A maximum area of 2,356,714 m² of the subtidal habitats within The Wash and North Norfolk Coast SAC is predicted to be impacted by temporary habitat loss/disturbance (i.e. from pre-construction sandwave clearance (and sandwave material deposition) and boulder clearance and cable installation including anchor placements), which represents 0.22% of the total area of The Wash and North Norfolk Coast SAC.</p> <p>The temporary loss/disturbance will be highly localised to the vicinity of the construction activity (i.e. limited to the immediate footprints) and will occur over the maximum construction phase of up to eight years. Individual activities resulting in temporary habitat loss/disturbance will occur intermittently throughout this time with only a small proportion of the total area of habitat to be affected being impacted at any one time.</p> <p>The maximum design scenario for temporary habitat loss/disturbance assumes that pre-construction sandwave clearance would occur along the entire extent of export cables within The Wash and North Norfolk Coast SAC. This is, however, a precautionary assumption and there may be discrete areas in which sandwave clearance will not be required but boulder clearance may be required and although this will not contribute to any additional habitat loss, the process will effectively redistribute boulders and cobbles within discrete areas and potentially concentrate these in the areas either side of the 25 m boulder clearance corridor.</p>	No effect on site integrity anticipated	<p>A maximum area of 1,488,339km² of the subtidal habitats within The Wash and North Norfolk Coast SAC is predicted to be impacted by temporary habitat loss/disturbance (i.e. from pre-construction sandwave clearance (and sandwave material deposition) and boulder clearance and cable installation including anchor placements), which represents 0.14% of the total area of The Wash and North Norfolk Coast SAC.</p> <p>The temporary loss/disturbance will be highly localised to the vicinity of the construction activity (i.e. limited to the immediate footprints) and will occur over the maximum construction phase of up to eight years. Individual activities resulting in temporary habitat loss/disturbance will occur intermittently throughout this time with only a small proportion of the total area of habitat to be affected being impacted at any one time.</p> <p>The maximum design scenario for temporary habitat loss/disturbance assumes that pre-construction sandwave clearance would occur along the entire extent of export cables within The Wash and North Norfolk Coast SAC. This is, however, a precautionary assumption and there may be discrete areas in which sandwave clearance will not be required but boulder clearance may be required and although this will not contribute to any additional habitat loss, the process will effectively redistribute boulders and cobbles within discrete areas and potentially concentrate these in the areas either side of the 25 m boulder clearance corridor.</p>	No effect on site integrity anticipated
	To ensure that, subject to natural change, the structure and function (including	Presence and abundance of key structural and influential	[Maintain OR Recover OR Restore] the abundance of listed species, to enable each of them to be a viable component of the habitat.	See above - due to the absence of characteristic Annex I sandbank communities in the proposed working cable corridor there exists no risk to the ability of key structural and influential species being viable components of Annex I Sandbanks which are slightly covered by sea water all the time where they occur within the site.	No effect on site integrity anticipated	See above - due to the absence of characteristic Annex I sandbank communities in the proposed working cable corridor there exists no risk to the ability of key structural and influential species being viable components of Annex I Sandbanks which are slightly covered by sea water all the time where they occur within the site.	No effect on site integrity anticipated	

Potential Impact: Temporary habitat loss/disturbance during construction/decommissioning								
Potential Impact: Temporary increases in suspended sediments/smothering during construction/decommissioning								
Potential Impact: Accidental pollution during construction/decommissioning								
		typical species) of qualifying natural habitats are maintained or restored	species					
			Non-native species and pathogens	Restrict the introduction and spread of non-native species and pathogens, and their impacts.	The proposed activities during construction/decommissioning do not represent a risk for the introduction or spread of non-native species and pathogens	No effect on site integrity anticipated	The proposed activities during construction/decommissioning do not represent a risk for the introduction or spread of non-native species and pathogens	No effect on site integrity anticipated
			Sediment composition and distribution	Maintain the distribution of sediment composition across the feature (and each of its subfeatures).	Sandwave clearance material from sandwaves cleared within The Wash and North Norfolk Coast SAC will be deposited within the boundary of The Wash and North Norfolk Coast SAC at a location that considers the net direction of sediment transport in the region to ensure that sediment will not be lost from the sandbank system (see section 1.11.5 in ES volume 1, chapter 1: Marine Processes).	No effect on site integrity anticipated	Sandwave clearance material from sandwaves cleared within The Wash and North Norfolk Coast SAC will be deposited within the boundary of The Wash and North Norfolk Coast SAC at a location that considers the net direction of sediment transport in the region to ensure that sediment will not be lost from the sandbank system (see section 1.11.5 in ES volume 1, chapter 1: Marine Processes).	No effect on site integrity anticipated
			Species composition of component communities	Maintain the species composition of component communities.	The proposed activities during construction/decommissioning are not anticipated to impact the range, relative abundance or overall biodiversity of the species composition of component communities of Annex I Sandbanks which are slightly covered by sea water all the time within this site	No effect on site integrity anticipated	The proposed activities during construction/decommissioning are not anticipated to impact the range, relative abundance or overall biodiversity of the species composition of component communities of Annex I Sandbanks which are slightly covered by sea water all the time within this site	No effect on site integrity anticipated

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Potential Impact: Accidental pollution during construction/decommissioning								
			Topography	<p>Maintain the presence of topographic characteristics of the feature, while allowing for natural responses to hydrodynamic regime, by preventing erosion or deposition through human induced activity.</p>	<p>The mobility of material in the nearshore area is such that under storm conditions, the combined action of currents and waves is expected to remobilise sediments with grain size of up to 100 mm (cobbles) in the shallowest water depths of up to 8 m and up to 15 mm (pebble gravel) in deeper nearshore areas (up to 14 m). This demonstrates that, over time, there will be a redistribution of the material displaced during boulder clearance and, whilst it is not possible to determine where the sediment will be redistributed to, it is reasonable to assume that some of the material will be moved back in to the areas which were cleared, thus partially restoring the topography of the area.</p> <p>Jack up operations, cable trenching also has the potential to leave scars on the seabed, the persistence of which will depend on the local seabed characteristics and ambient hydrodynamic conditions (see section 1.11.2 in ES volume 2, chapter 1: Marine Processes). In areas where mobile sands and gravels are present, such as are present across the majority of the Hornsea Three study area coinciding with The Wash and North Norfolk SAC, these scars are likely to be temporary features which may only persist for a period of weeks to months. However, even if scars persist for longer they are not expected to have implications for sediment transport; they are simply local depressions that will infill over time.</p>	<p>No effect on site integrity anticipated</p>	<p>The mobility of material in the nearshore area is such that under storm conditions, the combined action of currents and waves is expected to remobilise sediments with grain size of up to 100 mm (cobbles) in the shallowest water depths of up to 8 m and up to 15 mm (pebble gravel) in deeper nearshore areas (up to 14 m). This demonstrates that, over time, there will be a redistribution of the material displaced during boulder clearance and, whilst it is not possible to determine where the sediment will be redistributed to, it is reasonable to assume that some of the material will be moved back in to the areas which were cleared, thus partially restoring the topography of the area.</p> <p>Jack up operations, cable trenching also has the potential to leave scars on the seabed, the persistence of which will depend on the local seabed characteristics and ambient hydrodynamic conditions (see section 1.11.2 in ES volume 2, chapter 1: Marine Processes). In areas where mobile sands and gravels are present, such as are present across the majority of the Hornsea Three study area coinciding with The Wash and North Norfolk SAC, these scars are likely to be temporary features which may only persist for a period of weeks to months. However, even if scars persist for longer they are not expected to have implications for sediment transport; they are simply local depressions that will infill over time.</p>	<p>No effect on site integrity anticipated</p>

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Potential Impact: Temporary increases in suspended sediments/smothering during construction/decommissioning								
Potential Impact: Accidental pollution during construction/decommissioning								
			Volume	Maintain the existing volume of sediment in the sandbank, allowing for natural change.	The proposed sandwave clearance activities will result in local displacement of the disturbed sediment volume, which will remain the same sediment type as the surrounding seabed (i.e. it is reasonable to assume similarity of sediment particle size with depth based on sediment transport processes) and with no loss of seabed sediments from the local area. In the case of dredging, assuming that any material excavated is disposed of in close proximity to the dredge location, no sediment volume will be removed from the sandbank systems overall. The displaced material will be of the same or similar sediment type (mineralogy and grain size distribution) as the surrounding seabed and, following re-settlement, will be immediately available again for transport at the naturally occurring rate and direction, controlled entirely by natural processes. As such, the sediment will have immediately re-joined the natural sedimentary environment within the local area and so by definition is not 'lost from the system' due to the dredging/spoil disposal process.	No effect on site integrity anticipated	The proposed sandwave clearance activities will result in local displacement of the disturbed sediment volume, which will remain the same sediment type as the surrounding seabed (i.e. it is reasonable to assume similarity of sediment particle size with depth based on sediment transport processes) and with no loss of seabed sediments from the local area. In the case of dredging, assuming that any material excavated is disposed of in close proximity to the dredge location, no sediment volume will be removed from the sandbank systems overall. The displaced material will be of the same or similar sediment type (mineralogy and grain size distribution) as the surrounding seabed and, following re-settlement, will be immediately available again for transport at the naturally occurring rate and direction, controlled entirely by natural processes. As such, the sediment will have immediately re-joined the natural sedimentary environment within the local area and so by definition is not 'lost from the system' due to the dredging/spoil disposal process.	No effect on site integrity anticipated
		To ensure that, subject to natural change, the supporting processes on which qualifying natural habitats are maintained or restored	Energy / exposure	Maintain the natural physical energy resulting from waves, tides and other water flows, so that the exposure does not cause alteration to the biotopes, and stability, across the habitat.	The proposed activities during construction/decommissioning do not represent a risk to natural physical energy resulting from waves, tides and other water flows - see sediment movement and hydrodynamic regime attribute below.	No effect on site integrity anticipated	The proposed activities during construction/decommissioning do not represent a risk to natural physical energy resulting from waves, tides and other water flows - see sediment movement and hydrodynamic regime attribute below.	No effect on site integrity anticipated
			Physico-chemical properties	Maintain the natural physico-chemical properties of the water.	The proposed activities during construction/decommissioning do not represent a risk to the natural physico-chemical properties of the water - Accidental pollution events will be mitigated against by means of industry standard practices.	No effect on site integrity anticipated	The proposed activities during construction/decommissioning do not represent a risk to the natural physico-chemical properties of the water - Accidental pollution events will be mitigated against by means of industry standard practices.	No effect on site integrity anticipated

Potential Impact: Temporary habitat loss/disturbance during construction/decommissioning								
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Potential Impact: Accidental pollution during construction/decommissioning								
			Sediment contaminants	Restrict surface sediment contaminants (<1cm from the surface) to below the OSPAR Environment Assessment Criteria (EAC) or Effects Range Low (ERL) threshold. For example, mean cadmium levels should be maintained below the ERL of 1.2 mg per kg.	The proposed activities during construction/decommissioning do not represent a risk to altering surface sediment contaminants - Accidental pollution events will be mitigated against by means of industry standard practices.	No effect on site integrity anticipated	The proposed activities during construction/decommissioning do not represent a risk to altering surface sediment contaminants - Accidental pollution events will be mitigated against by means of industry standard practices.	No effect on site integrity anticipated
			Sediment movement and hydrodynamic regime	Maintain all hydrodynamic and physical conditions such that natural water flow and sediment movement are not significantly altered or prevented from responding to changes in environmental conditions	The patterns of processes governing the overall evolution of the systems (the flow regime, water depths and sediment availability) are at a much larger scale and so would not be affected by, the proposed local works. As a result, the proposed clearance is not likely to influence the overall form and function of the system and eventual recovery via natural processes is therefore expected. The rate of recovery would vary in relation to the rate of sediment transport processes, faster infill and recovery rates will be associated with higher local flow speeds and more frequent wave influence (see volume 1, chapter 1: Marine Processes). Where the sands are deposited into areas of different seabed type (e.g. areas of slightly coarser seabed in some sandwave troughs), the seabed may become locally relatively finer in texture until the body of sand has been winnowed away or reincorporated into a bedform migrating over that location. In all cases, the deposited sediments would be rapidly incorporated into the seabed and local accumulations would be subject to redistribution under the prevailing hydrodynamic conditions.	No effect on site integrity anticipated	The patterns of processes governing the overall evolution of the systems (the flow regime, water depths and sediment availability) are at a much larger scale and so would not be affected by, the proposed local works. As a result, the proposed clearance is not likely to influence the overall form and function of the system and eventual recovery via natural processes is therefore expected. The rate of recovery would vary in relation to the rate of sediment transport processes, faster infill and recovery rates will be associated with higher local flow speeds and more frequent wave influence (see volume 1, chapter 1: Marine Processes). Where the sands are deposited into areas of different seabed type (e.g. areas of slightly coarser seabed in some sandwave troughs), the seabed may become locally relatively finer in texture until the body of sand has been winnowed away or reincorporated into a bedform migrating over that location. In all cases, the deposited sediments would be rapidly incorporated into the seabed and local accumulations would be subject to redistribution under the prevailing hydrodynamic conditions.	No effect on site integrity anticipated
			Water quality - contaminants	Restrict aqueous contaminants to levels equating to High Status according to Annex VIII and Good Status according to Annex X of the Water Framework Directive,	The proposed activities during construction/decommissioning do not represent a risk to impacts on water quality - Accidental pollution events will be mitigated against by means of industry standard practices.	No effect on site integrity anticipated	The proposed activities during construction/decommissioning do not represent a risk to impacts on water quality - Accidental pollution events will be mitigated against by means of industry standard practices.	No effect on site integrity anticipated

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Potential Impact: Accidental pollution during construction/decommissioning								
				avoiding deterioration from existing level				
			Water quality - dissolved oxygen	Maintain the dissolved oxygen (DO) concentration at levels equating to High Ecological Status (specifically ≥ 5.7 mg per litre (at 35 salinity) for 95 % of the year), avoiding deterioration from existing levels.	The proposed activities during construction/decommissioning do not represent a risk to maintaining dissolved oxygen levels at levels equating to High Ecological Status.	No effect on site integrity anticipated	The proposed activities during construction/decommissioning do not represent a risk to maintaining dissolved oxygen levels at levels equating to High Ecological Status.	No effect on site integrity anticipated
			Water quality - nutrients	Maintain water quality at mean winter dissolved inorganic nitrogen levels where biological indicators of eutrophication (opportunistic macroalgal and phytoplankton blooms) do not affect the integrity of the site and features, avoiding deterioration from existing levels.	The proposed activities during construction/decommissioning do not represent a risk with regards to the alteration of existing nutrient levels.	No effect on site integrity anticipated	The proposed activities during construction/decommissioning do not represent a risk with regards to the alteration of existing nutrient levels.	No effect on site integrity anticipated
			Water quality - turbidity	Maintain natural levels of turbidity (eg suspended concentrations of sediment, plankton and other material) across the habitat.	Although temporary increases in localised suspended sediments will occur due to activities occurring during construction/decommissioning these will rapidly disperse and do not represent a risk at an ecosystem level.	No effect on site integrity anticipated	Although temporary increases in localised suspended sediments will occur due to activities occurring during construction/decommissioning these will rapidly disperse and do not represent a risk at an ecosystem level.	No effect on site integrity anticipated
	Reefs	To ensure that, subject to natural change, the extent and distribution of qualifying natural habitats are	Presence and spatial distribution of biological communities	Maintain the presence and spatial distribution of reef communities.	A maximum area of 2,356,714 m ² of the subtidal habitats within The Wash and North Norfolk Coast SAC is predicted to be impacted by temporary habitat loss/disturbance (i.e. from pre-construction sandwave clearance (and sandwave material deposition) and boulder clearance and cable installation including anchor placements), which represents 0.22% of the total area of The Wash and North Norfolk Coast SAC.	No effect on site integrity anticipated	A maximum area of 1,488,339km ² of the subtidal habitats within The Wash and North Norfolk Coast SAC is predicted to be impacted by temporary habitat loss/disturbance (i.e. from pre-construction sandwave clearance (and sandwave material deposition) and boulder clearance and cable installation including anchor placements), which represents 0.14% of the total area of The Wash and North Norfolk Coast SAC.	No effect on site integrity anticipated

Potential Impact: Temporary habitat loss/disturbance during construction/decommissioning									
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Potential Impact: Accidental pollution during construction/decommissioning									
		maintained or restored			<p>The temporary loss/disturbance will be highly localised to the vicinity of the construction activity (i.e. limited to the immediate footprints) and will occur over the maximum construction phase of up to eight years. Individual activities resulting in temporary habitat loss/disturbance will occur intermittently throughout this time with only a small proportion of the total area of habitat to be affected being impacted at any one time.</p> <p>The occurrence of <i>Sabellaria</i> biotopes throughout the Hornsea Three offshore cable corridor, together with other data such as the Humber REC dataset and the HADA MAREA dataset, indicates a wide distribution throughout this part of the southern North Sea, which suggests that <i>S. spinulosa</i> reefs in this area are likely to be ephemeral and, although the specific locations may change, the propensity for the presence of reef in The Wash and North Norfolk Coast SAC coincidental with the Hornsea Three offshore cable corridor is evident, however, no Annex I reef habitat was recorded along the Hornsea Three offshore cable corridor coinciding with The Wash and North Norfolk Coast SAC and therefore no direct impact to this habitat is predicted, however given the evidence for the propensity for reef to develop in this area, pre-construction surveys will be used to identify the presence of such reefs and ensure that measures can be designed, if necessary, to avoid direct impacts.</p>		<p>The temporary loss/disturbance will be highly localised to the vicinity of the construction activity (i.e. limited to the immediate footprints) and will occur over the maximum construction phase of up to eight years. Individual activities resulting in temporary habitat loss/disturbance will occur intermittently throughout this time with only a small proportion of the total area of habitat to be affected being impacted at any one time.</p> <p>The occurrence of <i>Sabellaria</i> biotopes throughout the Hornsea Three offshore cable corridor, together with other data such as the Humber REC dataset and the HADA MAREA dataset, indicates a wide distribution throughout this part of the southern North Sea, which suggests that <i>S. spinulosa</i> reefs in this area are likely to be ephemeral and, although the specific locations may change, the propensity for the presence of reef in The Wash and North Norfolk Coast SAC coincidental with the Hornsea Three offshore cable corridor is evident, however, no Annex I reef habitat was recorded along the Hornsea Three offshore cable corridor coinciding with The Wash and North Norfolk Coast SAC and therefore no direct impact to this habitat is predicted, however given the evidence for the propensity for reef to develop in this area, pre-construction surveys will be used to identify the presence of such reefs and ensure that measures can be designed, if necessary, to avoid direct impacts.</p>		
		To ensure that, subject to natural change, the structure and function (including typical	Presence and abundance of key structural and influential species	[Maintain OR Recover OR Restore] the abundance of listed species, to enable each of them to be a viable component of the habitat.	See above		No effect on site integrity anticipated	See above	No effect on site integrity anticipated

Potential Impact: Temporary habitat loss/disturbance during construction/decommissioning								
Potential Impact: Temporary increases in suspended sediments/smothering during construction/decommissioning								
Potential Impact: Accidental pollution during construction/decommissioning								
	species) of qualifying natural habitats are maintained or restored	Non-native species and pathogens	Restrict the introduction and spread of non-native species and pathogens, and their impacts.	The proposed activities during construction/decommissioning do not represent a risk to the introduction or spread of non-native species and pathogens.	No effect on site integrity anticipated	The proposed activities during construction/decommissioning do not represent a risk to the introduction or spread of non-native species and pathogens.	No effect on site integrity anticipated	
		Physical structure of rocky substrate	Maintain the surface and structural complexity, and the stability of the reef structure.	See above	No effect on site integrity anticipated	See above	No effect on site integrity anticipated	
		Species composition of component communities	Maintain the species composition of component communities.	The proposed activities during construction/decommissioning are not anticipated to impact the range, relative abundance or overall biodiversity of the species composition of component communities of this Annex I habitat within this site.	No effect on site integrity anticipated	The proposed activities during construction/decommissioning are not anticipated to impact the range, relative abundance or overall biodiversity of the species composition of component communities of this Annex I habitat within this site.	No effect on site integrity anticipated	
	To ensure that, subject to natural change, the supporting processes on which qualifying natural habitats are maintained or restored	Energy / exposure	Maintain the natural physical energy resulting from waves, tides and other water flows, so that the exposure does not cause alteration to the biotopes, and stability, across the habitat.	The proposed activities during construction/decommissioning do not represent a risk to natural physical energy resulting from waves, tides and other water flows.	No effect on site integrity anticipated	The proposed activities during construction/decommissioning do not represent a risk to natural physical energy resulting from waves, tides and other water flows.	No effect on site integrity anticipated	
		Physico-chemical properties	Maintain the natural physico-chemical properties of the water.	The proposed activities during construction/decommissioning do not represent a risk to the natural physico-chemical properties of the water - Accidental pollution events will be mitigated against by means of industry standard practices.	No effect on site integrity anticipated	The proposed activities during construction/decommissioning do not represent a risk to the natural physico-chemical properties of the water - Accidental pollution events will be mitigated against by means of industry standard practices.	No effect on site integrity anticipated	

Potential Impact: Temporary habitat loss/disturbance during construction/decommissioning								
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Potential Impact: Accidental pollution during construction/decommissioning								
			Sedimentation rate	Maintain the natural rate of sediment deposition to avoid smothering of the feature.	<p>The maximum design scenario for increases in SSC associated with export cable installation are predicted to occur because of installation by mass flow excavator (see ES volume 2, chapter 1: Marine Processes for full details). Disturbance of medium to coarse sand and gravels during cable installation is likely to result in a temporally and spatially limited plume affecting SSC levels (and settling out of suspension) near the point of release. SSC will be locally elevated within the plume close to active cable burial up to tens or hundreds of thousands of mg/l, although the change will only be present for a very short time locally (i.e. seconds to tens of seconds) before the material resettles to the seabed. Depending on the height to which the material is ejected and the current speed at the time of release, changes in SSC and deposition will be spatially limited to within metres downstream of the cable for gravels and within tens of metres for sands. Finer material will be advected away from the release location by the prevailing tidal current. High initial concentrations are to be expected but will be subject to rapid dispersion, both laterally and vertically, to near-background levels (tens of mg/l) within hundreds to a few thousands of metres of the point of release. Only a small proportion of the material disturbed is expected to be fines, with a corresponding reduction in the expected levels of SSC.</p> <p>Irrespective of sediment type, the volumes of sediment being displaced and deposited locally are relatively limited (up to 6 m³ per metre of cable burial) which also limits the combinations of sediment deposition thickness and extent that might realistically occur. The assessment presented in ES volume 2, chapter 1: Marine Processes suggests that the extent and so the area of deposition will normally be much smaller for sands and gravels, leading to a greater average thickness of deposition in the order of tens of centimetres to a few metres in the immediate vicinity of the cable trench. Fine material, by contrast, will be distributed much more widely, becoming so dispersed that it is unlikely to settle in measurable thickness locally.</p> <p>The installation of cables in nearshore areas of the</p>	No effect on site integrity anticipated	<p>The maximum design scenario for increases in SSC associated with export cable installation are predicted to occur because of installation by mass flow excavator (see ES volume 2, chapter 1: Marine Processes for full details). Disturbance of medium to coarse sand and gravels during cable installation is likely to result in a temporally and spatially limited plume affecting SSC levels (and settling out of suspension) near the point of release. SSC will be locally elevated within the plume close to active cable burial up to tens or hundreds of thousands of mg/l, although the change will only be present for a very short time locally (i.e. seconds to tens of seconds) before the material resettles to the seabed. Depending on the height to which the material is ejected and the current speed at the time of release, changes in SSC and deposition will be spatially limited to within metres downstream of the cable for gravels and within tens of metres for sands. Finer material will be advected away from the release location by the prevailing tidal current. High initial concentrations are to be expected but will be subject to rapid dispersion, both laterally and vertically, to near-background levels (tens of mg/l) within hundreds to a few thousands of metres of the point of release. Only a small proportion of the material disturbed is expected to be fines, with a corresponding reduction in the expected levels of SSC.</p> <p>Irrespective of sediment type, the volumes of sediment being displaced and deposited locally are relatively limited (up to 6 m³ per metre of cable burial) which also limits the combinations of sediment deposition thickness and extent that might realistically occur. The assessment presented in ES volume 2, chapter 1: Marine Processes suggests that the extent and so the area of deposition will normally be much smaller for sands and gravels, leading to a greater average thickness of deposition in the order of tens of centimetres to a few metres in</p>	No effect on site integrity anticipated

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Potential Impact: Temporary increases in suspended sediments/smothering during construction/decommissioning						
Potential Impact: Accidental pollution during construction/decommissioning						
				<p>Hornsea Three offshore cable corridor may occur in areas of seabed where chalk is present at or very close to the surface. In summary, cable burial into chalk will locally give rise to elevated SSC of up to hundreds of thousands of mg/l for several seconds at locations immediately adjacent (i.e. within a few tens of metres) to the cable trench. Any fine chalk arisings may persist in suspension for longer than sand sized materials (order of days) but the plume of increased SSC will be subject to significant dispersion in that time, reducing any change to SSC to tens of mg/l or less in the same timeframe. Because of dispersion, no measurable thickness of accumulation of fine sediment is expected. Further details are provided within ES volume 5, annex 1.1: Marine Processes Technical Annex and ES volume 2, chapter 1: Marine Processes.</p> <p>Furthermore <i>S. spinulosa</i> is tolerant of increased SSC and a limited amount of sediment deposition by fine sediment is likely to be well within the tolerance of <i>S. spinulosa</i>. As such, Annex I <i>S. spinulosa</i> reefs are not considered to be sensitive to the temporary anticipated increases in SSC.</p>	<p>the immediate vicinity of the cable trench. Fine material, by contrast, will be distributed much more widely, becoming so dispersed that it is unlikely to settle in measurable thickness locally.</p> <p>The installation of cables in nearshore areas of the Hornsea Three offshore cable corridor may occur in areas of seabed where chalk is present at or very close to the surface. In summary, cable burial into chalk will locally give rise to elevated SSC of up to hundreds of thousands of mg/l for several seconds at locations immediately adjacent (i.e. within a few tens of metres) to the cable trench. Any fine chalk arisings may persist in suspension for longer than sand sized materials (order of days) but the plume of increased SSC will be subject to significant dispersion in that time, reducing any change to SSC to tens of mg/l or less in the same timeframe. Because of dispersion, no measurable thickness of accumulation of fine sediment is expected. Further details are provided within ES volume 5, annex 1.1: Marine Processes Technical Annex and ES volume 2, chapter 1: Marine Processes.</p> <p>Furthermore <i>S. spinulosa</i> is tolerant of increased SSC and a limited amount of sediment deposition by fine sediment is likely to be well within the tolerance of <i>S. spinulosa</i>. As such, Annex I <i>S. spinulosa</i> reefs are not considered to be sensitive to the temporary anticipated increases in SSC.</p>	
			Water quality - contaminants	<p>Restrict aqueous contaminants to levels equating to High Status according to Annex VIII and Good Status according to Annex X of the Water Framework Directive, avoiding deterioration from existing level</p>	<p>The proposed activities during construction/decommissioning do not represent a risk to impacts on water quality - Accidental pollution events will be mitigated against by means of industry standard practices.</p>	<p>No effect on site integrity anticipated</p>
					<p>The proposed activities during construction/decommissioning do not represent a risk to impacts on water quality - Accidental pollution events will be mitigated against by means of industry standard practices.</p>	<p>No effect on site integrity anticipated</p>

Potential Impact: Temporary habitat loss/disturbance during construction/decommissioning Potential Impact: Temporary increases in suspended sediments/smothering during construction/decommissioning Potential Impact: Accidental pollution during construction/decommissioning								
			Water quality - dissolved oxygen	Maintain the dissolved oxygen (DO) concentration at levels equating to High Ecological Status (specifically ≥ 5.7 mg per litre (at 35 salinity) for 95 % of the year), avoiding deterioration from existing levels.	The proposed activities during construction/decommissioning do not represent a risk to maintaining dissolved oxygen levels at levels equating to High Ecological Status.	No effect on site integrity anticipated	The proposed activities during construction/decommissioning do not represent a risk to maintaining dissolved oxygen levels at levels equating to High Ecological Status.	No effect on site integrity anticipated
			Water quality - nutrients	Maintain water quality at mean winter dissolved inorganic nitrogen levels where biological indicators of eutrophication (opportunistic macroalgal and phytoplankton blooms) do not affect the integrity of the site and features, avoiding deterioration from existing levels.	The proposed activities during construction/decommissioning do not represent a risk with regards to the alteration of existing nutrient levels.	No effect on site integrity anticipated	The proposed activities during construction/decommissioning do not represent a risk with regards to the alteration of existing nutrient levels.	No effect on site integrity anticipated
			Water quality - turbidity	Maintain natural levels of turbidity (eg suspended concentrations of sediment, plankton and other material) across the habitat.	Although temporary increases in localised suspended sediments will occur due to activities occurring during construction/decommissioning these will rapidly disperse and do not represent a risk at an ecosystem level.	No effect on site integrity anticipated	Although temporary increases in localised suspended sediments will occur due to activities occurring during construction/decommissioning these will rapidly disperse and do not represent a risk at an ecosystem level.	No effect on site integrity anticipated

Table Error! No text of specified style in document..2 The Wash and North Norfolk Coast SAC Assessment Matrix – Operation and Maintenance

Potential Impact: Permanent habitat loss during operation/maintenance Potential Impact: Colonisation of hard structures during operation/maintenance Potential Impact: Changes in physical processes during operation/maintenance Potential Impact: Temporary seabed disturbance during operation/maintenance Potential Impact: Accidental pollution during operation/maintenance	
	Original route
	Alternative route

<p>Potential Impact: Permanent habitat loss during operation/maintenance</p> <p>Potential Impact: Colonisation of hard structures during operation/maintenance</p> <p>Potential Impact: Changes in physical processes during operation/maintenance</p> <p>Potential Impact: Temporary seabed disturbance during operation/maintenance</p> <p>Potential Impact: Accidental pollution during operation/maintenance</p>								
European Site	Qualifying Feature	Conservation Objective	Attributes	Conservation Objective target	Assessment overview/justification	Conclusion of effect on site integrity	Assessment overview/justification	Conclusion of effect on site integrity
The Wash and North Norfolk Coast SAC	Sandbanks which are slightly covered by sea water all the time	To ensure that, subject to natural change, the extent and distribution of qualifying natural habitats are maintained or restored	Presence and spatial distribution of biological communities	Maintain the presence and spatial distribution of subtidal sandbank communities.	<p>The permanent habitat loss predicted to occur within The Wash and North Norfolk Coast SAC due to activities associated with Hornsea Three is up to 46,200 m² (i.e. from cable protection where burial is not possible). This represents 0.0043% of the total area of The Wash and North Norfolk Coast SAC.</p> <p>Analysis of historic and site specific data does not indicate the presence of Annex I Sandbanks which are slightly covered by sea water all the time coinciding with the cable corridor within the boundary of the site. The biotopes identified within the section of the cable corridor occurring within The Wash and North Norfolk Coast SAC are not characteristic of sandbank communities with the exception of the NcirBat biotope, however; the occurrence of this biotope in this location is not indicative of this feature in this instance.</p> <p>As the overall proportion of The Wash and North Norfolk</p>	No effect on site integrity anticipated	<p>The permanent habitat loss predicted to occur within The Wash and North Norfolk Coast SAC due to activities associated with Hornsea Three is up to 29,442 m² (i.e. from cable protection where burial is not possible) This represents 0.0027% of the total area of The Wash and North Norfolk Coast SAC.</p> <p>Analysis of historic and site specific data does not indicate the presence of Annex I Sandbanks which are slightly covered by sea water all the time coinciding with the cable corridor within the boundary of the site. The biotopes identified within the section of the cable corridor occurring within The Wash and North Norfolk Coast SAC are not characteristic of sandbank communities with the exception of the NcirBat biotope, however; the occurrence of this biotope in this location is not indicative of this feature in this instance.</p>	No effect on site integrity anticipated

Potential Impact: Permanent habitat loss during operation/maintenance Potential Impact: Colonisation of hard structures during operation/maintenance Potential Impact: Changes in physical processes during operation/maintenance Potential Impact: Temporary seabed disturbance during operation/maintenance Potential Impact: Accidental pollution during operation/maintenance							
			Extent and distribution	Maintain the total extent and spatial distribution of subtidal sandbanks to ensure no loss of integrity, while allowing for natural change and succession.	<p>Coast SAC predicted to be affected is very small, 0.0043% of the total area of the site, there will remain sufficient similar available habitat for the creation of Annex I 'Sandbanks which are slightly covered by seawater all the time'. Therefore, it is not considered that the presence of cable protection will preclude the establishment of Annex I Sandbanks which are slightly covered by seawater all the time in these areas in the future. Additionally it is likely that a degree of, if not all, the cable protection will become covered in sediment by natural processes potentially providing a suitable habitat for settlement and establishment of sabellaria reef.</p> <p>The total temporary habitat disturbance loss predicted for Hornsea Three during operation and maintenance predicted to affect Annex I 'Sandbanks which are slightly covered by seawater all the time' habitat, within The Wash and North Norfolk Coast SAC over the 25 year design life of Hornsea Three as a result of export cable remedial burial and repair activities is up to 188,302 m². This equates to approximately 0.02% of the total habitat within The Wash and North Norfolk Coast SAC. It was considered over precautionary and unrealistic to assume that all the temporary habitat disturbance within the Hornsea Three offshore cable corridor would occur entirely within this site, therefore it has been calculated on the assumption that, as approximately 7% of the total export cable length coincides with The Wash and North Norfolk Coast SAC, 7% of the total operational temporary habitat loss along the Hornsea Three offshore cable corridor could occur within the site. The associated communities are predicted to recover rapidly from disturbance of this nature.</p>		<p>As the overall proportion of The Wash and North Norfolk Coast SAC predicted to be affected is very small, 0.0027% of the total area of the site, there will remain sufficient similar available habitat for the creation of Annex I 'Sandbanks which are slightly covered by seawater all the time'. Therefore, it is not considered that the presence of cable protection will preclude the establishment of Annex I Sandbanks which are slightly covered by seawater all the time in these areas in the future. Additionally it is likely that a degree of, if not all, the cable protection will become covered in sediment by natural processes potentially providing a suitable habitat for settlement and establishment of sabellaria reef.</p> <p>The total temporary habitat disturbance loss predicted for Hornsea Three during operation and maintenance predicted to affect Annex I 'Sandbanks which are slightly covered by seawater all the time' habitat, within The Wash and North Norfolk Coast SAC over the 25 year design life of Hornsea Three as a result of export cable remedial burial and repair activities is within is up to 126,500 m². This equates to approximately 0.012% of the total habitat within The Wash and North Norfolk Coast SAC. It was considered over precautionary and unrealistic to assume that all the temporary habitat disturbance within the Hornsea Three offshore cable corridor would occur entirely within this site, therefore it has been calculated on the assumption that, as approximately 4.3% of the total export cable length coincides with The Wash and North Norfolk Coast SAC, 4.3% of the total operational temporary habitat loss along the Hornsea Three offshore cable corridor could occur within the site. The associated communities are predicted to recover rapidly from disturbance of this nature.</p>

<p>Potential Impact: Permanent habitat loss during operation/maintenance</p> <p>Potential Impact: Colonisation of hard structures during operation/maintenance</p> <p>Potential Impact: Changes in physical processes during operation/maintenance</p> <p>Potential Impact: Temporary seabed disturbance during operation/maintenance</p> <p>Potential Impact: Accidental pollution during operation/maintenance</p>								
		To ensure that, subject to natural change, the structure and function (including typical species) of qualifying natural habitats are maintained or restored	Presence and abundance of key structural and influential species	[Maintain OR Recover OR Restore] the abundance of listed species, to enable each of them to be a viable component of the habitat.	See above	No effect on site integrity anticipated	see above	No effect on site integrity anticipated
			Non-native species and pathogens	Restrict the introduction and spread of non-native species and pathogens, and their impacts.	<p>The introduction of up to 57,135 m² of surface area of new hard substrate is predicted to occur within The Wash and North Norfolk Coast SAC. This is predicted to affect up to 0.005% of the potential Annex I habitat 'Sandbanks which are slightly covered by seawater all the time' within The Wash and North Norfolk Coast SAC and as such represents a very small area for potential INNS colonisation.</p> <p>Furthermore, designed-in measures including a biosecurity plan, a PEMMP and vessels complying with the IMO ballast water management guidelines will ensure that the risk of potential introduction and spread of INNS will be minimised.</p>	No effect on site integrity anticipated	<p>The introduction of up to 36,359 m² of surface area of new hard substrate is predicted to occur within The Wash and North Norfolk Coast SAC. This is predicted to affect up to 0.0034% of the potential Annex I habitat 'Sandbanks which are slightly covered by seawater all the time' within The Wash and North Norfolk Coast SAC and as such represents a very small area for potential INNS colonisation.</p> <p>Furthermore, designed-in measures including a biosecurity plan, a PEMMP and vessels complying with the IMO ballast water management guidelines will ensure that the risk of potential introduction and spread of INNS will be minimised.</p>	No effect on site integrity anticipated

Potential Impact: Permanent habitat loss during operation/maintenance Potential Impact: Colonisation of hard structures during operation/maintenance Potential Impact: Changes in physical processes during operation/maintenance Potential Impact: Temporary seabed disturbance during operation/maintenance Potential Impact: Accidental pollution during operation/maintenance								
			Sediment composition and distribution	Maintain the distribution of sediment composition across the feature (and each of its subfeatures).	<p>Installation of cable protection could result in a local elevation of the seabed profile by up to 2 m. Cable protection would be placed onto the seabed surface above the cable and therefore could present an obstacle to sediment transport, trapping sediment locally and thereby impacting down-drift locations through a reduction in sediment supply.</p> <p>Potential effects on sediment transport can only occur following installation of the cable protection and under conditions where sediment is being actively transported in a manner that is both susceptible to such blockage and in a direction that intersects the cable protection. The potential magnitude of any effect is correspondingly reduced if and when the rate of transport is naturally low, if the mode of sediment transport includes a larger proportion of material in high saltation or suspension, and/or where the axis of the cable protection and the local direction of sediment transport are relatively more aligned.</p> <p>At worst, the obstacle presented by the cable protection will locally prevent the onward passage of all sediment in transport, causing that sediment to accumulate locally. As the accumulated sediment volume increases, any open voids in the protection would become infilled and a sediment slope would develop on the updrift side (with a maximum slope angle equal to the angle of repose for sand ~30 degrees). As the stable slope approaches the top of the protection (up to 2 m above the seabed), the blockage effect of the cable protection will be progressively reduced to near zero and sediment will subsequently be transported directly over the obstacle (via the sediment slope and/or in saltation or suspension) unimpeded, at the naturally occurring ambient rate and direction.</p> <p>The maximum volume of sediment that could potentially accumulate in this way is limited by the dimensions of the protection to approximately 3.46 m³ of sediment per metre</p>	No effect on site integrity anticipated	<p>Installation of cable protection could result in a local elevation of the seabed profile by up to 2 m. Cable protection would be placed onto the seabed surface above the cable and therefore could present an obstacle to sediment transport, trapping sediment locally and thereby impacting down-drift locations through a reduction in sediment supply.</p> <p>Potential effects on sediment transport can only occur following installation of the cable protection and under conditions where sediment is being actively transported in a manner that is both susceptible to such blockage and in a direction that intersects the cable protection. The potential magnitude of any effect is correspondingly reduced if and when the rate of transport is naturally low, if the mode of sediment transport includes a larger proportion of material in high saltation or suspension, and/or where the axis of the cable protection and the local direction of sediment transport are relatively more aligned.</p> <p>At worst, the obstacle presented by the cable protection will locally prevent the onward passage of all sediment in transport, causing that sediment to accumulate locally. As the accumulated sediment volume increases, any open voids in the protection would become infilled and a sediment slope would develop on the updrift side (with a maximum slope angle equal to the angle of repose for sand ~30 degrees). As the stable slope approaches the top of the protection (up to 2 m above the seabed), the blockage effect of the cable protection will be progressively reduced to near zero and sediment will subsequently be transported directly over the obstacle (via the sediment slope and/or in saltation or suspension) unimpeded, at the naturally occurring ambient rate and direction.</p>	No effect on site integrity anticipated

Potential Impact: Permanent habitat loss during operation/maintenance Potential Impact: Colonisation of hard structures during operation/maintenance Potential Impact: Changes in physical processes during operation/maintenance Potential Impact: Temporary seabed disturbance during operation/maintenance Potential Impact: Accidental pollution during operation/maintenance								
					<p>of cable protection, which is small in both absolute and relative terms. The maximum dimensions of morphological change (seabed lowering) that might result from the maximum temporary reduction in sediment supply are therefore proportionally limited (e.g. a maximum of 0.1 m bed lowering might occur in an area up to 34.6 m downstream of the protection, or up to 0.5 m up to 6.92 m downstream, or 0.05 m up to 69.2 m downstream, etc) and is therefore unlikely to measurably affect the form and function of the seabed locally or regionally. The process of accumulating this maximum sediment volume might take place over a period of a few months or less, depending on rates of sediment transport.</p> <p>It is, however, also realistically possible that the rock protection may only cause partial or no measurable blockage of sediment transport, or associated sediment accumulation. In this case, the natural modes of sediment transport (suspension, saltation and bedload locally enhanced by scour-like processes) might be sufficient to collectively allow some or all sediment to simply pass over the obstacle presented by the cable protection with limited or no overall change or interruption to the natural rate or direction.</p>		<p>The maximum volume of sediment that could potentially accumulate in this way is limited by the dimensions of the protection to approximately 3.46 m³ of sediment per metre of cable protection, which is small in both absolute and relative terms. The maximum dimensions of morphological change (seabed lowering) that might result from the maximum temporary reduction in sediment supply are therefore proportionally limited (e.g. a maximum of 0.1 m bed lowering might occur in an area up to 34.6 m downstream of the protection, or up to 0.5 m up to 6.92 m downstream, or 0.05 m up to 69.2 m downstream, etc) and is therefore unlikely to measurably affect the form and function of the seabed locally or regionally. The process of accumulating this maximum sediment volume might take place over a period of a few months or less, depending on rates of sediment transport.</p> <p>It is, however, also realistically possible that the rock protection may only cause partial or no measurable blockage of sediment transport, or associated sediment accumulation. In this case, the natural modes of sediment transport (suspension, saltation and bedload locally enhanced by scour-like processes) might be sufficient to collectively allow some or all sediment to simply pass over the obstacle presented by the cable protection with limited or no overall change or interruption to the natural rate or direction.</p>	
			Species composition of component communities	Maintain the species composition of component communities.	The proposed activities during operation & maintenance are not anticipated to impact the range, relative abundance or overall biodiversity of the species composition of component communities of this Annex I habitat within this site.	No effect on site integrity anticipated	The proposed activities during operation & maintenance are not anticipated to impact the range, relative abundance or overall biodiversity of the species composition of component communities of this Annex I habitat within this site.	No effect on site integrity anticipated

<p>Potential Impact: Permanent habitat loss during operation/maintenance</p> <p>Potential Impact: Colonisation of hard structures during operation/maintenance</p> <p>Potential Impact: Changes in physical processes during operation/maintenance</p> <p>Potential Impact: Temporary seabed disturbance during operation/maintenance</p> <p>Potential Impact: Accidental pollution during operation/maintenance</p>								
			Topography	Maintain the presence of topographic characteristics of the feature, while allowing for natural responses to hydrodynamic regime, by preventing erosion or deposition through human induced activity.	The cable corridor is located at the far east of the site in a less dynamic and more homogenous area in comparison to other parts of the site e.g The Wash. The presence of cable protection is not anticipated to alter the topographic characteristics of the feature in the future and should sandbanks characteristic with the Annex I habitat "Sandbanks which are slightly covered by sea water all the time" form in this region in the future the presence of cable protection would not hinder the physical formation of this feature	No effect on site integrity anticipated	The cable corridor is located at the far east of the site in a less dynamic and more homogenous area in comparison to other parts of the site e.g The Wash. The presence of cable protection is not anticipated to alter the topographic characteristics of the feature in the future and should sandbanks characteristic with the Annex I habitat "Sandbanks which are slightly covered by sea water all the time" form in this region in the future the presence of cable protection would not hinder the physical formation of this feature	No effect on site integrity anticipated
			Volume	Maintain the existing volume of sediment in the sandbank, allowing for natural change.	The proposed activities during operation & maintenance are not anticipated to impact the volume of sediment available for the formation of this feature in this location in the future.	No effect on site integrity anticipated	The proposed activities during operation & maintenance are not anticipated to impact the volume of sediment available for the formation of this feature in this location in the future.	No effect on site integrity anticipated
		To ensure that, subject to natural change, the supporting processes on which qualifying natural habitats are maintained or restored	Energy / exposure	Maintain the natural physical energy resulting from waves, tides and other water flows, so that the exposure does not cause alteration to the biotopes, and stability, across the habitat.	The presence of the turbine foundations and associated infrastructure also has the potential to affect the wave regime which could lead to potential impacts on coastal habitats including Annex I habitats within The Wash and North Norfolk Coast SAC. However, the results of the wave assessment presented in ES volume 5, annex 1.1: Marine Processes Technical Report, indicates that although the presence of Hornsea Three will cause a localised reduction in wave heights, under all the wave conditions tested (magnitudes and directions), predicted measurable changes to wave heights due to the operational presence of Hornsea Three do not extend to the adjacent coastlines. Therefore, no effects are predicted on habitats within The Wash and North Norfolk Coast SAC as a result of changes to the wave regime. Impacts associated with cable protection will only exert a highly localised influence on the tidal regime such that the magnitude is considered to be negligible.	No effect on site integrity anticipated	The presence of the turbine foundations and associated infrastructure also has the potential to affect the wave regime which could lead to potential impacts on coastal habitats including Annex I habitats within The Wash and North Norfolk Coast SAC. However, the results of the wave assessment presented in ES volume 5, annex 1.1: Marine Processes Technical Report, indicates that although the presence of Hornsea Three will cause a localised reduction in wave heights, under all the wave conditions tested (magnitudes and directions), predicted measurable changes to wave heights due to the operational presence of Hornsea Three do not extend to the adjacent coastlines. Therefore, no effects are predicted on habitats within The Wash and North Norfolk Coast SAC as a result of changes to the wave regime. Impacts associated with cable protection will only exert a highly localised influence on the tidal regime such that the magnitude is considered to be negligible.	No effect on site integrity anticipated

Potential Impact: Permanent habitat loss during operation/maintenance Potential Impact: Colonisation of hard structures during operation/maintenance Potential Impact: Changes in physical processes during operation/maintenance Potential Impact: Temporary seabed disturbance during operation/maintenance Potential Impact: Accidental pollution during operation/maintenance								
			Physico-chemical properties	Maintain the natural physico-chemical properties of the water.	The proposed activities during operation & maintenance do not represent a risk to the natural physico-chemical properties of the water - Accidental pollution events will be mitigated against by means of industry standard practices.	No effect on site integrity anticipated	The proposed activities during operation & maintenance do not represent a risk to the natural physico-chemical properties of the water - Accidental pollution events will be mitigated against by means of industry standard practices.	No effect on site integrity anticipated
			Sediment contaminants	Restrict surface sediment contaminants (<1cm from the surface) to below the OSPAR Environment Assessment Criteria (EAC) or Effects Range Low (ERL) threshold. For example, mean cadmium levels should be maintained below the ERL of 1.2 mg per kg.	The proposed activities during operation & maintenance do not represent a risk to altering surface sediment contaminants - Accidental pollution events will be mitigated against by means of industry standard practices.	No effect on site integrity anticipated	The proposed activities during operation & maintenance do not represent a risk to altering surface sediment contaminants - Accidental pollution events will be mitigated against by means of industry standard practices.	No effect on site integrity anticipated
			Sediment movement and hydrodynamic regime	Maintain all hydrodynamic and physical conditions such that natural water flow and sediment movement are not significantly altered or prevented from responding to changes in environmental conditions	Sediment transport is in a predominantly easterly direction and considering the location of the proposed cable route at the easterly edge of the site the presence of any potential cable protection would not present a barrier to the formation of this feature within the site. Any localised "barrier effect" to the movement of sediment would be temporary (whilst sediments collect on the stoss side) and highly unlikely especially when considering the low elevation and variable orientation of any potential cable protection.	No effect on site integrity anticipated	Sediment transport is in a predominantly easterly direction and considering the location of the proposed cable route at the easterly edge of the site the presence of any potential cable protection would not present a barrier to the formation of this feature within the site. Any localised "barrier effect" to the movement of sediment would be temporary (whilst sediments collect on the stoss side) and highly unlikely especially when considering the low elevation and variable orientation of any potential cable protection.	No effect on site integrity anticipated
			Water quality - contaminants	Restrict aqueous contaminants to levels equating to High Status according to Annex VIII and Good Status according to Annex X of the Water Framework	The proposed activities during operation & maintenance do not represent a risk to impacts on water quality - Accidental pollution events will be mitigated against by means of industry standard practices.	No effect on site integrity anticipated	The proposed activities during operation & maintenance do not represent a risk to impacts on water quality - Accidental pollution events will be mitigated against by means of industry standard practices.	No effect on site integrity anticipated

Potential Impact: Permanent habitat loss during operation/maintenance Potential Impact: Colonisation of hard structures during operation/maintenance Potential Impact: Changes in physical processes during operation/maintenance Potential Impact: Temporary seabed disturbance during operation/maintenance Potential Impact: Accidental pollution during operation/maintenance								
				Directive, avoiding deterioration from existing level				
			Water quality - dissolved oxygen	Maintain the dissolved oxygen (DO) concentration at levels equating to High Ecological Status (specifically ≥ 5.7 mg per litre (at 35 salinity) for 95 % of the year), avoiding deterioration from existing levels.	The proposed activities during operation & maintenance do not represent a risk to maintaining dissolved oxygen levels at levels equating to High Ecological Status.	No effect on site integrity anticipated	The proposed activities during operation & maintenance do not represent a risk to maintaining dissolved oxygen levels at levels equating to High Ecological Status.	No effect on site integrity anticipated
			Water quality - nutrients	Maintain water quality at mean winter dissolved inorganic nitrogen levels where biological indicators of eutrophication (opportunistic macroalgal and phytoplankton blooms) do not affect the integrity of the site and features, avoiding deterioration from existing levels.	The proposed activities during operation & maintenance do not represent a risk with regards to the alteration of existing nutrient levels.	No effect on site integrity anticipated	The proposed activities during operation & maintenance do not represent a risk with regards to the alteration of existing nutrient levels.	No effect on site integrity anticipated
			Water quality - turbidity	Maintain natural levels of turbidity (eg suspended concentrations of sediment, plankton and other material) across the habitat.	Although temporary increases in localised suspended sediments may occur due to maintenance activities these will rapidly disperse and do not represent a risk at an ecosystem level.	No effect on site integrity anticipated	Although temporary increases in localised suspended sediments may occur due to maintenance activities these will rapidly disperse and do not represent a risk at an ecosystem level.	No effect on site integrity anticipated

Potential Impact: Permanent habitat loss during operation/maintenance
Potential Impact: Colonisation of hard structures during operation/maintenance
Potential Impact: Changes in physical processes during operation/maintenance
Potential Impact: Temporary seabed disturbance during operation/maintenance
Potential Impact: Accidental pollution during operation/maintenance

	Reefs	To ensure that, subject to natural change, the extent and distribution of qualifying natural habitats are maintained or restored	Presence and spatial distribution of biological communities	Maintain the presence and spatial distribution of reef communities.	The impact of long term habitat loss within The Wash and North Norfolk Coast SAC is predicted to be localised to discrete sections of the Hornsea Three offshore cable corridor, affecting a small proportion of the seabed within the eastern periphery of The Wash and North Norfolk Coast SAC. Hornsea Three will discuss and agree the most appropriate cable protection measures for the Wash and North Norfolk Coast SAC, taking into account the local baseline environment. This may include the use of rock protection which takes into account the typical grain sizes (e.g. coarse gravel and cobbles) known to occur naturally within the SAC. Where appropriately sized rock protection can be used, such measures may allow some recovery of communities in areas where cable protection is placed and reducing the extent of long term habitat loss in The Wash and North Norfolk Coast SAC.	No effect on site integrity anticipated	The impact of long term habitat loss within The Wash and North Norfolk Coast SAC is predicted to be localised to discrete sections of the Hornsea Three offshore cable corridor, affecting a small proportion of the seabed within the eastern periphery of The Wash and North Norfolk Coast SAC. Hornsea Three will discuss and agree the most appropriate cable protection measures for the Wash and North Norfolk Coast SAC, taking into account the local baseline environment. This may include the use of rock protection which takes into account the typical grain sizes (e.g. coarse gravel and cobbles) known to occur naturally within the SAC. Where appropriately sized rock protection can be used, such measures may allow some recovery of communities in areas where cable protection is placed and reducing the extent of long term habitat loss in The Wash and North Norfolk Coast SAC.	No effect on site integrity anticipated
			Extent and distribution	Maintain the total extent, spatial distribution and types of reef (and each of its subfeatures), subject to natural variation in sediment veneer	Historically, no reefs have been recorded in the area of the Hornsea Three benthic ecology study area coinciding with The Wash and North Norfolk Coast SAC and neither were they recorded during the site specific surveys in this area. Therefore, no direct effects from long term habitat loss are predicted. It is acknowledged however, that the presence of the cable protection material on the seabed has the potential to act as an ongoing barrier to the future establishment of Annex I reefs in those discrete areas. The MarESA for the SspiMx biotope does note, however, that <i>S. spinulosa</i> has been recorded colonising bedrock and artificial structures and an increase in the availability of hard substratum may, therefore, be beneficial in areas where sedimentary habitats were previously unsuitable for colonisation, although the resulting biotope would be different. Furthermore, as the overall proportion of The Wash and North Norfolk Coast SAC predicted to be affected is very small, 0.0043% of the total area of the site, there will		Historically, no reefs have been recorded in the area of the Hornsea Three benthic ecology study area coinciding with The Wash and North Norfolk Coast SAC and neither were they recorded during the site specific surveys in this area. Therefore, no direct effects from long term habitat loss are predicted. It is acknowledged however, that the presence of the cable protection material on the seabed has the potential to act as an ongoing barrier to the future establishment of Annex I reefs in those discrete areas. The MarESA for the SspiMx biotope does note, however, that <i>S. spinulosa</i> has been recorded colonising bedrock and artificial structures and an increase in the availability of hard substratum may, therefore, be beneficial in areas where sedimentary habitats were previously unsuitable for colonisation, although the resulting biotope would be different.	

Potential Impact: Permanent habitat loss during operation/maintenance Potential Impact: Colonisation of hard structures during operation/maintenance Potential Impact: Changes in physical processes during operation/maintenance Potential Impact: Temporary seabed disturbance during operation/maintenance Potential Impact: Accidental pollution during operation/maintenance								
					remain sufficient similar habitat available for the potential colonisation by <i>S. spinulosa</i> and establishment of reefs in the future. Therefore, it is not considered that the presence of cable protection will preclude the establishment of Annex I reefs in these areas in the future. However, should Annex I <i>S. spinulosa</i> reef be present in the pre-construction survey within The Wash and North Norfolk Coast SAC, appropriate measures will be put in place to avoid direct impacts to these reefs from cable protection this will also apply to any maintenance operations occurring across the lifetime of the development.		Furthermore, as the overall proportion of The Wash and North Norfolk Coast SAC predicted to be affected is very small, 0.0027% of the total area of the site, there will remain sufficient similar habitat available for the potential colonisation by <i>S. spinulosa</i> and establishment of reefs in the future. Therefore, it is not considered that the presence of cable protection will preclude the establishment of Annex I reefs in these areas in the future. However, should Annex I <i>S. spinulosa</i> reef be present in the pre-construction survey within The Wash and North Norfolk Coast SAC, appropriate measures will be put in place to avoid direct impacts to these reefs from cable protection this will also apply to any maintenance operations occurring across the lifetime of the development.	
		To ensure that, subject to natural change, the structure and function (including typical species) of qualifying natural habitats are maintained or restored	Presence and abundance of key structural and influential species	[Maintain OR Recover OR Restore] the abundance of listed species, to enable each of them to be a viable component of the habitat.	See above	No effect on site integrity anticipated	see above	No effect on site integrity anticipated
			Non-native species and pathogens	Restrict the introduction and spread of non-native species and pathogens, and their impacts.	No reefs were identified within the Hornsea Three benthic ecology study area coinciding with The Wash and North Norfolk Coast SAC during the site specific surveys and should Annex I reef be present in the pre-construction survey within The Wash and North Norfolk Coast SAC, appropriate measures will be put in place to avoid direct impacts to these reefs from cable protection. Furthermore, designed-in measures including a biosecurity plan, a PEMMP and vessels complying with the IMO ballast water management guidelines will ensure that the risk of potential introduction and spread of INNS will be minimised.	No effect on site integrity anticipated	No reefs were identified within the Hornsea Three benthic ecology study area coinciding with The Wash and North Norfolk Coast SAC during the site specific surveys and should Annex I reef be present in the pre-construction survey within The Wash and North Norfolk Coast SAC, appropriate measures will be put in place to avoid direct impacts to these reefs from cable protection. Furthermore, designed-in measures including a biosecurity plan, a PEMMP and vessels complying with the IMO ballast water management guidelines will ensure that the risk of potential introduction and spread of INNS will be	No effect on site integrity anticipated

Potential Impact: Permanent habitat loss during operation/maintenance Potential Impact: Colonisation of hard structures during operation/maintenance Potential Impact: Changes in physical processes during operation/maintenance Potential Impact: Temporary seabed disturbance during operation/maintenance Potential Impact: Accidental pollution during operation/maintenance								
							minimised.	
			Physical structure of rocky substrate	Maintain the surface and structural complexity, and the stability of the reef structure.	See above	No effect on site integrity anticipated	see above	No effect on site integrity anticipated
			Species composition of component communities	Maintain the species composition of component communities.	The proposed activities during construction/decommissioning are not anticipated to impact the range, relative abundance or overall biodiversity of the species composition of component communities of this Annex I habitat within this site.	No effect on site integrity anticipated	The proposed activities during construction/decommissioning are not anticipated to impact the range, relative abundance or overall biodiversity of the species composition of component communities of this Annex I habitat within this site.	No effect on site integrity anticipated
		To ensure that, subject to natural change, the supporting processes on which qualifying natural habitats are maintained or restored	Energy / exposure	Maintain the natural physical energy resulting from waves, tides and other water flows, so that the exposure does not cause alteration to the biotopes, and stability, across the habitat.	The presence of the turbine foundations and associated infrastructure also has the potential to affect the wave regime which could lead to potential impacts on coastal habitats including Annex I habitats within The Wash and North Norfolk Coast SAC. However, the results of the wave assessment presented in ES volume 5, annex 1.1: Marine Processes Technical Report, indicates that although the presence of Hornsea Three will cause a localised reduction in wave heights, under all the wave conditions tested (magnitudes and directions), predicted measurable changes to wave heights due to the operational presence of Hornsea Three do not extend to the adjacent coastlines. Therefore, no effects are predicted on habitats within The Wash and North Norfolk Coast SAC as a result of changes to the wave regime. Impacts associated with cable protection will only exert a highly localised influence on the tidal regime such that the magnitude is considered to be	No effect on site integrity anticipated	The presence of the turbine foundations and associated infrastructure also has the potential to affect the wave regime which could lead to potential impacts on coastal habitats including Annex I habitats within The Wash and North Norfolk Coast SAC. However, the results of the wave assessment presented in ES volume 5, annex 1.1: Marine Processes Technical Report, indicates that although the presence of Hornsea Three will cause a localised reduction in wave heights, under all the wave conditions tested (magnitudes and directions), predicted measurable changes to wave heights due to the operational presence of Hornsea Three do not extend to the adjacent coastlines. Therefore, no effects are predicted on habitats within The Wash and North Norfolk Coast SAC as a result of changes to the wave regime. Impacts associated with cable	No effect on site integrity anticipated

Potential Impact: Permanent habitat loss during operation/maintenance Potential Impact: Colonisation of hard structures during operation/maintenance Potential Impact: Changes in physical processes during operation/maintenance Potential Impact: Temporary seabed disturbance during operation/maintenance Potential Impact: Accidental pollution during operation/maintenance								
					negligible.		protection will only exert a highly localised influence on the tidal regime such that the magnitude is considered to be negligible.	
			Physico-chemical properties	Maintain the natural physico-chemical properties of the water.	The proposed activities during operation & maintenance do not represent a risk to the natural physico-chemical properties of the water - Accidental pollution events will be mitigated against by means of industry standard practices.	No effect on site integrity anticipated	The proposed activities during operation & maintenance do not represent a risk to the natural physico-chemical properties of the water - Accidental pollution events will be mitigated against by means of industry standard practices.	No effect on site integrity anticipated
			Sedimentation rate	Maintain the natural rate of sediment deposition to avoid smothering of the feature.	Any suspended sediments arising from future maintenance activities would be of levels far reduced than those already assessed during construction.	No effect on site integrity anticipated	Any suspended sediments arising from future maintenance activities would be of levels far reduced than those already assessed during construction.	No effect on site integrity anticipated
			Water quality - contaminants	Restrict aqueous contaminants to levels equating to High Status according to Annex VIII and Good Status according to Annex X of the Water Framework Directive, avoiding deterioration from existing level	The proposed activities during operation & maintenance do not represent a risk to impacts on water quality - Accidental pollution events will be mitigated against by means of industry standard practices.	No effect on site integrity anticipated	The proposed activities during operation & maintenance do not represent a risk to impacts on water quality - Accidental pollution events will be mitigated against by means of industry standard practices.	No effect on site integrity anticipated

Potential Impact: Permanent habitat loss during operation/maintenance Potential Impact: Colonisation of hard structures during operation/maintenance Potential Impact: Changes in physical processes during operation/maintenance Potential Impact: Temporary seabed disturbance during operation/maintenance Potential Impact: Accidental pollution during operation/maintenance								
			Water quality - dissolved oxygen	Maintain the dissolved oxygen (DO) concentration at levels equating to High Ecological Status (specifically ≥ 5.7 mg per litre (at 35 salinity) for 95 % of the year), avoiding deterioration from existing levels.	The proposed activities during operation & maintenance do not represent a risk to maintaining dissolved oxygen levels at levels equating to High Ecological Status.	No effect on site integrity anticipated	The proposed activities during operation & maintenance do not represent a risk to maintaining dissolved oxygen levels at levels equating to High Ecological Status.	No effect on site integrity anticipated
			Water quality - nutrients	Maintain water quality at mean winter dissolved inorganic nitrogen levels where biological indicators of eutrophication (opportunistic macroalgal and phytoplankton blooms) do not affect the integrity of the site and features, avoiding deterioration from existing levels.	The proposed activities during operation & maintenance do not represent a risk with regards to the alteration of existing nutrient levels.	No effect on site integrity anticipated	The proposed activities during operation & maintenance do not represent a risk with regards to the alteration of existing nutrient levels.	No effect on site integrity anticipated
			Water quality - turbidity	Maintain natural levels of turbidity (eg suspended concentrations of sediment, plankton and other material) across the habitat.	Although temporary increases in localised suspended sediments will occur due to activities occurring during operation & maintenance these will rapidly disperse and do not represent a risk at an ecosystem level.	No effect on site integrity anticipated	Although temporary increases in localised suspended sediments will occur due to activities occurring during operation & maintenance these will rapidly disperse and do not represent a risk at an ecosystem level.	No effect on site integrity anticipated

Table Error! No text of specified style in document..3 North Norfolk Sandbanks and Saturn Reef SAC Assessment Matrix – Construction/Decommissioning

Potential Impact: Temporary habitat loss/disturbance during construction/decommissioning Potential Impact: Temporary increases in suspended sediments/smothering during construction/decommissioning Potential Impact: Accidental pollution during construction/decommissioning								
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Potential Impact: Temporary habitat loss/disturbance during construction/decommissioning						
Potential Impact: Temporary increases in suspended sediments/smothering during construction/decommissioning						
Potential Impact: Accidental pollution during construction/decommissioning						
European Site	Qualifying Feature	Conservation Objective	Attributes	Conservation Objective target	Assessment overview/justification	Conclusion of effect on site integrity
North Norfolk Sandbanks and Saturn Reef SAC	Sandbanks which are slightly covered by sea water all the time	To ensure that, subject to natural change, the extent and distribution of qualifying habitats in the site are maintained or restored	Extent and distribution	Restore	<p>A maximum of 9,305,800 m² temporary habitat loss/disturbance this is predicted to occur within Annex I habitat 'Sandbanks which are slightly covered by seawater all the time' within the North Norfolk Sandbanks and Saturn Reef SAC (i.e. from pre-construction sandwave clearance (and sandwave material deposition) and boulder clearance, cable installation including anchor placements). This represents 0.26% of the total area of the North Norfolk Sandbanks and Saturn Reef SAC/Annex I habitat 'Sandbanks which are slightly covered by seawater all the time' within the SAC (i.e. the entire SAC is assigned to the Annex I sandbank habitat, as it is designated and viewed as one integrated sandbank system; JNCC, 2010).</p> <p>The North Norfolk Sandbank is an open shelf ridge sandbank, formed by strong tidal currents, and the Conservation Objectives and Advice on Operations document for the site states that, in response to physical loss, the sandbank could be replenished and recovery relatively rapidly between removal activities</p> <p>The impact of temporary loss/disturbance to Annex I sandbanks within the North Norfolk Sandbanks and Saturn Reef SAC is predicted to be localised to discrete sections of the Hornsea Three offshore cable corridor, of medium term duration (i.e. construction phase of up to eight years, although export cable installation will only comprise a small proportion of this (up to three years)), intermittent in nature and reversible.</p>	No effect on site integrity anticipated
		To ensure that, subject to natural change, the structure and function of the qualifying habitats in the site are maintained or restored	Physical structure: finer scale topography	Restore	<p>Sandwave clearance material from sandwaves cleared within the North Norfolk Sandbanks and Saturn Reef SAC will be deposited within the same sandwave system within the boundary of the North Norfolk Sandbanks and Saturn Reef SAC. The precise disposal location selected will consider the net direction of sediment transport in the region to ensure that sediment will not be lost from the sandbank system (see section 1.11 in ES volume 1, chapter 1: Marine Processes). It is reasonable to assume a similarity of sediment particle size with depth through the sandwave on the basis of sediment transport processes,</p>	No effect on site integrity anticipated

Potential Impact: Temporary habitat loss/disturbance during construction/decommissioning						
Potential Impact: Temporary increases in suspended sediments/smothering during construction/decommissioning						
Potential Impact: Accidental pollution during construction/decommissioning						
			Physical structure: sediment composition and distribution	Restore	therefore, in most cases the deposited material is likely to be similar in nature to that present in the area in which it is deposited. Where sands are deposited into areas of different seabed type however (e.g. areas of slightly coarser seabed in some sandwave troughs), the seabed may become locally relatively finer in texture until the body of sand has been winnowed away or reincorporated into a bedform migrating over that location. In all cases, the deposited sediments would be rapidly incorporated into the seabed and local accumulations would be subject to redistribution under the prevailing hydrodynamic conditions.	
			Biological structure: key and influential species	Restore	<p>Impacts will be localised and temporary in nature. With respect to ApriBatPo and NcirBat, these communities are naturally subject to, and tolerant of, high levels of physical disturbance. The predominantly infaunal mobile species are capable of re-burrowing following disturbance (Budd, 2008a; Tillin, 2016a and 2016e) although construction activities that remove sediment (e.g. seabed preparation) are likely to remove animals that are shallowly buried. Although resistance to abrasion/disturbance of the surface is none to low (medium for ApriBatPo; Tillin 2016e), as for example this could collapse burrows and damage species through compression, the resilience of these communities is assessed as high as sediment recovery will be enhanced by wave action and mobility of sand and the characterising species are likely to recover through transport of adults in the water column or migration from adjacent patches. Overall sensitivity to abrasion and disturbance is therefore considered to be low (Tillin, 2016a, 2016b and 2016e; Tillin and Rayment, 2016).</p> <p>The construction activities most likely to result in effects on Annex I 'Sandbanks which are slightly covered by seawater all the time' and Annex I reef habitats within the North Norfolk Sandbanks and Saturn Reef SAC from increased SSC and smothering are pre-construction sandwave clearance and export cable installation. The impact on these habitats is predicted to be of limited spatial extent, medium term duration (i.e. export cables installed over a period of four months to three years intermittent and reversible).</p> <p>Communities associated with 'Sandbanks which are slightly covered by seawater all the</p>	No effect on site integrity anticipated

Potential Impact: Temporary habitat loss/disturbance during construction/decommissioning							
Potential Impact: Temporary increases in suspended sediments/smothering during construction/decommissioning							
Potential Impact: Accidental pollution during construction/decommissioning							
			Biological structure: characteristic communities	Restore	<p>time' have low to no sensitivity to increased SSC and smothering because of deposition (Tillin, 2016b). These conditions are a natural feature of the environment in which these habitats occur. The sandy communities recorded in the Hornsea Three offshore cable corridor comprised biotopes that represent communities comprising low infaunal and epifaunal diversity, namely the NcirBat and ApriBatPo biotopes (see Figure 2.5 and volume 5, annex 2.1: Benthic Ecology Technical Report), in addition the biotope IMoSa has also been recorded at the sandbanks (Jenkins et al., 2015). The sandy communities associated with the sandbanks in this designated site are typically sparse and dominated by Bathyporeia spp. and Nephtys cirrosa (Jenkins et al., 2015). These taxa are considered to have a low sensitivity to increased SSC; the main impact being on the decreased light levels to diatoms which are a major food source of Bathyporeia spp. (Tillin, 2016b). Sandbank communities are not considered sensitive to light deposition (up to 5 cm of deposition in a single event) as the infauna are likely to be able to burrow through 5 cm of deposited sediment (Tillin, 2016b). The biotope ApriBatPo is determined to have a low sensitivity to both increased SSC and light deposition (Tillin, 2016e), increased SSC could reduce the availability of phytoplankton to the filter-feeding organisms, though the food supply would be quickly replenished from sources outside the Zol of the impact, therefore moderating such effects (Tillin, 2016e). Light deposition would generally have limited effects on burrowing bivalves and polychaetes, though species adapted to sandy sediments may not be so effective at moving through finer, more cohesive sediments (Tillin, 2016e).</p> <p>With regards to the deposition of sandwave clearance material, although the deposition of this material may result in the mortality of characterising amphipods and isopods, and possibly <i>N. cirrosa</i>, biotope resistance is assessed as low but resilience is assessed as high.</p>	No effect on site integrity anticipated	
			Function	Recover	Considering the above the activities occurring during construction/decommissioning are not anticipated to impact on the ecological function (ecosystem services) of this feature of the site.	No effect on site integrity anticipated	
			To ensure that, subject to natural change, the supporting processes on which qualifying habitats rely are maintained or restored	Hydrodynamic regime	Maintain	The proposed activities during construction/decommissioning do not represent a risk to natural physical energy resulting from waves, tides and other water flows.	No effect on site integrity anticipated
				Water quality	Maintain	The proposed activities during construction/decommissioning do not represent a risk to impacts on water quality - Accidental pollution events will be mitigated against by means of industry standard practices.	No effect on site integrity anticipated

Potential Impact: Temporary habitat loss/disturbance during construction/decommissioning						
Potential Impact: Temporary increases in suspended sediments/smothering during construction/decommissioning						
Potential Impact: Accidental pollution during construction/decommissioning						
			Sediment quality	Maintain	The proposed activities during construction/decommissioning do not represent a risk to impacts on sediment quality - Accidental pollution events will be mitigated against by means of industry standard practices.	No effect on site integrity anticipated
	Reefs (biogenic)	To ensure that, subject to natural change, the extent and distribution of qualifying habitats in the site are maintained or restored	Extent and distribution	Restore	Although the Hornsea Three offshore cable corridor coincides with the JNCC delineated boundary of <i>S. spinulosa</i> reef in the North Norfolk Sandbanks and Saturn Reef SAC, no Annex I reefs were identified during the site specific surveys of the Hornsea Three offshore cable corridor coinciding with the North Norfolk Sandbanks and Saturn Reef SAC. However, should Annex I <i>S. spinulosa</i> reef be identified in the pre-construction survey within the North Norfolk Sandbanks and Saturn Reef SAC, appropriate measures will be put in place to avoid direct impacts to these reefs. As such, figures are not presented for the temporary loss/disturbance of Annex I reef habitat as direct impacts to this habitat will be avoided.	No effect on site integrity anticipated
		To ensure that, subject to natural change, the structure and function (including typical species) of qualifying natural habitats are maintained or restored	Physical structure	Restore	As described above direct physical impacts to the feature will be avoided however it is noted that <i>S. spinulosa</i> reefs can recover their physical structure relatively quickly (within 16-24 months) from short-term or intermediate levels of physical impact/abrasion (Pearce et al., 2007; Gibb et al., 2014) and the evidence presented in the MarESA suggests that whilst <i>S. spinulosa</i> is sensitive to damage from siltation events recovery is likely to be rapid given that larval dispersal is not interrupted and new reefs may be able to establish over old buried ones (Tillin and Marshall, 2015).	No effect on site integrity anticipated
			Biological structure: key and influential species	Restore	As mentioned above impacts to established reefs will be avoided. The occurrence of Sabellaria biotopes throughout the Hornsea Three offshore cable corridor, together with other data such as the Humber REC dataset and the HADA MAREA dataset, indicates a wide distribution throughout this part of the southern North Sea. Considering the ephemeral nature of this species the proposed activities are not expected to alter the abundance and density of this species at a site/regional level.	No effect on site integrity anticipated
			Biological structure: characteristic communities	Restore	<i>S. spinulosa</i> is tolerant of increased SSC (Tillin and Marshall, 2015) and a limited amount of sediment deposition by fine sediment is likely to be well within the tolerance of <i>S. spinulosa</i> . As such, Annex I <i>S. spinulosa</i> reefs are not considered to be sensitive to increases in SSC.	No effect on site integrity anticipated
			Function	Recover	Considering the above the activities occurring during construction/decommissioning are not anticipated to impact on the ecological function (ecosystem services) of this feature of the site.	No effect on site integrity anticipated
		To ensure that, subject to natural change, the supporting processes on	Hydrodynamic regime	Maintain	The proposed activities during construction/decommissioning do not represent a risk to natural physical energy resulting from waves, tides and other water flows.	No effect on site integrity anticipated

Potential Impact: Temporary habitat loss/disturbance during construction/decommissioning Potential Impact: Temporary increases in suspended sediments/smothering during construction/decommissioning Potential Impact: Accidental pollution during construction/decommissioning						
		which qualifying habitats rely are maintained or restored	Supporting habitats	Restore	See extent and distribution/Physical structure: The activities occurring during construction/decommissioning are temporary in nature and will not result in a baseline shift in the prevailing conditions including sediment type (grade) and the ability for future reef formation will not be impacted.	No effect on site integrity anticipated
			Water quality	Maintain	The proposed activities during construction/decommissioning do not represent a risk to impacts on water quality - Accidental pollution events will be mitigated against by means of industry standard practices.	No effect on site integrity anticipated

Table Error! No text of specified style in document..4: North Norfolk Sandbanks and Saturn Reef Assessment Matrix – Operation and Maintenance

Potential Impact: Permanent habitat loss during operation/maintenance Potential Impact: Colonisation of hard structures during operation/maintenance Potential Impact: Changes in physical processes during operation/maintenance Potential Impact: Temporary seabed disturbance during operation/maintenance Potential Impact: Accidental pollution during operation/maintenance						
European Site	Qualifying Feature	Conservation Objective	Attributes	Conservation Objective target	Assessment overview/justification	Conclusion of effect on site integrity

<p>Potential Impact: Permanent habitat loss during operation/maintenance</p> <p>Potential Impact: Colonisation of hard structures during operation/maintenance</p> <p>Potential Impact: Changes in physical processes during operation/maintenance</p> <p>Potential Impact: Temporary seabed disturbance during operation/maintenance</p> <p>Potential Impact: Accidental pollution during operation/maintenance</p>						
North Norfolk Sandbanks and Saturn Reef SAC	Sandbanks which are slightly covered by sea water all the time	To ensure that, subject to natural change, the extent and distribution of qualifying habitats in the site are maintained or restored	Extent and distribution	Restore	<p>Up to 497,400 m² long term habitat loss is predicted to affect the Annex I habitat 'Sandbanks which are slightly covered by seawater all the time' within the North Norfolk Sandbanks and Saturn Reef SAC (i.e. from cable protection where burial is not possible and pipeline/cable crossings). This represents 0.01% of the total area of the North Norfolk Sandbanks and Saturn Reef SAC (i.e. all potential Annex I sandbank habitat). Cable protection requirements along the Hornsea Three offshore cable corridor will be detailed in the Cable Specification and Installation Plan that will be agreed in consultation with statutory consultees.</p> <p>The impact of long term habitat loss within the North Norfolk Sandbanks and Saturn Reef SAC is predicted to be localised to discrete sections of the Hornsea Three offshore cable corridor, affecting a small proportion of the seabed within the North Norfolk Sandbanks and Saturn Reef SAC. Hornsea Three will discuss and agree the most appropriate cable protection measures for the North Norfolk Sandbanks and Saturn Reef SAC, taking into account the local baseline environment. This may include measures which may encourage the burial of the scour/cable protection by the surrounding sediment or rock protection which takes into account the typical grain sizes (e.g. coarse gravel, cobbles and boulders) known to occur naturally within the SAC. Where such measures can be employed, these may allow local communities associated with the habitat features of the North Norfolk Sandbanks and Saturn Reef SAC (i.e. infaunal communities where sediment accumulation occurs; epifaunal in the case of appropriate rock protection) to colonise these areas, potentially providing some recovery of communities in areas where cable protection is placed and reducing the extent of long term habitat loss in the North Norfolk Sandbanks and Saturn Reef SAC.</p>	No effect on site integrity anticipated

Potential Impact: Permanent habitat loss during operation/maintenance Potential Impact: Colonisation of hard structures during operation/maintenance Potential Impact: Changes in physical processes during operation/maintenance Potential Impact: Temporary seabed disturbance during operation/maintenance Potential Impact: Accidental pollution during operation/maintenance						
		To ensure that, subject to natural change, the structure and function of the qualifying habitats in the site are maintained or restored	Physical structure: finer scale topography	Restore	The proposed activities during operation/maintenance will not impact the hydrodynamics (currents) which influence the fine-scale topography of the sandbanks within the site (see hydrodynamics below).	No effect on site integrity anticipated
			Physical structure: sediment composition and distribution	Restore	Whilst the potential for the introduction of cable protection within the site would represent a change in the substratum for 0.01% of the site, the presence of this material would not alter the sediment composition or distribution of the wider sandbank system representing 99.99% of the site i.e sediment composition/distribution across crest/flank/trough of existing or future sanbanks (see extent and distribution above). Additionally, of the total temporary habitat disturbance loss predicted for Hornsea Three during operation and maintenance up to 2,790,300 m ² of this is predicted to affect the Annex I 'Sandbanks which are slightly covered by seawater all the time' habitat within the North Norfolk Sandbanks and Saturn Reef SAC over the 25 year design life. This equates to 0.08% of the extent of this Annex I habitat within the North Norfolk Sandbanks and Saturn Reef SAC (i.e. assuming all sediment within the SAC is assigned to Annex I sandbank habitat; JNCC, 2010). It was considered over precautionary and unrealistic to assume that all the temporary habitat disturbance within the Hornsea Three offshore cable corridor would occur entirely within this site, therefore it has been calculated on the assumption that, as approximately 29% of the total export cable length coincides with the North Norfolk Sandbanks and Saturn Reef SAC, 29% of the total operational temporary habitat loss along the Hornsea Three offshore cable corridor could occur within the site.	No effect on site integrity anticipated

<p>Potential Impact: Permanent habitat loss during operation/maintenance</p> <p>Potential Impact: Colonisation of hard structures during operation/maintenance</p> <p>Potential Impact: Changes in physical processes during operation/maintenance</p> <p>Potential Impact: Temporary seabed disturbance during operation/maintenance</p> <p>Potential Impact: Accidental pollution during operation/maintenance</p>						
			Biological structure: key and influential species	Restore	<p>The introduction of up to 544,123 m² of surface area of new hard substrate is predicted to occur because of the protection of export cables and cable/pipeline crossings within the North Norfolk Sandbanks and Saturn Reef SAC. Associated increases in biodiversity will potentially affect up to 0.015% of the Annex I habitat 'Sandbanks which are slightly covered by seawater all the time'. In a habitat where encrusting epifaunal species are rare, this is likely to represent highly localised shifts in the baseline conditions.</p> <p>The introduction of hard substrate in the predominantly infaunal communities associated with the NcirBat, ApriBatPo and SspiMx biotopes has the potential to introduce species not typically present in these habitats to the area. The consequences, adverse or beneficial, are difficult to determine but the Annex I habitat 'Sandbanks which are slightly covered by seawater all the time' is deemed to be of low vulnerability.</p> <p>Designed-in measures including a biosecurity plan, a PEMMP and vessels complying with the IMO ballast water management guidelines will ensure that the risk of potential introduction and spread of INNS will be minimised.</p> <p>Subtidal mobile sandbanks are subject to continued reworking of the sediment by wave action and tidal streams and thus are dominated by species capable of tolerating severe changes in the hydro-physical regime (Elliott et al., 1998). The sandy communities recorded along the Hornsea Three offshore cable corridor within the North Norfolk Sandbanks and Saturn Reef SAC comprised biotopes that represent communities comprising low infaunal and epifaunal diversity, namely the NcirBat and ApriBatPo biotopes (see ES volume 5, annex 2.1: Benthic Ecology Technical Report), in addition the biotope IMoSa has also been recorded at the sandbanks (Jenkins et al., 2015). The sandy communities associated with</p>	No effect on site integrity anticipated

Potential Impact: Permanent habitat loss during operation/maintenance Potential Impact: Colonisation of hard structures during operation/maintenance Potential Impact: Changes in physical processes during operation/maintenance Potential Impact: Temporary seabed disturbance during operation/maintenance Potential Impact: Accidental pollution during operation/maintenance						
			Biological structure: characteristic communities	Restore	<p>the sandbanks in this designated site are typically sparse and dominated by Bathyporeia spp. and Nephtys cirrosa (Jenkins et al., 2015). The NcirBat biotope is not sensitive to local changes in tidal current flow or local changes in wave exposure (Tillin, 2016b). Mobile sands characterise this biotope and water movement is therefore an important physical parameter for this biotope, largely as wave action rather than tidal flow, however an increase in flow-related disturbance could shift the community assemblage to one characteristic of the IMoSa biotope, while a decrease can alter NcirBat to the FfabMag biotope (Tillin, 2016b).</p> <p>Similarly, the ApriBatPo biotope is not considered to be sensitive to local changes in tidal current flow or local changes in wave exposure (Tillin, 2016e). Characteristic species may be associated with troughs and crests of rippled bedforms which are created by the tidal flow and wave action, therefore this biotope may emerge following an increase in water flow, or disappear following a reduction in flow (Tillin, 2016e).</p> <p>The tidal currents across the former Hornsea Zone vary from approximately 0.6 ms⁻¹ to 1 ms⁻¹. ApriBatPo occurs in flow strengths of between <0.5 ms⁻¹ and 1.5 ms⁻¹, therefore the predicted maximum changes in current speeds resulting from Hornsea of +0.04 ms⁻¹ to -0.1 ms⁻¹ would be unlikely to cause the ApriBat biotope to disappear.</p> <p>Impacts arising from maintenance operations will be highly localised within the North Norfolk Sandbanks and Saturn Reef SAC with up to only 0.08% of Annex I habitat within the North Norfolk Sandbanks and Saturn Reef SAC affected and that the associated communities are predicted to recover rapidly from disturbance of this nature.</p>	No effect on site integrity anticipated
			Function	Recover	<p>Considering the above the activities occurring during operation & maintenance are not anticipated to impact on the ecological function (ecosystem services) of this feature of the site.</p>	

Potential Impact: Permanent habitat loss during operation/maintenance Potential Impact: Colonisation of hard structures during operation/maintenance Potential Impact: Changes in physical processes during operation/maintenance Potential Impact: Temporary seabed disturbance during operation/maintenance Potential Impact: Accidental pollution during operation/maintenance						
		To ensure that, subject to natural change, the supporting processes on which qualifying habitats rely are maintained or restored	Hydrodynamic regime	Maintain	The presence of the turbine foundations and associated infrastructure also has the potential to affect the wave regime which could lead to potential impacts on offshore sandbanks including Annex I 'Sandbanks which are slightly covered by seawater all the time' within the North Norfolk Sandbanks and Saturn Reef SAC. The results of the wave modelling predict a general reduction in wave height in the region of the north Norfolk sandbanks when waves are coming from the north, north northeast and north east, which is about 15% of the time. During these conditions, there may be a small reduction in wave height of up to 15% within the vicinity of the Indefatigable Bank system and up to ~2% within the vicinity of sandbanks closer inshore (e.g. Ower Bank; see ES volume 5, annex 1.1: Marine Processes Technical Annex). Whilst impacts to sandbanks could theoretically occur throughout the operational lifetime (i.e. 25 years) of Hornsea Three (i.e. be of long term duration), any impacts would be intermittent in nature.	No effect on site integrity anticipated
			Water quality	Maintain	The proposed activities during operation & maintenance do not represent a risk to impacts on water quality - Accidental pollution events will be mitigated against by means of industry standard practices.	No effect on site integrity anticipated
			Sediment quality	Maintain	The proposed activities during operation & maintenance do not represent a risk to impacts on sediment quality - Accidental pollution events will be mitigated against by means of industry standard practices.	No effect on site integrity anticipated
	Reefs (biogenic)	To ensure that, subject to natural change, the extent and distribution of qualifying habitats in the site are maintained or restored	Extent and distribution	Restore	<p>Up to 497,400 m² long term habitat loss is predicted to occur within the North Norfolk Sandbanks and Saturn Reef SAC (i.e. from cable protection where burial is not possible and pipeline/cable crossings). This represents 0.01% of the total area of the North Norfolk Sandbanks and Saturn Reef SAC. Cable protection requirements along the Hornsea Three offshore cable corridor will be detailed in the Cable Specification and Installation Plan that will be agreed in consultation with statutory consultees.</p> <p>The impact of long term habitat loss within the North Norfolk Sandbanks and Saturn Reef SAC is predicted to be localised to discrete sections of the Hornsea Three offshore cable corridor, affecting a very small proportion of the seabed within the North Norfolk Sandbanks and Saturn Reef SAC, with no predicted effects on existing Annex I reef habitats as direct impacts to this feature will be avoided.</p> <p>Temporary disturbance to Annex I reef features within this site during maintenance operations will be avoided where possible to minimise any direct impacts and, based on the current distribution of habitats within the Hornsea Three offshore cable corridor, impacts to Annex I reef habitat are not predicted.</p>	No effect on site integrity anticipated

Potential Impact: Permanent habitat loss during operation/maintenance Potential Impact: Colonisation of hard structures during operation/maintenance Potential Impact: Changes in physical processes during operation/maintenance Potential Impact: Temporary seabed disturbance during operation/maintenance Potential Impact: Accidental pollution during operation/maintenance						
		To ensure that, subject to natural change, the structure and function (including typical species) of qualifying natural habitats are maintained or restored	Physical structure	Restore	No impacts anticipated - see extent and distribution above	No effect on site integrity anticipated
			Biological structure: key and influential species	Restore	The impact of long term habitat loss within the North Norfolk Sandbanks and Saturn Reef SAC is predicted to be localised to discrete sections of the Hornsea Three offshore cable corridor, affecting a small proportion of the seabed within the North Norfolk Sandbanks and Saturn Reef SAC, with no predicted effects on qualifying Annex I reef habitats. The SspiMx biotope is not considered to be sensitive to INNS. However, designed-in measures including a biosecurity plan, a PEMMP and vessels complying with the IMO ballast water management guidelines will, however, ensure that the risk of potential introduction and spread of INNS will be minimised.	No effect on site integrity anticipated
			Biological structure: characteristic communities	Restore	Increase in biodiversity associated with colonisation of hard structure (cable protection) is not predicted to affect any Annex I reef features of the North Norfolk Sandbanks and Saturn Reef SAC as no reefs were identified within the Hornsea Three benthic ecology study area coinciding with the North Norfolk Sandbanks and Saturn Reef SAC during the site specific surveys and should Annex I reef be present in the pre-construction survey within the North Norfolk Sandbanks and Saturn Reef SAC, appropriate measures will be put in place to avoid direct impacts to these reefs from cable protection.	No effect on site integrity anticipated
			Function	Recover	Considering the above the activities occurring during operation & maintenance are not anticipated to impact on the ecological function (ecosystem services) of this feature of the site.	

Potential Impact: Permanent habitat loss during operation/maintenance Potential Impact: Colonisation of hard structures during operation/maintenance Potential Impact: Changes in physical processes during operation/maintenance Potential Impact: Temporary seabed disturbance during operation/maintenance Potential Impact: Accidental pollution during operation/maintenance						
			Hydrodynamic regime	Maintain	<p><i>S. spinulosa</i> is tolerant of local changes in tidal current flow and local changes in wave exposure (Tillin and Marshall, 2015). As such, Annex I <i>S. spinulosa</i> reefs are not considered to be sensitive to these effects.</p>	No effect on site integrity anticipated
		To ensure that, subject to natural change, the supporting processes on which qualifying habitats rely are maintained or restored	Supporting habitats	Restore	<p>The impact of long term habitat loss within the North Norfolk Sandbanks and Saturn Reef SAC is predicted to be localised to discrete sections of the Hornsea Three offshore cable corridor, affecting a very small proportion of the seabed within the North Norfolk Sandbanks and Saturn Reef SAC, with no predicted direct effects on existing Annex I reef habitats as direct impacts to this feature will be avoided.</p> <p>It is acknowledged that the presence of the cable protection within the North Norfolk Sandbanks and Saturn Reef SAC (representing 0.01% of the total area of the site) may serve as an ongoing barrier to the future establishment of Annex I reefs in those discrete areas. The MarESA for the SspiMx biotope does note, however, that <i>S. spinulosa</i> has been recorded colonising bedrock and artificial structures and an increase in the availability of hard substratum may, therefore, be beneficial in areas where sedimentary habitats were previously unsuitable for colonisation, although the resulting biotope would be different (Tillin and Marshall, 2015). Therefore, it is not considered that the presence of cable protection within the North Norfolk Sandbanks and Saturn Reef SAC will preclude the establishment of Annex I reefs, or indeed Annex I 'Sandbanks which are slightly covered by seawater all the time' in these areas in the future.</p>	No effect on site integrity anticipated

<p>Potential Impact: Permanent habitat loss during operation/maintenance</p> <p>Potential Impact: Colonisation of hard structures during operation/maintenance</p> <p>Potential Impact: Changes in physical processes during operation/maintenance</p> <p>Potential Impact: Temporary seabed disturbance during operation/maintenance</p> <p>Potential Impact: Accidental pollution during operation/maintenance</p>						
			Water quality	Maintain	The proposed activities during operation/maintenance do not represent a risk to impacts on water quality - Accidental pollution events will be mitigated against by means of industry standard practices	No effect on site integrity anticipated