Planning Scotland's Seas

SEA of Plans for Wind, Wave and Tidal Power in Scottish Marine Waters

Appendix C: Assessment of Technologies

The Scottish Government
Riaghaltas na h-Alba

marine scotland

1 Wind Technology

SEA Topic Areas	Wind technologies with gravity-base foundation devices	Wind technologies with monopile or multi-pile foundation devices	Wind technologies with tripod or steel jacket foundation devices	Wind technologies with mono or multi-caisson foundation devices	Floating wind turbines
Device Information[1]	• Involves the construction of gravity foundations directly on the seabed. • Gravity base foundations consist of concrete or steel structures, often internally ballasted to create a large mass on the seabed. • May be suitable for depths of 30 – 60m of water. • Able to be floated and towed out to windfarms and installed without specialist marine equipment with minimum seabed preparation. • Can incorporate scour protection, has low maintenance requirement and can be removed upon decommissioning.	• Like typical oil and gas pile designs. • Involves long steel tubes (monopiles) driven into the seabed using a hydraulic piling hammer, assisted by drilling where necessary. • Generally suitable for turbines in shallower waters, although ongoing research into deeper applications (i.e. >25m). • Considered likely to continue to be used in shallow waters in the short-term.	• Generally consist of turbines attached to multi-legged structures secured to a series of piles driven into the seabed. • Jackets are mounted on a 3 or 4 legged steel lattice rising out of the sea. • Tripods have a single vertical column above the water, with diagonal braces attaching the turbine mast to a 3-legged structure below the water surface and attached to the seabed. • Jackets in particular are very common in the oil and gas sector, with a number of variations available.	• Consists of a structure or suction caisson resembling an upturning bucket placed on a pre-prepared levelled seabed. • Placement is based on a pressure differential attachment to the seabed. The foundations weight combined with the hydrostatic pressure on the caisson when the internal water is pumped out of it provides the force to hold the bucket structure in place. • Can involve use of single or multiple caisson attachments. • Is generally considered a future technique.	• Have a variety of types being investigated, including: Spar and Tension Leg Platform (TLP) such as the 'Hywind' floating device equipped with a cement ballast (installed in Norway in 2009), and 'Windfloat' – a 3 cornered pontoon (installed in Portugal in 2011). • Likely involve attachment to the seabed using anchors (i.e. gravity anchors, moorlines, etc.). • Considered a new or future technique.
Biodiversity/ flora/ fauna[2]	Summary of key potential effects: • Physical disturbance during device installation and operation • Habitat exclusion and species displacement due to device presence and operation • Potential for creation of artificial habitats underwater and bird aggregation on surface-piercing structures • Noise and vibration during construction (particularly piling) and from device operation • Risk of bird collision with operating devices (e.g. foraging, migration) • Increased suspended sediment/turbidity from seabed disturbance during device installation and cable trenching • Substratum loss, caused by placement of devices and attaching support structures and cabling on the seabed Key measures to prevent adverse effects may include: avoidance of sensitive sites; avoidance of sensitive seasons during installation (e.g. breeding); protocols (such as use of Marine Mammal Observers) to ensure noisy construction activities do not occur when marine mammals are in close proximity; effective device design and project-specific studies to help design appropriate mitigation; carry out detailed routing studies at project level in accordance with 'Holford Rules' best practice guidance on routeing overhead transmission lines onshore.				
	Marine Mammals and fish Underwater noise and vibration during installation has the potential to impact on marine fauna (i.e. seals, otters, cetaceans, basking sharks). There is also the potential for cumulative impacts from multiple noise sources audible to marine mammals and fish during installation and increased vessel disturbance. Potential displacement or disturbance of	*Marine Mammals and fish* Underwater noise and vibration on mammals seals, otters and cetaceans during piling. There is also the potential for cumulative impacts from multiple noise sources audible to marine mammals and fish during piling and installation of turbines, and increased vessel disturbance. Potential displacement or disturbance of marine fauna through a combination of	*Marine Mammals and fish* Underwater noise and vibration during piling and the placement of tripod/jacket structures, with potential impacts to marine fauna (i.e. seals, otters, cetaceans, basking sharks). There is also the potential for cumulative impacts from multiple noise sources audible to marine mammals and fish during piling and installation of turbines, and increased vessel disturbance.	*Marine Mammals and fish* Underwater noise and vibration during installation has the potential to impact marine fauna (i.e. seals, otters, cetaceans, basking sharks). There is also the potential for cumulative impacts from multiple noise sources audible to marine mammals and fish during installation and increased vessel disturbance. Potential displacement or disturbance of	*Marine Mammals and fish* Underwater noise and vibration during installation (placement of concrete anchors and moorlines) has the potential to impact marine fauna (i.e. seals, otters, cetaceans, basking sharks). There is also the potential for cumulative impacts from multiple noise sources audible to marine mammals and fish during installation and increased vessel disturbance.

[1] Informed by: E.On UK (2013) Foundation Types [online] Available at: http://www.eon-uk.com/generation/3947.aspx [accessed 02/03/2013]; ARUP, Costain, Hochtief (undated) Gravity Base Foundations; Scharf R. and Siems M. (2013) Monopile foundations for offshore wind turbines – solutions for greater water depths, Steel Construction 6 (2013), No. 1, DOI: 10.1002/stco.201300010, pp. 47 – 53 [online] Available at: http://onlinelibrary.wiley.com/doi/10.1002/stco.201300010/pdf [accessed 27/03/2013]; and DW (2013) Scientists race to develop floating wind farms [online] Available at: http://www.dw.de/scientists-race-to-develop-floating-wind-farms/a-16540081 [accessed 02/03/2013].

[2] Informed by: Halcrow (2007) The Plan for Offshore Wind Energy in Scottish Territorial Waters, Environmental Report: Volume 1, Prepared for the Scottish Executive [online] Available at: http://www.scotland.gov.uk/Resource/Doc/312161/0098588.pdf [accessed 27/03/2013]; Talisman Energy (UK) LTD (2005) Environmental Statement [online] Available at: http://www.beatricewind.co.uk/downloads/statement.asp [accessed 25/03/2013]; EMU (2012) Neart na Gaoithe Offshore Wind Farm Environmental Statement, Prepared for Mainstream Renewable Power [online] Available at: http://mainstream-downloads.opendebate.co.uk/downloads/Contents-Pages.pdf [accessed 25/03/2013]; Aberdeen Wind Offshore Wind Farm Limited (2011) European Offshore Wind Deployment Centre: Non-Technical Summary, July 2011 [online] Available at: http://www.vattenfall.co.uk/en/file/EOWDC-consent-vol1.pdf_18476566.pdf [accessed 26/03/2013]; E-on (2008) Offshore Environmental Statement, April 2008 [online] Available at: http://www.eon-uk.com/generation/1309.aspx [accessed 26/03/2013]; E-on (2008) Onshore Cable Route Environmental Statement, April 2008 [online] Available at: http://www.eon-uk.com/generation/1309.aspx [accessed 26/03/2013]; and E-on (2009) Onshore Substation and Cable Spur Environmental Statement, November 2009 [online] Available at: http://www.eon-uk.com/generation/1309.aspx [accessed 26/03/2013.

SEA Topic Areas	Wind technologies with gravity-base foundation devices	Wind technologies with monopile or multi-pile foundation devices	Wind technologies with tripod or steel jacket foundation devices	Wind technologies with mono or multi-caisson foundation devices	Floating wind turbines
	marine fauna through a combination of factors including noise (and multiple noise sources), vibration, visual and light intensity changes, water quality changes, habitat disturbance or the presence of structures and vessels. Potential for injury with marine mammals and impacts during installation period (i.e. risk of injury to curious seals and dolphins during placement of foundations). Potential for EMF impacts associated with cabling and grid connection infrastructure. Cumulative impacts may occur, particularly affecting mammals and migratory fish, from an increased number of barriers affecting fish movement (i.e. device arrays, construction vessels/equipment, etc.). *Birds* Potential for bird-strike with turbine blades is likely to be site-specific. Potential for diving bird collisions with support devices (i.e. mooring cables if used). However, this is likely to be site and device-specific, and the likelihood of occurrence is not currently known. Potential disturbance of diving bird foraging areas due to surface noise, visual and light intensity changes, water quality changes, habitat disturbance or the presence of structures and vessels. *Benthic Habitats* Potential for creation of artificial habitats for marine organisms resulting from the presence of new structures. This may be aided by reductions in commercial fishing (e.g. trawling) in areas where wind farms are sited, as this may enhance biodiversity. These benefits could last for the life of the project, or potentially longer depending on the decommissioning scheme. Loss of seabed habitat from the placement of gravity foundation directly on/into the seabed, and potential for adverse impacts from sourcing of fill or dredged material for use in the gravity-based foundation (i.e. potential risk of impacts to marine fauna from dredging activities, turbidity, potential release of	factors including noise (and multiple noise sources), vibration, visual and light intensity changes, water quality changes, habitat disturbance or the presence of structures and vessels. Potential for injury with marine mammals and impacts during installation period (i.e. risk of injury to curious seals during piling activities). Can likely be mitigated using a variety of techniques (i.e. piling jackets, soft start, etc.). Potential for EMF impacts associated with cabling and grid connection infrastructure. Cumulative impacts may occur, particularly affecting mammals and migratory fish, from an increased number of barriers affecting fish movement (i.e. device arrays, construction vessels/equipment, etc.). *Birds* Potential for bird-strike with turbine blades is likely to be site-specific. Potential for diving bird collisions with support devices (i.e. mooring cables if used). However, this is likely to be site and device-specific, and the likelihood of occurrence is not currently known. Potential disturbance of diving bird foraging areas due to surface noise, visual and light intensity changes, water quality changes, habitat disturbance or the presence of structures and vessels. *Benthic Habitats* Potential for creation of artificial habitats for marine organisms resulting from the presence of new structures. This may be aided by reductions in commercial fishing (e.g. trawling) in areas where wind farms are sited, as this may enhance biodiversity. These benefits could last for the life of the project, or potentially longer depending on the decommissioning scheme. Loss of seabed habitat from the installation process for monopiling into the seabed. Direct adverse impacts to benthic habitats, particularly sensitive habitats such as shellfish growing waters, from sediment dispersion and deposition in	Potential displacement or disturbance of marine fauna through a combination of factors including noise (and multiple noise sources), vibration, visual and light intensity changes, water quality changes, habitat disturbance or the presence of structures and vessels. Potential for injury with marine mammals and impacts during installation period (i.e. risk of injury to curious seals during piling activities). Can likely be mitigated using a variety of techniques (i.e. piling jackets, soft start, etc.). Potential for EMF impacts associated with cabling and grid connection infrastructure. Cumulative impacts may occur, particularly affecting mammals and migratory fish, from an increased number of barriers affecting fish movement (i.e. device arrays, construction vessels/equipment, etc.). *Birds* Potential for bird-strike with turbine blades is likely to be site-specific. Potential for diving birds strike to support devices (support structures, mooring cables if used) is likely to be site-specific, and the likelihood of occurrence is not currently known. Potential disturbance of diving bird foraging areas due to surface noise, visual and light intensity changes, water quality changes, habitat disturbance or the presence of structures and vessels. *Benthic Habitats* Potential for creation of artificial habitats for marine organisms resulting from the presence of new structures. This may be aided by reductions in commercial fishing (e.g. trawling) in areas where wind farms are sited, as this may enhance biodiversity. These benefits could last for the life of the project, or potentially longer depending on the decommissioning scheme. Loss of seabed habitat from the installation process for piling into the seabed. Direct adverse impacts to benthic habitats, particularly sensitive habitats	marine fauna through a combination of factors including noise (and multiple noise sources), vibration, visual and light intensity changes, water quality changes, habitat disturbance or the presence of structures and vessels. Potential for injury with marine mammals and impacts during installation period (i.e. risk of injury to curious seals and dolphins during placement of foundations). Potential for EMF impacts associated with cabling and grid connection infrastructure. Cumulative impacts may occur, particularly affecting mammals and migratory fish, from an increased number of barriers affecting fish movement (i.e. device arrays, construction vessels/equipment, etc.). *Birds* Potential for bird-strike with turbine blades is likely to be site-specific. Potential for diving bird collisions with support devices (i.e. mooring cables if used). However, this is likely to be site and device-specific, and the likelihood of occurrence is not currently known. Potential disturbance of diving bird foraging areas due to surface noise, visual and light intensity changes, water quality changes, habitat disturbance or the presence of structures and vessels. *Benthic Habitats* Potential for creation of artificial habitats for marine organisms resulting from the presence of new structures. This may be aided by reductions in commercial fishing (e.g. trawling) in areas where wind farms are sited, as this may enhance biodiversity. These benefits could last for the life of the project, or potentially longer depending on the decommissioning scheme. Loss of seabed habitat from the placement of foundation directly on/into the seabed. Direct adverse impacts to benthic habitats, particularly sensitive habitats such as shellfish growing waters, from sediment dispersion and deposition in	Potential displacement or disturbance of marine fauna through a combination of factors including noise (and multiple noise sources), vibration, visual and light intensity changes, water quality changes, habitat disturbance or the presence of anchors and vessels. Potential for EMF impacts associated with cabling and grid connection infrastructure. Cumulative impacts may occur, particularly affecting mammals and migratory fish, from an increased number of barriers affecting fish movement (i.e. device arrays, construction vessels/equipment, etc.). *Birds* Potential for bird-strike with turbine blades is likely to be site-specific. Potential for diving bird collisions with support devices (i.e. mooring cables, anchors, etc.). However, this is likely to be site and device-specific, and the likelihood of occurrence is not currently known. Potential disturbance of diving bird foraging areas due to surface noise, visual and light intensity changes, water quality changes, habitat disturbance or the presence of structures and vessels. *Benthic Habitats* Potential for creation of artificial habitats for marine organisms resulting from the presence of new structures (i.e. gravity anchors). This may be aided by reductions in commercial fishing (e.g. trawling) in areas where wind farms are sited, as this may enhance biodiversity. These benefits could last for the life of the project, or potentially longer depending on the decommissioning scheme. Loss of small discrete areas of the seabed habitat from the placement of gravity anchors into the seabed. Direct adverse impacts to benthic habitats, particularly sensitive habitats such as shellfish growing waters, from sediment dispersion and deposition in the construction phase of works (i.e. east of Scotland (e.g. Bell Rock, Inch

SEA Topic Areas	Wind technologies with gravity-base foundation devices	Wind technologies with monopile or multi-pile foundation devices	Wind technologies with tripod or steel jacket foundation devices	Wind technologies with mono or multi-caisson foundation devices	Floating wind turbines
	contaminated materials, loss of habitat at source, etc.). Direct adverse impacts to benthic habitats, particularly sensitive habitats such as shellfish growing waters, from sediment dispersion and deposition in the construction phase of works (i.e. east of Scotland (e.g. Bell Rock, Inch Cape, Neart na Gaoithe and Forth Array) and west of Scotland (e.g. Argyll Array, Islay and Kintyre) where shellfish waters are prevalent. It is anticipated that many of the construction and decommissioning effects may be temporary and reversible (i.e. removal of the gravity base structure and rehabilitation of the seabed). However, some impacts on biodiversity experienced during operation of wind farms are likely to be permanent and irreversible.	the construction phase of works (i.e. east of Scotland (e.g. Bell Rock, Inch Cape, Neart na Gaoithe and Forth Array) and west of Scotland (e.g. Argyll Array, Islay and Kintyre) where shellfish waters are prevalent. It is anticipated that many of the construction and decommissioning effects may be temporary and reversible (i.e. removal of the turbines with the monopole remaining insitu). However, some impacts on biodiversity experienced during operation of wind farms are likely to be permanent and irreversible.	such as shellfish growing waters, from sediment dispersion and deposition in the construction phase of works (i.e. east of Scotland (e.g. Bell Rock, Inch Cape, Neart na Gaoithe and Forth Array) and west of Scotland (e.g. Argyll Array, Islay and Kintyre) where shellfish waters are prevalent. It is anticipated that many of the construction and decommissioning effects may be temporary and reversible (i.e. removal of the turbines and support structures, and piles remaining insitu). However, some impacts on biodiversity experienced during operation of wind farms are likely to be permanent and irreversible.	the construction phase of works (i.e. east of Scotland (e.g. Bell Rock, Inch Cape, Neart na Gaoithe and Forth Array) and west of Scotland (e.g. Argyll Array, Islay and Kintyre) where shellfish waters are prevalent. It is anticipated that many of the construction and decommissioning effects may be temporary and reversible (i.e. removal of the caisson). However, some impacts on biodiversity experienced during operation of wind farms are likely to be permanent and irreversible.	Cape, Neart na Gaoithe and Forth Array) and west of Scotland (e.g. Argyll Array, Islay and Kintyre) where shellfish waters are prevalent. It is anticipated that many of the construction and decommissioning effects may be temporary and reversible (i.e. removal of the gravity anchors and removal of the floating turbine structure). However, some impacts on biodiversity experienced during operation of wind farms are likely to be permanent and irreversible.
Population and human health[3]	Summary of key potential effects on population and human health: • Flicker and noise effects, particularly for near-shore devices • Displacement of other marine activities (i.e. fishing, recreational, shipping, aquaculture) • Reductions in the safety of navigation • Risk of collision by other marine users with turbine structures and installation/maintenance vessels • Requirement for the installation of new transmission infrastructure to connect the devices to the grid (i.e. cables on the seabed, terrestrial infrastructure) • Requirement for upgrading of nearby port/harbour infrastructure to install and/or maintain turbines Key measures to prevent adverse effects may include: siting devices away from spatially constrained areas and areas with high vessel densities; siting devices in open water; making use of industry guidance on assessment of effects and use of aids to navigation; use of notifications such as 'Notices to Mariners', publicising information at marina, and Sailing Directions; and adhering to appropriate safety regulations.				
	Provision of a new renewable energy supply for the projected increase in the Scottish population for the life of an operating wind farm. Potential for flicker and noise impacts, particularly if located near-shore. Potential impacts on other marine users (i.e. fishing, recreational, shipping, aquaculture) including the potential displacement of these activities, the risk of collision with turbine structures, and visual impacts associated with the presence of the turbines. Upon decommissioning, these effects will likely be reversible.	Provision of a new renewable energy supply for the projected increase in the Scottish population for the life of an operating wind farm. Potential for flicker and noise impacts, particularly if located near-shore. Potential impacts on other marine users (i.e. fishing, recreational, shipping, aquaculture) including the potential displacement of these activities, the risk of collision with turbine structures, and visual impacts associated with the presence of the turbines. Upon decommissioning, these effects will likely be reversible.	Provision of a new renewable energy supply for the projected increase in the Scottish population for the life of an operating wind farm. Potential for flicker and noise impacts, particularly if located near-shore. Potential impacts on other marine users (i.e. fishing, recreational, shipping, aquaculture) including the potential displacement of these activities, the risk of collision with turbine structures, and visual impacts associated with the presence of the turbines. Upon decommissioning, these effects will likely be reversible.	Provision of a new renewable energy supply for the projected increase in the Scottish population for the life of an operating wind farm. Potential for flicker and noise impacts, particularly if located near-shore. Potential impacts on other marine users (i.e. fishing, recreational, shipping, aquaculture) including the potential displacement of these activities, the risk of collision with turbine structures, and visual impacts associated with the presence of the turbines. Upon decommissioning, these effects will likely be reversible.	Provision of a new renewable energy supply for the projected increase in the Scottish population for the life of an operating wind farm. Potential for flicker and noise impacts, particularly if located near-shore. Potential impacts on other marine users (i.e. fishing, recreational, shipping, aquaculture) including the potential displacement of these activities, the risk of collision with turbine structures, and visual impacts associated with the presence of the turbines. Upon decommissioning or movement of the array (if undertaken)

[3] Informed by: Halcrow (2007) The Plan for Offshore Wind Energy in Scottish Territorial Waters, Environmental Report: Volume 1, Prepared for the Scottish Executive [online] Available at: http://www.scotland.gov.uk/Resource/Doc/312161/0098588.pdf [accessed 27/03/2013]; Talisman Energy (UK) LTD (2005) Environmental Statement [online] Available at: http://www.beatricewind.co.uk/downloads/statement.asp [accessed 25/03/2013]; EMU (2012) Neart na Gaoithe Offshore Wind Farm Environmental Statement, Prepared for Mainstream Renewable Power [online] Available at: http://mainstream-downloads.opendebate.co.uk/downloads/Contents-Pages.pdf [accessed 25/03/2013]; Aberdeen Wind Offshore Wind Farm Limited (2011) European Offshore Wind Deployment Centre: Non-Technical Summary, July 2011 [online] Available at: http://www.vattenfall.co.uk/en/file/EOWDC-consent-vol1.pdf_18476566.pdf [accessed 26/03/2013]; E-on (2008) Offshore Environmental Statement, April 2008 [online] Available at: http://www.eon-uk.com/generation/1309.aspx [accessed 26/03/2013]; E-on (2008) Onshore Cable Route Environmental Statement, April 2008 [online] Available at: http://www.eon-uk.com/generation/1309.aspx [accessed 26/03/2013]; and E-on (2009) Onshore Substation and Cable Spur Environmental Statement, November 2009 [online] Available at: http://www.eon-uk.com/generation/1309.aspx [accessed 26/03/2013.

SEA Topic Areas	Wind technologies with gravity-base foundation devices	Wind technologies with monopile or multi-pile foundation devices	Wind technologies with tripod or steel jacket foundation devices	Wind technologies with mono or multi-caisson foundation devices	Floating wind turbines
	Potential issues with navigation, although it is noted that this may be managed through the selection of appropriate sites and the MCA to ensure that there are no hazards to shipping. Potential for commercial impacts on the fishing and shipping industries (i.e. loss of access to fishing areas, reduced catches in such areas from displacement of fish populations, collision risk). Requirement for the installation of new transmission infrastructure to connect the devices to the grid (i.e. cables on the seabed, terrestrial infrastructure) could, in some circumstances, impact on recreational and commercial activities. Potential impacts, is likely to be site and development specific. Potential for upgrading of nearby port/harbour infrastructure to install and/or maintain turbines.	Potential issues with navigation, although it is noted that this may be managed through the selection of appropriate sites and the MCA to ensure that there are no hazards to shipping. Potential for commercial impacts on the fishing and shipping industries (i.e. loss of access to fishing areas, reduced catches in such areas from displacement of fish populations, collision risk). Requirement for the installation of new transmission infrastructure to connect the devices to the grid (i.e. cables on the seabed, terrestrial infrastructure) could, in some circumstances, impact on recreational and commercial activities. Potential impacts, is likely to be site and development specific. Potential for upgrading of nearby port/harbour infrastructure to install and/or maintain turbines.	Potential issues with navigation, although it is noted that this may be managed through the selection of appropriate sites and the MCA to ensure that there are no hazards to shipping. Potential for commercial impacts on the fishing and shipping industries (i.e. loss of access to fishing areas, reduced catches in such areas from displacement of fish populations, collision risk). Requirement for the installation of new transmission infrastructure to connect the devices to the grid (i.e. cables on the seabed, terrestrial infrastructure) could, in some circumstances, impact on recreational and commercial activities. Potential impacts, is likely to be site and development specific. Potential for upgrading of nearby port/harbour infrastructure to install and/or maintain turbines.	Potential issues with navigation, although it is noted that this may be managed through the selection of appropriate sites and the MCA to ensure that there are no hazards to shipping. Potential for commercial impacts on the fishing and shipping industries (i.e. loss of access to fishing areas, reduced catches in such areas from displacement of fish populations, collision risk). Requirement for the installation of new transmission infrastructure to connect the devices to the grid (i.e. cables on the seabed, terrestrial infrastructure) could, in some circumstances, impact on recreational and commercial activities. Potential impacts, is likely to be site and development specific. Potential for upgrading of nearby port/harbour infrastructure to install and/or maintain turbines.	these effects will likely be reversible. Potential issues with navigation, although it is noted that this may be managed through the selection of appropriate sites and the MCA to ensure that there are no hazards to shipping. Potential for commercial impacts on the fishing and shipping industries (i.e. loss of access to fishing areas, reduced catches in such areas from displacement of fish populations, collision risk). Requirement for the installation of new transmission infrastructure to connect the devices to the grid (i.e. cables on the seabed, terrestrial infrastructure) could, in some circumstances, impact on recreational and commercial activities. Potential impacts, is likely to be site and development specific. Potential for upgrading of nearby port/harbour infrastructure to install and/or maintain turbines.
Water and marine environment[4]	Summary of key potential effects on water quality include: • Disturbance of sediments during device installation and impacts to marine fauna, particularly benthic species (e.g. filter feeders) • Disturbance of contaminated sediments during device installation, e.g. disposal sites (silt, sand, rock and gravel sites, fish wastes and sludge, munitions dumps, and weapons ranges) Key measures to prevent adverse effects may include: siting devices away from sensitive areas, disposal sites, munitions dumps and weapons ranges; using best practice methodologies and technologies to minimise potential impacts during installation; adoption of appropriate management planning in installation works.				
	Potential impacts to water quality from installation of turbine foundations and structures (i.e. turbidity, seabed disturbance from placement of gravity-based supports, contamination from installation equipment and maintenance vessels) and the potential for associated impacts on marine biodiversity, particularly those species dependent on existing water conditions. Potential impacts to the ability of fish species to spawn, respire and feed, and on shellfish growing waters in the vicinity of windfarm sites are also noted. However, the significance of these impacts is currently uncertain. Construction and decommissioning	Potential impacts to water quality from installation of turbine monopiles (i.e. turbidity, seabed disturbance from piling works, contamination from installation equipment and maintenance vessels) and the potential for associated impacts on marine biodiversity, particularly those species dependent on existing water conditions. Potential impacts to the ability of fish species to spawn, respire and feed, and on shellfish growing waters in the vicinity of windfarm sites are also noted, However, the significance of these impacts is currently uncertain. Construction and decommissioning effects are temporary and may be	Potential impacts to water quality from installation of turbines and associated structures (i.e. turbidity, seabed disturbance from piling works and placement of support structures on the seabed, contamination from installation equipment and maintenance vessels) and the potential for associated impacts on marine biodiversity, particularly those species dependent on existing water conditions. Potential impacts to the ability of fish species to spawn, respire and feed, and on shellfish growing waters in the vicinity of windfarm sites are also noted, However, the significance of these impacts is currently uncertain.	Potential impacts to water quality from installation of turbine, caisson and seabed preparation activities (i.e. turbidity, seabed disturbance from preparation/levelling of seabed, potential placement of concrete foundations, placement of caisson and support structures, contamination from installation equipment and maintenance vessels) and the potential for associated impacts on marine biodiversity, particularly those species dependent on existing water conditions. Potential impacts to the ability of fish species to spawn, respire and feed, and on shellfish growing waters in the vicinity of windfarm sites are also noted. However, the	Potential impacts to water quality from installation of mooring anchors (i.e. turbidity, seabed disturbance from placement of gravity anchors, potential for contamination from installation equipment and maintenance vessels) and the potential for associated impacts on marine biodiversity, particularly those species dependent on existing water conditions. Potential impacts to the ability of fish species to spawn, respire and feed, and on shellfish growing waters in the vicinity of windfarm sites are also noted. However, the significance of these impacts is currently uncertain. Construction and decommissioning

[4] Informed by: Halcrow (2007) The Plan for Offshore Wind Energy in Scottish Territorial Waters, Environmental Report: Volume 1, Prepared for the Scottish Executive [online] Available at: http://www.scotland.gov.uk/Resource/Doc/312161/0098588.pdf [accessed 27/03/2013]; Talisman Energy (UK) LTD (2005) Environmental Statement [online] Available at: http://www.beatricewind.co.uk/downloads/statement.asp [accessed 25/03/2013]; EMU (2012) Neart na Gaoithe Offshore Wind Farm Environmental Statement, Prepared for Mainstream Renewable Power [online] Available at: http://mainstream-downloads.opendebate.co.uk/downloads/Contents-Pages.pdf [accessed 25/03/2013]; Aberdeen Wind Offshore Wind Farm Limited (2011) European Offshore Wind Deployment Centre: Non-Technical Summary, July 2011 [online] Available at: http://www.vattenfall.co.uk/en/file/EOWDC-consent-vol1.pdf_18476566.pdf [accessed 26/03/2013]; E-on (2008) Offshore Environmental Statement, April 2008 [online] Available at: http://www.eon-uk.com/generation/1309.aspx [accessed 26/03/2013]; E-on (2008) Onshore Cable Route Environmental Statement, April 2008 [online] Available at: http://www.eon-uk.com/generation/1309.aspx [accessed 26/03/2013]; and E-on (2009) Onshore Substation and Cable Spur Environmental Statement, November 2009 [online] Available at: http://www.eon-uk.com/generation/1309.aspx [accessed 26/03/2013].

SEA Topic Areas	Wind technologies with gravity-base foundation devices	Wind technologies with monopile or multi-pile foundation devices	Wind technologies with tripod or steel jacket foundation devices	Wind technologies with mono or multi-caisson foundation devices	Floating wind turbines
	effects are temporary and may be reversible. Potential for cross-contamination in the use of excavated fill material or dredging material as ballast in gravity-based foundations.	reversible.	Construction and decommissioning effects are temporary and may be reversible.	significance of these impacts is currently uncertain. Construction and decommissioning effects are temporary and may be reversible.	effects are temporary and may be reversible.
Climatic factors[5]	Benefits through contribution to decarbonisation of electricity generation through the long-term operation of the wind farms (i.e. displacement of non-renewable power generation).	Benefits through contribution to decarbonisation of electricity generation through the long-term operation of the wind farms (i.e. displacement of non-renewable power generation).	Benefits through contribution to decarbonisation of electricity generation through the long-term operation of the wind farms (i.e. displacement of non-renewable power generation).	Benefits through contribution to decarbonisation of electricity generation through the long-term operation of the wind farms (i.e. displacement of non-renewable power generation).	Benefits through contribution to decarbonisation of electricity generation through the long-term operation of the wind farms (i.e. displacement of non-renewable power generation).
Marine geology and coastal processes[6]	Summary of key potential effects on geology: • Disturbance or damage to coastal Geological SSSIs and GCRs during installation works. • Changes in coastal processes due to presence of devices in water column. • Seabed contamination and water quality (including disposal areas) during installation works. Key measures to prevent adverse effects may include: siting devices away from sensitive and designated areas; using best practice methodologies and technologies to minimise potential impacts during installation; adoption of appropriate management planning in installation works.				
	Direct adverse impacts to the seabed are likely from preparation of the seabed (i.e. limited dredging) and in the placement of the gravity-base foundation and associated scour protection on the seabed. Potential alteration of sediment dynamics and tidal flows/fluxes from the presence of gravity-based foundation structures on the seabed and presence of turbine masts and support structures in the water column. Impacts such as scouring, deposition and abrasion (particularly in the placement of mooring lines, if used) may also occur due to the foundation structures present at the seabed. However, it is assumed that scour protection would be used for such foundation structures and this may alleviate such risks. Impacts from construction and decommissioning works are likely to be temporary and are often reversible. However, impacts from seabed preparation works are likely to be permanent.	Potential for direct adverse impacts to the seabed during piling operations. Potential alteration of sediment dynamics and tidal flows/fluxes from the presence of piles and turbine structures into the seabed and presence of the turbine masts and support structures in the water column. Impacts such as scouring, deposition, abrasion (during installation of piles only) and vibration may also occur due to the installation and operation of the wind turbines. Impacts from construction and decommissioning works are likely to be temporary and are often reversible.	Potential for direct adverse impacts to the seabed during piling operations. Potential alteration of sediment dynamics and tidal flows/fluxes from the presence of piles and turbine structures into the seabed and presence of turbine masts and support structures in the water column. Impacts such as scouring, deposition, abrasion (during installation of piles only) and vibration may also occur due to the installation and operation of the wind turbines. Impacts from construction and decommissioning works are likely to be temporary and are often reversible.	Likely direct adverse impacts to the seabed from the preparation of seabed areas (i.e. dredging) and placement of caisson support structures directly on the seabed (e.g. turbidity, sediment disturbance, loss of geology, potential for release of contaminated materials bonded to sediments). Potential alteration of sediment dynamics and tidal flows/fluxes from the presence of gravity-based foundation structures on the seabed and presence of the turbine masts and support structures in the water column. Impacts such as scouring, deposition and abrasion (particularly in the placement of mooring lines, if used) may also occur due to the foundation structures present at the seabed. However, it is assumed that scour protection would be used for such foundation structures. Impacts from construction and decommissioning works are likely to be temporary and are often reversible. However, impacts from seabed	Potential for direct adverse impacts to the seabed from the placement of gravity concrete anchors and moorings directly on the seabed. Potential alteration of sediment dynamics and tidal flows/fluxes from the presence of anchor structures gravity-based foundation structures on the seabed and presence of moorlines in the water column. Impacts such as scouring, deposition and abrasion (particularly in the placement of mooring lines, if used) may also occur due to the foundation structures present at the seabed. However, it is assumed that scour protection would be used for such foundation structures. Impacts from construction and decommissioning works are likely to be temporary and are often reversible.

[5] Informed by: Halcrow (2007) The Plan for Offshore Wind Energy in Scottish Territorial Waters, Environmental Report: Volume 1, Prepared for the Scottish Executive [online] Available at: http://www.scotland.gov.uk/Resource/Doc/312161/0098588.pdf [accessed 27/03/2013]

[6] Informed by: OSPAR Commission (2004) Biodiversity Series: Environmental Impacts to marine species and habitats of dredging for navigational purposes [online] Available at: http://www.ospar.org/documents/dbase/publications/p00208_environmental%20impacts%20to%20marine%20species.pdf [accessed 28/03/2013]; Halcrow (2007) The Plan for Offshore Wind Energy in Scottish Territorial Waters, Environmental Report: Volume 1, Prepared for the Scottish Executive [online] Available at: http://www.scotland.gov.uk/Resource/Doc/312161/0098588.pdf [accessed 27/03/2013]; Talisman Energy (UK) LTD (2005) Environmental Statement [online] Available at: http://www.beatricewind.co.uk/downloads/statement.asp [accessed 25/03/2013]; EMU (2012) Neart na Gaoithe Offshore Wind Farm Environmental Statement, Prepared for Mainstream Renewable Power [online] Available at: http://mainstream-downloads.opendebate.co.uk/downloads/Contents-Pages.pdf [accessed 25/03/2013]; Aberdeen Wind Offshore Wind Farm Limited (2011) European Offshore Wind Deployment Centre: Non-Technical Summary, July 2011 [online] Available at: http://www.vattenfall.co.uk/en/file/EOWDC-consent-vol1.pdf_18476566.pdf [accessed 26/03/2013]; E-on (2008) Offshore Environmental Statement, April 2008 [online] Available at: http://www.eon-uk.com/generation/1309.aspx [accessed 26/03/2013]; E-on (2008) Onshore Cable Route Environmental Statement, April 2008 [online] Available at: http://www.eon-uk.com/generation/1309.aspx [accessed 26/03/2013]; and E-on (2009) Onshore Substation and Cable Spur Environmental Statement, November 2009 [online] Available at: http://www.eon-uk.com/generation/1309.aspx [accessed 26/03/2013.

SEA Topic Areas	Wind technologies with gravity-base foundation devices	Wind technologies with monopile or multi-pile foundation devices	Wind technologies with tripod or steel jacket foundation devices	Wind technologies with mono or multi-caisson foundation devices	Floating wind turbines
	Sourcing of fill or dredged material for gravity foundations, and potential impacts of taking fill from other areas. If terrestrial fill or dredged material is used, potential impacts at the source may include: loss of substrata or habitat if taken from suitable undisturbed areas; Potential for release of contaminated materials bonded to dredged sediments; potential for cross-contamination from source areas to windfarm site, particularly if sourced from shipping lanes or harbours; potential impacts on hydrodynamics and water flows at the source location from the removal of sediments; reduced water quality and increased turbidity from sediment disturbance during dredging operations; and potential impacts for marine fauna and flora, including the disturbance and physical injury risk from dredging operations. If material is sourced from the terrestrial environment it will have effects associated with the removal of material and its transportation.			preparation works are likely to be permanent.	
Historic Environment[7]	Summary of key potential effects on marine and coastal historic environment include: • Direct disturbance, damage, or destruction of submarine archaeological remains and wrecks during device installation and cable trenching. • Direct disturbance, damage or destruction of coastal archaeological remains during cable trenching (effects of grid connections are considered separately below). • Disturbance, damage or loss of archaeological remains and sites during installation of cables and overhead lines and substation construction from onshore grid connections. Key measures to prevent adverse effects may include: avoid sites of interest and exclusion zones for protected sites; follow Crown Estates 2007 JNAPC Code of Practice for seabed developers; carry out seabed surveys and walkover surveys prior to installation; carry out detailed routing studies at project level in accordance with 'Holford Rules' best practice guidance on routeing overhead transmission lines.				
	Potential for placement of gravity-based foundations and scour protection on known and designated historic sites and their exclusion zones, WHS, coastal listed buildings such as lighthouses, scheduled monuments and other unknown, submerged or non-designated archaeological assets features or paleo-landscapes to create adverse impacts. The potential scouring, siltation and deposition around these important sites located in the vicinity of such devices or arrays may also occur. However, adverse effects are likely to be avoided through careful siting of individual device foundations and arrays,	Potential for piling operations on or close to known and designated historic sites and their exclusion zones, WHS, coastal listed buildings such as lighthouses, scheduled monuments and other unknown, submerged or non-designated archaeological assets features or paleo-landscapes to create adverse impacts. Adverse effects are likely to be avoided through careful siting of device monopiles and arrays.	Potential for piling operations on or close to known and designated historic sites and their exclusion zones, WHS, coastal listed buildings such as lighthouses, scheduled monuments and other unknown, submerged or non-designated archaeological assets features or paleo-landscapes to create adverse impacts. Adverse effects are likely to be avoided through careful siting of device piles and arrays.	Potential for placement of foundations and caisson structures directly on the seabed in the vicinity of known and designated historic sites and their exclusion zones, WHS, coastal listed buildings such as lighthouses, scheduled monuments and other unknown, submerged or non-designated archaeological assets features or paleo-landscapes to create adverse impacts. The potential scouring, siltation and deposition around these important sites located in the vicinity of such devices or arrays may also occur. However, adverse effects are likely to be avoided through careful siting of	Potential for placement of concrete gravity anchors directly on the seabed, and installation of mooring lines in the vicinity of known and designated historic sites and their exclusion zones, WHS, coastal listed buildings such as lighthouses, scheduled monuments and other unknown, submerged or non-designated archaeological assets features or paleo-landscapes to create adverse impacts. The potential scouring, siltation and deposition around these important sites located in the vicinity of such anchors may also occur. However, adverse effects are likely to

[7] Informed by: Fjordr Marine and Historic Environment Consulting (2013) Historic Environment Guidance for Wave and Tidal Energy (*Draft*) [online] Available at: www.fjordr.com/uploads/3/0/0/2/3002891/historic_environment_guidance_for_wave_and_tidal_energy_-_consultation_draft_150213.pdf [accessed 03/04/2013]; Halcrow (2007) The Plan for Offshore Wind Energy in Scottish Territorial Waters, Environmental Report: Volume 1, Prepared for the Scottish Executive [online] Available at: http://www.scotland.gov.uk/Resource/Doc/312161/0098588.pdf [accessed 27/03/2013]; Talisman Energy (UK) LTD (2005) Environmental Statement [online] Available at: http://www.beatricewind.co.uk/downloads/statement.asp [accessed 25/03/2013]; EMU (2012) Neart na Gaoithe Offshore Wind Farm Environmental Statement, Prepared for Mainstream Renewable Power [online] Available at: http://mainstream-downloads.opendebate.co.uk/downloads/Contents-Pages.pdf [accessed 25/03/2013]; Aberdeen Wind Offshore Wind Farm Limited (2011) European Offshore Wind Deployment Centre: Non-Technical Summary, July 2011 [online] Available at: http://www.vattenfall.co.uk/en/file/EOWDC-consent-vol1.pdf_18476566.pdf [accessed 26/03/2013]; E-on (2008) Offshore Environmental Statement, April 2008 [online] Available at: http://www.eon-uk.com/generation/1309.aspx [accessed 26/03/2013]; E-on (2008) Onshore Cable Route Environmental Statement, April 2008 [online] Available at: http://www.eon-uk.com/generation/1309.aspx [accessed 26/03/2013]; and E-on (2009) Onshore Substation and Cable Spur Environmental Statement, November 2009 [online] Available at: http://www.eon-uk.com/generation/1309.aspx [accessed 26/03/201]3.

<table>
<tr><th>SEA Topic Areas</th><th>Wind technologies with gravity-base foundation devices</th><th>Wind technologies with monopile or multi-pile foundation devices</th><th>Wind technologies with tripod or steel jacket foundation devices</th><th>Wind technologies with mono or multi-caisson foundation devices</th><th>Floating wind turbines</th></tr>
<tr><td></td><td>although this may be more difficult for larger gravity bases or arrays of bases.</td><td></td><td></td><td>individual device foundations and arrays, although this may be more difficult for larger gravity bases or arrays of bases.</td><td>be avoided through careful siting of these anchors and installation of mooring cables.</td></tr>
<tr><td rowspan="2">Landscape/ Seascape[8]</td><td colspan="5">Summary of key potential effects on land/seascape include:
• Devices likely to be visible at distances of 26 miles (42 km) in daytime and 24 miles (39 km) in night-time views.
• Devices may be a focus of visual attention at distances of up to 10 miles (16 km).
• Landscape and visual intrusion from offshore turbine devices, and onshore substations, overhead lines and grid connections.
Key measures to prevent adverse effects may include: maximising the distance of devices from shore; reducing the height of devices above the water surface; reducing the area of sea occupied by the devices; and modifying the position and layout of devices to suit characteristics of the local seascape; carry out detailed routing studies at project level in accordance with 'Holford Rules' best practice guidance on routeing overhead transmission lines; provide screening for substations.</td></tr>
<tr><td>Potential for turbines and supporting infrastructure (i.e. additional platforms, construction, maintenance or decommissioning vessels and equipment) to adversely impact on valued receptors (i.e. designated or valued landscapes/seascapes). In general, greater impacts are likely for near-shore devices than those located further offshore.
Field observations of offshore wind facilities in the United Kingdom revealed that the facilities may be visible at distances of 26 miles (42 km) in daytime and 24 miles (39 km) in night-time views. They may be a focus of visual attention at distances of up to 10 miles (16 km).
Potential onshore impacts from supporting grid infrastructure and interconnectors with terrestrial grid, although these will likely depend on siting and surroundings (i.e. proximity to valued or sensitive landscapes/seascapes).
The potential for landscape impacts at the source of excavated terrestrial fill material, or from dredging areas for use as ballast in gravity-based foundations has also been identified.</td><td>Potential for turbines and supporting infrastructure (i.e. additional platforms, construction, maintenance or decommissioning vessels and equipment) to adversely impact on valued receptors (i.e. designated or valued landscapes/seascapes). In general, greater impacts are likely for near-shore devices than those located further offshore.
Field observations of offshore wind facilities in the United Kingdom revealed that the facilities may be visible at distances of 26 miles (42 km) in daytime and 24 miles (39 km) in night-time views. They may be a focus of visual attention at distances of up to 10 miles (16 km).
Potential onshore impacts from supporting grid infrastructure and interconnectors with terrestrial grid, although these will likely depend on siting and surroundings (i.e. proximity to valued or sensitive landscapes/seascapes).</td><td>Potential for turbines and supporting infrastructure (i.e. additional platforms, construction, maintenance or decommissioning vessels and equipment) to adversely impact on valued receptors (i.e. designated or valued landscapes/seascapes). In general, greater impacts are likely for near-shore devices than those located further offshore.
Field observations of offshore wind facilities in the United Kingdom revealed that the facilities may be visible at distances of 26 miles (42 km) in daytime and 24 miles (39 km) in night-time views. They may be a focus of visual attention at distances of up to 10 miles (16 km).
Potential onshore impacts from supporting grid infrastructure and interconnectors with terrestrial grid, although these will likely depend on siting and surroundings (i.e. proximity to valued or sensitive landscapes/seascapes).</td><td>Potential for turbines and supporting infrastructure (i.e. additional platforms, construction, maintenance or decommissioning vessels and equipment) to adversely impact on valued receptors (i.e. designated or valued landscapes/seascapes). In general, greater impacts are likely for near-shore devices than those located further offshore.
Field observations of offshore wind facilities in the United Kingdom revealed that the facilities may be visible at distances of 26 miles (42 km) in daytime and 24 miles (39 km) in night-time views. They may be a focus of visual attention at distances of up to 10 miles (16 km).
Potential onshore impacts from supporting grid infrastructure and interconnectors with terrestrial grid, although these will likely depend on siting and surroundings (i.e. proximity to valued or sensitive landscapes/seascapes).</td><td>Potential for turbines and supporting infrastructure (i.e. additional platforms, construction, maintenance or decommissioning vessels and equipment) to adversely impact on valued receptors (i.e. designated or valued landscapes/seascapes). In general, greater impacts are likely for near-shore devices than those located further offshore.
Field observations of offshore wind facilities in the United Kingdom revealed that the facilities may be visible at distances of 26 miles (42 km) in daytime and 24 miles (39 km) in night-time views. They may be a focus of visual attention at distances of up to 10 miles (16 km).
Potential onshore impacts from supporting grid infrastructure and interconnectors with terrestrial grid, although these will likely depend on siting and surroundings (i.e. proximity to valued or sensitive landscapes/seascapes).</td></tr>
</table>

[8] Informed by: OSPAR Commission (2004) Biodiversity Series: Environmental Impacts to marine species and habitats of dredging for navigational purposes [online] Available at: http://www.ospar.org/documents/dbase/publications/p00208_environmental%20impacts%20to%20marine%20species.pdf [accessed 28/03/2013]; Halcrow (2007) The Plan for Offshore Wind Energy in Scottish Territorial Waters, Environmental Report: Volume 1, Prepared for the Scottish Executive [online] Available at: http://www.scotland.gov.uk/Resource/Doc/312161/0098588.pdf [accessed 27/03/2013]; Talisman Energy (UK) LTD (2005) Environmental Statement [online] Available at: http://www.beatricewind.co.uk/downloads/statement.asp [accessed 25/03/2013]; EMU (2012) Neart na Gaoithe Offshore Wind Farm Environmental Statement, Prepared for Mainstream Renewable Power [online] Available at: http://mainstream-downloads.opendebate.co.uk/downloads/Contents-Pages.pdf [accessed 25/03/2013]; Aberdeen Wind Offshore Wind Farm Limited (2011) European Offshore Wind Deployment Centre: Non-Technical Summary, July 2011 [online] Available at: http://www.vattenfall.co.uk/en/file/EOWDC-consent-vol1.pdf_18476566.pdf [accessed 26/03/2013]; E-on (2008) Offshore Environmental Statement, April 2008 [online] Available at: http://www.eon-uk.com/generation/1309.aspx [accessed 26/03/2013]; E-on (2008) Onshore Cable Route Environmental Statement, April 2008 [online] Available at: http://www.eon-uk.com/generation/1309.aspx [accessed 26/03/2013]; and E-on (2009) Onshore Substation and Cable Spur Environmental Statement, November 2009 [online] Available at: http://www.eon-uk.com/generation/1309.aspx [accessed 26/03/2013].

2 Wave technology

SEA Topic Areas	Point Absorbers and Rotating Mass Devices	Attenuators and Bulge Wave Devices	Oscillating Wave Surge Converters	Submerged Pressure Differential	Oscillating Water Column (Offshore and Shoreline)	Overtopping Device (Offshore and Shoreline)
Device Information[9]	• Consist of floating structures that absorb energy in all directions through their movements at the water surface, or by device rotation created by wave movements. • Are located at the water surface with above water or near surface components (i.e. the spar and float that houses generation equipment). • Are likely to be anchored and moored to the seabed (i.e. embedded, gravity/deadweight or rock anchors) with mooring lines spanning the full depth of the water column. • Marker buoys and lighting are likely to be used for offshore awareness and navigation.	• Consists of elongated devices floating on the water surface with associated support structures or moorings. • Consist of large elongated structures made up of several floating parts with moving joints (e.g. Attenuators such as Pelamis) or flexible devices floating on the water surface (e.g. Bulge wave devices). • The device(s) floating on the surface, typically staggered in rows, and likely have a shallow draft. • Likely to be moored by anchors on the seabed (i.e. embedded, gravity/ deadweight or rock) and have associated mooring lines spanning the full depth of the water column. Support structures may also be present. • Marker buoys and lighting are likely to be used for offshore awareness and navigation.	• Consists of a surface or near-surface paddle device, mounted on a fixed base on the seabed, oscillating with passing waves (e.g. Oyster devices). • Is likely to be fixed to seabed with a gravity base (i.e. rock anchors/pins). • Energy generation equipment (i.e. pistons and joints) are located within the water column. • There is the possibility that the device will also involve pipelines to shore for pumping water. • Marker buoys and lighting are likely to be used for offshore awareness and navigation.	• Consists of near-surface but submerged device located offshore and fixed to the seabed. • The device floats within the water column, moving up and down with wave systems. • Is likely to be mounted on a fixed gravity base on the seabed attached by gravity or other means (i.e. rock anchors/pins, etc.) • Marker buoys are likely to be used for offshore awareness and navigation.	• Consists of a partially submerged hollow structure located offshore, or as a shoreline-based structure. • Offshore devices are likely to be moored by anchors (gravity, deadweight or embedded) with associated mooring lines present in the full depth of the water column. • Energy generation equipment is housed above the water surface in the floating component (offshore) or housed within an onshore structure (shoreline). • Marker buoys and lighting are likely to be used for offshore awareness and navigation.	• Consists of a floating structure with large catchment area (offshore) or located onshore at the shoreline, typically with a breakwater (shoreline). • Offshore devices are positively buoyant and are likely to be moored by anchors with mooring lines. • Energy generation equipment is housed above the water surface in the floating component of the device (offshore) or housed within an onshore structure (shoreline). • Marker buoys and lighting is likely to be used for offshore awareness and navigation.
Biodiversity/ flora/fauna[10]	Summary of key potential effects: • Physical disturbance during device installation. • Noise during construction (particularly piling) and from device operation. • Risk of bird collision with operating devices (e.g. migration). • Accidental contamination from device failures, vessel collisions and storm damage. • Habitat exclusion and species displacement due to device presence and operation. • Barriers to movement – due to avoidance reactions to noise and risk of collision. • Increased suspended sediment/turbidity from seabed disturbance during device installation and cable trenching. • Smothering from seabed disturbance during device installation and cable trenching. • Changes in tidal flow and wave regime due to device presence and operation. • Substratum loss, caused by attaching devices to the seabed. • Habitat and species loss/disturbance during installation of cables and overhead lines and substation construction from onshore grid connections Key measures to prevent adverse effects may include: avoidance of sensitive sites; avoidance of sensitive seasons (e.g. breeding) during installation; use of devices with attachments that cause smaller seabed					

[9] Aquatera (2012) A review of the Potential Impacts of Wave and Tidal Energy development on Scotland's Marine Environment, Prepared for Marine Scotland, Final Report Issued 9 March 2012.
[10] Informed by: McCluskie, A.E., Langston R.H.W. and Wilkinson N.I. (undated) Birds and wave & tidal stream energy: an ecological review, RSPB Research Report No. 42 [online] Available at: http://www.rspb.org.uk/Images/mccluskie_langston_wilkinson_2012_tcm9-307966.pdf [accessed 28/03/2013]; Faber Maunsell (2007) Scottish Marine Renewables SEA: Environmental Report, Prepared for the Scottish Executive, March 2007; Aquatera (2012) A review of the Potential Impacts of Wave and Tidal Energy development on Scotland's Marine Environment, Prepared for Marine Scotland, draft Report Issued 9 March 2012; Talisman Energy (UK) LTD (2005) Environmental Statement [online] Available at: http://www.beatricewind.co.uk/downloads/statement.asp [accessed 25/03/2013]; EMU (2012) Neart na Gaoithe Offshore Wind Farm Environmental Statement, Prepared for Mainstream Renewable Power [online] Available at: http://mainstream-downloads.opendebate.co.uk/downloads/Contents-Pages.pdf [accessed 25/03/2013]; Aberdeen Wind Offshore Wind Farm Limited (2011) European Offshore Wind Deployment Centre: Non-Technical Summary, July 2011 [online] Available at: http://www.vattenfall.co.uk/en/file/EOWDC-consent-vol1.pdf_18476566.pdf [accessed 26/03/2013]; E-on (2008) Offshore Environmental Statement, April 2008 [online] Available at: http://www.eon-uk.com/generation/1309.aspx [accessed 26/03/2013]; E-on (2008) Onshore Cable Route Environmental Statement, April 2008 [online] Available at: http://www.eon-uk.com/generation/1309.aspx [accessed 26/03/2013]; and E-on (2009) Onshore Substation and Cable Spur Environmental Statement, November 2009 [online] Available at: http://www.eon-uk.com/generation/1309.aspx [accessed 26/03/2013.

SEA Topic Areas	Point Absorbers and Rotating Mass Devices	Attenuators and Bulge Wave Devices	Oscillating Wave Surge Converters	Submerged Pressure Differential	Oscillating Water Column (Offshore and Shoreline)	Overtopping Device (Offshore and Shoreline)
	disturbance such as anchors and clump weights; protocols (such as use of Marine Mammal Observers) to ensure noisy construction activities do not occur when marine mammals are in close proximity; effective device design; and project-specific studies to help design appropriate mitigation; carry out detailed routeing studies at project level in accordance with 'Holford Rules' best practice guidance on routeing overhead transmission lines.					
	Fauna: *Attraction of Fauna* Bird aggregation utilising above water infrastructure may occur, particularly during calm water periods (if any) and if located in foraging waters. *Noise* Potential for underwater noise impacts on marine fauna, from drilling/installation works (i.e. anchoring works, etc.) or from machinery housing in floating or subsurface structures. As such, there is the potential for behavioural impacts to seals and otters (typically near shoreline), and cetaceans and basking sharks (offshore) possibly avoiding these locations during installation and operation. But there are significant unknowns on disturbance effects as they are likely to be site-specific, and also regarding actual noise levels generated by this technology. In summary, acute effects to these receptors are considered unlikely, with impacts likely to be most significant during piling and drilling activities (if undertaken). The potential for disturbance impacts to marine fauna (i.e. seals, otters) from above surface noise has been identified, particularly during installation works (i.e. machinery, vessels) and where floating device structures house noise-generating equipment (expected to be most devices of these types). This disturbance may be greater for those devices near to the shoreline, however, this will likely be site specific given the significant unknowns on the specific effects of such disturbance and likely receptors. *Shock Waves* There is the potential for shock or pressure waves from large waves	Fauna: *Attraction of Fauna* Bird aggregation utilising above water infrastructure may occur, particularly during calm water periods (if any) and if located in foraging waters. *Noise* Potential for underwater noise impacts on marine fauna, from drilling/installation works (i.e. rock anchors and mooring lines, etc.), from machinery housing in floating structures, structures on the seabed, and from anchors and mooring lines. As such, there is the potential for behavioural impacts to seals and otters (typically near shoreline), and cetaceans and basking sharks (offshore) possibly avoiding these locations during installation and operation. But there are significant unknowns on disturbance effects as they are likely to be site-specific, and also regarding actual noise levels generated by this technology. In summary, acute effects to these receptors are considered unlikely, with impacts likely to be most significant during piling and drilling activities (if undertaken). The potential for disturbance impacts to marine fauna (i.e. seals, otters) from above surface noise has been identified, particularly during installation works (i.e. machinery, vessels) and where floating device structures house noise-generating equipment (expected to be most devices of this type). This disturbance may be greater for those devices near to the shoreline, however, this will likely be site specific given the significant unknowns on the specific effects of such disturbance and likely receptors. *EMF*	Fauna: *Noise* Potential for underwater noise and vibration impacts on marine fauna, from drilling/installation works (i.e. anchoring works, etc.) or from machinery housing in subsurface structures. The potential for behavioural impacts to seals and otters (typically near shoreline), and cetaceans and basking sharks (offshore) with the likelihood of small-scale avoidance during operation. But there are significant unknowns on disturbance effects (likely site-specific), and noise levels that are actually generated. Acute effects are considered unlikely. Impacts are likely to be most significant during piling and drilling activities. While no surface noise is likely, the potential for impacts from above surface noise was identified during installation works (i.e. installation machinery, vessels). However, this is likely to be temporary and there are significant unknowns on disturbance effects of this nature as they are likely to be site-specific. *EMF* While no EMF impacts have been identified from the devices, there is the potential for EMF impacts from underwater cabling and grid connections. Further information is required to determine the potential susceptibility of marine fauna and likely effects associated with this issue. *Physical Barrier* The physical presence of these devices in the water column and mounted on the seabed may disrupt movements or migration of marine fauna. There are unknowns over known	Fauna: *Noise* Potential for underwater noise impacts on marine fauna, from drilling/installation works (i.e. anchoring works, etc.) or from machinery housing in subsurface devices. The potential for behavioural impacts to seals and otters (typically near shoreline), and cetaceans and basking sharks (offshore) with small-scale avoidance during operation. But there are significant unknowns on disturbance effects (likely site-specific), and noise levels that are actually generated. Acute effects are considered unlikely. Impacts are likely to be most significant during piling and drilling activities. The potential for impacts from above surface noise was identified during installation works (i.e. installation machinery, vessels). There are significant unknowns on disturbance effects of this nature as they are likely to be site-specific. *EMF* While no EMF impacts have been identified from the devices, there is the potential for EMF impacts from underwater cabling and grid connections. Further information is required to determine the potential susceptibility of marine fauna and likely effects associated with this issue. *Physical Barrier* The physical presence of device components in the water column and connection to seabed-based support structures may disrupt movements or migration of marine fauna. However, there are unknowns over known movements and migration routes	Fauna: *Attraction of Fauna* Bird aggregation utilising above water infrastructure may occur, particularly during calm water periods (if any) and if located in foraging waters. *Noise* There is the potential for underwater noise impacts on marine fauna, from drilling/installation works (i.e. anchoring works, etc.) and from machinery housing in floating or subsurface structures (for offshore devices only). This may also be a potential issue with installation works and the housing of noise generating equipment at shoreline devices as well. This could result in behavioural impacts to seals and otters (typically near shoreline), and cetaceans and basking sharks (offshore) with the likelihood of avoidance during installation and operation. But there are significant unknowns on disturbance effects (likely site-specific), and noise levels that are actually generated by these devices. Acute effects to fauna are considered unlikely, and impacts are considered likely to be most significant during piling and drilling activities. The potential for disturbance impacts to marine fauna (i.e. seals, otters) from above surface noise has been identified during maintenance and installation works (i.e. machinery, vessels). *Shock Waves* Potential for shock or pressure waves from large waves hitting the side of surface-piercing structures with high profiles above the water surface (offshore devices only). The magnitude of any impacts and their effects on these species is not currently known, although the potential for adverse impacts to	Fauna: *Attraction of Fauna* Bird aggregation utilising above water infrastructure may occur, particularly during calm water periods (if any) and if located in foraging waters. *Noise* Potential for underwater noise impacts on marine fauna, from drilling/installation works (i.e. anchoring works, etc.) or from machinery housing in floating or subsurface structures associated with offshore devices. This may also occur with installation works at the shoreline as well, although noise from equipment housed onshore is unlikely as these devices are likely to be located in areas with high background noise (i.e. the shoreline, waves breaking, etc.). There is the potential for behavioural impacts to seals and otters (typically in near-shore areas), and cetaceans and basking sharks (offshore) with the potential for some small-scale avoidance during installation and/or operation (offshore). However, there are significant unknowns on disturbance effects (likely to be site-specific), and on the noise levels that are actually generated. Acute effects are considered unlikely. Impacts are likely to be most significant during piling and drilling activities. The potential for disturbance impacts to marine fauna (i.e. seals, otters) from above surface noise has been identified, particularly during installation works (i.e. machinery, vessels) and where floating device structures house noise-generating equipment. This disturbance may be greater for those devices at or near the

SEA Topic Areas	Point Absorbers and Rotating Mass Devices	Attenuators and Bulge Wave Devices	Oscillating Wave Surge Converters	Submerged Pressure Differential	Oscillating Water Column (Offshore and Shoreline)	Overtopping Device (Offshore and Shoreline)
	hitting the side of surface-piercing structures with high profiles above the water surface. The magnitude of any impacts and their effects on these species is not yet known, although the potential for impacts to seals, cetaceans, otter and basking shark has been identified. *EMF* While no EMF impacts have been identified from the devices, there is the potential for EMF impacts from underwater cabling and grid connections. Further information is required to determine the potential susceptibility of marine fauna and likely effects associated with this issue. *Physical Barrier* The physical presence of new structures in the water column may disrupt movements or migration of marine fauna, particularly for groups of devices. Given the mobility of these species, any impacts are likely to be site specific. There are unknowns over movements and migration routes (i.e. basking sharks), patterns of movement of other species (i.e. seals, otters), and also over whether these devices and their moorings will be perceived by fauna, and if they will simply alter their movement accordingly. It is noted that near-shore devices may restrict movement more than offshore (e.g. potentially greater alternatives for movement around devices offshore). The potential for collisions between marine fauna and these devices and their moorings has been identified, particularly for those with moving parts. However, this will be largely dependent on the size and design of the device, the location of the device (i.e. proximity to seal haul out zones, etc.) and the response of the marine fauna involved. Avoidance is likely for many species (i.e. fish), but impact could also be fatal in some instances if it were to occur (i.e. seals, otters,	While no EMF impacts have been identified from the devices, there is the potential for EMF impacts from underwater cabling and grid connections. Further information is required to determine the potential susceptibility of marine fauna and likely effects associated with this issue. *Physical Barrier* The physical presence of new structures in the water column may disrupt movements or migration of marine fauna, particularly for groups of devices. Given the mobility of these species, any impacts are likely to be site specific. There are unknowns over movements and migration routes (i.e. basking sharks), patterns of movement of other species (i.e. seals, otters), and also over whether these devices and their supporting infrastructure (i.e. structures, moorings) will be perceived by fauna, and if they will simply alter their movement accordingly. It is noted that near-shore devices may restrict movement more than offshore (e.g. potentially greater alternatives for movement around devices offshore). The potential for collisions between marine fauna and these devices and their moorings has been identified, particularly for those with moving parts, and those with large footprints (i.e. Pelamis, Bulge wave devices). However, this will be largely dependent on the actual size and design of the device, the location of the device (i.e. proximity to seal haul out zones, etc.) and the response of the marine fauna involved. Avoidance is likely for many species (i.e. fish), but impact could also be fatal in some instances if it were to occur (i.e. seals, otters, cetaceans, basking shark). Collision with or entanglement in mooring lines associated with offshore devices is considered possible, particularly for larger	movements and migration routes (i.e. basking sharks), patterns of movement of other species (i.e. seals, otters), whether the devices will be perceived or if they will simply alter their movement accordingly. Near-shore devices may restrict movement more than offshore (e.g. potentially greater alternatives for movement around devices offshore). Potential for collisions for marine fauna with devices and support structures, although this will be largely dependent on the size and design of the device, the location of the device (i.e. proximity to seal haul out zones, etc.) and the response of the animal. Avoidance is likely for many species (i.e. fish), but impact could be fatal in some instances if it were to occur (i.e. seals, otters, cetaceans, basking shark). Collision with or entrapment in device arrays may be possible, particularly for larger species (i.e. cetaceans and basking sharks) with particular focus on complex arrays or groups of devices. However, whether this could occur is uncertain and while it may result in injury or fatality, it is considered unlikely. *Displacement* In general terms, the potential displacement of species from the presence of these devices and support structures, disturbance during installation, operation or decommissioning (i.e. noise, turbulence, vibration, displacement of prey, etc.) is likely to be site-specific and would depend on a range of other factors (suitable alternative sites, importance of habitat, etc.). It will also depend on what activities are being displaced and their importance (e.g. Basking sharks avoiding of structures or installation/servicing vessel	(i.e. basking sharks), patterns of movement of other species (i.e. seals, otters), whether moorings and devices will be perceived or if they will simply alter their movement accordingly. Near-shore devices (if used) may restrict movement more than offshore (e.g. potentially greater alternatives for movement around devices offshore). Potential for collisions for marine fauna with devices, particularly as they will move within the water column, although this will be largely dependent on the size and design of the device, the location of the device (i.e. proximity to seal haul out zones, etc.) and the response of the animal. Avoidance is likely for many species (i.e. fish), but impact could be fatal in some instances if it were to occur (i.e. seals, otters, cetaceans, basking shark). Collision with or entanglement in mooring lines associated with these devices is considered possible, particularly for larger species (i.e. cetaceans and basking sharks) with particular focus on complex arrays with groups of devices each with several mooring lines. However, whether this could occur is unknown, and while it may result in injury or fatality, it is considered unlikely. *Displacement* In general terms, the potential displacement of species from the presence of devices or associated structures, disturbance during installation, operation or decommissioning (i.e. noise, turbulence, vibration, displacement of prey, etc.) is likely to be site-specific and would depend on a range of other factors (suitable alternative sites, importance of habitat, etc.). Will also depend on what activities are being displaced and their importance (e.g. Basking sharks avoiding of	seals, cetaceans, otter and basking shark has been identified. *EMF* While no EMF impacts have been identified from the devices, there is the potential for EMF impacts from underwater cabling and grid connections. Further information is required to determine the potential susceptibility of marine fauna and likely effects associated with this issue. *Physical Barrier* Introduction of new structures at, or close to, the shoreline could disrupt routes to/from feeding grounds. Similarly, the physical presence of new structures in the upper water column may disrupt movements or migration of marine fauna. Unknowns over movements and migration routes (i.e. basking sharks), patterns of movement of other species (i.e. seals, otters), whether any moorings or device components will be perceived or if fauna will simply alter their movement accordingly around them. Shoreline devices may restrict movement for seals, otters and other land-based fauna more than offshore (e.g. potentially greater alternatives for movement around devices offshore, placement of devices in shoreline habitats, etc.). The potential for collisions for marine fauna with devices and their moorings may exist, although this will be largely dependent on the size and design of the device (i.e. perceptibility), the location of the device (i.e. proximity to seal haul out zones, etc.) and the response of the animal. Avoidance is likely for some species, but any impact could be fatal in some instances if it were to occur (i.e. seals, otters, cetaceans, basking shark). Collision with or entanglement in mooring lines associated with offshore devices is considered possible, particularly for larger species (i.e. minke whales which	shoreline, however, there are also significant unknowns on the specific effects of this disturbance given that they are likely to be site-specific. *EMF* While no EMF impacts have been identified from the devices, there is the potential for EMF impacts from underwater cabling and grid connections. Further information is required to determine the potential susceptibility of marine fauna and likely effects associated with this issue. *Physical Barrier* The introduction of new structures at, or close to, the shoreline could disrupt routes to/from feeding grounds. Similarly, the physical presence of new structures in the upper water column may disrupt movements or migration of marine fauna. Unknowns over movements and migration routes (i.e. basking sharks), patterns of movement of other species (i.e. seals, otters), whether moorings and devices will be perceived or if they will simply alter their movement accordingly around offshore devices. Near-shore or shoreline devices may restrict movement for seals, otters and other land-based fauna more than offshore (e.g. potentially greater alternatives for movement around devices offshore, shoreline habitats). The potential for collisions for marine fauna with devices and moorings may exist, although this will be largely dependent on the size and design of the device (i.e. perceptibility), the location of the device (i.e. proximity to seal haul out zones, etc.) and the response of the animal. The potential for injury to species "captured" within the device basin has been identified, and any such impacts from machinery within the device (i.e. turbines, etc.) could be fatal if it

SEA Topic Areas	Point Absorbers and Rotating Mass Devices	Attenuators and Bulge Wave Devices	Oscillating Wave Surge Converters	Submerged Pressure Differential	Oscillating Water Column (Offshore and Shoreline)	Overtopping Device (Offshore and Shoreline)
	cetaceans, basking shark). Collision with or entanglement in mooring lines associated with offshore devices is considered possible, particularly for larger species (i.e. minke whales which are more prone to entanglement than other ondontocetes/toothed whales) with a particular focus on complex arrays of devices and their multiple mooring lines (e.g. likely 3-point mooring systems). However, whether this is significant is not presently known, although it is noted that if it did occur, it may result in serious injury or fatality. *Displacement* In general terms, the potential displacement of species from the presence of devices or associated structures, disturbance during installation, operation or decommissioning (i.e. noise, turbulence, vibration, displacement of prey, etc.) is likely to be site-specific and would likely depend on a range of other factors (suitable alternative sites, importance of habitat, etc.). Any impacts would also likely depend on what activities are being displaced and their importance (e.g. Basking sharks avoiding of structures or installation/servicing vessel activities may lead to the displacement of foraging activities or courtship behaviour).	species (i.e. minke whales which are more prone to entanglement than other ondontocetes/toothed whales) with a particular focus on complex arrays of devices and their multiple mooring lines (e.g. likely multiple point mooring systems). However, whether this is significant is not presently known, although it is noted that if it did occur, it may result in serious injury or fatality. *Displacement* In general terms, the potential displacement of species from the presence of devices or associated structures, disturbance during installation, operation or decommissioning (i.e. noise, turbulence, vibration, displacement of prey, etc.) is likely to be site-specific and would likely depend on a range of other factors (suitable alternative sites, importance of habitat, etc.). Any impacts would also likely depend on what activities are being displaced and their importance (e.g. Basking sharks avoiding of structures or installation/servicing vessel activities may lead to the displacement of foraging activities or courtship behaviour).	activities may lead to the displacement of foraging activities or courtship behaviour). In placement of these devices on the seabed, or on supports placed on the seabed, some loss of benthic habitat will occur.	structures or installation/servicing vessel activities may lead to the displacement of foraging activities or courtship behaviour). In placement of support structures for these devices on the seabed, some loss of benthic habitat will occur.	are more prone to entanglement than other ondontocetes/toothed whales) and larger devices with several mooring lines. The potential for entrapment of marine fauna within the chamber/reservoir of devices such as the water column device (likely offshore for larger fauna, shoreline for smaller marine fauna) may also exist. However, whether either could actually occur and its significance is unknown. It is noted that while it may result in injury or fatality, such occurrences are considered unlikely. *Displacement* The potential displacement of shoreline habitats with the installation of shoreline devices (i.e. device footprint and infrastructure) will likely lead to displacement of fauna, particularly seals, otters, birds, etc. In most cases, the impact of this is likely to be site-specific and dependant on the availability of alternative habitats, siting options, activities displaced (i.e. haul out, breeding areas), etc. In general terms, the potential displacement of species due to the presence of offshore devices or associated structures, disturbance during installation, operation or decommissioning (i.e. noise, turbulence, vibration, displacement of prey, etc.) is likely to be site-specific and would depend on a range of other factors (suitable alternative sites, importance of habitat, etc.). This will also likely depend on what activities are being displaced and their importance (e.g. Basking sharks avoiding of structures or installation/servicing vessel activities may lead to the displacement of foraging activities or courtship behaviour).	were to occur (i.e. seals, otters, cetaceans, basking shark). Collision with or entanglement in mooring lines associated with offshore devices is considered possible, particularly for larger species (i.e. minke whales which are more prone to entanglement than other ondontocetes/toothed whales) and larger devices equipped with several mooring lines. The potential for entrapment of marine fauna within the chamber reservoir of these devices (likely offshore for larger fauna, shoreline for smaller marine fauna) has also been identified and may also exist and could potentially be fatal if it did occur. However, whether either could actually occur is unknown, and such occurrences are considered unlikely. *Displacement* The potential displacement of shoreline habitats with the installation of shoreline devices (i.e. device footprint and infrastructure) may lead to displacement of fauna, particularly seals, otters, birds, etc. In most cases, the impact of this is likely to be site-specific and dependant on the availability of alternative habitats, siting options, activities displaced (i.e. haul out, breeding areas), etc. In general terms, the potential displacement of species from the presence of devices or associated structures, disturbance during installation, operation or decommissioning (i.e. noise, turbulence, vibration, displacement of prey, etc.) is likely to be site-specific and would depend on a range of other factors (suitable alternative sites, importance of habitat, etc.). This is also likely to depend on what activities are being displaced and their importance (e.g. Basking sharks avoiding of structures or installation/servicing vessel

SEA Topic Areas	Point Absorbers and Rotating Mass Devices	Attenuators and Bulge Wave Devices	Oscillating Wave Surge Converters	Submerged Pressure Differential	Oscillating Water Column (Offshore and Shoreline)	Overtopping Device (Offshore and Shoreline)
						activities may lead to the displacement of foraging activities or courtship behaviour).
	Birds: *Collision* No collision risk identified in relation to wave devices for diving birds. The potential may exist for the aggregation of some seabirds on the top of surface-piercing devices (e.g. Penguin), particularly during calmer conditions. *Noise* Potential risk of underwater noise during installation, operation and decommissioning works of offshore devices has been identified. Increased noise levels are likely in drilling activities and installation of rock anchors if used. However, there are significant unknowns around the magnitude the impacts from installation and operation of these devices on diving bird populations, although it could potentially be damaging and create sufficient disturbance for displacement. Potential for noise impacts from generators and machinery located above the water surface. While high energy environments are likely to have high levels of background noise, this could create disturbances if located near coastal breeding sites. Noise within devices is likely to be low and constant and the effects are unknown, as effects of increased/altered noise levels are not known for birds at present (displacement/avoidance, impacts to foraging success, etc.). It is noted that the levels of underwater noise from the presence and operation of this device in offshore areas, is not currently known. Further the importance of hearing underwater for birds, threshold levels and the likelihood of any impacts are also unknown. Potential impacts may include displacement, avoidance, reduction in foraging success, no	Birds: *Collision* As a water surface type device, no collision risk identified in relation to wave devices for diving birds. The potential may exist for the aggregation of some seabirds on the top of surface-piercing devices, particularly during calmer conditions. *Noise* Potential risk of underwater noise during installation, operation and decommissioning works of offshore devices has been identified. Increased noise levels are likely in drilling activities and installation of rock anchors if used. However, there are significant unknowns around the magnitude the impacts from installation and operation of these devices on diving bird populations, although it could potentially be damaging and create sufficient disturbance for displacement. There is the potential for noise impacts from generators and machinery located above the water surface. While high energy environments are likely to have high levels of background noise, this could create disturbances if located near coastal breeding sites or in foraging sites located offshore. Noise within devices is likely to be low and constant and the specific effects are unknown at present, particularly the effects of increased/altered noise levels are not known for birds at present (displacement/avoidance, impacts to foraging success, etc.). It is noted that the levels of underwater noise from the presence and operation of this device in offshore areas, is not currently known. Further the importance of hearing underwater for birds, threshold levels and the likelihood of any impacts are also	Birds: *Collision* No collision risk identified in relation to wave devices for diving birds. The potential may exist for the aggregation of some seabirds on the top of surface-piercing devices, particularly during calmer conditions. *Turbulence and impacts on foraging* Localised changes in turbulence in the water column from the presence and operation of groups of these devices may have the potential to affect the foraging success of marine birds. However, the extent and nature of any potential effects is not currently known and may be difficult to identify a causal link between the two. *Noise* Potential risk of underwater noise during installation, operation and decommissioning works of offshore devices has been identified. Increased noise levels are likely in drilling activities and installation of rock anchors if used for the support structures. However, there are significant unknowns around the magnitude the impacts from installation and operation of these devices on diving bird populations, although it could potentially be damaging and create sufficient disturbance for displacement. There is the potential for noise impacts from generators and machinery located above the water surface. While high energy environments are likely to have high levels of background noise, this could create disturbances if located near coastal breeding sites. However, any noise within devices is likely to be low and	Birds: *Collision* No collision risk identified in relation to wave devices for diving birds. The potential may exist for the aggregation of some seabirds on the top of surface-piercing devices, particularly during calmer conditions. *Turbulence and impacts on foraging* Localised changes in turbulence in the water column from the presence and movement of these devices, and presence of any support structure, may have the potential to affect the foraging success of marine birds. However, the extent and nature of any potential effects is not currently known and may be difficult to identify a causal link between the two. *Noise* Potential risk of underwater noise during installation, operation and decommissioning works of offshore devices has been identified. Increased noise levels are likely in drilling activities and installation of rock anchors if used. It is noted that there are significant unknowns around the magnitude the impacts from installation and operation of these devices on diving bird populations, although it could potentially be damaging and create sufficient disturbance for displacement. The presence of noise-generating components in the device itself may also present the potential for disturbance. However, it is also noted that the levels of underwater noise from the presence and operation of this device in offshore areas, is not currently known. Further the importance of hearing underwater for birds, threshold	Birds: *Collision* As the device is largely located on the water surface, no collision risk identified in relation to wave devices for diving birds. The potential may exist for the aggregation of some seabirds on the top of surface-piercing devices, particularly during calmer conditions. *Noise* Potential risk of underwater noise during installation, operation and decommissioning works of offshore devices has been identified. Increased noise levels are likely in drilling activities and installation of rock anchors (if used). However, there are significant unknowns around the magnitude the impacts from installation and operation of these devices on diving bird populations. It is noted that this could potentially be damaging and create sufficient disturbance for displacement. The potential for above water noise impacts from generators housed within shoreline devices and above the water surface in near-shore devices, may occur for a wide range of bird species and coastal breeding sites. However, the noise generated within these devices is likely to be low level and constant and the high energy environments that are likely to host these wave devices are also likely to have high levels of background noise. In general, the likely effects of increased/altered noise levels are not known for birds at present (displacement/avoidance, impacts to foraging success, etc.). It is noted that the actual levels of underwater noise from the presence and operation of this device in offshore areas, is not	Birds: *Collision* As the device is largely located on the water surface, no collision risk identified in relation to wave devices for diving birds. The potential may exist for the aggregation of some seabirds on the top of surface-piercing devices, particularly during calmer conditions and if fish are captured in the overtopping basin portion of the device. *Noise* Potential risk of underwater noise during installation, operation and decommissioning works of offshore devices has been identified. Increased noise levels are likely in drilling activities and installation of rock anchors for offshore devices (if used). However, there are significant unknowns around the magnitude of the impacts from installation and operation of these devices on diving bird populations. It is noted that this could potentially be damaging and create sufficient disturbance for displacement. The potential for above water noise impacts from generators within shoreline devices and in near-shore devices, may impact on a wide range of bird species and coastal breeding sites if located nearby. However, noise within devices is likely to be low level and constant, and the high energy environments that are likely to host these wave devices are also likely to have high levels of background noise. The likely effects of increased/altered noise levels are not known for birds at present (displacement/avoidance, impacts to foraging success, etc.). It is noted that the levels of

SEA Topic Areas	Point Absorbers and Rotating Mass Devices	Attenuators and Bulge Wave Devices	Oscillating Wave Surge Converters	Submerged Pressure Differential	Oscillating Water Column (Offshore and Shoreline)	Overtopping Device (Offshore and Shoreline)
	effect, etc. *Disturbance and Displacement* Potential for displacement of birds during installation and operation, but this is likely to be dependent on other factors (i.e. sensitivity of habitats, availability of suitable alternative habitats) and may only be temporary (e.g. birds may become accustomed to devices). Likely dependent on site-specific conditions, including the sensitivity of species and the activities displaced (i.e. breeding, foraging, moulting, etc.). Potential for visual disturbance if surface-piercing components are present, with potential for greater impacts if located near-shore and close to coastal breeding and moulting sites, or offshore near foraging areas. However, the likelihood of impacts is presently unknown. In such instances, birds in flight may operate in a broadly similar way and use similar avoidance tactics to those employed when encountering other natural and man-made obstructions (i.e. by taking alternative flight routes, avoiding obstructions to a greater degree at night, etc.). *Predation* The 2007 Marine Renewables SEA raised the potential risk of increased mink colonisation of offshore islands due to the creation of islet chains between Scotland's western isles from the placement of devices with surface structures. Impacts such as increased predation on ground-nesting birds were identified. However, it is noted that there is no documented evidence indicating the likelihood of this occurring.	unknown. Potential impacts may include displacement, avoidance, reduction in foraging success, no effect, etc. *Disturbance and Displacement* Potential for displacement during installation and operation, but dependant on other factors (i.e. sensitivity of habitats, availability of suitable alternative habitats) and may only be temporary as fauna become accustomed to the devices. They are likely to be dependent on site-specific including the sensitivity of species and the activities displaced (i.e. breeding, foraging, moulting, etc.). Potential for visual disturbance if surface-piercing components are present, with potential for greater impacts if close to coastal breeding and moulting sites, or offshore near foraging areas. The likelihood of impacts is unknown. In such instances, birds may operate in a broadly similar way and use similar avoidance tactics to those employed when encountering other natural and man-made obstructions (i.e. by taking alternative flight routes, avoiding obstructions to a greater degree at night). *Predation* The 2007 Marine Renewables SEA raised the potential risk of increased mink colonisation of offshore islands due to the creation of islet chains between Scotland's western isles from the placement of devices with surface structures. Impacts such as increased predation on ground-nesting birds were identified. However, it is noted that there is no documented evidence indicating the likelihood of this occurring.	constant and the effects are unknown, as effects of increased/altered noise levels are not known for birds at present (displacement/avoidance, impacts to foraging success, etc.). It is noted that the levels of underwater noise from the presence and operation of this device in offshore areas, is not currently known. Further the importance of hearing underwater for birds, threshold levels and the likelihood of any impacts are also unknown. Potential impacts may include displacement, avoidance, reduction in foraging success, no effect, etc. *Disturbance and Displacement* There is the potential for displacement during installation and operation, but this will likely be dependent on other factors (i.e. sensitivity of habitats, type of bird species, availability of suitable alternative habitats and foraging areas) and may only be temporary as fauna become accustomed to the devices. It is also likely to be dependent on site-specific factors including the sensitivity of species and the activities displaced (i.e. breeding, foraging, moulting, etc.). There may be the potential for visual disturbance, if surface-piercing components are present on the device. Any such impacts are likely to be greater for near-shore devices (i.e. close to coastal breeding and moulting sites, or offshore near foraging areas). However, the likelihood of impacts is currently unknown. In such instances, birds may operate in a broadly similar way and use similar avoidance tactics to those employed when encountering other natural and man-made obstructions (i.e. by taking alternative flight routes, avoiding obstructions to a	levels and the likelihood of any impacts are also unknown. Potential impacts may include displacement, avoidance, reduction in foraging success, no effect, etc. *Disturbance and Displacement* Potential for displacement during installation and operation, but dependant on other factors (i.e. sensitivity of habitats, availability of suitable alternative habitats) and may only be temporary as fauna become accustomed to the devices. This is likely dependant on site-specific including the sensitivity of species and the activities displaced (i.e. breeding, foraging, moulting, etc.). No surface-piercing components are identified, and hence no visual disturbance impacts are considered likely.	currently known. Furthermore, the importance of hearing underwater for birds, threshold levels and the likelihood of any impacts are also unknown. Potential impacts may include displacement, avoidance, reduction in foraging success, no effect, etc. *Disturbance and Displacement* The potential for displacement of bird populations during installation and operation, particularly the construction of large units and associated infrastructure in shoreline areas (i.e. construction disturbance and displacement of areas used by birds) has been identified. Any impacts from shoreline and offshore devices are likely dependent on other factors including the sensitivity of species and habitats, availability of suitable alternative habitats, activities displaced (i.e. breeding, foraging, moulting, etc.). In some instances, disturbance may only be temporary until fauna become accustomed to the devices. Potential for visual disturbance from above surface components in both onshore and offshore areas, with potential for significant impacts if close to coastal breeding and moulting sites, or offshore near foraging areas. The likelihood of impacts is currently not known. In such instances, birds may operate in a broadly similar way and use similar avoidance tactics to those employed when encountering other natural and man-made obstructions (i.e. by taking alternative flight routes, avoiding obstructions to a greater degree at night). *Predation* The 2007 Marine Renewables SEA raised the potential risk of increased mink colonisation of offshore islands due to the creation of islet chains between Scotland's western isles from the placement of devices with surface structures (offshore only). Impacts such as increased predation on	underwater noise from the presence and operation of this device in offshore areas, is not currently known. Furthermore, the importance of hearing underwater for birds, threshold levels and the likelihood of any impacts are also unknown. Potential impacts may include displacement, avoidance, reduction in foraging success, no effect, etc. *Disturbance and Displacement* The potential for displacement of bird populations during installation and operation, particularly the construction of large units and associated infrastructure in shoreline areas (i.e. construction disturbance and displacement of areas used by birds) has been identified. Any impacts onshore and offshore are likely dependant on other factors including the sensitivity of species and habitats, availability of suitable alternative habitats, activities displaced (i.e. breeding, foraging, moulting, etc.). In some instances, disturbance may only be temporary until fauna become accustomed to the devices. Potential for visual disturbance from above surface components in both onshore and offshore areas, with potential for greater impacts if close to coastal breeding sites and moulting sites. The likelihood of impacts is unknown. In such instances, birds may operate in a broadly similar way and use similar avoidance tactics to those employed when encountering other natural and man-made obstructions (i.e. by taking alternative flight routes, avoiding obstructions to a greater degree at night). *Predation* The 2007 Marine Renewables SEA raised the potential risk of increased mink colonisation of offshore islands due to the creation of islet chains between

SEA Topic Areas	Point Absorbers and Rotating Mass Devices	Attenuators and Bulge Wave Devices	Oscillating Wave Surge Converters	Submerged Pressure Differential	Oscillating Water Column (Offshore and Shoreline)	Overtopping Device (Offshore and Shoreline)
			greater degree at night). *Predation* The 2007 Marine Renewables SEA raised the potential risk of increased mink colonisation of offshore islands due to the creation of islet chains between Scotland's western isles from the placement of devices with surface structures. Impacts such as increased predation on ground-nesting birds were identified. However, it is noted that there is no documented evidence indicating the likelihood of this occurring.		ground-nesting birds were identified. However, it is noted that there is no documented evidence indicating the likelihood of this occurring.	Scotland's western isles from the placement of devices with surface structures (offshore only). Impacts such as increased predation on ground-nesting birds were identified. However, it is noted that there is no documented evidence indicating the likelihood of this occurring.
	<u>Benthic Habitats and Water Column:</u> *Habitat Changes* The presence of these devices in the water column and their seabed moorings have the potential to contribute to habitat changes in a number of ways. In general, impacts on seabed habitats from the devices themselves are likely limited to wave energy dissipation, tidal flows and flux changes and deposition due in large to the presence of structures in the water column. These potential impacts can create adverse impacts to both benthic habitats and their species. Other impacts, such as scouring, deposition, abrasion, smothering and the potential for loss of habitat from placement of anchors on the seabed and mooring lines in the water column have also been identified. These may also occur due to wave and coastal process changes. Direct seabed impacts such as scouring and deposition/siltation have the potential to affect benthic habitats in a range of ways including the introduction of variations and shifts in grain size of sediments affecting habitat character and species distribution; shading or smothering of benthic areas changes in species distribution via interference with	<u>Benthic Habitats and Water Column:</u> *Habitat Changes* The presence of these devices at the water surface is and their seabed moorings or structures have the potential to contribute to habitat changes in a number of ways. In general, impacts on seabed habitats from the devices themselves are likely limited given their presence at the water surface only. As such, wave energy dissipation and potential impacts if placed in or near a mixing zone are the likely impacts. The main impacts to benthic habitats are likely to be from the presence of mooring cables and structures on the seabed. The potential for impacts will likely depend on the type of mooring (i.e. gravity/deadweight anchor, gravity base structure, rock anchors, etc.) and may involve effects such as scouring, deposition, abrasion, smothering, loss of habitat from placement of mooring anchors on the seabed, and mooring lines in the water column have also been identified. These may also occur due to wave and coastal process changes. Direct seabed impacts such as scouring and deposition/siltation have the potential to affect benthic habitats in a range of ways	<u>Benthic Habitats and Water Column:</u> *Habitat Changes* The presence of these devices near the water surface, and support structure mounted on the seabed has the potential to contribute to habitat changes in a number of ways. In general, impacts on seabed habitats from the devices and their supports may include changes in sediment dynamics, scouring, deposition/siltation and vibration. Additional impacts such as wave energy dissipation, potential effects of placement in or near a mixing zone, changes in tidal flows and fluxes, and changes in turbulence due to installation and operation may also occur. Direct seabed impacts such as scouring and deposition/siltation, and in-direct impacts from wave and tidal changes, have the potential to cause a range of adverse benthic impacts. These may include the introduction of variations and shifts in grain size of sediments, which can alter habitat character and species distribution; shading or smothering of benthic areas with sediments and the presence of the device itself; changes in species distribution via interference with filter feeders, inhibiting their respiration and reproduction; and secondary	<u>Benthic Habitats and Water Column:</u> *Habitat Changes* The presence of these devices in the water column and their moorings to the seabed, has the potential to contribute to habitat changes in a number of ways. In general, impacts on seabed habitats from the devices and their supports may include changes in sediment dynamics (creation of a shadow and turbulence), deposition/siltation and vibration (if positioned directly on the seabed). Additional impacts such as changes in tidal flows and fluxes, and changes in turbulence due to installation and operation may also occur. The impacts on wave energy and potential for dissipation from sub-surface devices are unclear at present. In general, these changes to sediment dynamics and coastal processes can create adverse impacts to benthic habitats and their species. This may include direct impacts such as the introduction of variations and shifts in grain size of sediments, which can alter habitat character and species distribution; shading or smothering of benthic areas with sediments and the presence of the device itself; changes in species distribution via interference with filter feeders,	<u>Benthic Habitats and Water Column:</u> *Habitat Changes* The presence of these devices and their moorings has the potential to contribute to habitat changes in a number of ways. In summary, changes to sediment dynamics (shoreline), vibration (shoreline), wave energy dissipation (offshore) and changes to coastal processes (shoreline) can create adverse impacts to benthic and shoreline habitats and species. This may have direct impacts in altered sediment movement and changes in coastal character and profile which have the potential for a range of adverse impacts to these habitats (i.e. smothering, coastal profile, etc.). Secondary impacts may include changes to species distribution, and potentially reducing food sources for other species supported by these habitats. Loss of habitat due to the placement of shoreline devices is likely. In such instances sessile or sedentary species would be affected. Even small amounts of lost habitat may diminish species populations, particularly rare or vulnerable populations. However, the nature and extent of impacts would be site-specific. *Sediment Dynamics and Wave*	<u>Benthic Habitats and Water Column:</u> *Habitat Changes* The presence of these devices and their moorings has the potential to contribute to habitat changes in a number of ways. In summary, changes to sediment dynamics (shoreline), vibration (shoreline), wave energy dissipation (offshore) and changes to coastal processes (shoreline) can create adverse impacts to benthic and shoreline habitats and species. These may have direct impacts in scouring (i.e. sediment accumulated in shoreline devices may be entrained in the outflow) and deposition/siltation from support structures which have the potential for a range of adverse impacts to these habitats (i.e. introduction of variations and shifts in grain size of sediments, shading or smothering of benthic areas, changes to ecosystem composition and coastline profiles, etc.). Secondary impacts may include changes to species distribution, interference with filter feeders, inhibiting respiration and reproduction, and reducing food sources for other species supported by these habitats. Loss of habitat due to the placement of shoreline devices

SEA Topic Areas	Point Absorbers and Rotating Mass Devices	Attenuators and Bulge Wave Devices	Oscillating Wave Surge Converters	Submerged Pressure Differential	Oscillating Water Column (Offshore and Shoreline)	Overtopping Device (Offshore and Shoreline)
	filter feeders, inhibiting respiration and reproduction, and reducing food sources for other species supported by these habitats; and leading to wider changes in ecosystem composition. In some instances, this may also result in changes to the shoreline and coastline. *Sediment Dynamics and Wave Dissipation* Changes in sediment dynamics due to the presence of moorings for these devices (gravity anchors and mooring lines) may occur, with the potential for associated changes to coastal processes via the dissipation of wave energy, and impacts such as scouring, deposition/siltation and smothering. While likely site specific, the potential for impacts in a range of UK Biodiversity Action Plan (BAP) habitats has been identified: • Changes in sediment dynamics in high energy littoral rock (including BAP habitat Tidal Swept Channels) due to moorings. Impacts unlikely but may have potential impacts for *F. distichus*. Wave dissipation effects may adversely impact filter feeders (i.e. *M. edulis*, *S. allantoides*) due to food dissipation and smothering, and create suitable conditions for other fucoid species to outcompete *F. distichus.* • Changes in sediment dynamics in Moderate energy littoral rock (including BAP habitat under boulder communities) due to moorings. Impacts unlikely but may have potential impacts on under-boulder communities (BAP). • Changes in sediment dynamics in Littoral biogenic reefs (including BAP habitat blue mussel beds) due to moorings. Decreases in wave action may adversely impact filter feeders (i.e. *M. edulis*) and reduced availability of	including the introduction of variations and shifts in grain size of sediments affecting habitat character and species distribution; shading or smothering of benthic areas changes in species distribution via interference with filter feeders, inhibiting respiration and reproduction, and reducing food sources for other species supported by these habitats; and leading to wider changes in ecosystem composition. In some instances, this may also result in changes to the shoreline and coastline. *Sediment Dynamics and Wave Dissipation* Changes in sediment dynamics due to the presence of moorings for these devices (gravity anchors and mooring lines) may occur. In offshore areas, there may be the potential for associated changes to coastal processes via the dissipation of wave energy, and impacts such as scouring, deposition/siltation and smothering. While likely site specific, the potential for impacts in a range of BAP habitats has been identified: • Changes in sediment dynamics in high energy littoral rock (including BAP habitat Tidal Swept Channels) due to moorings. Impacts unlikely but may have potential impacts for *F. distichus*. Wave dissipation effects may adversely impact filter feeders (i.e. *M. edulis*, *S. allantoides*) due to food dissipation and smothering, and create suitable conditions for other fucoid species to outcompete *F. distichus.* • Changes in sediment dynamics in Moderate energy littoral rock (including BAP habitat Under boulder communities) due to moorings. Impacts unlikely but may have potential impacts on under-boulder communities (BAP). • Changes in sediment	impacts such as reducing food sources for other species supported by these habitats. These may collectively lead to wider changes in ecosystem composition. In some instances, this may also result in changes to the shoreline and coastline. *Sediment Dynamics and Wave Dissipation* Changes in sediment dynamics due to the offshore presence and operation of these devices and their benthic support structures may occur during both the installation and operation phases. The operation of these devices may create the potential for associated changes to coastal processes via the dissipation of wave energy, and impacts such as scouring, deposition/siltation and smothering. While likely site specific, the potential for impacts in a range of BAP habitats has been identified: • Changes in sediment dynamics in high energy littoral rock (including BAP habitat Tidal Swept Channels) due to device and support structures (offshore). Impacts unlikely but may have potential impacts for *F. distichus*. Wave dissipation effects may adversely impact filter feeders (i.e. *M. edulis*, *S. allantoides*) due to food dissipation and smothering, and create suitable conditions for other fucoid species to outcompete *F. distichus.* • Changes in sediment dynamics in Moderate energy littoral (including BAP habitat Under boulder communities) due to device and support structures (offshore). Impacts unlikely but may have potential impacts on under-boulder communities (BAP). • Changes in sediment	inhibiting their respiration and reproduction; and secondary impacts such as reducing food sources for other species supported by these habitats. These may collectively lead to wider changes in ecosystem composition. In some instances, this may also result in changes to the shoreline and coastline. *Sediment Dynamics* Changes in sediment dynamics due to the offshore presence and operation of these devices and their seabed-based support structures may occur during both the installation and operation phases. In offshore areas, there may be the potential for changes to sediment dynamics and wave shadow effects, leading to deposition/siltation and smothering. The potential for scouring associated with gravity based support structures/mooring systems may also exist. No specific impacts from wave dissipation were identified. While likely site specific, the potential for impacts in a range of BAP habitats has been identified: • Changes in sediment dynamics in high energy littoral rock (including BAP habitat Tidal Swept Channels) due to device and moorings (offshore). Impacts unlikely but may have potential impacts for *F. distichus*. • Changes in sediment dynamics in Moderate energy littoral (including BAP habitat Under boulder communities) due to device and moorings (offshore). Impacts unlikely but may have potential impacts on under-boulder communities (BAP). • Changes in sediment dynamics in Littoral biogenic	*Dissipation* Changes in sediment dynamics due to the presence and operation of these devices at the shoreline or offshore, and from their moorings (gravity anchors and moorings) may occur during both the installation and operation phases. In offshore areas, there may be the potential for changes to coastal processes via the dissipation of wave energy and creation of wave shadow effects. Shoreline devices have the potential for changes in the coastal profile, largely due to the potential for changes in flows/turbulence, and impacts such as erosion, deposition/siltation and smothering. of habitats. While likely site specific, the potential for impacts in a range of BAP habitats has been identified: • Changes in sediment dynamics in high energy littoral rock (including BAP habitat Tidal Swept Channels) due to device (onshore) and moorings (offshore). Impacts unlikely but may have potential impacts for *F. distichus*. Wave dissipation effects may adversely impact filter feeders (i.e. *M. edulis*, *S. allantoides*) due to food dissipation and smothering, and create suitable conditions for other fucoid species to outcompete *F. distichus.* • Changes in sediment dynamics in Moderate energy littoral (including BAP habitat Under boulder communities) due to device (onshore) and moorings (offshore). Impacts unlikely but may have potential impacts on under-boulder communities (BAP). • Changes in sediment dynamics in Littoral biogenic reefs (including BAP habitat blue mussel beds) due to device (onshore) and moorings (offshore).	is likely. In such instances sessile or sedentary species would be affected, and even small amounts of lost habitat may diminish species populations, particularly rare or vulnerable populations. However, the extent of impacts would likely be site-specific. *Sediment Dynamics and Wave Dissipation* Changes in sediment dynamics due to the presence and operation of these devices at the shoreline or near-shore, and from their moorings (gravity anchors and moorings) may occur during both the installation and operation phases. In offshore areas, there may be the potential for changes to coastal processes via the dissipation of wave energy and creation of wave shadow effects, particularly for large offshore devices. Shoreline devices have the potential for changes in the coastal profile, largely due to the potential for changes in flows/turbulence (i.e. alteration of backflows released from the device chamber), and impacts such as localised scouring and water turbidity. While likely site specific, the potential for impacts in a range of BAP habitats has been identified: • Changes in sediment dynamics in high energy littoral rock (including BAP habitat Tidal Swept Channels) due to device (onshore) and moorings (offshore). Impacts unlikely but may have potential impacts for *F. distichus*. Wave dissipation effects may adversely impact filter feeders (i.e. *M. edulis*, *S. allantoides*) due to food dissipation and smothering, and create suitable conditions for other fucoid species to outcompete *F.*

SEA Topic Areas	Point Absorbers and Rotating Mass Devices	Attenuators and Bulge Wave Devices	Oscillating Wave Surge Converters	Submerged Pressure Differential	Oscillating Water Column (Offshore and Shoreline)	Overtopping Device (Offshore and Shoreline)
	sediment available for others (i.e. *S. alveolata*). Impacts are unlikely as many of these species are common, but there may be the potential for impacts for blue mussel beds if present. • Changes in sediment dynamics in Features of littoral sediment (including BAP habitat blue mussel beds) due to moorings. Decreases in wave action may adversely impact filter feeders (i.e. *M. edulis*). Impacts unlikely as many of these species are common, but there may be the potential for impacts for blue mussel beds if present. • Changes in sediment dynamics in sublittoral coarse sediment (including BAP habitats subtidal sands and gravel, horse mussel beds) due to moorings. Impacts may influence scouring, deposition and smothering, whilst affecting sediment grain sizes and impacting on the habitat and species in these areas (i.e. *E. timida*). Decreases in wave action may adversely impact filter feeders (i.e. *A. fragilis*). Impacts are unlikely and these species are common, but there may be the potential for impacts for *A. fragilis*, *C. cruoriaeformis*, *D. Montagnei*, *E. timida* or horse mussel beds if present. • Changes in sediment dynamics in Sublittoral sand (including BAP habitat sub-tidal sands and gravel, blue mussel beds) due to moorings. Impacts may influence scouring, deposition and smothering, whilst affecting sediment grain sizes and impacting on the habitat and species in these areas (i.e. *E. timida*). Decreases in wave action may adversely impact filter feeders (i.e. *A. fragilis*) through reduced food supplies and siltation. While impacts	dynamics in Littoral biogenic reefs (including BAP habitat blue mussel beds) due to moorings. Decreases in wave action may adversely impact filter feeders (i.e. *M. edulis*) and reduced availability of sediment available for others (i.e. *S. alveolata*). Impacts unlikely and these species are common, but there may be the potential for impacts for blue mussel beds if present. • Changes in sediment dynamics in Features of littoral sediment (including BAP habitat blue mussel beds) due to moorings. Decreases in wave action may adversely impact filter feeders (i.e. *M. edulis*). Impacts unlikely and these species are common, but there may be the potential for impacts for blue mussel beds if present. • Changes in sediment dynamics in Sublittoral coarse sediment (including BAP habitats subtidal sands and gravel, horse mussel beds) due to moorings. Impacts may influence scouring, deposition and smothering, whilst affecting sediment grain sizes and impacting on the habitat and species in these areas (i.e. *E. timida*). Decreases in wave action may adversely impact filter feeders (i.e. *A. fragilis*), and while impacts are unlikely and these species are common, but there may be the potential for impacts for *A. fragilis*, *C. cruoriaeformis*, *D. Montagnei*, *E. timida* or horse mussel beds if present. • Changes in sediment dynamics in Sublittoral sand (including BAP habitat sub-tidal sands and gravel, blue mussel beds) due to moorings. Impacts may influence scouring, deposition and smothering, whilst affecting sediment grain sizes and impacting on the habitat and	dynamics in Littoral biogenic reefs (including BAP habitat blue mussel beds) due to device and support structures (offshore). Decreases in wave action may adversely impact filter feeders (i.e. *M. edulis*) and reduced availability of sediment available for others (i.e. *S. alveolata*). Impacts unlikely and these species are common, but there may be the potential for impacts for blue mussel beds if present. • Changes in sediment dynamics in Features of littoral sediment (including BAP habitat blue mussel beds) due to device and support structures (offshore). Decreases in wave action may adversely impact filter feeders (i.e. *M. edulis*) and while impacts are unlikely as these species are common, but there may be the potential for impacts for blue mussel beds if present. • Changes in sediment dynamics in Sublittoral coarse sediment (including BAP habitats subtidal sands and gravel, horse mussel beds) due to device and support structures (offshore). Impacts may affect sediment grain size, and affect the habitat and species in these areas (i.e. *E. timida*). Decreases in wave action may adversely impact filter feeders (i.e. *A. fragilis*), and while impacts are unlikely and these species are common, but there may be the potential for impacts for *A. fragilis*, *C. cruoriaeformis*, *D. Montagnei*, *E. timida* or horse mussel beds if present. • Changes in sediment dynamics in Sublittoral sand (including BAP habitat sub-tidal sands and gravel, blue mussel beds) due to device	reefs (including BAP habitat blue mussel beds) due to device and moorings (offshore). Impacts unlikely and these species are common, but there may be the potential for impacts for blue mussel beds if present. • Changes in sediment dynamics in features of littoral sediment (including BAP habitat blue mussel beds) due to device and moorings (offshore). Impacts are unlikely as these species are common, but there may be the potential for impacts for blue mussel beds if present. • Changes in sediment dynamics in Sublittoral coarse sediment (including BAP habitats subtidal sands and gravel, horse mussel beds) due to device and moorings (offshore). Impacts may affect sediment grain size, and affect the habitat and species in these areas (i.e. *E. timida*). • Changes in sediment dynamics in Sublittoral sand (including BAP habitat sub-tidal sands and gravel, blue mussel beds) due to device and moorings (offshore). Impacts may affect sediment grain size, and affect the habitat and species in these areas (i.e. *E. timida*) • Changes in sediment dynamics in Sublittoral mixed sediments (including BAP habitat Horse mussel beds, file shell beds) due to device and moorings (offshore). Impacts may affect sediment grain size, and affect the habitat and species in these areas (i.e. *E. timida*). • Changes in sediment dynamics in Sublittoral macrophyte-dominated sediment (including BAP habitats maerl beds, tidal	Decreases in wave action may adversely impact filter feeders (i.e. *M. edulis*) and reduced availability of sediment available for others (i.e. *S. alveolata*). Impacts unlikely and these species are common, but there may be the potential for impacts for blue mussel beds if present. • Changes in sediment dynamics in Features of littoral sediment (including BAP habitat blue mussel beds) due to device (onshore) and moorings (offshore). Decreases in wave action may adversely impact filter feeders (i.e. *M. edulis*). Impacts unlikely and these species are common, but there may be the potential for impacts for blue mussel beds if present. • Changes in sediment dynamics in Sublittoral coarse sediment (including BAP habitats subtidal sands and gravel, horse mussel beds) due to device (onshore) and moorings (offshore). Impacts may affect sediment grain size, and affect the habitat and species in these areas (i.e. *E. timida*). Decreases in wave action may adversely impact filter feeders (i.e. *A. fragilis*). Impacts are unlikely and these species are common, but there may be the potential for impacts for *A. fragilis*, *C. cruoriaeformis*, *D. Montagnei*, *E. timida* or horse mussel beds if present. • Changes in sediment dynamics in Sublittoral sand (including BAP habitat sub-tidal sands and gravel, blue mussel beds) due to device (onshore) and moorings (offshore). Impacts may affect sediment grain size, and affect the habitat and species in these areas (i.e. *E. timida*) and decreases in wave action may adversely impact filter feeders (i.e. *A. fragilis*) through	*distichus.* • Changes in sediment dynamics in Moderate energy littoral rock (including BAP habitat Under boulder communities) due to device (onshore) and moorings (offshore). Impacts unlikely but may have potential impacts on under-boulder communities (BAP). • Changes in sediment dynamics in Littoral biogenic reefs (including BAP habitat blue mussel beds) due to device (onshore) and moorings (offshore). Decreases in wave action may adversely impact filter feeders (i.e. *M. edulis*) and reduced availability of sediment available for others (i.e. *S. alveolata*). Impacts unlikely and these species are common, but there may be the potential for impacts for blue mussel beds if present. • Changes in sediment dynamics in Features of littoral sediment (including BAP habitat blue mussel beds) due to device (onshore) and moorings (offshore). Decreases in wave action may adversely impact filter feeders (i.e. *M. edulis*). Impacts unlikely and these species are common, but there may be the potential for impacts for blue mussel beds if present. • Changes in sediment dynamics in Sublittoral coarse sediment (including BAP habitats subtidal sands and gravel, horse mussel beds) due to device (onshore) and moorings (offshore). Impacts may affect sediment grain size, and affect the habitat and species in these areas (i.e. *E. timida*). Decreases in wave action may adversely impact filter feeders (i.e. *A.*

SEA Topic Areas	Point Absorbers and Rotating Mass Devices	Attenuators and Bulge Wave Devices	Oscillating Wave Surge Converters	Submerged Pressure Differential	Oscillating Water Column (Offshore and Shoreline)	Overtopping Device (Offshore and Shoreline)
	are unlikely, there may be the potential for impacts for *A. fragilis*, *E. timida* or *A. sarsi* or blue mussel beds if present. • Changes in sediment dynamics in Sublittoral mixed sediments (including BAP habitat Horse mussel beds, file shell beds) due to moorings. Impacts may influence scouring, deposition and smothering, whilst affecting sediment grain sizes and impacting on the habitat and species in these areas (i.e. *E. timida*). Decreases in wave action or tidal flows may adversely impact filter feeders (i.e. *A. fragilis*) through reduced food supplies and siltation. While impacts are considered unlikely, there may be the potential for impacts for *A. fragilis*, *D. Montagnei*, *E. timida* or *A. sarsi*, horse mussel beds or file shell beds if present. • Changes in sediment dynamics in Sublittoral macrophyte-dominated sediment (including BAP habitats maerl beds, tidal swept channels, horse mussel beds, blue mussel beds) due to moorings. Impacts may influence scouring, deposition and smothering. Wave dissipation may also affect species competition (i.e. seaweeds and filter feeders with reductions in exposure and food supplies) and changes in sediment dynamics. While impacts are unlikely, there may be the potential for impacts for *A. fragilis*, *C. cruoriaeformis*, *D. Montagnei*, *P. calcareum*, *L. corallioides*, horse mussel beds or blue mussel beds or maerl beds present. • Changes in sediment dynamics in Sublittoral biogenic reefs (including BAP habitats horse mussel beds, cold-water coral reefs and blue	species in these areas (i.e. *E. timida*). Decreases in wave action may adversely impact filter feeders (i.e. *A. fragilis*) through reduced food supplies and siltation, and while impacts are unlikely, there may be the potential for impacts for *A. fragilis*, *E. timida* or *A. sarsi* or blue mussel beds if present. • Changes in sediment dynamics in Sublittoral mixed sediments (including BAP habitat Horse mussel beds, file shell beds) due to moorings. Impacts may influence scouring, deposition and smothering, whilst affecting sediment grain sizes and impacting on the habitat and species in these areas (i.e. *E. timida*). Decreases in wave action or tidal flows may adversely impact filter feeders (i.e. *A. fragilis*) through reduced food supplies and siltation, and while impacts are considered unlikely, there may be the potential for impacts for *A. fragilis*, *D. Montagnei*, *E. timida* or *A. sarsi*, horse mussel beds or file shell beds if present. • Changes in sediment dynamics in Sublittoral macrophyte-dominated sediment (including BAP habitats maerl beds, tidal swept channels, horse mussel beds, blue mussel beds) due to moorings. Impacts may influence scouring, deposition and smothering. Wave dissipation may also affect species competition (i.e. seaweeds and filter feeders with reductions in exposure and food supplies) and changes in sediment dynamics, and while impacts are unlikely, there may be the potential for impacts for *A. fragilis*, *C. cruoriaeformis*, *D. Montagnei*, *P. calcareum*, *L. corallioides*, horse mussel beds or blue mussel beds or	and support structures (offshore). Impacts may affect sediment grain size, and affect the habitat and species in these areas (i.e. *E. timida*) and decreases in wave action may adversely impact filter feeders (i.e. *A. fragilis*) through reduced food supplies and siltation, and while impacts are unlikely, there may be the potential for impacts for *A. fragilis*, *E. timida* or *A. sarsi* or blue mussel beds if present. • Changes in sediment dynamics in Sublittoral mixed sediments (including BAP habitat Horse mussel beds, file shell beds) due to device and support structures (offshore). Impacts may affect sediment grain size, and affect the habitat and species in these areas (i.e. *E. timida*) and decreases in wave action or tidal flows may adversely impact filter feeders (i.e. *A. fragilis*) through reduced food supplies and siltation, and while impacts are considered unlikely, there may be the potential for impacts for *A. fragilis*, *D. Montagnei*, *E. timida* or *A. sarsi*, horse mussel beds or file shell beds if present. • Changes in sediment dynamics in Sublittoral macrophyte-dominated sediment (including BAP habitats maerl beds, tidal swept channels, horse mussel beds, blue mussel beds) due to device and support structures (offshore). Wave dissipation may also affect species competition (i.e. seaweeds and filter feeders with reductions in exposure and food supplies) and changes in sediment dynamics, and while impacts are unlikely, there may be the potential for impacts for *A. fragilis*, *C. cruoriaeformis*,	swept channels, horse mussel beds, blue mussel beds) due to device and moorings (offshore). While impacts are unlikely, there may be the potential for impacts for *A. fragilis*, *C. cruoriaeformis*, *D. Montagnei*, *P. calcareum*, *L. corallioides*, horse mussel beds or blue mussel beds or maerl beds present. • Changes in sediment dynamics in Sublittoral biogenic reefs (including BAP habitats horse mussel beds, cold-water coral reefs and blue mussel beds) due to device and moorings (offshore). While impacts are unlikely, there may be the potential to affect horse mussel beds, cold coral reefs or blue mussel beds if present. • Changes in sediment dynamics in Atlantic and Mediterranean high energy circalittoral rock (including BAP habitat Tidal Swept Channels) due to device and moorings (offshore). Potential impacts for habitat and *S. pallida* as it is nationally scarce. • Changes in sediment dynamics in Atlantic and Mediterranean moderate energy circalittoral rock due to device and moorings (offshore). Potential impacts for *S. spinulosa, A dohrnii* and *S. pallida*. • Changes in sediment dynamics in circalittoral rock features due to device and moorings (offshore). Impacts are not considered likely, but included due to potential as this habitat is seldom recorded. *Changes in Tidal Flows and Fluxes* Decreases in tidal flows associated with these devices or	reduced food supplies and siltation. While impacts are unlikely, there may be the potential for impacts for *A. fragilis*, *E. timida* or *A. sarsi* or blue mussel beds if present. • Changes in sediment dynamics in Sublittoral mixed sediments (including BAP habitat Horse mussel beds, file shell beds) due to device (onshore) and moorings (offshore). Impacts may affect sediment grain size, and affect the habitat and species in these areas (i.e. *E. timida*) and decreases in wave action or tidal flows may adversely impact filter feeders (i.e. *A. fragilis*) through reduced food supplies and siltation. While impacts are considered unlikely, there may be the potential for impacts for *A. fragilis*, *D. Montagnei*, *E. timida* or *A. sarsi*, horse mussel beds or file shell beds if present. • Changes in sediment dynamics in Sublittoral macrophyte-dominated sediment (including BAP habitats maerl beds, tidal swept channels, horse mussel beds, blue mussel beds) due to device (onshore) and moorings (offshore). Wave dissipation may also affect species competition (i.e. seaweeds and filter feeders with reductions in exposure and food supplies) and changes in sediment dynamics. While impacts are unlikely, there may be the potential for impacts for *A. fragilis*, *C. cruoriaeformis*, *D. Montagnei*, *P. calcareum*, *L. corallioides*, horse mussel beds or blue mussel beds or maerl beds present. • Changes in sediment dynamics in Sublittoral biogenic reefs (including BAP habitats horse mussel beds, cold-water coral reefs and blue	*fragilis*). Impacts are unlikely and these species are common, but there may be the potential for impacts for *A. fragilis*, *C. cruoriaeformis*, *D. Montagnei*, *E. timida* or horse mussel beds if present. • Changes in sediment dynamics in Sublittoral sand (including BAP habitat sub-tidal sands and gravel, blue mussel beds) due to device (onshore) and moorings (offshore). Impacts may affect sediment grain size, and affect the habitat and species in these areas (i.e. *E. timida*) and decreases in wave action may adversely impact filter feeders (i.e. *A. fragilis*) through reduced food supplies and siltation. While impacts are unlikely, there may be the potential for impacts for *A. fragilis*, *E. timida* or *A. sarsi* or blue mussel beds if present. • Changes in sediment dynamics in Sublittoral mixed sediments (including BAP habitat Horse mussel beds, file shell beds) due to device (onshore) and moorings (offshore). Impacts may affect sediment grain size, and affect the habitat and species in these areas (i.e. *E. timida*) and decreases in wave action or tidal flows may adversely impact filter feeders (i.e. *A. fragilis*) through reduced food supplies and siltation. While impacts are considered unlikely, there may be the potential for impacts for *A. fragilis*, *D. Montagnei*, *E. timida, A. sarsi*, horse mussel beds or file shell beds if present. • Changes in sediment dynamics in Sublittoral macrophyte-dominated sediment (including BAP habitats maerl beds, tidal swept channels, horse

SEA Topic Areas	Point Absorbers and Rotating Mass Devices	Attenuators and Bulge Wave Devices	Oscillating Wave Surge Converters	Submerged Pressure Differential	Oscillating Water Column (Offshore and Shoreline)	Overtopping Device (Offshore and Shoreline)
	mussel beds) due to moorings. This may influence scouring, deposition and smothering. Wave dissipation also has the potential to impact of filter feeders (i.e. reduced food supplies, siltation, migration of some species to shallow water depths) thus potentially affecting the overall habitat. While impacts are unlikely, there may be the potential to affect horse mussel beds, cold coral reefs or blue mussel beds if present. • Changes in sediment dynamics in Atlantic and Mediterranean high energy circalittoral rock (including BAP habitat Tidal Swept Channels) due to moorings. Potential impacts for habitat and *S. pallida* as it is nationally scarce. • Changes in sediment dynamics in Atlantic and Mediterranean moderate energy circalittoral rock due to moorings. Potential impacts for *S. spinulosa, A dohrnii* and *S. pallida*. • Changes in sediment dynamics in circalittoral rock features due to moorings. Impacts are not considered likely, but included due to potential as this habitat is seldom recorded. *Change in Tidal Flows and Fluxes* Changes, predominantly decreases in tidal flows may have adverse effects on benthic areas, although these are expected to be site and habitat specific: • Changes in tidal flows and fluxes in Sublittoral coarse sediment (including BAP habitats subtidal sands and gravel, horse mussel beds) due to moorings (offshore). on filter feeders (i.e. *M. modiolus*, *A. digitatum* and *A. fragilis*) from reduced food supplies and siltation. Strong flows may detach weakly attached	maerl beds present. • Changes in sediment dynamics in Sublittoral biogenic reefs (including BAP habitats horse mussel beds, cold-water coral reefs and blue mussel beds) due to moorings. This may influence scouring, deposition and smothering. Wave dissipation also has the potential to impact of filter feeders (i.e. reduced food supplies, siltation, migration of some species to shallow water depths) thus potentially affecting the overall habitat. While impacts from wave dissipation are unlikely, there may be the potential to affect horse mussel beds, cold coral reefs or blue mussel beds if present. • Changes in sediment dynamics in Atlantic and Mediterranean high energy circalittoral rock (including BAP habitat Tidal Swept Channels) due to moorings. Potential impacts for habitat and *S. pallida* as it is nationally scarce. • Changes in sediment dynamics in Atlantic and Mediterranean moderate energy circalittoral rock due to moorings. Potential impacts for *S. spinulosa, A dohrnii* and *S. pallida*. • Changes in sediment dynamics in circalittoral rock features due to moorings. Impacts are not considered likely, but included due to potential as this habitat is seldom recorded. *Change in Tidal Flows and Fluxes* There are likely to be limited tidal flows and fluxes within suitable development areas for this device, and any impacts from device moorings are expected to be site and habitat specific. However, the potential for impacts via decreases in tidal flows may have	*D. Montagnei*, *P. calcareum*, *L. corallioides*, horse mussel beds or blue mussel beds or maerl beds present. • Changes in sediment dynamics in Sublittoral biogenic reefs (including BAP habitats horse mussel beds, cold-water coral reefs and blue mussel beds) due to device and support structures (offshore). Wave dissipation also has the potential to impact of filter feeders (i.e. reduced food supplies, siltation, migration of some species to shallow water depths) thus potentially affecting the overall habitat. While impacts from wave dissipation are unlikely, there may be the potential to affect horse mussel beds, cold coral reefs or blue mussel beds if present. • Changes in sediment dynamics in Atlantic and Mediterranean high energy infralittoral rock (including BAP habitat Tidal Swept Channels) due to device and support structures (offshore). Potential for impacts for *S. pallida,* given it is nationally scarce. • Changes in sediment dynamics in Atlantic and Mediterranean moderate energy infralittoral rock (including BAP habitat Tidal Swept Channels and *S. spinulosa* reefs) due to device and support structures (offshore). Impacts unlikely for small arrays (10MW) but potential impacts may exist for *S. pallida and S. spinulosa*. • Changes in sediment dynamics in Atlantic and Mediterranean high energy circalittoral rock (including BAP habitat Tidal Swept Channels) due to device and support structures (offshore). Potential impacts for habitat	support moorings may have adverse effects, particularly given the varying position of these devices in the water column. Any such impacts are expected to be site and habitat specific: • Changes in tidal flows and fluxes in Sublittoral coarse sediment (including BAP habitats subtidal sands and gravel, horse mussel beds) due to device and moorings (offshore). on filter feeders (i.e. *M. modiolus*, *A. digitatum* and *A. fragilis*) from reduced food supplies and siltation. Strong flows may detach weakly attached organisms. Changes in the overall habitat, through changing grain size in sediments may also occur. While many species are present in a variety of tidal flow conditions, impacts are unlikely. However, the potential may exist for impacts if *C. cruoriaeformis*, *D. Montagnei*, *E. timida*, *A. sarsi* or horse mussel beds are present. • Changes in tidal flows and fluxes in Sublittoral sand (including BAP habitat sub-tidal sands and gravel, blue mussel beds) due to device and moorings (offshore). on filter feeders (i.e. *M. modiolus*, *A. digitatum* and *A. fragilis*) from reduced food supplies and siltation. Strong flows may detach weakly attached organisms. Changes in the overall habitat, through changing grain size in sediments may also occur. While many species are present in a variety of tidal flow conditions, impacts are unlikely. However, the potential may exist for impacts if *A. fragilis*, *E. timida*, *A. sarsi* or blue mussel beds are present.	mussel beds) due to device (onshore) and moorings (offshore). Wave dissipation also has the potential to impact of filter feeders (i.e. reduced food supplies, siltation, migration of some species to shallow water depths) thus potentially affecting the overall habitat. While impacts are unlikely, there may be the potential to affect horse mussel beds, cold coral reefs or blue mussel beds if present. • Changes in sediment dynamics in Atlantic and Mediterranean high energy infralittoral rock (including BAP habitat Tidal Swept Channels) due to device (shoreline). Potential impacts for *S. pallida* as it is nationally scarce. • Changes in sediment dynamics in Atlantic and Mediterranean moderate energy infralittoral rock (including BAP habitat Tidal Swept Channels and *S. spinulosa* reefs) due to device (shoreline). Impacts unlikely for small arrays (10MW) but potential impacts may exist for *S. pallida and S. spinulosa.* • Changes in sediment dynamics in Atlantic and Mediterranean high energy circalittoral rock (including BAP habitat Tidal Swept Channels) due to device (onshore) or moorings (offshore). Potential impacts for habitat and *S. pallida* as it is nationally scarce. • Changes in sediment dynamics in Atlantic and Mediterranean moderate energy circalittoral rock due to device (onshore) and moorings (offshore). Potential impacts for *S. spinulosa, A dohrnii* and *S. pallida*. • Changes in sediment dynamics in circalittoral rock features due to device	mussel beds, blue mussel beds) due to device (onshore) and moorings (offshore). Wave dissipation may also affect species competition (i.e. seaweeds and filter feeders with reductions in exposure and food supplies) and changes in sediment dynamics. While impacts are unlikely, there may be the potential for impacts for *A. fragilis*, *C. cruoriaeformis*, *D. Montagnei*, *P. calcareum*, *L. corallioides*, horse mussel beds or blue mussel beds or maerl beds present. • Changes in sediment dynamics in Sublittoral biogenic reefs (including BAP habitats horse mussel beds, cold-water coral reefs and blue mussel beds) due to device (onshore) and moorings (offshore). Wave dissipation also has the potential to impact of filter feeders (i.e. reduced food supplies, siltation, migration of some species to shallow water depths) thus potentially affecting the overall habitat. While impacts are unlikely, there may be the potential to affect horse mussel beds, cold coral reefs or blue mussel beds if present. • Changes in sediment dynamics in Atlantic and Mediterranean high energy infralittoral rock (including BAP habitat Tidal Swept Channels) due to device (shoreline). Potential impacts for *S. pallida* as it is nationally scarce. • Changes in sediment dynamics in Atlantic and Mediterranean moderate energy infralittoral rock (including BAP habitat Tidal Swept Channels and *S. spinulosa* reefs) due to device (shoreline). Impacts unlikely for small arrays

SEA Topic Areas	Point Absorbers and Rotating Mass Devices	Attenuators and Bulge Wave Devices	Oscillating Wave Surge Converters	Submerged Pressure Differential	Oscillating Water Column (Offshore and Shoreline)	Overtopping Device (Offshore and Shoreline)
	organisms. Changes in the overall habitat, through changing grain size in sediments may also occur. While many species are present in a variety of tidal flow conditions, impacts are unlikely. However, the potential may exist for impacts if *C. cruoriaeformis*, *D. Montagnei*, *E. timida*, *A. sarsi* or horse mussel beds are present. • Changes in tidal flows and fluxes in Sublittoral sand (including BAP habitat sub-tidal sands and gravel, blue mussel beds) due to moorings (offshore). on filter feeders (i.e. *M. modiolus*, *A. digitatum* and *A. fragilis*) from reduced food supplies and siltation. Strong flows may detach weakly attached organisms. Changes in the overall habitat, through changing grain size in sediments may also occur. While many species are present in a variety of tidal flow conditions, impacts are unlikely. However, the potential may exist for impacts if *A. fragilis*, *E. timida*, *A. sarsi* or blue mussel beds are present. • Changes in tidal flows and fluxes in Sublittoral mixed sediments (including BAP habitat Horse mussel beds, file shell beds) due to moorings (offshore). on filter feeders (i.e. *M. modiolus*, *A. digitatum* and *A. fragilis*) from reduced food supplies and siltation. Strong flows may detach weakly attached organisms. Changes in the overall habitat, through changing grain size in sediments may also occur. While many species are present in a variety of tidal flow conditions, impacts are unlikely. However, the potential may exist for impacts if *A. fragilis*, *E. timida*, *A. sarsi*, horse mussel beds or file shell	adverse effects: • Changes in tidal flows and fluxes in Sublittoral coarse sediment (including BAP habitats subtidal sands and gravel, horse mussel beds) due to moorings (offshore). on filter feeders (i.e. *M. modiolus*, *A. digitatum* and *A. fragilis*) from reduced food supplies and siltation. Strong flows may detach weakly attached organisms. Changes in the overall habitat, through changing grain size in sediments may also occur. While many species are present in a variety of tidal flow conditions, impacts are unlikely. However, the potential may exist for impacts if *C. cruoriaeformis*, *D. Montagnei*, *E. timida*, *A. sarsi* or horse mussel beds are present. • Changes in tidal flows and fluxes in Sublittoral sand (including BAP habitat sub-tidal sands and gravel, blue mussel beds) due to moorings (offshore). on filter feeders (i.e. *M. modiolus*, *A. digitatum* and *A. fragilis*) from reduced food supplies and siltation. Strong flows may detach weakly attached organisms. Changes in the overall habitat, through changing grain size in sediments may also occur. While many species are present in a variety of tidal flow conditions, impacts are unlikely. However, the potential may exist for impacts if *A. fragilis*, *E. timida*, *A. sarsi* or blue mussel beds are present. • Changes in tidal flows and fluxes in Sublittoral mixed sediments (including BAP habitat Horse mussel beds, file shell beds) due to moorings (offshore). on filter feeders (i.e. *M. modiolus*, *A. digitatum* and *A. fragilis*) from reduced food supplies and siltation. Strong	and *S. pallida* as it is nationally scarce. • Changes in sediment dynamics in Atlantic and Mediterranean moderate energy circalittoral rock due to device and support structures (offshore). Potential impacts for *S. spinulosa, A dohrnii* and *S. pallida*. • Changes in sediment dynamics in circalittoral rock features due to device and supports (offshore). Impacts are not considered likely, but included due to potential as this habitat is seldom recorded. *Change in Tidal Flows and Fluxes* Decreases in tidal flows and fluxes associated with these devices or their seabed-based support structures may have adverse effects, although these are expected to be site and habitat specific: • Changes in tidal flows and fluxes in Sublittoral coarse sediment (including BAP habitats subtidal sands and gravel, horse mussel beds) due to device and support structures (offshore). on filter feeders (i.e. *M. modiolus*, *A. digitatum* and *A. fragilis*) from reduced food supplies and siltation. Strong flows may detach weakly attached organisms. Changes in the overall habitat, through changing grain size in sediments may also occur. While many species are present in a variety of tidal flow conditions, impacts are unlikely. However, the potential may exist for impacts if *C. cruoriaeformis*, *D. Montagnei*, *E. timida*, *A. sarsi* or horse mussel beds are present. • Changes in tidal flows and fluxes in Sublittoral sand	• Changes in tidal flows and fluxes in Sublittoral mixed sediments (including BAP habitat Horse mussel beds, file shell beds) due to device and moorings (offshore). on filter feeders (i.e. *M. modiolus*, *A. digitatum* and *A. fragilis*) from reduced food supplies and siltation. Strong flows may detach weakly attached organisms. Changes in the overall habitat, through changing grain size in sediments may also occur. While many species are present in a variety of tidal flow conditions, impacts are unlikely. However, the potential may exist for impacts if *A. fragilis*, *E. timida*, *A. sarsi*, horse mussel beds or file shell beds are present. • Changes in tidal flows and fluxes in Sublittoral macrophyte-dominated sediment (including BAP habitats maerl beds, tidal swept channels, horse mussel beds, blue mussel beds) due to device and moorings (offshore). on filter feeders (i.e. *M. modiolus*, *A. digitatum* and *A. fragilis*) from reduced food supplies and siltation. Strong flows may detach weakly attached organisms. Changes in the overall habitat, through changing grain size in sediments may also occur. While many species are present in a variety of tidal flow conditions, impacts are unlikely. However, the potential may exist for impacts if *A. fragilis*, *C. cruoriaeformis*, *D. Montagnei*, *P. calcareum*, *L. corallioides*, horse mussel beds or blue mussel beds or maerl beds present. • Changes in tidal flows and fluxes in Sublittoral biogenic reefs (including BAP habitats	(onshore) and moorings (offshore). Impacts are not considered likely, but included due to potential as this habitat is seldom recorded. *Change in Tidal Flows and Fluxes* Decreases in tidal flows and fluxes due to the presence of offshore and shoreline devices may have adverse effects on nearby the benthic habitats, although these are expected to be largely site-specific: • Changes in tidal flows and fluxes in Sublittoral coarse sediment (including BAP habitats subtidal sands and gravel, horse mussel beds) due to moorings (offshore). on filter feeders (i.e. *M. modiolus*, *A. digitatum* and *A. fragilis*) from reduced food supplies and siltation. Strong flows may detach weakly attached organisms. Changes in the overall habitat, through changing grain size in sediments may also occur. While many species are present in a variety of tidal flow conditions, impacts are unlikely. However, the potential may exist for impacts if *C. cruoriaeformis*, *D. Montagnei*, *E. timida*, *A. sarsi* or horse mussel beds are present. • Changes in tidal flows and fluxes in Sublittoral sand (including BAP habitat sub-tidal sands and gravel, blue mussel beds) due to moorings (offshore). on filter feeders (i.e. *M. modiolus*, *A. digitatum* and *A. fragilis*) from reduced food supplies and siltation. Strong flows may detach weakly attached organisms. Changes in the overall habitat, through changing grain size in sediments may also occur. While many species are present in a variety of tidal flow conditions, impacts are unlikely. However, the potential may exist for impacts	(10MW) but potential impacts may exist for *S. pallida and S. spinulosa*. • Changes in sediment dynamics in Atlantic and Mediterranean high energy circalittoral rock (including BAP habitat Tidal Swept Channels) due to device (onshore) or moorings (offshore). Potential impacts for habitat and *S. pallida* as it is nationally scarce. • Changes in sediment dynamics in Atlantic and Mediterranean moderate energy circalittoral rock due to device (onshore) and moorings (offshore). Potential impacts for *S. spinulosa, A dohrnii* and *S. pallida*. • Changes in sediment dynamics in circalittoral rock features due to device (onshore) and moorings (offshore). Impacts are not considered likely, but included due to potential as this habitat is seldom recorded. *Change in Tidal Flows and Fluxes* Decreases in tidal flows from the installation and placement of support structures and moorings (for offshore devices) may potentially have adverse effects, although these are expected to be site and habitat specific: • Changes in tidal flows and fluxes in Sublittoral coarse sediment (including BAP habitats subtidal sands and gravel, horse mussel beds) due to moorings (offshore). on filter feeders (i.e. *M. modiolus*, *A. digitatum* and *A. fragilis*) from reduced food supplies and siltation. Strong flows may detach weakly attached organisms. Changes in the overall habitat, through changing grain size in sediments may

SEA Topic Areas	Point Absorbers and Rotating Mass Devices	Attenuators and Bulge Wave Devices	Oscillating Wave Surge Converters	Submerged Pressure Differential	Oscillating Water Column (Offshore and Shoreline)	Overtopping Device (Offshore and Shoreline)
	beds are present. • Changes in tidal flows and fluxes in Sublittoral macrophyte-dominated sediment (including BAP habitats maerl beds, tidal swept channels, horse mussel beds, blue mussel beds) due to moorings (offshore). on filter feeders (i.e. *M. modiolus*, *A. digitatum* and *A. fragilis*) from reduced food supplies and siltation. Strong flows may detach weakly attached organisms. Changes in the overall habitat, through changing grain size in sediments may also occur. While many species are present in a variety of tidal flow conditions, impacts are unlikely. However, the potential may exist for impacts if *A. fragilis*, *C. cruoriaeformis*, *D. Montagnei*, *P. calcareum*, *L. corallioides*, horse mussel beds or blue mussel beds or maerl beds present. • Changes in tidal flows and fluxes in Sublittoral biogenic reefs (including BAP habitats horse mussel beds, cold-water coral reefs and blue mussel beds) due to moorings (offshore). on filter feeders (i.e. *M. modiolus*, *A. digitatum* and *A. fragilis*) from reduced food supplies and siltation. Strong flows may detach weakly attached organisms. Changes in the overall habitat, through changing grain size in sediments may also occur and increase competition between kelp species (i.e. *A. esculenta*) associated with changing flow rates. While many species are present in a variety of tidal flow conditions, impacts are unlikely. However, the potential may exist for impacts if horse mussel beds, cold coral reefs or blue mussel beds if present. *Scouring and Deposition* While likely site specific, this may	flows may detach weakly attached organisms. Changes in the overall habitat, through changing grain size in sediments may also occur. While many species are present in a variety of tidal flow conditions, impacts are unlikely. However, the potential may exist for impacts if *A. fragilis*, *E. timida*, *A. sarsi*, horse mussel beds or file shell beds are present. • Changes in tidal flows and fluxes in Sublittoral macrophyte-dominated sediment (including BAP habitats maerl beds, tidal swept channels, horse mussel beds, blue mussel beds) due to moorings (offshore). on filter feeders (i.e. *M. modiolus*, *A. digitatum* and *A. fragilis*) from reduced food supplies and siltation. Strong flows may detach weakly attached organisms. Changes in the overall habitat, through changing grain size in sediments may also occur. While many species are present in a variety of tidal flow conditions, impacts are unlikely. However, the potential may exist for impacts if *A. fragilis*, *C. cruoriaeformis*, *D. Montagnei*, *P. calcareum*, *L. corallioides*, horse mussel beds or blue mussel beds or maerl beds present. • Changes in tidal flows and fluxes in Sublittoral biogenic reefs (including BAP habitats horse mussel beds, cold-water coral reefs and blue mussel beds) due to moorings (offshore). on filter feeders (i.e. *M. modiolus*, *A. digitatum* and *A. fragilis*) from reduced food supplies and siltation. Strong flows may detach weakly attached organisms. Changes in the overall habitat, through changing grain size in sediments may also occur and increase competition between kelp species (i.e. *A. esculenta*)	(including BAP habitat sub-tidal sands and gravel, blue mussel beds) due to device and support structures (offshore). on filter feeders (i.e. *M. modiolus*, *A. digitatum* and *A. fragilis*) from reduced food supplies and siltation. Strong flows may detach weakly attached organisms. Changes in the overall habitat, through changing grain size in sediments may also occur. While many species are present in a variety of tidal flow conditions, impacts are unlikely. However, the potential may exist for impacts if *A. fragilis*, *E. timida*, *A. sarsi* or blue mussel beds are present. • Changes in tidal flows and fluxes in Sublittoral mixed sediments (including BAP habitat Horse mussel beds, file shell beds) due to device and support structures (offshore). on filter feeders (i.e. *M. modiolus*, *A. digitatum* and *A. fragilis*) from reduced food supplies and siltation. Strong flows may detach weakly attached organisms. Changes in the overall habitat, through changing grain size in sediments may also occur. While many species are present in a variety of tidal flow conditions, impacts are unlikely. However, the potential may exist for impacts if *A. fragilis*, *E. timida*, *A. sarsi*, horse mussel beds or file shell beds are present. • Changes in tidal flows and fluxes in Sublittoral macrophyte-dominated sediment (including BAP habitats maerl beds, tidal swept channels, horse mussel beds, blue mussel beds) due to device and support structures (offshore). on filter feeders (i.e. *M.*	horse mussel beds, cold-water coral reefs and blue mussel beds) due to device and moorings (offshore). on filter feeders (i.e. *M. modiolus*, *A. digitatum* and *A. fragilis*) from reduced food supplies and siltation. Strong flows may detach weakly attached organisms. Changes in the overall habitat, through changing grain size in sediments may also occur and increase competition between kelp species (i.e. *A. esculenta*) associated with changing flow rates. While many species are present in a variety of tidal flow conditions, impacts are unlikely. However, the potential may exist for impacts if horse mussel beds, cold coral reefs or blue mussel beds if present. *Scouring and Deposition* While likely site specific, this may present a potential risk to BAP species such as mussel beds, *M. edulis*, and filter feeders, with secondary impacts up the food chain (i.e. affecting predatory species that feed on them). The potential for scouring in a range of BAP habitats has been identified for offshore devices: • Potential deposition of sediment from device and moorings in littoral biogenic reefs (including BAP habitat blue mussel beds) if blue mussel beds are present. While deposition unlikely in high-energy environments, raised as potential issue due to presence of BAP habitats. • Potential for deposition of sediment in features of littoral sediment (including BAP habitat blue mussel beds) if blue mussel beds are present. May impact on habitat character.	if *A. fragilis*, *E. timida*, *A. sarsi* or blue mussel beds are present. • Changes in tidal flows and fluxes in Sublittoral mixed sediments (including BAP habitat Horse mussel beds, file shell beds) due to moorings (offshore). on filter feeders (i.e. *M. modiolus*, *A. digitatum* and *A. fragilis*) from reduced food supplies and siltation. Strong flows may detach weakly attached organisms. Changes in the overall habitat, through changing grain size in sediments may also occur. While many species are present in a variety of tidal flow conditions, impacts are unlikely. However, the potential may exist for impacts if *A. fragilis*, *E. timida*, *A. sarsi*, horse mussel beds or file shell beds are present. • Changes in tidal flows and fluxes in Sublittoral macrophyte-dominated sediment (including BAP habitats maerl beds, tidal swept channels, horse mussel beds, blue mussel beds) due to moorings (offshore). on filter feeders (i.e. *M. modiolus*, *A. digitatum* and *A. fragilis*) from reduced food supplies and siltation. Strong flows may detach weakly attached organisms. Changes in the overall habitat, through changing grain size in sediments may also occur. While many species are present in a variety of tidal flow conditions, impacts are unlikely. However, the potential may exist for impacts if *A. fragilis*, *C. cruoriaeformis*, *D. Montagnei*, *P. calcareum*, *L. corallioides*, horse mussel beds or blue mussel beds or maerl beds present. • Changes in tidal flows and fluxes in Sublittoral biogenic reefs (including BAP habitats horse mussel beds, cold-water	also occur. While many species are present in a variety of tidal flow conditions, impacts are unlikely. However, the potential may exist for impacts if *C. cruoriaeformis*, *D. Montagnei*, *E. timida*, *A. sarsi* or horse mussel beds are present. • Changes in tidal flows and fluxes in Sublittoral sand (including BAP habitat sub-tidal sands and gravel, blue mussel beds) due to moorings (offshore). on filter feeders (i.e. *M. modiolus*, *A. digitatum* and *A. fragilis*) from reduced food supplies and siltation. Strong flows may detach weakly attached organisms. Changes in the overall habitat, through changing grain size in sediments may also occur. While many species are present in a variety of tidal flow conditions, impacts are unlikely. However, the potential may exist for impacts if *A. fragilis*, *E. timida*, *A. sarsi* or blue mussel beds are present. • Changes in tidal flows and fluxes in Sublittoral mixed sediments (including BAP habitat Horse mussel beds, file shell beds) due to moorings (offshore). on filter feeders (i.e. *M. modiolus*, *A. digitatum* and *A. fragilis*) from reduced food supplies and siltation. Strong flows may detach weakly attached organisms. Changes in the overall habitat, through changing grain size in sediments may also occur. While many species are present in a variety of tidal flow conditions, impacts are unlikely. However, the potential may exist for impacts if *A. fragilis*, *E. timida*, *A. sarsi*, horse mussel beds or file shell beds are

SEA Topic Areas	Point Absorbers and Rotating Mass Devices	Attenuators and Bulge Wave Devices	Oscillating Wave Surge Converters	Submerged Pressure Differential	Oscillating Water Column (Offshore and Shoreline)	Overtopping Device (Offshore and Shoreline)
	present a potential risk to BAP species such as mussel beds, *M. edulis*, and filter feeders, with secondary impacts up the food chain (i.e. affecting predatory species that feed on them). The potential for scouring in a range of BAP habitats has been identified for offshore devices: • Increased scour and potential for deposition of sediment (i.e. smothering, inhibiting respiration, feeding and growth) in sublittoral coarse sediment (including BAP habitats subtidal sands and gravel, blue mussel beds) if *A. fragilis, C. cruoriaeformis, D. Montagnei, E. timida* or horse mussel beds are present. • Increased scour and deposition of sediment (i.e. smothering, inhibiting respiration, feeding and growth) in Sublittoral sand (including BAP habitat sub-tidal sands and gravel, blue mussel beds) if *A. fragilis, E. timida, A sarsi* or blue mussel beds are present. • Increased scour and deposition of sediment (i.e. smothering, inhibiting respiration, feeding and growth) in Sublittoral mixed sediments (including BAP habitat Horse mussel beds, file shell beds). Considered unlikely but has potential for impacts if *A. fragilis, D. Montagnei, E. timida, A sarsi,* horse mussel beds or file shell beds are present. • Increased scour and deposition of sediment (i.e. smothering, inhibiting respiration, feeding and growth) in Sublittoral macrophyte-dominated sediment (including BAP habitats maerl beds, tidal swept channels, horse mussel beds, blue mussel beds). Considered unlikely, but noted as a potential impact particularly if *C.*	associated with changing flow rates. While many species are present in a variety of tidal flow conditions, impacts are unlikely. However, the potential may exist for impacts if horse mussel beds, cold coral reefs or blue mussel beds if present. *Scouring and Deposition* While likely site specific, the presence of mooring systems associated with these devices may present a potential risk to BAP species such as mussel beds, *M. edulis*, and filter feeders, with secondary impacts up the food chain (i.e. affecting predatory species that feed on them). The potential for scouring in a range of BAP habitats has been identified: • Increased scour in sublittoral coarse sediment (including BAP habitats subtidal sands and gravel, blue mussel beds) if *A. fragilis, C. cruoriaeformis, D. Montagnei, E. timida* or horse mussel beds are present. Also potential for deposition of sediment due to moorings was raised due to the potential presence of these species. • Scouring in Sublittoral sand (including BAP habitat sub-tidal sands and gravel, blue mussel beds) if *A. fragilis, E. timida, A sarsi* or blue mussel beds are present. Also potential for deposition of sediment due to moorings was raised due to the potential presence of these species. • Scouring in Sublittoral mixed sediments (including BAP habitat Horse mussel beds, file shell beds) if *A. fragilis, D. Montagnei, E. timida, A sarsi,* horse mussel beds or file shell beds are present. Also potential for deposition of sediment due to moorings was raised due to the potential presence of these species. • Scouring in Sublittoral	*modiolus*, *A. digitatum* and *A. fragilis*) from reduced food supplies and siltation. Strong flows may detach weakly attached organisms. Changes in the overall habitat, through changing grain size in sediments may also occur. While many species are present in a variety of tidal flow conditions, impacts are unlikely. However, the potential may exist for impacts if *A. fragilis*, *C. cruoriaeformis*, *D. Montagnei*, *P. calcareum*, *L. corallioides*, horse mussel beds or blue mussel beds or maerl beds present. • Changes in tidal flows and fluxes in Sublittoral biogenic reefs (including BAP habitats horse mussel beds, cold-water coral reefs and blue mussel beds) due to device and support structures (offshore). on filter feeders (i.e. *M. modiolus*, *A. digitatum* and *A. fragilis*) from reduced food supplies and siltation. Strong flows may detach weakly attached organisms. Changes in the overall habitat, through changing grain size in sediments may also occur and increase competition between kelp species (i.e. *A. esculenta*) associated with changing flow rates. While many species are present in a variety of tidal flow conditions, impacts are unlikely. However, the potential may exist for impacts if horse mussel beds, cold coral reefs or blue mussel beds if present. *Scouring and Deposition* While likely site specific, this may present a potential risk to BAP species such as mussel beds, *M. edulis*, and filter feeders, with secondary impacts up the food chain (i.e. affecting predatory species that feed on	• Deposition of sediment (i.e. smothering, inhibiting respiration, feeding and growth) in sublittoral coarse sediment (including BAP habitats subtidal sands and gravel, blue mussel beds) if *A. fragilis, C. cruoriaeformis, D. Montagnei, E. timida* or horse mussel beds are present. • Potential for increased scouring and deposition of sediment (i.e. smothering, inhibiting respiration, feeding and growth) in Sublittoral sand (including BAP habitat sub-tidal sands and gravel, blue mussel beds) if *A. fragilis, E. timida, A sarsi* or blue mussel beds are present. • Potential for increased scouring and deposition of sediment (i.e. smothering, inhibiting respiration, feeding and growth) in Sublittoral mixed sediments (including BAP habitat Horse mussel beds, file shell beds). Considered unlikely but has potential for impacts if *A. fragilis, D. Montagnei, E. timida, A sarsi,* horse mussel beds or file shell beds are present. • Potential for increased scouring and deposition of sediment (i.e. smothering, inhibiting respiration, feeding and growth) in Sublittoral macrophyte-dominated sediment (including BAP habitats maerl beds, tidal swept channels, horse mussel beds, blue mussel beds). Considered unlikely, but noted as a potential impact particularly if *C. cruoriaeformis, D. Montagnei, P. calcareum, L. corallioides*, horse mussel beds, blue mussel beds or maerl beds are present. • Potential for increased scouring and potential	coral reefs and blue mussel beds) due to moorings (offshore). on filter feeders (i.e. *M. modiolus*, *A. digitatum* and *A. fragilis*) from reduced food supplies and siltation. Strong flows may detach weakly attached organisms. Changes in the overall habitat, through changing grain size in sediments may also occur and increase competition between kelp species (i.e. *A. esculenta*) associated with changing flow rates. While many species are present in a variety of tidal flow conditions, impacts are unlikely. However, the potential may exist for impacts if horse mussel beds, cold coral reefs or blue mussel beds if present. *Scouring and Deposition* While likely site specific, this may present a potential risk to BAP species such as mussel beds, *M. edulis*, and filter feeders, with secondary impacts up the food chain (i.e. affecting predatory species that feed on them). The potential for scouring due to the presence of offshore mooring systems in a range of BAP habitats has been identified: • Potential deposition of sediment associated with moorings in littoral biogenic reefs (including BAP habitat blue mussel beds) if blue mussel beds are present. While deposition unlikely in high-energy environments, raised as potential issue due to presence of BAP habitats. • Potential for deposition of sediment associated with moorings in features of littoral sediment (including BAP habitat blue mussel beds) if blue mussel beds are present. May impact on habitat character. • Increased scour, and deposition of sediment from moorings (i.e. smothering,	present. • Changes in tidal flows and fluxes in Sublittoral macrophyte-dominated sediment (including BAP habitats maerl beds, tidal swept channels, horse mussel beds, blue mussel beds) due to moorings (offshore). on filter feeders (i.e. *M. modiolus*, *A. digitatum* and *A. fragilis*) from reduced food supplies and siltation. Strong flows may detach weakly attached organisms. Changes in the overall habitat, through changing grain size in sediments may also occur. While many species are present in a variety of tidal flow conditions, impacts are unlikely. However, the potential may exist for impacts if *A. fragilis*, *C. cruoriaeformis*, *D. Montagnei*, *P. calcareum*, *L. corallioides*, horse mussel beds or blue mussel beds or maerl beds present. • Changes in tidal flows and fluxes in Sublittoral biogenic reefs (including BAP habitats horse mussel beds, cold-water coral reefs and blue mussel beds) due to moorings (offshore). on filter feeders (i.e. *M. modiolus*, *A. digitatum* and *A. fragilis*) from reduced food supplies and siltation. Strong flows may detach weakly attached organisms. Changes in the overall habitat, through changing grain size in sediments may also occur and increase competition between kelp species (i.e. *A. esculenta*) associated with changing flow rates. While many species are present in a variety of tidal flow conditions, impacts are unlikely. However, the potential may exist for impacts if horse mussel beds, cold coral reefs or blue

SEA Topic Areas	Point Absorbers and Rotating Mass Devices	Attenuators and Bulge Wave Devices	Oscillating Wave Surge Converters	Submerged Pressure Differential	Oscillating Water Column (Offshore and Shoreline)	Overtopping Device (Offshore and Shoreline)
	cruoriaeformis, *D. Montagnei*, *P. calcareum*, *L. corallioides*, horse mussel beds, blue mussel beds or maerl beds are present • Scouring in Sublittoral biogenic reefs (including BAP habitats horse mussel beds, cold-water coral reefs and blue mussel beds) if horse mussel beds, cold water coral reefs or blue mussel beds are present. • Potential for deposition of sediments in littoral biogenic reefs (including BAP habitat blue mussel beds) if blue mussel beds are present. While deposition unlikely in high-energy environments, raised as potential issue due to presence of BAP habitats. • Potential for deposition of sediment in features of littoral sediment (including BAP habitat blue mussel beds) if blue mussel beds are present. May impact on habitat character. • Potential for deposition of sediment on filter feeders in circalittoral rock features. Included due to potential; for impacts (i.e. smothering) although this is considered unlikely for arrays up to 10MW). *Loss of Habitat/Abrasion* The direct placement of offshore or near-shore devices, and/or their moorings on the seabed can result in damage to benthic habitats, or their loss in extreme instances (e.g. seabed structures, piling, drilling and anchoring, subsea cable placement). This could also include additional damage such as the abrasion of benthic areas by mooring lines in the placement process. The potential for abrasion of marine habitats and sessile/sedentary species (i.e. BAP species such as mussel and file shell beds) from the installation of infrastructure	macrophyte-dominated sediment (including BAP habitats maerl beds, tidal swept channels, horse mussel beds, blue mussel beds) if *C. cruoriaeformis*, *D. Montagnei*, *P. calcareum*, *L. corallioides*, horse mussel beds, blue mussel beds or maerl beds are present. Also potential for deposition of sediment due to moorings was raised due to the potential presence of these species. • Scouring in Sublittoral biogenic reefs (including BAP habitats horse mussel beds, cold-water coral reefs and blue mussel beds) if horse mussel beds, cold water coral reefs or blue mussel beds are present. Also potential for deposition of sediment due to moorings was raised due to the potential presence of these species. • Potential for deposition of sediments at moorings in littoral biogenic reefs (including BAP habitat blue mussel beds) if blue mussel beds are present. While deposition unlikely in high-energy environments, raised as potential issue due to presence of BAP habitats. • Potential for deposition of sediments due to moorings in littoral biogenic reefs (including BAP habitat blue mussel beds) if blue mussel beds are present. While deposition unlikely in high-energy environments, raised as potential issue due to presence of BAP habitats. • Potential for deposition of sediment due to moorings in features of littoral sediment (including BAP habitat blue mussel beds) if blue mussel beds are present. May impact on habitat character. *Loss of Habitat/Abrasion* The placement of moorings on the seabed can result in damage to	them). The potential for scouring in a range of BAP habitats has been identified for these devices: • Increased scour at high tide, and deposition of sediment on algal frond surfaces in high energy littoral rock (including BAP habitat Tidal Swept Channels) if *F. Distichus* is present. May impact on light availability (i.e. photosynthesis). • Increased scour at high tide, and deposition of sediment on algal frond surfaces in moderate energy littoral (including BAP habitat Under boulder communities) if under-boulder communities (BAP) are present. May impact on light availability (i.e. photosynthesis) and change character of habitat. • Increased scour at high tide, and potential deposition of sediment from device and support structures in littoral biogenic reefs (including BAP habitat blue mussel beds) if blue mussel beds are present. While deposition unlikely in high-energy environments, raised as potential issue due to presence of BAP habitats. • Increased scour at high tide, and deposition of sediment in features of littoral sediment (including BAP habitat blue mussel beds) if blue mussel beds are present. May impact on habitat character. • Increased scour and deposition of sediment (i.e. smothering, inhibiting respiration, feeding and growth) in sublittoral coarse sediment (including BAP habitats subtidal sands and gravel, blue mussel beds) if *A. fragilis, C. cruoriaeformis, D. Montagnei, E. timida* or horse mussel beds are present. • Increased scouring and	deposition of sediments in Sublittoral biogenic reefs (including BAP habitats horse mussel beds, cold-water coral reefs and blue mussel beds) if horse mussel beds, cold water coral reefs or blue mussel beds are present. • Potential for deposition of sediment on filter feeders in circalittoral rock features. Included due to potential; for impacts (i.e. smothering) although this is considered unlikely for arrays up to 10MW). • Potential for deposition of sediment in high energy littoral rock (including BAP habitat Tidal Swept Channels) if *F. Distichus* is present. *Loss of Habitat/Abrasion* The placement of offshore or near-shore devices, and/or their moorings on the seabed can result in damage to benthic habitats, or their loss in extreme instances (e.g. seabed structures, piling, drilling and anchoring, subsea cable placement). This could also include additional damage such as the abrasion of benthic areas by support structures and associated cabling in the placement process. The potential for abrasion of marine habitats and sessile/sedentary species (i.e. BAP species such as mussel and file shell beds) from the installation of infrastructure (i.e. mooring cables dragging during installation) and subsea cabling (i.e. placement and dragging during installation and operation) has been identified at: • Atlantic and Mediterranean high energy circalittoral rock (including BAP habitat Tidal Swept Channels). • Atlantic and Mediterranean	inhibiting respiration, feeding and growth) in sublittoral coarse sediment (including BAP habitats subtidal sands and gravel, blue mussel beds) if *A. fragilis, C. cruoriaeformis, D. Montagnei, E. timida* or horse mussel beds are present. • Increased scouring and deposition of sediment from moorings (i.e. smothering, inhibiting respiration, feeding and growth) in Sublittoral sand (including BAP habitat sub-tidal sands and gravel, blue mussel beds) if *A. fragilis, E. timida, A sarsi* or blue mussel beds are present. • Increased scouring, and deposition of sediment from moorings (i.e. smothering, inhibiting respiration, feeding and growth) in Sublittoral mixed sediments (including BAP habitat Horse mussel beds, file shell beds). Considered unlikely but has potential for impacts if *A. fragilis, D. Montagnei, E. timida, A sarsi,* horse mussel beds or file shell beds are present. • Increased scouring, and deposition of sediment from moorings (i.e. smothering, inhibiting respiration, feeding and growth) in Sublittoral macrophyte-dominated sediment (including BAP habitats maerl beds, tidal swept channels, horse mussel beds, blue mussel beds). Considered unlikely, but noted as a potential impact particularly if *C. cruoriaeformis*, *D. Montagnei*, *P. calcareum*, *L. corallioides*, horse mussel beds, blue mussel beds or maerl beds are present • Scouring and potential deposition of sediments from moorings in Sublittoral biogenic reefs (including BAP habitats horse mussel beds,	mussel beds if present. *Scouring and Deposition* While likely site specific, this may present a potential risk to BAP species such as mussel beds, *M. edulis*, and filter feeders, with secondary impacts up the food chain (i.e. affecting predatory species that feed on them). The potential for scouring due to the presence of offshore mooring systems in a range of BAP habitats has been identified: • Increased scour at high tide in high energy littoral rock (including BAP habitat Tidal Swept Channels) if *F. Distichus* is present. • Increased scour at high tide in moderate energy littoral (including BAP habitat Under boulder communities) if under-boulder communities (BAP) are present. • Increased scour at high tide and deposition of sediment in littoral biogenic reefs (including BAP habitat blue mussel beds) if blue mussel beds are present. • Increased scour and deposition of sediment at high tide in features of littoral sediment (including BAP habitat blue mussel beds) if blue mussel beds are present (i.e. by filling in interstices between mussels forming beds). • Increased scour and deposition of sediment (i.e. smothering, inhibiting respiration, feeding and growth) in sublittoral coarse sediment (including BAP habitats subtidal sands and gravel, blue mussel beds) if *A. fragilis, C. cruoriaeformis, D. Montagnei, E. timida* or horse mussel beds are present. • Increased scouring and deposition of sediment (i.e.

SEA Topic Areas	Point Absorbers and Rotating Mass Devices	Attenuators and Bulge Wave Devices	Oscillating Wave Surge Converters	Submerged Pressure Differential	Oscillating Water Column (Offshore and Shoreline)	Overtopping Device (Offshore and Shoreline)
	and subsea cabling (i.e. cables dragging during installation) has been identified at in the following habitats: • Atlantic and Mediterranean moderate energy infralittoral rock (including BAP habitat Tidal Swept Channels and *Sabellaria spinulosa* reefs). • Atlantic and Mediterranean high energy circalittoral rock (including BAP habitat Tidal Swept Channels). • Atlantic and Mediterranean moderate energy circalittoral rock. • Sublittoral coarse sediment (including BAP habitats subtidal sands and gravel, horse mussel beds). • Sublittoral sand (including BAP habitat sub-tidal sands and gravel, blue mussel beds). • Sublittoral mixed sediments (including BAP habitat Horse mussel beds, file shell beds). • Sublittoral macrophyte-dominated sediment (including BAP habitats maerl beds, tidal swept channels, horse mussel beds, blue mussel beds). • Sublittoral biogenic reefs (including BAP habitats horse mussel beds, cold-water coral reefs and blue mussel beds).	benthic habitats, and in some instances, their loss (e.g. seabed structures, piling, drilling and anchoring, subsea cable placement). This can also include additional damage such as the abrasion of benthic areas by mooring lines in the placement process. The potential for abrasion of marine habitats and sessile/sedentary species (i.e. BAP species such as mussel and file shell beds) from the installation of infrastructure (i.e. mooring cables dragging during installation) and subsea cabling (i.e. placement and dragging during installation and operation) has been identified at: • Atlantic and Mediterranean high energy circalittoral rock (including BAP habitat Tidal Swept Channels). • Atlantic and Mediterranean moderate energy circalittoral rock. • Sublittoral coarse sediment (including BAP habitats subtidal sands and gravel, horse mussel beds). • Sublittoral sand (including BAP habitat sub-tidal sands and gravel, blue mussel beds). • Sublittoral mixed sediments (including BAP habitat Horse mussel beds, file shell beds). • Sublittoral macrophyte-dominated sediment (including BAP habitats maerl beds, tidal swept channels, horse mussel beds, blue mussel beds). • Sublittoral biogenic reefs (including BAP habitats horse mussel beds, cold-water coral reefs and blue mussel beds).	deposition of sediment (i.e. smothering, inhibiting respiration, feeding and growth) in Sublittoral sand (including BAP habitat sub-tidal sands and gravel, blue mussel beds) if *A. fragilis, E. timida, A sarsi* or blue mussel beds are present. • Increased scouring and deposition of sediment (i.e. smothering, inhibiting respiration, feeding and growth) in Sublittoral mixed sediments (including BAP habitat Horse mussel beds, file shell beds). Considered unlikely but has potential for impacts if *A. fragilis, D. Montagnei, E. timida, A sarsi,* horse mussel beds or file shell beds are present. • Increased scouring and deposition of sediment (i.e. smothering, inhibiting respiration, feeding and growth) in Sublittoral macrophyte-dominated sediment (including BAP habitats maerl beds, tidal swept channels, horse mussel beds, blue mussel beds). Considered unlikely, but noted as a potential impact particularly if *C. cruoriaeformis*, *D. Montagnei*, *P. calcareum*, *L. corallioides*, horse mussel beds, blue mussel beds or maerl beds are present • Increased scouring and deposition of sediments in Sublittoral biogenic reefs (including BAP habitats horse mussel beds, cold-water coral reefs and blue mussel beds) if horse mussel beds, cold water coral reefs or blue mussel beds are present. May impact by smothering, hindering respiration, feeding and growth of filter feeders. • Potential for deposition of sediment on filter feeders in circalittoral rock features.	moderate energy circalittoral rock. • Sublittoral coarse sediment (including BAP habitats subtidal sands and gravel, horse mussel beds). • Sublittoral sand (including BAP habitat sub-tidal sands and gravel, blue mussel beds). • Sublittoral mixed sediments (including BAP habitat Horse mussel beds, file shell beds). • Sublittoral macrophyte-dominated sediment (including BAP habitats maerl beds, tidal swept channels, horse mussel beds, blue mussel beds). • Sublittoral biogenic reefs (including BAP habitats horse mussel beds, cold-water coral reefs and blue mussel beds).	cold-water coral reefs and blue mussel beds) if horse mussel beds, cold water coral reefs or blue mussel beds are present. • Potential for deposition of sediment associated with moorings on filter feeders in circalittoral rock features. Included due to potential; for impacts (i.e. smothering) although this is considered unlikely for arrays up to 10MW). *Loss of Habitat/Abrasion* The placement of shoreline devices, and seabed moorings for offshore devices, can result in damage to benthic habitats, and in some instances lead to the loss of habitat (e.g. the placement of shoreline devices, seabed structures including gravity base structures, piling, drilling and anchoring, subsea cable placement). In such instances sessile or sedentary species would be affected, and even small amounts of lost habitat may diminish species populations, particularly rare or vulnerable populations. However, the extent of impacts would likely be site-specific. The potential for abrasion of marine habitats and sessile/sedentary species (i.e. BAP species such as mussel and file shell beds) from the installation of infrastructure (i.e. mooring cables dragging during installation) and subsea cabling (i.e. placement and dragging during installation and operation) has been identified at: • Atlantic and Mediterranean high energy circalittoral rock (including BAP habitat Tidal Swept Channels). • Atlantic and Mediterranean moderate energy circalittoral rock. • Sublittoral coarse sediment (including BAP habitats subtidal sands and gravel,	smothering, inhibiting respiration, feeding and growth) in Sublittoral sand (including BAP habitat sub-tidal sands and gravel, blue mussel beds) if *A. fragilis, E. timida, A sarsi* or blue mussel beds are present. • Increased scouring and deposition of sediment (i.e. smothering, inhibiting respiration, feeding and growth) in Sublittoral mixed sediments (including BAP habitat Horse mussel beds, file shell beds). Considered unlikely but has potential for impacts if *A. fragilis, D. Montagnei, E. timida, A sarsi,* horse mussel beds or file shell beds are present. • Increased scouring and deposition of sediment (i.e. smothering, inhibiting respiration, feeding and growth) in Sublittoral macrophyte-dominated sediment (including BAP habitats maerl beds, tidal swept channels, horse mussel beds, blue mussel beds). Considered unlikely, but noted as a potential impact particularly if *C. cruoriaeformis*, *D. Montagnei*, *P. calcareum*, *L. corallioides*, horse mussel beds, blue mussel beds or maerl beds are present • Potential for increased scouring in Sublittoral biogenic reefs (including BAP habitats horse mussel beds, cold-water coral reefs and blue mussel beds) if horse mussel beds, cold water coral reefs or blue mussel beds are present. • Potential for deposition of sediment on filter feeders in circalittoral rock features. Included due to potential; for impacts (i.e. smothering) although this is considered unlikely for arrays up to

SEA Topic Areas	Point Absorbers and Rotating Mass Devices	Attenuators and Bulge Wave Devices	Oscillating Wave Surge Converters	Submerged Pressure Differential	Oscillating Water Column (Offshore and Shoreline)	Overtopping Device (Offshore and Shoreline)
			Included due to potential; for impacts (i.e. smothering) although this is considered unlikely for arrays up to 10MW). *Loss of Habitat/Abrasion* The placement of these devices, and their support structures on the seabed can result in damage to benthic habitats, and loss of habitat in extreme instances (e.g. seabed structures, piling, drilling and anchoring, subsea cable placement). This could also include additional damage such as the abrasion of benthic areas, particularly from support structure lines in the installation/placement process. The potential for abrasion of marine habitats and sessile/sedentary species (i.e. BAP species such as mussel and file shell beds) from the installation of infrastructure (i.e. support structure cables dragging during installation) and subsea cabling (i.e. placement and dragging during installation and operation) has been identified at: • Atlantic and Mediterranean high energy infralittoral rock (including BAP habitat Tidal Swept Channels). • Atlantic and Mediterranean moderate energy infralittoral rock (including BAP habitat Tidal Swept Channels and *S. spinulosa* reefs). • Atlantic and Mediterranean high energy circalittoral rock (including BAP habitat Tidal Swept Channels). • Atlantic and Mediterranean moderate energy circalittoral rock. • Sublittoral coarse sediment (including BAP habitats subtidal sands and gravel, horse mussel beds). • Sublittoral sand (including BAP habitat sub-tidal sands		horse mussel beds). • Sublittoral sand (including BAP habitat sub-tidal sands and gravel, blue mussel beds). • Sublittoral mixed sediments (including BAP habitat Horse mussel beds, file shell beds). • Sublittoral macrophyte-dominated sediment (including BAP habitats maerl beds, tidal swept channels, horse mussel beds, blue mussel beds). • Sublittoral biogenic reefs (including BAP habitats horse mussel beds, cold-water coral reefs and blue mussel beds).	10MW). *Loss of Habitat/Abrasion* The placement of offshore, near-shore or shoreline devices, and/or their moorings on the seabed, can result in damage to benthic habitats, or in some instances lead to the loss of habitat (e.g. the placement of shoreline devices, seabed structures including gravity base structures, piling, drilling and anchoring, subsea cable placement). In such instances sessile or sedentary species would be affected, and even small amounts of lost habitat may diminish or displace species populations, particularly those that are rare or vulnerable. The extent of impacts would likely be site-specific. The potential for abrasion of marine habitats and sessile/sedentary species (i.e. BAP species such as mussel and file shell beds) from the installation of infrastructure (i.e. mooring cables dragging during installation) and subsea cabling (i.e. placement and dragging during installation and operation) has been identified at: • Atlantic and Mediterranean high energy circalittoral rock (including BAP habitat Tidal Swept Channels). • Atlantic and Mediterranean moderate energy circalittoral rock. • Sublittoral coarse sediment (including BAP habitats subtidal sands and gravel, horse mussel beds). • Sublittoral sand (including BAP habitat sub-tidal sands and gravel, blue mussel beds). • Sublittoral mixed sediments (including BAP habitat Horse mussel beds, file shell beds). • Sublittoral macrophyte-dominated sediment

SEA Topic Areas	Point Absorbers and Rotating Mass Devices	Attenuators and Bulge Wave Devices	Oscillating Wave Surge Converters	Submerged Pressure Differential	Oscillating Water Column (Offshore and Shoreline)	Overtopping Device (Offshore and Shoreline)
			and gravel, blue mussel beds). • Sublittoral mixed sediments (including BAP habitat Horse mussel beds, file shell beds). • Sublittoral macrophyte-dominated sediment (including BAP habitats maerl beds, tidal swept channels, horse mussel beds, blue mussel beds). • Sublittoral biogenic reefs (including BAP habitats horse mussel beds, cold-water coral reefs and blue mussel beds).			(including BAP habitats maerl beds, tidal swept channels, horse mussel beds, blue mussel beds). • Sublittoral biogenic reefs (including BAP habitats horse mussel beds, cold-water coral reefs and blue mussel beds).
Population and human health[11]	Summary of key potential effects on population and human health: • Displaced/increased shipping density. • Reductions in the safety of navigation. • Risk of collision of recreational or commercial shipping with installation vessels and operational devices, particularly for devices and vessels that are low in the water and in high waves. • Access restrictions – the presence of devices in the water may restrict or reduce access to key recreational sailing areas or other water sports. Key measures to prevent adverse effects may include: siting devices away from spatially constrained areas and areas with high vessel densities; siting devices in open water; making use of industry guidance on assessment of effects and use of aids to navigation; use of notifications such as 'Notices to Mariners', publicising information at marina, and Sailing Directions; and adhering to appropriate safety regulations. Consideration of device types that are fully submerged and allow shipping to pass over the top of them could reduce effects, but guidance would need to be sought on a case-by-case basis on the level of clearance required.					
	The potential for vessel collisions with above water components, or components at shallow depths in the water column, has been identified and may have the potential for serious injury. However, navigational warnings (i.e. marker buoys, navigational aids, lighting) are likely to be required on such devices for navigational purposes.	The potential for vessel collisions with above water components has been identified, and may have the potential for serious injury. However, navigational warnings (i.e. marker buoys, navigational aids, lighting) are likely to be required on such devices for navigational purposes.	The potential for vessel collisions with device components at shallow depths in the water column has been identified and may have the potential for serious injury. However, navigational warnings (i.e. marker buoys, navigational aids, lighting) are likely to be required on such devices for navigational purposes.	The potential for vessel collisions with device components at shallow depths in the water column has been identified and may have the potential for serious injury. However, navigational warnings (i.e. marker buoys, navigational aids, lighting) are likely to be required on such devices for navigational purposes.	While above water components are likely to be clearly visible, the potential for vessel collisions with above water components or components at shallow depths in the water column, has been identified and has the potential for serious injury, particularly in periods of low light. However, lighting is likely to be required for navigational purposes on such devices.	While above water components are likely to be clearly visible, the potential for vessel collisions with above water components or components at shallow depths in the water column, has been identified and has the potential for serious injury, particularly in periods of low light. However, lighting is likely to be required for navigational purposes on such devices.
Water and marine environment[12]	Summary of key potential effects on water quality include: • Disturbance of contaminated sediments during device installation, e.g. disposal sites (silt, sand, rock and gravel sites, fish wastes and sludge); munitions dumps, and weapons ranges.					
	Potential for impacts from local changes in wave energy dissipation and deposition due to the presence of these devices in the water column, and for changes to sediment dynamics, scouring,	Potential for impacts from local changes in wave energy dissipation due to the presence of these devices at the top of the water column, and for changes to sediment dynamics, scouring,	Potential for impacts from local changes in wave energy dissipation, changes to sediment dynamics, scouring, deposition, tidal flows and fluxes, water turbidity and water turbulence	Potential for impacts from local changes in water turbulence due to the presence of these devices and their moorings. The potential may also exist for changes to sediment dynamics,	Potential for impacts from local changes in water turbulence due to the presence of offshore devices and their moorings. The potential may also exist for changes to sediment dynamics	Potential for impacts from local changes in water turbulence due to the presence of offshore devices and their moorings. The potential may also exist for changes to sediment dynamics

[11] Informed by: Faber Maunsell (2007) Scottish Marine Renewables SEA: Environmental Report, Prepared for the Scottish Executive, March 2007; Talisman Energy (UK) LTD (2005) Environmental Statement [online] Available at: http://www.beatricewind.co.uk/downloads/statement.asp [accessed 25/03/2013]; EMU (2012) Neart na Gaoithe Offshore Wind Farm Environmental Statement, Prepared for Mainstream Renewable Power [online] Available at: http://mainstream-downloads.opendebate.co.uk/downloads/Contents-Pages.pdf [accessed 25/03/2013]; Aberdeen Wind Offshore Wind Farm Limited (2011) European Offshore Wind Deployment Centre: Non-Technical Summary, July 2011 [online] Available at: http://www.vattenfall.co.uk/en/file/EOWDC-consent-vol1.pdf_18476566.pdf [accessed 26/03/2013]; E-on (2008) Offshore Environmental Statement, April 2008 [online] Available at: http://www.eon-uk.com/generation/1309.aspx [accessed 26/03/2013]; E-on (2008) Onshore Cable Route Environmental Statement, April 2008 [online] Available at: http://www.eon-uk.com/generation/1309.aspx [accessed 26/03/2013]; and E-on (2009) Onshore Substation and Cable Spur Environmental Statement, November 2009 [online] Available at: http://www.eon-uk.com/generation/1309.aspx [accessed 26/03/2013.

[12] Informed by: Faber Maunsell (2007) Scottish Marine Renewables SEA: Environmental Report, Prepared for the Scottish Executive, March 2007; Aquatera (2012) A review of the Potential Impacts of Wave and Tidal Energy development on Scotland's Marine Environment, Prepared for Marine Scotland, Final Report Issued 9 March 2012

SEA Topic Areas	Point Absorbers and Rotating Mass Devices	Attenuators and Bulge Wave Devices	Oscillating Wave Surge Converters	Submerged Pressure Differential	Oscillating Water Column (Offshore and Shoreline)	Overtopping Device (Offshore and Shoreline)
	deposition, tidal flows and fluxes and water turbulence associated with the presence of mooring cables and structures on the seabed. Potential for installation impacts such as water turbidity and contamination risks associated with installation and operation (e.g. leakage from vessels or equipment).	deposition, tidal flows and fluxes and water turbulence associated with the presence of mooring cables and structures on the seabed. Potential for installation impacts such as water turbidity and contamination risks associated with installation and operation (e.g. leakage from vessels or equipment).	associated with the presence of these devices and their support structures mounted on the seabed. Potential for installation impacts such as water turbidity and contamination risks associated with installation and operation (e.g. leakage from vessels or equipment).	scouring (associated with gravity based structures, if used), vibration, deposition, tidal flows and fluxes, water turbidity and water turbulence associated with the presence of these devices in the water column and their support structures mounted on the seabed. Potential for installation impacts such as water turbidity and contamination risks associated with installation and operation (e.g. leakage from vessels or equipment).	(shoreline), scouring (offshore associated with moorings, i.e. gravity based structures, etc.), vibration, dissipation of wave energy (offshore), water turbidity and water turbulence (both shoreline) associated with the presence of these devices and their support structures. The potential for installation impacts such as water turbidity and contamination risks associated with installation and operation (e.g. leakage from vessels or equipment) was also identified.	(shoreline), scouring (shoreline associated with outflows, and offshore associated with moorings, i.e. gravity based structures, etc.), dissipation of wave energy (offshore), changes in coastal processes and profile (both shoreline and offshore), water turbidity and water turbulence (both shoreline) associated with the presence of these devices and their support structures. The potential for installation impacts such as water turbidity and contamination risks associated with installation and operation (e.g. leakage from vessels or equipment) was also identified.
Climatic factors[13]	Potential for wave energy dissipation and, in some instances, may contribute to the protection of coastlines susceptible to erosion (i.e. Firth of Clyde). Likely contribution to renewable energy generation and reduction in GHG emissions (i.e. displacement of energy generated from non-renewable sources).	Potential for wave energy dissipation and, in some instances, may contribute to the protection of coastlines susceptible to erosion (i.e. Firth of Clyde). Likely contribution to renewable energy generation and reduction in GHG emissions (i.e. displacement of energy generated from non-renewable sources).	Potential for wave energy dissipation and, in some instances, may contribute to the protection of coastlines susceptible to erosion (i.e. Firth of Clyde). Likely contribution to renewable energy generation and reduction in GHG emissions (i.e. displacement of energy generated from non-renewable sources).	Likely contribution to renewable energy generation and reduction in GHG emissions (i.e. displacement of energy generated from non-renewable sources).	Potential for wave energy dissipation (offshore) and changes to coastal profile and character. The placement of shoreline devices may contribute to the protection of coastlines susceptible to erosion (i.e. Firth of Clyde). Likely contribution to renewable energy generation and reduction in GHG emissions (i.e. displacement of energy generated from non-renewable sources).	Potential for wave energy dissipation (offshore), changes to coastal processes and character/profile. The placement of these devices, in some instances, may contribute to the protection of coastlines susceptible to erosion (i.e. Firth of Clyde). Likely contribution to renewable energy generation and reduction in GHG emissions (i.e. displacement of energy generated from non-renewable sources).
Marine geology and coastal processes[14]	Summary of key potential effects on geology: • Disturbance or damage to coastal Geological SSSIs and Geological Conservation Review sites (GCRs) • Changes in coastal processes due to energy extraction, seabed contamination and water quality (including disposal areas)					
	Potential for impacts from local changes in wave energy dissipation and deposition due to the presence of these devices in the water column, and for changes to sediment dynamics, scouring, deposition, tidal flows and fluxes,	Potential for impacts from local changes in wave energy (i.e. dissipation) due to the presence of these devices, and for changes to sediment dynamics, scouring, deposition, water turbulence and direct abrasion on the seabed	Potential for impacts from local changes in wave energy (i.e. dissipation), changes to sediment dynamics, scouring, vibration, deposition, tidal flows and fluxes, water turbidity and water turbulence associated with	Potential for impacts from local changes in water turbulence due to the presence of these devices and their moorings. The potential may also exist for changes to sediment dynamics, scouring (associated with gravity	Potential local changes in water turbulence due to the presence of group of these devices, and the presence of support structures (likely gravity-based) in offshore and near-shore areas. The potential may also exist for	Potential local changes in water turbulence due to the presence of these devices at the shoreline, and in presence of support structures (likely gravity-based) in offshore and near-shore areas. The potential may also

[13] Informed by: Faber Maunsell (2007) Scottish Marine Renewables SEA: Environmental Report, Prepared for the Scottish Executive, March 2007; Talisman Energy (UK) LTD (2005) Environmental Statement [online] Available at: http://www.beatricewind.co.uk/downloads/statement.asp [accessed 25/03/2013]; EMU (2012) Neart na Gaoithe Offshore Wind Farm Environmental Statement, Prepared for Mainstream Renewable Power [online] Available at: http://mainstream-downloads.opendebate.co.uk/downloads/Contents-Pages.pdf [accessed 25/03/2013]; Aberdeen Wind Offshore Wind Farm Limited (2011) European Offshore Wind Deployment Centre: Non-Technical Summary, July 2011 [online] Available at: http://www.vattenfall.co.uk/en/file/EOWDC-consent-vol1.pdf_18476566.pdf [accessed 26/03/2013]; E-on (2008) Offshore Environmental Statement, April 2008 [online] Available at: http://www.eon-uk.com/generation/1309.aspx [accessed 26/03/2013]; E-on (2008) Onshore Cable Route Environmental Statement, April 2008 [online] Available at: http://www.eon-uk.com/generation/1309.aspx [accessed 26/03/2013]; and E-on (2009) Onshore Substation and Cable Spur Environmental Statement, November 2009 [online] Available at: http://www.eon-uk.com/generation/1309.aspx [accessed 26/03/2013.

[14] Informed by: Faber Maunsell (2007) Scottish Marine Renewables SEA: Environmental Report, Prepared for the Scottish Executive, March 2007; Talisman Energy (UK) LTD (2005) Environmental Statement [online] Available at: http://www.beatricewind.co.uk/downloads/statement.asp [accessed 25/03/2013]; EMU (2012) Neart na Gaoithe Offshore Wind Farm Environmental Statement, Prepared for Mainstream Renewable Power [online] Available at: http://mainstream-downloads.opendebate.co.uk/downloads/Contents-Pages.pdf [accessed 25/03/2013]; Aberdeen Wind Offshore Wind Farm Limited (2011) European Offshore Wind Deployment Centre: Non-Technical Summary, July 2011 [online] Available at: http://www.vattenfall.co.uk/en/file/EOWDC-consent-vol1.pdf_18476566.pdf [accessed 26/03/2013]; E-on (2008) Offshore Environmental Statement, April 2008 [online] Available at: http://www.eon-uk.com/generation/1309.aspx [accessed 26/03/2013]; E-on (2008) Onshore Cable Route Environmental Statement, April 2008 [online] Available at: http://www.eon-uk.com/generation/1309.aspx [accessed 26/03/2013]; and E-on (2009) Onshore Substation and Cable Spur Environmental Statement, November 2009 [online] Available at: http://www.eon-uk.com/generation/1309.aspx [accessed 26/03/2013.

SEA Topic Areas	Point Absorbers and Rotating Mass Devices	Attenuators and Bulge Wave Devices	Oscillating Wave Surge Converters	Submerged Pressure Differential	Oscillating Water Column (Offshore and Shoreline)	Overtopping Device (Offshore and Shoreline)
	water turbulence and direct abrasion on the seabed associated with the presence of moorings cables and structures.	associated with the presence of moorings cables and structures.	the presence of these devices and their support structures mounted on the seabed.	based structures, if used), vibration, deposition, tidal flows and fluxes, water turbidity and water turbulence associated with the presence of these devices in the water column and their support structures mounted on the seabed.	increased scouring and from changes to coastal processes and profiles (shoreline devices), and for seabed or coastal habitat disturbance/loss during installation, and abrasion of marine geology in installation of mooring systems and subsea cabling.	exist for scouring and changes to coastal processes (i.e. sediment dynamics, wave dissipation and tidal fluxes) during operation, and for seabed disturbance during installation (i.e. loss of habitat) and abrasion of marine geology in installation of mooring systems and subsea cabling.
Historic Environment[15]	Summary of key potential effects on marine and coastal historic environment include: • Direct disturbance, damage, or destruction of submarine archaeological remains and wrecks during device installation and cable trenching , • Direct disturbance, damage or destruction of coastal archaeological remains during cable trenching (effects of grid connections are considered separately below) • Disturbance, damage or loss of archaeological remains and sites during installation of cables and overhead lines and substation construction from onshore grid connections Key measures to prevent adverse effects may include: avoid sites of interest and exclusion zones for protected sites; follow Crown Estates 2007 JNAPC Code of Practice for seabed developers; carry out seabed surveys and walkover surveys prior to installation; carry out detailed routeing studies at project level in accordance with 'Holford Rules' best practice guidance on routeing overhead transmission lines.					
	There is the potential for placement of device moorings (i.e. gravity-base, anchors, etc.) on known and designated historic sites, and on unknown sites (i.e. wrecks). The potential may also exist for adverse effects on historic sites located nearby or downstream during operation (i.e. scouring, deposition/siltation or abrasion from moorings; deposition/siltation from the presence of devices). Adverse effects are likely to be avoided through careful siting of individual device moorings, although this may be more difficult for larger gravity bases or arrays of bases. Pre-construction impacts can result from intrusive site investigation. Construction effects as a result device installation, in particular from moorings, chains and cables. In particular as a result of piling and preparation of the seabed disturbing historic features. Secondary effects from construction might arise from vessels anchoring and from temporary visual impacts on the	There is the potential for placement of device moorings or structures (i.e. gravity-base, anchors, etc.) on known and designated historic sites, and on unknown sites (i.e. wrecks). The potential may also exist for adverse effects on historic sites located nearby or downstream during operation (i.e. scouring, deposition/siltation or abrasion from moorings). Adverse effects are likely to be avoided through careful siting of individual device moorings, although this may be more difficult for larger gravity bases or arrays of bases. Pre-construction impacts can result from intrusive site investigation. Construction effects as a result device installation, in particular from moorings, chains and cables. In particular as a result of piling and preparation of the seabed disturbing historic features. Secondary effects from construction might arise from vessels anchoring and from temporary visual impacts on the setting of historic features	There is the potential for placement of device support structures on known and designated historic sites, and on unknown sites (i.e. wrecks). The potential may also exist for adverse effects on historic sites located nearby or downstream during operation (i.e. scouring, deposition/siltation or abrasion from support structures). Adverse effects are likely to be avoided through careful siting of individual device support structures, although this may be more difficult for larger seabed-mounted structures or groups of structures. Pre-construction impacts can result from intrusive site investigation. Construction effects as a result device installation, in particular from moorings, chains and cables. In particular as a result of piling and preparation of the seabed disturbing historic features. Secondary effects from construction might arise from vessels anchoring and from temporary visual impacts on the	There is the potential for placement of device support structures on known and designated historic sites, and on unknown sites (i.e. wrecks). The potential may also exist for adverse effects on historic sites located nearby or downstream during operation (i.e. scouring, deposition/siltation or abrasion from support structures). Adverse effects are likely to be avoided through careful siting of individual device support structures, although this may be more difficult for larger seabed-mounted structures or groups of structures. Pre-construction impacts can result from intrusive site investigation. Construction effects as a result device installation, in particular from moorings, chains and cables. In particular as a result of piling and preparation of the seabed disturbing historic features. Secondary effects from construction might arise from vessels anchoring and from temporary visual impacts on the	There is the potential for placement of moorings (i.e. gravity-base, anchors, etc.) on known and designated historic sites, and on unknown sites (i.e. wrecks). The potential may also exist for adverse effects on historic sites located nearby or downstream during operation (i.e. scouring, deposition/siltation or abrasion from offshore support structures; scouring, changes in sediment dynamics and changes in the coastal profile/character from shoreline devices). Adverse effects are likely to be avoided through careful siting of individual device supports and moorings, although this may be more difficult for larger gravity bases or arrays of bases. Pre-construction impacts can result from intrusive site investigation. Construction effects as a result device installation, in particular from moorings, chains and cables. In particular as a result of piling and preparation of the seabed disturbing historic features. Secondary effects from construction might arise from	There is the potential for placement of offshore mooring structures or shoreline devices on known and designated historic sites, and on unknown sites (i.e. wrecks). The potential may also exist for adverse effects on historic sites located nearby or downstream of offshore devices during operation (i.e. scouring, deposition/siltation or abrasion from offshore support structures; scouring, changes in sediment dynamics and changes in the coastal profile/character from shoreline devices). Adverse effects are likely to be avoided through careful siting of individual devices and their supports or moorings, although this may be more difficult for shoreline structures, large gravity bases or arrays of bases. Pre-construction impacts can result from intrusive site investigation. Construction effects as a result device installation, in particular from moorings, chains and cables. In particular as a result of piling and preparation of the seabed disturbing historic

[15] Informed by: Fjordr Marine and Historic Environment Consulting (2013) Historic Environment Guidance for Wave and Tidal Energy (*Draft*) [online] Available at: www.fjordr.com/uploads/3/0/0/2/3002891/historic_environment_guidance_for_wave_and_tidal_energy_-_consultation_draft_150213.pdf [accessed 03/04/2013]; Faber Maunsell (2007) Scottish Marine Renewables SEA: Environmental Report, Prepared for the Scottish Executive, March 2007; Talisman Energy (UK) LTD (2005) Environmental Statement [online] Available at: http://www.beatricewind.co.uk/downloads/statement.asp [accessed 25/03/2013]; EMU (2012) Neart na Gaoithe Offshore Wind Farm Environmental Statement, Prepared for Mainstream Renewable Power [online] Available at: http://mainstream-downloads.opendebate.co.uk/downloads/Contents-Pages.pdf [accessed 25/03/2013]; Aberdeen Wind Offshore Wind Farm Limited (2011) European Offshore Wind Deployment Centre: Non-Technical Summary, July 2011 [online] Available at: http://www.vattenfall.co.uk/en/file/EOWDC-consent-vol1.pdf_18476566.pdf [accessed 26/03/2013]; E-on (2008) Offshore Environmental Statement, April 2008 [online] Available at: http://www.eon-uk.com/generation/1309.aspx [accessed 26/03/2013]; E-on (2008) Onshore Cable Route Environmental Statement, April 2008 [online] Available at: http://www.eon-uk.com/generation/1309.aspx [accessed 26/03/2013]; and E-on (2009) Onshore Substation and Cable Spur Environmental Statement, November 2009 [online] Available at: http://www.eon-uk.com/generation/1309.aspx [accessed 26/03/2013.

SEA Topic Areas	Point Absorbers and Rotating Mass Devices	Attenuators and Bulge Wave Devices	Oscillating Wave Surge Converters	Submerged Pressure Differential	Oscillating Water Column (Offshore and Shoreline)	Overtopping Device (Offshore and Shoreline)
	setting of historic features Associated cables and grid could directly impact on archaeological features on the seabed. Operational effects are more limited Mooring requires lengthy chains and cables that rest on the sea bed and these can cause damage to heritage assets. Changes to sediment processes and associated coastal erosion might cause impacts on some resources but may also help to reduce energy reaching shore and some erosion related heritage impacts. Visual impacts for the setting of historic features during operation, construction and decommissioning.	Associated cables and grid could directly impact on archaeological features on the seabed. Operational effects are more limited Mooring requires lengthy chains and cables that rest on the sea bed and these can cause damage to heritage assets. Changes to sediment processes and associated coastal erosion might cause impacts on some resources but may also help to reduce energy reaching shore and some erosion related heritage impacts. Visual impacts for the setting of historic features during operation, construction and decommissioning.	setting of historic features Associated cables and grid could directly impact on archaeological features on the seabed. Operational effects are more limited Mooring requires lengthy chains and cables that rest on the sea bed and these can cause damage to heritage assets. Changes to sediment processes and associated coastal erosion might cause impacts on some resources but may also help to reduce energy reaching shore and some erosion related heritage impacts. Visual impacts for the setting of historic features during operation, construction and decommissioning.	setting of historic features Associated cables and grid could directly impact on archaeological features on the seabed. Operational effects are more limited Mooring requires lengthy chains and cables that rest on the sea bed and these can cause damage to heritage assets. Changes to sediment processes and associated coastal erosion might cause impacts on some resources but may also help to reduce energy reaching shore and some erosion related heritage impacts. Visual impacts for the setting of historic features during operation, construction and decommissioning.	vessels anchoring and from temporary visual impacts on the setting of historic features Associated cables and grid could directly impact on archaeological features on the seabed. Operational effects are more limited Mooring requires lengthy chains and cables that rest on the sea bed and these can cause damage to heritage assets. Changes to sediment processes and associated coastal erosion might cause impacts on some resources but may also help to reduce energy reaching shore and some erosion related heritage impacts. Visual impacts for the setting of historic features during operation, construction and decommissioning.	features. Secondary effects from construction might arise from vessels anchoring and from temporary visual impacts on the setting of historic features Associated cables and grid could directly impact on archaeological features on the seabed. Operational effects are more limited Mooring requires lengthy chains and cables that rest on the sea bed and these can cause damage to heritage assets. Changes to sediment processes and associated coastal erosion might cause impacts on some resources but may also help to reduce energy reaching shore and some erosion related heritage impacts. Visual impacts for the setting of historic features during operation, construction and decommissioning.
Landscape and Seascape[16]	Summary of key potential effects on land/seascape include: • For linear structures, with devices at 0-5km from the coastline, effects may occur for all seascape types. The further from the coast, the less the effect becomes, and beyond 10km the effects are typically minor. • For point structures, 8 out of the 10 seascape types are of high sensitivity to these types of device, with potential effects occurring at 0-10km from coastline. Moderate effects may also occur at distances over 10km. • Submerged structures are likely to have negligible effects on seascape (although marker buoys and lighting may be required) • Fixed coastal structures may have moderate effects depending on their design and location. • Landscape and visual intrusion from substations and overhead lines as onshore grid connections. Key measures to prevent adverse effects may include: maximising the distance of devices from shore; reducing the height of devices above the surface; reducing the area of sea occupied by the devices; and modifying the position and layout of devices to suit characteristics of the local seascape; carry out detailed routeing studies at project level in accordance with 'Holford Rules' best practice guidance on routeing overhead transmission lines; avoid sensitive sites and areas; provide screening (substations).					
	The presence of surface-piercing devices, structures and marker buoys (e.g. lights for navigation) may have the potential to alter the aesthetic character of the coastline, particularly if located near-shore and in large numbers. In general terms, 8 out of the 10 seascape types are of high sensitivity to point structures such the surface-piercing structures on	Despite having a low profile comprising units on or above the water surface (i.e. Pelamis, bulge wave devices), these devices may have the potential to alter the aesthetic character of the coastline if placed in near-shore areas, particularly if surface-piercing support structures are also present. In general terms, effects may	The low profile of surface-piercing structures above the water surface may have the potential to alter the aesthetic character of the coastline, particularly if navigational lighting is used (i.e. noise and visual impacts).	No surface-piercing components, therefore no impacts identified during operation. There may potentially be temporary impacts during installation or decommissioning.	The profile of surface-piercing structures above the water surface (offshore) or on the shoreline (shoreline) may have the potential to alter the aesthetic character of the coastline (i.e. noise and visual impacts).	The profile of surface-piercing structures above the water surface (offshore) or on the shoreline (shoreline) may have the potential to alter the aesthetic character of the coastline (i.e. noise and visual impacts).

[16] Informed by: Faber Maunsell (2007) Scottish Marine Renewables SEA: Environmental Report, Prepared for the Scottish Executive, March 2007; Talisman Energy (UK) LTD (2005) Environmental Statement [online] Available at: http://www.beatricewind.co.uk/downloads/statement.asp [accessed 25/03/2013]; EMU (2012) Neart na Gaoithe Offshore Wind Farm Environmental Statement, Prepared for Mainstream Renewable Power [online] Available at: http://mainstream-downloads.opendebate.co.uk/downloads/Contents-Pages.pdf [accessed 25/03/2013]; Aberdeen Wind Offshore Wind Farm Limited (2011) European Offshore Wind Deployment Centre: Non-Technical Summary, July 2011 [online] Available at: http://www.vattenfall.co.uk/en/file/EOWDC-consent-vol1.pdf_18476566.pdf [accessed 26/03/2013]; E-on (2008) Offshore Environmental Statement, April 2008 [online] Available at: http://www.eon-uk.com/generation/1309.aspx [accessed 26/03/2013]; E-on (2008) Onshore Cable Route Environmental Statement, April 2008 [online] Available at: http://www.eon-uk.com/generation/1309.aspx [accessed 26/03/2013]; and E-on (2009) Onshore Substation and Cable Spur Environmental Statement, November 2009 [online] Available at: http://www.eon-uk.com/generation/1309.aspx [accessed 26/03/2013.

SEA Topic Areas	Point Absorbers and Rotating Mass Devices	Attenuators and Bulge Wave Devices	Oscillating Wave Surge Converters	Submerged Pressure Differential	Oscillating Water Column (Offshore and Shoreline)	Overtopping Device (Offshore and Shoreline)
	this device, with the potential for effects occurring at 0-10km from coastline. Moderate effects may also occur at distances over 10km.	occur for all seascape types with the presence of linear surface-piercing structures on devices less than 5km from the coastline. The further from the coast, the less the effect becomes, and beyond 10km the effects are typically minor.				

3 Tidal technology

SEA Topic Areas	Horizontal Axis Turbines	Vertical Axis Turbines	Reciprocating Hydrofoils	Emerging Technologies[17]
Device Information[18]	• Moving blades. • Can be suspended as part of a floating array (i.e. with moorings), or mounted directly on the seabed (i.e. monopiles). • Support structure/moorings may include by gravity/deadweight anchors, monopole, rock anchors or even gravity-base structures. • Potentially with surface-piercing components (i.e. monopole or pontoon support structures). • Generating equipment housed in support structure. • Marker buoys and other navigational aids are likely required.	• Moving blades. • Can be suspended as part of a floating array (i.e. with moorings), or mounted directly on the seabed (i.e. monopiles). • Support structure/moorings may include by gravity/deadweight anchors, rock anchors or even gravity-base structures. • Potentially with surface-piercing components (i.e. pontoon support structures). • Generating equipment housed in support structure. • Marker buoys and other navigational aids are likely required.	• Hydrofoils. • Can be mounted or moored on the seabed (i.e. monopiles, gravity-based). • Support structure/moorings may include by gravity/deadweight anchors, monopole, rock anchors or even gravity-base structures. • Potentially with surface-piercing components (i.e. pontoon support structures). • Present in upper, mid or lower water column. • Generating equipment housed in support structure. • Marker buoys and other navigational aids are likely required.	• Includes other emerging tidal technologies such as Venturia Effect or Enclosed Tip devices, Archimedes Screw and Tidal kite devices. • Can be mounted or moored on the seabed. • Support structure/moorings may include by gravity/deadweight anchors, monopole, rock anchors or even gravity-base structures. • Present in upper, mid or lower water column. • Marker buoys and other navigational aids are likely required.
Biodiversity/flora/ fauna[19]	Summary of key potential effects: • Physical disturbance during device installation • Noise during construction (particularly piling) and from device operation • Risk of collision with operating devices during foraging and feeding/travel (e.g. migration) • Accidental contamination from device failures, vessel collisions and storm damage • Habitat exclusion and species displacement due to device presence and operation • Increased mink predation due to the creation of islet chains between islands • Barriers to movement – due to avoidance reactions to noise and risk of collision • Increased suspended sediment/turbidity from seabed disturbance during device installation and cable trenching • Smothering from seabed disturbance during device installation and cable trenching • Changes in tidal flow and wave regime due to device presence and operation • Substratum loss, caused by attaching devices to the seabed • Habitat and species loss/disturbance during installation of cables and overhead lines and substation construction from onshore grid connections Key measures to prevent adverse effects may include: avoidance of sensitive sites; avoidance of sensitive seasons (e.g. breeding) during installation; use of devices with attachments that cause smaller seabed disturbance such as anchors and clump weights; protocols (such as use of Marine Mammal Observers) to ensure noisy construction activities do not occur when marine mammals are in close proximity; effective device design; and project-specific studies to help design appropriate mitigation; carry out detailed routeing studies at project level in accordance with 'Holford Rules' best practice guidance on routeing overhead transmission lines; avoid sensitive sites and areas; provide screening (substations)			
	Fauna: *Noise* Potential for underwater noise impacts on marine fauna during drilling/installation works and operation has been identified. There may	Fauna: *Noise* Potential for underwater noise impacts on marine fauna, particularly during drilling/installation works. Potential for	Fauna: *Attraction of Fauna* Potential for fish aggregation during shutdown periods or slack water (i.e. turbines not moving). There may be a potential risk of physical injury	Fauna: With similarities in infrastructure and the overall presence of devices in within the water column to that of turbine and hydrofoil devices, many of the potential impacts identified in the columns to

[17] For some tidal technologies, the potential effects specific to an individual technology may be less well known due, in part, to technologies still being in development. Whilst they may provide solutions for development within draft plan options, any potential impacts for commercial scale deployment may not have been fully ascertained through approved research. In these instances professional judgement has been used to consider whether the effects of similar technologies would also be applicable.
[18] Aquatera (2012) A review of the Potential Impacts of Wave and Tidal Energy development on Scotland's Marine Environment, Prepared for Marine Scotland, Final Report Issued 9 March 2012.
[19] Informed by Faber Maunsell (2007) Scottish Marine Renewables SEA: Environmental Report, Prepared for the Scottish Executive, March 2007; Aquatera (2012) A review of the Potential Impacts of Wave and Tidal Energy development on Scotland's Marine Environment, Prepared for Marine Scotland, Final Report Issued 9 March 2012; McCluskie, A.E., Langston R.H.W. and Wilkinson N.I. (undated) Birds and wave & tidal stream energy: an ecological review, RSPB Research Report No. 42 [online] Available at: http://www.rspb.org.uk/Images/mccluskie_langston_wilkinson_2012_tcm9-307966.pdf [accessed 28/03/2013];; Talisman Energy (UK) LTD (2005) Environmental Statement [online] Available at: http://www.beatricewind.co.uk/downloads/statement.asp [accessed 25/03/2013]; EMU (2012) Neart na Gaoithe Offshore Wind Farm Environmental Statement, Prepared for Mainstream Renewable Power [online] Available at: http://mainstream-downloads.opendebate.co.uk/downloads/Contents-Pages.pdf [accessed 25/03/2013]; Aberdeen Wind Offshore Wind Farm Limited (2011) European Offshore Wind Deployment Centre: Non-Technical Summary, July 2011 [online] Available at: http://www.vattenfall.co.uk/en/file/EOWDC-consent-vol1.pdf_18476566.pdf [accessed 26/03/2013]; E-on (2008) Offshore Environmental Statement, April 2008 [online] Available at: http://www.eon-uk.com/generation/1309.aspx [accessed 26/03/2013]; E-on (2008) Onshore Cable Route Environmental Statement, April 2008 [online] Available at: http://www.eon-uk.com/generation/1309.aspx [accessed 26/03/2013]; and E-on (2009) Onshore Substation and Cable Spur Environmental Statement, November 2009 [online] Available at: http://www.eon-uk.com/generation/1309.aspx [accessed 26/03/2013.

SEA Topic Areas	Horizontal Axis Turbines	Vertical Axis Turbines	Reciprocating Hydrofoils	Emerging Technologies[17]
	be the potential for behavioural impacts to marine fauna (i.e. seals, cetaceans, otter, basking shark), but there are significant unknowns on disturbance effects (likely site-specific), and noise levels that are actually generated. Acute effects are considered unlikely. The potential for impacts from above surface noise was identified for marine fauna, during installation works and where floating structures house noise-generating equipment. This potential impact relates to disturbance of species such as seals and otters, and these may be greater for devices located near to the shoreline. There are significant unknowns on disturbance effects (likely site-specific). *Shock Waves* The potential for shock waves was identified from the installation of monopiles and from waves hitting the side of high-profile surface-piercing structures. Hence, this is only applicable for devices with high-profile surface-piercing components. The likely magnitude of any impacts and their effects on these species is unknown, however, the potential for impacts to seals, cetaceans, otter and basking shark has been identified. Those with low-profile components (i.e. floating structures) are unlikely to create shock waves. *EMF* While no EMF impacts have been identified from the devices, there is the potential for EMF impacts from underwater cabling and grid connections. Further information is required to determine the potential susceptibility of marine fauna and likely effects associated with this issue. *Physical Barrier* The introduction of new structures in the water column, potentially the whole water column with support structures in place, may disrupt movements or migration of marine fauna. Unknowns over movements and migration routes (i.e. cetaceans, basking sharks), patterns of movement of other species (i.e. seals, otters), whether moorings and devices will be perceived or if they will simply alter their movement accordingly. Near-shore devices may restrict movement more than offshore (e.g. potentially greater alternatives for movement around devices offshore). Potential for fatal collisions for marine fauna with devices and moorings, particularly with moving turbine blades. Avoidance is likely for	behavioural impacts to seals, cetaceans, otter and basking shark. But there are significant unknowns on disturbance effects (likely site-specific), and noise levels that are actually generated. Acute effects are considered unlikely. The potential for impacts from above surface noise was identified for marine fauna, particularly during drilling/piling/installation works and where floating structures house noise-generating equipment. The potential relates to disturbance of species such as seals and otters, and these may be greater for devices near to the shoreline. There are significant unknowns on disturbance effects (likely site-specific). *Shock Waves* The potential for shock waves was identified from the installation of monopiles and from waves hitting the side of high-profile surface-piercing structures. Hence, this is only applicable for devices with high-profile surface-piercing components. The likely magnitude of any impacts and their effects on these species is unknown, however, the potential for impacts to seals, cetaceans, otter and basking shark has been identified. Those with low-profile components (i.e. floating structures) are unlikely to create shock waves. *EMF* While no EMF impacts have been identified from the devices, there is the potential for EMF impacts from underwater cabling and grid connections. Further information is required to determine the potential susceptibility of marine fauna and likely effects associated with this issue. *Physical Barrier* The introduction of new structures in the water column may disrupt movements or migration of marine fauna. Unknowns over known movements and migration routes (i.e. cetaceans, basking sharks), patterns of movement of other species (i.e. seals, otters), whether moorings and devices will be perceived or if they will simply alter their movement accordingly. Near-shore devices may restrict movement more than offshore (e.g. potentially greater alternatives for movement around devices offshore). Potential for fatal collisions for marine fauna with devices and moorings, particularly with moving turbine blades. Avoidance is likely for	to some species during periods of start-up (i.e. when the blades start moving), due to this aggregation. *Noise* Potential for underwater noise impacts on marine fauna, particularly during drilling/installation works. Potential for behavioural impacts to seals, cetaceans, otter and basking shark. But there are significant unknowns on disturbance effects (likely site-specific), and noise levels that are actually generated. Acute effects are considered unlikely. The potential for impacts from above surface noise was identified for marine fauna, particularly during drilling/piling/installation works and where floating structures house noise-generating equipment. The potential relates to disturbance of species such as seals and otters, and these may be greater for devices near to the shoreline. There are significant unknowns on disturbance effects (likely site-specific). *EMF* While no EMF impacts have been identified from the devices, there is the potential for EMF impacts from underwater cabling and grid connections. Further information is required to determine the potential susceptibility of marine fauna and likely effects associated with this issue. *Physical Barrier* The introduction of new structures in the water column may disrupt movements or migration of marine fauna. Unknowns over known movements and migration routes (i.e. cetaceans, basking sharks), patterns of movement of other species (i.e. seals, otters), whether moorings and devices will be perceived or if they will simply alter their movement accordingly. Near-shore devices may restrict movement more than offshore (e.g. potentially greater alternatives for movement around devices offshore). Potential for fatal collisions for marine fauna with devices and support structures/moorings. Collision with or entanglement in mooring lines is also considered possible for larger species (i.e. cetaceans and basking sharks), particularly in complex arrays. Avoidance is likely for many species (i.e. fish), but impact could be fatal for some species if it were to occur (i.e. seals, otters, cetaceans, basking shark). It is however, considered unlikely.	the left are likely to be associated with these emerging technologies. For example, effects such as the potential for attraction of fauna, underwater noise impacts during operation and drilling/installation works, and potential for EMF effects associated with cabling may be applicable for these technologies and their associated infrastructure. Other effects, such as the potential for behavioural impacts and disturbance (i.e. displacement of foraging, etc.), possible collision with devices and moorings, have also been identified. However, as indicated for other tidal energy devices, there are likely to be significant unknowns over such effects.

SEA Topic Areas	Horizontal Axis Turbines	Vertical Axis Turbines	Reciprocating Hydrofoils	Emerging Technologies[17]
	some species (i.e. fish), but impact could be fatal for some species if it were to occur (i.e. seals, otters, cetaceans, basking shark). Collision with, entanglement or entrapment by mooring lines is also considered possible for larger species (i.e. cetaceans and basking sharks), particularly in groups of devices or complex mooring arrays. While this may also result in injury or fatality, it is also considered unlikely. *Displacement* Displacement is likely to be site-specific and would depend on a range of other factors (suitable alternative sites, importance of habitat, etc.). It can be due to the presence of devices or structures, or from disturbance in installation, operation or decommissioning (i.e. noise above and below the water surface, displacement of prey, etc.). This will also likely depend on what activities are being displaced (e.g. Basking sharks avoiding of structures or installation/servicing vessel activities may lead to the displacement of foraging activities or courtship behaviour). Others may simply choose alternative sites for foraging or as migratory routes if sufficiently disturbed, and if suitable areas are available.	many species (i.e. fish), but impact could be fatal for some species if it were to occur (i.e. seals, otters, cetaceans, basking shark). Collision with or entanglement in mooring lines is also considered possible for larger species (i.e. cetaceans and basking sharks), particularly in complex arrays. While this may also result in injury or fatality, it is considered unlikely. *Displacement* Displacement is likely to be site-specific and would depend on a range of other factors (suitable alternative sites, importance of habitat, etc.). Can be from presence of devices or structures, or due to disturbance in installation, operation or decommissioning (i.e. noise, vibration, displacement of prey, etc.). Will also depend on what activities are being displaced (e.g. Basking sharks avoiding of structures or installation/servicing vessel activities may lead to the displacement of foraging activities or courtship behaviour). Others may simply choose alternative sites for foraging or as migratory routes if disturbed, if these are available.	*Displacement* Displacement is likely to be site-specific and would depend on a range of other factors (suitable alternative sites, importance of habitat, etc.). Can be from presence of devices or structures, or due to disturbance in installation, operation or decommissioning (i.e. noise, vibration, displacement of prey, etc.). Will also depend on what activities are being displaced (e.g. Basking sharks avoiding of structures or installation/servicing vessel activities may lead to the displacement of foraging activities or courtship behaviour). Others may simply choose alternative sites for foraging or as migratory routes if disturbed, if these are available.	
	Birds: *Collision* Potential collision risk with devices within the water column for shallow-diving birds. Collisions have the potential to be fatal for marine birds, which can dive to depths of up to 60m from the water surface (e.g. common guillemots, long-tailed ducks). This is likely to be of particular concern with the moving blades present on these devices. *Impacts on foraging* Localised changes in turbulence from the presence and operation of devices (e.g. moving blades, presence of structures in the water column) may have the potential to affect the foraging success of marine birds. However, the potential effects are not currently known and may be difficult to identify a causal link between the two. *Noise* Potential noise risk, both above and below water surface, during installation and decommissioning works in particular (i.e. during piling, drilling for rock anchors, if used) and operation of blades below the water surface. Significant unknowns around the magnitude of	Birds: *Collision* Potential collision risk with devices within the water column for shallow-diving birds. Collisions have the potential to be fatal for marine birds, which can dive to depths of up to 60m from the water surface (e.g. common guillemots, long-tailed ducks). Of particular concern if there are moving blades on the device. *Impacts on foraging* Localised changes in turbulence from the presence and operation of devices (e.g. moving blades, presence of structures in the water column) may have the potential to affect the foraging success of marine birds. However, the potential effects are not currently known and may be difficult to identify a causal link between the two. *Noise* Potential noise risk, both above and below water surface, during installation and decommissioning works in particular (i.e. during piling, drilling for rock anchors, if used). Significant unknowns around the magnitude of impact, although it could potentially be	Birds: *Collision* Potential collision risk with devices within the water column for shallow-diving birds. Collisions have the potential to be fatal for marine birds, which can dive to depths of up to 60m from the water surface (e.g. common guillemots, long-tailed ducks). Blades are likely to be slower moving that other devices (i.e. horizontal/vertical axis turbines), and as such, may present less of a hazard to diving marine birds. *Impacts on foraging* Localised changes in turbulence from the presence and operation of devices (e.g. presence of structures in the water column) may have the potential to affect the foraging success of marine birds. However, the potential effects are not currently known and may be difficult to identify a causal link between the two. *Noise* Potential noise risk below water surface, during installation and decommissioning works in particular (i.e. during piling, if used). Significant unknowns around the magnitude of impact, although it could potentially be damaging.	Birds: With similarities in infrastructure and the overall presence of devices in within the water column to that of turbine and hydrofoil devices, many of the potential impacts identified in the columns to the left are likely to be associated with these emerging technologies. The potential for effects such as collision risk with devices and their associated structures (e.g. moorings), behavioural impacts (e.g. foraging) and disturbance from underwater noise on diving birds has been identified (see left).

SEA Topic Areas	Horizontal Axis Turbines	Vertical Axis Turbines	Reciprocating Hydrofoils	Emerging Technologies[17]
	impact, although it has been identified as potentially damaging. Potential for noise impacts from generators within devices or their support structures for species, particularly for coastal breeding sites if devices are located in near-shore environment. Noise within devices is likely to be low and constant and the effects are unknown, as effects of increased/altered noise levels are not known for birds at present (displacement/avoidance, impacts to foraging success, etc.). It is noted that high energy environments are likely to have high levels of background noise. Underwater noise from the presence and operation of devices, the importance of hearing underwater for birds and their threshold levels is not currently known. As such the effects of altered underwater noise levels is not known, but potential impacts such as displacement, avoidance, reduction in foraging success, no effect, etc. have been identified. *Disturbance and Displacement* Potential for displacement during installation and operation, but dependant on other factors (i.e. sensitivity of habitats, availability of suitable alternative habitats) and may only be temporary as fauna become accustomed to the devices. Likely dependant on site-specific including the sensitivity of species and the activities displaced (i.e. foraging, noise disturbance, etc.). Potential for visual disturbance if surface-piercing components are present, with the potential for greater impacts if located near-shore and close to coastal breeding sites and moulting sites. In such instances, birds in flight may operate in a broadly similar way and use similar avoidance tactics to those employed when encountering other natural and man-made obstructions (i.e. by taking alternative flight routes, avoiding obstructions to a greater degree at night).	damaging. Potential for noise impacts from generators within devices for species, particularly for coastal breeding sites if devices are located in near-shore environment. Noise within devices is likely to be low and constant and the effects are unknown, as effects of increased/altered noise levels are not known for birds at present (displacement/avoidance, impacts to foraging success, etc.). It is noted that high energy environments are likely to have high levels of background noise. Underwater noise from presence and operation of devices is not known, as is the importance of hearing underwater for birds and threshold levels. As such the effects of altered underwater noise levels is not known, but potential impacts may include displacement, avoidance, reduction in foraging success, no effect, etc. *Disturbance and Displacement* Potential for displacement during installation and operation, but dependant on other factors (i.e. sensitivity of habitats, availability of suitable alternative habitats) and may only be temporary as fauna become accustomed to the devices. Likely dependant on site-specific including the sensitivity of species and the activities displaced (i.e. foraging, noise disturbance, etc.). Potential for visual disturbance if surface-piercing components are present, with potential for greater impacts if close to coastal breeding sites and moulting sites. In such instances, birds in flight may operate in a broadly similar way and use similar avoidance tactics to those employed when encountering other natural and man-made obstructions (i.e. by taking alternative flight routes, avoiding obstructions to a greater degree at night).	Underwater noise from presence and operation of devices is not known, as is the importance of hearing underwater for birds and threshold levels. As such the effects of altered underwater noise levels is not known, but potential impacts may include displacement, avoidance, reduction in foraging success, no effect, etc. *Disturbance and Displacement* Potential for displacement during installation and operation, but dependant on other factors (i.e. sensitivity of habitats, availability of suitable alternative habitats) and may only be temporary as fauna become accustomed to the devices. Likely dependant on site-specific including the sensitivity of species and the activities displaced (i.e. foraging, noise disturbance, etc.). Unlikely to have permanent above-water components (other than in installation), and therefore are not considered to create visual disturbance.	
	<u>Benthic Habitats:</u> *Habitat Changes* The presence of these devices in the water column and their supporting structures (i.e. moorings, monopole structures, etc.) has the potential to contribute to habitat changes in a number of ways. In general, impacts on seabed habitats from the devices themselves are likely limited to changes in tidal flows, fluxes and turbulence due to the presence of these devices and associated structures in the	<u>Benthic Habitats:</u> *Habitat Changes* The presence of these devices in the water column and their supporting structures (i.e. moorings, monopole structures, etc.) has the potential to contribute to habitat changes in a number of ways. In general, impacts on seabed habitats from the devices themselves are likely limited to changes in tidal flows, fluxes and turbulence due to the presence of these devices and associated structures in the	<u>Benthic Habitats:</u> *Habitat Changes* The presence of these devices in the water column and their supporting structures (i.e. moorings, monopole structures, etc.) has the potential to contribute to habitat changes in a number of ways. In general, impacts on benthic habitats from the devices themselves are likely limited to changes in tidal flows, fluxes and turbulence due to the presence of these devices and associated structures in the water column.	<u>Benthic Habitats:</u> With the presence of tidal energy devices within the water column and the likelihood of seabed disturbance during installation, many of the potential impacts identified in the columns to the left are likely to be associated with these emerging technologies. In general terms, the potential for impacts on benthic habitats from the devices themselves is likely limited to loss of benthos from the installation of a device and its seabed mounting,

SEA Topic Areas	Horizontal Axis Turbines	Vertical Axis Turbines	Reciprocating Hydrofoils	Emerging Technologies[17]
	water column. Other impacts, such as scouring, deposition/siltation, abrasion, smothering and the potential for loss of habitat are likely to be associated with the placement of supports (i.e. gravity and rock anchors, etc.) on the seabed and mooring lines in the water column. Direct seabed impacts such as changes in sediment dynamics, scouring, deposition/siltation and abrasion from supports and moorings have the potential to affect benthic habitats in a range of ways. These can include the introduction of variations and shifts in grain size of sediments affecting habitat character and species distribution; shading or smothering of benthic areas, changes in species distribution via interference with filter feeders (i.e. interference with feeding, inhibiting respiration, smothering, reproduction, loss of habitat, affecting species distribution, reducing food sources for other species, etc.), and leading to wider changes in ecosystem composition. In some instances, this may also result in changes to changing in coastal character/profile. *Sediment Dynamics, Scour, deposition and Smothering* Changes in sediment dynamics due to the presence of moorings for these devices (gravity anchors, gravity base structures, monopiles, rock anchors and mooring lines) may occur, with the potential for associated impacts such as scouring, deposition/siltation and smothering. The potential for significant change to habitats has been identified. While likely site specific, this may present a potential risk to BAP species such as mussel beds, *M. edulis*, and filter feeders initially with secondary impacts up the food chain (i.e. affecting predatory species that feed on them). The potential for impacts in a range of BAP habitats has been identified: • Changes in sediment dynamics, increased scour and sediment deposition in High energy littoral rock (including BAP habitat Tidal Swept Channels) if *F. distichus* is present. • Changes in sediment dynamics, increased scour, and the deposition of sediment during high tide in Moderate energy littoral (including BAP habitat Under boulder communities) if under boulder communities are present. Deposition may reduce photosynthesis for algae (i.e. *F. serratus, F. vesticulosus, M. stellatus*).	water column. Other impacts, such as scouring, deposition/siltation, abrasion, smothering and the potential for loss of habitat are likely to be associated with the placement of supports (i.e. gravity and rock anchors, etc.) on the seabed and mooring lines in the water column. Direct seabed impacts from these systems, such as changes in sediment dynamics, scouring, deposition/siltation and abrasion from supports and moorings have the potential to affect benthic habitats in a range of ways. These can include the introduction of variations and shifts in grain size of sediments affecting habitat character and species distribution; shading or smothering of benthic areas, changes in species distribution via interference with filter feeders (i.e. interference with feeding, inhibiting respiration, smothering, reproduction, loss of habitat, affecting species distribution, reducing food sources for other species, etc.), and leading to wider changes in ecosystem composition. In some instances, this may also result in changes to changing in coastal character/profile. *Sediment Dynamics, Scour, deposition and Smothering* Changes in sediment dynamics due to the presence of moorings for these devices (gravity anchors, gravity base structures, monopiles, rock anchors and mooring lines) may occur, with the potential for associated impacts such as scouring, deposition/siltation and smothering. The potential for significant change to habitats has been identified. While likely site specific, this may present a potential risk to BAP species such as mussel beds, *M. edulis*, and filter feeders initially with secondary impacts up the food chain (i.e. affecting predatory species that feed on them). The potential for impacts in a range of BAP habitats has been identified: • Changes in sediment dynamics, increased scour and sediment deposition in High energy littoral rock (including BAP habitat Tidal Swept Channels) if *F. distichus* is present. • Changes in sediment dynamics, increased scour, and the deposition of sediment during high tide in Moderate energy littoral (including BAP habitat Under boulder communities) if under boulder communities are present. Deposition may reduce photosynthesis for algae (i.e. F. serratus,	Other impacts, such as scouring, deposition/siltation, abrasion, smothering and the potential for loss of habitat are likely to be associated with the placement of supports (i.e. gravity and rock anchors, etc.) on the seabed and mooring lines in the water column. Direct seabed impacts such as changes in sediment dynamics, scouring, deposition/siltation and abrasion from supports and moorings have the potential to affect benthic habitats in a range of ways. These can include the introduction of variations and shifts in grain size of sediments affecting habitat character and species distribution; shading or smothering of benthic areas, changes in species distribution via interference with filter feeders (i.e. interference with feeding, inhibiting respiration, smothering, reproduction, loss of habitat, affecting species distribution, reducing food sources for other species, etc.), and leading to wider changes in ecosystem composition. *Sediment Dynamics, Scour, deposition and Smothering* Changes in sediment dynamics due to the presence of moorings for these devices (gravity anchors, gravity base structures, monopiles, rock anchors and mooring lines) may occur, with the potential for associated impacts such as scouring, deposition/siltation and smothering. The potential for significant change to habitats has been identified. While likely site specific, this may present a potential risk to BAP species such as mussel beds, *M. edulis*, and filter feeders initially with secondary impacts up the food chain (i.e. affecting predatory species that feed on them). The potential for impacts in a range of BAP habitats has been identified: • Changes in sediment dynamics, increased scour and sediment deposition in High energy littoral rock (including BAP habitat Tidal Swept Channels) if *F. distichus* is present. • Changes in sediment dynamics, increased scour, and the deposition of sediment during high tide in Moderate energy littoral (including BAP habitat Under boulder communities) if under boulder communities are present. Deposition may reduce photosynthesis for algae (i.e. F. serratus, F. vesticulosus, M. stellatus). • Changes in sediment dynamics, increased scour, and deposition of sediment during high tide in Littoral biogenic reefs (including BAP habitat blue mussel beds) and interference with filter feeders (i.e. *M. edulis*, *S. alveolata*). Impacts are unlikely, but	(i.e. anchors, piling, etc.) to changes in tidal flows, fluxes and turbulence due to the presence of these devices and associated structures in the water column. The potential for associated effects (e.g. sediment deposition, scouring, smothering, abrasion, etc.) during the operational phase of a project has also been identified for a range of habitats (see left).

SEA Topic Areas	Horizontal Axis Turbines	Vertical Axis Turbines	Reciprocating Hydrofoils	Emerging Technologies[17]
	• Changes in sediment dynamics, increased scour, and deposition of sediment during high tide in Littoral biogenic reefs (including BAP habitat blue mussel beds) and interference with filter feeders (i.e. *M. edulis*, *S. alveolata*). Impacts are unlikely, but potential noted if blue mussel beds are present. Potential for changing the character of this habitat. • Changes in sediment dynamics, increased scour and deposition of sediment in features of littoral sediment (including BAP habitat blue mussel beds) and interference with filter feeders (i.e. *M. edulis*). Impacts are unlikely in small arrays, but may change the habitat character, with potential impacts noted if blue mussel beds are present. • Changes in sediment dynamics, and associated increased scour, deposition and smothering in Sublittoral coarse sediment (including BAP habitats subtidal sands and gravel, blue mussel beds). Impacts unlikely for small arrays, although potential for interference with filter feeders (i.e. *M. modiolus*, *A. digitatum*, *A. fragilis*) and potential impacts identified if *A. fragilis*, *C. cruoriaeformis*, *D. Montagnei*, *E. timida* or horse mussel beds are present. • Changes in sediment dynamics, and associated increased scour, deposition and smothering in Sublittoral sand (including BAP habitat sub-tidal sands and gravel, blue mussel beds). Impacts are unlikely for small arrays, although potential for interference with filter feeders (i.e. *M. edulis*, *A. fragilis*) and potential impacts identified if *A. fragilis*, *E. timida*, *A. sarsi* or blue mussel beds are present • Changes in sediment dynamics, and associated increased scour, deposition and smothering in Sublittoral mixed sediments (including BAP habitat Horse mussel beds, file shell beds). Impacts are unlikely for a small array, although there may be the potential for interference with filter feeders (i.e. *M. modiolus*, *A. digitatum*, *A. fragilis*) and potential impacts have been identified if *A. fragilis*, *D. Montagnei*, *E. timida*, horse mussel beds or file shell beds are present. • Changes in sediment dynamics, and associated increased scour, deposition and smothering in Sublittoral macrophyte-dominated sediment (including BAP habitats maerl beds, tidal swept channels, horse mussel beds, blue mussel beds). Impacts are unlikely for a small array,	F. vesticulosus, M. stellatus). • Changes in sediment dynamics, increased scour, and deposition of sediment during high tide in Littoral biogenic reefs (including BAP habitat blue mussel beds) and interference with filter feeders (i.e. *M. edulis*, *S. alveolata*). Impacts are unlikely, but potential noted if blue mussel beds are present. Potential for changing the character of this habitat. • Changes in sediment dynamics, increased scour and deposition of sediment in features of littoral sediment (including BAP habitat blue mussel beds) and interference with filter feeders (i.e. *M. edulis*). Impacts are unlikely in small arrays, but may change the habitat character, with potential impacts noted if blue mussel beds are present. • Changes in sediment dynamics, and associated increased scour, deposition and smothering in Sublittoral coarse sediment (including BAP habitats subtidal sands and gravel, blue mussel beds). Impacts unlikely for small arrays, although potential for interference with filter feeders (i.e. *M. modiolus*, *A. digitatum*, *A. fragilis*) and potential impacts identified if *A. fragilis*, *C. cruoriaeformis*, *D. Montagnei*, *E. timida* or horse mussel beds are present. • Changes in sediment dynamics, and associated increased scour, deposition and smothering in Sublittoral sand (including BAP habitat sub-tidal sands and gravel, blue mussel beds). Impacts are unlikely for small arrays, although potential for interference with filter feeders (i.e. *M. edulis*, *A. fragilis*) and potential impacts identified if *A. fragilis*, *E. timida*, *A. sarsi* or blue mussel beds are present • Changes in sediment dynamics, and associated increased scour, deposition and smothering in Sublittoral mixed sediments (including BAP habitat Horse mussel beds, file shell beds). Impacts are unlikely for a small array, although there may be the potential for interference with filter feeders (i.e. *M. modiolus*, *A. digitatum*, *A. fragilis*) and potential impacts have been identified if *A. fragilis*, *D. Montagnei*, *E. timida*, horse mussel beds or file shell beds are present. • Changes in sediment dynamics, and associated increased scour, deposition and smothering in Sublittoral macrophyte-	potential noted if blue mussel beds are present. Potential for changing the character of this habitat. • Changes in sediment dynamics, increased scour and deposition of sediment in features of littoral sediment (including BAP habitat blue mussel beds) and interference with filter feeders (i.e. *M. edulis*). Impacts are unlikely in small arrays, but may change the habitat character, with potential impacts noted if blue mussel beds are present. • Changes in sediment dynamics, and associated increased scour, deposition and smothering in Sublittoral coarse sediment (including BAP habitats subtidal sands and gravel, blue mussel beds). Impacts unlikely for small arrays, although potential for interference with filter feeders (i.e. *M. modiolus*, *A. digitatum*, *A. fragilis*) and potential impacts identified if *A. fragilis*, *C. cruoriaeformis*, *D. Montagnei*, *E. timida* or horse mussel beds are present. • Changes in sediment dynamics, and associated increased scour, deposition and smothering in Sublittoral sand (including BAP habitat sub-tidal sands and gravel, blue mussel beds). Impacts are unlikely for small arrays, although potential for interference with filter feeders (i.e. *M. edulis*, *A. fragilis*) and potential impacts identified if *A. fragilis*, *E. timida*, *A. sarsi* or blue mussel beds are present • Changes in sediment dynamics, and associated increased scour, deposition and smothering in Sublittoral mixed sediments (including BAP habitat Horse mussel beds, file shell beds). Impacts are unlikely for a small array, although there may be the potential for interference with filter feeders (i.e. *M. modiolus*, *A. digitatum*, *A. fragilis*) and potential impacts have been identified if *A. fragilis*, *D. Montagnei*, *E. timida*, horse mussel beds or file shell beds are present. • Changes in sediment dynamics, and associated increased scour, deposition and smothering in Sublittoral macrophyte-dominated sediment (including BAP habitats maerl beds, tidal swept channels, horse mussel beds, blue mussel beds). Impacts are unlikely for a small array, although there may be the potential for interference with filter feeders (i.e. *M. modiolus*, *A. digitatum*, *M. edulis*, *A. fragilis*) and potential impacts have been identified if *A. fragilis*, *C. cruoriaeformis*, *D. Montagnei*, *P. calcareum*, *L. corallioides*, horse mussel beds, blue	

SEA Topic Areas	Horizontal Axis Turbines	Vertical Axis Turbines	Reciprocating Hydrofoils	Emerging Technologies[17]
	although there may be the potential for interference with filter feeders (i.e. *M. modiolus*, *A. digitatum*, *M. edulis*, *A. fragilis*) and potential impacts have been identified if *A. fragilis*, *C. cruoriaeformis*, *D. Montagnei*, *P. calcareum*, *L. corallioides*, horse mussel beds, blue mussel beds of maerl beds are present • Changes in sediment dynamics, and associated increased scour, deposition and smothering in Sublittoral biogenic reefs (including BAP habitats horse mussel beds, cold-water coral reefs and blue mussel beds). Impacts are unlikely for a small array, although there may be the potential for interference with filter feeders (i.e. *M. modiolus*, *A. digitatum*, *M. edulis*) and potential impacts have been identified if horse mussel beds, cold-water coral reefs or blue mussel beds are present. • Changes in sediment dynamics in Atlantic and Mediterranean high energy infralittoral rock (including BAP habitat Tidal Swept Channels). Smothering may affect filter feeders (*S. pallida*, *U. feline*, *A. digitatum*, *B. schlosseri*, *H. panacea*) from feeding and growth, while photosynthesis by algae may be compromised. Potential for impacts on *S. pallida*, as even small impacts may have important influences on UK populations. • Changes in sediment dynamics in Atlantic and Mediterranean moderate energy infralittoral rock (including BAP habitat Tidal Swept Channels and *S. spinulosa* reefs). Smothering may affect filter feeders (*S. pallida*, *U. feline*, *A. digitatum*, *B. schlosseri*, *H. panacea*) from feeding and growth, while photosynthesis by algae may be compromised. Potential for impacts on A. dohrnii and *S. pallida*, as even small impacts may have important influences on UK populations. • Changes in sediment dynamics in Atlantic and Mediterranean high energy circalittoral rock (including BAP habitat Tidal Swept Channels). Smothering may affect filter feeders (*S. pallida*, *U. feline*, *A. digitatum*, *B. schlosseri*, *H. panacea*) from feeding and growth, while photosynthesis by algae may be compromised. Potential for impacts on *S. pallida*, as even small impacts may have important influences on UK populations. • Changes in sediment dynamics in Atlantic and Mediterranean moderate energy circalittoral rock. Potential for smothering impacts on A. dohrnii and *S. pallida*, as	dominated sediment (including BAP habitats maerl beds, tidal swept channels, horse mussel beds, blue mussel beds). Impacts are unlikely for a small array, although there may be the potential for interference with filter feeders (i.e. *M. modiolus*, *A. digitatum*, *M. edulis*, *A. fragilis*) and potential impacts have been identified if *A. fragilis*, *C. cruoriaeformis*, *D. Montagnei*, *P. calcareum*, *L. corallioides*, horse mussel beds, blue mussel beds of maerl beds are present • Changes in sediment dynamics, and associated increased scour, deposition and smothering in Sublittoral biogenic reefs (including BAP habitats horse mussel beds, cold-water coral reefs and blue mussel beds). Impacts are unlikely for a small array, although there may be the potential for interference with filter feeders (i.e. *M. modiolus*, *A. digitatum*, *M. edulis*) and potential impacts have been identified if horse mussel beds, cold-water coral reefs or blue mussel beds are present. • Changes in sediment dynamics in Atlantic and Mediterranean high energy infralittoral rock (including BAP habitat Tidal Swept Channels). Smothering may affect filter feeders (*S. pallida*, *U. feline*, *A. digitatum*, *B. schlosseri*, *H. panacea*) from feeding and growth, while photosynthesis by algae may be compromised. Potential for impacts on *S. pallida*, as even small impacts may have important influences on UK populations. • Changes in sediment dynamics in Atlantic and Mediterranean moderate energy infralittoral rock (including BAP habitat Tidal Swept Channels and *S. spinulosa* reefs). Smothering may affect filter feeders (*S. pallida*, *U. feline*, *A. digitatum*, *B. schlosseri*, *H. panacea*) from feeding and growth, while photosynthesis by algae may be compromised. Potential for impacts on A. dohrnii and *S. pallida*, as even small impacts may have important influences on UK populations. • Changes in sediment dynamics in Atlantic and Mediterranean high energy circalittoral rock (including BAP habitat Tidal Swept Channels). Smothering may affect filter feeders (*S. pallida*, *U. feline*, *A. digitatum*, *B. schlosseri*, *H. panacea*) from feeding and growth, while photosynthesis by algae may be compromised. Potential for impacts on *S. pallida*, as even small	mussel beds of maerl beds are present • Changes in sediment dynamics, and associated increased scour, deposition and smothering in Sublittoral biogenic reefs (including BAP habitats horse mussel beds, cold-water coral reefs and blue mussel beds). Impacts are unlikely for a small array, although there may be the potential for interference with filter feeders (i.e. *M. modiolus*, *A. digitatum*, *M. edulis*) and potential impacts have been identified if horse mussel beds, cold-water coral reefs or blue mussel beds are present. • Changes in sediment dynamics in Atlantic and Mediterranean high energy infralittoral rock (including BAP habitat Tidal Swept Channels). Smothering may affect filter feeders (*S. pallida*, *U. feline*, *A. digitatum*, *B. schlosseri*, *H. panacea*) from feeding and growth, while photosynthesis by algae may be compromised. Potential for impacts on *S. pallida*, as even small impacts may have important influences on UK populations. • Changes in sediment dynamics in Atlantic and Mediterranean moderate energy infralittoral rock (including BAP habitat Tidal Swept Channels and *S. spinulosa* reefs). Smothering may affect filter feeders (*S. pallida*, *U. feline*, *A. digitatum, B. schlosseri, H. panacea*) from feeding and growth, while photosynthesis by algae may be compromised. Potential for impacts on A. dohrnii and *S. pallida*, as even small impacts may have important influences on UK populations. • Changes in sediment dynamics in Atlantic and Mediterranean high energy circalittoral rock (including BAP habitat Tidal Swept Channels). Smothering may affect filter feeders (*S. pallida*, *U. feline*, *A. digitatum*, *B. schlosseri*, *H. panacea*) from feeding and growth, while photosynthesis by algae may be compromised. Potential for impacts on *S. pallida*, as even small impacts may have important influences on UK populations. • Changes in sediment dynamics in Atlantic and Mediterranean moderate energy circalittoral rock. Potential for smothering impacts on A. dohrnii and *S. pallida*, as even small impacts may have important influences on UK populations. • Changes in sediment dynamics and deposition in features of circalittoral rock may hinder filter feeders (i.e. respiration, feeding and growth). While characteristic	

SEA Topic Areas	Horizontal Axis Turbines	Vertical Axis Turbines	Reciprocating Hydrofoils	Emerging Technologies[17]
	even small impacts may have important influences on UK populations. • Changes in sediment dynamics and deposition in features of circalittoral rock may hinder filter feeders (i.e. respiration, feeding and growth). While characteristic species are common and widespread, potential for impact is noted since this habitat is seldom recorded. *Loss of Habitat/Abrasion* The direct placement of offshore or near-shore devices, and/or their moorings on the seabed can result in damage to benthic habitats, or their loss in extreme instances (e.g. seabed structures, piling, drilling and anchoring, subsea cable placement). This could also include additional damage such as the abrasion of marine habitats and sessile/sedentary species (i.e. BAP species such as mussel and file shell beds) from the installation of technology (i.e. mooring cables dragging during installation) and subsea cabling (i.e. placement and dragging during installation and operation). The potential for impacts in a range of BAP habitats has been identified: • Loss of habitat and Abrasion from foundation/mooring systems in Atlantic and Mediterranean high energy infralittoral rock (including BAP habitat Tidal Swept Channels), particularly if *S. pallida* populations is present. Even small amounts of abrasion may impact on these populations. • Loss of habitat and abrasion from foundation/mooring systems in Atlantic and Mediterranean moderate energy infralittoral rock (including BAP habitat Tidal Swept Channels and *S. spinulosa* reefs), particularly if *S. pallida* and A. dohrnii populations are present. Even small amounts of abrasion may impact on these populations. • Loss of habitat and abrasion from foundation/mooring systems in Atlantic and Mediterranean high energy circalittoral rock (including BAP habitat Tidal Swept Channels), particularly if *S. pallida* populations is present. Even small amounts of abrasion may impact on these populations. • Loss of habitat and abrasion from foundation/mooring systems in Atlantic and Mediterranean moderate energy circalittoral	impacts may have important influences on UK populations. • Changes in sediment dynamics in Atlantic and Mediterranean moderate energy circalittoral rock. Potential for smothering impacts on *A. dohrnii* and *S. pallida*, as even small impacts may have important influences on UK populations. • Changes in sediment dynamics and deposition in features of circalittoral rock may hinder filter feeders (i.e. respiration, feeding and growth). While characteristic species are common and widespread, potential for impact is noted since this habitat is seldom recorded. *Loss of Habitat/Abrasion* The direct placement of offshore or near-shore devices, and/or their moorings on the seabed can result in damage to benthic habitats, or their loss in extreme instances (e.g. seabed structures, piling, drilling and anchoring, subsea cable placement). This could also include additional damage such as the abrasion of marine habitats and sessile/sedentary species (i.e. BAP species such as mussel and file shell beds) from the installation of technology (i.e. mooring cables dragging during installation) and subsea cabling (i.e. placement and dragging during installation and operation). The potential for impacts in a range of BAP habitats has been identified: • Loss of habitat and Abrasion from foundation/mooring systems in Atlantic and Mediterranean high energy infralittoral rock (including BAP habitat Tidal Swept Channels), particularly if *S. pallida* populations is present. Even small amounts of abrasion may impact on these populations. • Loss of habitat and abrasion from foundation/mooring systems in Atlantic and Mediterranean moderate energy infralittoral rock (including BAP habitat Tidal Swept Channels and *S. spinulosa* reefs), particularly if *S. pallida* and A. dohrnii populations are present. Even small amounts of abrasion may impact on these populations. • Loss of habitat and abrasion from foundation/mooring systems in Atlantic and Mediterranean high energy circalittoral rock (including BAP habitat Tidal Swept Channels), particularly if *S. pallida*	species are common and widespread, potential for impact is noted since this habitat is seldom recorded. *Loss of Habitat/Abrasion* The direct placement of offshore or near-shore devices, and/or their moorings on the seabed can result in damage to benthic habitats, or their loss in extreme instances (e.g. seabed structures, piling, drilling and anchoring, subsea cable placement). This could also include additional damage such as the abrasion of marine habitats and sessile/sedentary species (i.e. BAP species such as mussel and file shell beds) from the installation of technology (i.e. mooring cables dragging during installation) and subsea cabling (i.e. placement and dragging during installation and operation). The potential for impacts in a range of BAP habitats has been identified: • Loss of habitat and Abrasion from foundation/mooring systems in Atlantic and Mediterranean high energy infralittoral rock (including BAP habitat Tidal Swept Channels), particularly if *S. pallida* populations is present. Even small amounts of abrasion may impact on these populations. • Loss of habitat and abrasion from foundation/mooring systems in Atlantic and Mediterranean moderate energy infralittoral rock (including BAP habitat Tidal Swept Channels and *S. spinulosa* reefs), particularly if *S. pallida* and A. dohrnii populations are present. Even small amounts of abrasion may impact on these populations. • Loss of habitat and abrasion from foundation/mooring systems in Atlantic and Mediterranean high energy circalittoral rock (including BAP habitat Tidal Swept Channels), particularly if *S. pallida* populations is present. Even small amounts of abrasion may impact on these populations. • Loss of habitat and abrasion from foundation/mooring systems in Atlantic and Mediterranean moderate energy circalittoral rock, particularly if *S. pallida* and *A. dohrnii* populations are present. Even small amounts of abrasion may impact on these populations. • Loss of habitat and abrasion from foundation/mooring systems in Sublittoral coarse sediment (including BAP habitats	

SEA Topic Areas	Horizontal Axis Turbines	Vertical Axis Turbines	Reciprocating Hydrofoils	Emerging Technologies[17]
	rock, particularly if *S. pallida* and A. dohrnii populations are present. Even small amounts of abrasion may impact on these populations. • Loss of habitat and abrasion from foundation/mooring systems in Sublittoral coarse sediment (including BAP habitats subtidal sands and gravel, horse mussel beds). Impacts are considered unlikely for small arrays, although the potential for effects on *A. fragilis*, *C.cruoriaeformis*, *D. Montagnei*, *E. timida* or horse mussel beds are present. • Loss of habitat and abrasion from foundation/mooring systems in Sublittoral sand (including BAP habitat sub-tidal sands and gravel, blue mussel beds). Impacts are considered unlikely for small arrays, although the potential for effects on *A. fragilis*, *E. timida*, *A. sarsi* or blue mussel beds are present. • Loss of habitat and abrasion from foundation/mooring systems in Sublittoral mixed sediments (including BAP habitat Horse mussel beds, file shell beds). Impacts are considered unlikely for small arrays, although the potential effects *A. fragilis*, *D. Montagnei*, *E. timida*, *A. sarsi*, horse mussel beds or file shell beds are present. • Loss of habitat and abrasion from foundation/mooring systems in Sublittoral macrophyte-dominated sediment (including BAP habitats maerl beds, tidal swept channels, horse mussel beds, blue mussel beds). Impacts are considered unlikely for small arrays, although the potential effects *A. fragilis*, C.cruoriaeformis, *D. Montagnei*, *P. calcareum*, *E. timida*, *A. sarsi*, horse mussel beds or file shell beds are present. • Loss of habitat and abrasion from foundation/mooring systems in Sublittoral biogenic reefs (including BAP habitats horse mussel beds, cold-water coral reefs and blue mussel beds). Impacts are considered unlikely for small arrays, although the potential effects horse mussel beds, cold water coral beds or blue mussel beds are present. *Change in Tidal Flows and Fluxes* Changes, predominantly decreases in tidal flows associated with device supports or mooring systems may have adverse effects on benthic areas, although these are largely expected to be site and habitat specific:	populations is present. Even small amounts of abrasion may impact on these populations. • Loss of habitat and abrasion from foundation/mooring systems in Atlantic and Mediterranean moderate energy circalittoral rock, particularly if *S. pallida* and A. dohrnii populations are present. Even small amounts of abrasion may impact on these populations. • Loss of habitat and abrasion from foundation/mooring systems in Sublittoral coarse sediment (including BAP habitats subtidal sands and gravel, horse mussel beds). Impacts are considered unlikely for small arrays, although the potential for effects on *A. fragilis*, C.cruoriaeformis, *D. Montagnei*, *E. timida* or horse mussel beds are present. • Loss of habitat and abrasion from foundation/mooring systems in Sublittoral sand (including BAP habitat sub-tidal sands and gravel, blue mussel beds). Impacts are considered unlikely for small arrays, although the potential for effects on *A. fragilis*, *E. timida*, *A. sarsi* or blue mussel beds are present. • Loss of habitat and abrasion from foundation/mooring systems in Sublittoral mixed sediments (including BAP habitat Horse mussel beds, file shell beds). Impacts are considered unlikely for small arrays, although the potential effects *A. fragilis*, *D. Montagnei*, *E. timida*, *A. sarsi*, horse mussel beds or file shell beds are present. • Loss of habitat and abrasion from foundation/mooring systems in Sublittoral macrophyte-dominated sediment (including BAP habitats maerl beds, tidal swept channels, horse mussel beds, blue mussel beds). Impacts are considered unlikely for small arrays, although the potential effects *A. fragilis*, C.cruoriaeformis, *D. Montagnei*, *P. calcareum*, *E. timida*, *A. sarsi*, horse mussel beds or file shell beds are present. • Loss of habitat and abrasion from foundation/mooring systems in Sublittoral biogenic reefs (including BAP habitats horse mussel beds, cold-water coral reefs and blue mussel beds). Impacts are considered unlikely for small arrays, although the potential effects horse mussel beds, cold water coral beds or blue mussel	subtidal sands and gravel, horse mussel beds). Impacts are considered unlikely for small arrays, although the potential for effects on *A. fragilis*, C.cruoriaeformis, *D. Montagnei*, *E. timida* or horse mussel beds are present. • Loss of habitat and abrasion from foundation/mooring systems in Sublittoral sand (including BAP habitat sub-tidal sands and gravel, blue mussel beds). Impacts are considered unlikely for small arrays, although the potential for effects on *A. fragilis*, *E. timida*, *A. sarsi* or blue mussel beds are present. • Loss of habitat and abrasion from foundation/mooring systems in Sublittoral mixed sediments (including BAP habitat Horse mussel beds, file shell beds). Impacts are considered unlikely for small arrays, although the potential effects *A. fragilis*, *D. Montagnei*, *E. timida*, *A. sarsi*, horse mussel beds or file shell beds are present. • Loss of habitat and abrasion from foundation/mooring systems in Sublittoral macrophyte-dominated sediment (including BAP habitats maerl beds, tidal swept channels, horse mussel beds, blue mussel beds). Impacts are considered unlikely for small arrays, although the potential effects *A. fragilis*, C.cruoriaeformis, *D. Montagnei*, *P. calcareum*, *E. timida*, *A. sarsi*, horse mussel beds or file shell beds are present. • Loss of habitat and abrasion from foundation/mooring systems in Sublittoral biogenic reefs (including BAP habitats horse mussel beds, cold-water coral reefs and blue mussel beds). Impacts are considered unlikely for small arrays, although the potential effects horse mussel beds, cold water coral beds or blue mussel beds are present. *Change in Tidal Flows and Fluxes* Changes, predominantly decreases in tidal flows associated with device supports or mooring systems may have adverse effects on benthic areas, although these are largely expected to be site and habitat specific: • Changes in tidal flows and fluxes in Sublittoral coarse sediment (including BAP habitats subtidal sands and gravel, horse mussel beds) due to moorings (offshore). on filter feeders (i.e. *M. modiolus*, *A. digitatum* and *A. fragilis*) from reduced food supplies and siltation. Strong flows may detach weakly attached organisms. Changes in the	

SEA Topic Areas	Horizontal Axis Turbines	Vertical Axis Turbines	Reciprocating Hydrofoils	Emerging Technologies[17]
	• Changes in tidal flows and fluxes in Sublittoral coarse sediment (including BAP habitats subtidal sands and gravel, horse mussel beds) due to moorings (offshore). on filter feeders (i.e. *M. modiolus*, *A. digitatum* and *A. fragilis*) from reduced food supplies and siltation. Strong flows may detach weakly attached organisms. Changes in the overall habitat, through changing grain size in sediments may also occur. While many species are present in a variety of tidal flow conditions, impacts are unlikely. However, the potential may exist for impacts if *C. cruoriaeformis*, *D. Montagnei*, *E. timida*, *A. sarsi* or horse mussel beds are present. • Changes in tidal flows and fluxes in Sublittoral sand (including BAP habitat sub-tidal sands and gravel, blue mussel beds) due to moorings (offshore). on filter feeders (i.e. *M. modiolus*, *A. digitatum* and *A. fragilis*) from reduced food supplies and siltation. Strong flows may detach weakly attached organisms. Changes in the overall habitat, through changing grain size in sediments may also occur. While many species are present in a variety of tidal flow conditions, impacts are unlikely. However, the potential may exist for impacts if *A. fragilis*, *E. timida*, *A. sarsi* or blue mussel beds are present. • Changes in tidal flows and fluxes in Sublittoral mixed sediments (including BAP habitat Horse mussel beds, file shell beds) due to moorings (offshore). on filter feeders (i.e. *M. modiolus*, *A. digitatum* and *A. fragilis*) from reduced food supplies and siltation. Strong flows may detach weakly attached organisms. Changes in the overall habitat, through changing grain size in sediments may also occur. While many species are present in a variety of tidal flow conditions, impacts are unlikely. However, the potential may exist for impacts if *A. fragilis*, *E. timida*, *A. sarsi*, horse mussel beds or file shell beds are present. • Changes in tidal flows and fluxes in Sublittoral macrophyte-dominated sediment (including BAP habitats maerl beds, tidal swept channels, horse mussel beds, blue mussel beds) due to moorings (offshore). on filter feeders (i.e. *M. modiolus*, *A. digitatum* and *A. fragilis*) from reduced food supplies and siltation. Strong flows may detach weakly attached organisms. Changes in the overall habitat, through changing grain size in sediments may also	beds are present. *Change in Tidal Flows and Fluxes* Changes, predominantly decreases in tidal flows associated with device supports or mooring systems may have adverse effects on benthic areas, although these are largely expected to be site and habitat specific: • Changes in tidal flows and fluxes in Sublittoral coarse sediment (including BAP habitats subtidal sands and gravel, horse mussel beds) due to moorings (offshore). on filter feeders (i.e. *M. modiolus*, *A. digitatum* and *A. fragilis*) from reduced food supplies and siltation. Strong flows may detach weakly attached organisms. Changes in the overall habitat, through changing grain size in sediments may also occur. While many species are present in a variety of tidal flow conditions, impacts are unlikely. However, the potential may exist for impacts if *C. cruoriaeformis*, *D. Montagnei*, *E. timida*, *A. sarsi* or horse mussel beds are present. • Changes in tidal flows and fluxes in Sublittoral sand (including BAP habitat sub-tidal sands and gravel, blue mussel beds) due to moorings (offshore). on filter feeders (i.e. *M. modiolus*, *A. digitatum* and *A. fragilis*) from reduced food supplies and siltation. Strong flows may detach weakly attached organisms. Changes in the overall habitat, through changing grain size in sediments may also occur. While many species are present in a variety of tidal flow conditions, impacts are unlikely. However, the potential may exist for impacts if *A. fragilis*, *E. timida*, *A. sarsi* or blue mussel beds are present. • Changes in tidal flows and fluxes in Sublittoral mixed sediments (including BAP habitat Horse mussel beds, file shell beds) due to moorings (offshore). on filter feeders (i.e. *M. modiolus*, *A. digitatum* and *A. fragilis*) from reduced food supplies and siltation. Strong flows may detach weakly attached organisms. Changes in the overall habitat, through changing grain size in sediments may also occur. While many species are present in a variety of tidal flow conditions, impacts are unlikely. However, the potential may exist for impacts if *A. fragilis*, *E. timida*, *A. sarsi*, horse mussel beds or file shell beds are present. • Changes in tidal flows and fluxes in	overall habitat, through changing grain size in sediments may also occur. While many species are present in a variety of tidal flow conditions, impacts are unlikely. However, the potential may exist for impacts if *C. cruoriaeformis*, *D. Montagnei*, *E. timida*, *A. sarsi* or horse mussel beds are present. • Changes in tidal flows and fluxes in Sublittoral sand (including BAP habitat sub-tidal sands and gravel, blue mussel beds) due to moorings (offshore). on filter feeders (i.e. *M. modiolus*, *A. digitatum* and *A. fragilis*) from reduced food supplies and siltation. Strong flows may detach weakly attached organisms. Changes in the overall habitat, through changing grain size in sediments may also occur. While many species are present in a variety of tidal flow conditions, impacts are unlikely. However, the potential may exist for impacts if *A. fragilis*, *E. timida*, *A. sarsi* or blue mussel beds are present. • Changes in tidal flows and fluxes in Sublittoral mixed sediments (including BAP habitat Horse mussel beds, file shell beds) due to moorings (offshore). on filter feeders (i.e. *M. modiolus*, *A. digitatum* and *A. fragilis*) from reduced food supplies and siltation. Strong flows may detach weakly attached organisms. Changes in the overall habitat, through changing grain size in sediments may also occur. While many species are present in a variety of tidal flow conditions, impacts are unlikely. However, the potential may exist for impacts if *A. fragilis*, *E. timida*, *A. sarsi*, horse mussel beds or file shell beds are present. • Changes in tidal flows and fluxes in Sublittoral macrophyte-dominated sediment (including BAP habitats maerl beds, tidal swept channels, horse mussel beds, blue mussel beds) due to moorings (offshore). on filter feeders (i.e. *M. modiolus*, *A. digitatum* and *A. fragilis*) from reduced food supplies and siltation. Strong flows may detach weakly attached organisms. Changes in the overall habitat, through changing grain size in sediments may also occur. While many species are present in a variety of tidal flow conditions, impacts are unlikely. However, the potential may exist for impacts if *A. fragilis*, *C. cruoriaeformis*, *D. Montagnei*, *P. calcareum*, *L. corallioides*, horse mussel beds or blue mussel beds or maerl beds present. • Changes in tidal flows and fluxes in	

SEA Topic Areas	Horizontal Axis Turbines	Vertical Axis Turbines	Reciprocating Hydrofoils	Emerging Technologies[17]
	occur. While many species are present in a variety of tidal flow conditions, impacts are unlikely. However, the potential may exist for impacts if *A. fragilis*, *C. cruoriaeformis*, *D. Montagnei*, *P. calcareum*, *L. corallioides*, horse mussel beds or blue mussel beds or maerl beds present. • Changes in tidal flows and fluxes in Sublittoral biogenic reefs (including BAP habitats horse mussel beds, cold-water coral reefs and blue mussel beds) due to moorings (offshore). on filter feeders (i.e. *M. modiolus*, *A. digitatum* and *A. fragilis*) from reduced food supplies and siltation. Strong flows may detach weakly attached organisms. Changes in the overall habitat, through changing grain size in sediments may also occur and increase competition between kelp species (i.e. *A. esculenta*) associated with changing flow rates. While many species are present in a variety of tidal flow conditions, impacts are unlikely. However, the potential may exist for impacts if horse mussel beds, cold coral reefs or blue mussel beds if present.	Sublittoral macrophyte-dominated sediment (including BAP habitats maerl beds, tidal swept channels, horse mussel beds, blue mussel beds) due to moorings (offshore). on filter feeders (i.e. *M. modiolus*, *A. digitatum* and *A. fragilis*) from reduced food supplies and siltation. Strong flows may detach weakly attached organisms. Changes in the overall habitat, through changing grain size in sediments may also occur. While many species are present in a variety of tidal flow conditions, impacts are unlikely. However, the potential may exist for impacts if *A. fragilis*, *C. cruoriaeformis*, *D. Montagnei*, *P. calcareum*, *L. corallioides*, horse mussel beds or blue mussel beds or maerl beds present. • Changes in tidal flows and fluxes in Sublittoral biogenic reefs (including BAP habitats horse mussel beds, cold-water coral reefs and blue mussel beds) due to moorings (offshore). on filter feeders (i.e. *M. modiolus*, *A. digitatum* and *A. fragilis*) from reduced food supplies and siltation. Strong flows may detach weakly attached organisms. Changes in the overall habitat, through changing grain size in sediments may also occur and increase competition between kelp species (i.e. *A. esculenta*) associated with changing flow rates. While many species are present in a variety of tidal flow conditions, impacts are unlikely. However, the potential may exist for impacts if horse mussel beds, cold coral reefs or blue mussel beds if present.	Sublittoral biogenic reefs (including BAP habitats horse mussel beds, cold-water coral reefs and blue mussel beds) due to moorings (offshore). on filter feeders (i.e. *M. modiolus*, *A. digitatum* and *A. fragilis*) from reduced food supplies and siltation. Strong flows may detach weakly attached organisms. Changes in the overall habitat, through changing grain size in sediments may also occur and increase competition between kelp species (i.e. *A. esculenta*) associated with changing flow rates. While many species are present in a variety of tidal flow conditions, impacts are unlikely. However, the potential may exist for impacts if horse mussel beds, cold coral reefs or blue mussel beds if present.	
Population and human health[20]	Summary of key potential effects on population and human health: • Displaced/increased shipping density. • Reductions in the safety of navigation. • Risk of collision of recreational or commercial shipping with installation vessels and operational devices, particularly for devices and vessels that are low in the water and in high waves. • Access restrictions – the presence of devices in the water may restrict or reduce access to key recreational sailing areas or other water sports. Key measures to prevent adverse effects may include: siting devices away from spatially constrained areas and areas with high vessel densities; siting devices in open water; making use of industry guidance on assessment of effects and use of aids to navigation; use of notifications such as 'Notices to Mariners', publicising information at marina, and Sailing Directions; and adhering to appropriate safety regulations. Consideration of device types that are fully submerged and allow shipping to pass over the top of them could reduce effects, but guidance would need to be sought on a case-by-case basis on the level of clearance required.			
	The potential for vessel collisions with above water device components, or components at shallow depths in the water column, has been identified and may have the potential for serious injury.	The potential for vessel collisions with above water device components, or components at shallow depths in the water column, has been identified and may have the potential for serious injury.	The potential for vessel collisions with device components at shallow depths in the water column has been identified and may have the potential for serious injury. However, navigational warnings (i.e. marker	As for other tidal devices, the potential for vessel collisions with device components at shallow depths in the water column, has been identified and may have the potential for serious injury.

[20] Informed by: Faber Maunsell (2007) Scottish Marine Renewables SEA: Environmental Report, Prepared for the Scottish Executive, March 2007; Talisman Energy (UK) LTD (2005) Environmental Statement [online] Available at: http://www.beatricewind.co.uk/downloads/statement.asp [accessed 25/03/2013]; EMU (2012) Neart na Gaoithe Offshore Wind Farm Environmental Statement, Prepared for Mainstream Renewable Power [online] Available at: http://mainstream-downloads.opendebate.co.uk/downloads/Contents-Pages.pdf [accessed 25/03/2013]; Aberdeen Wind Offshore Wind Farm Limited (2011) European Offshore Wind Deployment Centre: Non-Technical Summary, July 2011 [online] Available at: http://www.vattenfall.co.uk/en/file/EOWDC-consent-vol1.pdf_18476566.pdf [accessed 26/03/2013]; E-on (2008) Offshore Environmental Statement, April 2008 [online] Available at: http://www.eon-uk.com/generation/1309.aspx [accessed 26/03/2013]; E-on (2008) Onshore Cable Route Environmental Statement, April 2008 [online] Available at: http://www.eon-uk.com/generation/1309.aspx [accessed 26/03/2013]; and E-on (2009) Onshore Substation and Cable Spur Environmental Statement, November 2009 [online] Available at: http://www.eon-uk.com/generation/1309.aspx [accessed 26/03/2013.

SEA Topic Areas	Horizontal Axis Turbines	Vertical Axis Turbines	Reciprocating Hydrofoils	Emerging Technologies[17]
	However, navigational warnings (i.e. marker buoys, navigational aids, lighting) are likely to be required on such devices for navigational purposes.	However, navigational warnings (i.e. marker buoys, navigational aids, lighting) are likely to be required on such devices for navigational purposes.	buoys, navigational aids, lighting) are likely to be required on such devices for navigational purposes.	However, navigational warnings (i.e. marker buoys, navigational aids, lighting) are likely to be required on such devices for navigational purposes.
Water and marine environment[21]	Summary of key potential effects on water quality include: Disturbance of contaminated sediments during device installation, e.g. disposal sites (silt, sand, rock and gravel sites, fish wastes and sludge); munitions dumps, and weapons ranges.			
	Potential for impacts from local changes in water quality during installation (i.e. turbulence, turbidity) and due to the presence of these devices in the water column (i.e. water turbulence, changes in tidal flows/fluxes) with localised impacts. Additional impacts (i.e. changes to sediment dynamics, scouring, deposition, smothering and water turbulence) may be associated with the installation and presence of support cables and structures on the seabed (i.e. gravity anchor and mooring). Potential for installation impacts such as water turbidity and contamination risks associated with installation and operation (e.g. leakage from vessels or equipment). See Biodiversity section.	Potential for impacts from local changes in water quality during installation (i.e. turbulence, turbidity) and due to the presence of these devices in the water column (i.e. water turbulence, changes in tidal flows/fluxes) with localised impacts. Additional impacts (i.e. changes to sediment dynamics, scouring, deposition, smothering and water turbulence) may be associated with the installation and presence of support cables and structures on the seabed (i.e. gravity anchor and mooring). Potential for installation impacts such as water turbidity and contamination risks associated with installation and operation (e.g. leakage from vessels or equipment). See Biodiversity section.	Potential for impacts from local changes in water quality during installation (i.e. turbulence, turbidity) and due to the presence of these devices in the water column (i.e. water turbulence, changes in tidal flows/fluxes) with localised impacts. Additional impacts (i.e. changes to sediment dynamics, scouring, deposition, smothering and water turbulence) may be associated with the installation and presence of support cables and structures on the seabed (i.e. gravity anchor and mooring). Potential for installation impacts such as water turbidity and contamination risks associated with installation and operation (e.g. leakage from vessels or equipment). See Biodiversity section.	Potential for impacts from local changes in water quality during installation (i.e. turbulence, turbidity) and due to the presence of these devices in the water column (i.e. water turbulence, changes in tidal flows/fluxes) with localised impacts. Additional impacts (i.e. changes to sediment dynamics, scouring, deposition, smothering and water turbulence) may be associated with the installation and presence of support cables and structures on the seabed (i.e. gravity anchor and mooring). Potential for installation impacts such as water turbidity and contamination risks associated with installation and operation (e.g. leakage from vessels or equipment). See Biodiversity section.
Climatic factors[22]	Contribution to renewable generation and reduction in GHG emissions (i.e. displacement of energy generated from non-renewable sources).	Contribution to renewable generation and reduction in GHG emissions (i.e. displacement of energy generated from non-renewable sources).	Contribution to renewable generation and reduction in GHG emissions (i.e. displacement of energy generated from non-renewable sources).	Contribution to renewable generation and reduction in GHG emissions (i.e. displacement of energy generated from non-renewable sources).
Marine geology and coastal processes[23]	Summary of key potential effects on geology: • Disturbance or damage to coastal Geological SSSIs and GCRs. Changes in coastal processes due to energy extraction Seabed contamination and water quality (including disposal areas): key issues.			
	As detailed in Biodiversity section, the potential may exist for changes to flows in the boundary layer, and localised reductions in tidal flows from the devices themselves. Other impacts may occur from the placement of support structures or moorings for these devices on the seabed, including increased scouring, deposition/siltation from changes to coastal processes (i.e. sediment dynamics and tidal fluxes) associated with the during operation, benthic disturbance during installation (i.e. loss of habitat), abrasion of	As detailed in Biodiversity section, the potential may exist for changes to flows in the boundary layer, and localised reductions in tidal flows from the devices themselves. Other impacts may occur from the placement of support structures or moorings for these devices on the seabed, including increased scouring, deposition/siltation from changes to coastal processes (i.e. sediment dynamics and tidal fluxes) associated with the during operation, benthic disturbance during installation (i.e. loss of habitat), abrasion of	As detailed in Biodiversity section, the potential may exist for changes to flows in the boundary layer, and localised reductions in tidal flows from the devices themselves. Other impacts may occur from the placement of support structures or moorings for these devices on the seabed, including increased scouring, deposition/siltation from changes to coastal processes (i.e. sediment dynamics and tidal fluxes) associated with the during operation, benthic disturbance during installation (i.e. loss of habitat), abrasion of	As detailed in Biodiversity section, the potential may exist for changes to flows in the boundary layer, and localised reductions in tidal flows from the devices themselves. Other impacts may occur from the placement of support structures or moorings for these devices on the seabed, including increased scouring, deposition/siltation from changes to coastal processes (i.e. sediment dynamics and tidal fluxes) associated with the during operation, benthic disturbance during installation (i.e. loss of habitat), abrasion of

[21] Informed by: Faber Maunsell (2007) Scottish Marine Renewables SEA: Environmental Report, Prepared for the Scottish Executive, March 2007. Talisman Energy (UK) LTD (2005) Environmental Statement [online] Available at: http://www.beatricewind.co.uk/downloads/statement.asp [accessed 25/03/2013]; EMU (2012) Neart na Gaoithe Offshore Wind Farm Environmental Statement, Prepared for Mainstream Renewable Power [online] Available at: http://mainstream-downloads.opendebate.co.uk/downloads/Contents-Pages.pdf [accessed 25/03/2013]; Aberdeen Wind Offshore Wind Farm Limited (2011) European Offshore Wind Deployment Centre: Non-Technical Summary, July 2011 [online] Available at: http://www.vattenfall.co.uk/en/file/EOWDC-consent-vol1.pdf_18476566.pdf [accessed 26/03/2013]; E-on (2008) Offshore Environmental Statement, April 2008 [online] Available at: http://www.eon-uk.com/generation/1309.aspx [accessed 26/03/2013]; E-on (2008) Onshore Cable Route Environmental Statement, April 2008 [online] Available at: http://www.eon-uk.com/generation/1309.aspx [accessed 26/03/2013]; and E-on (2009) Onshore Substation and Cable Spur Environmental Statement, November 2009 [online] Available at: http://www.eon-uk.com/generation/1309.aspx [accessed 26/03/2013.

[22] Informed by: Faber Maunsell (2007) Scottish Marine Renewables SEA: Environmental Report, Prepared for the Scottish Executive, March 2007. Talisman Energy (UK) LTD (2005) Environmental Statement [online] Available at: http://www.beatricewind.co.uk/downloads/statement.asp [accessed 25/03/2013]; EMU (2012) Neart na Gaoithe Offshore Wind Farm Environmental Statement, Prepared for Mainstream Renewable Power [online] Available at: http://mainstream-downloads.opendebate.co.uk/downloads/Contents-Pages.pdf [accessed 25/03/2013]; Aberdeen Wind Offshore Wind Farm Limited (2011) European Offshore Wind Deployment Centre: Non-Technical Summary, July 2011 [online] Available at: http://www.vattenfall.co.uk/en/file/EOWDC-consent-vol1.pdf_18476566.pdf [accessed 26/03/2013]; E-on (2008) Offshore Environmental Statement, April 2008 [online] Available at: http://www.eon-uk.com/generation/1309.aspx [accessed 26/03/2013]; E-on (2008) Onshore Cable Route Environmental Statement, April 2008 [online] Available at: http://www.eon-uk.com/generation/1309.aspx [accessed 26/03/2013]; and E-on (2009) Onshore Substation and Cable Spur Environmental Statement, November 2009 [online] Available at: http://www.eon-uk.com/generation/1309.aspx [accessed 26/03/2013.

[23] Informed by: Faber Maunsell (2007) Scottish Marine Renewables SEA: Environmental Report, Prepared for the Scottish Executive, March 2007. Talisman Energy (UK) LTD (2005) Environmental Statement [online] Available at: http://www.beatricewind.co.uk/downloads/statement.asp [accessed 25/03/2013]; EMU (2012) Neart na Gaoithe Offshore Wind Farm Environmental Statement, Prepared for Mainstream Renewable Power [online] Available at: http://mainstream-downloads.opendebate.co.uk/downloads/Contents-Pages.pdf [accessed 25/03/2013]; Aberdeen Wind Offshore Wind Farm Limited (2011) European Offshore Wind Deployment Centre: Non-Technical Summary, July 2011 [online] Available at: http://www.vattenfall.co.uk/en/file/EOWDC-consent-vol1.pdf_18476566.pdf [accessed 26/03/2013]; E-on (2008) Offshore Environmental Statement, April 2008 [online] Available at: http://www.eon-uk.com/generation/1309.aspx [accessed 26/03/2013]; E-on (2008) Onshore Cable Route Environmental Statement, April 2008 [online] Available at: http://www.eon-uk.com/generation/1309.aspx [accessed 26/03/2013]; and E-on (2009) Onshore Substation and Cable Spur Environmental Statement, November 2009 [online] Available at: http://www.eon-uk.com/generation/1309.aspx [accessed 26/03/2013.

SEA Topic Areas	Horizontal Axis Turbines	Vertical Axis Turbines	Reciprocating Hydrofoils	Emerging Technologies[17]
	marine geology in installation of technology and subsea cabling (i.e. damage to habitats, particularly to sensitive habitats (BAP)).	marine geology in installation of technology and subsea cabling (i.e. damage to habitats, particularly to sensitive habitats (BAP)).	marine geology in installation of technology and subsea cabling (i.e. damage to habitats, particularly to sensitive habitats (BAP)).	marine geology in installation of technology and subsea cabling (i.e. damage to habitats, particularly to sensitive habitats (BAP)).
Historic Environment[24]	Summary of key potential effects on marine and coastal historic environment include: • Direct disturbance, damage, or destruction of submarine archaeological remains and wrecks during device installation and cable trenching. • Direct disturbance, damage or destruction of coastal archaeological remains during cable trenching (effects of grid connections are considered separately below). • Disturbance, damage or loss of archaeological remains and sites during installation of cables and overhead lines and substation construction from onshore grid connections. Key measures to prevent adverse effects may include: avoid sites of interest and exclusion zones for protected sites; follow Crown Estates 2007 JNAPC Code of Practice for seabed developers; carry out seabed surveys and walkover surveys prior to installation; carry out detailed routeing studies at project level in accordance with 'Holford Rules' best practice guidance on routeing overhead transmission lines; avoid sensitive sites and areas; provide screening (substations).			
	There is the potential for placement of device moorings (i.e. gravity-base, anchors, etc.) on known and designated historic sites, and on unknown sites (i.e. wrecks). The potential may also exist for adverse effects on historic sites located nearby or downstream during operation (i.e. scouring, deposition/siltation or abrasion from moorings; deposition/siltation from the presence of devices). Adverse effects are likely to be avoided through careful siting of individual device moorings, although this may be more difficult for larger gravity bases or arrays of bases. Pre-construction impacts can result from intrusive site investigation. Construction effects as a result device installation, in particular from moorings, chains and cables. In particular as a result of piling and preparation of the seabed disturbing historic features. Secondary effects from construction might arise from vessels anchoring and from temporary visual impacts on the setting of historic features Associated cables and grid could directly impact on archaeological features on the seabed. Operational effects are more limited Mooring requires lengthy chains and cables that rest on the sea bed and these can cause damage to heritage assets. Changes to sediment processes and associated coastal erosion might cause impacts on some resources but may also help to reduce energy reaching shore and some erosion related heritage impacts. Visual impacts for the setting of historic features during operation, construction and	There is the potential for placement of device moorings (i.e. gravity-base, anchors, etc.) on known and designated historic sites, and on unknown sites (i.e. wrecks). The potential may also exist for adverse effects on historic sites located nearby or downstream during operation (i.e. scouring, deposition/siltation or abrasion from moorings; deposition/siltation from the presence of devices). Adverse effects are likely to be avoided through careful siting of individual device moorings, although this may be more difficult for larger gravity bases or arrays of bases. Pre-construction impacts can result from intrusive site investigation. Construction effects as a result device installation, in particular from moorings, chains and cables. In particular as a result of piling and preparation of the seabed disturbing historic features. Secondary effects from construction might arise from vessels anchoring and from temporary visual impacts on the setting of historic features Associated cables and grid could directly impact on archaeological features on the seabed. Operational effects are more limited Mooring requires lengthy chains and cables that rest on the sea bed and these can cause damage to heritage assets. Changes to sediment processes and associated coastal erosion might cause impacts on some resources but may also help to reduce energy reaching shore and some erosion related heritage impacts. Visual impacts for the setting of historic	There is the potential for placement of device moorings (i.e. gravity-base, anchors, etc.) on known and designated historic sites, and on unknown sites (i.e. wrecks). The potential may also exist for adverse effects on historic sites located nearby or downstream during operation (i.e. scouring, deposition/siltation or abrasion from moorings; deposition/siltation from the presence of devices). Adverse effects are likely to be avoided through careful siting of individual device moorings, although this may be more difficult for larger gravity bases or arrays of bases. Pre-construction impacts can result from intrusive site investigation. Construction effects as a result device installation, in particular from moorings, chains and cables. In particular as a result of piling and preparation of the seabed disturbing historic features. Secondary effects from construction might arise from vessels anchoring and from temporary visual impacts on the setting of historic features Associated cables and grid could directly impact on archaeological features on the seabed. Operational effects are more limited Mooring requires lengthy chains and cables that rest on the sea bed and these can cause damage to heritage assets. Changes to sediment processes and associated coastal erosion might cause impacts on some resources but may also help to reduce energy reaching shore and some erosion related heritage impacts. Visual impacts for the setting of historic features during operation, construction and	There is the potential for placement of device moorings (i.e. gravity-base, anchors, etc.) on known and designated historic sites, and on unknown sites (i.e. wrecks). The potential may also exist for adverse effects on historic sites located nearby or downstream during operation (i.e. scouring, deposition/siltation or abrasion from moorings; deposition/siltation from the presence of devices). Adverse effects are likely to be avoided through careful siting of individual device moorings, although this may be more difficult for larger gravity bases or arrays of bases. Pre-construction impacts can result from intrusive site investigation. Construction effects as a result device installation, in particular from moorings, chains, cables and installation of supports such as piling (if required). Secondary effects from construction might arise from vessels anchoring and from temporary visual impacts on the setting of historic features Associated cables and grid could directly impact on archaeological features on the seabed. Operational effects are more limited Mooring requires lengthy chains and cables that rest on the sea bed and these can cause damage to heritage assets. Changes to sediment processes and associated coastal erosion might cause impacts on some resources but may also help to reduce energy reaching shore and some erosion related heritage impacts. Visual impacts for the setting of historic features during operation, construction and decommissioning

[24] Informed by: Fjordr Marine and Historic Environment Consulting (2013) Historic Environment Guidance for Wave and Tidal Energy (*Draft*) [online] Available at: www.fjordr.com/uploads/3/0/0/2/3002891/historic_environment_guidance_for_wave_and_tidal_energy_-_consultation_draft_150213.pdf [accessed 03/04/2013]; Faber Maunsell (2007) Scottish Marine Renewables SEA: Environmental Report, Prepared for the Scottish Executive, March 2007; Talisman Energy (UK) LTD (2005) Environmental Statement [online] Available at: http://www.beatricewind.co.uk/downloads/statement.asp [accessed 25/03/2013]; EMU (2012) Neart na Gaoithe Offshore Wind Farm Environmental Statement, Prepared for Mainstream Renewable Power [online] Available at: http://mainstream-downloads.opendebate.co.uk/downloads/Contents-Pages.pdf [accessed 25/03/2013]; Aberdeen Wind Offshore Wind Farm Limited (2011) European Offshore Wind Deployment Centre: Non-Technical Summary, July 2011 [online] Available at: http://www.vattenfall.co.uk/en/file/EOWDC-consent-vol1.pdf_18476566.pdf [accessed 26/03/2013]; E-on (2008) Offshore Environmental Statement, April 2008 [online] Available at: http://www.eon-uk.com/generation/1309.aspx [accessed 26/03/2013]; E-on (2008) Onshore Cable Route Environmental Statement, April 2008 [online] Available at: http://www.eon-uk.com/generation/1309.aspx [accessed 26/03/2013]; and E-on (2009) Onshore Substation and Cable Spur Environmental Statement, November 2009 [online] Available at: http://www.eon-uk.com/generation/1309.aspx [accessed 26/03/2013.

SEA Topic Areas	Horizontal Axis Turbines	Vertical Axis Turbines	Reciprocating Hydrofoils	Emerging Technologies[17]
	decommissioning	features during operation, construction and decommissioning	decommissioning	
Landscape/Seascape[25]	Summary of key potential effects on land/seascape include: • For linear structures, with devices at up to 5km from the coastline, effects may occur for all seascape types. The further from the coast, the less the effect becomes, and beyond 10km the effects are typically minor. • For point structures, 8 out of the 10 seascape types are of high sensitivity to these types of device, with potential effects occurring at 0-10km from coastline. Moderate effects may also occur at distances over 10km. • Submerged structures are likely to have negligible effects on seascape (although marker buoys and lighting may be required). • Fixed coastal structures may have moderate effects depending on their design and location. • Landscape and visual intrusion from substations and overhead lines as onshore grid connections. Key measures to prevent adverse effects may include: maximising the distance of devices from shore; reducing the height of devices above the surface; reducing the area of sea occupied by the devices; and modifying the position and layout of devices to suit characteristics of the local seascape; carry out detailed routeing studies at project level in accordance with 'Holford Rules' best practice guidance on routeing overhead transmission lines; avoid sensitive sites and areas; provide screening (substations).			
	Potential for visual issues identified if surface-piercing structures are present and during installation and maintenance periods (i.e. monopiling equipment, etc.). This may result in an alteration of aesthetic character of the coastline, particularly if positioned near shore, which may be viewed by some as negative impacts. No shore based infrastructure is anticipated, hence only impacts considered are those from devices in coastal waters.	Potential for visual issues identified if surface-piercing structures are present and during installation and maintenance periods (i.e. monopiling equipment, etc.). This may result in an alteration of aesthetic character of the coastline, particularly if positioned near shore, which may be viewed by some as negative impacts. No shore based infrastructure is anticipated, hence only impacts considered are those from devices in coastal waters.	Potential for visual issues identified during installation and maintenance periods (i.e. monopiling equipment, etc.). This may result in an alteration of aesthetic character of the coastline, particularly if positioned near shore, which may be viewed by some as negative impacts. No shore based infrastructure is anticipated, hence only impacts considered are those from devices in coastal waters.	Potential for visual issues identified during installation and maintenance periods (i.e. vessels and installation equipment). This may result in an alteration of aesthetic character of the coastline, particularly if positioned near shore, which may be viewed by some as negative impacts. No shore based infrastructure is anticipated, hence only impacts considered are those from devices in coastal waters.

[25] Faber Maunsell (2007) Scottish Marine Renewables SEA: Environmental Report, Prepared for the Scottish Executive, March 2007; Talisman Energy (UK) LTD (2005) Environmental Statement [online] Available at: http://www.beatricewind.co.uk/downloads/statement.asp [accessed 25/03/2013]; EMU (2012) Neart na Gaoithe Offshore Wind Farm Environmental Statement, Prepared for Mainstream Renewable Power [online] Available at: http://mainstream-downloads.opendebate.co.uk/downloads/Contents-Pages.pdf [accessed 25/03/2013]; Aberdeen Wind Offshore Wind Farm Limited (2011) European Offshore Wind Deployment Centre: Non-Technical Summary, July 2011 [online] Available at: http://www.vattenfall.co.uk/en/file/EOWDC-consent-vol1.pdf_18476566.pdf [accessed 26/03/2013]; E-on (2008) Offshore Environmental Statement, April 2008 [online] Available at: http://www.eon-uk.com/generation/1309.aspx [accessed 26/03/2013]; E-on (2008) Onshore Cable Route Environmental Statement, April 2008 [online] Available at: http://www.eon-uk.com/generation/1309.aspx [accessed 26/03/2013]; and E-on (2009) Onshore Substation and Cable Spur Environmental Statement, November 2009 [online] Available at: http://www.eon-uk.com/generation/1309.aspx [accessed 26/03/2013.

4 Transmission Infrastructure[26]

SEA Topic Areas	Transmission Infrastructure components - offshore	Subsea Transmission Cables	Landfall and Transition Pit	Transmission Infrastructure components - onshore	Overhead Lines	Onshore AC Substations	Onshore DC/AC Converter Stations
Device Information	• Includes offshore AC substations and AC/DC substations. • Common designs are based upon experience in offshore oil and gas industry. • Common designs consist of a 'topside' component housing the main equipment, and a foundation structure (e.g. steel jacket, monopile, gravity based structure)	• Cables to transfer the power from the AC substation or the offshore AC/DC convertor station to the shore. • Installed from a ship or barge, using installation tools to plough, jet or excavate a trench for placement, followed by backfilling of the trench.	• Designed to bring the subsea cables to shore, and connect to buried onshore cables or overhead power lines. • Can be undertaken from a number of methods (e.g. Horizontal Directional Drilling (HDD), trenching) or a combination of them, using drilling rigs or trenching equipment.	• Comprises buried onshore transmission cables and their connections from landfall or transition pit to onshore electricity network. • Typically undertaken using standard civil engineering equipment performing trench excavations and backfilling. • Horizontal Directional Drilling (HDD) may be used in some instances (e.g. crossing roads, railway lines, rivers, etc.). • May require additional controls (e.g. traffic management, etc.) in some instances.	• Installed to transmit electrical power on land via towers and cables. • Typically undertaken using standard civil engineering equipment excavating and installation foundations for the towers, and placement of infrastructure. • May require additional controls (e.g. traffic management, clearing, tree cutting, etc.) in some instances.	• Houses electrical equipment for switching and protection of the electrical system. • In most cases it also steps up electrical voltages to connect to the onshore electricity transmission system. • Involves standard civil engineering practices for drainage, foundations, buildings, fences and other structures.	• To convert from HVDC connection from the offshore wind farm to AC for connection to the onshore electricity system. It should be noted that a converter station can be both for converting from AC to DC and vice versa. • Involves standard civil engineering practices for drainage, foundations, buildings, fences and other structures.
Biodiversity/ flora/ fauna	*Marine Mammals and fish* Noise from construction from piling (e.g. behavioural response, lethal effects, displacement from natural habitat and possible feeding areas, physical injury to hearing organs). Potential habitat loss or disturbance, especially to bottom dwelling species such as sand eels, which are important prey species for birds, marine mammals and fish. Potential collision risk with submerged structures and associated cabling (if any). Potential for increased suspended solids during construction and sediment deposition affecting respiration in bottom dwelling and spawning species (e.g. sand eel).	*Marine Mammals and fish* Potential habitat loss or disruption to seabed communities during installation. Potential temporary displacement to other areas and potential collision risk during installation. Potential EMF from the cable distribution, and potential for impacts such as changes in behaviour and migratory patterns of some fish and mammal species. *Seabirds* Potential loss of prey species in offshore feeding grounds from installation activities. *Marine and Coastal Habitats* Installation can lead to potential increases to suspended solids and deposition, leading to	*Marine Mammals and fish* Potential habitat loss or disruption to inshore seabed communities from installation. Potential temporary displacement to other areas during installation. Potential EMF from the cable distribution, and potential for impacts such as changes in behaviour and migratory patterns of some fish and mammal species. *Seabirds* Possible effects from proximity of landfall sites to protected areas for breeding or wintering birds (e.g. oystercatcher.) Potential for loss of prey species in feeding grounds. *Marine and Coastal Habitats*	*Onshore Fauna* Potential loss or disturbance of protected or notable species, in particular, water vole, otter, badger, great crested newts, reptiles and breeding birds. *Onshore Habitats* Potential degradation or loss of important habitats (e.g. ponds, hedgerows, woodland, watercourses, grassland). Potential adverse effects on designated (statutory and non-statutory) nature conservation sites. Reinstatement to land from previous condition can include enhancement measures.	*Onshore Fauna* Potential collision risk of overhead lines to birds and bats, and disturbance during breeding from noise and light associated with maintenance activities. Potential loss or disturbance of protected or notable species (e.g. water vole, otter). *Onshore Habitats* Possible degradation or loss of important habitats (e.g. ponds, hedgerows). Potential integrity loss of designed nature conservation sites. Potential adverse effects and loss of integrity of designated nature conservation sites.	*Onshore Fauna* Potential degradation or loss of important habitats such as ponds, hedgerows, woodland, watercourses and grassland. *Onshore Habitats* Potential loss or disturbance of protected or notable species (in particular: water vole, badger, great crested newts, reptiles and breeding birds). Potential adverse effects on designated (statutory and non-statutory) nature conservation sites. Additional landscape works and screening may provide habitats and opportunities for biodiversity enhancement.	*Onshore Fauna* Potential loss or disturbance of protected or notable species (e.g. water vole, otter). *Onshore Habitats* Possible degradation or loss of important habitats (e.g. ponds, hedgerows). Potential adverse effects on designated (statutory and non-statutory) nature conservation sites. Additional landscape works and screening may provide habitats and opportunities for biodiversity enhancement.

[26] Information taken from: The Crown Estate (2013) Transmission infrastructure associated with connecting offshore generation [online] Available at: http://www.transmissioninfrastructure-offshoregen.co.uk/ (accessed 10/04/2013)

SEA Topic Areas	Transmission Infrastructure components - offshore	Subsea Transmission Cables	Landfall and Transition Pit	Transmission Infrastructure components - onshore	Overhead Lines	Onshore AC Substations	Onshore DC/AC Converter Stations
	Potential for EMF effects during operation as part of cable distribution. Potential creation of artificial rocky habitats due to the presence of submerged infrastructure. *Seabirds* Potential displacement due to disturbance during construction from offshore feeding sites to other areas (e.g. herring gull, great cormorant, etc.). Potential loss of feeding grounds for on-passage (migrating) species due to presence of structures (e.g. dunlin, knot, etc.) and associated with loss of prey species (e.g. sand eel for migratory species such as Arctic Tern). *Marine and Coastal Habitats* Potential loss or disturbance to especially sensitive/ designated habitats from construction (e.g. reefs and associated species which may take time to recover). Potential for increased suspended solids and sediment deposition associated with construction site, and associated effects for epibenthic species, especially filter feeders.	smothering of seabed communities. Potential habitat loss or disruption to benthic communities during installation. Potential habitat disturbance due to maintenance and repair activity.	Potential habitat loss or disruption to inshore seabed communities from installation activities. Potential disruption to intertidal habitats and benthic species. Potential increase in suspended solids and smothering (deposition) during installation works. Potential disturbance to seabed and intertidal areas due to maintenance and repair activity.				
Population and human health	Construction vessels and helicopter flights may cross other user's transit routes (e.g. dredging, oil and gas operations and freight). Potential for increased collision risk, impacts for navigation and displacement of other marine users (e.g. shipping, recreation, etc.) during construction and maintenance activities. Potential for displacement of	Potential for collision with cable excavation vessels in transit during installation. Potential for displacement of other marine users during construction and maintenance activities (e.g. shipping, recreation, etc.) and operation al periods (e.g. fishing activities with potential gear interactions with submerged structures, etc.). Potential interference with	Potential for collision with cable excavation vessels in transit during construction. Potential for displacement of other marine users during construction and maintenance activities (e.g. shipping, recreation, etc.) and operation al periods (e.g. fishing activities with potential gear interactions with submerged structures, etc.).	Potential disturbance of previously contaminated land, potential transportation of contaminates (by physical movement, water and air) and the impact on human health and ecology. Potential noise and vibration from construction traffic and equipment, especially at compounds and drilling locations. Potential contamination and associated risk to humans	Potential noise and vibration from construction traffic and equipment, especially at compounds and location towers. Potential for dust generation during construction works. Potential for disruption to communities during construction (e.g. road closures, diversions, etc.). Potential for loss of land to existing use (e.g.	Potential for dust arising from areas where vegetation has been removed, soils stored, and vehicle tracks, particularly in dry or windy conditions, potential to cause impacts on human health especially where sensitive receptors exist (e.g. schools, hospitals). Potential for noise and vibration from construction traffic and equipment, especially at compounds	Potential for dust arising from areas where vegetation has been removed, soils stored, and vehicle tracks, particularly in dry or windy conditions, potential to cause impacts on human health especially where sensitive receptors exist (e.g. schools, hospitals). Potential for noise and vibration from construction traffic and equipment, especially at compounds

SEA Topic Areas	Transmission Infrastructure components - offshore	Subsea Transmission Cables	Landfall and Transition Pit	Transmission Infrastructure components - onshore	Overhead Lines	Onshore AC Substations	Onshore DC/AC Converter Stations
	some marine users during construction (e.g. safety exclusion areas during construction) and operation (e.g. fishing activities with potential gear interactions with permanent seabed structures).	communications due to EMF.		and riparian ecology from construction activities (e.g. activities using oil, bentonite or other harmful substances). Potential for disruption to communities during construction (e.g. road closures, diversions, etc.). Potential for loss of land to existing use (e.g. agricultural production).	agricultural production).	and piling locations and during ground works. Construction likely to take a significant amount of time in a single location. Potential for noise from operation from the operation of the substation, in particular a 'humming' associated mainly with the operation of the cooling equipment, particularly in relation to transformers and reactors. Potential noise and vibration from operation and maintenance activities. Potential for loss of land to existing use (e.g. agricultural production).	and piling locations and during ground works. Construction likely to take a significant amount of time in a single location. Potential for noise from operation from the operation of the substation, in particular a 'humming' associated mainly with the operation of the cooling equipment, particularly in relation to transformers and reactors. Potential noise and vibration from operation and maintenance activities, and the operation of switchgear. Potential for loss of land to existing use (e.g. agricultural production).
Water and marine environment	Potential re-suspension of sediments and associated hazardous substances during construction. Potential for accidental spillage from construction vessels and structures during operation.	Potential re-suspension of sediments and hazardous substances due to excavation during installation and during major repair activity. Potential for accidental spillage from construction and cable repair vessels during operation.	Potential re-suspension of sediments and release of hazardous substances due to excavation. Potential for accidental spillage from construction equipment.	Potential contamination and associated risk to humans and riparian ecology from construction activities using oil, bentonite or other harmful substances. Potential sedimentation and increase in turbidity of watercourses during open cut installation or from adjacent soil storage and trench areas, particularly during wet periods.	Potential for accidental spillage from construction equipment entering water courses located near to sites.	Potential water contamination and the associated risks to humans and riparian ecology from construction activities using oil or other harmful substances. Potential sedimentation and increase in turbidity of watercourses from areas where vegetation has been cleared. Requirement for significant excavation and potentially pilling may impact on groundwater quality and regimes. Requirement for de-watering and discharging of water may have potential impacts on water resources (e.g. abstractions) and riparian ecology. Potential increase in flood risk to facility itself and to others downstream from increase surface water run-off, especially from large areas of hard standing, for example access tracks and	Potential water contamination and the associated risks to humans and riparian ecology from construction activities using oil or other harmful substances. Potential sedimentation and increase in turbidity of watercourses from areas where vegetation has been cleared. Requirement for significant excavation and potentially pilling may impact on groundwater quality and regimes. Requirement for de-watering and discharging of water may have potential impacts on water resources (e.g. abstractions) and riparian ecology. Potential increase in flood risk to facility itself and to others downstream from increase surface water run-off, especially from large areas of hard standing, for example access tracks and

SEA Topic Areas	Transmission Infrastructure components - offshore	Subsea Transmission Cables	Landfall and Transition Pit	Transmission Infrastructure components - onshore	Overhead Lines	Onshore AC Substations	Onshore DC/AC Converter Stations
						buildings, where sustainable drainage systems are not employed.	buildings, where sustainable drainage systems are not employed.
Climatic factors	Construction vessel emissions have the potential to impact on air quality and contribute to greenhouse emissions.	Construction vessel emissions have the potential to impact on air quality and contribute to greenhouse emissions.	Construction vessel and vehicle emissions have the potential to impact on air quality, and subsequently human health, and contribute to greenhouse emissions.	Construction vehicle emissions have the potential to impact on air quality, and subsequently human health, and contribute to greenhouse emissions.	Construction vehicle emissions have the potential to impact on air quality, and subsequently human health, and contribute to greenhouse emissions.	Construction vehicle emissions have the potential to impact on air quality, and subsequently human health, and contribute to greenhouse emissions.	Construction vehicle emissions have the potential to impact on air quality, and subsequently human health, and contribute to greenhouse emissions.
Marine geology and coastal processes / Onshore soils	Scour from seabed foundations (e.g. piles) and sediment deposition during construction and operation phases have the potential to alter physical processes and sediment structure.	Sediment disturbance during construction has the potential to alter physical processes and sediment structure.	Sediment disturbance during construction has the potential to alter physical processes and sediment structure at landfall.	Potential disturbance of previously contaminated land, potential transportation of contaminates (by physical movement, water and air) and the impact on human health and ecology. Potential for land contamination from construction activities, in particular the storage and use of oil and the use of bentonite for drilling or filling ducts. Potential degradation or loss of soil resource, and displacement of land use due to construction activities. Potential soil heating from electrical cables at full rating, with potential secondary impacts (e.g. altered crop growth).	Potential loss of land use during construction and operation phases at the tower base and along line routes (e.g. pylon or overhead lines may obstruct existing agricultural activities). Potential degradation or loss of soil resource, and displacement of land use due to construction activities.	Potential disturbance of previously contaminated land, potential transportation of contaminants (by physical movement, water and air) and impact on human health and ecology. Potential degradation or loss of soil resource (construction). Potential land loss from existing use (e.g. agricultural production).	Potential disturbance of previously contaminated land, potential transportation of contaminants (by physical movement, water and air) and impact on human health and ecology. Potential degradation or loss of soil resource (construction). Potential land loss from existing use (e.g. agricultural production).
Historic Environment	Potential loss of or damage to known and unknown buried heritage in construction activities. Potential damage to known and unknown buried heritage from maintenance/repair activities (e.g. vessels anchoring).	Potential loss of or damage to known or unknown buried heritage due to corridor excavation by ploughing or trenching during installation. Potential damage to known and unknown buried heritage from maintenance/repair activities (e.g. vessels anchoring).	Potential loss of or damage to known or unknown buried heritage due to corridor excavation by ploughing or trenching during installation. Potential damage to known and unknown buried heritage from maintenance/repair activities (e.g. vessels anchoring).	Potential loss of or damage to known or unknown buried heritage.	Potential direct loss of or damage to known and unknown buried heritage. Potential setting impacts on heritage assets and the historic landscape.	Potential direct loss of, or damage to, known and unknown buried archaeology. Potential direct loss of, or damage to, designated assets or areas. Provide opportunities for research and recording previously unknown archaeology.	Potential direct loss of, or damage to, known and unknown buried archaeology. Potential direct loss of, or damage to, designated assets or areas. Opportunities for research and recording previously unknown archaeology.
Landscape/ Seascape	Potential for the seascape to change. Potential issues of lighting during construction and operation.	Potential issues of temporary lighting during construction.	Potential impacts to landscape/seascape during construction.	Potential impacts to landscape/seascape during construction. Reinstatement to land from previous condition can include enhancement	The construction of towers, poles and wire are more likely to have an impact on views and landscape character. Where existing features,	Potential change in the character of the landscape and on views particularly if situated within open countryside or residential areas (e.g. removal of	Potential change in the character of the landscape and on views particularly if situated within open countryside or residential areas (e.g. removal of

SEA Topic Areas	Transmission Infrastructure components - offshore	Subsea Transmission Cables	Landfall and Transition Pit	Transmission Infrastructure components - onshore	Overhead Lines	Onshore AC Substations	Onshore DC/AC Converter Stations
				measures.	such as trees and woodland, are removed, e.g. trees and woodland, there is the potential for the landscape character to change. Screening may be used to mitigate impacts. Potential alteration and disruption of existing views from infrastructure, particularly if located in or near to designated landscape areas (e.g. AONB, NSAs, etc.).	existing ground features). During construction, areas will be needed for soil storage, site laydown areas, equipment storage, internal access tracks, etc. Potential for impacts from lighting of compounds. Potentially tall (e.g. overhead line gantries and switchgear) and bulky (e.g. transformers, buildings and converter sheds) equipment may effect landscape character and views of local area. Additional landscape works and screening may mitigate views of infrastructure.	existing ground features). During construction, areas will be needed for soil storage, site laydown areas, equipment storage, internal access tracks, etc. Potential impacts from lighting of compounds. Potentially tall (e.g. overhead line gantries and switchgear) and bulky (e.g. transformers, buildings and converter sheds) equipment may effect landscape character and views of local area. Additional landscape works and screening may mitigate views of infrastructure.

The Scottish Government
Riaghaltas na h-Alba

ISBN: 978-1-78256-746-2 (web only)

The Scottish Government
St Andrew's House
Edinburgh
EH1 3DG

Produced for the Scottish Government by APS Group Scotland
DPPAS14475 (07/13)

Published by the Scottish Government, July 2013