

ASSESSMENT AGAINST THE MCZ SELECTION GUIDELINES

Outer Belfast Lough Proposed Marine Conservation Zone (pMCZ)

Ocean quahog (Arctica islandica)



Document version control

Version	Date	Author	Comments
Version 0.1	27/05/2015	Clara Alvarez Alonso	Template – Belfast Lough Initial draft
Version 0.2	11/08/2015	Liz Pothanikat	Amendments
Version 0.3	19/10/2015	Liz Pothanikat, Clara Alvarez Alonso, Stephanie Bennett, Joe Breen, Nuala McQuaid	Amendments
Version 1.1	16/11/2015	Stephanie Bennett	Amendments

Distribution List

Version	Issue date	Issued to
Version 1.0	28/10/15	Internal Consultation
Version 2.0	14/12/2015	Public Consultation



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Summary

The assessment against the Guidance on selection and designation of Marine Conservation Zones (MCZs) in the Northern Ireland Inshore Region is a document produced as part of the consultation evidence base, following the OSPAR design principles. This assessment helps to identify Areas of Search (AoS) and determine features proposed for protection within them. It also highlights where additional locations or features are required or when a different size or shape of boundary is needed to develop the Marine Protected Area (MPA) network.

Following the NI Guidance the process includes five stages from the identification of the AoS (Stage 1) to the development of the MCZ proposals (Stage 5). Only locations which have passed through all the stages of the assessment are considered for formal designation and inclusion in the MPA network.

This document provides details of the assessment of Outer Belfast Lough pMCZ against the selection criteria.

Additional information on Outer Belfast Lough pMCZ and proposed features includes:

- Guidance on selection and designation of Marine Conservation Zones (MCZs) in the Northern Ireland Inshore Region
- Justification report for selection of proposed Marine Conservation Zone (pMCZ) features
- Guidance on the development of Conservation Objectives and potential Management Options
- Conservation Objectives and potential Management Options for Outer Belfast Lough pMCZ
- Data Confidence Assessment for Outer Belfast Lough pMCZ

History of development

The Outer Belfast Lough pMCZ was identified for the pMCZ feature Ocean quahog, *Arctica islandica*, (as a species not as aggregations). The habitat Subtidal (sublittoral) sand was recommended for inclusion as a broad scale pMCZ habitat feature associated with the Ocean quahog. Recent survey work carried out by AFBI (2015) identified the presence of sea-pen and burrowing megafauna communities in the muddy sand/fine sand substrata; this is a Subtidal (sublittoral) sand variation of the OSPAR biotope occurring in circalittoral mud (Hughes, 1998; JNCC, 2014).

Recent survey work completed by DOE (June 2015) included underwater video/still images, infaunal grab samples and Particle Size Analysis (PSA) which validated the variations of Subtidal (sublittoral) sand sediment in the AoS (from muddy sand to coarser gravelly sand). The presence of multiple burrows with associated megafauna was also recorded.

This survey, combined with new additional data gathered for Ocean quahog (Bangor University), supported the amendment of the initial proposed boundary. The new boundary was drawn following the extent of the Ocean quahog (main feature) to support

the MCZ acting as a functional whole for the conservation of Ocean quahog while representing and maintaining the integrity of all the proposed features. The buffer zone of 500m was incorporated into the boundary; this was based on the suggested minimum distance for larval dispersal of 0.5km² (Natural England & JNCC, 2010). An area of 5.75km² is sufficient to be self sustaining for Subtidal (sublittoral) sand (SS) and the majority of its associated diversity (Hill *et al.*, 2010; Natural England & JNCC, 2010). Details on the supporting evidence are provided on the Outer Belfast Lough Data confidence assessment.

Glossary of Terms and Acronyms

AoS – Area of Search used to underpin the proposed Marine Conservation Zone

AFBI - Agri-food and Biosciences Institute

Conservation objective – A statement of the desired ecological/geological state (quality) of a feature (habitat, species or geological) for which the MCZ is designated

EUNIS – The European nature information system, is a habitat classification system used throughout Europe and covers all types of natural and artificial habitats, both aquatic and terrestrial

MCZ - Marine Conservation Zone used to refer to MCZs designated under section 13 of the Marine Act (Northern Ireland) 2013 in the Northern Ireland inshore region and in section 116 of the Marine and Coastal Access Act 2009 in the Northern Ireland offshore region adjacent to Northern Ireland

MPA – As a generic term Marine Protected Areas are a clearly defined geographical space, recognised, dedicated and managed through legal or other means, to achieve the long-term conservation of nature with associated ecosystem services and cultural values. As a specific term it refers to a national designation in Scotland (equivalent to an MCZ)

OQ – Ocean quahog

OSPAR - OSPAR is the mechanism by which fifteen Governments of the western coasts and catchments of Europe, together with the European Union, cooperate to protect the marine environment of the North-East Atlantic

OSPAR T&D - OSPAR List of Threatened and/or Declining Species and Habitats

PMF - Priority Marine Feature - collective term for those features (habitats, species and geological/geomorphological features) which are considered to be of conservation importance in the Northern Ireland inshore region

pMCZ - Proposed Marine Conservation Zone

pMCZ Feature - proposed Marine Conservation Zone Feature(s) that will underpin the MCZ designation

RIA – Regulatory Impact Assessment

PSA - Particle Size Analysis

SS - Subtidal (sublittoral) sands

VMS – Vessel Monitoring System

Outer Belfast Lough pMCZ – Application of the MCZ selection guidelines

Stage 1 - Identifying the Area of Search

Summary of assessment	The Outer Belfast Lough AoS (Figure 1) encompasses two pMCZ features: the first one is the species Ocean quahog (<i>Arctica islandica</i>) which is on the OSPAR T&D List. The second pMCZ feature is Subtidal (sublittoral) sand, which is a broad scale habitat associated with the Ocean quahog and is representative of Northern Ireland's seas more generally. Additionally, this habitat contains sea-pen and burrowing megafauna communities, which are also on the OSPAR T&D List while the sea-pen <i>Virgularia mirabilis</i> is a Northern Ireland Priority Species.
	Guideline met.

Detailed assessment			
Proposed protected features	Guideline 1a <i>Presence of key features</i>	Guideline 1b <i>Presence of features at threat and/or decline</i>	Guideline 1c <i>Presence of ecological resources/geological processes critical to functioning of the ecosystem</i>
<i>Biodiversity</i>			
Ocean quahog (<i>A. islandica</i>) (OQ)	✓	✓ OSPAR T&D Representative feature ¹	
Subtidal (sublittoral) sand ² (SS)	✓	<i>Representative feature</i>	
<ul style="list-style-type: none"> SS: Sea-pen and burrowing megafauna communities³ (SPBM) 	✓	✓ OSPAR T&D ⁴	

¹ OQ is an OSPAR T&D species (OSPAR, 2009). Whilst not considered by OSPAR to be under threat and/or decline in OSPAR Region III, they are considered to be of conservation interest due to their slow growth and vulnerability to bottom fishing gear (Clements and Loureiro, 2014). They are also defined as a Priority Marine Feature (PMF) in Northern Ireland. Given the conservation importance of this species it is proposed as a representative feature.

² Broad scale habitat EUNIS Code A5.2 comprising the predicted biotopes: circalittoral and infralittoral fine sand ([SS.SSa.CFiSa](#) - A5.25 and [SS.SSa.IFiSa](#) - A5.23) and circalittoral and infralittoral muddy sand ([SS.SSa.CMuSa](#) - A5.26 and [SS.SSa.IMuSa](#) - A5.24) (JNCC, 2008). A5.2 broad scale habitat is in the UK list of Priority Species and Habitats (UK BAP) (JNCC, 2008).

³ SS component habitat. Biotope - SPBM ([SS.SMu.CFiMu.SpnMeg](#) – A5.361. This biotope occurs in the area in fine muddy sand substrata rather than in circalittoral fine mud. (JNCC, 2014; Hughs, 1998).

⁴ OSPAR list of Threatened and/or Declining species and habitats (OSPAR, 2008 a & b).

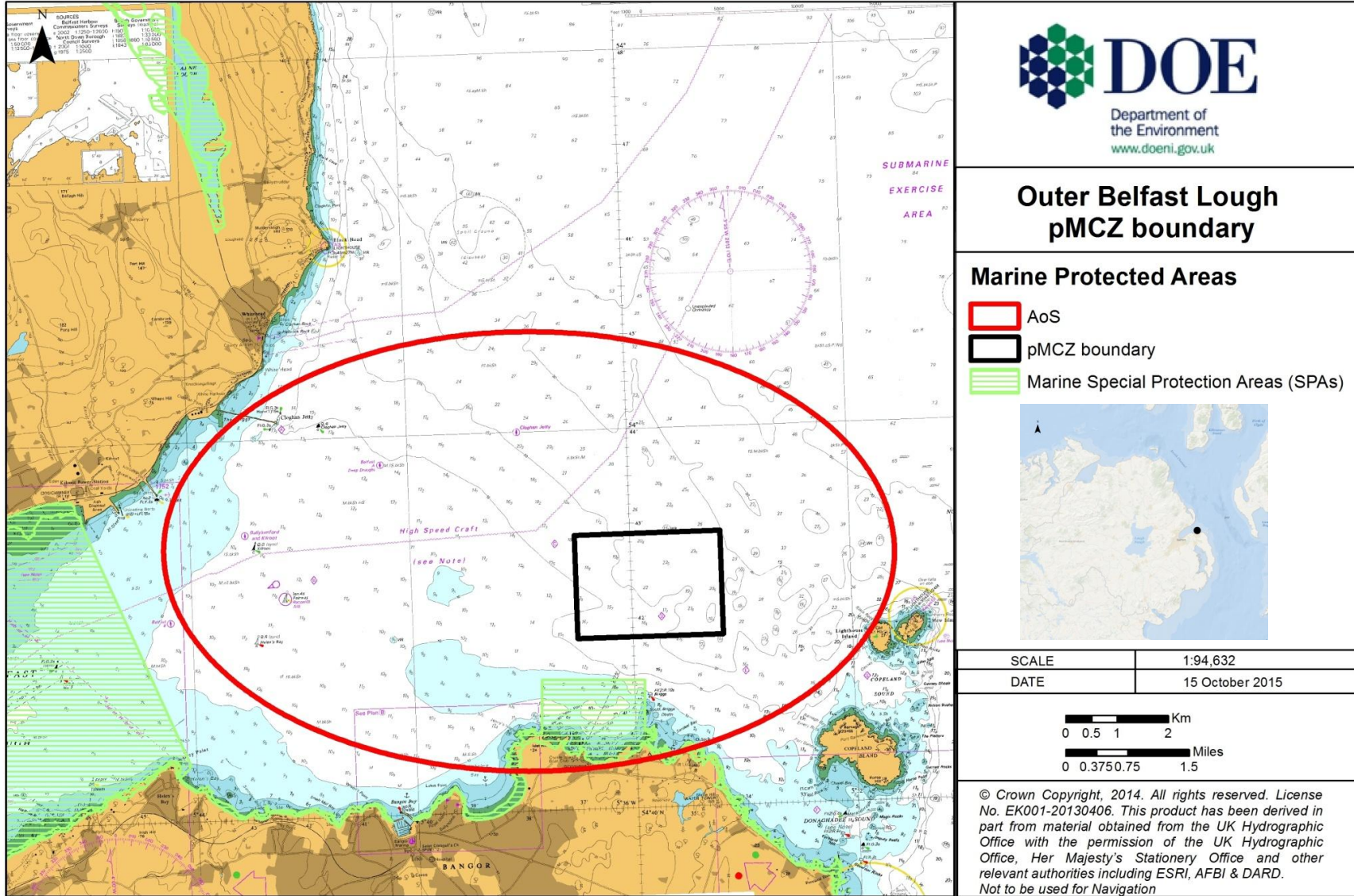


Figure 1 Location of Area of Search and the proposed boundary of Outer Belfast Lough pMCZ

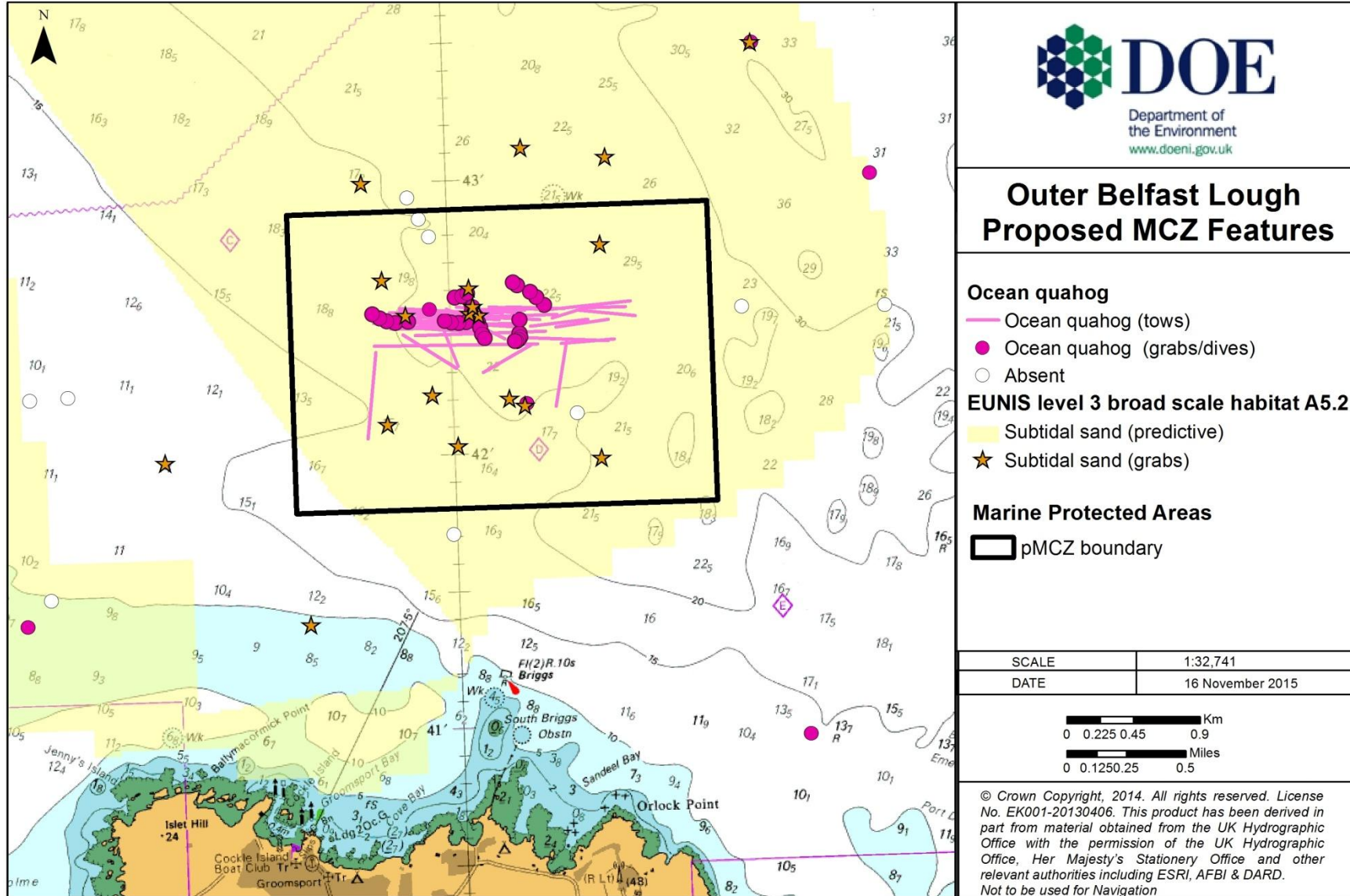


Figure 2 Distribution of the pMCZ features in Outer Belfast Lough

Stage 2 - Prioritise the Area of Search based on quality of pMCZ features contained

Summary of assessment	<p>Outer Belfast Lough is proposed as an MCZ for two spatially and functionally linked features. Subtidal (sublittoral) sand habitats (along with SPBM communities) are naturally diverse biotopes. This muddy/gravelly sand seabed is inhabited by a dense and undisturbed population of OQ (Witbaard and Bergman, 2003; JNCC, 2008; Sabatini & Pizzolla, 2008) and this represents the most populated area (for OQ) in the Irish Sea and the second most dense population in UK waters (De Wilde <i>et al.</i>, 1986; Ridgway <i>et al.</i>, 2012). Belfast Lough is impacted by human activity with a rapidly growing commercial sector and booming leisure activities (the Lough is a major shipping port); however, the pMCZ features are currently not thought to be adversely affected as the features are deemed to be in a natural and relatively undisturbed state. The pMCZ features are vulnerable to a range of pressures (such as dredging and anchoring by large ships) and are therefore considered to be at moderate risk of future significant damage. Evidence of anchoring and dredging is clearly visible in the southwest corner of the pMCZ.</p>
	Five of the six Stage 2 Guidelines have been met (2a-2e).

Detailed assessment

Guideline 2a The Area of Search contains a combination of features especially those that are functionally linked

Outer Belfast Lough is proposed for two pMCZ features. The SS sediments are closely associated and grade into one another across the AoS (from fine sands/muddy sands to coarser gravelly sands). It is known that OQ occurs in this seabed habitat (mostly muddy or fine sand) (Witbaard and Bergman 2003; JNCC, 2008; Sabatini & Pizzolla, 2008; Natural England & JNCC, 2010) and lives buried in this sediment to escape from predation (fish and crustaceans). The sea-pen (*V. mirabilis*) and burrowing megafauna communities are present in the area as a biotope component of the habitat SS, most likely due to the high percentage of mud in the fine sediments, rich organic content and suitability for burrow formation. Sea-pens are indicative of stable sediments whilst the bioturbation created by the megafaunal burrowers may increase the food supply for suspension feeding OQ and sea-pens (Hughes, 1998; Hill *et al.*, 2010). As a filter feeder OQ represents a benthic-pelagic link, removing plankton and detritus from the water column (Lancaster *et al.*, 2014).

2a Result

Guideline met.

Guideline 2b The Area of Search contains features with naturally high biodiversity (for habitats only)

Subtidal (sublittoral) sand & Sea-pen and burrowing megafauna

Within Outer Belfast Lough pMCZ this proposed broad scale habitat incorporates four biotope complexes: circalittoral fine sand ([SS.SSa.CFiSa](#)), infralittoral fine sand ([SS.SSa.IFiSa](#)), infralittoral muddy sand ([SS.SSa.IMuSa](#)) and circalittoral muddy sand ([SS.SSa.CMuSa](#)). The south-east area of the pMCZ consists of mostly cobbles and small boulders, surrounded by finer sands. The cobbles and boulders support epifauna such as bryozoan

Guideline 2b The Area of Search contains features with naturally high biodiversity (for habitats only)	
	<i>(Flustra foliacea)</i> and hydrozoan turf. The infralittoral sandy sediments are dominated by species such as <i>Asterias rubens</i> , <i>Cancer pagurus</i> , <i>Liocarcinus</i> sp and <i>Pagurus</i> sp. The circalittoral sandy substratum (graded from muddy/fine sands to coarser gravelly sands) tends to be more stable and rich in infaunal communities. This sediment is characterised by burrows from <i>Nephrops norvegicus</i> and other burrowing shrimps. The sea-pen <i>V. mirabilis</i> is also present in this area (SS.SMu.CFiMu.Spnmeg). Sediment grabs in the pMCZ/AoS also yielded dead <i>A. islandica</i> shells (AFBI, 2015).
2b Result	Guideline met.
Guideline 2c The Area of Search contains coherent features not smaller fragmented ones	
Ocean quahog (<i>Arctica islandica</i>)	<p>OQ population in the AoS represents one of the best examples in terms of population density and age of the population compared to other known <i>A. islandica</i> populations in the Irish Sea. The Outer Belfast Lough population has been found to have a high density in a very restricted area with some individuals up to 200 years old (Ridgway <i>et al.</i>, 2012). OQ are distributed throughout the pMCZ with the greatest density in the northern section, around the 20m depth contour line. Records are likely to be under-represented because the species is often missed by grab sampling. Further camera tows/survey work is required to detect surface signs (siphon holes) within the area, but visibility is greatly affected by the maritime traffic sediment plume and open sea conditions and depth.</p> <p><i>A. islandica</i> is exceptionally long-lived; recent work suggests that individuals may live for up to 400 years (Ridgway & Richardson, 2010). They have a very small home range but widely dispersing larvae (in excess of 40km depending upon local hydrographic conditions). There is no information regarding the size of the area required for a minimum viable population (Hill <i>et al.</i>, 2010) but in the absence of disturbance or changes in habitat suitability, populations of the species are considered likely to persist.</p>
Subtidal (sublittoral) sand & Sea-pen and burrowing megafauna	Camera and grab sample data in the area confirms the SS habitat comprising a mosaic of different sediment types. The different biotopes of the pMCZ habitat SS within the AoS are considered typical for Northern Irish coasts. There has been very little research on the spatial and temporal variability on the seabed in the area. However, this area has been recommended for protection as it provides suitable sediment for OQ colonisation. Summary reviews presented in Hill <i>et al.</i> (2010) suggest that majority of resident species in this habitat have a larval phase, capable of dispersing and levels of OQ recruitment in SS appear stable in this area (Ridgway <i>et al.</i> , 2012). In absence of significant disturbance species such as OQ are expected to persist (see details in the Data Confidence Assessment).
2c Result	Guidelines met.

Guideline 2d The Area of Search contains features considered least damaged/more natural	
Ocean quahog (<i>A. islandica</i>)	Side-scan sonar (DOE, 2015; Figure 3 & Plates 1-3) clearly shows that large areas, particularly within the southern sector, have been subject to mobile fishing gear. This, combined with Vessel Monitoring System (VMS) data from fishing vessels (during 2009-2013) indicates that the OQ and its habitat may have been modified by exposure to demersal fishing (scallop dredging), resulting in a coarser sediment and making it less suitable for burrowing. The data indicates that the OQ numbers have reduced since the baseline surveys. Further detail is required on the level of current and recent mobile gear fishing within the site to inform on the likelihood and level of damage. Despite the site having evidence of damage it is the best known OQ bed in Northern Ireland. Indication of change or damage to this pMCZ feature has been reported in recent surveys (Ridgway <i>et al.</i> , 2012; Clements & Loureiro, 2014; DOE North Channel disposal grounds monitoring programme 1990-2014; AFBI, 2015; DOE underwater camera survey 2015; DOE side-scan survey, 2015 (Figure 3 & Plates 1-3); refer to the Data Confidence Assessment for more details). However, there is insufficient data relating to the long-term trends of the OQ population and whether this has been affected by anthropogenic activities. Although the scale and subsequent impact of mobile fishing gear in the area has not been significant the lack of records of OQ in the lower section of the pMCZ suggest the population might have been affected by historic fishing (refer to Conservation Objectives and potential Management Options for Outer Belfast Lough for further detail).
Subtidal (sublittoral) sand & Sea-pen and burrowing megafauna	In the wider area surrounding the AoS this feature is considered to be largely natural due to the hydrographic processes with different sedimentation rates causing different sediment types. There is no direct evidence on the condition of SS in the area. However, side-scan (DOE, 2015) and VMS data (from 2009-2013) indicates that the habitat may have been modified by exposure to demersal fishing (scallop dredging) resulting in a coarser sediment (although the scale and subsequent impact of demersal trawls in the AoS does not appear to be significant). Boat anchoring, particularly from large ships has the potential to pose a risk to the seabed in the AoS (DOE, 2015).
2d Result	Guidelines met.

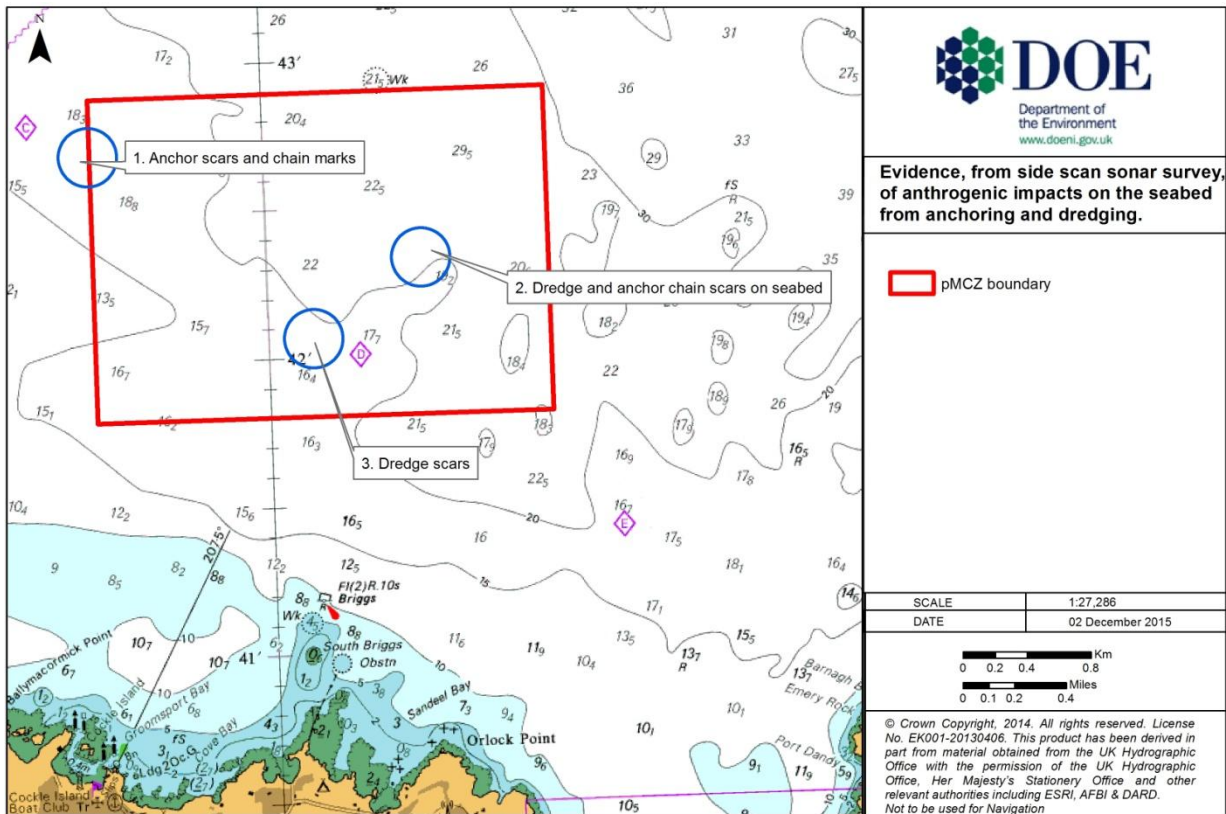


Figure 3 Areas of side scan survey carried out in Outer Belfast Lough pMCZ

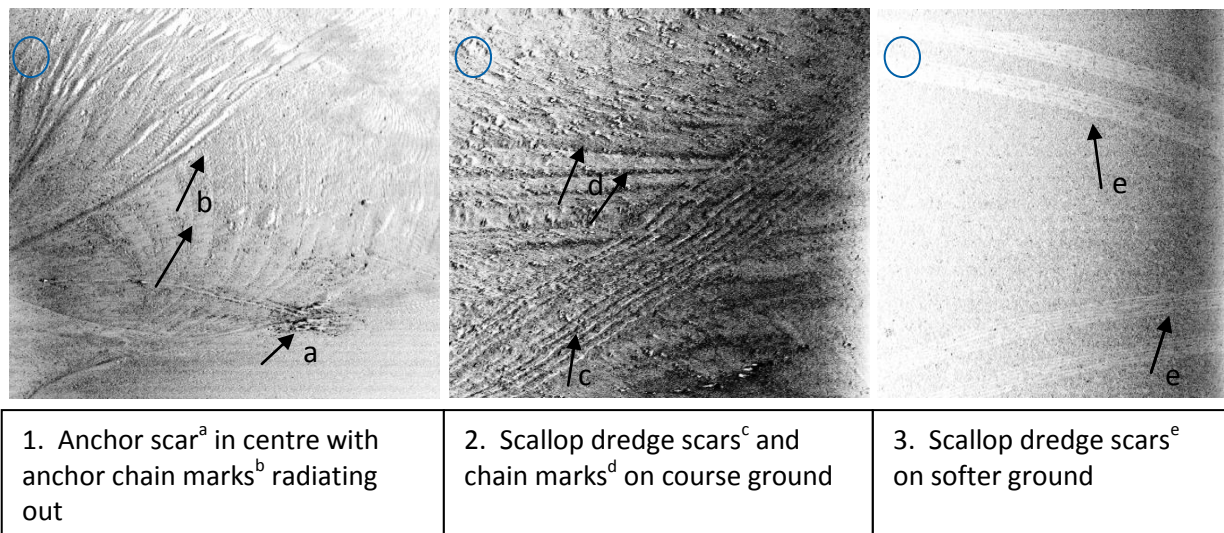


Plate 1-3 Side scan sonar images of physical disturbance to the seabed from anthropogenic activities in Outer Belfast Lough pMCZ.

Guideline 2e The Area of Search contains features at risk⁵ of damage by human activity	
Ocean quahog (<i>A. islandica</i>)	On the basis of the risk assessment (Annex A), undertaken at a local level of the Outer Belfast Lough AoS, this feature is considered to be at moderate risk of significant damage associated with anthropogenic activities. This is a result of potential exposure to pressures associated with fishing activity (specifically hydraulic and scallop dredging are considered to present a high risk while static gear presents a lower risk), mooring and anchoring (presents a moderate to high risk), discharges and dredge disposal (moderate risk) and cable infrastructure operation and/or development (considered to be a moderate risk), while tourism and recreation activities pose a low to moderate risk due to depth. Side-scan data (Figure 3 & Plates 1-3) (DOE, 2015) shows damage in the south-eastern corner of the pMCZ (refer to Guideline 2d).
Subtidal (sublittoral) sand & Sea-pen and burrowing megafauna	SS is considered to be at moderate risk of damage associated with activities occurring in the area. This is due to pressures associated with demersal fishing (high risk of altering the seabed type and moderate risk associated with other fishing pressures), marine traffic (mooring and anchoring considered to be a moderate risk), discharges and dredge disposal (moderate risk) and cable infrastructure operation and/or development (considered to be a moderate risk).
2e Result	Guidelines met.
Guideline 2f The Area of Search contains historic sites which could be restored	
2f Result	Guideline not met as this is not applicable.

⁵ Information on the sensitivity of the proposed biodiversity protected features to pressures and their associated activities was taken from Tillin *et al.* (2010), FEAST (Feature Activity Sensitivity Tool) <http://www.marine.scotland.gov.uk/FEAST/Index.aspx> and more developed sensitivity matrices by JNCC. The degree to which a feature is exposed to activities associated with pressures to which it is sensitive in each AoS/pMCZ region was assessed to provide a qualitative measure of risk. Risk assessments for the various activities were examined to produce an overall qualitative risk assessment by pMCZ region. The conclusions may not reflect the level of risk at the level of the possible pMCZ. More detailed information on the process can be found on the papers: Guidance on the development of Conservation Objectives and potential Management Options and Outer Belfast Lough Conservation Objectives and potential Management Options. The risk assessment for Outer Belfast Lough pMCZ is included in the Annex A.

Stage 3 - Assess the size of the Area of Search to ensure this is sufficient to maintain the integrity of features protected

Summary of assessment	The pMCZ reflects the distribution of OQ and the range of SS habitats suitable for OQ colonisation. The SS habitats are also representative of the wider Outer Belfast Lough area and include records of SPBM communities which are on the OSPAR T&D list. The proposed boundary is suitable for maintaining the integrity of the features for which the MCZ is being considered.
	Guideline met.

Detailed assessment

The size of the area of search should be adapted where necessary to ensure it is suitable for maintaining the integrity of the features for which the MCZ is being considered. Account should also be taken where relevant, of the need for effective management of relevant activities

Ocean quahog (<i>A. islandica</i>)	The AoS focussed on the high numbers of OQ and relevant activities in the area; the size and shape of the Outer Belfast Lough pMCZ boundary has been modified to reflect all survey records of OQ and to include areas of sediments considered a suitable habitat for OQ colonisation (Sabatini & Pizzolla, 2008). The boundary includes a 500m buffer around OQ records, calculated based on the suggested minimum distance for larval dispersal of 0.5km ² .
Subtidal (sublittoral) sand & Sea-pen and burrowing megafauna	The pMCZ boundary incorporates examples of different types of SS that are considered representative of the wider Outer Belfast Lough area. This includes the biotopes: circalittoral and infralittoral fine sand (SS.SSa.CFiSa - A5.25 and SS.SSa.IFiSa - A5.23) and circalittoral and infralittoral muddy sand (SS.SSa.CMuSa - A5.26 and SS.SSa.IMuSa - A5.24) (JNCC, 2008). The proposed boundary incorporates a representative range of muddy sand and gravelly sand substrates to the north and southwest supporting OQ populations and SPBM communities. To the southeast, the boundary encompasses coarser substrates such as sandy gravel sediments. The extension of SS in the AoS is supported by the broad coverage of grab samples, PSA analysis, predictive habitat mapping (UK SeaMap 2010 and EU SeaMap 2014 v8.3) and biotope assignment from photographic/video images and grab samples (AFBI, 2015; DOE Outer Belfast Lough pMCZ survey 2015).

Stage 4 - Assess the effectiveness of managing features within the proposed Area of Search

Summary of assessment	There is potential for management measures to be implemented successfully to achieve the conservation objectives of the pMCZ features.
	Guideline met. As a result the original AoS and subsequent pMCZ progresses as potential area for MCZ to Stage 5.

Detailed assessment

There is a high probability that management measures, and the ability to implement them, will deliver the objectives of the MCZ

As the Outer Belfast Lough pMCZ features are in unfavourable condition the conservation objectives have been set to '*recover the features to favourable condition*'. The current available evidence indicates that the population of OQ is considered to be in unfavourable condition possibly as a result of historic fishing that has taken place combined with reduced recruitment (see 2d). This combined with a number of activities (present and future) that are capable of adversely affecting the features indicate there is a need to consider what additional management is required. This will aid in the achievement of the conservation objectives for the pMCZ features.

There are mechanisms through the European Commission under the Fisheries Act (Northern Ireland) 1966 that can be used to support the introduction of spatial fisheries measures to conserve the feature of the pMCZ. Under the Marine and Coastal Access Act (2009) the Department has the responsibility for licensing certain activities; in some cases the Environmental Impact Assessment (EIA) process may be applicable. The Department also has the powers to introduce bye-laws if required under the Marine Act (Northern Ireland) 2013. The Conservation Objectives and Potential Management Options for Outer Belfast Lough pMCZ details the various activities likely to affect the pMCZ feature and suggested management options.

Stage 5 - Assess the ecological coherence to prioritise between different areas based on the contribution to the MPA network

Summary of assessment	This is the only pMCZ put forward for Northern Ireland for the OSPAR T&D species OQ so the site contributes significantly to the MPA network. The site also makes a contribution towards the MPA network for the representative biotopes of SS in OSPAR Region III.
	Guideline met.

Detailed assessment

The potential area contributes significantly to the coherence of the MPA network in the seas around Northern Ireland

Feature	Representation	Replication	Adequacy
Ocean quahog (<i>A. islandica</i>)	The AoS in Northern Ireland is a stronghold as it contains the second densest population of OQ in UK waters. This feature is an OSPAR T&D species (OSPAR, 2009) and PMF in Northern Ireland.	Replication of this feature in the network is proposed within OSPAR Region III. (Offshore and inshore Scottish MPAs). As an OSPAR T&D species in Region II it is considered important to have greater replication for the feature in the OSPAR region.	The whole aggregation of OQ is included within the pMCZ.
	Viability	Connectivity	Management
	The precautionary approach has been applied as there is no information for the size of area required for a minimum viable population which covers the whole OQ life-cycle (Hill <i>et al.</i> , 2010). Suggested larval dispersal distance is up to 49km. JNCC guidance	Not applicable ⁶ .	There is potential for management measures to be implemented successfully to achieve the conservation objectives of the pMCZ feature such as fisheries measures, licensing activities and through bye-laws.

⁶ Connectivity between different regional networks and individual MPAs has only been assessed for some mobile species and large scale features. There is currently little evidence on linkages for low mobility species and sea-bed habitats in UK waters. More modelling work for assessing linkages is needed.

	<p>suggests a minimum viable patch diameter of 0.5km (Natural England & JNCC, 2010). Where the feature occurs in a restricted location protection of the whole patch is required for viability (Hill <i>et al.</i>, 2010). The pMCZ boundary covers the OQ extension with an area of 5.75km². The minimum diameter in the pMCZ is 2km.</p>		
	<p>Best available evidence</p>	<p>Economic, cultural and social issues</p>	
	<p>Best available evidence has been used to arrive at the decision regarding the feature and boundary development. Refer to Data confidence assessment for Outer Belfast Lough pMCZ for further details.</p>	<p>For further details refer to Conservation Objectives and potential Management Options for Outer Belfast Lough pMCZ and Regulatory Impact Assessment (RIA).</p>	

Subtidal (sublittoral) sand & Sea-pen and burrowing megafauna communities	Representation	Replication	Adequacy
	Representative of NI marine environment. SS sediments are a key habitat supporting populations of OQ. This habitat is considered to be functionally linked to OQ and critical to its seabed colonisation. The broad scale habitat SS A5.2 is in the UK list of Priority Species and Habitats (UK BAP).	Replication of this feature in the network is proposed within OSPAR Region III. (Offshore and inshore Scottish MPAs).	For adequacy, a minimum proportion target of 15% for SS is suggested to support the network of MPAs (A5.2) (Natural England & JNCC, 2010). At present a current proportion of 10.16% is protected within Northern Ireland's MPAs, therefore the addition of the pMCZ would increase the percentage to 10.51%.(Barnard <i>et al.</i> 2014)
			The area of SS in Northern Ireland is 1643.3km ² while 167km ² of this is currently protected in the existing MPA network. The pMCZ will increase this area to 172.75km ² .
	Viability	Connectivity	Management
The home range of characteristic species for this habitat would be covered by an area less than 10km ² . This is based on the area required to support a genetically viable population of the majority of the characteristic species. An area of 478m ² is thought to be adequate to protect the majority of species utilising	There are multiple connections in the NI network, including Waterfoot pMCZ (Barnard <i>et al.</i> 2014). This seabed feature with different types of sediment is important for its wider functional significance and its role supporting high biodiversity and provision of	There is potential for management measures to be implemented successfully to achieve the conservation objectives of the pMCZ features such as fisheries measures, licensing activities and though bylaws.	

	Subtidal (sublittoral) sand and be self sustaining (Hill <i>et al.</i> , 2010, Natural England & JNCC, 2010). The current pMCZ area is 5.75km ² .	migration corridor and increased productivity. The open area that is the pMCZ is well connected with the exiting MPA network.	
	Best available evidence	Economic, cultural and social issues	
	Best available evidence has been used at the time. Refer to Data Confidence Assessment for Belfast Lough pMCZ for further details.	For further details refer to Conservation Objectives and potential Management Options Outer Belfast Lough pMCZ and RIA.	

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Annex A

Sensitivity, exposure and vulnerability Matrix for Outer Belfast Lough pMCZ

Sensitivity and Exposure Key: ●●● High ●● Moderate ● Low ○ Not sensitive ?No information

Vulnerability Key: High vulnerability Moderate vulnerability Low vulnerability No vulnerability Unknown

Table 1: Ocean quahog (*Arctica islandica*) Vulnerability Assessment

Pressure category	Pressures	Activities associated in the area	Ocean quahog: <i>Arctica islandica</i>			
			Sensitivity	Exposure	Vulnerability	
Physical Loss	Physical loss	Infrastructure - coastal defence & land claim	●●●	●	Moderate Vulnerability	
	Physical change (to another seabed type)	Infrastructure - coastal defence & land claim	●●●	●	Moderate Vulnerability	
Physical Damage	Siltation rate changes (low)		○		No Vulnerability	
	Siltation rate changes (high)	Discharges/Dr edge disposal	●●●	●	Moderate Vulnerability	
	Sub-surface abrasion/penetration: damage to seabed surface and penetration ≤25mm	Fishing – hydraulic dredging, scallop dredging, creeling & potting			●●	High Vulnerability
		Infrastructure - ports, marinas, leisure facilities, cables, coastal defence & land claim		●●●	●	Moderate Vulnerability
	Energy production - Tidal turbine			○	No Vulnerability	

		energy production				
		Marine traffic - Moorings, anchoring & navigation		••	High Vulnerability	
		Tourism & recreation		•	Moderate Vulnerability	
	Surface abrasion: damage to seabed surface features	Fishing – hydraulic dredging, scallop dredging, creeling & potting			••	Low Vulnerability
		Infrastructure - ports, marinas, leisure facilities, cables, coastal defence & land claim	•		•	Low Vulnerability
		Marine traffic - Moorings, anchoring & navigation			••	Low Vulnerability
		Tourism & recreation			•	Low Vulnerability
		Physical removal (extraction of substratum)	Infrastructure - ports, marinas, leisure facilities, cables, coastal defence & land claim	•••		•
	Barrier to species movement (behaviour, reproduction)			○		No Vulnerability

	Death or injury by collision		○		No Vulnerability
Non-physical disturbance & Climate change	Litter		?		Unknown
	Introduction of light		?		Unknown
	Electromagnetic changes		?		Unknown
	Underwater noise		○		No Vulnerability
	Visual disturbance (behaviour)		?		Unknown
	Temperature changes - regional/national		?		Unknown
	Temperature changes - local	Infrastructure - cables	●●●	○	No Vulnerability
	Atmospheric climate change			○	No Vulnerability
	Emergence regime changes (sea level) - regional/national			○	No Vulnerability
	Emergence regime changes - local			○	No Vulnerability
	Water flow (tidal & ocean current) changes - regional/national		○		No Vulnerability
	Wave exposure changes - regional/national			○	No Vulnerability
	Water flow (tidal current) changes - local	Infrastructure - ports, marinas, leisure facilities, cables, coastal defence & land claim	●	●	Low Vulnerability

		Energy production - Tidal turbine energy production		○	No Vulnerability
	Wave exposure changes - local	Infrastructure - ports, marinas, leisure facilities, cables, coastal defence & land claim	●●	●	Low Vulnerability
		Energy production - Tidal turbine energy production		○	No Vulnerability
Toxic Contamination	Introduction of other substances (solid, liquid or gas)		?		Unknown
	Non-synthetic compound contamination (inc. heavy metals, hydrocarbons, produced water)		○		No Vulnerability
	Synthetic compound contamination (inc. pesticides, antifoulants, pharmaceuticals)		○		No Vulnerability
	Radionuclide contamination		○		No Vulnerability
Non-toxic Contamination	Organic enrichment		○		No Vulnerability
	Salinity changes - local		○		No Vulnerability
	Salinity changes -		○		No

	regional/national				Vulnerability
	pH changes		?		Unknown
	De-oxygenation		○		No Vulnerability
	Nitrogen & phosphorus enrichment		○		No Vulnerability
	Water clarity changes			○	No Vulnerability
Biological Disturbance	Removal of target species (lethal)		○		No Vulnerability
	Removal of non-target species (lethal)	Fishing – hydraulic dredging, scallop dredging, creeling & potting	●●	●●	Moderate Vulnerability
	Genetic modification & translocation of indigenous species			○	No Vulnerability
	Introduction of microbial pathogens (disease)		○		No Vulnerability
	Introduction or spread of non-indigenous species & translocations (competition)		○		No Vulnerability

Table 2: Sublittoral (subtidal) sand Vulnerability Assessment

Pressure category	Pressures	Activities associated in the area	Subtidal sand		
			Sensitivity	Exposure	Vulnerability
Physical Loss	Physical loss	Infrastructure - coastal defence & land claim	●●●	●	Moderate Vulnerability
	Physical change (to another seabed type)	Fishing – hydraulic dredging, scallop dredging	●●●	●●	High Vulnerability
		Discharges/dredge disposal		●	Moderate Vulnerability
		Infrastructure - ports, marinas, leisure facilities, cables , coastal defence & land claim		●	Moderate Vulnerability
		Energy production - Tidal turbine energy production		○	No Vulnerability
Physical Damage	Siltation rate changes (low)	Fishing – hydraulic dredging, scallop dredging	●●	●●	Moderate Vulnerability
		Discharges/dredge disposal		●	Low Vulnerability
	Siltation rate changes (high)	Fishing – hydraulic dredging	●●●	○	No Vulnerability
		Discharges/Dredge disposal		●	Moderate Vulnerability
	Sub-surface abrasion/penetration: damage to	Fishing – hydraulic dredging,	●●	●●	Moderate Vulnerability

	seabed surface and penetration ≤25mm	scallop dredging			
		Infrastructure - ports, marinas, leisure facilities, cables , coastal defence & land claim		•	Low Vulnerability
		Energy production - Tidal turbine energy production		○	No Vulnerability
		Marine traffic - Moorings, anchoring & navigation		••	Moderate Vulnerability
		Tourism & recreation		•	Low Vulnerability
	Surface abrasion: damage to seabed surface features	Fishing – hydraulic dredging, scallop dredging, creeling & potting	••	••	Moderate Vulnerability
		Marine traffic - Moorings, anchoring & navigation		••	Moderate Vulnerability
		Tourism & recreation		•	Low Vulnerability
	Physical removal (extraction of substratum)	Infrastructure - cables	•••	•	Moderate Vulnerability
	Barrier to species movement (behaviour, reproduction)			○	No Vulnerability
	Death or injury by collision			○	No Vulnerability

Non-physical disturbance & Climate change	Litter		?		Unknown
	Introduction of light		?		Unknown
	Electromagnetic changes		○		No Vulnerability
	Underwater noise		○		No Vulnerability
	Visual disturbance (behaviour)		○		No Vulnerability
	Temperature changes - regional/national		?		Unknown
	Temperature changes - local		?		Unknown
	Atmospheric climate change			○	No Vulnerability
	Emergence regime changes (sea level) - regional/national			○	No Vulnerability
	Emergence regime changes - local			○	No Vulnerability
	Water flow (tidal & ocean current) changes - regional/national		○		No Vulnerability
	Wave exposure changes - regional/national		○		No Vulnerability
	Water flow (tidal current) changes - local	Infrastructure - ports, marinas, leisure facilities, cables , coastal defence & land claim	●	●	Low Vulnerability
		Energy production - Tidal turbine energy		○	No Vulnerability

		production			
	Wave exposure changes - local		○		No Vulnerability
					No Vulnerability
Toxic Contamination	Introduction of other substances (solid, liquid or gas)		?		Unknown
	Non-synthetic compound contamination (inc. heavy metals, hydrocarbons, produced water)		○		No Vulnerability
	Synthetic compound contamination (inc. pesticides, antifoulants, pharmaceuticals)		○		No Vulnerability
	Radionuclide contamination		○		No Vulnerability
Non-toxic Contamination	Organic enrichment		○		No Vulnerability
	Salinity changes - local	Infrastructure - coastal defence & land claim	●●	●	Low vulnerability
	Salinity changes - regional/national		○		No Vulnerability
	pH changes		?		Unknown
	De-oxygenation		○		No Vulnerability
	Nitrogen & phosphorus enrichment		○		No Vulnerability
	Water clarity changes		○		No Vulnerability
Biological	Removal of non-target species	Fishing – hydraulic	●●	●●	Moderate

Disturbance	(lethal)	dredging, scallop dredging, creeling & potting			Vulnerability
		Tourism & recreation		•	Low vulnerability
	Removal of target species (lethal)		○		No Vulnerability
	Genetic modification & translocation of indigenous species		?		Unknown
	Introduction of microbial pathogens (disease)		○		No Vulnerability
	Introduction or spread of non- indigenous species & translocations (competition)	Marine traffic - navigation	••	••	Moderate Vulnerability

Risk of Damage Assessment for Outer Belfast Lough pMCZ

Risk Key: ■ High risk ■ Moderate risk ■ Low risk

Table 3: Ocean quahog (*Arctica islandica*) (OQ) Risk of Damage Matrix (based on Vulnerability identified in Table 1)

OQ							
List of pressures which may cause deterioration or disturbance		Activity associated with pressure	Vulnerability	Is the Current Management adequate?*	Comments	Level of Risk	Action Advised
Physical loss	Physical loss	Infrastructure – coastal defence & land claim	Moderate Vulnerability	Yes	The pMCZ is 2 miles off the coast, and new developments may require future management action (licensing/permits) if they are likely to impact on the pMCZ features.	Low	- No action required at present
	Physical change (to another seabed type)	Infrastructure – coastal defence & land claim	Moderate Vulnerability	Yes	Although the pMCZ is 2 miles off the coast, new developments may require future management	Low	- No action required at present

* This does not refer to any future activities or situations where active management is not required

					action (licensing/permits) if they are likely to impact on the pMCZ features.		
Physical damage	Siltation rate changes (high)	Discharges/Dredge disposal	Moderate Vulnerability	Yes	New developments require future management action (licensing/permits) which should ensure the pMCZ features are not impacted.	Moderate	- Remove or avoid new waste water discharges and dredge disposal and expansion or relocation of existing disposal activities
	Sub-surface abrasion/penetration: damage to seabed surface and penetration $\leq 25\text{mm}$	Fishing – hydraulic dredging, scallop dredging, creeling & potting	High Vulnerability	No	No site specific management of this activity in place.	High	- Reduce or limit static gear fishing inside the pMCZ - Remove or avoid mobile gear fishing inside the pMCZ
		Infrastructure – ports, marinas, leisure facilities, cables, coastal	Moderate Vulnerability		No	Existing cables lie adjacent to the pMCZ. The pMCZ features should be	Moderate

		defence & land claim			considered in the current management of associated operations in the area and new developments require future management action (licensing/permits).		operations close to the pMCZ - Remove or avoid new developments in the pMCZ
		Marine traffic – Moorings, anchoring	High Vulnerability	No	No site specific management of this activity is in place.	High	- Remove or avoid anchoring inside the pMCZ
		Tourism & recreation	Moderate Vulnerability	No	No management in place however, due to the depth of the pMCZ activities associated with recreation and tourism are unlikely to adversely impact the features of site.	Low	- No action required at present
	Surface abrasion: damage to seabed surface features	Fishing – hydraulic dredging, scallop dredging, creeling	Low Vulnerability	No	No site specific management of this activity is in	Moderate	- Reduce or limit static gear fishing inside the

		& potting			place.		pMCZ - Remove or avoid mobile gear fishing inside the pMCZ
		Infrastructure – ports, marinas, leisure facilities, cables , coastal defence & land claim	Low Vulnerability	No	Existing cables lie adjacent to the pMCZ. The pMCZ features should be considered in the current management of associated operations in the area and new developments require future management action (licensing/permits)	Moderate	- Reduce or limit pressures associated with cable operations close to the pMCZ - Remove or avoid new developments in the pMCZ
		Marine traffic – Moorings, anchoring & navigation	Low Vulnerability	No	No site specific management of this activity in place.	Moderate	- Remove or avoid anchoring inside the pMCZ
		Tourism & recreation	Low Vulnerability	Yes	No management in place, however, due to the depth of	Low	

					the pMCZ activities associated with recreation and tourism are unlikely to adversely impact the features of site		
	Physical removal (extraction of substratum)	Infrastructure – ports, marinas, leisure facilities, cables , coastal defence & land claim	Moderate Vulnerability	No	Existing cables lie adjacent to the pMCZ. The pMCZ features should be considered in the current management of associated operations in the area and new developments require future management action (licensing/permits)	Moderate	<ul style="list-style-type: none"> - Reduce and limit pressures associated with cable operations close to the pMCZ - Remove or avoid new developments in the pMCZ
Non-physical disturbance & Climate change	Water flow (tidal current) changes - local	Infrastructure – ports, marinas, leisure facilities, cables , coastal defence & land claim	Low Vulnerability	No	Existing cables lie adjacent to the pMCZ. The pMCZ features should be considered in the current management of associated operations in the	Moderate	<ul style="list-style-type: none"> - Reduce and limit pressures associated with cable operations close to the pMCZ - Remove or

					area and new developments require future management action (licensing/permits)		avoid new developments in the pMCZ
	Wave exposure changes - local	Infrastructure – ports, marinas, leisure facilities, cables , coastal defence & land claim	Low Vulnerability	No	Existing cables lie adjacent to the pMCZ. The pMCZ features should be considered in the current management of associated operations in the area and new developments require future management action (licensing/permits)	Moderate	<ul style="list-style-type: none"> - Reduce and limit pressures associated with cable operations close to the pMCZ - Remove or avoid new developments in the pMCZ

<p>Biological disturbance</p>	<p>Removal of non-target species (lethal)</p>	<p>Fishing– hydraulic dredging, scallop dredging, creeling & potting</p>	<p>Moderate Vulnerability</p>	<p>No</p>	<p>No site specific management of this activity in place.</p>	<p>Moderate</p>	<ul style="list-style-type: none"> - Reduce and limit static gear fishing inside the pMCZ - Remove or avoid mobile gear fishing inside the pMCZ
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Table 4: Sublittoral (subtidal) sand (SS) Risk of Damage Matrix (based on Vulnerability identified in Table 2)

Risk Key:  High risk  Moderate risk  Low risk

SS							
List of pressures which may cause deterioration or disturbance		Activity associated with pressure	Vulnerability	Is Current Management adequate?*	Comments	Level of Risk	Action Advised
Physical loss	Physical loss	Infrastructure – coastal defence & land claim	Moderate Vulnerability	Yes	The pMCZ is 2 miles off the coast, and new developments may require future management action (licensing/permits) if they are likely to impact on the pMCZ features.	Low	- No action required at present
	Physical change (to another seabed type)	Fishing – hydraulic dredging, scallop dredging, creeling & potting	High Vulnerability	No	No site specific management of this activity in place.	High	- Reduce and limit static gear fishing inside the pMCZ - Remove or avoid mobile gear fishing

* This does not refer to any future activities or situations where active management is not required

							inside the pMCZ
		Discharges/dredge disposal	Moderate Vulnerability	Yes	New developments require future management action (licensing/permits) which should ensure the pMCZ features are not impacted.	Moderate	- Remove or avoid new waste water discharges and dredge disposal and expansion or relocation of existing disposal activities
		Infrastructure – coastal defence & land claim	Moderate Vulnerability	Yes	Although the pMCZ is 2 miles off the coast, new developments may require future management action (licensing/permits) if they are likely to impact on the pMCZ features.	Low	- No action required at present
Physical damage	Siltation rate changes (low)	Fishing – hydraulic dredging, scallop dredging	Moderate Vulnerability	No	No site specific management of this activity in place.	Moderate	- Reduce static gear fishing inside the pMCZ - Remove or avoid mobile

							gear fishing inside the pMCZ
		Discharges/dredge disposal	Low Vulnerability	Yes	New developments require future management action (licensing/permits) which should ensure the PMCZ features are not impacted.	Moderate	- Remove or avoid new waste water discharges and dredge disposal and expansion or relocation of existing disposal activities
	Siltation rate changes (high)	Discharges/dredge disposal	Moderate Vulnerability	Yes	New developments require future management action (licensing/permits) which should ensure the PMCZ features are not impacted.	Moderate	- Remove or avoid new waste water discharges and dredge disposal and expansion or relocation of existing disposal activities

	Sub-surface abrasion/penetration: damage to seabed surface and penetration ≤25mm	Fishing – hydraulic dredging, scallop dredging, creeling & potting	Moderate Vulnerability	No	No site specific management of this activity in place.	Moderate	<ul style="list-style-type: none"> - Reduce and limit static gear fishing inside the pMCZ - Remove or avoid mobile gear fishing inside the pMCZ
		Infrastructure – ports, marinas, leisure facilities, cables , coastal defence & land claim	Low Vulnerability	No	<p>Existing cables lie adjacent to the pMCZ. The pMCZ features should be considered in the current management of associated operations in the area and new developments require future management action (licensing/permits).</p> <p>Although the pMCZ is 2 miles off the coast, new developments may require future</p>	Moderate	<ul style="list-style-type: none"> - Reduce and limit pressures associated with cable operations close to the pMCZ - Remove or avoid new developments in the pMCZ

					management action (licensing/permits) if they are likely to impact on the pMCZ features.		
		Marine traffic – Shipping, Moorings, anchoring	Moderate Vulnerability	No	No site specific management of this activity in place.	Moderate	- Remove or avoid anchoring inside the pMCZ
		Tourism & recreation	Low Vulnerability	No	No management in place, however, due to the depth of the pMCZ activities associated with recreation and tourism are unlikely to adversely impact the features of site.	Low	No action required at present
	Surface abrasion: damage to seabed surface features	Fishing – hydraulic dredging, scallop dredging, creeling & potting	Moderate Vulnerability	No	No site specific management of this activity in place.	Moderate	- Reduce and limit static gear fishing inside the pMCZ - Remove or avoid mobile

							gear fishing inside the pMCZ
		Marine traffic – Shipping, Moorings, anchoring	Moderate Vulnerability	No	No site specific management of this activity in place.	Moderate	- Remove or avoid anchoring inside the pMCZ
		Tourism & recreation	Low Vulnerability	No	No management in place, however, due to the depth of the pMCZ activities associated with recreation and tourism are unlikely to adversely impact the features of site.	Low	- No action required at present
	Physical removal (extraction of substratum)						
		Infrastructure – cables	Moderate Vulnerability	No	Existing cables lie adjacent to the pMCZ. The pMCZ features should be considered in the current management of associated operations in the area and new	Moderate	- Reduce and limit pressures associated with cable operations close to the pMCZ - Remove or

					developments require future management action (licensing/permits).		avoid new developments in the pMCZ
Non-physical disturbance & Climate change	Water flow (tidal current) changes - local	Infrastructure – ports, marinas, leisure facilities, cables , coastal defence & land claim	Low Vulnerability	No	Existing cables lie adjacent to the pMCZ. The pMCZ features should be considered in the current management of associated operations in the area and new developments require future management action (licensing/permits).	Moderate	- Reduce and limit pressures associated with cable operations close to the pMCZ - Remove or avoid new developments in the pMCZ
Non-toxic Contamination	Salinity changes - local	Infrastructure – coastal defence & land claim	Low vulnerability	Yes	The pMCZ is located in open water with strong tidal flow; salinity changes are highly unlikely to occur.	Low	No action required at present

Biological disturbance	Removal of non-target species (lethal)	Fishing – hydraulic dredging, scallop dredging, creeling & potting	Moderate Vulnerability	No	No site specific management of this activity in place.	Moderate	- Reduce and limit static gear fishing inside the pMCZ - Remove or avoid mobile gear fishing inside the pMCZ
		Tourism & recreation	Low vulnerability	No	No management in place, however, due to the depth of the pMCZ activities associated with recreation and tourism are unlikely to adversely impact the features of site.	Low	- No action required at present

	Introduction or spread of non-indigenous species & translocations (competition)	Marine traffic – mooring, anchoring and shipping	Moderate Vulnerability	No	No management in place, however, due to the depth of the pMCZ activities associated with marine traffic (shipping) are unlikely to adversely impact the features of site.	Moderate	- No action required at present
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Department of
the Environment
www.doeni.gov.uk

Department of the Environment
Marine Division
2nd Floor, Klondyke Building
Cromac Avenue
Belfast BT7 2AJ

Telephone: 028 90569262

Email:
MarineDivision.InfoRequests@doeni.gov.uk

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