Appendix 10.1 Planning Policy Screening

Scotland's National Marine Plan Policies Screening Assessment

From: https://www.gov.scot/publications/scotlands-national-marine-plan/pages/1/

Marine Plan Policy Listing and Screening in Relation to the Proposed Development

Policy ID	Policy Title	Policy Text	Screening Rationale	Relevant Section of the AEE
GEN 1	General planning principle	There is a presumption in favour of sustainable development and use of the marine environment when consistent with the policies and objectives of this Plan.	Policy screened for consideration in AEE	Chapter 10
GEN 2	Economic benefit	Sustainable development and use which provides economic benefit to Scottish communities is encouraged when consistent with the objectives and policies of this Plan.	Policy screened for consideration in AEE	Chapter 10
GEN 3	Social benefit	Sustainable development and use which provides social benefits is encouraged when consistent with the objectives and policies of this Plan.	Policy screened for consideration in AEE	Chapter 10
GEN 4	Co-existence	Proposals which enable coexistence with other development sectors and activities within the Scottish marine area are encouraged in planning and decision making processes, when consistent with policies and objectives of this Plan.	Policy screened for consideration in AEE	Chapter 10
GEN 5	Climate change	Marine planners and decision makers must act in the way best calculated to mitigate, and adapt to, climate change.	Policy screened for consideration in AEE	Section 10.12
GEN 6	Historic environment	Development and use of the marine environment should protect and, where appropriate, enhance heritage assets in a manner proportionate to their significance.	Policy screened for consideration in AEE	Section 10.12, Sections 10.10.104 - 10.10.112
GEN 7	Landscape/seascape	Marine planners and decision makers should ensure that development and use of the marine environment take seascape, landscape and visual impacts into account.	Policy screened for consideration in AEE	Section 10.12
GEN 8	Coastal process and flooding	Developments and activities in the marine environment should be resilient to coastal change and flooding, and not have unacceptable adverse impact on coastal processes or contribute to coastal flooding.	Policy screened for consideration in AEE	Section 10.12
GEN 9	Natural heritage	Development and use of the marine environment must: (a) Comply with legal requirements for protected areas and protected species. (b) Not result in significant impact on the national status of Priority Marine Features. (c) Protect and, where appropriate, enhance the health of the marine area.	Policy screened for consideration in AEE	Section 10.12
GEN 10	Invasive non-native species	Opportunities to reduce the introduction of invasive non-native species to a minimum or proactively improve the practice of existing activity should be taken when decisions are being made.	Policy screened for consideration in AEE	Section 10.12
GEN 11	Marine litter	Developers, users and those accessing the marine environment must take measures to address marine litter where appropriate. Reduction of litter must be taken into account by decision makers.	Policy screened for consideration in AEE	Section 10.12
GEN 12	Water quality and resource	Developments and activities should not result in a deterioration of the quality of waters to which the Water Framework Directive, Marine Strategy Framework Directive or other related Directives apply.	Policy screened for consideration in AEE	Section 10.12
GEN 13	Noise	Development and use in the marine environment should avoid significant adverse effects of man-made noise and vibration, especially on species sensitive to such effects.	Policy screened for consideration in AEE	Section 10.12
GEN 14	Air quality	Development and use of the marine environment should not result in the deterioration of air quality and should not breach any statutory air quality limits.	Policy screened for consideration in AEE	Section 10.12
GEN 15	Planning alignment A	Marine and terrestrial plans should align to support marine and land-based components required by development and seek to facilitate appropriate access to the shore and sea.	Policy screened for consideration in AEE	Chapter 10
GEN 16	Planning alignment B	Marine plans should align and comply where possible with other statutory plans and should consider objectives and policies of relevant non-statutory plans where appropriate to do so. <applies to inshore waters only>	Policy screened for consideration in AEE	Section 10.12
GEN 17	Fairness	All marine interests will be treated with fairness and in a transparent manner when decisions are being made in the marine environment.	Policy screened for consideration in AEE	Chapter 10
GEN 18	Engagement	Early and effective engagement should be undertaken with the general public and all interested stakeholders to facilitate planning and consenting processes.	Policy screened for consideration in AEE	Section 10.3.1
GEN 19	Sound evidence	Decision making in the marine environment will be based on sound scientific and socio-economic evidence.	Policy screened for consideration in AEE	Chapter 10
GEN 20	Adaptive management	Adaptive management practices should take account of new data and information in decision making, informing future decisions and future iterations of policy.	Policy screened for consideration in AEE	Chapter 10
GEN 21	Cumulative impacts	Cumulative impacts affecting the ecosystem of the marine plan area should be addressed in decision making and plan implementation.	Policy screened for consideration in AEE	Section 10.13
FISHERIES 1		Taking account of the EU's Common Fisheries Policy, Habitats Directive, Birds Directive and Marine Strategy Framework Directive, marine planners and decision makers should aim to ensure: - Existing fishing opportunities and activities are safeguarded wherever possible. - An ecosystem-based approach to the management of fishing which ensures sustainable and resilient fish stocks and avoids damage to fragile habitats. - Protection for vulnerable stocks (in particular for juvenile and spawning stocks through continuation of sea area closures where appropriate). - Improved protection of the seabed and historical and archaeological remains requiring protection through effective identification of high-risk areas and management measures to mitigate the impacts of fishing, where appropriate. - That other sectors take into account the need to protect fish stocks and sustain healthy fisheries for both economic and conservation reasons. - Delivery of Scotland's international commitments in fisheries, including the ban on discards. - Mechanisms for managing conflicts between fishermen and/or between the fishing sector and other users of the marine environment.	Policy screened for consideration in AEE	Sections 10.10.141 - 10.10 .149
FISHERIES 2		The following key factors should be taken into account when deciding on uses of the marine environment and the potential impact on fishing: - The cultural and economic importance of fishing, in particular to vulnerable coastal communities. - The potential impact (positive and negative) of marine developments on the sustainability of fish and shellfish stocks and resultant fishing opportunities in any given area. - The environmental impact on fishing grounds (such as nursery, spawning areas), commercially fished species, habitats and species more generally. - The potential effect of displacement on: fish stocks; the wider environment; use of fuel; socio-economic costs to fishers and their communities and other marine users.	Policy screened for consideration in AEE	Sections 10.10.141 - 10.10 .149

FISHERIES 3		Where existing fishing opportunities or activity cannot be safeguarded, a Fisheries Management and Mitigation Strategy should be prepared by the proposer of development or use, involving full engagement with local fishing interests (and other interests as appropriate) in the development of the Strategy. All efforts should be made to agree the Strategy with those interests. Those interests should also undertake to engage with the proposer and provide transparent and accurate information and data to help complete the Strategy. The Strategy should be drawn up as part of the discharge of conditions of permissions granted. The content of the Strategy should be relevant to the particular circumstances and could include: - An assessment of the potential impact of the development or use on the affected fishery or fisheries, both in socio-economic terms and in terms of environmental sustainability. - A recognition that the disruption to existing fishing opportunities/activity should be minimised as far as possible. - Reasonable measures to mitigate any constraints which the proposed development or use may place on existing or proposed fishing activity. - Reasonable measures to mitigate any potential impacts on sustainability of fish stocks (e.g. impacts on spawning grounds or areas of fish or shellfish abundance) and any socio-economic impacts. Where it does not prove possible to agree the Strategy with all interests, the reasons for any divergence of views between the parties should be fully explained in the Strategy and dissenting views should be given a platform within the Strategy to make their case.	Policy screened for consideration in AEE	Sections 13.10.141 - 13.10 .149
FISHERIES 4		Ports and harbours should seek to engage with fishing and other relevant stakeholders at an early stage to discuss any changes in infrastructure that may affect them. Any port or harbour developments should take account of the needs of the dependent fishing fleets with a view to avoiding commercial harm where possible. Where a port or harbour has reached a minimum level of infrastructure required to support a viable fishing fleet, there should be a presumption in favour of maintaining this infrastructure, provided there is an ongoing requirement for it to remain in place and that it continues to be fit for purpose.	Policy not relevant to the Proposed Development (sector specific policy)	N/A
FISHERIES 5		Inshore Fisheries Groups (IFGs) should work with all local stakeholders with an interest to agree joint fisheries management measures. These measures should inform and reflect the objectives of regional marine plans. <applies to inshore waters>	Policy not relevant to the Proposed Development (geographic policy)	N/A
AQUACULTURE 1		Marine planners and decision makers should seek to identify appropriate locations for future aquaculture development and use, including the potential use of development planning briefs as appropriate. System carrying capacity (at the scale of a water body or loch system) should be a key consideration.	Policy screened for consideration in AEE	N/A
AQUACULTURE 2		Marine and terrestrial development plans should jointly identify areas which are potentially suitable and sensitive areas which are unlikely to be appropriate for such development, reflecting Scottish Planning Policy and any Scottish Government guidance on the issue. There is a continuing presumption against further marine finfish farm developments on the north and east coasts to safeguard migratory fish species.	Policy screened for consideration in AEE	N/A
AQUACULTURE 3		In relation to nutrient enhancement and benthic impacts, as set out under Locational Guidelines for the Authorisation of Marine Fish Farms in Scottish Waters, fish farm development is likely to be acceptable in Category 3 areas, subject to other criteria being satisfied. A degree of precaution should be applied to consideration of further fish farming development in Category 2 areas and there will be a presumption against further fish farm development in Category 1 areas.	Policy not relevant to the Proposed Development (sector specific policy)	N/A
AQUACULTURE 4		There is a presumption that further sustainable expansion of shellfish farms should be located in designated shellfish waters if these have sufficient capacity to support such development.	Policy not relevant to the Proposed Development (sector specific policy)	N/A
AQUACULTURE 5		Aquaculture developments should avoid and/or mitigate adverse impacts upon the seascape, landscape and visual amenity of an area, following SNH guidance on the siting and design of aquaculture.	Policy not relevant to the Proposed Development (sector specific policy)	N/A
AQUACULTURE 6		New aquaculture sites should not bridge Disease Management Areas although boundaries may be revised by Marine Scotland to take account of any changes in fish farm location, subject to the continued management of risk.	Policy not relevant to the Proposed Development (sector specific policy)	N/A
AQUACULTURE 7		Operators and regulators should continue to utilise a risk based approach to the location of fish farms and potential impacts on wild fish.	Policy not relevant to the Proposed Development (sector specific policy)	N/A
AQUACULTURE 8		Guidance on harassment at designated seal haul out sites should be taken into account and seal conservation areas should also be taken into account in site selection and operation. Seal licences will only be granted where other management options are precluded or have proven unsuccessful in deterrence.	Policy not relevant to the Proposed Development (sector specific policy)	N/A
AQUACULTURE 9		Consenting and licensing authorities should be satisfied that appropriate emergency response plans are in place.	Policy not relevant to the Proposed Development (sector specific policy)	N/A
AQUACULTURE 10		Operators should carry out pre-application discussion and consultation, and engage with local communities and others who may be affected, to identify and, where possible, address any concerns in advance of submitting an application.	Policy not relevant to the Proposed Development (sector specific policy)	N/A
AQUACULTURE 11		Aquaculture equipment, including but not limited to installations, facilities, moorings, pens and nets must be fit for purpose for the site conditions, subject to future climate change. Any statutory technical standard must be adhered to. Equipment and activities should be optimised in order to reduce greenhouse gas emissions.	Policy not relevant to the Proposed Development (sector specific policy)	N/A
AQUACULTURE 12		Applications which promote the use of sustainable biological controls for sea lice (such as farmed wrasse) will be encouraged.	Policy not relevant to the Proposed Development (sector specific policy)	N/A
AQUACULTURE 13		Proposals that contribute to the diversification of farmed species will be supported, subject to other objectives and policies being satisfied.	Policy not relevant to the Proposed Development (sector specific policy)	N/A
AQUACULTURE 14		The Scottish Government, aquaculture companies and Local Authorities should work together to maximise benefit to communities from aquaculture development.	Policy not relevant to the Proposed Development (sector specific policy)	N/A
WILD FISH 1		The impact of development and use of the marine environment on diadromous fish species should be considered in marine planning and decision making processes. Where evidence of impacts on salmon and other diadromous species is inconclusive, mitigation should be adopted where possible and information on impacts on diadromous species from monitoring of developments should be used to inform subsequent marine decision making.	Policy screened for consideration in AEE	Sections 10.10.141 - 10.10.149
OIL & GAS 1		The Scottish Government will work with DECC, the new Oil and Gas Authority and the industry to maximise and prolong oil and gas exploration and production whilst ensuring that the level of environmental risks associated with these activities are regulated. Activity should be carried out using the principles of Best Available Technology (BAT) and Best Environmental Practice. Consideration will be given to key environmental risks including the impacts of noise, oil and chemical contamination and habitat change.	Policy not relevant to the Proposed Development (sector specific policy)	N/A
OIL & GAS 2		Where re-use of oil and gas infrastructure is not practicable, either as part of oil and gas activity or by other sectors such as carbon capture and storage, decommissioning must take place in line with standard practice, and as allowed by international obligations. Re-use or removal of decommissioned assets from the seabed will be fully supported where practicable and adhering to relevant regulatory process.	Policy not relevant to the Proposed Development (sector specific policy)	N/A
OIL & GAS 3		Supporting marine and coastal infrastructure for oil and gas developments, including for storage, should utilise the minimum space needed for activity and should take into account environmental and socio-economic constraints.	Policy not relevant to the Proposed Development (sector specific policy)	N/A
OIL & GAS 4		All oil and gas platforms will be subject to 9 nautical mile consultation zones in line with Civil Aviation Authority guidance.	Policy screened for consideration in AEE	Sections 10.10.76 - 10.10.83
OIL & GAS 5		Consenting and licensing authorities should have regard to the potential risks, both now and under future climates, to oil and gas operations in Scottish waters, and be satisfied that installations are appropriately sited and designed to take account of current and future conditions.	Policy screened for consideration in AEE	Sections 10.10.76 - 10.10.83
OIL & GAS 6		Consenting and licensing authorities should be satisfied that adequate risk reduction measures are in place, and that operators should have sufficient emergency response and contingency strategies in place that are compatible with the National Contingency Plan and the Offshore Safety Directive.	Policy screened for consideration in AEE	Sections 10.10.76 - 10.10.83
CCS 1		CCS commercialisation projects or developments should be supported through an alignment of marine and terrestrial planning processes, particularly where proposals allow timely deployment of CCS to re-use suitable existing redundant oil and gas infrastructure.	Policy not relevant to the Proposed Development (sector specific policy)	N/A
CCS 2		Consideration should be given to the development of marine utility corridors which will allow CCS to capitalise, where possible, on current infrastructure in the North Sea, including shared use of spatial corridors and pipelines.	Policy screened for consideration in AEE	N/A

RENEWABLES 1		Proposals for commercial scale offshore wind and marine renewable energy development should be sited in the Plan Option areas identified through the Sectoral Marine Plan process. Plan Options are considered the preferred strategic locations for the sustainable development of offshore wind and marine renewables. This preference should be taken into account by marine planners and decision makers if alternative development or use of these areas is being considered. Proposals are subject to licensing and consenting processes.	Policy not relevant to the Proposed Development (sector specific policy)	N/A
RENEWABLES 2		Sites with agreements for lease for wave and tidal energy development in the Pentland Firth Strategic Area must be taken into account by marine planners and decision makers if alternative use of these areas, or use which would affect access to these areas, is being considered. Proposals are subject to licensing and consenting processes. Regional Locational Guidance and the Pentland Firth and Orkney Waters Marine Spatial Plans should also be taken into account when reaching decisions.	Policy not relevant to the Proposed Development (geographic policy)	N/A
RENEWABLES 3		Marine planners and decision makers should consider proposals for sustainable development of test and demonstration for offshore wind and marine renewable energy development on a case-by-case basis where sites are identified. This preference should be taken into account by marine planners and decision makers if alternative development or use of these areas is being considered. Regional Locational Guidance should be taken into account and proposals are subject to licensing and consenting processes.	Policy not relevant to the Proposed Development (sector specific policy)	N/A
RENEWABLES 4		Applications for marine licences and consents relating to offshore wind and marine renewable energy projects should be made in accordance with the Marine Licensing Manual and Marine Scotland's Licensing Policy Guidance.	Policy not relevant to the Proposed Development (sector specific policy)	N/A
RENEWABLES 5		Marine planners and decision makers must ensure that renewable energy projects demonstrate compliance with Environmental Impact Assessment and Habitats Regulations Appraisal legislative requirements.	Policy not relevant to the Proposed Development (sector specific policy)	N/A
RENEWABLES 6		New and future planned grid connections should align with relevant sectoral and other marine spatial planning processes, where appropriate, to ensure a co-ordinated and strategic approach to grid planning. Cable and network owners and marine users should also take a joined-up approach to development and activity to minimise impacts on the marine historic and natural environment and other users.	Policy not relevant to the Proposed Development (sector specific policy)	N/A
RENEWABLES 7		Marine planners and decision makers should ensure infrastructure is fit for purpose now and in future. Consideration should be given to the potential for climate change impacts on coasts vulnerable to erosion.	Policy not relevant to the Proposed Development (sector specific policy)	N/A
RENEWABLES 8		Developers bringing forward proposals for new developments must actively engage at an early stage with the general public and interested stakeholders of the area to which the proposal relates and of adjoining areas which may be affected.	Policy not relevant to the Proposed Development (sector specific policy)	N/A
RENEWABLES 9		Marine planners and decision makers should support the development of joint research and monitoring programmes for offshore wind and marine renewables energy development.	Policy not relevant to the Proposed Development (sector specific policy)	N/A
RENEWABLES 10		Good practice guidance for community benefit from offshore wind and renewable energy development should be followed by developers, where appropriate.	Policy not relevant to the Proposed Development (sector specific policy)	N/A
REC & TOURISM 1		Opportunities to promote sustainable development of marine recreation and tourism should be supported.	Policy screened for consideration in AEE	Sections 10.10.160 - 10.10.168
REC & TOURISM 2		The following key factors should be taken into account when deciding on uses of the marine environment and the potential impact on recreation and tourism: - The extent to which the proposal is likely to adversely affect the qualities important to recreational users, including the extent to which proposals may interfere with the physical infrastructure that underpins a recreational activity. - The extent to which any proposal interferes with access to and along the shore, to the water, use of the resource for recreation or tourism purposes and existing navigational routes or navigational safety. - Where significant impacts are likely, whether reasonable alternatives can be identified for the proposed activity or development. - Where significant impacts are likely and there are no reasonable alternatives, whether mitigation, through recognised and effective measures, can be achieved at no significant cost to the marine recreation or tourism sector interests.	Policy screened for consideration in AEE	Sections 10.10.160 - 10.10.168
REC & TOURISM 3		Regional marine plans should identify areas that are of recreational and tourism value and identify where prospects for significant development exist, including opportunities to link to the National Long Distance Walking and Cycle Routes, and more localised and/or bespoke recreational opportunities and visitor attractions.	Policy screened for consideration in AEE	Sections 10.10.160 - 10.10.168
REC & TOURISM 4		Marine and terrestrial planners, marine decision makers and developers should give consideration to the facility requirements of marine recreation and tourism activities, including a focus on support for participation and development in sport. Co-operation and sharing infrastructure and/or facilities, where appropriate, with complementary sectors should be supported as should provision of low carbon transport options.	Policy screened for consideration in AEE	Sections 10.10.160 - 10.10.168
REC & TOURISM 5		Marine planners and decision makers should support enhancement to the aesthetic qualities, coastal character and wildlife experience of Scotland's marine and coastal areas, to the mutual benefit of the natural environment, human quality of life and the recreation and tourism sectors.	Policy screened for consideration in AEE	Sections 10.10.160 - 10.10.168
REC & TOURISM 6		Codes of practice for invasive non-native species and Marine Wildlife Watching should be complied with.	Policy screened for consideration in AEE	Sections 10.10.160 - 10.10.168
TRANSPORT 1		Navigational safety in relevant areas used by shipping now and in the future will be protected, adhering to the rights of innocent passage and freedom of navigation contained in UN Convention on the Law of the Sea (UNCLOS). The following factors will be taken into account when reaching decisions regarding development and use: - The extent to which the locational decision interferes with existing or planned routes used by shipping, access to ports and harbours and navigational safety. This includes commercial anchorages and defined approaches to ports. - Where interference is likely, whether reasonable alternatives can be identified. - Where there are no reasonable alternatives, whether mitigation through measures adopted in accordance with the principles and procedures established by the International Maritime Organization can be achieved at no significant cost to the shipping or ports sector.	Policy screened for consideration in AEE	Sections 10.10.160 - 10.10.168
TRANSPORT 2		Marine development and use should not be permitted where it will restrict access to, or future expansion of, major commercial ports or existing or proposed ports and harbours which are identified as National Developments in the current NPF or as priorities in the National Renewables Infrastructure Plan. Regional marine plans should identify regionally important ports and harbours, giving consideration to social and economic aspects of the port or harbour and the users of the facility subject to policies and objectives of this Plan. Regional plans should consider setting out criteria against which proposed activities and developments should be evaluated. <applies to inshore waters only>	Policy not relevant to the Proposed Development (sector specific policy)	N/A
TRANSPORT 3		Ferry routes and maritime transport to island and remote mainland areas provide essential connections and should be safeguarded from inappropriate marine development and use that would significantly interfere with their operation. Developments will not be consented where they will unacceptably interfere with lifeline ferry services.	Policy screened for consideration in AEE	Sections 10.10.94 - 10.10.103, Sections 10.10.150 - 10.10.159
TRANSPORT 4		Maintenance, repair and sustainable development of port and harbour facilities in support of other sectors should be supported in marine planning and decision making. <applies to inshore waters only>	Policy not relevant to the Proposed Development (sector specific policy)	N/A
TRANSPORT 5		Port and harbour operators should take into account future climate change and extreme water level projections, and where appropriate take the necessary steps to ensure their ports and harbours remain viable and resilient to a changing climate. Climate and sea level projections should also be taken into account in the design of any new ports and harbours, or of improvements to existing facilities. <applies to inshore waters only>	Policy not relevant to the Proposed Development (sector specific policy)	N/A
TRANSPORT 6		Marine planners and decision makers and developers should ensure displacement of shipping is avoided where possible to mitigate against potential increased journey lengths (and associated fuel costs, emissions and impact on journey frequency) and potential impacts on other users and ecologically sensitive areas.	Policy screened for consideration in AEE	Sections 10.10.94 - 10.10.103, Sections 10.10.150 - 10.10.159
TRANSPORT 7		Marine and terrestrial planning processes should co-ordinate to: - Provide co-ordinated support to ports, harbours and ferry terminals to ensure they can respond to market influences and provide support to other sectors with necessary facilities and transport links. - Consider spatial co-ordination of ferries and other modes of transport to promote integrated and sustainable travel options.	Policy not relevant to the Proposed Development (sector specific policy)	N/A

CABLES 1		Cable and network owners should engage with decision makers at the early planning stage to notify of any intention to lay, repair or replace cables before routes are selected and agreed. When making proposals, cable and network owners and marine users should evidence that they have taken a joined-up approach to development and activity to minimise impacts, where possible, on the marine historic and natural environment, the assets, infrastructures and other users. Appropriate and proportionate environmental considertion and risk assessments should be provided which may include cable protection measures and mitigation plans. Any deposit, removal or dredging carried out for the purpose of executing emergency inspection or repair works to any cable is exempt from the marine licensing regime with approval by Scottish Ministers. However, cable replacement requires a marine licence. Marine Licensing Guidance should be followed when considering any cable development and activity.	Policy not relevant to the Proposed Development (sector specific policy)	N/A
CABLES 2		The following factors will be taken into account on a case by case basis when reaching decisions regarding submarine cable development and activities: - Cables should be suitably routed to provide sufficient requirements for installation and cable protection. - New cables should implement methods to minimise impacts on the environment, seabed and other users, where operationally possible and in accordance with relevant industry practice. - Cables should be buried to maximise protection where there are safety or seabed stability risks and to reduce conflict with other marine users and to protect the assets and infrastructure. - Where burial is demonstrated not to be feasible, cables may be suitably protected through recognised and approved measures (such as rock or mattress placement or cable armouring) where practicable and cost-effective and as risk assessments direct. - Consideration of the need to reinstate the seabed, undertake post-lay surveys and monitoring and carry out remedial action where required.	Policy not relevant to the Proposed Development (sector specific policy)	N/A
CABLES 3		A risk-based approach should be applied by network owners and decision makers to the removal of redundant submarine cables, with consideration given to cables being left in situ where this would minimise impacts on the marine historic and natural environment and other users.	Policy not relevant to the Proposed Development (sector specific policy)	N/A
CABLES 4		When selecting locations for land-fall of power and telecommunications equipment and cabling, developers and decision makers should consider the policies pertaining to flooding and coastal protection in Chapter 4, and align with those in Scottish Planning Policy and Local Development Plans.	Policy not relevant to the Proposed Development (sector specific policy)	N/A
DEFENCE 1		To maintain operational effectiveness in Scottish waters used by the armed services, development and use will be managed in these areas: - Naval areas including bases and ports: Safety of navigation and access to naval bases and ports will be maintained. The extent to which a development or use interferes with access or safety of navigation, and whether reasonable alternatives can be identified, will be taken into account by consenting bodies. Proposals for development and use should be discussed with the MOD at an early stage in the process. - Firing Danger Areas (Map 13): Development of new permanent infrastructure is unlikely to be compatible with the use of Firing Danger Areas by the MOD. Permitted activities may have temporal restrictions imposed. Proposals for development and use should be discussed with the MOD at an early stage in the process. - Exercise Areas (Map 13): Within Exercise Areas, activities may be subject to temporal restrictions. Development and use that either individually or cumulatively obstructs or otherwise prevents the defence activities supported by an exercise area may not be permitted. Proposals for development and use should be discussed with the MOD at an early stage in the process. - Communications: Navigations and surveillance including radar: Development and use which causes unacceptable interference with radar and other systems necessary for national defence may be prohibited if mitigation cannot be determined. Proposals for development and use should be discussed with the MOD at an early stage in the process.	Policy not relevant to the Proposed Development (geographic policy)	N/A
DEFENCE 2		For the purposes of national defence, the MOD may establish by-laws for exclusions and closures of sea areas. In most areas this will mean temporary exclusive use of areas by the MOD. Where potential for conflict with other users is identified, appropriate mitigation will be identified and agreed with the MOD, prior to planning permission, a marine licence, or other consent being granted.	Policy not relevant to the Proposed Development (sector specific policy)	N/A
DEFENCE 3		The established code of conduct for managing fishing and military activity detailed in the documents 'Fishing Vessels Operating in Submarine Exercise Areas' [155] and 'Fishing Vessel Avoidance: The UK Code of Practice Fishing Vessel Avoidance' [156] will be adhered to.	Policy not relevant to the Proposed Development (sector specific policy)	N/A
AGGREGATES 1		Marine planners and decision makers should consider the impacts of other development or activity on areas of marine aggregate or mineral resource. Where an interaction is identified, consideration should be given to whether there are permissions for aggregate or mineral extraction and whether they require any degree of safeguarding.	Policy not relevant to the Proposed Development (geographic policy)	N/A
AGGREGATES 2		Decision makers should ensure all the necessary environmental issues are considered and safeguards are in place when determining whether any proposed marine aggregate dredging is considered to be environmentally acceptable and is in accordance with the other policies and objectives of this Plan.	Policy not relevant to the Proposed Development (sector specific policy)	N/A

Shetland Local Development Plan Policies Screening Assessment

From: https://www.shetland.gov.uk/downloads/file/1930/local-development-plan-2014

Local Development Plan Listing and Screening in Relation to the Proposed Development

Policy ID	Policy Title	Policy Text	Screening Rationale	Relevant Section of the AEE
GP 1	Sustainable Development	Development will be planned to meet the economic and social needs of Shetland in a manner that does not compromise the ability of future generations to meet their own needs and to enjoy the area's high quality environment. Tackling climate change and associated risks is a major consideration for all development proposals. New residential, employment, cultural, educational and community developments should be in or adjacent to existing settlements that have basic services and infrastructure in order to enhance their viability and vitality and facilitate ease of access for all. This will be achieved through Allocations, Sites with Development Potential and Areas of Best Fit.	Policy screened for consideration in AEE	Chapter 10

GP 2	General Requirements for All Development	Applications for new buildings or for the conversion of existing buildings should meet all of the following General Requirements: a. Developments should not adversely affect the integrity or viability of sites designated for their landscape and natural heritage value. b. Development should not occur any lower than 5 metres Above Ordnance Datum (Newlyn) unless the development meets the requirements of Policy WD1; c. Development should be located, constructed and designed so as to minimise the use of energy and to adapt to impacts arising from climate change, such as the increased probability of flooding; water stress, such as water supply; health or community impacts as a result of extreme climatic events; and a change in richness of biodiversity. d. Suitable water, waste water and surface water drainage must be provided; e. All new buildings shall avoid a specified and rising proportion of the projected greenhouse gas emissions from their use, through the installation and operation of low and zero-carbon generating technologies (LZCGT). The proportion of such emissions shall be specified in the council's Supplementary Guidance – Design. That guidance will also set out the approach to existing buildings which are being altered or extended, including historic buildings, and the approach to applications where developers are able to demonstrate that there are significant technical constraints to using on-site low and zero carbon generating technologies. f. Suitable access, car parking and turning should be provided; g. Development should not adversely affect areas, buildings or structures of archaeological, architectural or historic interest; h. Development should not sterilise mineral reserves; i. Development should not sterilise allocated sites as identified within the Shetland Local Development Plan; j. Development should not have a significant adverse effect on existing uses; k. Development should not compromise acceptable health and safety standards or levels; l. Development should be consistent with National Planning Policy, other Local Development Plan policies and Supplementary Guidance.	Policy screened for consideration in AEE	Chapter 10
GP 3	All Development: Layout and Design	All new development should be sited and designed to respect the character and local distinctiveness of the site and its surroundings. The proposed development should make a positive contribution to: • maintaining identity and character • ensuring a safe and pleasant space • ensuring ease of movement and access for all • a sense of welcome • long term adaptability, and • good use of resources The Planning Authority may request a Masterplan and/ or Design and Access Statement in support of development proposals. A Masterplan should be submitted with applications where Major Development is proposed; Major Development is defined in the Town and Country Planning (Hierarchy of Developments) (Scotland) Regulations 2009, Reg 2 (1). Further details for these requirements are set out in Supplementary Guidance.	Policy screened for consideration in AEE	Chapter 10
NH 1	International and National Designations	Any development proposal that is likely to have a significant effect on an internationally important site, (Special Area of Conservation (SAC), Special Protection Areas (SPA) or Ramsar Sites) and is not directly connected with or necessary to the conservation management of that site will be subject to an assessment of the implications for the site's conservation objectives. Development that could have a significant effect on a site will only be permitted where: • An appropriate assessment has demonstrated that it will not adversely affect the integrity of the site, or • There are no alternative solutions, and • There are imperative reasons of over-riding public interest that may, for sites not hosting a priority habitat type and/or priority species, be of a social or economic nature. Development that affects a National Scenic Area (NSA), National Nature Reserve (NNR) or a Site of Special Scientific Interest (SSSI) will only be permitted where: • It will not adversely affect the integrity of the area or the qualities or protected features for which it has been designated, or • Any such adverse effects are clearly outweighed by social, environmental or economic benefits of national importance.	Policy screened for consideration in AEE	Section 10.12
NH 2	Protected Species	Where there is good reason to suggest that a species protected under the Wildlife and Countryside Act 1981 (as amended), Annex IV of the Habitats Directive or Annex 1 of the Birds Directive is present on site, or may be affected by a proposed development, the Council will require any such presence to be established. If such a species is present, a plan should be provided to avoid or mitigate any adverse impacts on the species, prior to determining the application. Planning permission will not be granted for development that would be likely to have an adverse effect on a European Protected Species unless the Council is satisfied that: • The development is required for preserving public health or public safety or for other imperative reasons of overriding public interest including those of a social or economic nature and beneficial consequences of primary importance for the environment; and • There is no satisfactory alternative; and • The development will not be detrimental to the maintenance of the population of the European Protected Species concerned at a favourable conservation status in their natural range. Planning permission will not be granted for development that would be likely to have an adverse effect on a species protected under Schedule 5 (animals) or 8 (plants) of the Wildlife and Countryside Act 1981 (as amended) unless the Council is satisfied that: • Undertaking the development will give rise to, or contribute towards the achievement of, a significant social, economic or environmental benefit; and • There is no satisfactory solution. Planning permission will not be granted for development that would be likely to have an adverse effect on a species protected under Schedules 1, 1A or A1 (birds) of the Wildlife and Countryside Act 1981 (as amended), unless the Council is satisfied that: o The development is required for preserving public health or public safety; and o There is no other satisfactory solution. Applicants should submit supporting evidence for any development meeting these criteria, demonstrating both the need for the development and that a full range of possible alternative courses of action have been properly examined and none found to acceptably meet the need identified. The Council will apply the precautionary principle where the impacts of a proposed development on natural heritage are uncertain but potentially significant. Where development is constrained on the grounds of uncertainty, the potential for research, surveys or assessments to remove or reduce uncertainty should be considered.	Policy screened for consideration in AEE	Section 10.12

NH 3	Furthering the Conservation of Biodiversity	Development will be considered against the Council's obligation to further the conservation of biodiversity and the ecosystem services it delivers. The extent of these measures should be relevant and proportionate to the scale of the development. Proposals for development that would have a significant adverse effect on habitats or species identified in the Shetland Local Biodiversity Action Plan, Scottish Biodiversity List, UK Biodiversity Action Plan, Annexes I and II of the Habitats Directive, Annex I of the Birds Directive (if not included in Schedule 1 of the Wildlife and Countryside Act) or on the ecosystem services of biodiversity, including any cumulative impact, will only be permitted where it has been demonstrated by the developer that; • The development will have benefits of overriding public interest including those of a social or economic nature that outweigh the local, national or international contribution of the affected area in terms of habitat or populations of species; and • Any harm or disturbance to the ecosystem services, continuity and integrity of the habitats or species is avoided, or reduced to acceptable levels by mitigation.	Policy screened for consideration in AEE	Section 10.12
NH 4	Local Designations	Development that affects a Local Nature Conservation Site or Local Landscape Area will only be permitted where: • It will not adversely affect the integrity of the area or the qualities for which it has been identified; or • Any such effects are clearly outweighed by social, environmental or economic benefits.	Policy screened for consideration in AEE	Section 10.12
NH 6	Geodiversity	Development will only be permitted where appropriate measures are taken to protect and/or enhance important geological and geomorphological resources and sites, including those of educational or research value. Proposals that will have an unavoidable effect on geodiversity will only be permitted where it has been demonstrated that: • The development will have benefits of overriding public interest including those of a social or economic nature that outweigh the local, national or international contribution of the affected area in terms of its geodiversity; • Any loss of geodiversity is reduced to acceptable levels by mitigation, and a record is made prior to any loss. For certain scales of development where a soil management plan is required, reference should also be made to geodiversity on site.	Policy screened for consideration in AEE	Section 10.12
NH 7	Water Environment	Development will only be permitted where appropriate measures are taken to protect the marine and freshwater environments to an extent that is relevant and proportionate to the scale of development. Development adjacent to a watercourse or water body must be accompanied by sufficient information to enable a full assessment of the likely effects. Where there is potential for the development to have an adverse impact the applicant/developer must demonstrate that: • There will be no deterioration in the ecological status of the watercourse or water body; • It does not encroach on any existing buffer strips and that access to these buffer strips has been maintained; and • Both during the construction phase and after completion it would not significantly affect: o Water quality flows in adjacent watercourses or areas downstream o Natural flow patterns and sediment transport processes in all water bodies or watercourses.	Policy screened for consideration in AEE	Section 10.12
HE 1	Historic Environment	The Council should presume in favour of the protection, conservation and enhancement of all elements of Shetland's historic environment, which includes buildings, monuments, landscapes and areas.	Policy screened for consideration in AEE	Section 10.12, Sections 10.10.104 - 10.10.114
HE 4	Archaeology	Scheduled monuments, designated wrecks and other identified nationally important archaeological resources should be preserved in situ, and within an appropriate setting. Developments that have an adverse effect on scheduled monuments and designated wrecks or the integrity of their settings should not be permitted unless there are exceptional circumstances. All other significant archaeological resources should be preserved in situ wherever feasible. Where preservation in situ is not possible the planning authority should ensure that developers undertake appropriate archaeological excavation, recording, analysis, publication and archiving in advance of and/ or during development.	Policy screened for consideration in AEE	Section 10.12, Sections 10.10.104 - 10.10.114
CST 1	Coastal Development	Proposals for developments and infrastructure in the coastal zone (above Mean Low Water Mark of Ordinary Spring Tides) will only be permitted where the proposal can demonstrate that: • It will not have a significant impact, either individually or cumulatively, on the natural, built environment and cultural heritage resources either in the sea or on land; • The location, scale and design are such that it will not have a significant adverse impact. • It does not result in any deterioration in ecological status or potential for any water body or prevent it from achieving good ecological status in the future; • There is no significant adverse impact on other users of marine resources, and/or neighbouring land. Proposals for marine aquaculture developments or amendments to existing fish farm developments will require to have regard to the foregoing criteria and will be assessed against the Supplementary Guidance Policy for Aquaculture. All proposals will be assessed against the Shetland Islands Marine Spatial Plan that sets out a spatial strategy and policy framework to guide marine developments in the coastal waters around Shetland. The Marine Spatial Plan identifies the constraints developers are required to consider when contemplating development in the coastal area and will form supplementary guidance to this plan.	Policy screened for consideration in AEE	Section 10.12

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Appendix 10.2 Marine and Transboundary Effects – Baseline Conditions

Study Area A

The sections below characterise the water quality, biodiversity and human receptors with likely presence in Study Area A, based on a review of available published and unpublished literature, alongside resources from advisors and regulators.

Water Quality

Contaminants

Contaminants are chemical substances that are atypically found in the marine environment and have the potential to cause harm to marine life. Contaminants can be either anthropogenic or natural in origin. As stated by ICES (2003), there are four main groups of contaminants:

- Trace metals: heavy metals such as cadmium and mercury, from metallurgic industries, and copper, from anti-foulant;
- Organic compounds: from agricultural run-off;
- Oil: from marine activities and hydrocarbon extraction;
- Radioactive elements: from nuclear operations.

Oil pollution in Study Area A is likely to be lower than other marine regions due to the low overall level of development and anthropogenic presence. The small amounts of exploration and drilling of oil in the Arctic has so far been limited to Russia, North America and west Greenland (i.e. none in the vicinity of Study Area A) (NPC, 2015). The Arctic has received significant interest from the petroleum industry, and it is possible that exploration will become more widespread in the future. Marine traffic in Study Area A typically decreases with distance from the coast, though there is an offshore convergence zone of traffic routes between Norway and Iceland (see Section 10.5). Though there have no doubt been occurrences of hydrocarbons entering the water from vessels, there had not been a major oil spill in the Arctic until June 2020 when one occurred from an energy plant in eastern Russia (though this is significantly outwith Study Area A). The baseline level of hydrocarbons in Study Area A is considered to be very low.

OSPAR have assessed the level of contaminants across different parts of the OSPAR maritime area as part of their 2017 Intermediate Assessment (OSPAR, 2017). The level of polycyclic aromatic hydrocarbons (PAHs) and polychlorinated biphenyls (PCBs) in shellfish and sediments in the Northern North Sea (overlapping the southern extent of Study Area A) is below levels likely to harm marine species. The level of polybrominated diphenyl ethers (PBDEs) in shellfish and sediment in the Northern North Sea is decreasing annually. Heavy metal (mercury Hg; cadmium Cd; and lead, Pb) concentrations in the fish and shellfish and sediments of the Northern North Sea are above background levels, but most are below the level at which effects would occur (with the exception of lead in sediments which are above levels where adverse ecological effects cannot be ruled out). Note that the Northern North Sea has potentially the highest level of anthropogenic pressure in Study Area A as it is more proximate to land where anthropogenic sources of contaminants are higher.

In comparison to the North Sea, the Arctic is relatively unpolluted. Based on the OSPAR Commission Quality Status Report 2010, the Arctic (Region 1) has the lowest percentages of monitoring sites that have unacceptable levels of cadmium, mercury, lead, PAHs, and PCBs, out of all OSPAR regions (OSPAR, 2010). Of these, PAHs and PCBs are present in unacceptable levels in the highest percentages of sites (~30%), whereas for the heavy metals this is typically <10%. The monitoring sites included are restricted to coastal waters and so represent the worst-case scenario for pollutants as they are closer to the anthropogenic sources. It is likely that levels of pollutants offshore are lower than that reported at the coast. The release of most contaminants is controlled by legislative measures that aim to cease their production, and as a result there has been a general decrease in the number of pollutants in the Arctic which is predicted to continue.

There has been a historic decrease in the concentration of most anthropogenic radionuclides in the Eurasian Arctic (Josefsson, 1998). Concentration of radionuclides decreases with depth in the water column. The concentrations in the sediments of the deep Arctic Ocean are much lower than the concentrations on the shelf, primarily due to the low particle flux in the open ocean (Josefsson, 1998). There are no nuclear facilities in Study Area A (OSPAR, 2016), therefore input of radionuclides is limited to transport from distant sources and global fallout. In summary there are likely to be negligible concentrations of radionuclides in Study Area A.

Microplastics

Microplastics, described as plastic particles or fragments less than 5 mm in length (NOAA, 2020a), are present in most marine systems around the world (Barceló and Picó, 2019). Although the Arctic is remote and difficult to study, there has been an increase in the focus on plastic pollution in this region. Microplastics have been found both in the water and the marine organisms such as fish in the Arctic, with the most common types being polyethylene and polyester (Morgana *et al.,* 2018). The concentration of microplastics is greater than most seas at lower latitude, indicating that the Arctic regions is a hotspot for plastic pollution (e.g., Obbard *et al.,* 2014). Plastic pollution can originate from local sources such as vessel discharge or more distant sources, which enter the region via sea surface and sub-surface currents. Given the comparatively few direct sources in the region, it is likely that most microplastics originate outside the Arctic. The amount of microplastics in the Arctic is predicted to increase in the coming years, due to the increase in anthropogenic presence and pressure as climate change increases accessibility to the region.

Biodiversity

Physical features

The physical features of the marine environment directly influence the biodiversity found in the surrounding waters. Study Area A comprises predominantly deep waters up to ~4,000 m below relative sea level with some shallower areas adjacent to nearby land masses including Iceland, Faroe Islands and Jan Mayen (Figure A10.1). The area is characterised by bathymetric features including plateaus, basins, rises, and ridges, including segments of the Mid-Atlantic Ridge (Figure A10.2).

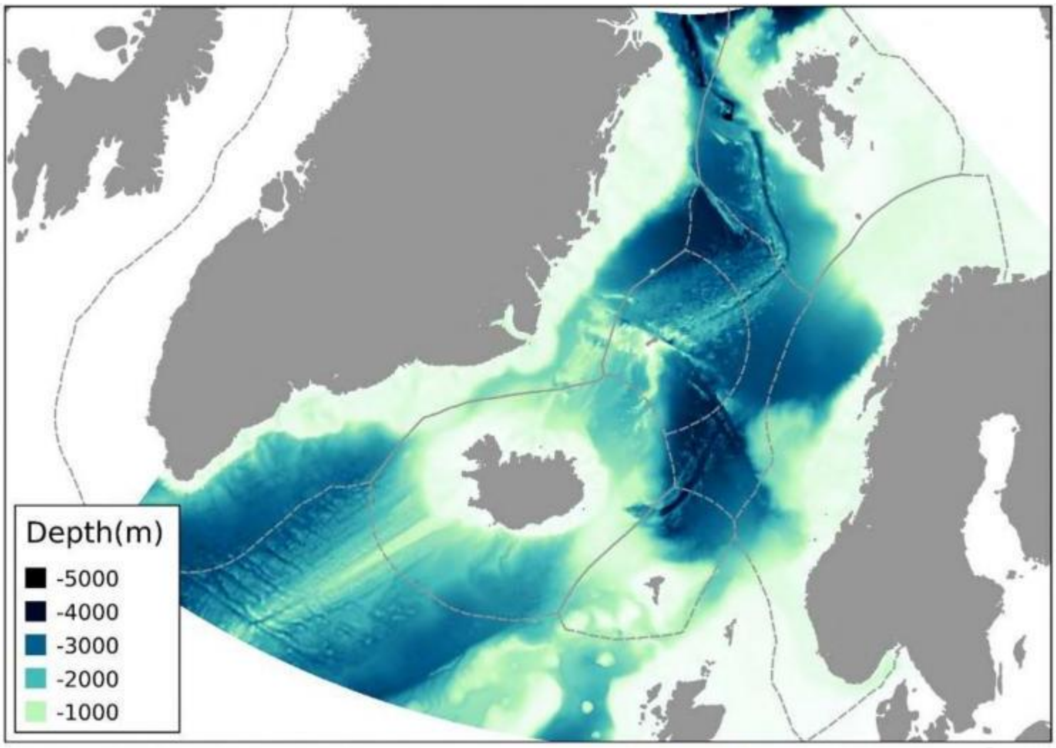


Figure A10.1 Water depth in the northeast Atlantic and Arctic regions (From: Buhl-Mortensen* et al.*, 2019)

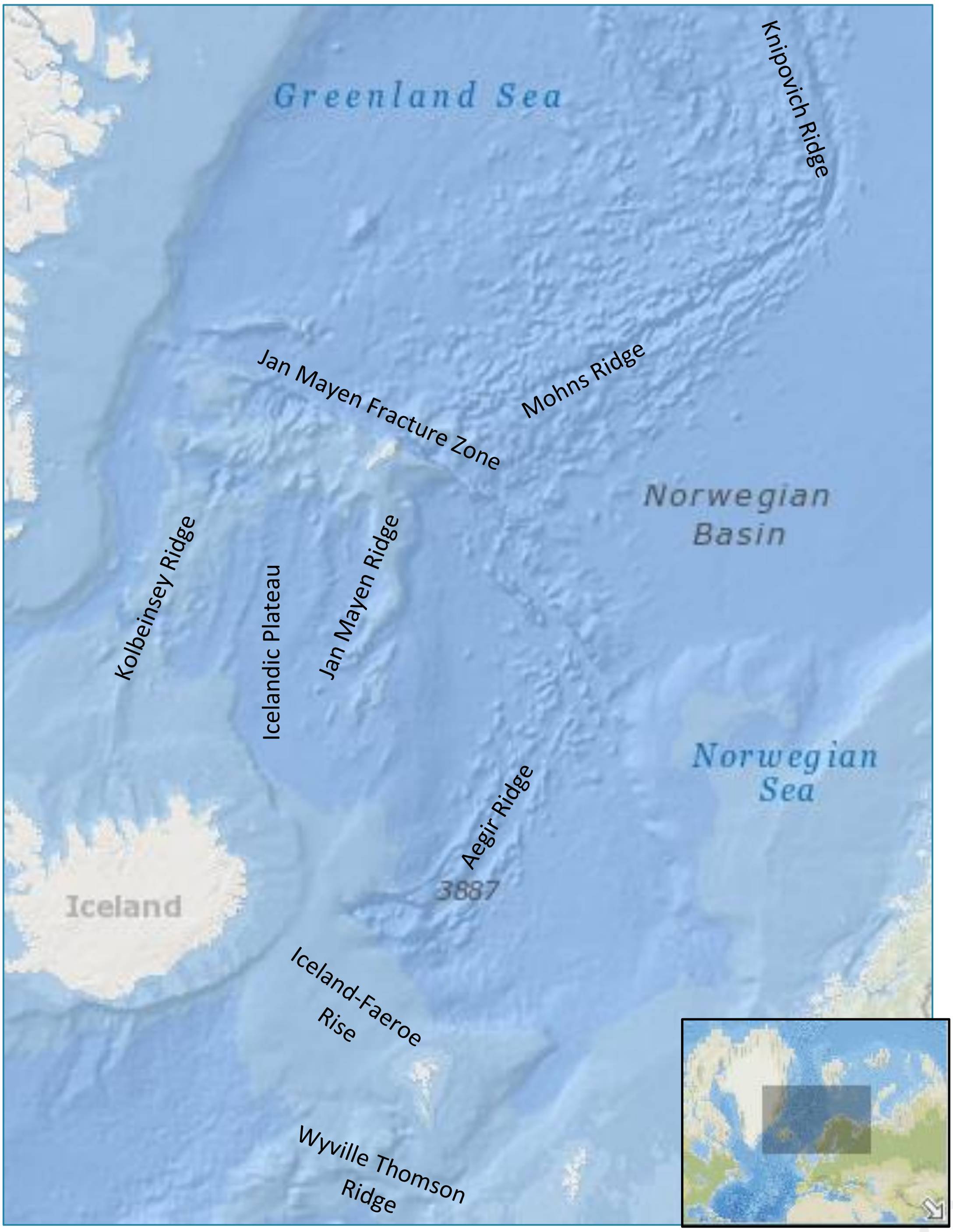


Figure A10.2 Bathymetry and bathymetric features in the vicinity of Study Area A (Source: NOAA, 2020b)

Surface sea currents in Study Area A comprise a mix of warm currents and cold currents (ICES, 2003). Travelling in a north-east direction, the North Atlantic Drift traverses between the UK and the Faroe Islands, through the Norwegian Sea and continues to the Arctic. Offshoots of this current travel between the Faroe Islands and Norway, south into the North Sea, and also circulate anti-clockwise from the Norwegian Sea towards Jan Mayen. Cold currents travel in a south/southwesterly direction from the Arctic; the East Greenland Current travels down the east coast of Greenland, with offshoots circulating clockwise towards Jan Mayen and north of Iceland (East Icelandic Current). The centre of Study Area A comprises a convergence of cold and warm surface currents, resulting in gyres such as the Icelandic Gyre and Greenland Sea Gyre.

The highest annual mean sea surface temperature (SST) in the region is approximately 9-10°C, in the south and southeast of Study Area A (NOAA, 2020c), as these waters are most influenced by the warm surface waters. Influence of the Arctic-derived sea surface currents in the north and west of Study Area A lead to minimum annual mean SST of 0-3°C. The temperature is typically 2-3° below and above average in the winter and summer, respectively (NOAA, 2020c). Temperature at the sea-bottom is -1°C throughout much of the offshore waters of Study Area A (Buhl-Mortensen *et al.,* 2019). Warmer sea-bottom temperatures of 6.8-9.4°C are present across the areas of continental shelf that extend around the Faroe Islands and north of Shetland (Buhl-Mortensen *et al.,* 2019). Annual salinity in Study Area A is 35-36 with minimal seasonal variation (NOAA, 2020d).

The maximum Arctic sea ice extent does not extend into Study Area A except for a very small portion in the northwest corner near to Greenland (NOAA, 2012). As this represents such a small portion of Study Area A it is considered to have negligible effects on the biodiversity of Study Area A.

The seabed sediments in waters beyond the continental shelf, which comprises the majority of Study Area A, are characterised as A6.5 Deep-sea mud (EMODnet, 2019). The seabed sediments in the areas beyond national jurisdiction are described on EMODnet as A.6 Deep-sea bed with no further information on the sediments themselves. Other seabed sediments that are present on the continental shelf adjacent to the Faroe Islands include A5.27 Deep circalittoral sand, A6.3 Deep-sea sand or A6.4 Deep-sea muddy sand, and A5.45 Deep circalittoral mixed sediment. A similar range of deep-sea sediments are also present on the continental shelf that extends north of Shetland, with the addition of A5.15 Deep circalittoral coarse sediment.

Plankton

Plankton, comprising bacteria, Archaea, phytoplankton, protists and zooplankton, form the base of the food web in cold waters such as Study Area A and so are extremely important to the ecosystem as a whole (CAFF, 2017). Despite this, the plankton community in this region is poorly known. A summary of the knowledge of plankton in Arctic waters, which encompasses the majority of waters in Study Area A, is provided in CAFF's (2017) State of the Arctic Marine Biodiversity Report. Monitoring of plankton in the Arctic has been most frequent in the waters of Jan Mayen, Iceland, and Greenland.

Phytoplankton are the only primary producers in cold waters such as Study Area A and so form the base of the food web (CAFF, 2017). The Atlantic Arctic comprises the highest diversity of phytoplankton of all Arctic regions, as it contains a mixture of Arctic and North Atlantic species (CAFF, 2017). Dinoflagellates and diatoms are the most common functional groups (as found by microscopy) in the Atlantic Arctic (CAFF, 2017). Phytoplankton and other single-celled plankton are the main food for larger zooplankton such as copepods.

The zooplankton community comprises single and multi-celled organisms and is highly diverse in the Arctic, with over 350 species recorded (CAFF, 2017). Multicellular zooplankton include a wide range of invertebrates and larvae of other marine organisms such as fish (CAFF, 2017). Their longer life spans have led to the development of strategies, such as vertical migrations on daily and seasonal cycles, and preferred depth niches (CAFF, 2017). Copepods are the most abundant and well-studied species group of zooplankton, accounting for 80-90% of zooplankton biomass in the Arctic (CAFF, 2017). Copepods are highly diverse as over 150 species have been recorded in Arctic waters (CAFF, 2017). The copepod *Calanus finmarchicus* is the most common copepod species in sub-Arctic waters (CAFF, 2017). Copepods and other zooplankton such as hyperiid amphipods and euphausiids, are important prey items for other marine species including fish, seabirds, and baleen whales.

Plankton are strongly affected by environmental conditions such as water depth, current patterns, salinity, and temperature. The cyclic variation of these environmental factors leads to a predictable series of seasonal blooms by different components of the plankton community. Phytoplankton bloom in the spring, followed by an increase in zooplankton in that extends through to summer and is closely linked to availability of food as well as warmer temperatures.

Benthic Species and Habitats

Benthic invertebrates are an important part of the food web and form part of the diet of fish, marine mammals, and seabirds (CAFF, 2017). Despite their importance, they remain relatively poorly understood.

In the Arctic, monitoring has been focussed on macro- and mega-benthic species (species >1 mm and species identifiable through imagery techniques, respectively), with comparatively less monitoring effort on meiofauna (0.1-1.0 mm) and microfauna (<0.1 mm) (CAFF, 2017). There has been an increase in benthic monitoring around Iceland, Greenland and the Norwegian Sea, though many Arctic areas remain poorly understood.

The benthos is influenced by a variety of environmental factors including water depth, currents, temperature, food availability, and seabed sediments. The degree to which these environmental factors influence the benthos depends on their life strategies. For example, benthic fauna can be mobile or sessile, with sessile organisms more heavily influenced by local environmental conditions than mobile species which can move to areas of suitable habitat. Similarly, relative influence of conditions will vary by the species' position in relation to the sediment i.e. in the sediment (infauna), on the sediment (epifauna), or just above the sediment (hyperbenthos).

Over 4,000 benthic species have been recorded in Arctic waters, accounting for the majority of marine diversity in the Arctic (CAFF, 2017). The most numerous species group in the Arctic, including Study Area A, is arthropods (Figure A10.3). Other species of high richness in the several Arctic regions that overlap Study Area A (Iceland, Faroe Islands, Norway West, and Greenland) are polychaetes and molluscs. Beyond these top three groups there are localised differences between the regions: in the Faroe Islands and Greenland foraminifera are the fourth most rich species; this position is held by echinoderms in Norway West; and in Iceland there are several different groups, including 'other', which contribute notable percentages of the total species richness. The total number of species in these regions range from 1,807-2,345.

There is a paucity of trawl stations in the offshore waters of Study Area A in comparison to other regions of the Arctic. Nevertheless, the few trawl stations show that typically fewer than 20 benthic megafaunal species/taxa have been recorded at each trawl station in Study Area A, which is low compared to other regions of the Arctic (CAFF, 2017).

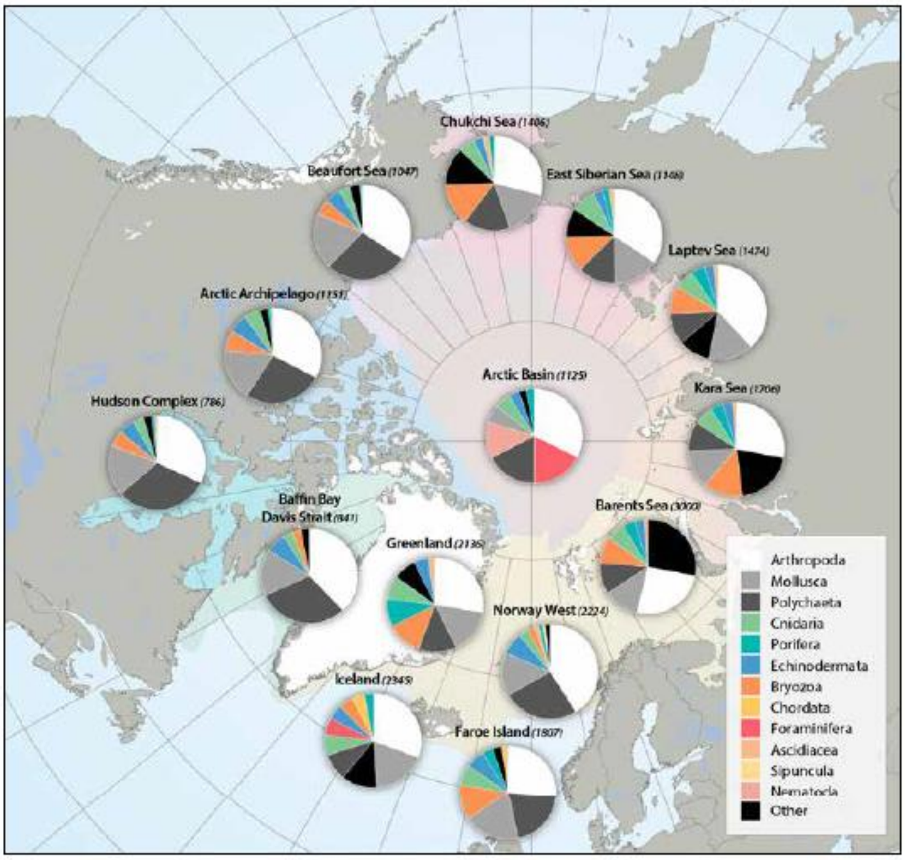


Figure A10.3 Regional pie charts showing the species/taxon number (in brackets) per region and the relative proportion of certain taxa in species richness (From: CAFF, 2017)

Certain benthic habitats, created by habitat-forming species, are especially sensitive to anthropogenic effects; these are known as Vulnerable Marine Ecosystems (VMEs). The FAO define VMEs as those areas that may be vulnerable to impacts from fishing activities (Buhl-Mortensen et al., 2019), though for the purpose of this study this definition is extended to include any anthropogenic activity that may interact with the seabed, which includes the proposed operations at SSC.

There are seven VME habitat types listed by the North East Atlantic Fisheries Commission (NEAFC): cold-water coral reef; coral garden; deep-sea sponge aggregations; seapen fields; tube-dwelling anemone patches; mud- and sand-emergent fauna; and bryozoan patches (FAO, 2020a). As shown in Figure A10.4, there are records of VMEs in Study Area A, though comparatively fewer than the numbers recorded around the coast of Iceland, Norway, and the Faroe Islands (Buhl-Mortensen et al., 2019). The distribution of records is likely to be compounded by the amount of survey effort in each area. To overcome this, Buhl-Mortensen et al. (2019) modelled the predicted suitability of habitats throughout the Arctic and sub-Arctic for VMEs. The results of the modelling showed that the number of VMEs is negatively correlated with water depth and positively correlated with water temperature at the sea-bottom. The majority of Study Area A is not predicted to provide conditions for VMEs, except for localised areas around the Faroes and the Faroe-Shetland belt.

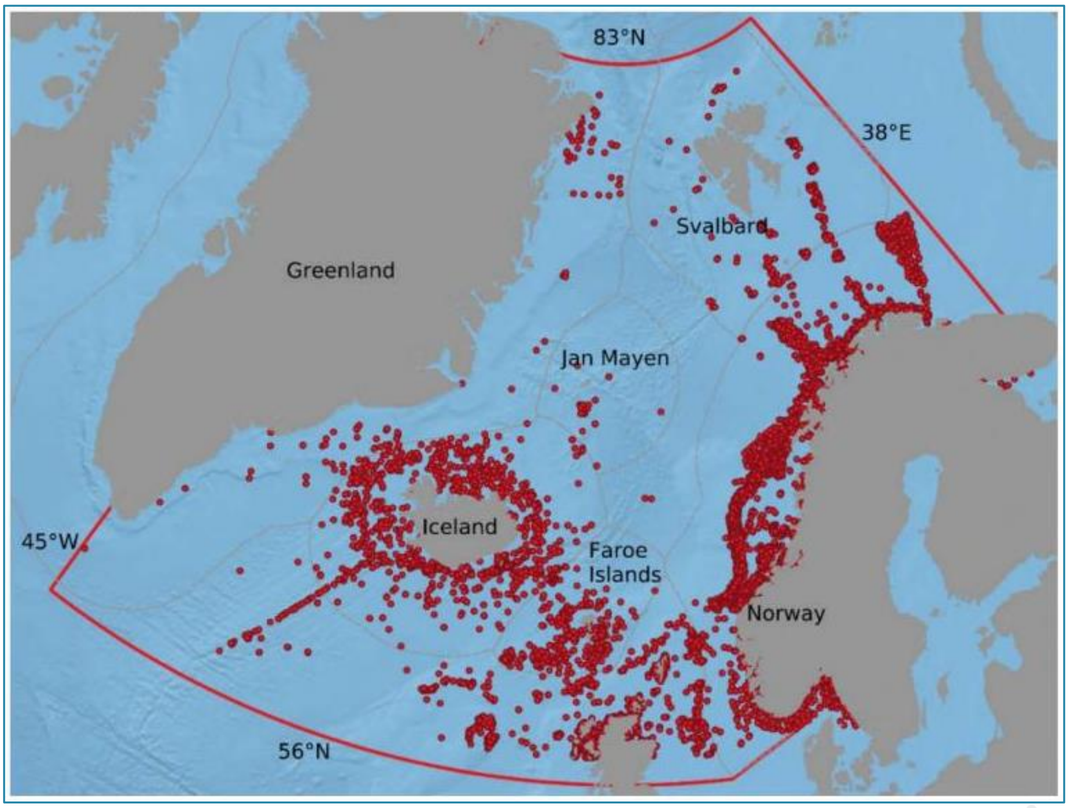


Figure A10.4 The location of Vulnerable Marine Ecosystem (VME) records in the northeast Atlantic (From: Buhl-Mortensen et al., 2019)

Fish

The Arctic waters of Study Area A are highly productive and support a diverse fish community. A total of 633 species of marine fish have been recorded in the Arctic Ocean and adjacent seas (CAFF, 2017). Approximately 10% of these species are targeted commercially and so are subjected to stock assessments and are well-understood. Due to the lack of knowledge on the remaining 90%, this discussion focuses on the commercially important stocks.

According to OSPAR (2020), the Arctic waters support six fish species of major commercial importance: Atlantic cod *Gadus morhua*, saithe/pollock *Pollachius virens*, haddock *Melanogrammus aeglefinus*, blue whiting *Micromesistius poutassou*, Atlantic herring *Clupea harengus*, and capelin *Mallotus villosus*. The analysis of commercial fisheries data from ICES presented in Section **Error! Reference source not found.** indicates that Atlantic mackerel *Scomber scombrus* are also of commercial importance.

Atlantic cod, saithe, haddock, and blue whiting are benthopelagic, feeding at or near the seabed, whereas Atlantic herring and capelin are pelagic mid-water column fish.

An overview of the distribution of these species and their spawning activity is presented in Table A10.1. Spawning grounds are not prevalent in Study Area A due to its offshore location away from most coastal areas where spawning occurs. The exception are saithe and blue whiting which spawn offshore over deep waters. There may be minor overlap with spawning grounds at the southern extent of Study Area A due to overlap with the northern North Sea. The key spawning period for most fish species is spring, though some Atlantic herring stocks in Study Area A also spawn in autumn and summer.

Table A10.1 Overview of the key commercial fish species in Study Area A (From: Johnson, 1977; Holste and Slotte, 1995; Jakobsson and Stefansson, 1999; Dickey-Collas* et al.*, 2010; ICES, 2005; FishSource, 2019; FAO, 2020b)

Species	Spatial Distribution In Study Area A	Spawning Activity
Atlantic cod *Gadus morhua*	Atlantic cod is present in discrete stocks around Norway, the Faroe Islands, Iceland, and the North Sea	Spawning typically occurs in discrete areas near the coasts of the country within the stock's home range, except for the North Sea where spawning activity is widespread. Spawning occurs from January to April
Saithe/pollock *Pollachius virens*	Saithe are widespread in the northeast Atlantic. They occur in three separate stock areas: Icelandic, Faroese, and Continental	Saithe spawn offshore, have nursery grounds in coastal waters, then migrate offshore as adults. They have spawning areas in the Norwegian Sea. Spawning occurs between January-March
Haddock *Melanogrammus aeglefinus*	Haddock stocks are present around Iceland, Faroe Islands and North Sea	Key spawning grounds are along Iceland, Norway and Shetland coasts, mostly outside of Study Area A. Peak spawning occurs in March-April
Blue whiting *Micromesistius poutassou*	Blue whiting occurs in a single stock widespread in the northeast Atlantic	Spawning in northeast Atlantic occurs in deep water along the Faroe-Shetland channel. Spawning occurs in in spring
Atlantic herring *Clupea harengus*	Study Area A overlaps considerably with the large northeast Atlantic/Norwegian stock of herring, as well as small distinct stocks around Iceland and the North Sea	These stocks spawn along the coast (of Norway, Iceland, and southern Shetland), outside of Study Area A. Spawning occurs during autumn for the North Sea stock, in summer for the Icelandic stock, and in spring for the NE Atlantic stock
Capelin *Mallotus villosus*	The capelin stock that occurs in Study Area A occurs in the waters between Jan Mayen and Iceland	Spawning grounds occur off southern Iceland, outside Study Area A. Spawning occurs in spring
Atlantic mackerel *Scomber scombrus*	Atlantic mackerel occurs as a single stock throughout	Spawning occurs in summer in warmer waters to the south of Study Area A (though there is

Species	Spatial Distribution In Study Area A	Spawning Activity
	northeast Atlantic waters and are widespread	minor overlap with low density spawning at the southern limit of Study Area A i.e. the northern North Sea)

Marine Ornithology

The cold northern regions of the North Atlantic are highly productive and support large numbers of breeding and visiting seabirds.

Study Area A overlaps ICES region E1 (Barents and Norwegian Seas), which has a seabird community comprising 69% auks, 18% gulls, 10% petrels, and ≤2% eiders, terns and Pelecaniformes (Barrett *et al.,* 2006). There is not a single estimate for the number of species that may occur in Study Area A. In Jan Mayen, over 98 bird species have been recorded (Gabrielsen and Strøm, 2004); 64 seabird species are recognised as part of the Arctic ecosystem (CAFF, 2017); and approximately 60 seabird species have been recorded in the Faroe Islands. It is clear that Study Area A supports a highly diverse seabird community.

There are approximately 7.4 million breeding pairs, and 25.5 million seabirds total, in region E1 (Barrett *et al.,* 2006). Of the breeding birds, approximately 70% are auk species. The Faroe Islands, which lie adjacent to the study area, have recorded at least 21 species of seabird are reported to breed (Visit Faroe Islands, 2020). The most abundant breeding seabirds are northern fulmar *Fulmarus glacialis*, European storm-petrel *Hydrobates pelagicus*, Atlantic puffin *Fratercula arctica*, black-legged kittiwake *Rissa tridactyla*, and common guillemot *Uria aalge*. On Jan Mayen, 27 birds have been reported to breed, most of which are related to the marine environment (Gabrielsen and Strøm, 2004). The most common breeding species here are northern fulmar, black-legged kittiwake, Brünnich's guillemot *Uria lomvia*, and little auk *Alle alle*. Skov *et al*. (1995) reported that the most common seabirds during summer in the southern portion of Study Area A was northern fulmar and Atlantic puffin.

Table A10.2 provides an overview of the seabird species groups that are likely to be present within Study Area A, detailing example species, their distribution and feeding ecology. From the available data it is apparent that there is the potential for multiple species to be present in Study Area A at all times of the year, either on a resident, breeding, wintering or migratory basis. The numbers of seabirds present will vary seasonally and also across different locations in Study Area A.

Seabird species establish nests and rear chicks on land, therefore there are only a few locations in Study Area A where breeding may occur. Some species breed throughout all land-based locations in Study Area A and may be seen in the region most of the year-round. Other species' breeding is limited to the Arctic, in the northern part of Study Area A, however these species may be seen at-sea in the southern part of Study Area A during winter. Most seabird species breed on the sea cliffs, though some also use areas further inland such as heathlands (Visit Faroe Islands, 2020). The breeding season for seabird runs from May through September (Visit Faroe Islands, 2020), and so during this summer period seabirds are present in the highest numbers. During the breeding season seabirds will undertake at-sea foraging trips whilst at the colony. The distances to which they forage varies greatly between species, from 25 km for great cormorant to up to several hundreds of kilometres for northern gannet and northern fulmar (Woodward *et al.,* 2019).

The distribution of seabirds outside the breeding season is comparatively less well-known. It is hypothesised that seabird abundance in winter is linked to areas of high productivity, such as the waters southwest of Greenland, which is used by seabirds from both European and North American colonies (Boertmann *et al.,* 2004; Fredericksen *et al.,* 2012).

The SEATRACK project presents tracking data of seabirds from northwest Europe colonies during the non-breeding season (autumn through spring, August to April) from 2009-2019 (SEAPOP, 2020). Seabird distribution during the winter varies greatly depending on the species' strategy. Species including Atlantic puffin, black-legged kittiwake, common guillemot, and northern fulmar are widely distributed in Study Area A during the non-breeding season. Brünnich's guillemot and little auk distribution is restricted to the northerly portion, bounded to the south by Iceland. Some species like common eider, European shag, glaucous gull herring gull remain close to their breeding colonies year-round. Lesser black-backed gull are concentrated around their breeding colonies but also have significant hotspots along southerly migration corridors to the equator.

The seabird community is diverse in form, comprising species that occupy a range of feeding niches, including surface-feeders like the gulls, sub-surface divers like auks, gannets and divers, and bottom feeders such as sea ducks (Barrett *et al.,* 2006; CAFF, 2017). Many seabirds feed exclusively in the marine environment, however, some also opportunistically scavenge or feed off the land, such as gulls and geese.

Table A10.2 Seabird groups, representative species with likely presence in Study Area A and their autecology (From: Virtual Hebrides, 2014; CAFF, 2017; Oceanwide Expeditions, 2020; RSPB, 2020; Visit Faroe Islands, 2020)

Species Group	Representative Species	Spatiotemporal Distribution In Study Area A	Feeding Ecology
Gaviformes	Great northern diver *Gavia immer*, red-throated diver *G. stellata*	Summers in Scotland and Iceland, which coincides with their breeding season (April-May). Great northern diver breeds in more northerly latitudes than red-throated diver. Once summer has passed, they move to warm waters further south. During the breeding season divers occupy sheltered water bodies, whereas outside the breeding season they spend time at sea.	Undertakes dives, up to 60 m in depth (for the great northern diver), to catch fish and crustaceans.
Sea ducks	Long-tailed duck *Clangula hyemalis*, common eider *Somateria mollissima*, velvet scoter *Melanitta fusca*, red-breasted merganser *Mergus serrator*	Some species of sea duck, like common eider and red-breasted merganser, breed in Study Area A. Others, like the long-tailed duck and velvet scoter, do not as they breed along Arctic coasts. Those species that breed in Study Area A do not typically reside there in winter, whereas the long-tailed duck and velvet scoter can be found in Iceland and Britain in winter.	Sea ducks dive to locate prey, taking aquatic invertebrates, fish, and plant matter. The extent of their diving nature varies; the best diver is the long-tailed duck, which can dive to 60 m.
Geese	Pink-footed goose *Anser brachyrhnychus*, barnacle goose *Branta leucopsis*, brent goose *B. bernicla*	These geese species typically breed in the northern part of Study Area A such as Iceland, though barnacle geese have a small breeding population in the UK (south of Study Area A). They are more common in the southern part of Study Area A whilst migrating and during winter.	Geese feed off the land, eating grain, winter cereals, potatoes and grass
Pelecaniformes	Great cormorant *Phalacrocorax carbo*, European shag *P. aristotelis*, northern gannet *Morus bassanus*	European shag, great cormorant and gannets have been known to breed at coastal sites in Study Area A, as well as having presence in other seasons in lower numbers	Pelecaniformes are piscivores and are well-adapted to visual hunting of fish. Shags and cormorants hunt in shallower waters as they target prey

Species Group	Representative Species	Spatiotemporal Distribution In Study Area A	Feeding Ecology
			at the seabed, whereas gannets hunt shoaling fish near the surface
Petrels	Northern fulmar *Fulmarus glacialis*, Arctic skua *Stercorarius parasiticus*, great skua *Stercorarius skua*, Manx shearwater *Puffinus puffinus*, European storm-petrel *Hydrobates pelagicus*	The skuas, Manx shearwater and European storm-petrel visit Study Area A during the warmer months; they breed here in summer and can also been seen in spring and autumn. Fulmar also breed here though they can be seen year-round in Study Area A	Skuas are parasitic feeders in that they steal food from other seabirds, as well as scavenging off dead animals. Fulmars are opportunistic feeders, taking fish and invertebrates but also rubbish and carrion. Manx shearwater and European storm-petrel feed on small fish and invertebrates, and offal at the surface
Gulls	Black-legged kittiwake *Rissa tridactyla*, common gull *Larus canus*, herring gull *Larus argentatus*, glaucous gull *Larus hyperboreus*, great black-backed gull *Larus marinus*, lesser black-backed gull *Larus fuscus*, ivory gull *Pagophila eburnea*, black-headed gull *Chroicocephalus ridibundus*	Most gull species can be seen year-round in Study Area A, with the exception of lesser black-backed gull which is absent in winter. Many species breed in Study Area A, such as black-legged kittiwake, great black-backed gull, and glaucous gull, and so are more numerous in the warmer months. Iceland gull and glaucous gull are predominantly winter visitors.	Kittiwakes are exclusive marine feeders in that they eat small fish or the remains of fish, caught at the sea surface. Other gull species will also take land-based prey, carrion and rubbish, with less importance on marine prey
Terns	Arctic tern *Sterna paradisea*, common tern *Sterna hirundo*	Arctic tern is a common breeder in Study Area A, and common tern breeds in low numbers on Shetland. Both species can be found in the warmer summer months, following which they migrate south in winter	Terns predominantly get their food from marine sources, eating small fish and pelagic invertebrates. They visually scan the sea for food at or just beneath the surface
Auks	Atlantic puffin *Fratercula arctica*, little auk *Alle alle*, common guillemot *Uria aalge*, Brünnich's guillemot *Uria lomvia*, black guillemot *Cepphus grylle*, razorbill *Alca torda*	Auks are the most abundant and the most abundantly breeding seabird species group in Study Area A. Outside the breeding season auks are scarcer. Some species like Brünnich's guillemot and little auk only breed in the northern region of Study Area A, and winter at sea in the southern portion.	Auk species feed on fish and crustaceans. Auks are characterised by their short wings which they use to propel themselves on whilst diving for food

Marine Megafauna

A number of marine mammal species (cetaceans, including whales, dolphins and porpoises, and pinnipeds, including seals and walrus) have been recorded within Study Area A. Information from several sources that report on areas overlapping Study Area A have been reviewed, including OSPAR (2020) and the North Atlantic Marine Mammal Commission (NAMMCO, 2020), a body that comprises representatives from Faroe Islands, Greenland, Iceland and Norway.

Seven species of pinniped, including six species of true seal and the walrus, are found in the waters of the Arctic and the North-east Atlantic (NAMMCO, 2020; OSPAR, 2020). Of these, four species of seal and the walrus are considered to be associated with the sea ice and do not have any management areas that are within Study Area A (NAMMCO, 2019), therefore these species are not considered further. The two remaining seal species, harbour seal *Phoca vitulina* and grey seal *Halichoerus grypus*, are described as coastal and are likely to be present in Study Area A.

Sixteen species of cetacean, including six species of baleen whale and 10 species of toothed whale, are common permanent residents in the North Atlantic region (NAMMCO, 2020). Of these, three species are associated with the sea ice, namely bowhead whale *Balaena mysticetus*, beluga *Delphinapterus leucas*, and narwhal *Monodon monoceros*, and shall not be considered further. The remaining species have movement patterns which overlap Study Area A.

Table A10.3 provides an overview of the marine mammal species that are likely to be present within Study Area A, detailing their distribution and feeding ecology. From the available data it is apparent that there is the potential for multiple species to be present in Study Area A at all times of the year. The numbers of marine mammal's present will vary seasonally and also across different locations in Study Area A.

A survey conducted in summer 1987 and 1989 reported that the most abundant species were long-finned pilot whale *Globicephala melas*, Atlantic white-sided dolphin *Lagenorhynchus acutus*, and common dolphin *Delphinus delphis*, which accounted for 93% of the cetacean abundance observed (Skov *et al.,* 1995).

Other species of megafauna that may be present in Study Area A include common sunfish *Mola mola* and basking shark *Cetorhinus maximus* (CMS, 2020; Ocean Sunfish, 2020). These species have been included as part of the megafauna because their behavioural trait, of often remaining just below the sea surface, is more similar to marine mammals than other fish species.

Table A10.3 Overview of the marine mammal species with likely presence in Study Area A (Source: NatureScot, 2019; SCOS, 2019; NAMMCO, 2020; NBN Atlas, 2020)

Marine Mammal Species	Abundance	Distribution	Habitat	Key Seasons	Prey
Harbour seal *Phoca vitulina*	The combined populations in Norway, Shetland and Iceland are approximately 23,500	There are several distinct populations in Study Area A; Ireland-Scotland, Faroe Islands (historical), Iceland, and West Coast Norway	Harbour seals typically remain within 50 km of their coastal haul out sites	Harbour seal breeding season across their range occurs from February to July, though breeding colonies will differ in their timing	They are generalist predator, taking predominantly small to medium sized fish including cod, herring, sandeel and flatfish
Grey seal *Halichoerus grypus*	The combined populations in Norway, Faroe Islands, Shetland and Iceland is approximately 16,500	There are 2 distinct populations in Study Area A; the northeast Atlantic which occurs in the waters of Scotland, Faroe Islands and Norway; and the Icelandic population	Grey seal haul out on islands, isolated beaches or on the pack ice. From these haul out sites they undertake foraging trips which can be 1-30 days, and up to several hundred kilometres from their haul out sites	Grey seal breeding season runs from late September until February/March, with peak activity in October/November	They are generalist feeders, taking a wide variety of prey usually near the sea bottom (demersal and benthic fish)
Blue whale *Balaenoptera musculus*	Abundance of blue whale in the North Atlantic is low, estimated to be 2,490 in the Central North Atlantic	The species is rare in the northeast Atlantic except for in the waters around Iceland. There have also been sightings around Jan Mayen. The species undertakes extensive	Generally, occur in offshore waters	Very little is known of blue whale mating and calving. Calving generally occurs in the winter, whilst the species is in warm waters	Blue whale feed almost exclusively on euphausiids (krill)

Marine Mammal Species	Abundance	Distribution	Habitat	Key Seasons	Prey
		migrations each year, and are present in North Atlantic waters during summer months only, for feeding			
Common minke whale *Balaenoptera acutorostrata*	Minke whales in Study Area A comprise the northeast Atlantic stock, which has most recently been estimated as having an abundance of approximately 90,000 individuals	The species is common in the northeast Atlantic, particularly in Icelandic waters. Like other baleen whales, common minke whale undertakes extensive migrations each year, summering in the cool North Atlantic waters that comprise their feeding areas	Generally, occur in offshore waters though occasionally recorded in productive inshore waters e.g. upwelling zones	Calving of common minke whale generally occurs in the winter, whilst the species is in warm waters	Common minke whales feed on a variety of fish and invertebrates. In Arctic waters their diet comprises mostly krill, with increasing importance of fish with distance south
Fin whale *Balaenoptera physalus*	There are two fin whale management areas within Study Area A; East Iceland and Faroe Islands, and North-West Norway. These two populations comprise approximately 30,500 individuals	Fin whale is distribution through the North Atlantic with peak numbers west of Iceland. Like other baleen whales, fin whale undertakes extensive migrations each year, summering in the cool North Atlantic waters that comprise their feeding areas	Fin whales are largely pelagic, but may occasionally be seen in coastal waters	Mating and calving occur in the warm breeding grounds during winter	Fin whale feed on euphausiids (krill) and small pelagic fish

Marine Mammal Species	Abundance	Distribution	Habitat	Key Seasons	Prey
Humpback whale *Megaptera novaeangliae*	There are two discrete humpback whale areas in Study Area A; the Iceland/Faroes, and Norway. Abundance in these two areas is estimated at 20,500 individuals	Humpback whales in the northeast Atlantic are most common in Icelandic waters, with fewer sightings in offshore areas. Most humpback whales undertake extensive migrations each year, though some remain in the cool waters of the North Atlantic year-round	Humpback whales are largely pelagic, though during the feeding season they occur in highly productive upwelling zones	Mating and calving occur in the warm breeding grounds during winter	Feed mainly on euphausiids (krill) and small schooling fish
Sei whale *Balaenoptera borealis*	The most recent surveys indicate an abundance of ~4,000 animals in the Central North Atlantic and European Atlantic	Sei whale distribution is poorly understood due to their offshore nature. Most sightings in summer are between Greenland and Iceland, with some in the Faroe-Shetland Channel. Scarce in UK and Norwegian waters	Sei whale prefers offshore and warmer waters than other baleen whales. They are often associated with bathymetric features like rises, due to prey abundance	Mating and calving occur in the warm breeding grounds during winter	The diet will vary depending on what is locally available. Preferred prey includes copepods, euphausiids (krill), other crustaceans and fish
Atlantic white-sided dolphin *Lagenorhynchus acutus*	Likely to be a single stock across the North Atlantic. Most recent surveys indicate 130,000 animals in this region	In the northeast Atlantic they are found in waters between East Greenland, Iceland, UK and Norway	They are found throughout Study Area A, over steep areas of the continental shelf and open oceanic waters. They have a large home range	Birthing occurs in the summer months, from May to August with a peak in June and July	They have a varied diet, feeding opportunistically on schooling fish and occasionally cephalopods

Marine Mammal Species	Abundance	Distribution	Habitat	Key Seasons	Prey
			that they move throughout, following seasonal movements of their prey		
Common bottlenose dolphin *Tursiops truncatus*	There have been several estimates of common bottlenose dolphin abundance in the wider European Atlantic waters, ranging from 19,000-28,000	Common bottlenose are found in waters across the Atlantic Ocean, as far north as Scotland, Faroe Islands and Norway	Common bottlenose dolphin inhabits a wide range habitats, from inshore sheltered areas to open oceans	Calving occurs during the warmer months, from May to October, peaking when sea temperatures are warmest	Common bottlenose dolphin varies their diet depending on location and season. They take pelagic and demersal fish, cephalopods and crustaceans
Harbour porpoise *Phocoena phocoena*	An estimated 22,800 animals occur in the European waters north of the UK	Harbour porpoise are mostly associated with the coasts of Iceland, Norway, Faroe Islands, and the UK. They have been known to make seasonal movements depending on habitat and prey requirements	Harbour porpoise is found in coastal areas, though they may sometimes be observed over deeper waters offshore	Mating and birthing occurs in summer, from May to July	Harbour porpoise diet varies by season and location. They can take a wide variety of benthic and pelagic prey, though only take two or three species at a time
Killer whale *Orcinus orca*	Up to 14,000 killer whales are estimated to use the waters of Iceland and Norway; these likely move within	In the northeast Atlantic, killer whale may be found off the coast of Shetland, Iceland, and Norway	Killer whales can be found both inshore and offshore, in association with their prey. They undertake long-	Calving of killer whales is poorly understood, but it is thought that there is no distinct season	Killer whales are generalist feeders, taking a range of marine species, though can become

Marine Mammal Species	Abundance	Distribution	Habitat	Key Seasons	Prey
	the wider northeast Atlantic		distance movements throughout their range		specialised in local areas
Long-finned pilot whale *Globicephala melas*	The most recent survey centred around the Faroe Islands indicated a population abundance of 344,000	The species is widely distributed in the northeast Atlantic. They are frequently found in the waters around the Faroe Islands, though do not typically go further north than Iceland	The species utilises both coastal and offshore habitats. Movements coincide with movements of prey	Breeding and mating usually takes place between April and September	Diet primarily consists of schooling squid, small pelagic fish also taken
Northern bottlenose whale *Hyperoodon ampullatus*	Approximately 28,000 individuals have been estimated for the North Sea, Norwegian Sea, and the waters around Iceland and the Faroe Islands	The species only occurs in the cool, northern parts of the North Atlantic. They are regularly seen in the Norwegian Sea and off the Faroe Islands	These whales prefer deep waters seaward of the continental shelf. Migration strategies vary between individuals	The breeding of northern bottlenose whale is not well understood. Calving is thought to occur in spring to early summer	The species feeds on deep-water squid only
Risso's dolphin *Grampus griseus*	There is an estimated abundance of 11,000 individuals in the northeast Atlantic	The species prefers warmer waters of the North Atlantic, hence it is only an occasional visitor to Study Area A	Risso's dolphin are primarily found over continental slope, outer shelf, and oceanic areas. They do not undertake migrations, but will move to follow prey distribution	Risso's dolphin calve year-round, with a peak in summer between March and July	Their diet comprises cephalopods, with variable importance of species dependent on location

Marine Mammal Species	Abundance	Distribution	Habitat	Key Seasons	Prey
Sperm whale *Physeter macrocephalus*	The most recent survey around Iceland/Faroes created an abundance estimate of 23,200 individuals	Sperm whales are found throughout the world's oceans, right up to the ice edge at the poles.	Sperm whales are found in the open ocean though increase in numbers around the continental shelf and seamounts. Migrations are sec-specific, with predominantly males found at higher latitudes	Sperm whales breed and calve in the summer months in tropical waters	Their diet comprises mostly deep-sea cephalopods, with some fish species also taken
Striped dolphin *Stenella coeruleoalba*	In the European Atlantic waters it is estimated that there are 372,000 striped dolphin	Striped dolphin are found in warm waters; the observations in Norway, Faroe Islands and Iceland are considered extra-limital	The species' distribution is linked to prey availability	Calving of striped dolphins occurs in summer or autumn	Their diet comprises mostly oceanic pelagic fish, particularly lanternfish and cod
White-beaked dolphin *Lagenorhynchus albirostris*	In excess of 100,000 individuals are estimated to occur in the North Atlantic Ocean	White-beaked dolphin are found in the cold waters of the North Atlantic. The species is common around Iceland, Norway, and the UK	The species shows a preference for water depths <200m, though it can be found both on and off the continental shelf	Both mating and calving is thought to occur in the summer months, between June and September	The species feeds mostly on fish species, but occasionally cephalopods and crustaceans too

Marine Mammal Species	Abundance	Distribution	Habitat	Key Seasons	Prey
Beaked whales Ziphiidae	The most recent surveys indicate that at least 14,500 individuals occur in European waters (closest extent to Study Area A)	Beaked whales are found in all oceans of the world, though some species have restricted distribution	Generally found in deep waters area off continental shelves, often associated with areas of steep bathymetric relief	The reproduction of beaked whales is unknown	Beaked whales take deep water species of squid a fish, which they detect using echolocation

Marine Protected Areas

Study Area A supports several Marine Protected Areas (MPAs) of different designations and under different jurisdictions. There are also a range of MPAs in coastal waters of the countries in the vicinity of Study Area A, such as Iceland, Greenland, and Norway. Further details on the MPAs that have direct spatial overlap with Study Area A are provided in Table A10.4.

Table A10.4 Details of marine protected areas that overlap Study Area A (Source: JNCC, 2020a; Scottish Natural Heritage, 2020)

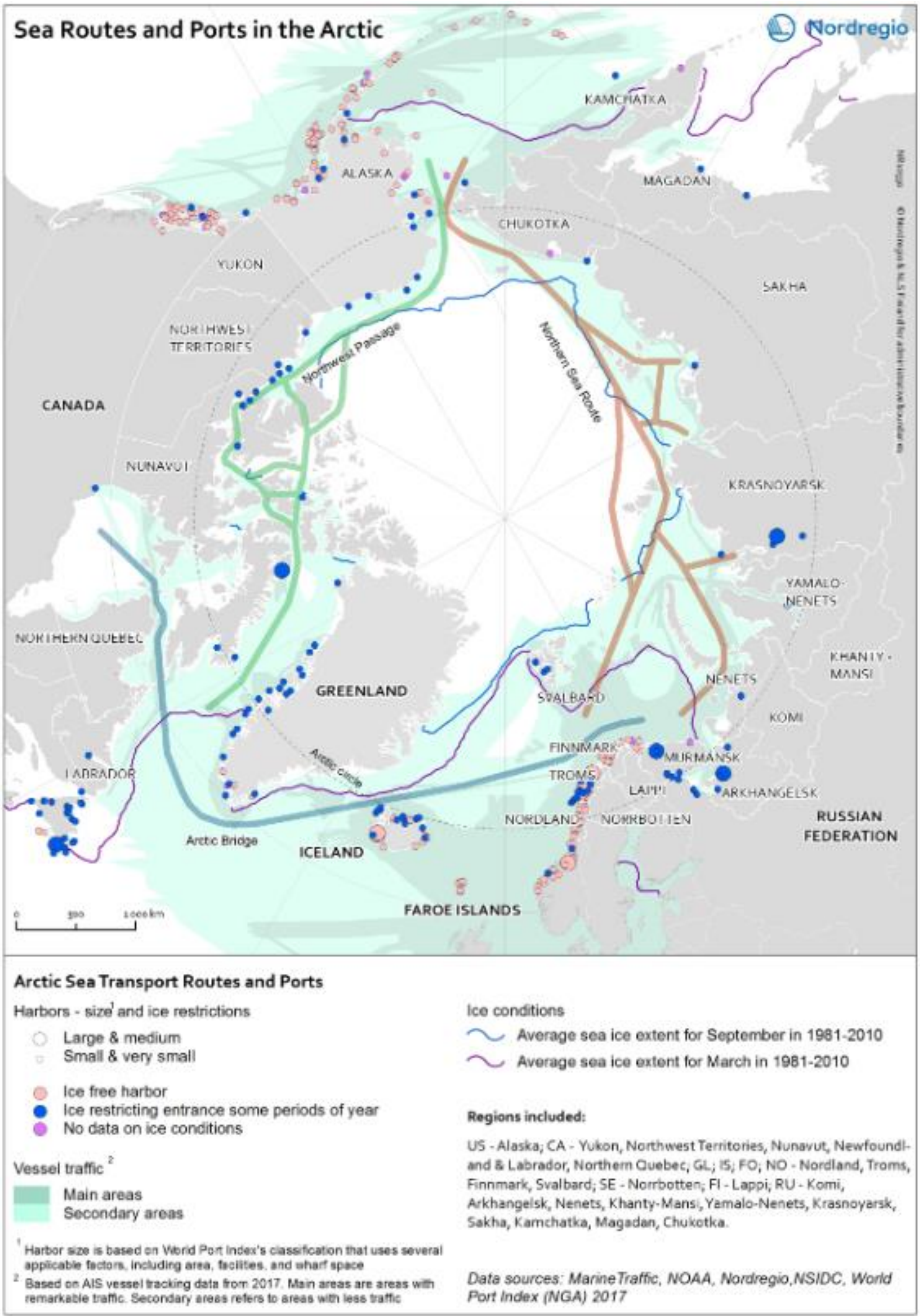
Marine Protected Area	Designated Features
Faroe-Shetland Sponge Belt Nature Conservation Marine Protected Area	Deep sea sponge aggregations Offshore subtidal sands and gravels Ocean quahog aggregations Continental slope Quaternary of Scotland - continental slope channels; iceberg ploughmark fields, prograding wedges Submarine Mass Movement - slide deposits Marine Geomorphology of the Scottish Deep Ocean Seabed - sand wave field, sediment wave field
North-east Faroe-Shetland Channel Nature Conservation Marine Protected Area	Deep sea sponge aggregations Offshore dee- sea muds Offshore subtidal sands and gravels Continental slope Quaternary of Scotland - prograding wedge; Submarine Mass Movement - slide deposits Marine Geomorphology of the Scottish Deep Ocean Seabed - contourite sand/silt Cenozoic Structures of the Atlantic Margin - mud diapirs
West Shetland Shelf Nature Conservation Marine Protected Area	Offshore subtidal sands and gravels
Hermaness, Saxa Vord and Valla Field Special Protection Area	Fulmar *Fulmarus glacialis*, breeding Gannet *Morus bassanus*, breeding Great skua *Stercorarius skua*, breeding Guillemot *Uria aalge*, breeding Kittiwake *Rissa tridactyla*, breeding Puffin *Fratercula arctica*, breeding Red-throated diver *Gavia stellata*, breeding Seabird assemblage, breeding Shag *Phalacrocorax aristotelis*, breeding
Fetlar Special Protection Area	Arctic skua *Stercorarius parasiticus*, breeding Arctic tern *Sterna paradisaea*, breeding Dunlin *Calidris alpina schinzii*, breeding Fulmar, breeding Great skua, breeding Red-necked phalarope *Phalaropus lobatus*, breeding Seabird assemblage, breeding Whimbrel *Numenius phaeopus*, breeding

Marine Protected Area	Designated Features
Fetlar to Haroldswick Nature Conservation Marine Protected Area	Black guillemot *Cepphus grylle* Circalittoral sand and coarse sediment communities Horse mussel beds Kelp and seaweed communities on sublittoral sediments Maerl beds Shallow tide-swept coarse sands with burrowing bivalves Marine Geomorphology of the Scottish Shelf Seabed
Pobie Bank Reef Special Area of Conservation	Reefs
Jan Mayen Strict Nature Reserve	The whole island and up to 12 nautical miles from the coastline

Humans/Human Activities

Shipping and Navigation

As Study Area A encompasses mostly open ocean, there are very few ports in Study Area A itself. Ports are present along of the coasts of adjacent countries such as Shetland, Iceland, Faroe Islands, and Norway, though these are mostly small (Figure A10.5). The majority of Study Area A lies within the main area of vessel traffic in the Arctic, with the waters around Jan Mayen and Greenland form part of the secondary areas of traffic (Figure A10.5). Study Area A does not overlap any of the three main Arctic Sea transport routes (Figure A10.5). As displayed for the wider region in Figure A10.6, vessel density is highest adjacent to the coasts where there are ports (Iceland, Norway, the Faroe Islands) which is mostly outside Study Area A. Vessel density in Study Area A can be characterised as low.



FigureA10.5 Sea routes and ports in the Arctic (From: Nordregio, 2020)

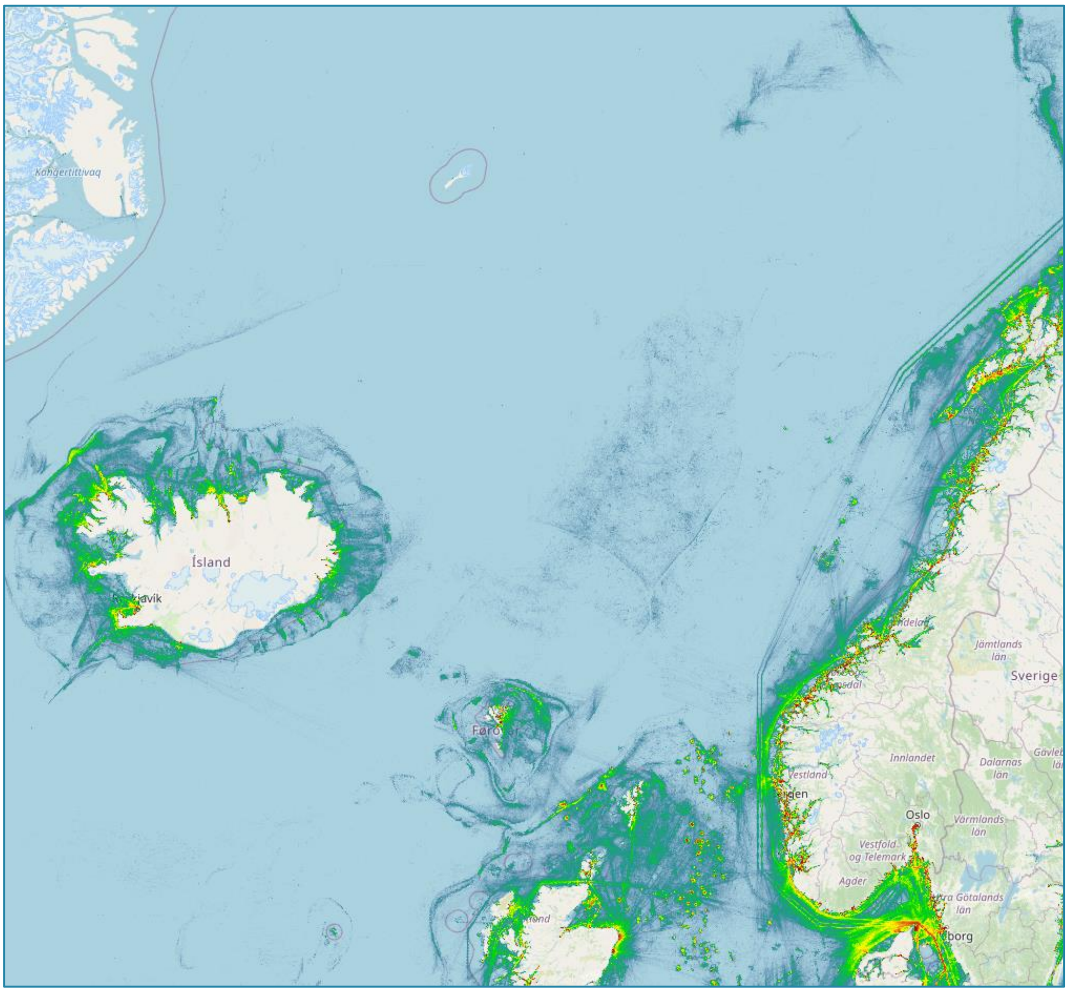


Figure A10.6 Ship traffic density in the vicinity of Study Area A (From: EMODnet, 2020)

Oil and gas

Oil and gas infrastructure are present in high density in the UK Exclusive Economic Zone (EEZ) portion of the Study Area, and to a lesser extent in Norwegian waters. Many boreholes have been drilled in these areas; the majority of boreholes are located within active licence areas for hydrocarbon exploration. Installations are restricted to the west of Shetland and northeast of Shetland (in UK/Norwegian waters) and these are mostly operational with some being decommissioned (EMODnet, 2020). In the waters of Jan Mayen several deep-sea boreholes were drilled in 1974 but these have not been further exploited (Orkustofnun, 2008). Drilling campaigns have also occurred in the Faroe Islands with mixed success (Offshore Mag, 2004), and at present there are no installations.

There is significant interest by the petroleum industry in extraction of the potential hydrocarbon reserves located in Study Area A, particularly in the offshore areas of the Faroe Islands, Iceland, and Norway. It is likely that hydrocarbon extraction in the area will increase in the coming years, therefore the potential risk to new developments will need to be taken into account for future launches from the SSC.

Cables and pipelines

Several subsea cables traverse the southern section of Study Area A in UK and Faroese waters. These are (TeleGeography, 2020):

- FARICE-1: this cable connects Iceland, the Faroe Islands and Scotland and is owned by Icelandic company Farice. Landfall points are Dunnet Bay, Scotland, Funningsfjordur, Faroe Islands, and Seydisfjordur, Iceland;
- SHEFA-2: this cable connects the Faroe Islands with Shetland and north Scotland and is operated by the Faroese company Shefa. The cable makes landfall at Torshavn, Faroe Islands, Sandwick and Maywick in Shetland, Ayre of Cara in Orkney, and Banff in Scotland. There is also a cross-cable which connects Glen Lyon and BP Clair Ridge offshore;
- CANTAT-3: this cable connects Vestmannaeyjar, Iceland, Tjornuvik, Faroe Islands, and several locations in the North Sea and Denmark. It is also operated by Shefa;
- DANICE: this cable connects Landeyjasandur, Iceland, to Denmark, and is operated by Farice.

In addition to subsea cables, oil and gas pipelines are present in the southern portion of Study Area A in UK and Norwegian waters. There are four pipelines that connect the various platforms in the oil and gas fields to the west of Shetland and those to the northeast of Shetland to onshore stations on Shetland such as the Sullom Voe Terminal. There is also a network of interconnecting pipelines between the numerous platforms in the oil and gas field to the northeast of Shetland.

Military

Study Area A is used for military exercises by the North Atlantic Treaty Organization (NATO) and Russia. Study Area A lies within Russia's bastion defence area, an area in the Norwegian Sea in which Russia has undertaken complex military exercises, including as recent as June 2020 (The Barents Observer, 2020). Study Area A is also overlapped by the NATO sea exercise areas, which has been used for large exercises such as the Trident Juncture in 2018 (DW, 2018). Military exercises occur intermittently in these areas and can comprise both marine and aviation operations. There is potential for military activity to increase in Study Area A in the future with increasing accessibility to the Arctic.

Other sea users

Other sea users include marine renewables (wave, wind, and tidal), aquaculture areas, marine aggregate dredging and disposal sites, carbon capture and storage, natural gas storage and minerals evaporites areas . There appear to be three other users of the marine environment in Study Area A; aquaculture, waste disposal sites and marine renewable energy. There are many aquaculture sites located on the coast of Shetland. Aquaculture is of extreme economic importance to Shetland; in conjunction with fisheries it accounts for £300 million a year of revenue (Fish Farming Expert, 2020). The two waste disposal sites, located offshore in Faroese and Norwegian waters, have been utilised for dumping munitions (EMODnet, 2020). There are two marine renewable energy installations in Study Area A, at the coast of Shetland, which are Shetland Tidal Array and the NOVA 30 Demonstrator (EMODnet, 2020). Though there are no offshore wind farms within Study Area A, one offshore wind farm, Hywind Tampen, is located adjacent to the southeast corner (4C Offshore, 2020). There are no marine aggregate dredging sites, carbon capture and storage, or natural gas storage and mineral evaporites areas in Study Area A (EMODnet, 2020).

Socioeconomics/Tourism

Due to the offshore location of Study Area A, there are minimal sources of marine tourism. Perhaps the only source is cruise liners, which may be present in Study Area A whilst transiting between ports in the wider region (Marine Vessel Traffic, 2020). As passengers do not disembark in Study Area A, cruise ships can be considered as part of shipping and navigation.

For further consideration of the socioeconomics and tourism of Shetland, please see Chapter 14 of this EIA Report.

Marine Archaeology

There is a paucity of readily available information on the marine archaeological features in offshore waters across several countries' jurisdiction. Information on marine archaeological data is likely held by the countries that overlap Study Area A, namely Scotland, Denmark, Iceland, and Norway. The difficulty of acquiring this data has been determined to be disproportionate to the level of information required to provide a preliminary characterisation.

Information on the location of shipwrecks in Scottish waters is available to view on Marine Scotland's National Marine Plan interactive (NMPi) website. There are numerous wrecks in the Scottish extent of Study Area A; to illustrate, see Figure A10.17 for the location of wrecks within 90 km of the launch site. It can be inferred from the NMPi that the number of wrecks decreases with distance from the coast and increasing water depth. The potential for maritime wrecks is greater closer to land, notably ports and historic transit passages, but there is still potential outside of this. It is understood that there were several notable battles that occurred in Study Area A which may provide discrete areas where a greater number of finds would be located. Aviation and prehistory are likely to have a different spatial distribution. It is therefore logical to assume that the number of wrecks present in Study Area A will be low.

There is limited palaoelandscape potential where glacial, though there may be a few discrete areas closer to land and in sheltered locations.

Commercial Fisheries

Study Area A overlaps the territorial fishing waters of several countries: Scotland, Norway, Denmark (Greenland and Faroe Islands). Beyond these territorial waters fishing rights are controlled by the NEAFC.

The estimated fishing effort in Study Area A is variable. Based on Figure A10.7, fishing effort in the southern portion of Study Area A (between Scotland and the Faroe Islands) is high (~1.0h/km^2), and decreases with increasing distance north through Study Area A. With exception of south of Faroe Islands, fishing in most countries' waters is concentrated around the coast and so has minimal effort overlap with Study Area A (Kroodsma *et al.*, 2018; ICES, 2019a; 2019b). An assessment of estimated fishing effort in the NEAFC area indicated that fishing effort in 2005 was at or below 750 signals in each 0.5° × 0.5° grid cell for the portion of the NEAFC area that overlaps Study Area A (FIRMS, 2009). The gear type that corresponded to the highest amount of effort in Study Area A is pelagic trawls and seines, with bottom otter trawls used in highly localised areas also (Kroodsma *et al.*, 2018; ICES, 2019a; 2019b).

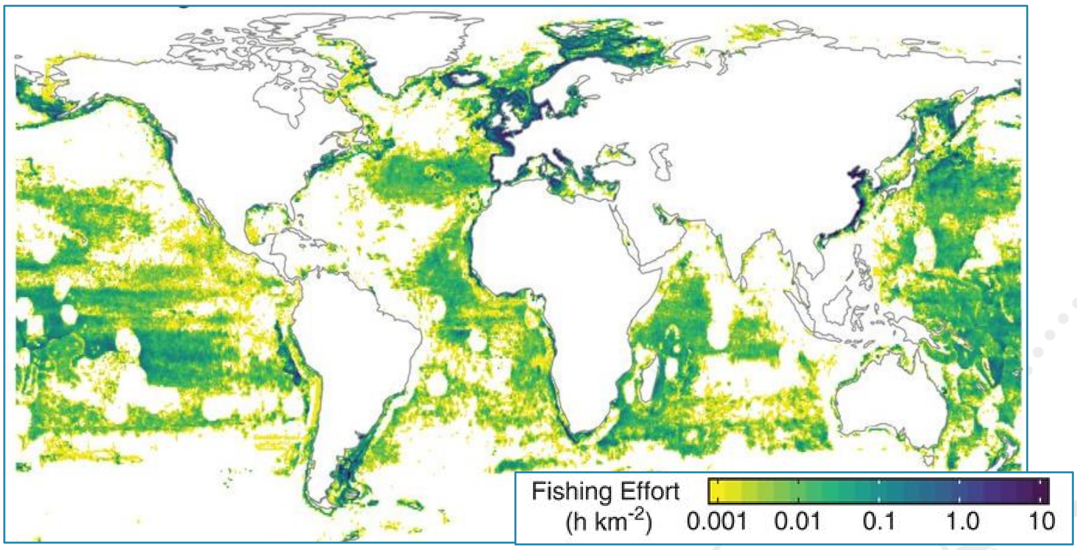


Figure A10.7: Total global fishing effort [hours fished per square kilometre (h/km^2)] in 2016 by all vessels with automatic identification system enabled (From: Kroodsma et al.*, 2018)*

Study Area A overlaps the following ICES Statistical Areas: IIa (Norwegian Sea), IVa (Northern North Sea), Va (Iceland Grounds), Vb (Faroes Grounds), and XIVa (North-East Greenland) (EC, 2020). ICES report on the annual nominal catches for all ICES regions submitted by the 20 ICES member countries (ICES, 2020). Data from the period 2013-2017 has been analysed for the purposes of characterising fishing in these areas.

Across all years in the period 2013-2017, the ICES area with the highest landings was Area IIa, which averaged approximately 3 mega tonnes (Mt) live weight per year. Landings in Area IIa have increased on a near-yearly basis. Area Va has traditionally been the second most productive, though in 2017 the amount landed here was slightly lower than in Area Vb, as this area has seen a near doubling in the total live weight landed across the timeframe analysed. Area IVa has consistently reported approximately 1 Mt each year. Landings in North-East Greenland are notably lower than the other regions.

Table A10.5 Total annual catch landed in each ICES Statistical Area overlapped by Study Area A

Region	2013	2014	2015	2016	2017
IIa Norwegian Sea	2,949,560	3,111,124	3,132,679	2,878,558	3,596,486
IVa Northern North Sea	872,379	1,012,761	962,860	1,013,493	997,513
Va Iceland Grounds	2,561,050	1,747,167	2,352,502	1,765,015	1,914,735
Vb Faroes Grounds	1,158,214	1,234,380	1,618,992	1,559,118	1,960,229
XIVa North-East Greenland	2,493	56,624	11,079	19,354	10,500

Through analysis of the catch data it is also possible to comment on the relative contribution of different species to the overall landings in each area (as displayed in Figure A10.8-Figure A10.12). In Area IIa, Atlantic herring, Atlantic cod and Atlantic mackerel were the three most landed species for the period 2013-2017. A total of 4.2 Mt, 4.0 Mt, and 3.8 Mt were landed of Atlantic herring, Atlantic cod, and Atlantic mackerel, respectively. Atlantic herring and Atlantic mackerel were the two most commercially important species in Area IVa, with 1.8 Mt and 1.5 Mt landed, respectively. In Area Va, the following species comprised the most live weight landed (in decreasing order): capelin, Atlantic cod, Atlantic mackerel, Atlantic herring. Blue whiting dominated the landings in with over 5.7 Mt landed, an order of magnitude greater than the next most landed species. The two major species landed in Area XIVa are Atlantic herring and capelin, though the amount landed is much smaller than in other areas. In summary, the most commercially important species across the region are Atlantic cod, Atlantic mackerel, Atlantic herring, capelin, and blue whiting.

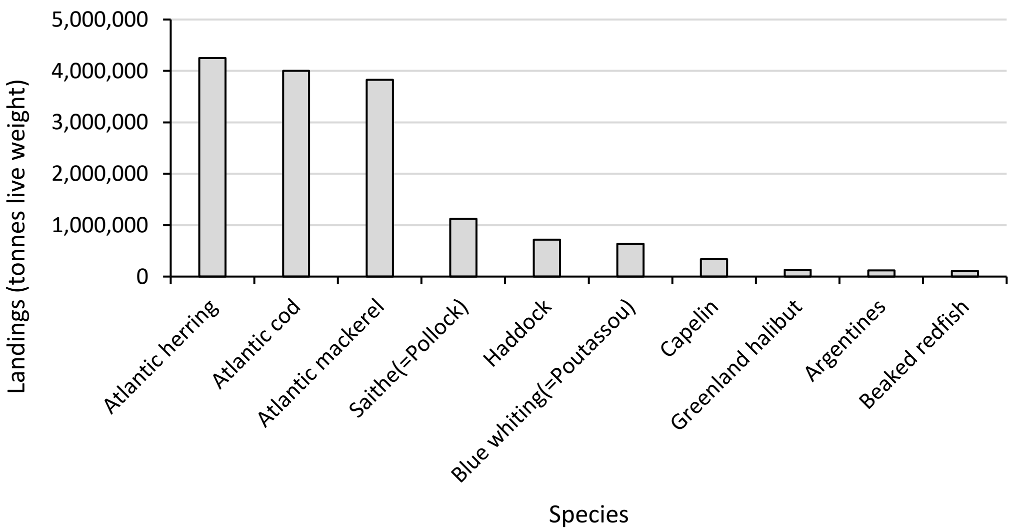


Figure A10.8 Landings weight of the top 10 species landed in Area IIa

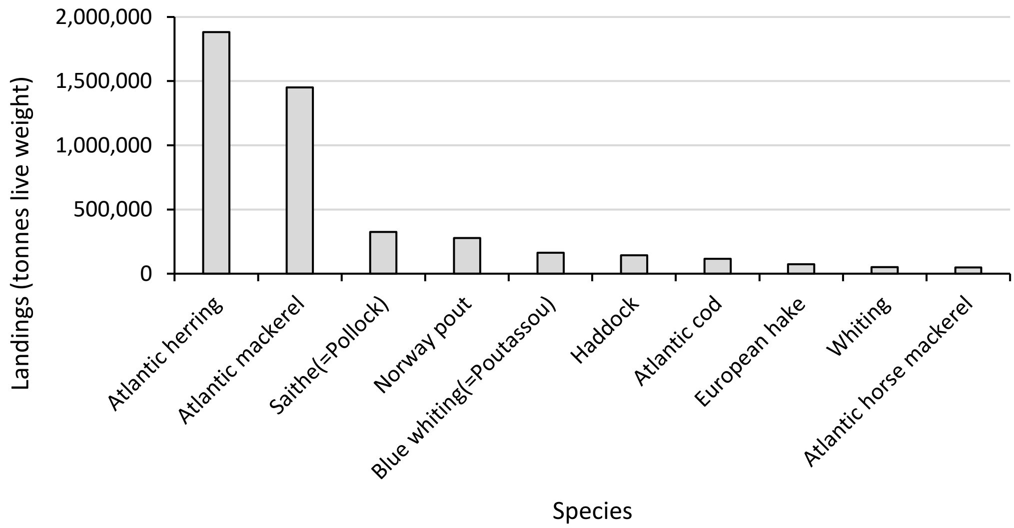


Figure A10.9 Landings weight of the top 10 species landed in Area IVa

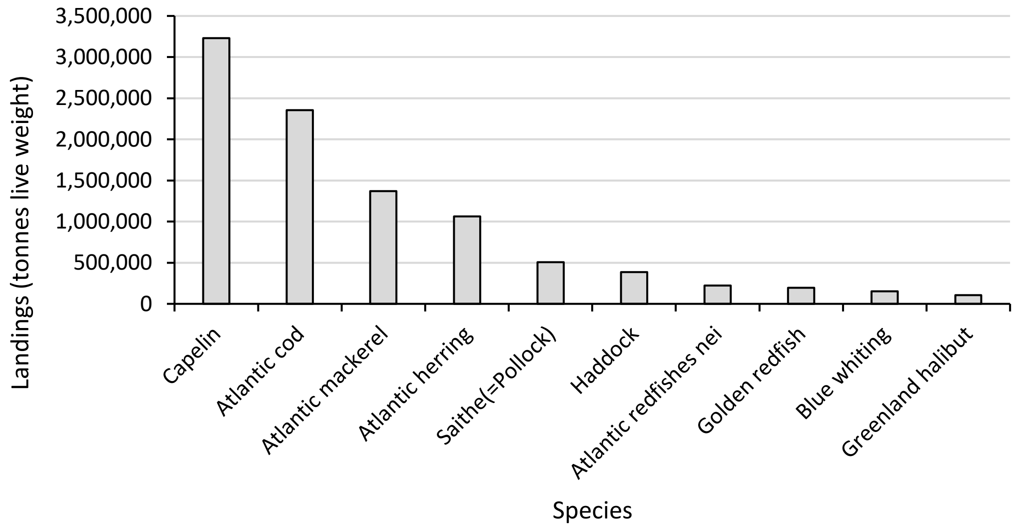


Figure A10.10 Landings weight of the top 10 species landed in Area Va

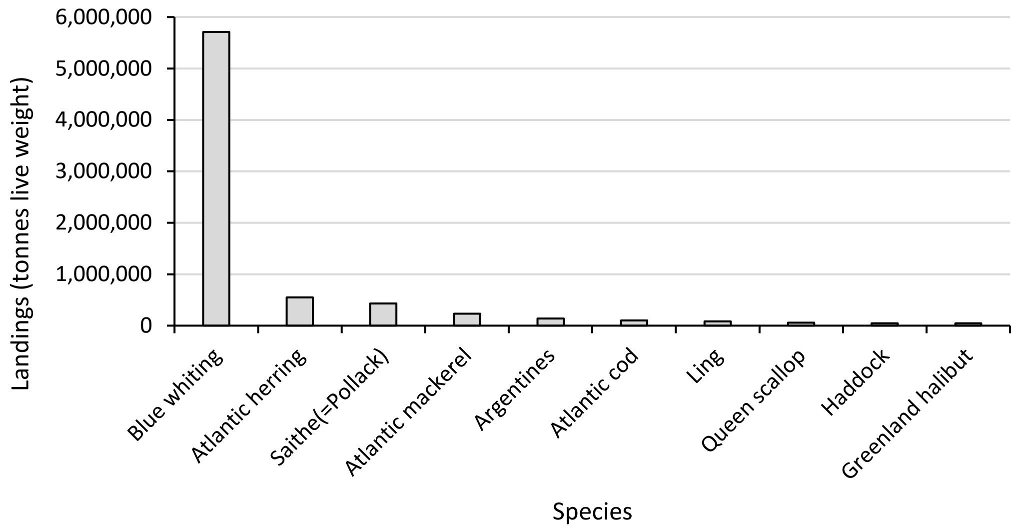
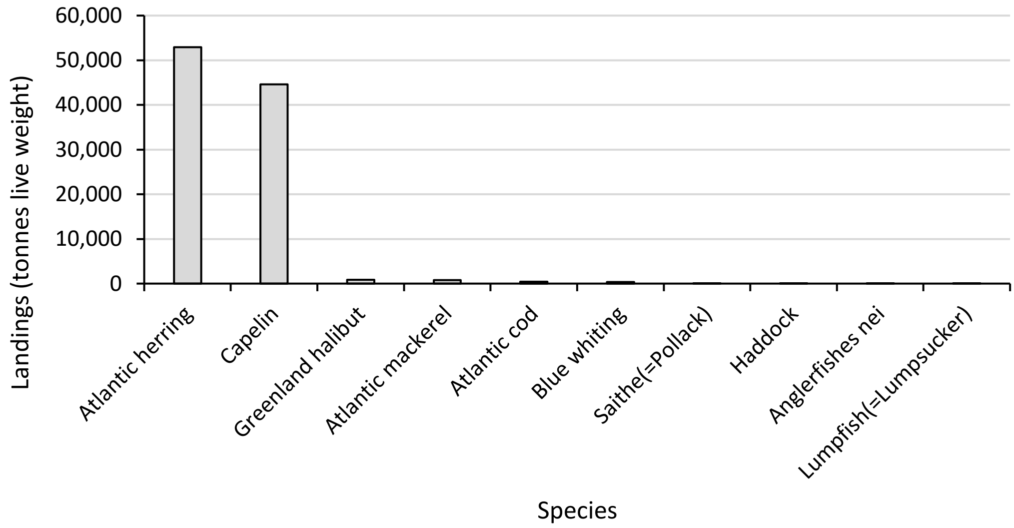


Figure A10.11 Landings weight of the top 10 species landed in Area Vb



FigureA10.12 Landings weight of the top 10 species landed in Area XIVa

Study Area B

Water Quality

Contaminants

Braer, an oil tanker, wrecked in 1993 on the south coast of the Shetland Islands, within the southern extent of Study Area B. The incident resulted in the spillage of the entire cargo (87,000 tonnes) of crude oil into the sea (ESGOSS, 1994). The spillage resulted in the death of at least 1,500 seabirds and affected a quarter of the local grey seal *Halichoerus grypus* population. A quarter of a century on, the incident continues to put local wildlife in danger (BBC News, 2018).

Between 1995 and 2015, a beached oil monitoring programme was implemented, including 49 around all coasts of the Shetland Islands. The samples included reports of oiled seabirds and beached oil/tar balls (Todd and Runciman, 2018). Around the Shetlands, three types of oil were found: refined oil (fuel), crude oil, and non-oil residue. In the early years of the study, the majority of samples were of fuel, however over the last 8 years, the number of samples containing crude oil has increased, although the total number of reports has been decreasing since 2003 (Todd and Runciman, 2018).

As previously noted, OSPAR Commission monitor contaminants in seabed sediments, and fish and shellfish populations in each OSPAR Region. Study Area B is located, and entirely within, the extreme north of OSPAR Region II (Greater North Sea). The most recent assessment for OSPAR Region II has been summarised in Table 10.6.

Table A10.6: Summary of the 2017 Intermediate Assessment of contaminants in fish and shellfish and marine sediments (Source: OSPAR, 2017)

Contaminant(s)	Receptor	Assessment Outcome
Polycyclic Aromatic Hydrocarbons (PAHs)	Shellfish	Concentration below Environmental Assessment Criteria (EAC) and unlikely to cause adverse effects.
	Sediment	Concentrations at background levels; however, are below the Effects Range-Low (ERL) and therefore unlikely to result in adverse effects.
Polychlorinated Biphenyls (PCB)	Fish and Shellfish	All PCBs were above background levels. CB118, the most toxic PCB congener, was above the EAC, therefore adverse effects may be possible due to this contaminant.
	Sediment	
Polybrominated Diphenyl Ethers (PBDEs)	Fish and Shellfish	Levels are decreasing by approximately 10% per year and were at approximately 0.1 µg/kg wet weight in 2017. As there are no assessment criteria, OSPAR (2017) was unable to assess the environmental significance.
	Sediments	Insufficient data available for the northern North Sea.
Antifouling paints (Tributyltin; TBT)	Shellfish	Imposex (display of male sexual characteristics in female individuals) caused by TBT contamination is decreasing in gastropod molluscs.
Antifouling paints (TBT and Organotin)	Sediments	Not monitored in the northern North Sea.
Heavy metals (Mercury, Hg; Cadmium, Cg; and Lead, Pb)	Fish and Shellfish	All three heavy metals are above background levels, however, are below European Commission standards for food for human consumption.
	Sediment	Hg and Cd concentrations are below the ERL limit, however Pb concentrations are not statistically below the ERL limit. OSPAR concluded that adverse ecological effects may be possible.

Microplastics

Studies have shown plastic pollution in the northeast Atlantic around Scottish coasts (Murphy *et al.*, 2017; Hann *et al.*, 2019), around the Orkney Islands (Capper *et al.*, 2018), in the North Sea (Roscher, 2017; Lorenz *et al.*, 2019), and on the beaches of Shetland (Barton, 2018).

A considerable volume of marine litter, including microplastics, has been recorded in the seas around and on the beaches of the Shetland Islands (Shucksmith, 2017). Sources of marine litter pollution in Shetland include land-based sources washing into the sea, purposeful or accidental disposal from ships, and litter carried on ocean currents from other parts of the world (Shucksmith, 2017). Between 1991 and 2044, as part of the community project '*Da Voar Redd Up*' ('*The Spring Clean Up*') on the Shetland Islands (Shetland

Amenity Trust, 2020), the mass of litter collected increased from approximately 20 tonnes to over 100 tonnes (Shucksmith, 2017). However, in more recent years (2005-2014), the volume of litter fluctuates around 60 tonnes per year (Shucksmith, 2017).

Although marine litter collected is not entirely microplastics, the amount of litter can be used as an indicator for the levels of microplastics, as it is well-known that larger plastic items breakdown in the marine environment, and the number of microplastic particles is expected to be far greater than of macroplastic (>5 mm length) particles (Eriksen *et al.*, 2014).

Biodiversity

Physical Features

Water depths in Study Area B are mostly 200 m or shallower, quickly decreasing to 100 m or shallower near the coastline. In the far northwest of Study Area B, the water depth rapidly increases to 800 m at the edge of the Faroe-Shetland Channel.

Near-bed and surface sea temperature and salinity in Scottish waters have been monitored from 1971-2000 (Marine Scotland, 2020).

The mean SST in the northern half of Study Area B ranged from 7.1°C in March to 12.0°C in August, with an annual mean of 9.7°C. The southern half, including all coasts of the Shetland Islands, and a small area in the north of Study Area B, has a marginally lower annual mean SST of approximately 9.5°C, although a wider range of 6.8°C in March to 10.0°C in August (Marine Scotland, 2020). Near-bed temperature follows different spatial trend, with cooler mean temperatures in the far east of Study Area B (annual mean: approximately 8.1°C) and warmer in the west and around the coasts of Shetland (annual mean: approximately 8.6°C).

Sea surface salinity is mostly uniform, with an annual mean of 35.27 (ranging from 35.22-35.30, January-June), with a slight decrease to an annual mean of 35.2 in the extreme southwest of Study Area B. Near-bed salinity has as wider range (35.15-35.32, January-April) although a similar mean (35.25) and is constant across the whole of Study Area B (Marine Scotland, 2020).

The annual mean significant wave height varies across, reaching 2.71-3.00 m in the offshore northern and western proportions of Study Area B, but then decreasing to 1.81-2.10 m in most of the inshore regions, with localised patches of 1.51-1.80 m in sheltered areas on the east coast of the Shetland Islands (Marine Scotland, 2020). The mean spring tidal range of approximately 1.82 m is uniform across Study Area B (Marine Scotland, 2020).

The seabed sediments around the Shetland Islands and within Study Area B vary. The nearshore areas to the north and west of the Shetlands consist largely of coarse sediment with localised patches of mixed sediment, there is a large patch of rock or diamicton to the southeast of the Shetland Islands, covering almost a quarter of Study Area B (Marine Scotland, 2020). The remainder of Study Area B consists almost entirely of sand and muddy sand, with some patches of coarse sediment to the north, northeast, and west (Marine Scotland, 2020).

Plankton

There is limited information on plankton around the Shetland Islands and within Study Area B specifically. EMODnet (2020) displays sporadic counts of phytoplankton within Study Area B, showing a band of 61-100 records orientated northwest-southeast across the centre of Study Area B, passing just north of the SSC launch site. In addition to this, there are grid cells on the southernmost point of the Shetland Islands with up to 956 records of phytoplankton (EMODnet, 2020). EMODnet (2020) also shows a very low relative abundance of chlorophyll by functional group within Study Area B for all four seasons.

The plankton assemblages vary around the Shetland Islands, with the algae *Rhizosolenia styliformis* recorded in the eastern inshore waters and in lower numbers to the northwest of the SSC launch site (Aiken *et al.*, 1977). The faunal plankton assemblage, consisting of species such as the copepods *Pleuromamma robusta*, *Rhinacalanus nastus*, *Aetidus armatus*, *Candacia armata*, and *Corycaus anglicus*; and the mollusc *Peraclis* sp. located to the northwest of the Shetland Islands, but absent from the eastern survey stations. The bioluminescent copepod *Metridia lucens* and the planktonic diatoms *Chaetoceros* (*Hyalochaete*) spp. were recorded in relatively equal abundances in the sample stations in the east, west, and north of the Shetland Islands (Aiken *et al.*, 1977).

As noted in Paragraph 0, planktonic assemblages, such as those described above, are essential in the trophic web (Frederiksen *et al.*, 2006). Plankton assemblages provide food source for larger organisms, ultimately supporting commercially important fish populations, including Atlantic herring (Checkley, 1982), Atlantic salmon *Salmo salar* (Treasurer *et al.*, 2003), sandeel species Family: Ammodytidae (Bergstad *et al.*, 2002; van Deurs *et al.*, 2009); and ecologically important seabird populations, such as northern fulmar (Furness and Todd, 1984).

Benthic Species

Benthic communities in the intertidal and nearshore subtidal zones of the Shetland Islands are typical of those found on similar rocky habitats in the north of the UK.

A number of barnacle species, such as *Semibalanus balanoides*, and the limpets *Patella* spp., blue mussel *Mytilus edulis*, along with rockweed *Fucus distichus* ssp. *anceps*, spiral wrack *F. spiralis f. nana*, the green algae *Blidingia* spp., coral weed *Corallina officinalis*, and thongweed *Himanthalia elongata*, are characteristic of the exposed littoral rock communities (Eleftheriou, 2003). The abundance of fucoids and barnacles decreases as the level of shelter increases. In areas of intermediate exposure, species diversity is highest, with the sides of geos on exposed rocky shores providing suitable habitat for encrusting sponges, ascidians, and hydrozoans; barnacles, and blue mussel (Eleftheriou, 2003).

Where mixed sediment and larger boulders are present in the more sheltered, inner parts of the voes and inlets, Howson (1999) found barnacles and mussels and common periwinkle *Littorina littorea* were regular inhabitants. Other characteristic species of such habitats include channelled wrack *Pelvita caniculata* and bladder wrack *Fucus vesiculosus* (Eleftheriou, 2003). The benthic communities in gravelly and stony beaches around the islands are characterised by amphipods, littorinids, and blue mussel (Eleftheriou, 2003).

The sublittoral zone at northern limit of the Shetland Islands, north and northwest of the SSC launch site, consists of steep bedrock, which transitions to clean sediments at 20-30 m depth (Wilding *et al.*, 2005). Characteristic species down to approximately 30 m include tangle *Laminaria hyperborea*, sugar kelp *L.saccharina*, and sea beech *Delesseria sanguinea*, the latter of which extends down to 35 m. Faunal species present in the area include jewel anemone *Corynactis viridis* beds, dead man's fingers *Alcyonium digitatum*, and a number of colonial ascidian species. Keel worm *Spirobranchus* (*Pomatoceros*) *triqueter* and the common sea urchin *Echinus esculentus* (Wilding *et al.*, 2005).

To the southwest of the SSC launch site, between the islands of Yell and Unst, is the Bluemull Sound strait, which experiences strong tidal currents up to 2.6 m/s and depths up to 40 m (Wilding *et al.*, 2005). Much of the shoreline through the strait consists of steep bedrock and boulders, although there are areas of shingle and muddy sediments in the bays. The rocky shores transition to boulder and cobble plains, with several rocky outcrops in the centre of the channel. In the east, mixed sediment is present, along with the largest maerl bed in Shetland (Wilding *et al.*, 2005). In areas of high tidal flow, sponges such as *Halichondria panicea* and *Pachymatisma johnstonia*, the ascidian *Diplosoma spongiforme*, frilled anemone *Metridium senile* and elegant anemone *Sagartia elegans* characterise the benthic communities (Wilding *et al.*, 2005). Kelp forests are also present in the channel, rooted to bedrock outcrops. The forests support species such as tangle, sugar kelp, furbelows *Saccorhiza polyschides*, *H. panicea*, dahlia anemone *Urticina felina*, and daisy anemone *Cereus penduncculatus* (Wilding *et al.*, 2005).

Similar to Bluemull Sound, the rocky shores at Yell Sound give way to boulder and cobble plains at 20-25 m depth (Wilding *et al.*, 2005). There are patches of fine sand plains, which support diverse bivalve mollusc communities, including species such as razor clam *Ensis magnus*, otter shell *Lutraria lutraria*, blunt gaper *Mya truncata*, yellow carpet shell *Venerupis rhomboides*, and the saltwater clam *Dosinia exoleta* (Wilding *et al.*, 2005). There are also a number of polychaete worm species, burrowing echinoderms, crabs and starfish present.

There are a number of MPAs within Study Area B, of relevance to the benthic environment are the Fetlar to Haroldswick Nature Conservation MPA (ncMPA), Faroe-Shetland Sponge Belt ncMPA, and Pobie Bank Reef Special Area of Conservation (SAC).

Nearest to the SSC launch site is the Fetlar to Haroldswick ncMPA, which spans from Haroldswick on the east of Unst, down to cover the entire coastline of Fetlar, and as far westward as the Mid Yell Voe and the southeastern proportion of Bluemull Sound. The site covers a variety of habitats, including maerl beds, kelp and seaweed communities, shallow tide-swept sands, and horse mussel *Modiolus modiolus* beds (NatureScot, 2020a). In the shallower waters in the inner parts of the MPA, maerl beds provide shelter and protection to a variety of marine animals, including some commercially important fish species. Between the islands, bivalve molluscs can be found in the coarse gravelly sands, with some areas of sugar kelp and bootlace weed *Chorda filum*. The horse mussel beds are found in the deeper, tide-swept areas of the MPA, which support brittlestar communities, starfish, sea urchins, feather stars, and sponges (NatureScot, 2020a).

In the extreme northwest of Study Area B, between the Shetland Islands and the Faroe Islands, lies the Faroe-Shetland Channel, a rift basin with depths up to 1,900 m that separates the Scottish and Faroese continental shelves. Part of the channel is covered by the Faroe-Shetland Sponge Belt NCMPA, where the benthic fauna is dominated by sponge communities known as "*Ostebund*" or "*cheese-bottoms*" (NatureScot, 2020b). The sponges provide shelter for a range of small organisms and an elevated perch for brittlestars to filter feed from (NatureScot, 2020b).

To the east of the SSC launch site, within Study Area B, is a stony and bedrock reef, which provides habitat to encrusting and robust sponge and bryozoan communities (JNCC, 2020b). The shallower areas consist of bedrock and boulders, which support encrusting coralline algae. The regionally rare bryozoan *Omalosecosa ramulosa* is common on the Pobie Reef. Cup sponges *Axinella infundibuliformis* are common at depths from 70-100 m, whereas at depths exceeding 100 m, low-lying, silty bedrock is colonised by small erect sponges, cup corals *Carypphyllia smithii* and the brittlestar *Ophiura albida* (JNCC, 2020b). The reef is protected by the Pobie Bank Reef SAC.

Fish

As described in previously, the Arctic waters north of the Shetland Islands, within Study Area A, is highly productive and supports a wide variety of fish species. The nearshore waters of the Shetland Islands are also highly productive, with the habitats described in the benthic characterisation providing shelter and nursery grounds for a range of fish species.

Similarly, to the information presented for Study Area A, the following information on fish within Study Area B concentrates on the commercially important species, as detailed information on the distribution of non-commercially important species around the Shetland Islands is sparse due limited research.

The commercially important fish and shellfish that may be present around the shores of the Shetland Islands and within Study Area B are presented in Table A10.7.

Table A10.7: Commercially important fish and shellfish species within Study Area B

Species	Study Area B Usage
Atlantic mackerel *Scomber scombrus*	The North Sea stock of Atlantic mackerel overwinter in deep water to the east and north of the Shetland Islands, before migrating south into the North Sea to spawn May-July (Barreto and Bailey, 2015). Since 1977, the distribution of adult mackerel has moved from being mostly located at the western margin of Study Area B, to the northeast and east of the Shetland Islands, covering most of the eastern half of Study Area B in 2010 (Jansen *et al.*, 2012). The study linked the change in distribution to changes in sea temperature in the region.

Species	Study Area B Usage
Atlantic herring *Clupea harengus*	The Atlantic herring North Sea stock has three distinct spawning populations, of note is the Buchan/Shetland herring, which spawns off the Scottish and Shetland coasts in August and September (Barreto and Bailey, 2015). The spawning grounds cover the southern and western coasts of the Shetland Islands, overlapping the southwestern proportion of Study Area B. The spawning grounds of Atlantic herring have been shown to vary year on year. Acoustic surveys showed that although the extent of the stock varied largely over a 12-year period, spawning took place around the Shetland Islands in the southern half of Study Area B every year (Bailey *et al.*, 1998).
Atlantic cod *Gadus morhua*	Atlantic cod spawning grounds are present to the east of the Shetland Islands, with the western extent overlapping the eastern proportion of Study Area B (Barreto and Bailey, 2015). It has also been shown that Atlantic cod occasionally spawn around the northern coasts of the Shetland Islands, and the southeast coasts constitute recruitment spawning areas (González-Irusta and Wright, 2016). The northern proportion of Study Area B constitutes unfavourable spawning grounds for the species. A study completed in the coastal waters of the Shetland Islands showed that Atlantic cod moved to deeper water in the winter, and shallower in the summer, however most recaptured individuals were within 15 km of their initial capture location (Neat *et al.*, 2005). Hedger *et al.* (2004) recorded low abundances of cod around the Shetland Islands, although found that the abundance in the northern inshore waters increased in 1990-1999 compared to 1980-1989.
Anglerfish (monkfish) *Lophius piscatorius*	The commercially important anglerfish (also commonly called monkfish) is found around the coasts of the Shetland Islands, down to depths exceeding 1,000 m (Afonso-Dias and Hislop, 1996; Barreto and Bailey, 2015). In a capture-tag-recapture study of anglerfish in the inshore waters around the Shetland Islands, 35% of recaptured individuals were found less than 25 km from their original capture location (Laurenson *et al.*, 2005). This suggests, that despite their wide depth range and distribution, a substantial proportion of individuals remain local.
Saithe/pollock *Pollachius virens*	Young saithe are found on Scottish coastal waters, including the Shetland Islands, in the late summer and autumn before moving offshore to water depths around 200 m. There is a known spawning ground located to the northeast and east of the Shetland Islands (Barreto and Bailey, 2015), that spans from the north coast to the edge of Study Area B.
Haddock *Melanogrammus aeglefinus*	The North Sea stock of haddock is known to spawn from February-May in the coastal inshore waters and to the northeast and east of the Shetland Islands (Barreto and Bailey, 2015). The eastern half of Study Area B overlaps with these spawning grounds. Hedger *et al.* (2004) showed that from 1990-1999, haddock abundance around the Shetland Islands was highest in the south and west, although moderate abundance was recorded around all shores. In the previous 10 years (1980-1989), the abundance around the Shetland Islands was lower, although higher abundance was recorded to the southwest, outside Study Area B (Hedger *et al.*, 2004).

Species	Study Area B Usage
Blue whiting *Micromesistius poutassou*	There is a known spawning ground for blue whiting located to the west of the Shetland Islands, in the southwest quarter of Study Area B (Barreto and Bailey, 2015). After spawning, the species migrate to feeding areas in the Norwegian Sea to the northeast of Study Area B (Hansen and Jákupsstovu, 1992). Blue whiting that spawn to the west of Scotland, on the Rockall Plateau also migrate to the Norwegian Sea, via the Faroe-Shetland Channel (Hansen and Jákupsstovu, 1992; Hátún *et al.*, 2009), and therefore pass through the northwest margin of Study Area B.
Sandeel species Family: Ammodytidae	Although not commercially important for the Shetland Islands specifically, sandeel species are commercially important for the UK in general. The species is also important as an umbrella species, as prey for a variety of seabird species, including black guillemot *Cepphus grylle*, Atlantic puffin *Fratercula arctica* and northern gannet *Morus* (*Sula*) *bassanus*, around the Shetland Islands (Martin, 1989; Ewins, 1990). Sandeel distribution around Shetland includes west isles and the southeast coast (Evans *et al.*, 1997; Scottish Government, 2017b), in the central south of Study Area B. An area off the south of Shetland constitutes an important area for sandeel recruitment into the adult stock (MCCIP, 2018).
Brown crab *Cancer pagurus* and velvet crab *Necora puber*	Brown crab and velvet crab are present around the Shetland Islands in sufficient numbers to support commercial fisheries. The majority of landings in the Shetland region were caught off the west coast (Barreto and Bailey, 2015), suggesting a reasonable population around the Shetland Islands.
European lobster *Homarus gammarus*	European lobster is fished in the waters around the Shetland Islands, although the landings for 2013 were low compared to other fisheries in Scotland, such as those in the southeast (Barreto and Bailey, 2015).

Marine Ornithology

The Shetland Islands and the surrounding seas are vital habitats for a number of seabird species. A thorough characterisation of the ornithological receptors of the Shetland Islands and potential impacts is provided in Chapter 6 of this EIAR. This section provides further detail on specific marine species within Study Area B that have the potential to be impacted by sub-orbital launches, i.e. marine species that utilise the marine area around the Shetland Islands. For more information on the terrestrial ornithological receptors and their potential impacts, please see Chapter 6 of this EIAR.

There are 11 Special Protection Areas (SPAs) on and around the Shetland Islands, seven of which are within Study Area B. The seven SPAs associated within Study Area B are displayed in Table A10.8. It is noted that there is the potential for designated seabird features from other, more distant SPAs to also be present in Study Area B during launches, due to their wide-ranging nature. The scope of the table below is not to provide a comprehensive list of all SPAs that could be impacted, but simply a list of SPAs within Study Area B.

Table A10.8: Designated Special Protection Areas (SPAs) within Study Area B (Source: Marine Scotland, 2020)

Site Code	Site Name	Designated Features
UK9002051	Papa Stour	Arctic tern *Sterna paradisaea*, ringed plover *Charadrius hiaticula*
UK9002041	Ronas Hill – North Roe and Tingon	Great skua *Stercorarius skua*, red-throated diver *Gavia stellata*

Site Code	Site Name	Designated Features
UK9002021	Ramna Stacks and Gruney	Leach's storm-petrel *Oceanodroma leucorhoa*
UK9002941	Otterswick and Graveland	Red-throated diver
UK9002081	Noss	Common guillemot *Uria aalge*, great skua, northern fulmar *Fulmarus glacialis*, northern gannet *Morus bassanus*
UK9002011	Hermaness, Saxa Vord and Valla Field	Common guillemot, great skua, northern fulmar, northern gannet
UK9002031	Fetlar	Arctic skua *Stercorarius parasiticus*, arctic tern, dunlin *Calidris alpina schinzii*, northern fulmar

The scope of this chapter is the marine environment, therefore terrestrial and coastal designated ornithological receptors of the SPAs in Table A10.8 are not considered further, namely dunlin and ringed plover.

In order to characterise the ornithological receptors that use the marine environment around Shetland but are not necessarily designated features of SPAs in Study Area B, the report by Kober *et al.* (2010) was used.

In addition to the designated seabird features of SPAs, listed in Table A10.8, there are several seabird species that also utilise the marine area of the Shetland Islands within Study Area B (Kober *et al.,* 2010). Table A10.9 provides details of seabird species with hotspots within Study Area B, including most designated features of the SPAs detailed in Table A10.8.

Kober *et al.* (2010) indicate that the marine density of Leach's storm-petrel is 0.00 throughout all of Study Area B in June to October, therefore there is unlikely to be a marine impact pathway with this species (including the designated feature of the Ramna Stacks and Gruney SPA) as a result of the activities in Study Area B.

Kober *et al.* (2010) did not provide information on the density of redthroated diver in Study Area B, though it is a designated feature of two SPAs within Study Area B. Marine Scotland (2020) shows that wintering red-throated diver utilise the coastal waters of the Shetland Islands. Between 100 and 200 individuals are estimated to winter in Shetland, however numbers often rise in later winter (February and March) as a result of passing migrants heading further north (Barton and Pollock, 2004). The density in the majority of Study Area B is <0.01 individuals per km^2, with a slight increase to up to 0.09 individuals per km^2 in the south during the winter (October-March), and an increase to 0.49 individuals per km^2 in the centre of the Shetland Islands from April-September (Barton and Pollock, 2004).

Chapter 6 of this EIAR identified black guillemot *Cepphys grylle* as being present during the targeted ornithological surveys. Black guillemot are known to use the Shetland Islands for nesting and the surrounding waters for foraging. In contrast to other auk species, black guillemots do not migrate, but instead spend the entire year on the Scottish coasts. The Seabird 2000 census provides the most comprehensive assessment of abundance (JNCC, 2020d), showing that the abundance around the Shetland Islands ranges from 11,000 individuals at various counting sites (Mitchell et al., 2004). The highest counts were recorded on the northeast coast; however, abundance is shown to be relatively constant around all coastlines. Black guillemot have a foraging distance of up to 5 km (on average) from their breeding colonies, up to a maximum of 9 km (Woodward *et al.* 2019). Therefore, they are not expected to be encountered beyond these distances in Study Area B.

Table A10.9: The densities and distributions of the seabird species that regularly use the Shetland Islands and surrounding waters within Study Area B (Source: Kober et al.*, 2010)*

Species	Peak Density (individuals per km^2)	Notes
Northern fulmar *Fulmarus glacialis*	Breeding (March-July): 111-285 Winter (August-February): 90-239	During the breeding season there is a hotspot for northern fulmar offshore to the east and west of the Shetland Space Centre (SSC) launch site. In the winter season, the western hotspot is not present, however the eastern hotspot has higher density, although is slightly further offshore near to the boundary of Study Area B.
European storm-petrel *Hydrobates pelagicus*	Breeding (June-October): 2.67-9.27	During the breeding season, there is a hotspot for European storm-petrel density to the west of the Shetland Islands, on the boundary of Study Area B. The density of the species is also elevated (0.3-2.66 individuals per km^2) in the northern half of Study Area B.
Northern gannet *Morus bassanus*	Breeding (May-September): 8.5-22.1 Winter (October-April): 10.4-24.9	There is a small hotspot on the southern tip of the Shetland Islands, on the southernmost boundary of Study Area B, during the breeding season. During the winter season, there is a distinct hotspot on the northeast coast of the Shetland Islands, located to the east, just offshore of the SSC launch site.
European shag *Phalacrocorax aristotelis*	Breeding (March-September): 0.67-5.73 Winter (October-February): 0.6-2.5	The density of European shag is 0.00 throughout the majority of Study Area B in both the breeding and winter seasons, however the species does have a slight increase in density along the western coasts of the Shetland Islands. There is a small increase in density in the southwest of Study Area B, on the central west coast of the Shetland Islands, where density peaks at 5.73 individuals per km2. During the winter season, there is slightly elevated activity around all the coasts of the Shetland Islands, with density increasing to 0.1-0.5 individuals per km2. Similarly, to the breeding season, there is a concentrated area of increased density (0.6-2.5 individuals per km2) on the central west coast of the Shetland Islands.
Arctic skua *Stercorarius parasiticus*	Breeding (May-August): 1.1-2.4 Additional (September-November): 0.014-0.048	During the breeding season, there is not one distinct hotspot for arctic skua, however there are a number of smaller hotpots throughout the northern and western portions of Study Area B, and on the east coast of the southern Shetland Islands. During the additional season, peak densities are much lower and are concentrated between mainland Shetland, the island of Yell, and north of the island of Shetland.

Species	Peak Density (individuals per km^2)	Notes
Great skua *Stercorarius skua*	Breeding (May-August): 0.49-1.55 Winter (September-April): 2.12-4.30	During the breeding season, the Shetland Islands constitute a major UK hotspot for great skua, notably to the northwest, north, northeast, and southwest. Excluding a band running from the Shetland Islands to the western boundary of Study Area B, and the southeast quarter, the entire of Study Area B overlaps an area with population density ranging 0.49-1.55 individuals per km^2, the largest and most dense in the UK during the breeding season. Over the winter season, the peak population density increases, however this is limited to a relatively small location southwest of the Shetland Islands, just within Study Area B. The majority of Study Area B has a population density of great skua ranging from 0.01-0.31 individuals per km^2.
Black-legged kittiwake *Rissa tridactyla*	Breeding (May-September): 1.6-6.1 Winter (October-April): 20.6-48.0	During the breeding season, there is no notable hotspot for black-legged kittiwake, with almost all of Study Area B having a population density of 0.1-1.5 individuals per km^2, with small, localised spots of 1.6-6.1 individuals per km^2. Over the winter season, there is a hotspot (1.8-48.0 individuals per km^2) running in a band from the SSC launch site to the northeast boundary of Study Area B. The southwest end of this hotspot, just offshore of the Space Centre has a peak density of 20.6-48.0 individuals per km^2.
Great black-backed gull *Larus marinus*	Breeding (April-August): 2.78-4.79 Winter (September-March): 1.22-3.5	The waters and coasts of the Shetland Islands contain five of 12 hotspots for great black-back gull in the UK during the breeding season. Four of these hotspots are within Study Area B, one to the central north, one to the northeast, one to the east, and one to the southwest. The northwest hotspot is the largest and has the highest density, being one of three areas in the UK where such densities exist. During the winter season, the northwest hotspot density lowers to 0.38-1.21 individuals per km^2, with localised areas of 1.22-3.5.
Herring gull *Larus argentatus*	Breeding (April-August): 0.4-1.1 Winter (September-March): 3.4-9.2	There is no distinct hotspot within Study Area B during the breeding season, however a hotspot is present to the northwest of the SSC launch site during the winter period.
Iceland gull *Larus glaucoides*	Winter (September-March): 0.016-0.032	During the winter season, almost all of Study Area B has a population density of 0 individuals, however there is a small hotspot for Iceland gull located to the northeast of the SSC launch site.
Glaucous gull *Larus hyperboreus*	Winter (October-March): 0.089-0.231	There are hotspots for glaucous gull throughout the water’s northeast of Scotland, including on the west coast and to the northeast of the Shetland Islands, within Study Area B.

Species	Peak Density (individuals per km^2)	Notes
Arctic tern *Sterna paradisaea*	Breeding (May-August): 4.99-9.49	During the breeding season, much of the inshore waters around the Shetland Islands has an Arctic tern density ranging 0.01-0.93 individuals, with localised hotspots on the west and east coasts of mainland Shetland with densities up to 9.49 individuals per km^2.
Common guillemot *Uria aalge*	Breeding (May-June): 35.4-98.3 Additional (August-September): 10.8-24.0 Winter (October-April): 5.8-11.3	During the breeding season, the peak density was recorded in a hotspot on the northern tip of the Shetland Islands, however most of the coastline has a lower density of 3.8-12.9 individuals per km^2. The additional season sees most of Study Area B have a density of 0.1-3.1 individuals per km^2 with small areas of up to 24 individuals per km^2. During the winter season, there is a distinct hotspot to the southwest of the Shetland Islands, however only the northeast margin of this overlaps with Study Area B. The majority of Study Area B has a population density ranging from 0.1-2.5 individuals per km^2.
Razorbill *Alca torda*	Breeding (May-June): 1.8-3.4 Additional (August-September): 0.1-1.1 Winter (October-April): 0.3-0.7	During the breeding season, much of Study Area B has a razorbill population density ranging from 0.1-0.3 individuals per km^2, with localised areas up to 3.4 individuals per km^2. There is no distinct hotspot the additional season or the winter season.
Little auk *Alle alle*	Winter (November-March): 1.3-2.8	The coastline of the southern islands and the northern portion of Study Area B has a little auk population density of 0.1-0.2 individuals per km^2 during the breeding season, however there is a localised hotspot of up to 2.8 individual per km^2 on the southwest coast.
Atlantic puffin *Fratercula arctica*	Breeding (April-July): 5.2-14.8 Winter (August-March): 0.8-1.6	There is an area of 1.4-14.8 Atlantic puffin individuals per km^2 in the breeding season to the west and southwest of the Shetland Islands, however the majority of the coastline has a population density of 0.1-5.1 individuals per km^2. During the winter season, most of Study Area B has a population density of 0.1-0.2 individuals per km^2, although the southeast boundary has a density up to 1.6 individuals per km^2.

Marine Megafauna

A large variety of marine megafauna inhabit arctic waters and Study Area A. As the extent of Study Area B is not as northern as Study Area A, the variety in marine megafauna is lower within Study Area B.

This section concentrates on species which are regularly seen around the Shetland Islands and within Study Area B, and/or spend a large proportion of their time at or very near to the surface of the sea, increasing their sensitivity to returning payloads from the sub-orbital launches.

Shetland Islands Council (2019a) lists grey seal *Halichoerus grypus* and harbour seal *Phoca vitulina*, otter *Lutra lutra*, harbour porpoise *Phocoena phocoena*, and killer whale *Orcinus orca* as marine mammal species of interest around the islands. Seawatch Foundation (2012) adds a humpback whale *Megaptera novaeangliae*, minke whale *Balaenoptera acutorostrata*, long-finned pilot whale, Risso's dolphin *Grampus griseus*, white-beaked dolphin *Lagenorhynchus albirostris*, and Atlantic white-sided dolphin *L. acutus* to the list of species commonly observed from the coasts of the Shetland Islands. Table A10.10 presents the commonly seen marine mammal species, their approximate abundance, distribution and peak seasonality.

Hammond *et al.* (2017) divided UK waters into observation blocks and produced estimates for cetacean abundance in each block. The data was collected in summer of 2016 via aerial and ship surveys. The Shetland Islands are located in the west of Block T, however the western proportion of Study Area B is located in Block S. Therefore, where species were observed in either or both blocks, the estimated abundance for the entire block has been given in Table A10.10.

Table A10.10: Marine mammal species within Study Area B (Source: SCOS, 2018; Scottish Government, 2014; Hammond et al., 2017)

Species	Abundance	Distribution	Peak Seasonality
Grey seal *Halichoerus grypus*	1,558 individuals counted (2015)	Present all around the Shetland Islands. There are designated seal haul-out sites around the Shetland Islands, concentrated mostly on mainland Shetland, although there is one site on the west of Unst and one to the south of the Shetland Space Centre on the north coast of Fetlar	Year-round
Harbour seal *Phoca vitulina*	3,369 individuals counted (2015-2017)	Present all around the Shetland Islands. The Shetland Islands form a harbour seal management unit. There is designated seal haul-out sites around the Shetland Islands, concentrated mostly on mainland Shetland, although there is one site on the west of Unst and one to the south of the Shetland Space Centre on the north coast of Fetlar	Year-round
Harbour porpoise *Phocoena phocoena*	6,147 (SCANS-III, block S); 26,309 (SCANS-III, block T)	Present all around the Shetland Islands within Study Area B.	Year-round
Killer whale *Orcinus orca*	Group sizes range from 1-12 individuals, although are more commonly 6 or less	Closely associated with the mackerel fishery in the winter, months, and is often 80-150 km offshore. Widely distributed in inshore waters in the spring and summer months	Year-round

Species	Abundance	Distribution	Peak Seasonality
Humpback whale *Megaptera novaeangliae*	1-3 individuals recorded per year	Most commonly seen on the southern tip of the Shetland Islands, in the extreme south of Study Area B	May-September
Minke whale *Balaenoptera acutorostrata*	Most common whale, observed in groups of up to 15 individuals; 383 (SCANS-III, block S); 2,068 (SCANS-III, block T)	Most commonly seen on the east coasts of Shetland, in the eastern and northern portions of Study Area B	July-September
Long-finned pilot whale *Globicephala melas*	Limited data on abundance around Shetland	Continental shelf edge, recorded in waters around the Shetland Islands, more prominently to the northwest	September-March
Risso's dolphin *Grampus griseus*	Group sizes vary from 5-20 individuals	Widespread and common in inshore waters, particularly on the east coast of Unst and mainland Shetland	April-November
White-beaked dolphin *Lagenorhynchus albirostris*	868 (SCANS-III, block S); 2,417 (SCANS-III, block T)	Present in all Scottish waters, regularly seen around all coasts of the Shetland Islands	Year-round, peak abundance from July-September
Atlantic white-sided dolphin *Lagenorhynchus acutus*	1,366 (SCANS-III, block T)	Present along the continental shelf slope and north of the Shetland Islands.	June-November

In addition to the marine mammal species noted in Table A10.10, this section covers two species of fish that are considered marine megafauna and spend time at the ocean surface: basking shark *Cetorhinus maximus* and common sunfish *Mola mola*.

Basking shark is the second largest fish in the world, and the largest in the UK, reaching up to 12 m in length and weighing up to four tonnes (Sims, 2008). Although the Shetland Islands do not constitute a hotspot for basking shark, the species has been recorded around all coasts of the Shetland Islands (Witt *et al.*, 2012; Marine Scotland, 2020), most commonly between April and October, peaking in the summer months from June-August (Witt *et al.*, 2012). Basking shark is a filter-feeding species that inhabits waters of depth from 50-800 m, however spends much of its time near the surface of the water feeding on plankton (Wilson *et al.*, 2020), although also displays surface behaviour during courtship (Hayes *et al.*, 2018). In a study carried out off the west coast of Shetland, in the west-northwest of Study Area B, a total of 22 breaching individuals were recorded over a 63-day period, all of which were in waters less than 200 m (Hayes *et al.*, 2018).

Common sunfish is one of the heaviest bony fish in the world, weighing up to 2.3 tonnes (Roach, 2003). The species is mostly associated with waters off the east coast of North America, the coasts of Australia, and the Mediterranean, however a number of sightings have been recorded in the cooler waters of the northeast Atlantic (Pope *et al.*, 2010; Philips *et al.*, 2015). Initially, the common sunfish was thought to be a globally rare species with the only recordings at the sea surface, however it is now known that it can be found in a range of water depths, down to over 800 m (Pope *et al.*, 2010). There have been sightings around the UK, including some around the Shetland Islands at the northerly limit of the species' distribution (Philips *et al.*, 2015).

Marine Protected Areas

There are a number of marine protected areas (MPAs) within Study Area B, including Nature Conservation MPAs (ncMPAs), Special Areas of Conservation (SACs), SPAs, and Sites of Special Scientific Interest (SSSIs) that contribute to Scotland's MPA network. The MPAs and associated features of conservation interest are listed in Table A10.11.

Table A10.11: Marine protected areas within Study Area B (Source: Marine Scotland, 2020; NatureScot, 2020c)

Site Type	Site Name	Feature(s) Of Conservation Interest
Nature Conservation Marine Protected Area	Faroe-Shetland Sponge Belt	Deep-sea sponge aggregations; Offshore subtidal sands and gravels; Ocean quahog *Arctica islandica* aggregations; Continental slope (Large-scale feature); Continental slope channels, iceberg plough marks, prograding wedges and slide deposits representative of the West Shetland Margin palea-depositional system Key Geodiversity Area (geomorphological feature); Sand wave fields and sediment wave fields representative of the West Shetland Margin contourite deposits Key Geodiversity Area (geomorphological feature).
	Mousa to Boddam	Sandeels Family: Ammodytidae; Marine geomorphology of the Scottish shelf seabed (geodiversity feature).
	Fetlar to Haroldswick	Black guillemot *Cepphus grylle*; Circalittoral sand and coarse sediment communities; Horse mussel *Modiolus modiolus* beds; Kelp and seaweed communities on sublittoral sediment; Maerl beds; Shallow tide-swept coarse sands with burrowing bivalves; Marine geomorphology of the Scottish shelf seabed (geodiversity feature).
Special Area of Conservation	Papa Stour	Reefs; Submerged or partially submerged sea caves.
	The Vadills	Coastal lagoons (priority feature).
	Sullom Voe	Large shallow inlets and bays; Coastal lagoons (priority feature); Reefs.
	Yell Sound Coast	Otter *Lutra lutra*; Harbour sea *Phoca vitulina*.
	Mousa	Reefs; Submerged or partially submerged sea caves; Harbour seal.
	Hascosay	Blanket bogs (priority feature); Otter.
	Pobie Bank Reef	Reefs.

Site Type	Site Name	Feature(s) Of Conservation Interest
Special Protection Areas	Foula	Arctic skua *Stercorarius parasiticus* (breeding); Arctic tern *Sterna paradisaea* (breeding); Atlantic puffin *Fratercula arctica* (breeding); Black-legged kittiwake *Rissa tridactyla* (breeding); Common guillemot *Uria aalge* (breeding); European shag *Phalacrocorax aristotelis* (breeding); Great skua *Stercorarius skua* (breeding); Leach's storm-petrel *Oceanodroma leucorhoa* (breeding); Northern fulmar *Fulmarus glacialis* (breeding); Razorbill *Alca torda* (breeding); Red-throated diver *Gavia stellata* (breeding); Seabird assemblage (breeding).
	Papa Stour	Arctic tern (breeding); Ringed plover *Charadrius hiaticula* (breeding).
	Noss	Black-legged kittiwake (breeding); Common guillemot (breeding); Great skua (breeding); Northern fulmar (breeding); Norther gannet *Morus bassanus* (breeding); Seabird assemblage (breeding).
	Hermaness, Saxa Vord and Valla Field	Atlantic puffin (breeding); Black-legged kittiwake (breeding); Common guillemot (breeding); European shag (breeding); Great skua (breeding); Northern fulmar (breeding); Northern gannet (breeding); Red-throated diver (breeding); Seabird assemblage (breeding).
	Fetlar	Arctic skua (breeding); Arctic tern (breeding); Dunlin *Caldris alpine schinzii* (breeding); Great skua (breeding); Northern fulmar (breeding); Red-necked phalarope *Phalaropus lobatus* (breeding); Whimbrel *Numenius phaeopus* (breeding); Seabird assemblage (breeding).
Proposed Special Protection Areas	Seas off Foula	Arctic skua (breeding); Atlantic puffin (breeding); Common guillemot (breeding and non-breeding); Great skua (breeding and non-breeding); Northern fulmar (breeding and non-breeding).
	East Mainland Coast, Shetland	Common eider *Somateria mollissima* (non-breeding); Great northern diver *Gavia immer* (non-breeding); Long-tailed duck *Clangula hyemalis* (non-breeding); Red-breasted merganser *Mergus serrator* (non-breeding); Red-throated diver (breeding); Slavonian grebe *Podiceps auritus* (non-breeding).
	Bluemull and Colgrave Sounds	Red-throated diver (breeding).

Site Type	Site Name	Feature(s) Of Conservation Interest
Sites of Special Scientific Interest	Papa Stour	Coastal Geomorphology of Scotland (geological); Silurian - Devonian Chordata (geological); Maritime cliff; Rocky shore; Arctic skua (breeding); Arctic tern (breeding); Ringed plover (breeding).
	Sandness Coast	Rocky shore.
	The Vadills	Egg wrack *Ascophyllum nodosum* ecad *mackaii*; Saline lagoon; Tidal rapids.
	Yell Sound Coast	Otter *Lutra lutra*.
	Mousa	Arctic tern (breeding); Black guillemot (breeding); European storm-petrel (breeding); Harbour seal.
	North Fetlar	Arctic skua (breeding); Arctic tern (breeding); Great skua (breeding); Red-necked phalarope (breeding); Whimbrel (breeding); Breeding bird assemblage; Grey seal *Halichoerus grypus*; Harbour seal; Calaminarian grassland and serpentine heath.

Humans/Human Activities

Shipping and Navigation

There are three principal ports on the Shetland Islands (Shetlands Islands Council, 2020). Sullom Voe is a major oil port located in the north of the islands that handles deep-sea tanker traffic and oil from the Atlantic Frontier, west of Scotland. Lerwick Port is the principal commercial port for the Shetland Islands, located on the east coast, and the port of Scalloway on the west of the islands, ideally situated for servicing oil-related shipping in the west of Scotland, although also provides for a range of cargo, fishing and recreational vessel traffic.

Within Study Area B, in the vicinity of the Shetland Islands, the water depth is mostly between 60 m and 120 m deep, however in some locations it exceeds 120 m. The deep waters present opportunities for ships to navigate close to and around the Shetland Islands. The majority of deep-sea vessel traffic passes to the south of the Shetland Islands, however a commercial cargo route between the Baltic and Faroe Islands passes the Shetlands to the north. A navigational ‘Area to be Avoided’ has been implemented around the Shetland Islands in order to minimise the hazards to shipping vessels arising from the strong tidal currents, offshore obstructions and change sea states.

ABPmer (2020) recorded Automatic Identification System (AIS) vessel transit tracks over two 14-day periods, one in August 2019 and one in January 2020, representing a busy and a quiet period, respectively (ABPmer, 2020). The study showed that nearshore vessel activity was concentrated mostly in the south of mainland Shetland, although there was also a hotspot for traffic around Lerwick and Bluemull Sound strait (Figure A10.13; Figure A10.14). A hotspot associated with fishing grounds on the west-northwest edge of Study Area B was also identified. Vessel transits leaving the Shetlands were more numerous on the eastern side, with tracks leading to the offshore oil and gas wells just outside the extent of Study Area B (ABPmer, 2020).

Oil and gas

There are five oil wells (including present and planned) in three exploration areas (namely Glenlivet, Edradour, and Clair) within Study Area B, located to the west of the SSC launch site (Figure A10.15). The oil wells are all within the outer 15 km of Study Area B, >75 km from the launch site. Additionally, there is a cluster of 16 exploration areas and 29 present/planned oil wells located to the east-northeast of Study Area B, outside the 90 km radius.

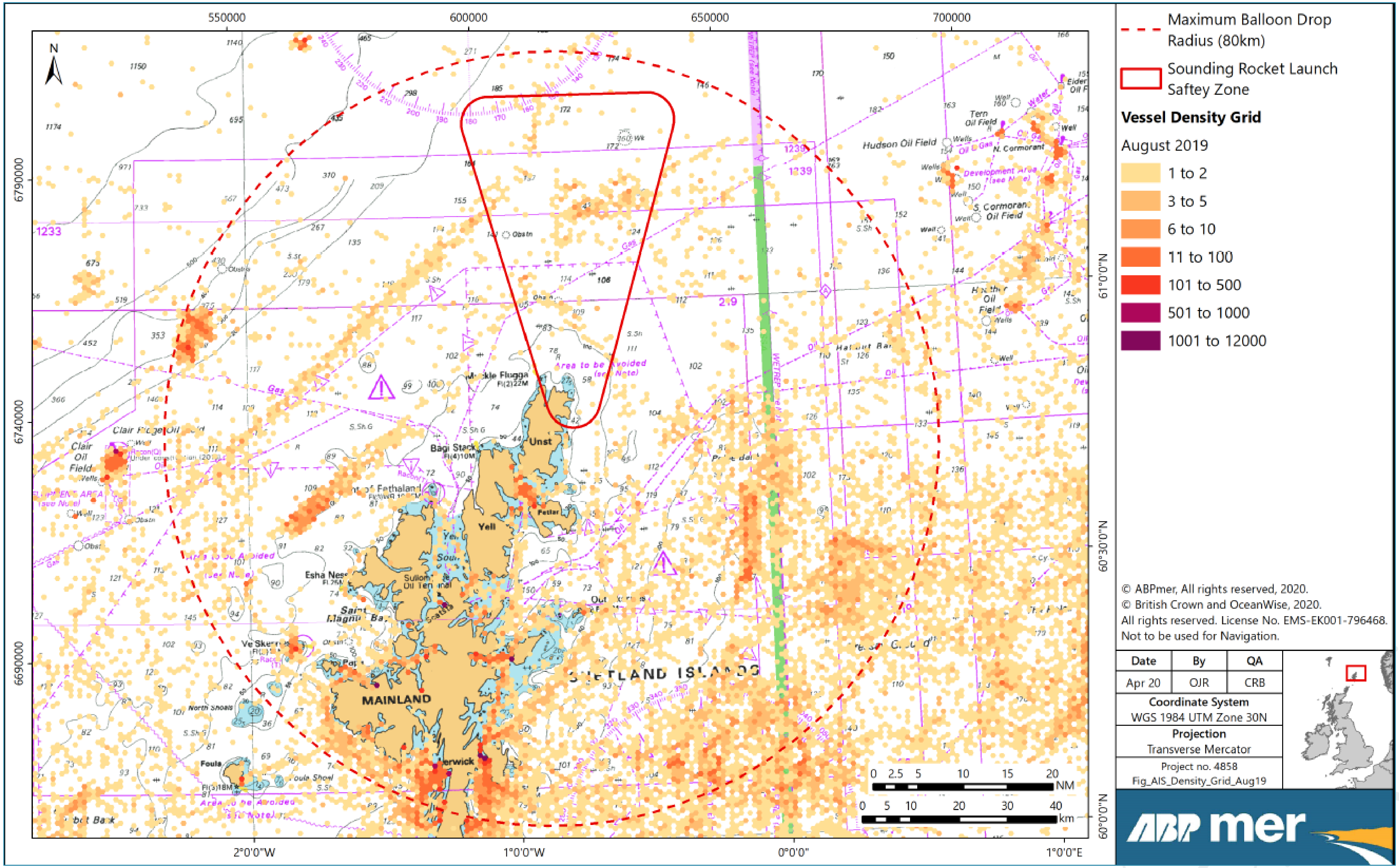


Figure A10.13: Vessel density as recorded by automatic identification system within Study Area B in August 2019 (From: ABPmer, 2020)

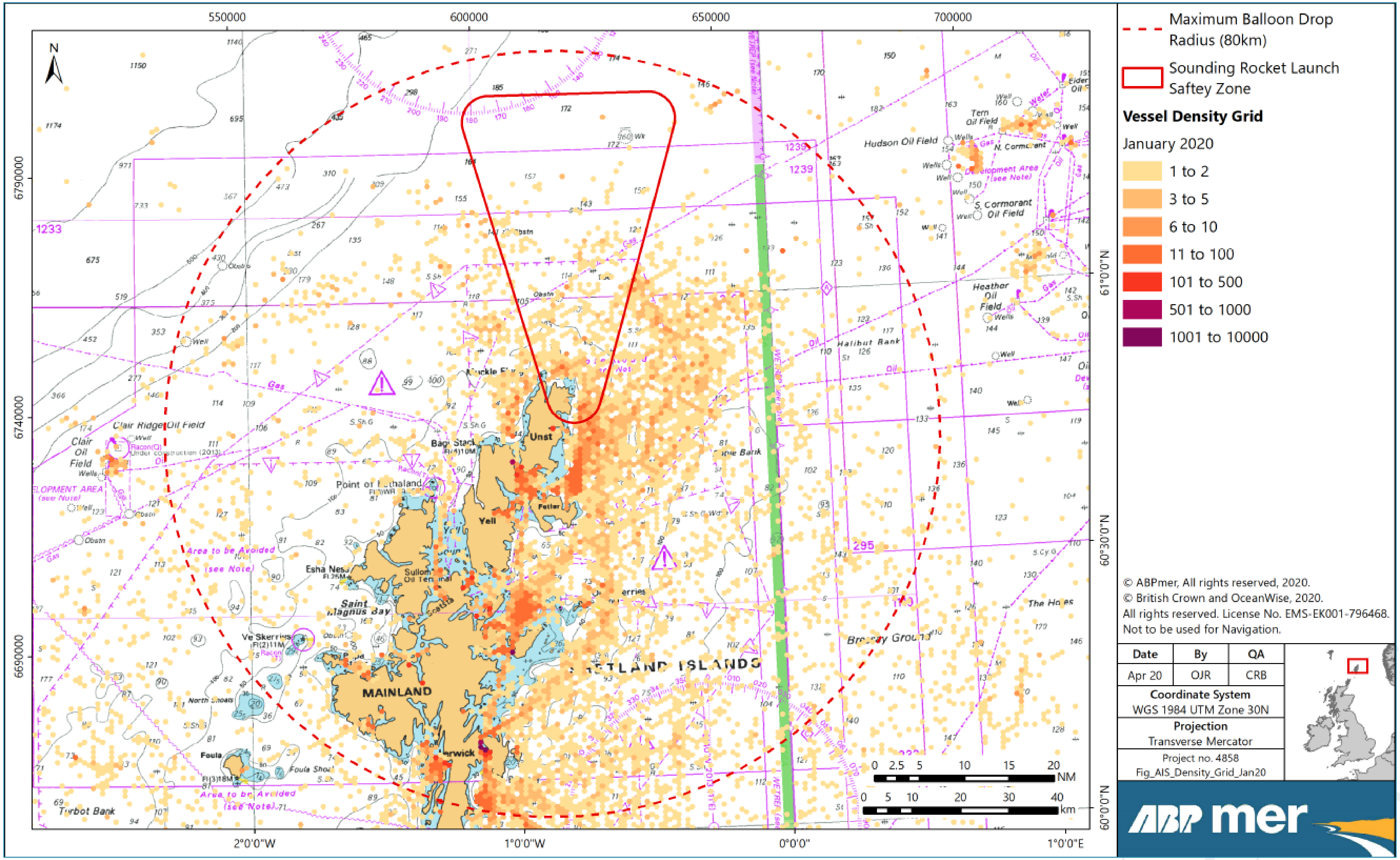


Figure A10.14: Vessel density as recorded by automatic identification system within Study Area B in January 2020 (From: ABPmer, 2020)

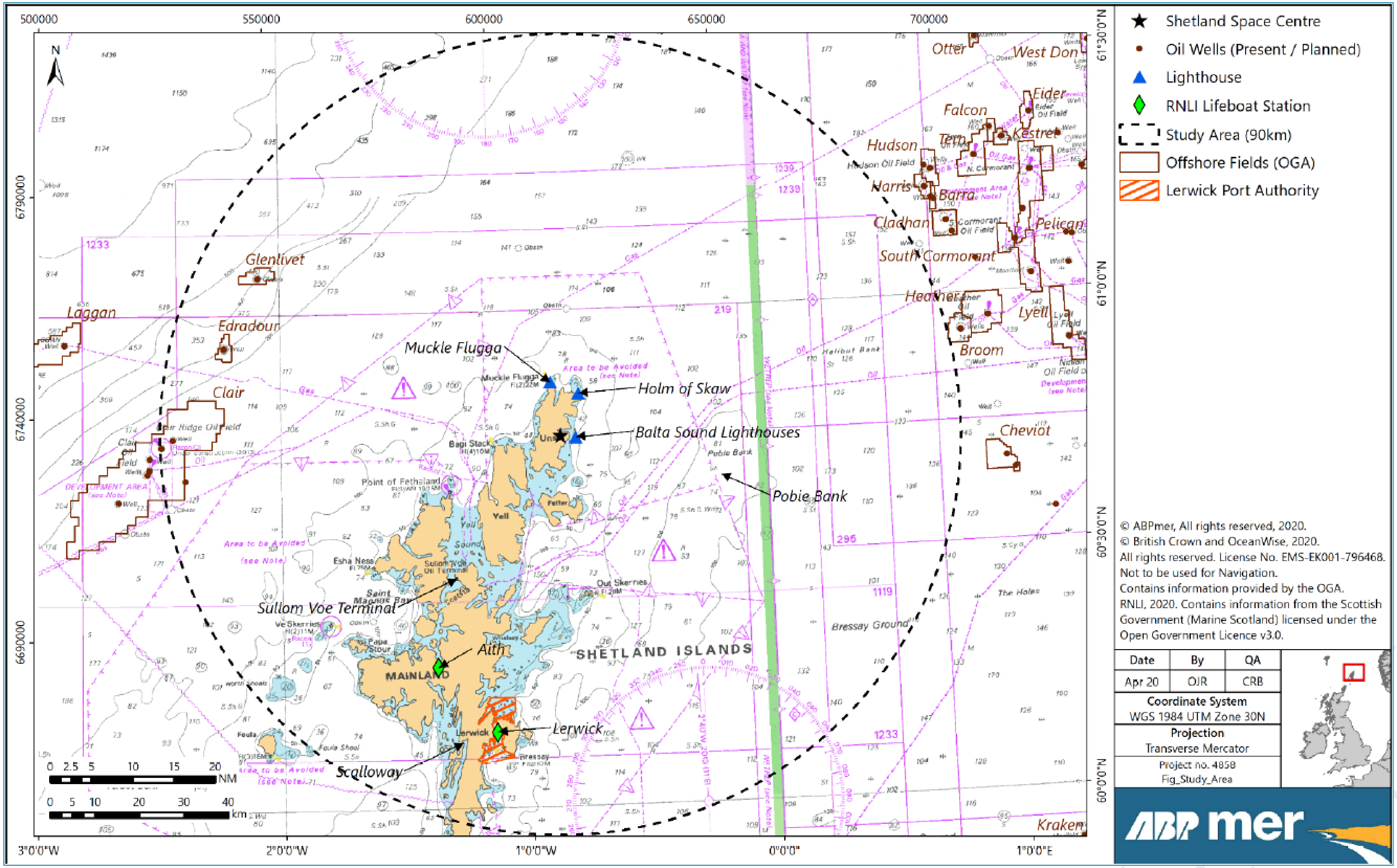


Figure A10.15: Present and planned oil wells and offshore fields in Study Area B (From: ABPmer, 2020)

Cables and pipelines

A number of subsea cables run through the northern North Sea, one of which passes through the south and southwest of Study Area B. This is an active telecommunications cable owned by Faroese Telecom, named SHEFA-2 (ESCA and Seafish, 2019). The cable connects Banff, on the coast of Scotland, to Hvítanes, on the east coast of the Faroe Islands, via the Orkney Islands, and Sandwick and Maywick on the Shetland Islands.

In addition to subsea cables, oil and gas pipelines are present in the northern North Sea, connecting the various oil wells to the network and onshore stations. Within Study Area B, there are three gas pipelines with landfalls on the Shetland Islands, one from the northwest, one from the northeast and one from the south; three oil pipelines, one from the northwest and two from the east; and one mixed hydrocarbon pipeline which enters Study Area B from the northwest.

Military

The nearest military area in UK waters is located greater than 150 km to the south of the SSC launch site (Marine Scotland, 2020). As described previously, Study Area A overlaps with NATO and Russian military practice areas, however these do not extend south into Study Area B. Therefore, there are no designated military areas within Study Area B.

The NRA (ABPmer, 2020) grouped military and law enforcement vessel activity within Study Area B, recorded 194 military/law enforcement vessel AIS positions within 90 km of the SSC launch site in August 2019 and zero in January 2020. In the 84-day survey, nine military/law enforcement vessel transit tracks were recorded, accounting for 0.2% of all vessel transit counts within Study Area B. Military and law enforcement vessel activity was limited to within the vicinity of Lerwick and along routes to the eastern oil and gas fields (ABPmer, 2020).

Other sea users

There is one marine renewable energy development currently in operation within Study Area B, the Shetland Tidal Array located in the Bluemull Sound strait between Unst and Yell in the North Isles of Shetland.The arr ay consists of three turbine generators, installed in March and August 2016 and early 2017, with aims to expand to six generators under the European Union’s Enabling Future Arrays in Tidal (EnFAIT) project (Nova Innovation Ltd, 2020).

There are also five areas for potential future development of renewable energy (wind, wave, and tidal) projects within Study Area B. These include the Muckle Flugga, Yell Sound, and Sumburgh 2013 tidal Draft Plan Options (DPOs), located in the north, central, and south Shetland Islands, respectively. To the southwest of the Shetland Islands, there is a 2013 wave DPO, and to the east is a 2019 DPO for offshore wind (Marine Scotland, 2020).

Although there are no aggregate extraction licence areas within Study Area B, potential aggregate resource has been identified around the Shetland Islands, from the southwest, clockwise around the islands to the east. In addition to these areas, there are also two points of heavy mineral sand, one located southeast of the SSC launch site, and one located off the west coast of mainland Shetland. There is also an area of evaporite resource to the east of the Shetland Islands, partially overlaps the easternmost portion of Study Area B. Largely coinciding with the spatial extent of the evaporite resource is a potential carbon capture and storage area.

At present, there are seven dredge spoil disposal sites within Study Area B, all located on the coasts of the Shetland Islands. The nearest to the SSC launch site are disposal site FI070 ‘Cullivoe’, located in the Bluemull Sound strait; and FI068 ‘Skerries’, located to the south.

Socioeconomics/Tourism

The Shetland Islands have a diverse range of economic sectors, ranging from commercial fishing and seafood, to textiles, to tourism and recreation.

The seafood industry in the Shetlands is valued at over £300 million per year. The oil and gas industry contribute £100 million to the economy (Shetland Islands Council, 2019b), with Total and BP committing to significant investments in a new gas plant and the main oil terminal at Sullom Voe.

Figure A10.16 shows recreation and tourism activities around the Shetland Islands and within Study Area B. There are a number of nearshore recreational dive sites around the islands, two of which are on the shoreline of Unst. There are also surfing locations and two beaches with awards under the '*Keep Scotland Beautiful*' scheme. There are several marinas around the Shetland Islands. Although most recreational boating activity (recorded via AIS) is concentrated in the south of Study Area B, there is a small pocket of activity further offshore in the northwest.

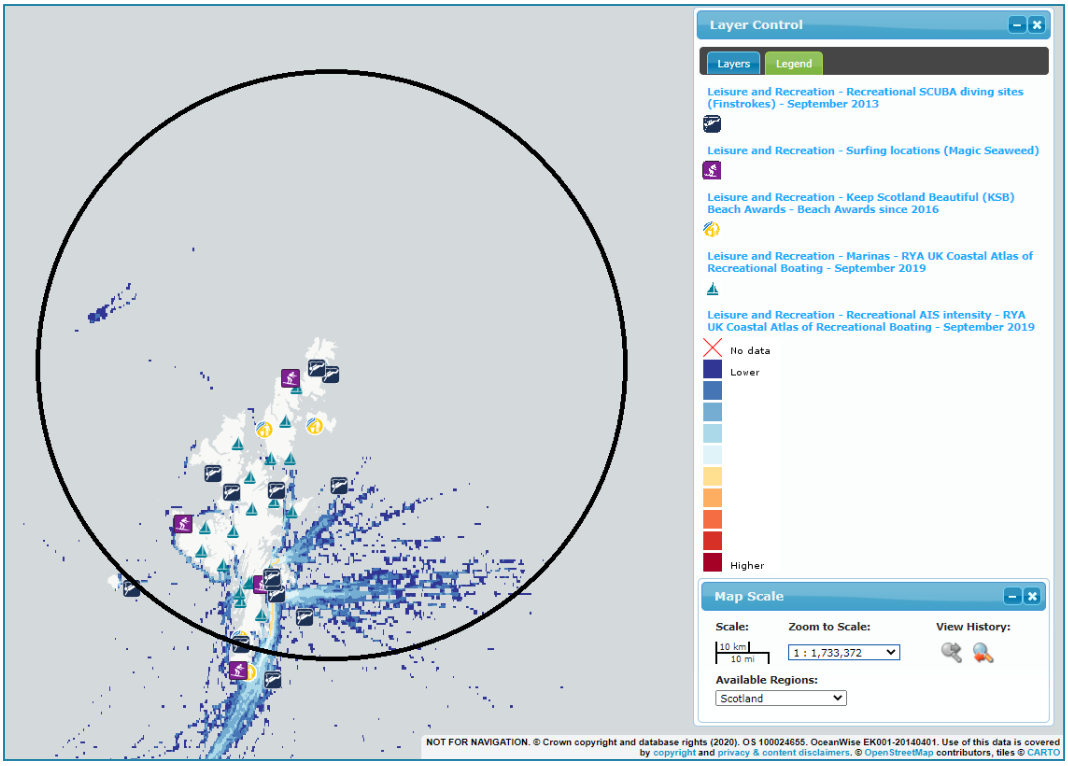


Figure A10.16: Recreational use of the sea and coast within Study Area B (Source: Marine Scotland, 2020)

There are also a number of coastal visitor attractions and facilities, coastal walking routes, beaches, and shore access points located on all coasts of the Shetland Islands (Shetland Islands Marine Planning Partnership, 2019). Additional activities, not presented in Figure A10.16, include kayaking, rowing, sail racing, sea angling, and yacht racing and cruising routes (Shetland Islands Marine Planning Partnership, 2019). Aside from the latter, all these activities are located very near to the coast. Yacht racing and cruising routes are mostly located at and around the coast, however routes leave the islands in two directions: east and south, as represented by the AIS data in Figure A10.16. There are three tourist boat trip/cruise routes on the Shetland Islands, one located south of mainland Shetland, in extreme south of Study Area B; one circling Bressay Island, also in the south of Study Area B, and one that traverses the northern half of Unst, in the centre of Study Area B (Shetland Islands Marine Planning Partnership, 2019).

For further consideration of the socioeconomics and tourism of Shetland, please see Chapter 14 of this EIA Report.

Marine Archaeology

Figure A10.17 shows the known wreck sites within Study Area B, three of which are designated:

- HMS *E49*, a British submarine constructed between February 1915 and September 1916, which was mined on 12 March 1917 by a minefield laid at the entrance to Balta Sound by the German U-boat *UC-76*. All crew were lost in the sinking and the site is now a designated war grave (Canmore, 2020a);
- *Wrangles Palais*, a vessel built in Holland, 1662, and was put into the Swedish navy in 1669. In 1677, she was captured by the Danish fleet during the Scanian War, and on 23 July 1687, struck rocks in dense fog while patrolling the North Sea for Turkish pirates. The vessel sank on the east coast of Bound Skerry, the easternmost islet in the Out Skerries. Of the 240 crew, at least 88 died in the incident (Canmore, 2020b);
- *Kennemerland*, an armed merchant vessel belonging to the Dutch East India Company. She was wrecked at Stoura Stack in the south of the Out Skerries on 20 December 1664 after avoiding the Royal Navy while travelling from Texel, Netherlands to Batavia (now Jakarta), East Indies. Her cargo included gold, mercury, clay pipes, tobacco boxes, golf clubs, lead ingots, and building bricks (Canmore, 2020c).

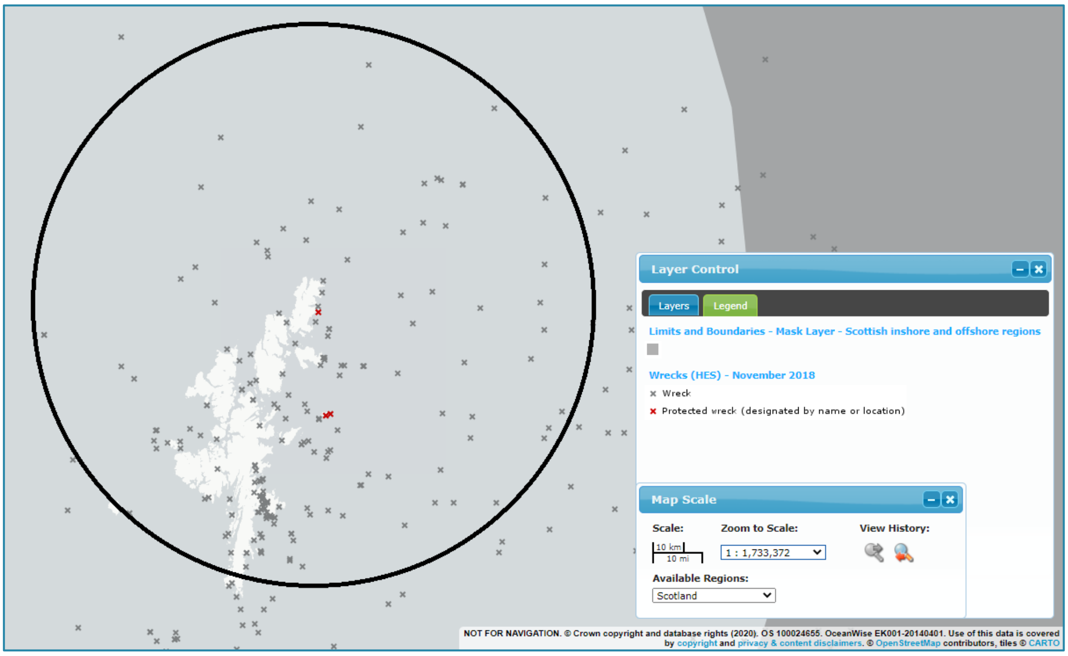


Figure A10.17: Wreck sites within Study Area B (Source: Marine Scotland, 2020)

Commercial Fisheries

Commercial fishing forms a substantial proportion of the economy of the Shetlands Islands, and historically has been a way of life for residents of the islands. Shetland's seafood industry is worth over £320 million, and in 2017, over 17,000 tonnes of whitefish and 40,000 tonnes of pelagic fish, each worth over £30 million were landed in Shetland's harbours (Shetland Islands Council, 2019c).

The ICES rectangles around the Shetland Islands are landings hotspots for both pelagic and demersal fisheries (Figure A10.18). Although not all catch from around the Shetland Islands is landed at Lerwick Port, in 2018 the port ranked second in the UK for fisheries landings by quantity (41,800 tonnes) and value (£46 million), second only to Peterhead Port on mainland Scotland (MMO, 2019).

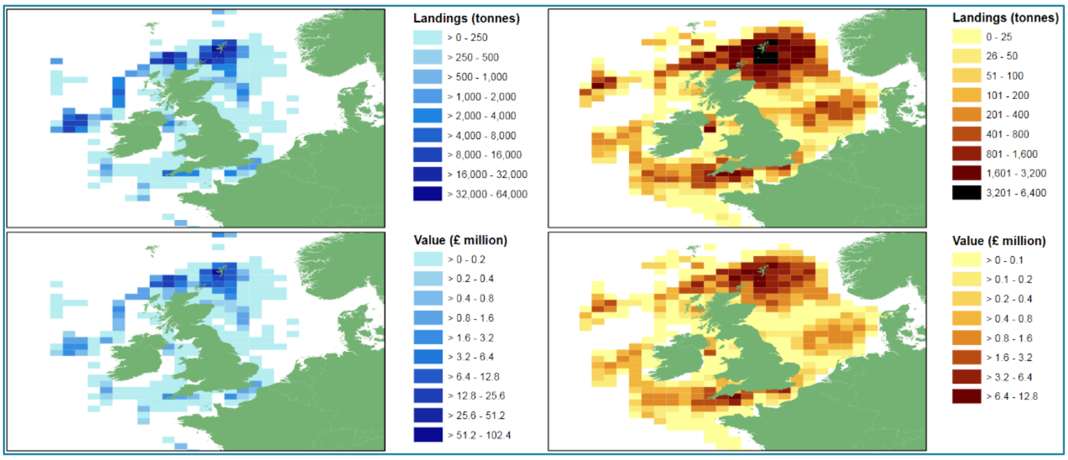


Figure A10.18: UK pelagic (left) and demersal (right) fisheries landings by weight (top) and value (bottom) in 2018 by ICES rectangle (From: MMO, 2019)

In addition to the inshore and offshore fisheries, the Shetland Islands are important for aquaculture, with over 100 shellfish, over 50 finfish, and 14 other fishery aquaculture sites located around the Islands. The aquaculture industry provides a major source of income for the islands, with over 30,000 tonnes (25% of Scotland's total production) of salmon harvested in 2017, worth over £150 million (Shetland Islands Council, 2019c). Shellfish aquaculture sites also provide a substantial contribution, with 81% (6,500 tonnes) of Scottish mussel harvested in Shetland (Shetland Islands Council, 2019c).

AIS data collected from fishing vessels operating within Study Area B (ABPmer, 2020) shows that most fishing activity takes place to the south and east of the Shetland Islands, with vessels transiting to offshore fishing grounds from the main ports on the islands (Figure A10.19). The northeast and northwest of Study Area B show dense vessel transit tracks, suggesting there are fishing grounds present in these areas, associated with the Faroe-Shetland Channel and the deeper offshore waters to the northeast.

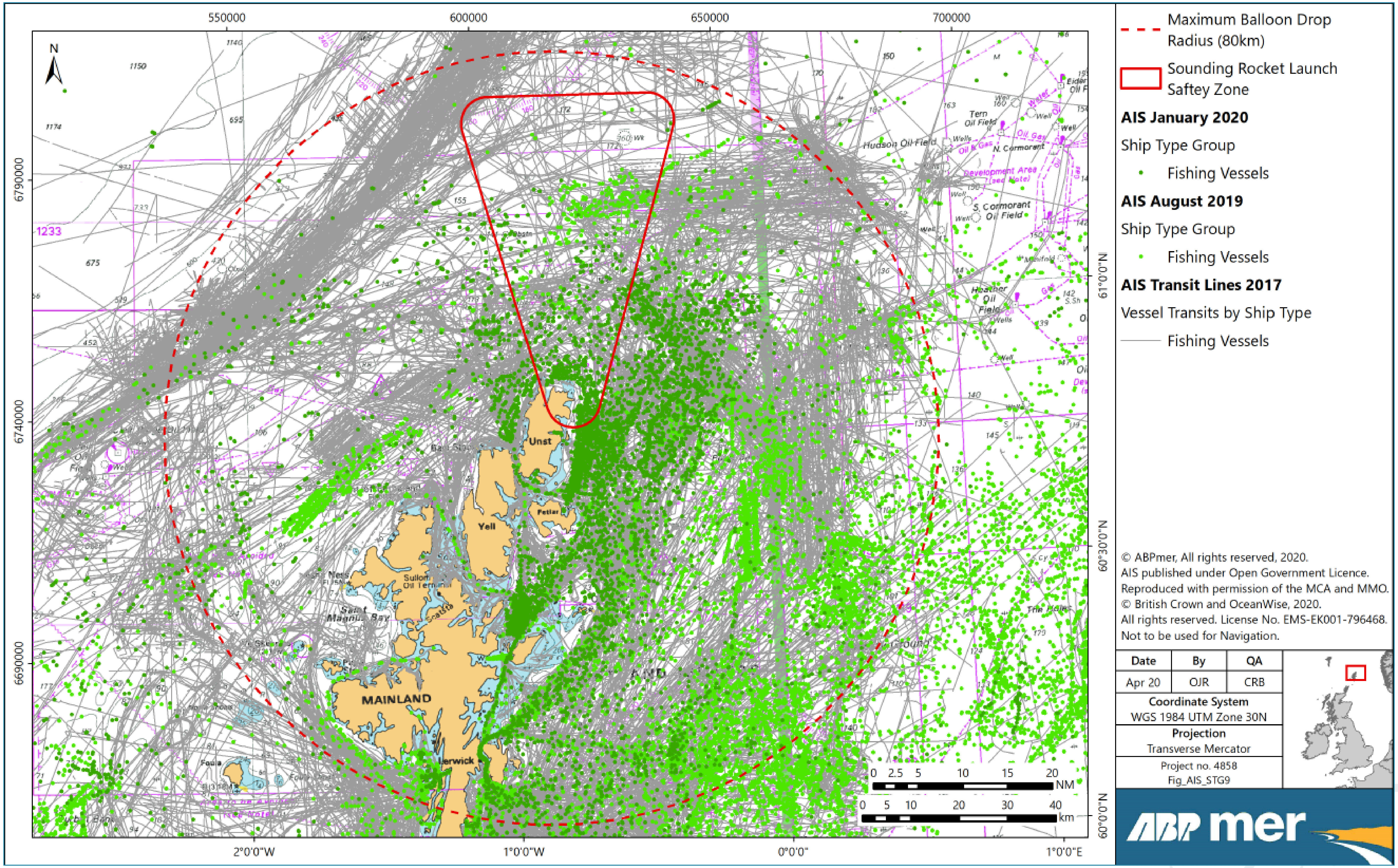


Figure A10.19: Fishing vessel transit tracks and automatic identification system points within Study Area B (From: ABPmer, 2020

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Appendix 10.3 Water Quality Risk Matrix

SSC AEE Report Technical Appendix 10.3 - water quality risk matrix

Receptor	Water quality
Pressure Pathway/Impact	Effects from Fuel Spillage

Sensitivity of the Receptor

Value (importance, rarity, quality) of receptor	Qualifying Statement	Consideration	Classification
0	Receptor has no measurable financial, environmental or cultural value		
1	Receptor has a low financial, environmental or cultural value		
2	Receptor has a medium financial, environmental or cultural value		
3	Receptor has a high financial, environmental or cultural value	The water quality of an area is of high environmental value and underpins the surrounding marine environment.	3

Tolerance of receptor	Qualifying Statement	Consideration	Classification
0	Receptor is entirely tolerant of the impact and will not exhibit change if exposed		
1	Receptor is very tolerant of the impact and will exhibit marginal change if exposed		
2	Receptor is slightly tolerant of the impact and will exhibit noticeable change if exposed	Sea water exposed to hydrocarbons will lead to local increases in hydrocarbon concentration which could lead to notable changes to the water's properties.	2
3	Receptor is intolerant of the impact and will exhibit substantial change if exposed		

Adaptability of receptor	Qualifying Statement	Consideration	Classification
0	Receptor is entirely adaptable and as such will be unaffected by exposure		
1	Receptor is very adaptable and as such will be marginally affected by exposure		
2	Receptor is slightly adaptable and as such will be noticeably affected by exposure	Sea water exposed to hydrocarbons will lead to local increases in hydrocarbon concentration which could affect the water's properties.	2
3	Receptor is not adaptable and as such will be substantially affected by exposure		

Recoverability of receptor	Qualifying Statement	Consideration	Classification
0	Receptor will recover entirely within short timescales (<1 year)	The source of hydrocarbons (LVs) will pass through the water column and then rest on the seabed. It is anticipated that any residual fuel will be released into the marine environment immediately upon entering it, following which it'll disperse. Given the small amount of residual fuel expected, it is anticipated that hydrocarbon levels local to the LV will reach background levesl over a short time scale.	0
1	Receptor will recover entirely within medium timescales (1-5 years)		
2	Receptor will recover entirely within long timescales (>5 years)		
3	Receptor will not entirely recover over any timescale		

Overall Sensitivity of the Receptor	7	1

Exposure of Receptor to Impact

Exposure to the impact (time)	Qualifying Statement	Consideration	Classification
0	Receptor is not exposed to impact		
1	Receptor is exposed to impact over limited periods of time		
2	Receptor is exposed to impact over considerable periods of time		
3	Receptor is exposed to impact over extensive periods of time	The water quality receptor is likely to be exposed to impacts over considerable periods of time, i.e. the duration of the 30 year licence.	3

Exposure to the impact (frequency)	Qualifying Statement	Consideration	Classification
0	Receptor is very infrequently exposed to impact over limited periods of time (<1 event per month for the duration of the licence)	There is expected to be up to 10 launches per year in the initial years, rising to a maximum of 30 launches per year. However, the occurrence of residual fuel is anticipated to be rare as under normal circumstances all fuel it utilised during the launch.	0
1	Receptor is infrequently exposed to impact over limited periods of time (1-5 events per month for the duration of the licence)		
2	Receptor is frequently exposed to impact over considerable periods of time (5-15 events per month for the duration of the licence)		
3	Receptor is constantly exposed to impact over considerable periods of time (>15 events per month for the duration of the licence)		

Exposure to the impact (space)	Qualifying Statement	Consideration	Classification
0	Receptor is not exposed to impact		
1	Receptor is exposed to impact over limited spatial scales	Due to the highly limited impact zone at the waters surface as a result of hydrocarbon spill (<0.5 km^2), impacts will be low.	1
2	Receptor is exposed to impact over considerable spatial scales		
3	Receptor is exposed to impact over extensive and unconfined spatial scales		

Overall Exposure of Receptor to Impact	4	1

Magnitude of Impact

Magnitude of the impact (in the context of natural variability)	Qualifying Statement	Consideration	Classification
0	Impact is not measurable above natural variability		
1	Impact is measurable above natural variability (0-5% change in contaminant concentration)	Direct impacts to the hydrocarbon concentration of the sea water is likely to be measureable above natural variability, as there are limited other sources of hydrocarbons in the marine environment.	1
2	Impact is measurable above natural variability (6-10% change in contaminant concentration)		
3	Impact is measurable above natural variability (>10% change in contaminant concentration)		

Magnitude of the impact (in the context of environmental baseline conditions)	Qualifying Statement	Consideration	Classification
0	Impact is not measurable above present baseline conditions		
1	Impact is measurable above present baseline conditions (0-5% change in contaminant concentration)	Direct impacts to the hydrocarbon concentration of the sea water is likely to slightly detectable above the baseline (at a very localised scale), as there are limited other sources of hydrocarbons in the marine environment.	1
2	Impact is measurable above present baseline conditions (6-10% change in contaminant concentration)		
3	Impact is measurable above present baseline conditions (>10% change in contaminant concentration)		

Overall Magnitude of Impact	**2**	**1**
Overall Risk (sensitivity x exposure x magnitude)	**Low**	**1**

Receptor	**Water quality**
Pressure Pathway/Impact	**Effects from Metal Corrosion**

Sensitivity of the Receptor

Value (importance, rarity, quality) of receptor	Qualifying Statement	Consideration	Classification
0	Receptor has no measurable financial, environmental or cultural value		
1	Receptor has a low financial, environmental or cultural value		
2	Receptor has a medium financial, environmental or cultural value		
3	Receptor has a high financial, environmental or cultural value	The water quality of an area is of high environmental value and underpins the surrounding marine environment.	3

Tolerance of receptor	Qualifying Statement	Consideration	Classification
0	Receptor is entirely tolerant of the impact and will not exhibit change if exposed		
1	Receptor is very tolerant of the impact and will exhibit marginal change if exposed		
2	Receptor is slightly tolerant of the impact and will exhibit noticeable change if exposed	Sea water exposed to metal corrosion will lead to local increases in metal concentration which could lead to notable changes to the water's properties.	2
3	Receptor is intolerant of the impact and will exhibit substantial change if exposed		

Adaptability of receptor	Qualifying Statement	Consideration	Classification
0	Receptor is entirely adaptable and as such will be unaffected by exposure		
1	Receptor is very adaptable and as such will be marginally affected by exposure		
2	Receptor is slightly adaptable and as such will be noticeably affected by exposure	Sea water exposed to metal corrosion will lead to local increases in metal concentration which could affect the water's properties.	2
3	Receptor is not adaptable and as such will be substantially affected by exposure		

Recoverability of receptor	Qualifying Statement	Consideration	Classification
0	Receptor will recover entirely within short timescales (<1 year)		
1	Receptor will recover entirely within medium timescales (1-5 years)		
2	Receptor will recover entirely within long timescales (>5 years)	The source of metals (LVs) will pass through the water column and then rest on the seabed. Metal corrision could happen throughout this passage, though it is anticipated to be highest at the seabed due to longevity in this environment. The LV has only small amounts of metals, predominantly aluminium, which is one of the least corrosive in the marine environment. Given the longevity of aluminium in the marine environment, water quality will recover over a long time scale.	2
3	Receptor will not entirely recover over any timescale		

Overall Sensitivity of the Receptor	9	**2**

Exposure of Receptor to Impact

Exposure to the impact (time)	Qualifying Statement	Consideration	Classification
0	Receptor is not exposed to impact		
1	Receptor is exposed to impact over limited periods of time		
2	Receptor is exposed to impact over considerable periods of time		
3	Receptor is exposed to impact over extensive periods of time	The water quality receptor is likely to be exposed to impacts over considerable periods of time, i.e. the duration of the 30 year licence.	3

Exposure to the impact (frequency)	Qualifying Statement	Consideration	Classification
0	Receptor is very infrequently exposed to impact over limited periods of time (<1 event per month for the duration of the licence)		
1	Receptor is infrequently exposed to impact over limited periods of time (1-5 events per month for the duration of the licence)	There is expected to be up to 10 launches per year in the initial years, rising to a maximum of 30 launches per year.	1
2	Receptor is frequently exposed to impact over considerable periods of time (5-15 events per month for the duration of the licence)		
3	Receptor is constantly exposed to impact over considerable periods of time (>15 events per month for the duration of the licence)		

Exposure to the impact (space)	Qualifying Statement	Consideration	Classification
0	Receptor is not exposed to impact		
1	Receptor is exposed to impact over limited spatial scales	Due to the highly limited impact zone around LVs as they pass through the water column and rest at the seabed, impacts will be low.	1
2	Receptor is exposed to impact over considerable spatial scales		
3	Receptor is exposed to impact over extensive and unconfined spatial scales		

Overall Exposure of Receptor to Impact	5	2

Magnitude of Impact

Magnitude of the impact (in the context of natural variability)	Qualifying Statement	Consideration	Classification
0	Impact is not measurable above natural variability		
1	Impact is measurable above natural variability (0-5% change in contaminant concentration)	Direct impacts to the metal concentration of the sea water is likely to be measureable above natural variability. Aluminium is the main metal which is occurs naturally in the marine environment but in low concentration.	1
2	Impact is measurable above natural variability (6-10% change in contaminant concentration)		
3	Impact is measurable above natural variability (>10% change in contaminant concentration)		

Magnitude of the impact (in the context of environmental baseline conditions)	Qualifying Statement	Consideration	Classification
0	Impact is not measurable above present baseline conditions		0
1	Impact is measurable above present baseline conditions (0-5% change in contaminant concentration)	Direct impacts to the metal concentration of the sea water is likely to be measureable above the baseline. Aluminium is the main metal which is occurs naturally in the marine environment but in low concentration.	
2	Impact is measurable above present baseline conditions (6-10% change in contaminant concentration)		
3	Impact is measurable above present baseline conditions (>10% change in contaminant concentration)		

Overall Magnitude of Impact	1	1
Overall Risk (sensitivity x exposure x magnitude)	Low	4

Receptor	**Water quality**
Pressure Pathway/Impact	**Effects from Microplastics and Debris**

Sensitivity of the Receptor

Value (importance, rarity, quality) of receptor	Qualifying Statement	Consideration	Classification
0	Receptor has no measurable financial, environmental or cultural value		
1	Receptor has a low financial, environmental or cultural value		
2	Receptor has a medium financial, environmental or cultural value		
3	Receptor has a high financial, environmental or cultural value	The water quality of an area is of high environmental value and underpins the surrounding marine environment.	3

Tolerance of receptor	Qualifying Statement	Consideration	Classification
0	Receptor is entirely tolerant of the impact and will not exhibit change if exposed		
1	Receptor is very tolerant of the impact and will exhibit marginal change if exposed		
2	Receptor is slightly tolerant of the impact and will exhibit noticeable change if exposed	Microplastic exposure will lead to local increases in microplastic concentration which could lead to notable changes to the water's properties.	2
3	Receptor is intolerant of the impact and will exhibit substantial change if exposed		

Adaptability of receptor	Qualifying Statement	Consideration	Classification
0	Receptor is entirely adaptable and as such will be unaffected by exposure		
1	Receptor is very adaptable and as such will be marginally affected by exposure		
2	Receptor is slightly adaptable and as such will be noticeably affected by exposure	Microplastic exposure will lead to local increases in microplastic concentration which could affect the water's properties.	2
3	Receptor is not adaptable and as such will be substantially affected by exposure		

Recoverability of receptor	Qualifying Statement	Consideration	Classification

0	Receptor will recover entirely within short timescales (<1 year)	The source of microplastics (LVs) will pass through the water column and then rest on the seabed. Microplastics have the potential to be released throughout this passage. Given the small amount of plastics expected, it is anticipated that microplastic levels local to the LV will reach background levesl over a short time scale.	0	
1	Receptor will recover entirely within medium timescales (1-5 years)			
2	Receptor will recover entirely within long timescales (>5 years)			
3	Receptor will not entirely recover over any timescale			
Overall Sensitivity of the Receptor			**7**	**1**

Exposure of Receptor to Impact

Exposure to the impact (time)	Qualifying Statement	Consideration	Classification
0	Receptor is not exposed to impact		
1	Receptor is exposed to impact over limited periods of time		
2	Receptor is exposed to impact over considerable periods of time		
3	Receptor is exposed to impact over extensive periods of time	The water quality receptor is likely to be exposed to impacts over considerable periods of time, i.e. the duration of the 30 year licence.	3

Exposure to the impact (frequency)	Qualifying Statement	Consideration	Classification
0	Receptor is very infrequently exposed to impact over limited periods of time (<1 event per month for the duration of the licence)		
1	Receptor is infrequently exposed to impact over limited periods of time (1-5 events per month for the duration of the licence)	There is expected to be up to 10 launches per year in the initial years, rising to a maximum of 30 launches per year. It is noted that, based on our current understanding, not all of the rockets launched from the SSC site will contain plastics (so far, 1 of 3 clients' rockets has been identified as utilising plastic).	1
2	Receptor is frequently exposed to impact over considerable periods of time (5-15 events per month for the duration of the licence)		
3	Receptor is constantly exposed to impact over considerable periods of time (>15 events per month for the duration of the licence)		

Exposure to the impact (space)	Qualifying Statement	Consideration	Classification
0	Receptor is not exposed to impact		
1	Receptor is exposed to impact over limited spatial scales	Due to the limited impact zone around LVs as they sink through the water column, impacts will be low.	1
2	Receptor is exposed to impact over considerable spatial scales		
3	Receptor is exposed to impact over extensive and unconfined spatial scales		

Overall Exposure of Receptor to Impact			**5**	**2**

Magnitude of Impact

Magnitude of the impact (in the context of natural variability)	Qualifying Statement	Consideration	Classification
0	Impact is not measurable above natural variability		0
1	Impact is measurable above natural variability (0-5% change in contaminant concentration)	Direct impacts to the microplastic concentration of the sea water is likely to be slightly measureable above natural variability.	1
2	Impact is measurable above natural variability (6-10% change in contaminant concentration)		
3	Impact is measurable above natural variability (>10% change in contaminant concentration)		

Magnitude of the impact (in the context of environmental baseline conditions)	Qualifying Statement	Consideration	Classification
0	Impact is not measurable above present baseline conditions		0
1	Impact is measurable above present baseline conditions (0-5% change in contaminant concentration)	Direct impacts to the microplastic concentration of the sea water is likely to be slightly measureable above the baseline (at a highly local scale).	1
2	Impact is measurable above present baseline conditions (6-10% change in contaminant concentration)		
3	Impact is measurable above present baseline conditions (>10% change in contaminant concentration)		

Overall Magnitude of Impact			**2**	**1**
Overall Risk (sensitivity x exposure x magnitude)			**Low**	**2**

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Appendix 10.4 Biodiversity Risk Matrix

Receptor	Plankton
Pressure Pathway/Impact	Effects from Fuel Spillage/Metal Corrosion/Debris and Microplastics

Sensitivity of the Receptor

Value (importance, rarity, quality) of receptor	Qualifying Statement	Consideration	Classification
0	Receptor has no measurable financial, environmental or cultural value		
1	Receptor has a low financial, environmental or cultural value	Plankton themselves are not financially or cultural important, but they support other receptors that are.	1
2	Receptor has a medium financial, environmental or cultural value		
3	Receptor has a high financial, environmental or cultural value		

Tolerance of receptor	Qualifying Statement	Consideration	Classification
0	Receptor is entirely tolerant of the impact and will not exhibit change if exposed		
1	Receptor is very tolerant of the impact and will exhibit marginal change if exposed		
2	Receptor is slightly tolerant of the impact and will exhibit noticeable change if exposed		
3	Receptor is intolerant of the impact and will exhibit substantial change if exposed	The worst-case scenario of plankton being exposed to hydrocarbons could have lethal effects on individuals in the immediate vicinity of hydrocarbon spills.	3

Adaptability of receptor	Qualifying Statement	Consideration	Classification
0	Receptor is entirely adaptable and as such will be unaffected by exposure		
1	Receptor is very adaptable and as such will be marginally affected by exposure		
2	Receptor is slightly adaptable and as such will be noticeably affected by exposure		
3	Receptor is not adaptable and as such will be substantially affected by exposure	The worst-case scenario of plankton being exposed to hydrocarbons could have lethal effects on individuals in the immediate vicinity of hydrocarbon spills.	3

Recoverability of receptor	Qualifying Statement	Consideration	Classification
0	Receptor will recover entirely within short timescales (<1 year)	The source of contaminants (LVs) will pass through the water column and then rest on the seabed. Plankton will predominantly be exposed whilst the LV is in the water column. Given the high turnover of plankton in the ocean and the very small proportion of total plankton in the area predicted to be exposed, it is anticipated that plankton will recover within short timescales.	0
1	Receptor will recover entirely within medium timescales (1-5 years)		
2	Receptor will recover entirely within long timescales (>5 years)		
3	Receptor will not entirely recover over any timescale		

Overall Sensitivity of the Receptor	7	2

Exposure of Receptor to Impact

Exposure to the impact (time)	Qualifying Statement	Consideration	Classification
0	Receptor is not exposed to impact		
1	Receptor is exposed to impact over limited periods of time		
2	Receptor is exposed to impact over considerable periods of time		
3	Receptor is exposed to impact over extensive periods of time	Plankton are likely to be exposed to impacts over considerable periods of time, i.e. the duration of the 30 year licence.	3

Exposure to the impact (frequency)	Qualifying Statement	Consideration	Classification
0	Receptor is very infrequently exposed to impact over limited periods of time (<1 event per month for the duration of the licence)		
1	Receptor is infrequently exposed to impact over limited periods of time (1-5 events per month for the duration of the licence)	There is expected to be up to 10 launches per year in the initial years, rising to a maximum of 30 launches per year.	1
2	Receptor is frequently exposed to impact over considerable periods of time (5-15 events per month for the duration of the licence)		
3	Receptor is constantly exposed to impact over considerable periods of time (>15 events per month for the duration of the licence)		

Exposure to the impact (space)	Qualifying Statement	Consideration	Classification
0	Receptor is not exposed to impact		
1	Receptor is exposed to impact over limited spatial scales	Due to the highly limited impact zone around LVs as they sink through the water column, impacts will be low.	1
2	Receptor is exposed to impact over considerable spatial scales		
3	Receptor is exposed to impact over extensive and unconfined spatial scales		

Overall Exposure of Receptor to Impact	5	2

Magnitude of Impact

Magnitude of the impact (in the context of natural variability)	Qualifying Statement	Consideration	Classification
0	Impact is not measurable above natural variability		
1	Impact is measurable above natural variability (0-5% change)	Direct impacts to the contaminant levels of plankton are likely to be measureable above natural variability.	1
2	Impact is measurable above natural variability (6-10% change)		
3	Impact is measurable above natural variability (>10% change)		

Magnitude of the impact (in the context of environmental baseline conditions)	Qualifying Statement	Consideration	Classification
0	Impact is not measurable above present baseline conditions	Direct impacts to the contaminant levels of plankton are not likely to affect the plankton baseline, when taking into account the very small spatial scale of effect in the context of the entire Study Area A and the abundance and high turnover of plankton.	0
1	Impact is measurable above present baseline conditions (0-5% change in baseline population)		
2	Impact is measurable above present baseline conditions (6-10% change in baseline population)		
3	Impact is measurable above present baseline conditions (>10% change principle in baseline population)		

Overall Magnitude of Impact	1	1

Overall Risk (sensitivity x exposure x magnitude)	Low	4

Receptor	Plankton
Pressure Pathway/Impact	Disturbance Effects from the Return of Launch Parts

Sensitivity of the Receptor

Value (importance, rarity, quality) of receptor	Qualifying Statement	Consideration	Classification
0	Receptor has no measurable financial, environmental or cultural value		
1	Receptor has a low financial, environmental or cultural value	Plankton themselves are not financially or cultural important, but they support other receptors that are.	1
2	Receptor has a medium financial, environmental or cultural value		
3	Receptor has a high financial, environmental or cultural value		

Tolerance of receptor	Qualifying Statement	Consideration	Classification
0	Receptor is entirely tolerant of the impact and will not exhibit change if exposed		
1	Receptor is very tolerant of the impact and will exhibit marginal change if exposed		
2	Receptor is slightly tolerant of the impact and will exhibit noticeable change if exposed		
3	Receptor is intolerant of the impact and will exhibit substantial change if exposed	The worst-case scenario of plankton being exposed to the noise of impact could have lethal effects on individuals in the immediate vicinity.	3

Adaptability of receptor	Qualifying Statement	Consideration	Classification
0	Receptor is entirely adaptable and as such will be unaffected by exposure		
1	Receptor is very adaptable and as such will be marginally affected by exposure		
2	Receptor is slightly adaptable and as such will be noticeably affected by exposure		
3	Receptor is not adaptable and as such will be substantially affected by exposure	The worst-case scenario of plankton being exposed to the noise of impact could have lethal effects on individuals in the immediate vicinity.	3

Recoverability of receptor	Qualifying Statement	Consideration	Classification
0	Receptor will recover entirely within short timescales (<1 year)		
1	Receptor will recover entirely within medium timescales (1-5 years)		
2	Receptor will recover entirely within long timescales (>5 years)		
3	Receptor will not entirely recover over any timescale	The worst-case scenario of plankton being exposed to the noise of impact could have lethal effects on individuals in the immediate vicinity. At an individual level the receptor would not be able to recover from this.	3

Overall Sensitivity of the Receptor	10	3

Exposure of Receptor to Impact

Exposure to the impact (time)	Qualifying Statement	Consideration	Classification
0	Receptor is not exposed to impact		
1	Receptor is exposed to impact over limited periods of time		
2	Receptor is exposed to impact over considerable periods of time		
3	Receptor is exposed to impact over extensive periods of time	Plankton are likely to be exposed to impacts over considerable periods of time, i.e. the duration of the 30 year licence.	3

Exposure to the impact (frequency)	Qualifying Statement	Consideration	Classification
0	Receptor is very infrequently exposed to impact over limited periods of time (<1 event per month for the duration of the licence)		
1	Receptor is infrequently exposed to impact over limited periods of time (1-5 events per month for the duration of the licence)	There is expected to be up to 10 launches per year in the initial years, rising to a maximum of 30 launches per year.	1
2	Receptor is frequently exposed to impact over considerable periods of time (5-15 events per month for the duration of the licence)		
3	Receptor is constantly exposed to impact over considerable periods of time (>15 events per month for the duration of the licence)		

Exposure to the impact (space)	Qualifying Statement	Consideration	Classification
0	Receptor is not exposed to impact		
1	Receptor is exposed to impact over limited spatial scales	Due to the limited impact zone around LVs as they enter the marine environment (up to 1.2 km), impacts will be low.	1
2	Receptor is exposed to impact over considerable spatial scales		
3	Receptor is exposed to impact over extensive and unconfined spatial scales		

Overall Exposure of Receptor to Impact	5	2

Magnitude of Impact

Magnitude of the impact (in the context of natural variability)	Qualifying Statement	Consideration	Classification
0	Impact is not measurable above natural variability	Direct impacts to the mortality rate of plankton will not be measureable above natural variability.	0
1	Impact is measurable above natural variability (0-5% change)		
2	Impact is measurable above natural variability (6-10% change)		
3	Impact is measurable above natural variability (>10% change)		

Magnitude of the impact (in the context of environmental baseline conditions)	Qualifying Statement	Consideration	Classification
0	Impact is not measurable above present baseline conditions	Direct impacts to the mortality rate of plankton will not cause a measurable change in the baseline.	0
1	Impact is measurable above present baseline conditions (0-5% change in baseline population)		
2	Impact is measurable above present baseline conditions (6-10% change in baseline population)		
3	Impact is measurable above present baseline conditions (>10% change principle in baseline population)		

Overall Magnitude of Impact	0	0
Overall Risk (sensitivity x exposure x magnitude)	Low	0

Receptor	Benthic Habitats
Pressure Pathway/Impact	Effects from Fuel Spillage/Metal Corrosion/Debris and Microplastics

Sensitivity of the Receptor

Value (importance, rarity, quality) of receptor	Qualifying Statement	Consideration	Classification
0	Receptor has no measurable financial, environmental or cultural value		
1	Receptor has a low financial, environmental or cultural value		
2	Receptor has a medium financial, environmental or cultural value		
3	Receptor has a high financial, environmental or cultural value	The seabed habitats within Study Area A are well represented in the wider region. There is likely presence of VMEs in Study Area A, though these are only protected from the impacts of fishing and not other seabed impacts. There are designated benthic habitat features of MPAs in the region.	3

Tolerance of receptor	Qualifying Statement	Consideration	Classification
0	Receptor is entirely tolerant of the impact and will not exhibit change if exposed		
1	Receptor is very tolerant of the impact and will exhibit marginal change if exposed		
2	Receptor is slightly tolerant of the impact and will exhibit noticeable change if exposed	The benthic communities are likely to be sensitive to change as they have had limited exposure to anthropogenic activities and the introduction of contaminants.	2
3	Receptor is intolerant of the impact and will exhibit substantial change if exposed		

Adaptability of receptor	Qualifying Statement	Consideration	Classification
0	Receptor is entirely adaptable and as such will be unaffected by exposure		
1	Receptor is very adaptable and as such will be marginally affected by exposure		
2	Receptor is slightly adaptable and as such will be noticeably affected by exposure	Benthic habitats are adaptable to changes in contaminant levels as they can accumulate a certain level before experiencing physiological effects	2
3	Receptor is not adaptable and as such will be substantially affected by exposure		

Recoverability of receptor	Qualifying Statement	Consideration	Classification
0	Receptor will recover entirely within short timescales (<1 year)		
1	Receptor will recover entirely within medium timescales (1-5 years)		
2	Receptor will recover entirely within long timescales (>5 years)	The source of contaminants will be present for different lengths of time, the longest being the metal and associated corrosion, which will be present for extended periods. Once the source of contaminants has broken down benthic habitats will be able to fully recover. The contaminants may remain in the system of benthic species for a notable amount of time.	2
3	Receptor will not entirely recover over any timescale		

Overall Sensitivity of the Receptor	**9**	**2**

Exposure of Receptor to Impact

Exposure to the impact (time)	Qualifying Statement	Consideration	Classification
0	Receptor is not exposed to impact		
1	Receptor is exposed to impact over limited periods of time		
2	Receptor is exposed to impact over considerable periods of time		2
3	Receptor is exposed to impact over extensive periods of time	Benthic habitats are likely to be exposed to impacts over considerable periods of time, i.e. the duration of the 30 year licence.	

Exposure to the impact (frequency)	Qualifying Statement	Consideration	Classification
0	Receptor is very infrequently exposed to impact over limited periods of time (<1 event per month for the duration of the licence)		
1	Receptor is infrequently exposed to impact over limited periods of time (1-5 events per month for the duration of the licence)	There is expected to be up to 10 launches per year in the initial years, rising to a maximum of 30 launches per year.	
2	Receptor is frequently exposed to impact over considerable periods of time (5-15 events per month for the duration of the licence)		2
3	Receptor is constantly exposed to impact over considerable periods of time (>15 events per month for the duration of the licence)		

Exposure to the impact (space)	Qualifying Statement	Consideration	Classification
0	Receptor is not exposed to impact		
1	Receptor is exposed to impact over limited spatial scales	Due to the highly limited impact zone around LVs at the seabed, impacts will be low.	1
2	Receptor is exposed to impact over considerable spatial scales		
3	Receptor is exposed to impact over extensive and unconfined spatial scales		

Overall Exposure of Receptor to Impact	**5**	**2**

Magnitude of Impact

Magnitude of the impact (in the context of natural variability)	Qualifying Statement	Consideration	Classification
0	Impact is not measurable above natural variability		
1	Impact is measurable above natural variability (0-5% change)	Direct impacts to the contaminant levels of benthic habitats are likely to be measureable above natural variability.	1
2	Impact is measurable above natural variability (6-10% change)		
3	Impact is measurable above natural variability (>10% change)		

Magnitude of the impact (in the context of environmental baseline conditions)	Qualifying Statement	Consideration	Classification
0	Impact is not measurable above present baseline conditions	Direct impacts to the contaminant levels of benthic habitats are not likely to affect the benthic habitat baseline, when taking into account the very small spatial scale of effect in the context of the entire Study Area A.	0
1	Impact is measurable above present baseline conditions (0-5% change in baseline population)		
2	Impact is measurable above present baseline conditions (6-10% change in baseline population)		
3	Impact is measurable above present baseline conditions (>10% change in baseline population)		

Overall Magnitude of Impact	**1**	**1**
Overall Risk (sensitivity x exposure x magnitude)	**Low**	**4**

Receptor	Benthic Habitats
Pressure Pathway/Impact	Direct loss of seabed habitat via deposition of material on the seabed

Sensitivity of the Receptor

Value (importance, rarity, quality) of receptor	Qualifying Statement	Consideration	Classification
0	Receptor has no measurable financial, environmental or cultural value		
1	Receptor has a low financial, environmental or cultural value		
2	Receptor has a medium financial, environmental or cultural value		
3	Receptor has a high financial, environmental or cultural value	The seabed habitats within Study Area A are well represented in the wider region. There is likely presence of VMEs in Study Area A, though these are only protected from the impacts of fishing and not other seabed impacts. There are designated benthic habitat features of MPAs in the region.	3

Tolerance of receptor	Qualifying Statement	Consideration	Classification
0	Receptor is entirely tolerant of the impact and will not exhibit change if exposed		
1	Receptor is very tolerant of the impact and will exhibit marginal change if exposed		
2	Receptor is slightly tolerant of the impact and will exhibit noticeable change if exposed		
3	Receptor is intolerant of the impact and will exhibit substantial change if exposed	The worst-case example of VMEs are intolerant of direction deposition of material on them and would experience substantial change.	3

Adaptability of receptor	Qualifying Statement	Consideration	Classification
0	Receptor is entirely adaptable and as such will be unaffected by exposure		
1	Receptor is very adaptable and as such will be marginally affected by exposure		
2	Receptor is slightly adaptable and as such will be noticeably affected by exposure		
3	Receptor is not adaptable and as such will be substantially affected by exposure	The worst-case example of VMEs are not adaptable to direction deposition of material on them and would be susbstantially affected.	3

Recoverability of receptor	Qualifying Statement	Consideration	Classification
0	Receptor will recover entirely within short timescales (<1 year)		
1	Receptor will recover entirely within medium timescales (1-5 years)		
2	Receptor will recover entirely within long timescales (>5 years)	The LV will likely break down in the marine environment. Once this occurs, the receptor will be able to recover i.e. recolonise that area. Given the size of the LV in comparison to the size of the habitat, only a small proportion will be affected so recolonisation from surrounding habtiats is possible.	2
3	Receptor will not entirely recover over any timescale		

Overall Sensitivity of the Receptor	**11**	3

Exposure of Receptor to Impact

Exposure to the impact (time)	Qualifying Statement	Consideration	Classification
0	Receptor is not exposed to impact		
1	Receptor is exposed to impact over limited periods of time		
2	Receptor is exposed to impact over considerable periods of time		
3	Receptor is exposed to impact over extensive periods of time	Benthic habitats are likely to be exposed to impacts over considerable periods of time, i.e. the duration of the 30 year licence.	3

Exposure to the impact (frequency)	Qualifying Statement	Consideration	Classification
0	Receptor is very infrequently exposed to impact over limited periods of time (<1 event per month for the duration of the licence)	There is expected to be up to 10 launches per year in the initial years, rising to a maximum of 30 launches per year. However, the likelihood of LVs repeatedly encountering an MPA with designated benthic feature or a VME is extemely low, taking into account the extent of the study area.	0
1	Receptor is infrequently exposed to impact over limited periods of time (1-5 events per month for the duration of the licence)		
2	Receptor is frequently exposed to impact over considerable periods of time (5-15 events per month for the duration of the licence)		
3	Receptor is constantly exposed to impact over considerable periods of time (>15 events per month for the duration of the licence)		

Exposure to the impact (space)	Qualifying Statement	Consideration	Classification
0	Receptor is not exposed to impact		
1	Receptor is exposed to impact over limited spatial scales	Due to the highly limited impact zone around LVs at the seabed, impacts will be low.	1
2	Receptor is exposed to impact over considerable spatial scales		
3	Receptor is exposed to impact over extensive and unconfined spatial scales		

Overall Exposure of Receptor to Impact	4	1

Magnitude of Impact

Magnitude of the impact (in the context of natural v	Qualifying Statement	Consideration	Classification
0	Impact is not measurable above natural variability		
1	Impact is measurable above natural variability (0-5% change)	Direct impacts to the benthic habitats are likely to be measureable above natural variability as there is not element of natural variability and the most sensitive habitats are long-lived.	1
2	Impact is measurable above natural variability (6-10% change)		
3	Impact is measurable above natural variability (>10% change)		

Magnitude of the impact (in the context of environm	Qualifying Statement	Consideration	Classification
0	Impact is not measurable above present baseline conditions		
1	Impact is measurable above present baseline conditions (0-5% change in baseline population)	Direct impacts to the benthic habitats are only likely to have a small effect on the baseline, when taking into account the very small spatial scale of effect in the context of the extent of benthic habitats in Study Area A.	1
2	Impact is measurable above present baseline conditions (6-10% change in baseline population)		
3	Impact is measurable above present baseline conditions (>10% change in baseline population)		

Overall Magnitude of Impact	**2**	**1**
Overall Risk (sensitivity x exposure x magnitude)	**Low**	**3**

Receptor	Fish
Pressure Pathway/Impact	Effects from Fuel Spillage/Metal Corrosion/Debris and Microplastics

Sensitivity of the Receptor

Value (importance, rarity, quality) of receptor	Qualifying Statement	Consideration	Classification
0	Receptor has no measurable financial, environmental or cultural value		
1	Receptor has a low financial, environmental or cultural value		
2	Receptor has a medium financial, environmental or cultural value		
3	Receptor has a high financial, environmental or cultural value	The number of fish species in the study area is very high. Several of these species are commercially important.	3

Tolerance of receptor	Qualifying Statement	Consideration	Classification
0	Receptor is entirely tolerant of the impact and will not exhibit change if exposed		
1	Receptor is very tolerant of the impact and will exhibit marginal change if exposed	Fish species exposed to increased contaminants may accumulate them, though only in low amounts due to the low amounts predicted to be released and the high mobility of fish species.	1
2	Receptor is slightly tolerant of the impact and will exhibit noticeable change if exposed		
3	Receptor is intolerant of the impact and will exhibit substantial change if exposed		

Adaptability of receptor	Qualifying Statement	Consideration	Classification
0	Receptor is entirely adaptable and as such will be unaffected by exposure		
1	Receptor is very adaptable and as such will be marginally affected by exposure	Fish species that accumulate low levels of contaminants will only be marginally affected and show minimal physiological effects at worst.	1
2	Receptor is slightly adaptable and as such will be noticeably affected by exposure		
3	Receptor is not adaptable and as such will be substantially affected by exposure		

Recoverability of receptor	Qualifying Statement	Consideration	Classification
0	Receptor will recover entirely within short timescales (<1 year)	The source of contaminants (LVs) will pass through the water column and then rest on the seabed. The most persistent source of contamination is the metal and associated corrosion, which will be present for extended periods on the seabed. However, given the very small amount of exposure predicted, it is expected that fish species can recover within short timescales.	0
1	Receptor will recover entirely within medium timescales (1-5 years)		
2	Receptor will recover entirely within long timescales (>5 years)		
3	Receptor will not entirely recover over any timescale		

Overall Sensitivity of the Receptor	**5**	**1**

Exposure of Receptor to Impact

Exposure to the impact (time)	Qualifying Statement	Consideration	Classification
0	Receptor is not exposed to impact		
1	Receptor is exposed to impact over limited periods of time		
2	Receptor is exposed to impact over considerable periods of time		
3	Receptor is exposed to impact over extensive periods of time	Fish are likely to be exposed to impacts over considerable periods of time, i.e. the duration of the 30 year licence.	3

Exposure to the impact (frequency)	Qualifying Statement	Consideration	Classification
0	Receptor is very infrequently exposed to impact over limited periods of time (<1 event per month for the duration of the licence)		
1	Receptor is infrequently exposed to impact over limited periods of time (1-5 events per month for the duration of the licence)	There is expected to be up to 10 launches per year in the initial years, rising to a maximum of 30 launches per year.	1
2	Receptor is frequently exposed to impact over considerable periods of time (5-15 events per month for the duration of the licence)		
3	Receptor is constantly exposed to impact over considerable periods of time (>15 events per month for the duration of the licence)		

Exposure to the impact (space)	Qualifying Statement	Consideration	Classification
0	Receptor is not exposed to impact		
1	Receptor is exposed to impact over limited spatial scales	Due to the highly limited impact zone around LVs as they pass through the water column and rest at the seabed, impacts will be low.	1
2	Receptor is exposed to impact over considerable spatial scales		
3	Receptor is exposed to impact over extensive and unconfined spatial scales		

Overall Exposure of Receptor to Impact	**5**	**2**

Magnitude of Impact

Magnitude of the impact (in the context of natural variability)	Qualifying Statement	Consideration	Classification
0	Impact is not measurable above natural variability		
1	Impact is measurable above natural variability (0-5% change)	Direct impacts to the contaminant levels of fish are likely to be measureable above natural variability.	1
2	Impact is measurable above natural variability (6-10% change)		
3	Impact is measurable above natural variability (>10% change)		

Magnitude of the impact (in the context of environmental baseline conditions)	Qualifying Statement	Consideration	Classification
0	Impact is not measurable above present baseline conditions	Direct impacts to the contaminant levels of fish are not likely to affect the fish baseline, when taking into account the very small spatial scale of effect in the context of the entire Study Area A and the high mobility of fish.	0
1	Impact is measurable above present baseline conditions (0-5% change in baseline population)		
2	Impact is measurable above present baseline conditions (6-10% change in baseline population)		
3	Impact is measurable above present baseline conditions (>10% change in baseline population)		

Overall Magnitude of Impact	**1**	**1**
Overall Risk (sensitivity x exposure x magnitude)	**Low**	**2**

Receptor	Fish
Pressure Pathway/Impact	Disturbance Effects from the Return of Launch Parts

Sensitivity of the Receptor

Value (importance, rarity, quality) of receptor	Qualifying Statement	Consideration	Classification
0	Receptor has no measurable financial, environmental or cultural value		
1	Receptor has a low financial, environmental or cultural value		
2	Receptor has a medium financial, environmental or cultural value		
3	Receptor has a high financial, environmental or cultural value	The number of fish species in the study area is very high. Several of these species are commercially important.	3

Tolerance of receptor	Qualifying Statement	Consideration	Classification
0	Receptor is entirely tolerant of the impact and will not exhibit change if exposed		
1	Receptor is very tolerant of the impact and will exhibit marginal change if exposed		
2	Receptor is slightly tolerant of the impact and will exhibit noticeable change if exposed		
3	Receptor is intolerant of the impact and will exhibit substantial change if exposed	The worst-case scenario of fish being exposed to the noise of impact could have injury effects on individuals in the immediate vicinity, which would cause a substantial change.	3

Adaptability of receptor	Qualifying Statement	Consideration	Classification
0	Receptor is entirely adaptable and as such will be unaffected by exposure		
1	Receptor is very adaptable and as such will be marginally affected by exposure		
2	Receptor is slightly adaptable and as such will be noticeably affected by exposure		
3	Receptor is not adaptable and as such will be substantially affected by exposure	The worst-case scenario of fish being exposed to the noise of impact could have injury effect on individuals in the immediate vicinity, which would affect them substantially.	3

Recoverability of receptor	Qualifying Statement	Consideration	Classification
0	Receptor will recover entirely within short timescales (<1 year)		
1	Receptor will recover entirely within medium timescales (1-5 years)		
2	Receptor will recover entirely within long timescales (>5 years)		
3	Receptor will not entirely recover over any timescale	The worst-case scenario of fish being exposed to the noise of impact could have injury effects on individuals in the immediate vicinity. At an individual level the receptor would not be able to recover from this.	3

Overall Sensitivity of the Receptor	12	3

Exposure of Receptor to Impact

Exposure to the impact (time)	Qualifying Statement	Consideration	Classification
0	Receptor is not exposed to impact		
1	Receptor is exposed to impact over limited periods of time		
2	Receptor is exposed to impact over considerable periods of time		
3	Receptor is exposed to impact over extensive periods of time	Fish are likely to be exposed to impacts over considerable periods of time, i.e. the duration of the 30 year licence.	3

Exposure to the impact (frequency)	Qualifying Statement	Consideration	Classification
0	Receptor is very infrequently exposed to impact over limited periods of time (<1 event per month for the duration of the licence)		
1	Receptor is infrequently exposed to impact over limited periods of time (1-5 events per month for the duration of the licence)	There is expected to be up to 10 launches per year in the initial years, rising to a maximum of 30 launches per year.	1
2	Receptor is frequently exposed to impact over considerable periods of time (5-15 events per month for the duration of the licence)		
3	Receptor is constantly exposed to impact over considerable periods of time (>15 events per month for the duration of the licence)		

Exposure to the impact (space)	Qualifying Statement	Consideration	Classification
0	Receptor is not exposed to impact		
1	Receptor is exposed to impact over limited spatial scales	Due to the limited impact zone of noise and visual disturbance around the LV stages/vessel, impacts will be low.	1
2	Receptor is exposed to impact over considerable spatial scales		
3	Receptor is exposed to impact over extensive and unconfined spatial scales		

Overall Exposure of Receptor to Impact	5	2

Magnitude of Impact

Magnitude of the impact (in the context of natural variability)	Qualifying Statement	Consideration	Classification
0	Impact is not measurable above natural variability	Direct impacts to fish will not be measureable above natural variability.	0
1	Impact is measurable above natural variability (0-5% change)		
2	Impact is measurable above natural variability (6-10% change)		
3	Impact is measurable above natural variability (>10% change)		

Magnitude of the impact (in the context of environmental baseline conditions)	Qualifying Statement	Consideration	Classification
0	Impact is not measurable above present baseline conditions	Direct impacts to fish will not cause a measurable change in the baseline.	0
1	Impact is measurable above present baseline conditions (0-5% change in baseline population)		
2	Impact is measurable above present baseline conditions (6-10% change in baseline population)		
3	Impact is measurable above present baseline conditions (>10% change principle in baseline population)		

Overall Magnitude of Impact	0	0

Overall Risk (sensitivity x exposure x magnitude)	Low	0

Receptor	Marine Megafauna
Pressure Pathway/Impact	Effects from Fuel Spillage/Metal Corrosion/Debris and Microplastics - indirect effects to prey

Sensitivity of the Receptor

Value (importance, rarity, quality) of receptor	Qualifying Statement	Consideration	Classification
0	Receptor has no measurable financial, environmental or cultural value		
1	Receptor has a low financial, environmental or cultural value		
2	Receptor has a medium financial, environmental or cultural value		
3	Receptor has a high financial, environmental or cultural value	Marine megafauna have a high cultural value and many species are protected by international law. The Arctic Region region is likely to have presence of marine megafauna, though it is not considered a special habitat. There are not anticipated to be any calving or nursery grounds for cetaceans due to the latitude. There is the presence of pupping areas for pinnipeds, but only on land.	3

Tolerance of receptor	Qualifying Statement	Consideration	Classification
0	Receptor is entirely tolerant of the impact and will not exhibit change if exposed		
1	Receptor is very tolerant of the impact and will exhibit marginal change if exposed	Marine megafauna are very tolerant of impacts as they range over a wide area and alternative feeding areas are available to them.	1
2	Receptor is slightly tolerant of the impact and will exhibit noticeable change if exposed		
3	Receptor is intolerant of the impact and will exhibit substantial change if exposed		

Adaptability of receptor	Qualifying Statement	Consideration	Classification
0	Receptor is entirely adaptable and as such will be unaffected by exposure		
1	Receptor is very adaptable and as such will be marginally affected by exposure	Marine megafauna are considered very adaptable by virtue of their considerable mobility and ability to forage over wide ranges.	1
2	Receptor is slightly adaptable and as such will be noticeably affected by exposure		
3	Receptor is not adaptable and as such will be substantially affected by exposure		

Recoverability of receptor	Qualifying Statement	Consideration	Classification
0	Receptor will recover entirely within short timescales (<1 year)	Species that target that area would be able to return as soon as the LV had passed through the water column (predicted to be <1 year)	0
1	Receptor will recover entirely within medium timescales (1-5 years)		
2	Receptor will recover entirely within long timescales (>5 years)		
3	Receptor will not entirely recover over any timescale		

Overall Sensitivity of the Receptor	5	1

Exposure of Receptor to Impact

Exposure to the impact (time)	Qualifying Statement	Consideration	Classification
0	Receptor is not exposed to impact		
1	Receptor is exposed to impact over limited periods of time		
2	Receptor is exposed to impact over considerable periods of time		
3	Receptor is exposed to impact over extensive periods of time	Species are likely to be exposed to impacts over considerable periods of time, i.e. the duration of the 30 year licence.	3

Exposure to the impact (frequency)	Qualifying Statement	Consideration	Classification
0	Receptor is very infrequently exposed to impact over limited periods of time (<1 event per month for the duration of the licence)		
1	Receptor is infrequently exposed to impact over limited periods of time (1-5 events per month for the duration of the licence)	There is expected to be up to 10 launches per year in the initial years, rising to a maximum of 30 launches per year.	1
2	Receptor is frequently exposed to impact over considerable periods of time (5-15 events per month for the duration of the licence)		
3	Receptor is constantly exposed to impact over considerable periods of time (>15 events per month for the duration of the licence)		

Exposure to the impact (space)	Qualifying Statement	Consideration	Classification
0	Receptor is not exposed to impact		
1	Receptor is exposed to impact over limited spatial scales	Due to the limited impact zone from the returning LVs and wide foraging ranges of marine megafauna exposure to impacts will be low.	1
2	Receptor is exposed to impact over considerable spatial scales		
3	Receptor is exposed to impact over extensive and unconfined spatial scales		

Overall Exposure of Receptor to Impact	5	2

Magnitude of Impact

Magnitude of the impact (in the context of natural variability)	Qualifying Statement	Consideration	Classification
0	Impact is not measurable above natural variability	The magnitude of the impact (i.e. any changes at a population scale) will not be detectable above natural variability.	0
1	Impact is measurable above natural variability (0-5% change)		
2	Impact is measurable above natural variability (6-10% change)		
3	Impact is measurable above natural variability (>10% change)		

Magnitude of the impact (in the context of environmental baseline conditions)	Qualifying Statement	Consideration	Classification
0	Impact is not measurable above present baseline conditions	The magnitude of the impact (i.e. the amount of feeding habitat that becomes unvailable on the short timescale) will not be detectable above the baseline.	0
1	Impact is measurable above present baseline conditions (0-5% change in baseline population)		
2	Impact is measurable above present baseline conditions (6-10% change in baseline population)		
3	Impact is measurable above present baseline conditions (>10% change in baseline population)		

Overall Magnitude of Impact	0	0
Overall Risk (sensitivity x exposure x magnitude)	Negligible	0

Receptor	Marine Megafauna
Pressure Pathway/Impact	Direct stike causing mortality/serious injury

Sensitivity of the Receptor

Value (importance, rarity, quality) of receptor	Qualifying Statement	Consideration	Classification
0	Receptor has no measurable financial, environmental or cultural value		
1	Receptor has a low financial, environmental or cultural value		
2	Receptor has a medium financial, environmental or cultural value		
3	Receptor has a high financial, environmental or cultural value	Marine megafauna have a high cultural value and many species are protected by international law. The Arctic Region region is likely to have presence of marine megafauna, though it is not considered a special habitat. There are not anticipated to be any calving or nursery grounds for cetaceans due to the latitude. There is the presence of pupping areas for pinnipeds, but only on land.	3

Tolerance of receptor	Qualifying Statement	Consideration	Classification
0	Receptor is entirely tolerant of the impact and will not exhibit change if exposed		
1	Receptor is very tolerant of the impact and will exhibit marginal change if exposed		
2	Receptor is slightly tolerant of the impact and will exhibit noticeable change if exposed		
3	Receptor is intolerant of the impact and will exhibit substantial change if exposed	If an individual marine megafauna is struck by returning parts of the LV it will likely have lethal or serious injury consequences	3

Adaptability of receptor	Qualifying Statement	Consideration	Classification
0	Receptor is entirely adaptable and as such will be unaffected by exposure		
1	Receptor is very adaptable and as such will be marginally affected by exposure		
2	Receptor is slightly adaptable and as such will be noticeably affected by exposure		
3	Receptor is not adaptable and as such will be substantially affected by exposure	If an individual marine megafauna is struck by returning parts of the LV it will likely have lethal or serious injury consequences	3

Recoverability of receptor	Qualifying Statement	Consideration	Classification
0	Receptor will recover entirely within short timescales (<1 year)		
1	Receptor will recover entirely within medium timescales (1-5 years)		
2	Receptor will recover entirely within long timescales (>5 years)		
3	Receptor will not entirely recover over any timescale	If an individual marine megafauna is struck by returning parts of the LV it will likely have lethal or serious injury consequences which are not recoverable	3

Overall Sensitivity of the Receptor	**12**	3

Exposure of Receptor to Impact

Exposure to the impact (time)	Qualifying Statement	Consideration	Classification
0	Receptor is not exposed to impact		
1	Receptor is exposed to impact over limited periods of time		
2	Receptor is exposed to impact over considerable periods of time		
3	Receptor is exposed to impact over extensive periods of time	Species are likely to be exposed to impacts over considerable periods of time, i.e. the duration of the 30 year licence.	3

Exposure to the impact (frequency)	Qualifying Statement	Consideration	Classification
0	Receptor is very infrequently exposed to impact over limited periods of time (<1 event per month for the duration of the licence)	There is expected to be up to 10 launches per year in the initial years, rising to a maximum of 30 launches per year. However, the likelihood of such an event occurring is very low, a single individual will only be exposed to this impact pathway a maximum of one time during it's lifetime.	0
1	Receptor is infrequently exposed to impact over limited periods of time (1-5 events per month for the duration of the licence)		
2	Receptor is frequently exposed to impact over considerable periods of time (5-15 events per month for the duration of the licence)		
3	Receptor is constantly exposed to impact over considerable periods of time (>15 events per month for the duration of the licence)		

Exposure to the impact (space)	Qualifying Statement	Consideration	Classification
0	Receptor is not exposed to impact		
1	Receptor is exposed to impact over limited spatial scales	Due to the highly spatially limited impact zone from the returning LVs and wide foraging ranges of Marine megafauna exposure to impacts will be low.	1
2	Receptor is exposed to impact over considerable spatial scales		
3	Receptor is exposed to impact over extensive and unconfined spatial scales		

Overall Exposure of Receptor to Impact	**4**	1

Magnitude of Impact

Magnitude of the impact (in the context of natural variability)	Qualifying Statement	Consideration	Classification
0	Impact is not measurable above natural variability	The very low level of effects on Marine megafauna will not be measurable above natural variability.	0
1	Impact is measurable above natural variability (0-5% change)		
2	Impact is measurable above natural variability (6-10% change)		
3	Impact is measurable above natural variability (>10% change)		

Magnitude of the impact (in the context of environmental baseline conditions)	Qualifying Statement	Consideration	Classification
0	Impact is not measurable above present baseline conditions	The very low level of effects on Marine megafauna will not be measurable above the baseline.	0
1	Impact is measurable above present baseline conditions (0-5% change in baseline population)		
2	Impact is measurable above present baseline conditions (6-10% change in baseline population)		
3	Impact is measurable above present baseline conditions (>10% change in baseline population)		

Overall Magnitude of Impact	**0**	0
Overall Risk (sensitivity x exposure x magnitude)	Negligible	0

Receptor	Marine Megafauna
Pressure Pathway/Impact	Disturbance Effects from the Return of Launch Parts

Sensitivity of the Receptor

Value (importance, rarity, quality) of receptor	Qualifying Statement	Consideration	Classification
0	Receptor has no measurable financial, environmental or cultural value		
1	Receptor has a low financial, environmental or cultural value		
2	Receptor has a medium financial, environmental or cultural value		
3	Receptor has a high financial, environmental or cultural value	Marine megafauna have a high cultural value and many species are protected by international law. The Arctic Region region is likely to have presence of marine megafauna, though it is not considered a special habitat. There are not anticipated to be any calving or nursery grounds for cetaceans due to the latitude. There is the presence of pupping areas for pinnipeds, but only on land.	3

Tolerance of receptor	Qualifying Statement	Consideration	Classification
0	Receptor is entirely tolerant of the impact and will not exhibit change if exposed		
1	Receptor is very tolerant of the impact and will exhibit marginal change if exposed		
2	Receptor is slightly tolerant of the impact and will exhibit noticeable change if exposed		
3	Receptor is intolerant of the impact and will exhibit substantial change if exposed	The worst-case scenario of marine megafauna being exposed to the noise of impact could have injury effects on individuals in the immediate vicinity, which would cause a substantial change.	3

Adaptability of receptor	Qualifying Statement	Consideration	Classification
0	Receptor is entirely adaptable and as such will be unaffected by exposure		
1	Receptor is very adaptable and as such will be marginally affected by exposure		
2	Receptor is slightly adaptable and as such will be noticeably affected by exposure		
3	Receptor is not adaptable and as such will be substantially affected by exposure	The worst-case scenario of marine megafauna being exposed to the noise of impact could have injury effects on individuals in the immediate vicinity, which would affect them substantially.	3

Recoverability of receptor	Qualifying Statement	Consideration	Classification
0	Receptor will recover entirely within short timescales (<1 year)		
1	Receptor will recover entirely within medium timescales (1-5 years)		
2	Receptor will recover entirely within long timescales (>5 years)		
3	Receptor will not entirely recover over any timescale	The worst-case scenario of marine megafauna being exposed to the noise of impact could have injury effects on individuals in the immediate vicinity. At an individual level the receptor would not be able to recover from this.	3

Overall Sensitivity of the Receptor	12	3

Exposure of Receptor to Impact

Exposure to the impact (time)	Qualifying Statement	Consideration	Classification
0	Receptor is not exposed to impact		
1	Receptor is exposed to impact over limited periods of time		
2	Receptor is exposed to impact over considerable periods of time		
3	Receptor is exposed to impact over extensive periods of time	Marine megafauna are likely to be exposed to impacts over considerable periods of time, i.e. the duration of the 30 year licence.	3

Exposure to the impact (frequency)	Qualifying Statement	Consideration	Classification
0	Receptor is very infrequently exposed to impact over limited periods of time (<1 event per month for the duration of the licence)		
1	Receptor is infrequently exposed to impact over limited periods of time (1-5 events per month for the duration of the licence)	There is expected to be up to 10 launches per year in the initial years, rising to a maximum of 30 launches per year.	1
2	Receptor is frequently exposed to impact over considerable periods of time (5-15 events per month for the duration of the licence)		
3	Receptor is constantly exposed to impact over considerable periods of time (>15 events per month for the duration of the licence)		

Exposure to the impact (space)	Qualifying Statement	Consideration	Classification
0	Receptor is not exposed to impact		
1	Receptor is exposed to impact over limited spatial scales	Due to the limited impact zone of noise and visual disturbance around the LV stages/vessel, impacts will be low.	1
2	Receptor is exposed to impact over considerable spatial scales		
3	Receptor is exposed to impact over extensive and unconfined spatial scales		

Overall Exposure of Receptor to Impact	5	2

Magnitude of Impact

Magnitude of the impact (in the context of natural variability)	Qualifying Statement	Consideration	Classification
0	Impact is not measurable above natural variability	Direct impacts to marine megafauna will not be measureable above natural variability.	0
1	Impact is measurable above natural variability (0-5% change)		
2	Impact is measurable above natural variability (6-10% change)		
3	Impact is measurable above natural variability (>10% change)		

Magnitude of the impact (in the context of environmental baseline conditions)	Qualifying Statement	Consideration	Classification
0	Impact is not measurable above present baseline conditions	Direct impacts to marine megafauna will not cause a measurable change in the baseline.	0
1	Impact is measurable above present baseline conditions (0-5% change in baseline population)		
2	Impact is measurable above present baseline conditions (6-10% change in baseline population)		
3	Impact is measurable above present baseline conditions (>10% change principle in baseline population)		

Overall Magnitude of Impact	0	0
Overall Risk (sensitivity x exposure x magnitude)	Low	0

Receptor	Marine Ornithology
Pressure Pathway/Impact	Effects from Fuel Spillage/Metal Corrosion/Debris and Microplastics - indirect effects to prey

Sensitivity of the Receptor

Value (importance, rarity, quality) of receptor	Qualifying Statement	Consideration	Classification
0	Receptor has no measurable financial, environmental or cultural value		
1	Receptor has a low financial, environmental or cultural value		
2	Receptor has a medium financial, environmental or cultural value		
3	Receptor has a high financial, environmental or cultural value	Marine ornithological receptors have a high cultural value and many species are protected by international law. The Arctic Region region has notable presence of marine ornithological features, though it is not considered a special habitat. There is the presence of breeding colonies for seabirds, but only on land.	3

Tolerance of receptor	Qualifying Statement	Consideration	Classification
0	Receptor is entirely tolerant of the impact and will not exhibit change if exposed		
1	Receptor is very tolerant of the impact and will exhibit marginal change if exposed	Marine ornithological features are very tolerant of impacts as they range over a wide area and alternative feeding areas are available to them.	1
2	Receptor is slightly tolerant of the impact and will exhibit noticeable change if exposed		
3	Receptor is intolerant of the impact and will exhibit substantial change if exposed		

Adaptability of receptor	Qualifying Statement	Consideration	Classification
0	Receptor is entirely adaptable and as such will be unaffected by exposure		
1	Receptor is very adaptable and as such will be marginally affected by exposure	Marine ornithological features are considered very adaptable by virtue of their ability to forage over wide ranges and take a variety of prey.	1
2	Receptor is slightly adaptable and as such will be noticeably affected by exposure		
3	Receptor is not adaptable and as such will be substantially affected by exposure		

Recoverability of receptor	Qualifying Statement	Consideration	Classification
0	Receptor will recover entirely within short timescales (<1 year)	Species that target that area would be able to return as soon as the LV had passed through the water column (predicted to be <1 year)	0
1	Receptor will recover entirely within medium timescales (1-5 years)		
2	Receptor will recover entirely within long timescales (>5 years)		
3	Receptor will not entirely recover over any timescale		

Overall Sensitivity of the Receptor	5	1

Exposure of Receptor to Impact

Exposure to the impact (time)	Qualifying Statement	Consideration	Classification
0	Receptor is not exposed to impact		
1	Receptor is exposed to impact over limited periods of time		
2	Receptor is exposed to impact over considerable periods of time		
3	Receptor is exposed to impact over extensive periods of time	Species are likely to be exposed to impacts over considerable periods of time, i.e. the duration of the 30 year licence.	3

Exposure to the impact (frequency)	Qualifying Statement	Consideration	Classification
0	Receptor is very infrequently exposed to impact over limited periods of time (<1 event per month for the duration of the licence)		
1	Receptor is infrequently exposed to impact over limited periods of time (1-5 events per month for the duration of the licence)	There is expected to be up to 10 launches per year in the initial years, rising to a maximum of 30 launches per year.	1
2	Receptor is frequently exposed to impact over considerable periods of time (5-15 events per month for the duration of the licence)		
3	Receptor is constantly exposed to impact over considerable periods of time (>15 events per month for the duration of the licence)		

Exposure to the impact (space)	Qualifying Statement	Consideration	Classification
0	Receptor is not exposed to impact		
1	Receptor is exposed to impact over limited spatial scales	Due to the limited impact zone from the returning LVs and wide foraging ranges of seabirds exposure to impacts will be low.	1
2	Receptor is exposed to impact over considerable spatial scales		
3	Receptor is exposed to impact over extensive and unconfined spatial scales		

Overall Exposure of Receptor to Impact	5	2

Magnitude of Impact

Magnitude of the impact (in the context of natural variability)	Qualifying Statement	Consideration	Classification
0	Impact is not measurable above natural variability	The magnitude of the impact (i.e. any changes at a population scale) will not be detectable above natural variability.	0
1	Impact is measurable above natural variability (0-5% change)		
2	Impact is measurable above natural variability (6-10% change)		
3	Impact is measurable above natural variability (>10% change)		

Magnitude of the impact (in the context of environmental baseline conditions)	Qualifying Statement	Consideration	Classification
0	Impact is not measurable above present baseline conditions	The magnitude of the impact (i.e. the amount of feeding habitat that becomes unvailable on the short timescale) will not be detectable above the baseline.	0
1	Impact is measurable above present baseline conditions (0-5% change in baseline population)		
2	Impact is measurable above present baseline conditions (6-10% change in baseline population)		
3	Impact is measurable above present baseline conditions (>10% change in baseline population)		

Overall Magnitude of Impact	0	0

Overall Risk (sensitivity x exposure x magnitude)	Negligible	0

Receptor	Marine Ornithology
Pressure Pathway/Impact	Direct stike causing mortality/serious injury - whilst loafing/flying

Sensitivity of the Receptor

Value (importance, rarity, quality) of receptor	Qualifying Statement	Consideration	Classification
0	Receptor has no measurable financial, environmental or cultural value		
1	Receptor has a low financial, environmental or cultural value		
2	Receptor has a medium financial, environmental or cultural value		
3	Receptor has a high financial, environmental or cultural value	Marine ornithological receptors have a high cultural value and many species are protected by international law. The Arctic Region region has notable presence of marine ornithological features, though it is not considered a special habitat. There is the presence of breeding colonies for seabirds, but only on land.	3

Tolerance of receptor	Qualifying Statement	Consideration	Classification
0	Receptor is entirely tolerant of the impact and will not exhibit change if exposed		
1	Receptor is very tolerant of the impact and will exhibit marginal change if exposed		
2	Receptor is slightly tolerant of the impact and will exhibit noticeable change if exposed		
3	Receptor is intolerant of the impact and will exhibit substantial change if exposed	If a seabird is struck by returning parts of the LV it will likely have lethal or serious injury consequences	3

Adaptability of receptor	Qualifying Statement	Consideration	Classification
0	Receptor is entirely adaptable and as such will be unaffected by exposure		
1	Receptor is very adaptable and as such will be marginally affected by exposure		
2	Receptor is slightly adaptable and as such will be noticeably affected by exposure		
3	Receptor is not adaptable and as such will be substantially affected by exposure	If a seabird is struck by returning parts of the LV it will likely have lethal or serious injury consequences to which it cannot adapt	3

Recoverability of receptor	Qualifying Statement	Consideration	Classification
0	Receptor will recover entirely within short timescales (<1 year)		
1	Receptor will recover entirely within medium timescales (1-5 years)		
2	Receptor will recover entirely within long timescales (>5 years)		
3	Receptor will not entirely recover over any timescale	If a seabird is struck by returning parts of the LV it will likely have lethal or serious injury consequences which are not recoverable	3

Overall Sensitivity of the Receptor	12	3

Exposure of Receptor to Impact

Exposure to the impact (time)	Qualifying Statement	Consideration	Classification
0	Receptor is not exposed to impact		
1	Receptor is exposed to impact over limited periods of time		
2	Receptor is exposed to impact over considerable periods of time		
3	Receptor is exposed to impact over extensive periods of time	Species are likely to be exposed to impacts over considerable periods of time, i.e. the duration of the 30 year licence.	3

Exposure to the impact (frequency)	Qualifying Statement	Consideration	Classification
0	Receptor is very infrequently exposed to impact over limited periods of time (<1 event per month for the duration of the licence)	There is expected to be up to 10 launches per year in the initial years, rising to a maximum of 30 launches per year. However, a single individual will only be exposed to this impact pathway a maximum of one time during it's lifetime.	0
1	Receptor is infrequently exposed to impact over limited periods of time (1-5 events per month for the duration of the licence)		
2	Receptor is frequently exposed to impact over considerable periods of time (5-15 events per month for the duration of the licence)		
3	Receptor is constantly exposed to impact over considerable periods of time (>15 events per month for the duration of the licence)		

Exposure to the impact (space)	Qualifying Statement	Consideration	Classification
0	Receptor is not exposed to impact		
1	Receptor is exposed to impact over limited spatial scales	Due to the highly spatially limited impact zone from the returning LVs and wide habitat usage by seabirds exposure to impacts will be low.	1
2	Receptor is exposed to impact over considerable spatial scales		
3	Receptor is exposed to impact over extensive and unconfined spatial scales		

Overall Exposure of Receptor to Impact	4	1

Magnitude of Impact

Magnitude of the impact (in the context of natural variability)	Qualifying Statement	Consideration	Classification
0	Impact is not measurable above natural variability	The very low level of effects on seabirds will not be measurable above natural variability.	0
1	Impact is measurable above natural variability (0-5% change)		
2	Impact is measurable above natural variability (6-10% change)		
3	Impact is measurable above natural variability (>10% change)		

Magnitude of the impact (in the context of environmental baseline conditions)	Qualifying Statement	Consideration	Classification
0	Impact is not measurable above present baseline conditions	The very low level of effects on seabirds will not be measurable above the baseline.	0
1	Impact is measurable above present baseline conditions (0-5% change in baseline population)		
2	Impact is measurable above present baseline conditions (6-10% change in baseline population)		
3	Impact is measurable above present baseline conditions (>10% change in baseline population)		

Overall Magnitude of Impact	0	0

Overall Risk (sensitivity x exposure x magnitude)	Negligible	0

Receptor	Marine Ornithology
Pressure Pathway/Impact	Disturbance Effects from the Return of Launch Parts

Sensitivity of the Receptor

Value (importance, rarity, quality) of receptor	Qualifying Statement	Consideration	Classification
0	Receptor has no measurable financial, environmental or cultural value		
1	Receptor has a low financial, environmental or cultural value		
2	Receptor has a medium financial, environmental or cultural value		
3	Receptor has a high financial, environmental or cultural value	Marine ornithological receptors have a high cultural value and many species are protected by international law. The Arctic Region region has notable presence of marine ornithological features, though it is not considered a special habitat. There is the presence of breeding colonies for seabirds, but only on land.	3

Tolerance of receptor	Qualifying Statement	Consideration	Classification
0	Receptor is entirely tolerant of the impact and will not exhibit change if exposed		
1	Receptor is very tolerant of the impact and will exhibit marginal change if exposed		
2	Receptor is slightly tolerant of the impact and will exhibit noticeable change if exposed	Seabirds are predicted to be entirely tolerant of the disturbance effect from the presence of an LV and recovery vessel at the sea surface.	2
3	Receptor is intolerant of the impact and will exhibit substantial change if exposed		

Adaptability of receptor	Qualifying Statement	Consideration	Classification
0	Receptor is entirely adaptable and as such will be unaffected by exposure		
1	Receptor is very adaptable and as such will be marginally affected by exposure	Seabirds are predicted to have a high adaptability to the disturbance effect from the presence of an LV and recovery vessel at the sea surface.	1
2	Receptor is slightly adaptable and as such will be noticeably affected by exposure		
3	Receptor is not adaptable and as such will be substantially affected by exposure		

Recoverability of receptor	Qualifying Statement	Consideration	Classification
0	Receptor will recover entirely within short timescales (<1 year)	As seabirds are predicted to not be changed or affected by the disturbance effect, they will reocver instantly.	0
1	Receptor will recover entirely within medium timescales (1-5 years)		
2	Receptor will recover entirely within long timescales (>5 years)		
3	Receptor will not entirely recover over any timescale		

Overall Sensitivity of the Receptor	**6**	**2**

Exposure of Receptor to Impact

Exposure to the impact (time)	Qualifying Statement	Consideration	Classification
0	Receptor is not exposed to impact		
1	Receptor is exposed to impact over limited periods of time	Marine ornithology features are likely to be exposed to impacts over considerable periods of time, i.e. the duration of the 30 year licence, however disturbance events will only occur for a minimal period of time (up to 45 minutes per launch)	1
2	Receptor is exposed to impact over considerable periods of time		
3	Receptor is exposed to impact over extensive periods of time		

Exposure to the impact (frequency)	Qualifying Statement	Consideration	Classification
0	Receptor is very infrequently exposed to impact over limited periods of time (<1 event per month for the duration of the licence)		
1	Receptor is infrequently exposed to impact over limited periods of time (1-5 events per month for the duration of the licence)	There is expected to be up to 10 launches per year in the initial years, rising to a maximum of 30 launches per year.	1
2	Receptor is frequently exposed to impact over considerable periods of time (5-15 events per month for the duration of the licence)		
3	Receptor is constantly exposed to impact over considerable periods of time (>15 events per month for the duration of the licence)		

Exposure to the impact (space)	Qualifying Statement	Consideration	Classification
0	Receptor is not exposed to impact		
1	Receptor is exposed to impact over limited spatial scales	Due to the limited impact zone of noise and visual disturbance around the LV stages/vessel, impacts will be low.	1
2	Receptor is exposed to impact over considerable spatial scales		
3	Receptor is exposed to impact over extensive and unconfined spatial scales		

Overall Exposure of Receptor to Impact	**3**	**1**

Magnitude of Impact

Magnitude of the impact (in the context of natural variability)	Qualifying Statement	Consideration	Classification
0	Impact is not measurable above natural variability	Direct impacts to marine ornithology will not be measureable above natural variability.	0
1	Impact is measurable above natural variability (0-5% change)		
2	Impact is measurable above natural variability (6-10% change)		
3	Impact is measurable above natural variability (>10% change)		

Magnitude of the impact (in the context of environmental baseline conditions)	Qualifying Statement	Consideration	Classification
0	Impact is not measurable above present baseline conditions	Direct impacts to marine ornithology will not cause a measurable change in the baseline.	0
1	Impact is measurable above present baseline conditions (0-5% change in baseline population)		
2	Impact is measurable above present baseline conditions (6-10% change in baseline population)		
3	Impact is measurable above present baseline conditions (>10% change principle in baseline population)		

Overall Magnitude of Impact	**0**	**0**
Overall Risk (sensitivity x exposure x magnitude)	**Negligible**	**0**

Receptor	**Marine Protected Areas**	
Pressure Pathway/Impact	**Effects from Fuel Spillage/Metal Corrosion/Debris and Microplastics**	See the risk matrix for water quality, benthic habitats, and marine ornithology for effects to designated marine ecological and water quality features of the MPAs.

Receptor	**Marine Protected Areas**	
Pressure Pathway/Impact	**Direct loss of seabed habitat via deposition of material on the seabed**	See the risk matrix for benthics for effects to designated marine ecological and water quality features of the MPAs.

Receptor	**Marine Protected Areas**	
Pressure Pathway/Impact	**Direct strike causing mortality/serious injury**	See the risk matrix for marine ornithology for effects to designated marine ecological features of the MPAs.

Receptor	**Marine Protected Areas**	
Pressure Pathway/Impact	**Disturbance Effects from the Return of Launch Parts**	See the risk matrix for plankton, fish, marine megafauna and marine ornithology for effects to designated marine ecological features of the MPAs.

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Appendix 10.5 Humans and Human Activities Risk Matrix

SSC AEE report Appendix 10.5 - humans and human activities risk matrix

Receptor	**Commercial and Recreational Fishing**
Pressure Pathway/Impact	**Displacement of fishing stock**

Sensitivity of the Receptor

Value (importance, rarity, quality) of receptor	Qualifying Statement	Consideration	Classification
0	Receptor has no measurable financial, environmental or cultural value		
1	Receptor has a low financial, environmental or cultural value		
2	Receptor has a medium financial, environmental or cultural value		
3	Receptor has a high financial, environmental or cultural value	The study area supports commercially important fisheries for several nations.	3

Tolerance of receptor	Qualifying Statement	Consideration	Classification
0	Receptor is entirely tolerant of the impact and will not exhibit change if exposed		
1	Receptor is very tolerant of the impact and will exhibit marginal change if exposed	Fishing vessels in the study areas are predominantly mobile, due to their mostly offshore location, and therefore are able to move to follow displaced fishing stocks.	1
2	Receptor is slightly tolerant of the impact and will exhibit noticeable change if exposed		
3	Receptor is intolerant of the impact and will exhibit substantial change if exposed		

Adaptability of receptor	Qualifying Statement	Consideration	Classification
0	Receptor is entirely adaptable and as such will be unaffected by exposure		
1	Receptor is very adaptable and as such will be marginally affected by exposure	Adaptability is high as most fishing vessels will be able to move to follow displaced fishing stocks.	1
2	Receptor is slightly adaptable and as such will be noticeably affected by exposure		
3	Receptor is not adaptable and as such will be substantially affected by exposure		

Recoverability of receptor	Qualifying Statement	Consideration	Classification
0	Receptor will recover entirely within short timescales (<1 year)	Fish are highly mobile and will be able to return to an area once an LV has passed, predicted to occur on the short-term scale. Fishing vessels are adaptable and would also be able to return to the area where fish were.	0
1	Receptor will recover entirely within medium timescales (1-5 years)		
2	Receptor will recover entirely within long timescales (>5 years)		
3	Receptor will not entirely recover over any timescale		

Overall Sensitivity of the Receptor	**5**	**1**

Exposure of Receptor to Impact

Exposure to the impact (time)	Qualifying Statement	Consideration	Classification
0	Receptor is not exposed to impact		
1	Receptor is exposed to impact over limited periods of time		
2	Receptor is exposed to impact over considerable periods of time	Fish are likely to be exposed to impacts over considerable periods of time, i.e. the duration of the 30 year licence. However, given the short duration of the proposed impact, the longevity of the exposure is reduced.	2
3	Receptor is exposed to impact over extensive periods of time		

Exposure to the impact (frequency)	Qualifying Statement	Consideration	Classification
0	Receptor is very infrequently exposed to impact over limited periods of time (<1 event per month for the duration of the licence)		
1	Receptor is infrequently exposed to impact over limited periods of time (1-5 events per month for the duration of the licence)	There is expected to be up to 10 launches per year in the initial years, rising to a maximum of 30 launches per year.	1
2	Receptor is frequently exposed to impact over considerable periods of time (5-15 events per month for the duration of the licence)		
3	Receptor is constantly exposed to impact over considerable periods of time (>15 events per month for the duration of the licence)		

Exposure to the impact (space)	Qualifying Statement	Consideration	Classification
0	Receptor is not exposed to impact		
1	Receptor is exposed to impact over limited spatial scales	Due to the highly limited impact zone around LVs as they pass through the water column and rest at the seabed, impacts will be low.	1
2	Receptor is exposed to impact over considerable spatial scales		
3	Receptor is exposed to impact over extensive and unconfined spatial scales		

Overall Exposure of Receptor to Impact	**4**	**1**

Magnitude of Impact

Magnitude of the impact (in the context of natural variability)	Qualifying Statement	Consideration	Classification
0	Impact is not measurable above natural variability	The displacement of fish as a result of LVs entering the marine environment will not be detectable above natural variation.	0
1	Impact is measurable above natural variability (0-5% change in fishing stock)		
2	Impact is measurable above natural variability (6-10% change in fishing stock)		
3	Impact is measurable above natural variability (>10% change in fishing stock)		

Magnitude of the impact (in the context of environmental baseline conditions)	Qualifying Statement	Consideration	Classification
0	Impact is not measurable above present baseline conditions	The fish stock baseline will not change as a result of the LVs entering the marine environment.	0
1	Impact is measurable above present baseline conditions (0-5% change in fishing stock)		
2	Impact is measurable above present baseline conditions (6-10% change in fishing stock)		
3	Impact is measurable above present baseline conditions (>10% change in fishing stock)		

Overall Magnitude of Impact	**0**	**0**
Overall Risk (sensitivity x exposure x magnitude)	**Negligible**	**0**

Receptor	Commercial and Recreational Fishing
Pressure Pathway/Impact	Vessel displacement

Sensitivity of the Receptor

Value (importance, rarity, quality) of receptor	Qualifying Statement	Consideration	Classification
0	Receptor has no measurable financial, environmental or cultural value		
1	Receptor has a low financial, environmental or cultural value		
2	Receptor has a medium financial, environmental or cultural value		
3	Receptor has a high financial, environmental or cultural value	The study area supports commercially important fisheries for several nations.	3

Tolerance of receptor	Qualifying Statement	Consideration	Classification
0	Receptor is entirely tolerant of the impact and will not exhibit change if exposed		
1	Receptor is very tolerant of the impact and will exhibit marginal change if exposed	Vessels will receive communications wrt to the location of exclusion zones around the predicting landing area of LVs. Vessels are highly mobile and will be able to move away from these locations if required. Given the highly localised nature of the impact zones in comparison to the distribution of target species, fishing vessels are considered very tolerant of the impact.	1
2	Receptor is slightly tolerant of the impact and will exhibit noticeable change if exposed		
3	Receptor is intolerant of the impact and will exhibit substantial change if exposed		

Adaptability of receptor	Qualifying Statement	Consideration	Classification
0	Receptor is entirely adaptable and as such will be unaffected by exposure		
1	Receptor is very adaptable and as such will be marginally affected by exposure	Adaptability is high as most fishing vessels will be able to move to areas outside the impact zone.	1
2	Receptor is slightly adaptable and as such will be noticeably affected by exposure		
3	Receptor is not adaptable and as such will be substantially affected by exposure		

Recoverability of receptor	Qualifying Statement	Consideration	Classification
0	Receptor will recover entirely within short timescales (<1 year)	Fishing vessels are highly mobile and will be able to return to an area once an LV has passed, predicted to occur on the short-term scale (i.e. hours).	0
1	Receptor will recover entirely within medium timescales (1-5 years)		
2	Receptor will recover entirely within long timescales (>5 years)		
3	Receptor will not entirely recover over any timescale		

Overall Sensitivity of the Receptor	5	1

Exposure of Receptor to Impact

Exposure to the impact (time)	Qualifying Statement	Consideration	Classification
0	Receptor is not exposed to impact		
1	Receptor is exposed to impact over limited periods of time		
2	Receptor is exposed to impact over considerable periods of time		
3	Receptor is exposed to impact over extensive periods of time	Fishing vessels are likely to be exposed to impacts over considerable periods of time, i.e. the duration of the 30 year licence.	3

Exposure to the impact (frequency)	Qualifying Statement	Consideration	Classification
0	Receptor is very infrequently exposed to impact over limited periods of time (<1 event per month for the duration of the licence)		
1	Receptor is infrequently exposed to impact over limited periods of time (1-5 events per month for the duration of the licence)	There is expected to be up to 10 launches per year in the initial years, rising to a maximum of 30 launches per year.	1
2	Receptor is frequently exposed to impact over considerable periods of time (5-15 events per month for the duration of the licence)		
3	Receptor is constantly exposed to impact over considerable periods of time (>15 events per month for the duration of the licence)		

Exposure to the impact (space)	Qualifying Statement	Consideration	Classification
0	Receptor is not exposed to impact		
1	Receptor is exposed to impact over limited spatial scales	Due to the small spatial extent of the impact zone around returning LVs, impacts will be low.	1
2	Receptor is exposed to impact over considerable spatial scales		
3	Receptor is exposed to impact over extensive and unconfined spatial scales		

Overall Exposure of Receptor to Impact	5	2

Magnitude of Impact

Magnitude of the impact (in the context of natural variability)	Qualifying Statement	Consideration	Classification
0	Impact is not measurable above natural variability		
1	Impact is measurable above natural variability (0-5% change in distribution of fishing vessels)	The displacement of fishing vessels as a result of LVs entering the marine environment will be slightly detectable above natural variation.	1
2	Impact is measurable above natural variability (6-10% change in distribution of fishing vessels)		
3	Impact is measurable above natural variability (>10% change in distribution of fishing vessels)		

Magnitude of the impact (in the context of environmental baseline conditions)	Qualifying Statement	Consideration	Classification
0	Impact is not measurable above present baseline conditions	The fishing vessel presence baseline will not change as a result of the exclusion zones around LVs entering the marine environment.	0
1	Impact is measurable above present baseline conditions (0-5% change in distribution of fishing vessels)		
2	Impact is measurable above present baseline conditions (6-10% change in distribution of fishing vessels)		
3	Impact is measurable above present baseline conditions (>10% change in distribution of fishing vessels)		

Overall Magnitude of Impact	1	1
Overall Risk (sensitivity x exposure x magnitude)	Low	2

SSC AEE report Appendix 10.5 - humans and human activities risk matrix

Receptor	Human infrastructure (subsea cables/pipelines)
Pressure Pathway/Impact	Direct impact as a result of LVs returning

Sensitivity of the Receptor

Value (importance, rarity, quality) of receptor	Qualifying Statement	Consideration	Classification
0	Receptor has no measurable financial, environmental or cultural value		
1	Receptor has a low financial, environmental or cultural value		
2	Receptor has a medium financial, environmental or cultural value		
3	Receptor has a high financial, environmental or cultural value	Subsea cables and pipelines are of high financial value.	3

Tolerance of receptor	Qualifying Statement	Consideration	Classification
0	Receptor is entirely tolerant of the impact and will not exhibit change if exposed		
1	Receptor is very tolerant of the impact and will exhibit marginal change if exposed		
2	Receptor is slightly tolerant of the impact and will exhibit noticeable change if exposed		
3	Receptor is intolerant of the impact and will exhibit substantial change if exposed	Subsea cables and pipelines would potentially be intolerant of the impact of an LV as it could cause significant structural damage.	3

Adaptability of receptor	Qualifying Statement	Consideration	Classification
0	Receptor is entirely adaptable and as such will be unaffected by exposure		
1	Receptor is very adaptable and as such will be marginally affected by exposure		
2	Receptor is slightly adaptable and as such will be noticeably affected by exposure		
3	Receptor is not adaptable and as such will be substantially affected by exposure	Subsea cables and pipelines would potentially be not adapble to the impact of an LV as it could cause significant structural damage.	3

Recoverability of receptor	Qualifying Statement	Consideration	Classification
0	Receptor will recover entirely within short timescales (<1 year)		
1	Receptor will recover entirely within medium timescales (1-5 years)		
2	Receptor will recover entirely within long timescales (>5 years)		
3	Receptor will not entirely recover over any timescale	Subsea cables and pipelines could potentially not recover from the impact of an LV if it caused significant structural damage.	3

Overall Sensitivity of the Receptor	12	3

Exposure of Receptor to Impact

Exposure to the impact (time)	Qualifying Statement	Consideration	Classification
0	Receptor is not exposed to impact		
1	Receptor is exposed to impact over limited periods of time		
2	Receptor is exposed to impact over considerable periods of time		
3	Receptor is exposed to impact over extensive periods of time	Human infrastructure are likely to be exposed to impacts over extensive periods of time, i.e. the duration of the 30 year licence.	3

Exposure to the impact (frequency)	Qualifying Statement	Consideration	Classification
0	Receptor is very infrequently exposed to impact over limited periods of time (<1 event per month for the duration of the licence)	There is expected to be up to 10 launches per year in the initial years, rising to a maximum of 30 launches per year. However, the likelihood of LVs repeatedly encountering any given human infrastructure is extemely low, taking into account the extent of the study area.	0
1	Receptor is infrequently exposed to impact over limited periods of time (1-5 events per month for the duration of the licence)		
2	Receptor is frequently exposed to impact over considerable periods of time (5-15 events per month for the duration of the licence)		
3	Receptor is constantly exposed to impact over considerable periods of time (>15 events per month for the duration of the licence)		

Exposure to the impact (space)	Qualifying Statement	Consideration	Classification
0	Receptor is not exposed to impact		
1	Receptor is exposed to impact over limited spatial scales	Due to the highly limited impact zone around LVs, impacts will be low.	1
2	Receptor is exposed to impact over considerable spatial scales		
3	Receptor is exposed to impact over extensive and unconfined spatial scales		

Overall Exposure of Receptor to Impact	4	1

Magnitude of Impact

Magnitude of the impact (in the context of natural variability)	Qualifying Statement	Consideration	Classification
0	Impact is not measurable above natural variability		N/A
1	Impact is measurable above natural variability (0-5% change in total numbers of individuals)		N/A
2	Impact is measurable above natural variability (6-10% change in total numbers of individuals)		N/A
3	Impact is measurable above natural variability (>10% change in total numbers of individuals)		N/A

Magnitude of the impact (in the context of environmental baseline conditions)	Qualifying Statement	Consideration	Classification
0	Impact is not measurable above present baseline conditions		
1	Impact is measurable above present baseline conditions (0-5% change in total undisturbed available habitat)	If the impact was to occur then the magnitude of the impact would be high. However, it is considered that the likelihood of such an impact is negligible, hence the overall magnitude has been reduced	1
2	Impact is measurable above present baseline conditions (6-10% change in total undisturbed available habitat)		
3	Impact is measurable above present baseline conditions (>10% change in total undisturbed available habitat)		

Overall Magnitude of Impact	1	1
Overall Risk (sensitivity x exposure x magnitude)	Low	3

SSC AEE report Appendix 10.5 - humans and human activities risk matrix

Receptor	Marine and Coastal Tourism
Pressure Pathway/Impact	Interference/Displacement

Sensitivity of the Receptor

Value (importance, rarity, quality) of receptor	Qualifying Statement	Consideration	Classification
0	Receptor has no measurable financial, environmental or cultural value		
1	Receptor has a low financial, environmental or cultural value		
2	Receptor has a medium financial, environmental or cultural value	The study area supports a moderate amount of tourism and recreation activitly, which are mostly concentrated at the coast.	2
3	Receptor has a high financial, environmental or cultural value		

Tolerance of receptor	Qualifying Statement	Consideration	Classification
0	Receptor is entirely tolerant of the impact and will not exhibit change if exposed		
1	Receptor is very tolerant of the impact and will exhibit marginal change if exposed	Notices will be given out prior to launches from the Shetland Space Centre, which will allow many tourism/recreational activities to temporarily alter location or pause for the duration of the launch.	1
2	Receptor is slightly tolerant of the impact and will exhibit noticeable change if exposed		
3	Receptor is intolerant of the impact and will exhibit substantial change if exposed		

Adaptability of receptor	Qualifying Statement	Consideration	Classification
0	Receptor is entirely adaptable and as such will be unaffected by exposure		
1	Receptor is very adaptable and as such will be marginally affected by exposure	Most vessels are highly mobile and will be able to adapt if required to move away, with only small vessels that are slightly less adaptable.	1
2	Receptor is slightly adaptable and as such will be noticeably affected by exposure		
3	Receptor is not adaptable and as such will be substantially affected by exposure		

Recoverability of receptor	Qualifying Statement	Consideration	Classification
0	Receptor will recover entirely within short timescales (<1 year)	All vessels are highly mobile and will be able to return to an area once an LV has passed, predicted to occur on the short-term scale (i.e. hours).	0
1	Receptor will recover entirely within medium timescales (1-5 years)		
2	Receptor will recover entirely within long timescales (>5 years)		
3	Receptor will not entirely recover over any timescale		

Overall Sensitivity of the Receptor	**4**	**1**

Exposure of Receptor to Impact

Exposure to the impact (time)	Qualifying Statement	Consideration	Classification
0	Receptor is not exposed to impact		
1	Receptor is exposed to impact over limited periods of time	Tourism activities are likely to be exposed to impacts over considerable periods of time, i.e. the duration of the 30 year licence, however only for a short period per launch (45 minutes), up to a maximum of 11.25 hours over the licence term (30 launches per year × 30 years × 0.75 hours).	1
2	Receptor is exposed to impact over considerable periods of time		
3	Receptor is exposed to impact over extensive periods of time		

Exposure to the impact (frequency)	Qualifying Statement	Consideration	Classification
0	Receptor is very infrequently exposed to impact over limited periods of time (<1 event per month for the duration of the licence)		
1	Receptor is infrequently exposed to impact over limited periods of time (1-5 events per month for the duration of the licence)	There is expected to be up to 10 launches per year in the initial years, rising to a maximum of 30 launches per year.	1
2	Receptor is frequently exposed to impact over considerable periods of time (5-15 events per month for the duration of the licence)		
3	Receptor is constantly exposed to impact over considerable periods of time (>15 events per month for the duration of the licence)		

Exposure to the impact (space)	Qualifying Statement	Consideration	Classification
0	Receptor is not exposed to impact		
1	Receptor is exposed to impact over limited spatial scales	Due to the small spatial extent of the impact zone around returning LVs and the concentration of most tourist activities around the coast, impacts will be low.	1
2	Receptor is exposed to impact over considerable spatial scales		
3	Receptor is exposed to impact over extensive and unconfined spatial scales		

Overall Exposure of Receptor to Impact	**3**	**0**

Magnitude of Impact

Magnitude of the impact (in the context of natural variability)	Qualifying Statement	Consideration	Classification
0	Impact is not measurable above natural variability	N/A	N/A
1	Impact is measurable above natural variability (0-5% change in total numbers of individuals)	N/A	N/A
2	Impact is measurable above natural variability (6-10% change in total numbers of individuals)	N/A	N/A
3	Impact is measurable above natural variability (>10% change in total numbers of individuals)	N/A	N/A

Magnitude of the impact (in the context of environmental baseline conditions)	Qualifying Statement	Consideration	Classification
0	Impact is not measurable above present baseline conditions	The current tourism baseline will not impacted by the temporary implementation of small exclusion zones.	0
1	Impact is measurable above present baseline conditions (0-5% change in total undisturbed available habitat)		
2	Impact is measurable above present baseline conditions (6-10% change in total undisturbed available habitat)		
3	Impact is measurable above present baseline conditions (>10% change in total undisturbed available habitat)		

Overall Magnitude of Impact	**0**	**0**
Overall Risk (sensitivity x exposure x magnitude)	**Negligible**	**0**

SSC AEE report Appendix 10.5 - humans and human activities risk matrix

Receptor	Navigation and Shipping
Pressure Pathway/Impact	Vessel displacement

Sensitivity of the Receptor

Value (importance, rarity, quality) of receptor	Qualifying Statement	Consideration	Classification
0	Receptor has no measurable financial, environmental or cultural value		
1	Receptor has a low financial, environmental or cultural value		
2	Receptor has a medium financial, environmental or cultural value	The study area supports a moderate density of shipping traffic, which is mostly concentrated at the coast.	2
3	Receptor has a high financial, environmental or cultural value		

Tolerance of receptor	Qualifying Statement	Consideration	Classification
0	Receptor is entirely tolerant of the impact and will not exhibit change if exposed		
1	Receptor is very tolerant of the impact and will exhibit marginal change if exposed	Vessels will receive communications wrt to the location of exclusion zones around the predicting landing area of LVs. Most vessels are highly mobile and will be able to move away from these locations if required. There are no shipping lanes from which vessels could not move.	1
2	Receptor is slightly tolerant of the impact and will exhibit noticeable change if exposed		
3	Receptor is intolerant of the impact and will exhibit substantial change if exposed		

Adaptability of receptor	Qualifying Statement	Consideration	Classification
0	Receptor is entirely adaptable and as such will be unaffected by exposure		
1	Receptor is very adaptable and as such will be marginally affected by exposure	Most vessels are highly mobile and will be able to adapt if required to move away, with only small vessels that are slightly less adaptable.	1
2	Receptor is slightly adaptable and as such will be noticeably affected by exposure		
3	Receptor is not adaptable and as such will be substantially affected by exposure		

Recoverability of receptor	Qualifying Statement	Consideration	Classification
0	Receptor will recover entirely within short timescales (<1 year)	All vessels are highly mobile and will be able to return to an area once an LV has passed, predicted to occur on the short-term scale (i.e. hours).	0
1	Receptor will recover entirely within medium timescales (1-5 years)		
2	Receptor will recover entirely within long timescales (>5 years)		
3	Receptor will not entirely recover over any timescale		

Overall Sensitivity of the Receptor	**4**	**1**

Exposure of Receptor to Impact

Exposure to the impact (time)	Qualifying Statement	Consideration	Classification
0	Receptor is not exposed to impact		
1	Receptor is exposed to impact over limited periods of time		
2	Receptor is exposed to impact over considerable periods of time		
3	Receptor is exposed to impact over extensive periods of time	Vessels are likely to be exposed to impacts over considerable periods of time, i.e. the duration of the 30 year licence.	3

Exposure to the impact (frequency)	Qualifying Statement	Consideration	Classification
0	Receptor is very infrequently exposed to impact over limited periods of time (<1 event per month for the duration of the licence)		
1	Receptor is infrequently exposed to impact over limited periods of time (1-5 events per month for the duration of the licence)	There is expected to be up to 10 launches per year in the initial years, rising to a maximum of 30 launches per year.	1
2	Receptor is frequently exposed to impact over considerable periods of time (5-15 events per month for the duration of the licence)		
3	Receptor is constantly exposed to impact over considerable periods of time (>15 events per month for the duration of the licence)		

Exposure to the impact (space)	Qualifying Statement	Consideration	Classification
0	Receptor is not exposed to impact		
1	Receptor is exposed to impact over limited spatial scales	Due to the small spatial extent of the impact zone around returning LVs, impacts will be low.	1
2	Receptor is exposed to impact over considerable spatial scales		
3	Receptor is exposed to impact over extensive and unconfined spatial scales		

Overall Exposure of Receptor to Impact	**5**	**2**

Magnitude of Impact

Magnitude of the impact (in the context of natural variability)	Qualifying Statement	Consideration	Classification
0	Impact is not measurable above natural variability	N/A	N/A
1	Impact is measurable above natural variability (0-5% change in total numbers of individuals)	N/A	N/A
2	Impact is measurable above natural variability (6-10% change in total numbers of individuals)	N/A	N/A
3	Impact is measurable above natural variability (>10% change in total numbers of individuals)	N/A	N/A

Magnitude of the impact (in the context of environmental baseline conditions)	Qualifying Statement	Consideration	Classification
0	Impact is not measurable above present baseline conditions	The current shipping baseline will not impacted by the temporary implementation of small exclusion zones.	0
1	Impact is measurable above present baseline conditions (0-5% change in total undisturbed available habitat)		
2	Impact is measurable above present baseline conditions (6-10% change in total undisturbed available habitat)		
3	Impact is measurable above present baseline conditions (>10% change in total undisturbed available habitat)		

Overall Magnitude of Impact	**0**	**0**
Overall Risk (sensitivity x exposure x magnitude)	**Negligible**	**0**

SSC AEE report Appendix 10.5 - humans and human activities risk matrix

Receptor	Military Activities
Pressure Pathway/Impact	Vessel displacement

Sensitivity of the Receptor

Value (importance, rarity, quality) of receptor	Qualifying Statement	Consideration	Classification
0	Receptor has no measurable financial, environmental or cultural value		
1	Receptor has a low financial, environmental or cultural value		
2	Receptor has a medium financial, environmental or cultural value		
3	Receptor has a high financial, environmental or cultural value	Military activities are important in terms of economics and defence. Military activities occur intermittently in the study area.	3

Tolerance of receptor	Qualifying Statement	Consideration	Classification
0	Receptor is entirely tolerant of the impact and will not exhibit change if exposed		
1	Receptor is very tolerant of the impact and will exhibit marginal change if exposed	There will be communications wrt to the location of exclusion zones around the predicting landing area of LVs. Military vessels are highly mobile and will be able to move away from these locations if required.	1
2	Receptor is slightly tolerant of the impact and will exhibit noticeable change if exposed		
3	Receptor is intolerant of the impact and will exhibit substantial change if exposed		

Adaptability of receptor	Qualifying Statement	Consideration	Classification
0	Receptor is entirely adaptable and as such will be unaffected by exposure		
1	Receptor is very adaptable and as such will be marginally affected by exposure	Military vessels are highly mobile and will be able to adapt if required to move away, with only small vessels that are slightly less adaptable.	1
2	Receptor is slightly adaptable and as such will be noticeably affected by exposure		
3	Receptor is not adaptable and as such will be substantially affected by exposure		

Recoverability of receptor	Qualifying Statement	Consideration	Classification
0	Receptor will recover entirely within short timescales (<1 year)	Military vessels are highly mobile and will be able to return to an area once an LV has passed, predicted to occur on the short-term scale (i.e. hours).	0
1	Receptor will recover entirely within medium timescales (1-5 years)		
2	Receptor will recover entirely within long timescales (>5 years)		
3	Receptor will not entirely recover over any timescale		

Overall Sensitivity of the Receptor	5	1

Exposure of Receptor to Impact

Exposure to the impact (time)	Qualifying Statement	Consideration	Classification
0	Receptor is not exposed to impact		
1	Receptor is exposed to impact over limited periods of time		
2	Receptor is exposed to impact over considerable periods of time		
3	Receptor is exposed to impact over extensive periods of time	Vessels are likely to be exposed to impacts over considerable periods of time, i.e. the duration of the 30 year licence.	3

Exposure to the impact (frequency)	Qualifying Statement	Consideration	Classification
0	Receptor is very infrequently exposed to impact over limited periods of time (<1 event per month for the duration of the licence)	There is expected to be up to 10 launches per year in the initial years, rising to a maximum of 30 launches per year. Howver, military exercises occur on an intermittent basis i.e. not every month.	0
1	Receptor is infrequently exposed to impact over limited periods of time (1-5 events per month for the duration of the licence)		
2	Receptor is frequently exposed to impact over considerable periods of time (5-15 events per month for the duration of the licence)		
3	Receptor is constantly exposed to impact over considerable periods of time (>15 events per month for the duration of the licence)		

Exposure to the impact (space)	Qualifying Statement	Consideration	Classification
0	Receptor is not exposed to impact		
1	Receptor is exposed to impact over limited spatial scales	Due to the small spatial extent of the impact zone around returning LVs, impacts will be low.	1
2	Receptor is exposed to impact over considerable spatial scales		
3	Receptor is exposed to impact over extensive and unconfined spatial scales		

Overall Exposure of Receptor to Impact	4	1

Magnitude of Impact

Magnitude of the impact (in the context of natural variability)	Qualifying Statement	Consideration	Classification
0	Impact is not measurable above natural variability	N/A	N/A
1	Impact is measurable above natural variability (0-5% change in total numbers of individuals)	N/A	N/A
2	Impact is measurable above natural variability (6-10% change in total numbers of individuals)	N/A	N/A
3	Impact is measurable above natural variability (>10% change in total numbers of individuals)	N/A	N/A

Magnitude of the impact (in the context of environmental baseline conditions)	Qualifying Statement	Consideration	Classification
0	Impact is not measurable above present baseline conditions	The baseline military exercise in the study area is highly intermittent. Therefore the baseline will not change as a result of short-term implementation of ex	0
1	Impact is measurable above present baseline conditions (0-5% change in total undisturbed available habitat)		
2	Impact is measurable above present baseline conditions (6-10% change in total undisturbed available habitat)		
3	Impact is measurable above present baseline conditions (>10% change in total undisturbed available habitat)		

Overall Magnitude of Impact	0	0
Overall Risk (sensitivity x exposure x magnitude)	Negligible	0

SSC AEE report Appendix 10.5 - humans and human activities risk matrix

Receptor	Maritime archaeology
Pressure Pathway/Impact	Direct impacts - damage

Sensitivity of the Receptor

Value (importance, rarity, quality) of receptor	Qualifying Statement	Consideration	Classification
0	Receptor has no measurable financial, environmental or cultural value		
1	Receptor has a low financial, environmental or cultural value		
2	Receptor has a medium financial, environmental or cultural value		
3	Receptor has a high financial, environmental or cultural value	Any marine archaeological site in the study area is likely to have a high value associated, dependent on the items era.	3

Tolerance of receptor	Qualifying Statement	Consideration	Classification
0	Receptor is entirely tolerant of the impact and will not exhibit change if exposed		
1	Receptor is very tolerant of the impact and will exhibit marginal change if exposed		
2	Receptor is slightly tolerant of the impact and will exhibit noticeable change if exposed		
3	Receptor is intolerant of the impact and will exhibit substantial change if exposed	The tolerance of any archaeological sites in the area are considered relatively vulnerable via impact.	3

Adaptability of receptor	Qualifying Statement	Consideration	Classification
0	Receptor is entirely adaptable and as such will be unaffected by exposure		
1	Receptor is very adaptable and as such will be marginally affected by exposure		
2	Receptor is slightly adaptable and as such will be noticeably affected by exposure		
3	Receptor is not adaptable and as such will be substantially affected by exposure	There is no adaptability of any archaeological items or sites.	3

Recoverability of receptor	Qualifying Statement	Consideration	Classification
0	Receptor will recover entirely within short timescales (<1 year)		
1	Receptor will recover entirely within medium timescales (1-5 years)		
2	Receptor will recover entirely within long timescales (>5 years)		
3	Receptor will not entirely recover over any timescale	As any archaeological finds are anthropogenic items or sites, they are unable to recover.	3

Overall Sensitivity of the Receptor	12	3

Exposure of Receptor to Impact

Exposure to the impact (time)	Qualifying Statement	Consideration	Classification
0	Receptor is not exposed to impact		
1	Receptor is exposed to impact over limited periods of time		
2	Receptor is exposed to impact over considerable periods of time		
3	Receptor is exposed to impact over extensive periods of time	Marine archaeological sites are likely to be exposed to impacts over considerable periods of time, i.e. the duration of the 30 year licence.	3

Exposure to the impact (frequency)	Qualifying Statement	Consideration	Classification
0	Receptor is very infrequently exposed to impact over limited periods of time (<1 event per month for the duration of the licence)	There is expected to be up to 10 launches per year in the initial years, rising to a maximum of 30 launches per year. However, the likelihood of LVs repeatedly impacting any given marine archaeological site is extemely low, taking into account the extent of the study area.	0
1	Receptor is infrequently exposed to impact over limited periods of time (1-5 events per month for the duration of the licence)		
2	Receptor is frequently exposed to impact over considerable periods of time (5-15 events per month for the duration of the licence)		
3	Receptor is constantly exposed to impact over considerable periods of time (>15 events per month for the duration of the licence)		

Exposure to the impact (space)	Qualifying Statement	Consideration	Classification
0	Receptor is not exposed to impact		
1	Receptor is exposed to impact over limited spatial scales	Due to the small spatial extent of the impact zone around LVs reaching the seabed, impacts will be low.	1
2	Receptor is exposed to impact over considerable spatial scales		
3	Receptor is exposed to impact over extensive and unconfined spatial scales		

Overall Exposure of Receptor to Impact	4	1

Magnitude of Impact

Magnitude of the impact (in the context of natural variability)	Qualifying Statement	Consideration	Classification
0	Impact is not measurable above natural variability		N/A
1	Impact is measurable above natural variability (0-5% change in total numbers of individuals)		N/A
2	Impact is measurable above natural variability (6-10% change in total numbers of individuals)		N/A
3	Impact is measurable above natural variability (>10% change in total numbers of individuals)		N/A

Magnitude of the impact (in the context of environmental baseline conditions)	Qualifying Statement	Consideration	Classification
0	Impact is not measurable above present baseline conditions		
1	Impact is measurable above present baseline conditions (0-5% change in total undisturbed available habitat)	There is a very low likelihood that LVs reaching the seabed will have known impact on marine archaeological sites, but if this did occur it would affect the b	1
2	Impact is measurable above present baseline conditions (6-10% change in total undisturbed available habitat)		
3	Impact is measurable above present baseline conditions (>10% change in total undisturbed available habitat)		

Overall Magnitude of Impact	1	1
Overall Risk (sensitivity x exposure x magnitude)	Low	3

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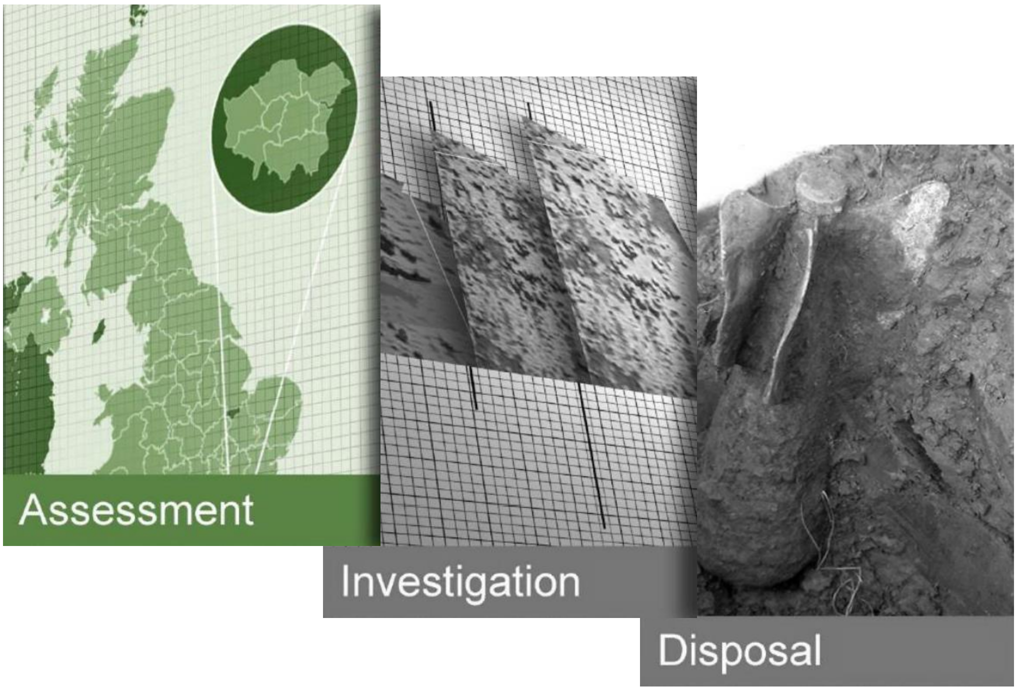
Appendix 11.1 Emissions Factors and Benchmarks

Appendix 11.1 Emission Factors and Benchmarks

Electricity			
Buildings	**Building Type (CIBSE benchmarks)**	**$kgCO_2$ per m^2 annual electricity consumption**	**Source**
Launch site processing facility, hazard store, gate house, pyrotechnic store, transporter holding building	Storage facility (storage warehouse or depot)	19.3	CIBSE 2008 Energy Benchmarks > Table 1 > Category 28 > Electricity typical benchmark
Administration building, control rooms, control centre	General office (general office and commercial working areas)	52.3	CIBSE 2008 Energy Benchmarks > Table 1 > Category 1 > Electricity typical benchmark
Saxa Vord Resort	Accommodation (general accommodation)	33	CIBSE 2008 Energy Benchmarks > Table 1 > Category 9 > Electricity typical benchmark
Natural gas			
Buildings	**Building Type (CIBSE benchmarks)**	**$kgCO_2$ per m^2 annual fuel consumption**	**Source**
Launch site processing facility, hazard store, gate house, pyrotechnic store, transporter holding building	Storage facility (storage warehouse or depot)	30.4	CIBSE 2008 Energy Benchmarks > Table 1 > Category 28 > Fossil fuel typical benchmark
Administration building, control rooms, control centre	General office (general office and commercial working areas)	22.8	CIBSE 2008 Energy Benchmarks > Table 1 > Category 1 > Fossil fuel typical benchmark
Saxa Vord resort	Accommodation (general accommodation)	57	CIBSE 2008 Energy Benchmarks > Table 1 > Category 9 > Fossil fuel typical benchmark

Launch Emissions			
Fuel	**Fuel (DEFRA emission factors)**	**kg CO_2e per tonne**	**Source**
Kerosene	Aviation turbine fuel	3,181	DEFRA 2020 Emissions Factors > Fuels > Liquid Fuels > Aviation Turbine Fuel > Tonnes > E54
Transport			**Phase: Operation and Construction**
Vehicle	**Vehicle (DEFRA emission factors)**	**kg CO_2e per km**	**Source of emissions factor**
HGV	Average HGV (diesel)	0.8654	DEFRA Conversion Factors 2020 > Freighting Goods > Q64
Car	Average car (unknown fuel)	0.1714	DEFRA Conversion Factors 2020 > Business travel-land > Y53
Light vehicle	Average van (unknown fuel)	0.24621	DEFRA Conversion Factors 2020 > Freighting Goods > U36
Vehicle	**Vehicle (DEFRA emission factors)**	**kg CO_2e per tonne transported 1km**	**Source of emissions factor**
Ferry	Ferry (average RoRo Ferry)	0.05166	DEFRA Conversion Factors 2020 > Freighting Goods > RoRo Ferry > Average > Tonne.km > F165
Vehicle	**Vehicle (DEFRA emission factors)**	**kg CO_2e per passenger transported 1km**	**Source of emissions factor**
Plane	Domestic to/from UK, with radiative forcing	0.02674	DEFRA Conversion Factors 2020 > WTT - business travel - air > WTT - flights > domestic to/from UK, average passenger > passenger.km > F20
Sea freight	Average cargo ship	0.01323 $kgCO_2e$/ tonne km	Cargo Ship - General Cargo - average

Appendix 12.1 ZETICA UXO Report



Shetland Space Centre - UXO Desk Study & Risk Assessment

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Checked by Sven Leman
Authorised by Stefan Lang

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UXO DESK STUDY & RISK ASSESSMENT

EXECUTIVE SUMMARY

Key findings: No significant sources of Unexploded Ordnance (UXO) hazard have been identified on the Site.

Key actions: UXO awareness briefing.

UXO Hazard Assessment

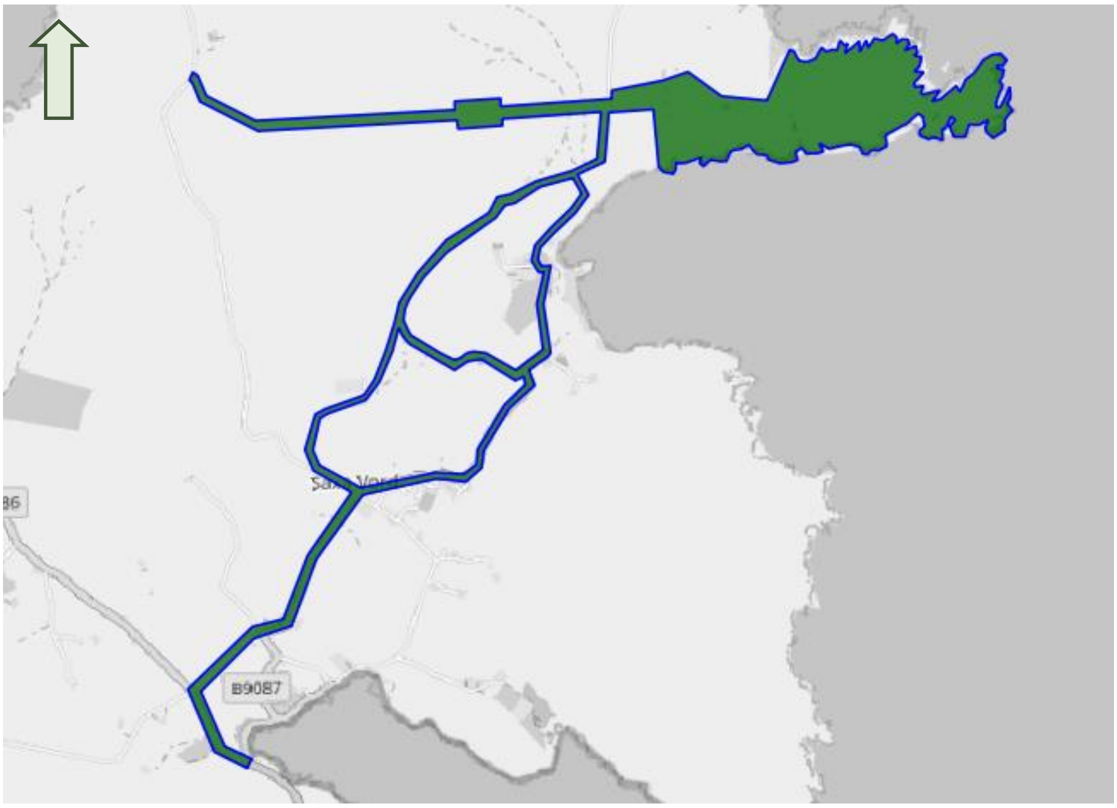
During WWII, Royal Air Force (RAF) Skaw, a radar station, was located on the eastern part of the Site.

No records of significant HE bombing or military activity associated with RAF Skaw likely to provide a significant source of UXO hazard has been found.

Given this, it is considered that the Site has a low UXO hazard level, as shown in the following Figure, reproduced as Figure 5 in the report.

The UXO hazard zone plan of the Site is also given in the accompanying P9238-19-R1-MAP01-B.

Figure	UXO hazard zone plan of the Site



Source: OpenStreetMap *Not to Scale*

Legend			
	Very Low	Low	Moderate
	High	Very High	Site boundary

It should be noted that the potential for encountering Small Arms Ammunition (SAA) or close combat munitions on any former military establishment as a result of localised disposal or spillage cannot be totally discounted. As such, staff should be suitably sensitised to the risk of encountering UXO.

The main findings of the report are summarised below.

- No records of bombing or military activity on the Site during World War One (WWI) have been found.
- In 1940, RAF Skaw was established on the eastern part of the Site to detect and track enemy aircraft over the North Sea. Associated Anti-Aircraft (AA) gun emplacements, anti-invasion defences and ammunition stores were also established on the Site.
- During WWII, RAF Skaw was a strategic target.
- Records have been found indicating that 8No. High Explosive (HE) bombs fell on the Site during WWII, causing minimal damage. 1No. of these was recorded as an Unexploded Bomb (UXB) and was removed.
- RAF Skaw closed in 1947. No records of other military activity on the Site post-WWII have been found.

Data Confidence Level

In general, there is a good level of confidence in the researched information sources used for this report.

Proposed Works

It is understood that initial works on the Site will include intrusive ground investigation, including excavated trial pits and peat probing.

Risk Assessment

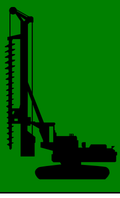
The Table below, reproduced as Table 3 in the main report, provides a UXO risk assessment for the proposed works on the Site.

Further details on the methodology for the risk assessment are provided in Section 7.2 of the main report.

Table	UXO risk assessment for the Site							
Potential UXO Hazard	**Anticipated Works**	**PE**	**PD**	**P = PE x PD**	**Likelihood**	**Severity**	**Risk Rating**	**UXO Risk**
UXB	Excavations	1	1	1	1	5	5	Low
	Ground Investigations	1	1	1	1	4	4	Low
Close Combat Munitions	Excavations	1	1	1	1	4	4	Low
	Ground Investigations	1	1	1	1	3	3	Low
Other UXO	Excavations	1	1	1	1	4	4	Low
	Ground Investigations	1	1	1	1	3	3	Low
SAA	Excavations	1	1	1	1	2	2	Low
	Ground Investigations	1	1	1	1	2	2	Low
PE (Probability of Encounter), PD (Probability of Detonation), P (Overall Probability)								
SAA (Small Arms Ammunition)								

Risk Mitigation Plan

The Table below, reproduced as Table 4 in the main report, summarises the UXO risk for proposed works on the Site and recommended actions.

Table	Summary of UXO risk and mitigation recommendations	
Proposed Works	**UXO Risk**	**Recommended Mitigation**
Excavations		**UXO awareness briefing -** Given the Site's military history it is recommended that a formal UXO awareness briefing is provided to staff involved in excavation.
Ground Investigations		**UXO awareness briefing** – as above

In summary, no additional measures are considered essential to reduce the UXO risk on the Site to As Low As is Reasonably Practicable (ALARP).

What Do I Do Next?

If you wish to proceed with UXO risk mitigation, Zetica would be happy to assist. Just contact us via phone (01993 886682) or email (uxo@zetica.com) and we can provide a proposal with options and prices.

If you have requirements to identify other buried hazards (such as mapping utilities or obstructions) we can provide these surveys.

If proposed works on the Site change, or additional works are planned, contact Zetica for a re-assessment of the UXO risk and the risk mitigation requirements.

CONTENTS

Figures, Plates, Tables & Drawings

Accompanying GIS Data

P9238-20-R1-MAP01-A (UXO Desk Study)

ABBREVIATIONS

AA	Anti-Aircraft
ACH	Advanced Chain Home
AES	Admiralty Experimental Station
ALARP	As Low As Reasonably Practicable
ARP	Air Raid Precaution
AXO	Abandoned Explosive Ordnance
BD	Bomb Disposal
BDO	Bomb Disposal Officer
BDU	Bomb Disposal Unit
CH	Chain Home
CMD	Conventional Munitions Disposal
DCLG	Department of Communities and Local Government
EO	Explosive Ordnance
EOC	Explosive Ordnance Clearance
EOR	Explosive Ordnance Reconnaissance
ERW	Explosive Remnants of War
ESA	Explosive Substances and Articles
FFE	Free From Explosives
HAA	Heavy Anti-Aircraft
HE	High Explosive
HSE	Health and Safety Executive
IB	Incendiary Bomb
IED	Improvised Explosive Device
IEDD	Improvised Explosive Device Disposal
JSEODOC	Joint Services EOD Operations Centre
LAA	Light Anti-Aircraft
MoD	Ministry of Defence
OB	Oil Bomb
PM	Parachute Mine
PUCA	Pick Up and Carry Away
RA	Royal Artillery
RAF	Royal Air Force
RCAF	Royal Canadian Air Force
RFC	Royal Flying Corps
RE	Royal Engineers
RN	Royal Navy
RRH	Remote Radar Head
TEP	Time Expired Pyrotechnics
UXAA	Unexploded Anti-Aircraft
UXB	Unexploded Bomb
UXO	Unexploded Ordnance
WWI	World War One
WWII	World War Two

UXO DESK STUDY & RISK ASSESSMENT

Please read: Zetica has colour coded each paragraph. Paragraphs with black text on a white background are paragraphs that provide site-specific information or information specifically researched as part of this project.

Boxed paragraphs in a dark green text with a green background are paragraphs providing general information and, where appropriate, links to online resources giving further detail. These are all available at www.zeticauxo.com. If you cannot gain access to these resources, Zetica can forward them on request.

1 INTRODUCTION

1.1 Project Outline

Zetica Ltd was commissioned by AECOM to carry out a detailed Unexploded Ordnance (UXO) Desk Study and Risk Assessment for an area of approximately 133.9 hectares (ha) at Skaw on Unst, Shetland (the 'Site').

The aim of this report is to gain a fair and representative view of the UXO hazard for the Site and its immediate surrounding area in accordance with the Construction Industry Research and Information Association (CIRIA) C681 'Unexploded Ordnance (UXO), a Guide for the Construction Industry'.

Where appropriate, this hazard assessment includes:

- Likelihood of ordnance being present.
- Type of ordnance (size, filling, fuze mechanisms).
- Quantity of ordnance.
- Potential for live ordnance.
- Probable location.
- Ordnance condition.

It should be noted that some military activity providing a source of UXO hazard may not be recorded and therefore there cannot be any guarantee that all UXO hazards affecting the Site have been identified in this report.

1.2 Sources of Information

Zetica Ltd researched the military history of the Site and its surrounding area using a range of information sources. The main sources of information are detailed in the following sections and referenced at the end of this report.

1.2.1 Zetica Ltd Defence Related Site Records

Zetica Ltd's in-house records were consulted, including reference books and archived materials from past work in the region. Relevant documents have been cited within the bibliography of this report.

1.2.2 Zetica Ltd Bombing Density Records and Maps

Reference has been made to the Zetica Ltd bomb risk maps located on Zetica's website (http://zeticauxo.com/downloads-and-resources/risk-maps/)

1.2.3 Ministry of Defence and Government Records

Government departments and units within the Ministry of Defence (MoD) were approached for information of past and present military activity in the area. These included the Department of Communities and Local Government (DCLG) records of abandoned bombs.

1.2.4 Other Historical Records, Maps and Drawings

Numerous reference documents including historical maps, aerial photographs and drawings have been consulted from sources such as the National Archives, the Scottish Government, the National Collection of Aerial Photography (NCAP), the US National Archives & Records Administration (NARA), the Imperial War Museum (IWM), Historic Environment Scotland (HES) and the Defence of Britain Project.

The British Geological Survey (BGS) was consulted for borehole information.

1.2.5 Local Authority Records

Information was obtained from Shetland Islands Council.

1.2.6 Local Record Offices and Libraries

Shetland Museum & Archives were consulted for records.

1.2.7 Local Historical and Other Groups

Local history groups and archaeological bodies were consulted, including the Shetlands Historic Environmental Record (HER), A History of Saxa Vord blog, and Shetland Flyer Aerial Aerial Media.

1.3 Data Confidence Level

In general, there is a good level of confidence in the researched information sources used for this report.

2 THE SITE

2.1 Site Location

The Site is centred on Ordnance Survey National Grid Reference (OSNGR) HP 650142. It is located approximately 3.3km northeast of Beltasound and approximately 72.7km north-northeast of Lerwick.

The Site comprises the footprint of the former Royal Air Force (RAF) Skaw and country roads between Haroldswick and Skaw. It is primarily bounded on the north, west and south by open fields, and to the east by the North Sea.

Figure 1 is a Site location map and Plate 1 is a recent aerial photograph of the Site.

Figure 1	Site location map

Source: OpenStreetMap *Not to Scale*

Legend	Site boundary (blue line)

Plate 1	Recent aerial photograph of the Site

Source: Google Earth *Not to Scale*

Legend	Site boundary

3 MILITARY ACTIVITY

The following sections outline the recorded military activity in the vicinity of the Site. The potential UXO hazard from WWI and WWII bombing is detailed in Section 4.

Each sub-section provides hyperlinks to further information on potential sources of UXO hazard. These are also available at www.zeticauxo.com. If you cannot gain access to these resources, Zetica can forward them on request.

3.1 RAF Skaw

Between 1940 and 1947, RAF Skaw was located on the eastern part of the Site. A brief operational history of the station is given below.

3.1.1 Operational History of RAF Skaw

Between January and April 1940, the Lamba Ness peninsula was surveyed and chosen as the location of a radar station, part of a network established on Scotland's eastern coast to defend against a potential German invasion from Norway.

The station opened as an Advanced Chain Home (ACH) establishment, with military accommodation buildings and wooden radar towers constructed on the eastern part of the Site. In November 1940, the first RAF personnel arrived on the Site and ACH Skaw was operational from January 1941.

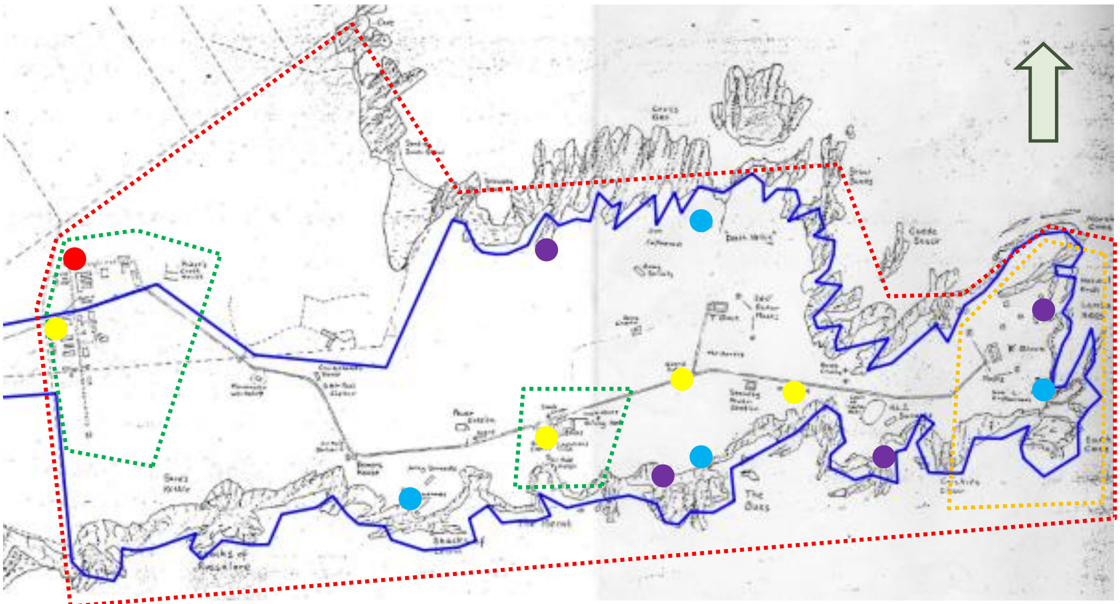
From 1941, RAF Skaw was engaged in plotting the movements of enemy aircraft over the Shetland Islands.

In April 1941, the command of ACH Skaw was transferred to No. 71 Wing RAF.

Between 1941 and 1942, the station expanded with the construction of steel radar towers, as well as 2No. accommodation and administrative camps constructed on the western part of Lamba Ness, on the Site. In May 1942, the station was upgraded to a Chain Home (CH) station.

Figure 2 is a plan of RAF Skaw, dating from WWII, at its greatest extent. The plan shows the location of radar and accommodation facilities, as well as the station's defences.

Figure 2	Plan of RAF Skaw, WWII

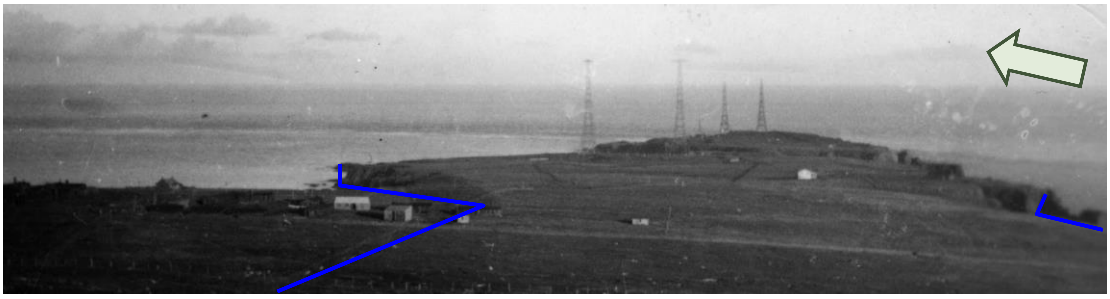


Source: A History of Saxa Vord *Not to Scale*

Legend		
Site boundary	ACH Site	RAF Skaw
Domestic sites	Machine gun emplacements	Bofors guns
Guard hut	Ammunition store	

Plate 2 is an oblique aerial photograph of RAF Skaw, dating from 1944/1945.

Plate 2	Oblique aerial photograph of RAF Skaw, 1944/1945



Source: A History of Saxa Vord *Not to Scale*

Legend	Site boundary

As the danger posed by enemy aircraft over Shetland receded, the operations of the radar station were gradually downscaled and by April 1944 the steel radar towers had been dismantled. Until August 1944, the station's main duty was to support the operations of Royal Navy (RN) Saxa Vord, located approximately 0.8km north of the Site (see Section 3.2).

In August 1945, the station was ordered to cease operations and was put into care and maintenance until its final closure in 1947.

The remaining radar facilities and military equipment was removed, and the remaining buildings and defences were abandoned. Records indicate that after 1947, empty buildings on the Site were occasionally used for fire-fighting practice by both RAF and civilian fire departments.

Details of activities at RAF Skaw that may provide a source of UXO hazard are given in the Sections below.

3.1.2 Military activities at RAF Skaw

The following sections provide details about potential sources of UXO hazard associated with military activities at RAF Skaw.

Ordnance Stores

Records indicate that 1No. ammunition store was established at RAF Skaw, north of the main residential camp, approximately 80m north of the Site (see Figure 2). Records indicate that this contained primarily SAA and Type 36M grenades.

Additionally, 4No. guard huts were established across the Site which were equipped with ammunition lockers for SAA. Records indicate that these stores were removed after the closure of RAF Skaw.

Ordnance stores are not considered to provide a source of UXO hazard to the Site.

Station Defences

In 1940, 3No. Light Anti-Aircraft (LAA) guns were established at RAF Skaw, on the Site, to defend against low-flying enemy aircraft. These comprised Browning machine guns and were manned and operated by troops from the Argyle and Sutherland Highlanders.

These defences could also be used to defend against an attack from the land.

Plate 3 is a recent photograph of a machine gun emplacement on the Site.

Plate 3 Photograph of a machine gun emplacement on the Site

Source: A History of Saxa Vord *Not to Scale*

By January 1942, 4No. additional LAA emplacements were constructed on the Site. These housed 40mm Bofors guns and had associated ammunition stores.

Plate 4 is a recent photograph of an LAA emplacement on the Site.

Plate 4	Photograph of LAA emplacement on the Site

Source: A History of Saxa Vord *Not to Scale*

By August 1942, additional machine gun posts were established on the Site (see Figure 2) which could be used as AA defences and against a ground attack if necessary.

After the closure of RAF Skaw in 1945, the station was disarmed. Records indicate that some of the LAA guns were relocated to the RN Saxa Vord station.

Potential UXO Hazard

Station defences had associated ammunition caches which would have stored Small Arms Ammunition (SAA), in addition to close combat munitions such as grenades. 4No. LAA guns on the Site had associated ammunition huts to store 40mm shells.

Records indicate that these munitions caches were removed after RAF Skaw closed, though the possibility of localised spillage around station defences cannot be totally discounted.

SAA is not considered to provide a significant source of UXO hazard (see Appendix 1).

3.2 Firing Ranges and Military Training Areas

For further information on firing ranges and military training areas, and the potential UXO hazards associated with them, follow the links below:

- Artillery Ranges
- Bombing Ranges
- Military Training Areas
- Small Arms Ranges

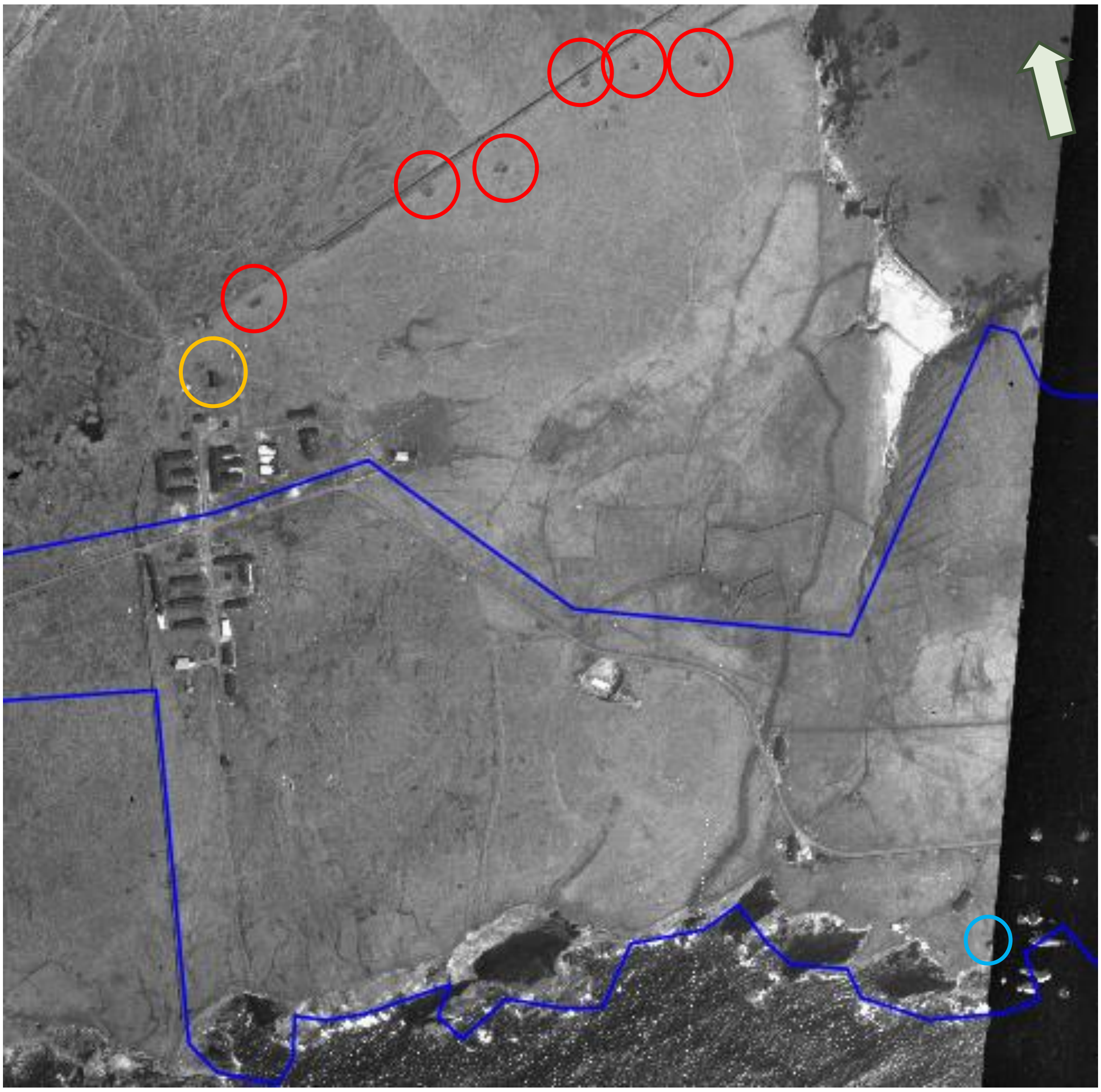
No records of artillery or bombing ranges on or in close proximity to the Site have been found.

Records have been found indicating that rifle practice took place at RAF Skaw at an undisclosed location. No dedicated ranges or training areas have been identified on the Site and it is considered possible that firing was directed out to sea.

Plate 5 is an aerial photograph of the western part of RAF Skaw, dated the 18th May 1946. No evidence of disturbed ground typical of military training or ordnance disposal have been identified.

The locations of the ammunition store and a machine gun emplacement are shown. Possible bomb craters have also been highlighted (see Section 4).

Plate 5	Aerial photograph of the western part of RAF Skaw, 18th May 1946



Source: NCAP *Not to Scale*

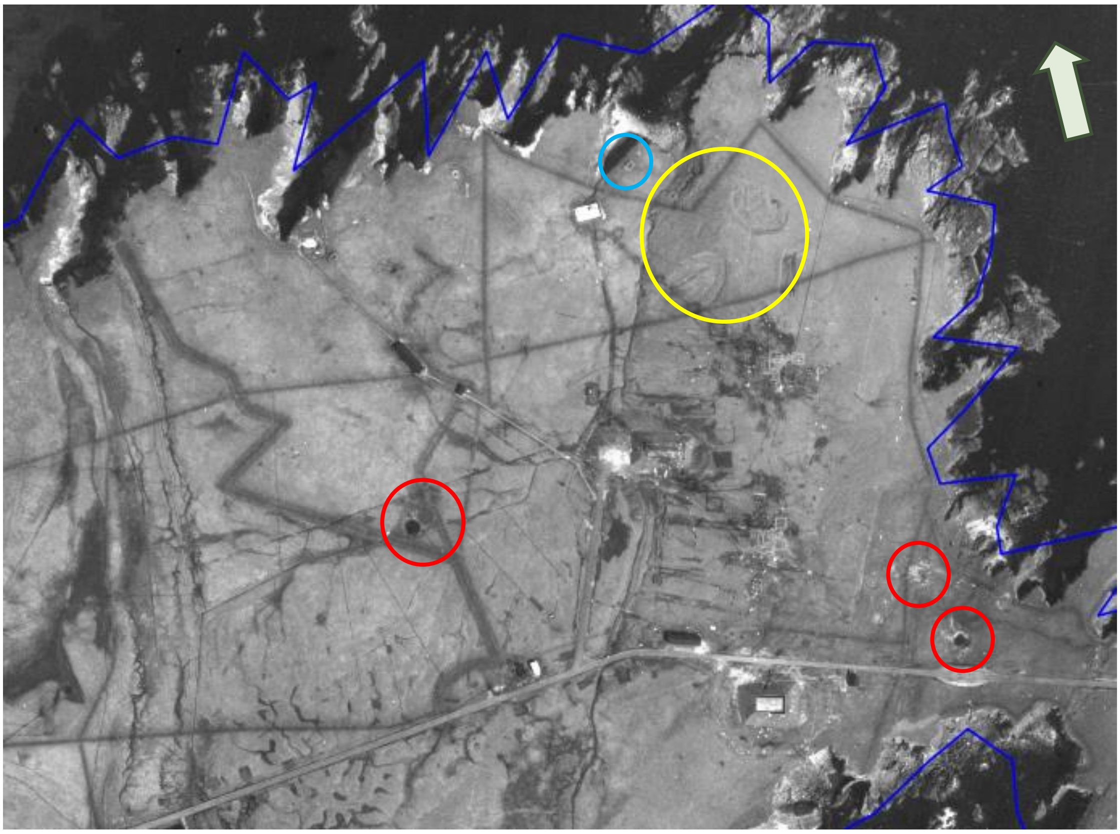
Legend	Site boundary	Machine gun emplacement	Ammunition store
	Possible bomb damage		

Plate 6 is an aerial photograph of the central part of RAF Skaw, dated the 18th May 1946. No evidence of disturbed ground typical of military training or ordnance disposal have been identified.

AA and anti-invasion defences have been highlighted, as well as an area of possible historic peat excavation.

Bomb craters have also been highlighted (see Section 4).

Plate 6	Aerial photograph of the central part of RAF Skaw, 18th May 1946



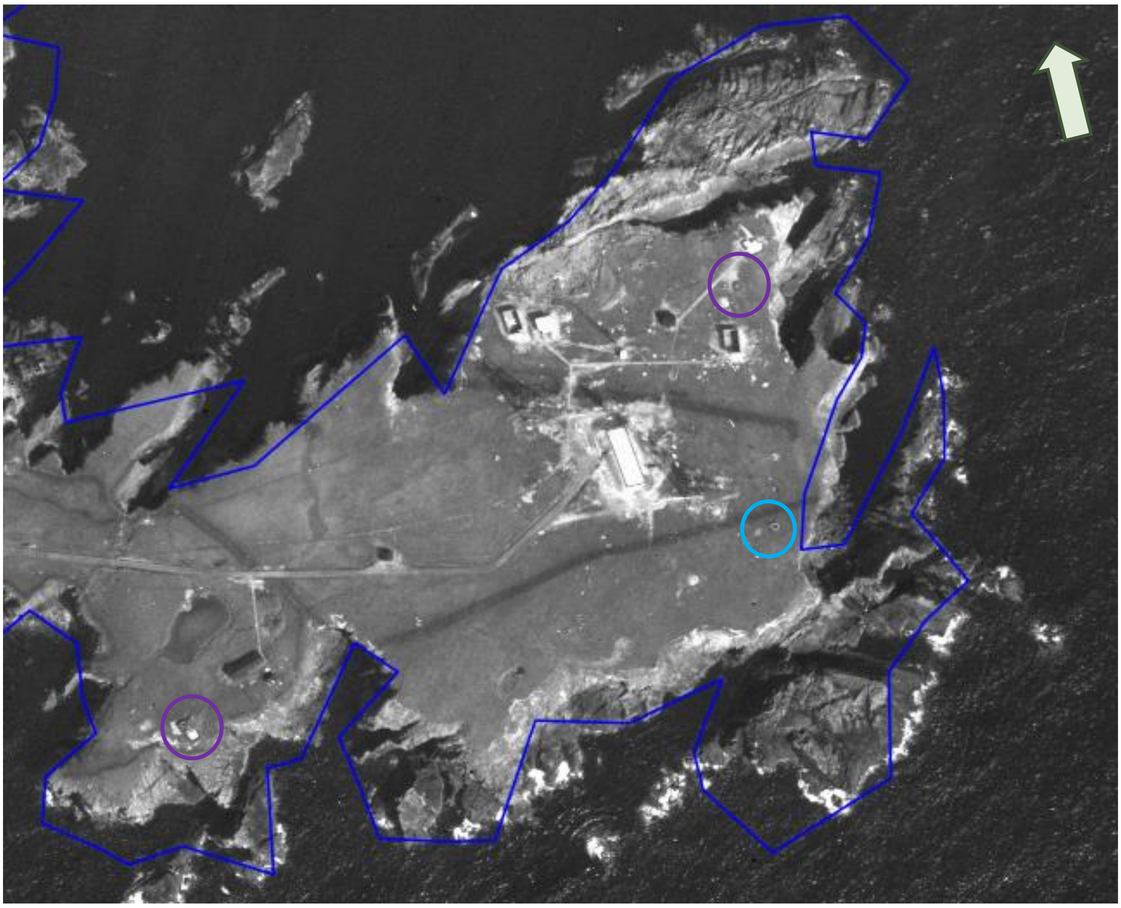
Source: NCAP *Not to Scale*

Legend		
	Site boundary	Machine gun emplacement
	Possible bomb damage	Possible peat excavations

Plate 7 is an aerial photograph of the eastern part of RAF Skaw, dated the 18th May 1946. No evidence of disturbed ground typical of military training or ordnance disposal have been identified.

AA and anti-invasion defences have been highlighted.

Plate 7	Aerial photograph of the eastern part of RAF Skaw, 18th May 1946



Source: NCAP *Not to Scale*

Legend	Site boundary	Machine gun emplacement
	Bofors guns	

Potential UXO Hazard

No obvious evidence of significant military training has been identified on historical aerial photography.

Given the history of RAF Skaw and intensive military use of the area during WWII, the possibility that training was conducted on the Site cannot be totally discounted.

3.3 Explosives Factories, Munitions Depots and Disposal Areas

For further information on explosives factories, munitions depots and disposal areas, and the potential UXO hazards associated with them, follow the links below:

- Explosives Factories
- Munitions Depots
- Munitions Disposal Areas

Other than those detailed in Section 3.1, no records of any explosives factories or munitions depots on or in close proximity to the Site have been found.

3.3.1 Munitions Disposal Areas

No records of any formal munitions disposal areas at RAF Skaw have been found.

Records indicate that the official procedure for dealing with defective munitions was to return them to a central ordnance depot located in the vicinity of Lerwick, Shetland, approximately 70km southwest of the Site.

Potential UXO Hazard

No evidence of features typical of munitions disposal areas, such as disturbed ground and burning pits, have been identified on historical aerial photographs.

As with any military establishment during WWII, the possibility that surplus or faulty munitions were disposed of locally cannot be totally discounted.

This would typically occur at remote and uninhabited locations nearby and it is possible that nearby beaches may have presented a convenient location for disposal operations.

Recent photographs provided by the Client indicate that domestic waste has been regularly disposed of over the sea cliffs surrounding the Site at RAF Skaw. It is possible that excess or faulty munitions were similarly disposed of in this manner during WWII.

3.4 Other Military Establishments

3.4.1 Royal Navy (RN) Saxa Vord

In September 1940, a Royal Navy (RN) radar station was established approximately 0.8km north of the Site, known as both No. 4 Admiralty Experimental Station (AES) and His Majesty's Ship (HMS) Fox.

RN Saxa Vord was one of 6No. naval radar stations established across the Shetland Islands during WWII whose main purpose was mapping the movements of German U-boats. RN Saxa Vord was operated by navy personnel, supported by the RAF personnel of RAF Skaw.

In the summer of 1940, Royal Marines engaged in the construction of an air strip in the vicinity of the Baltasound Pier, approximately 2.9km south of the Site, were stationed at the residential quarters of RN Saxa Vord.

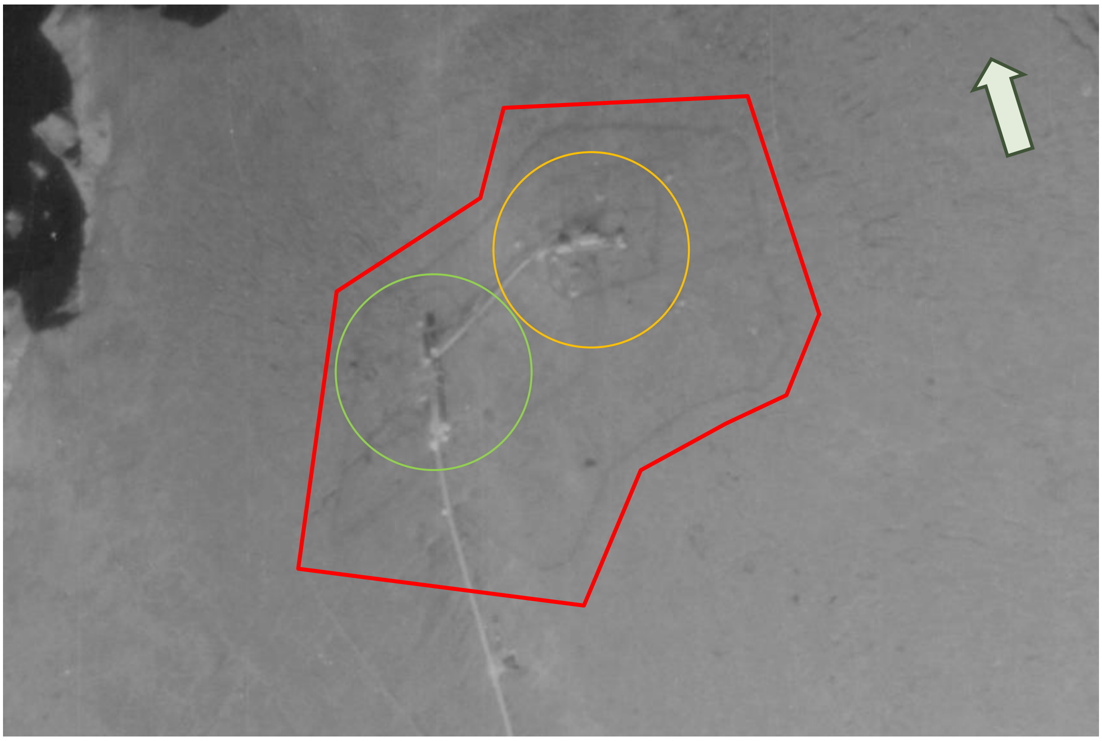
Records have been found indicating that Royal Canadian Air Force (RCAF) personnel were present at RN Saxa Vord.

The station comprised a lower site with accommodation buildings and power generators, and an upper site containing radar equipment. These had been developed further by 1942.

Records indicate that the defences at RN Saxa Vord included 2No. Hotchkiss machine guns.

Plate 8 is an aerial photograph dating from 1944, showing the accommodation and radar sites of RN Saxa Vord, protected by a wire fence.

Plate 8	Aerial photograph of RN Saxa Vord, 1944



Source: NCAP *Not to Scale*

Legend	RN Saxa Vord	Accommodation site	Radar site

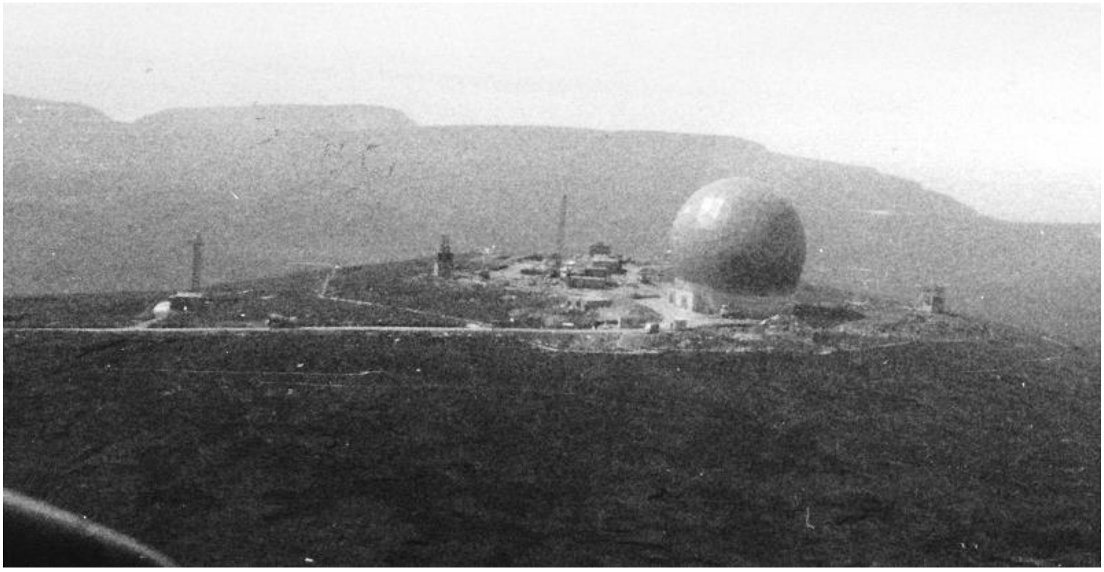
In 1946, RN Saxa Vord ceased operations and was put into care and maintenance until 1954, when it re-opened as No. 91 Signal Unit to provide radar coverage over the North Sea during the Cold War. Approximately 150-200No. personnel were present at the station.

During the 1950s, married quarters were established on Settler`s Hill, adjacent to the central part of the Site.

During the 1960s, units from the Royal Engineers (RE) constructed an airstrip at Ordale, approximately 4.2km south of the Site. Records indicate that RE personnel visited No. 91 Signal Unit at Saxa Vord at this time and were equipped with explosives.

Plate 9 is an oblique aerial photograph, dating from 1976-1977, showing the No. 91 Signal Unit at Saxa Vord.

Plate 9	Aerial photograph of No. 91 Signal Unit Saxa Vord, 1976-1977



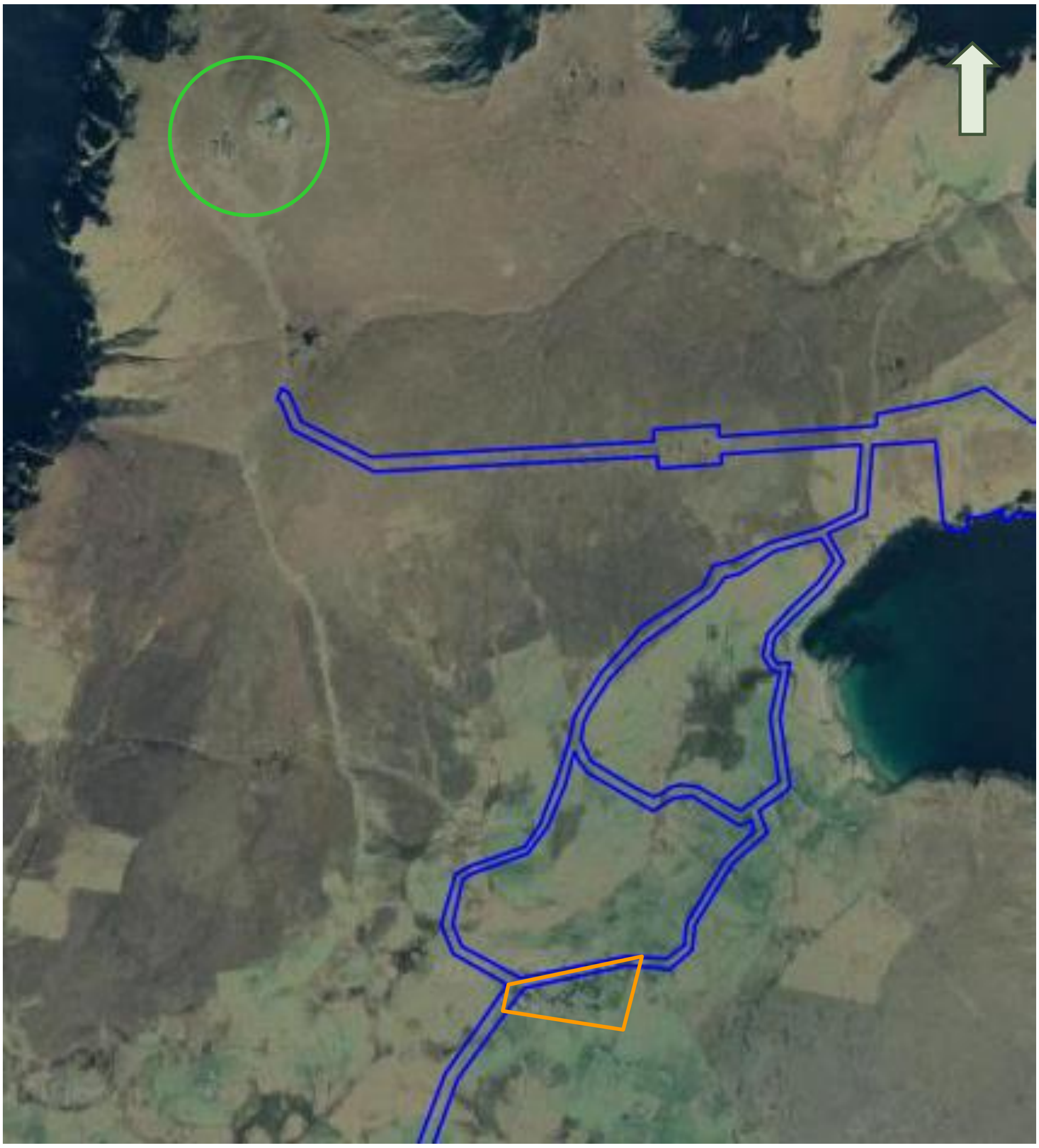
Source: A History of Saxa Vord *Not to Scale*

In 1987, the station was renamed to RAF Saxa Vord.

In 2000, the radar station was downscaled to Remote Radar Head (RRH) Saxa Vord. It was put in care and maintenance again in 2015. A re-opening was announced in 2017.

Plate 10 is a recent aerial photograph showing the location of RRH Saxa Vord and the former accommodation Site in Settler's Hill.

Plate 10	Aerial photograph of RRH Saxa Vord



Source: Google Earth *Not to Scale*

Legend	Site boundary	RRH Saxa Vord	Accommodation site

RN Saxa Vord is not considered to provide a source of UXO hazard to the Site.

3.5 Defences

For further information on military defences, and the potential UXO hazards associated with them, follow the links below:

- Anti-Aircraft Guns
- Anti-Invasion Defences
- Barrage Balloons
- Bombing Decoys

- Home Guard
- Mined Locations
- Mortar & Gun Emplacements
- Pillboxes

During WWII, approximately 20,000No. troops were stationed across the Shetland Islands to maintain ant-invasion defences and for training.

Records indicate that several Highland Light Infantry, Black Watch Home Defence, and Royal Artillery (RA) units were stationed on the island of Unst, manning the defences at RAF Skaw and RN Saxa Vord.

Other than those discussed in Section 3.1, no further military defences have been identified on or in the vicinity of the Site.

3.6 Military Airfields

For further information on military airfields, and the potential UXO hazards associated with them, follow the links below:

- Military Airfields

No records of any military airfields on or in close proximity to the Site have been found.

During WWI, there was a seaplane station at Cat Firth, Shetland (HU 458524), approximately 61.7km southwest of the Site.

The nearest operational airfield during WWII was Royal Air Force (RAF) Sullom Voe (HU 411747), approximately 44.3km west-southwest of the Site. This was a sea plane station.

Records indicate that during WWII, a temporary landing strip was established near the Baltasound Pier, approximately 2.7km south of the Site. This serviced mainly Walrus seaplanes delivering supplies and personnel to Unst.

Military airfields are not considered to provide a source of UXO hazard to the Site.

3.7 Aircraft Crashes

For further information on military aircraft crashes, and the potential UXO hazards associated with them, follow the links below:

- Aircraft Crashes

No records of any aircraft crashes on or in close proximity to the Site have been found.

4 BOMBING

4.1 WWI Bombing

For further information on WWI bombing in the UK, and the potential UXO hazard associated with it, see Appendix 2.1. Alternatively, use the following link.

- WWI Bombing

No records have been found indicating that the Site was bombed during WWI.

4.2 WWII Bombing

For further information on WWII bombing in the UK, and the potential UXO hazard associated with it, see Appendix 2.2. Alternatively, use the following link.

- WWII Bombing

Records have been found indicating that several bombs fell on the Site during WWII. Details of WWII bombing in the vicinity of the Site are provided in the following sections.

4.2.1 Bombing in Shetland

From prior to the declaration of war in 1939, Britain, including Shetland, was subjected to reconnaissance flights by the Luftwaffe which was building up a photographic record of potential targets.

This northerly part of the British Isles was strategically important to both sides. The Allied forces needed the bases to be able to control the sea passages to the north and west of Britain, whilst it was believed that the Germans considered invading Britain from Norway through Shetland.

Lerwick, the capital was a major port which was subject to attack by mining the approaches and bombing the town and its defences.

4.2.2 Strategic Targets

RAF Skaw, on the Site, was a potential target of opportunity for Luftwaffe bombers passing overhead. Other strategic targets in the vicinity of the Site included other military establishments such as RN Saxa Vord, approximately 0.8km north of the Site.

Plate 11 is a Luftwaffe target photograph of RAF Scatsa, Shetland, dating from February 1941, approximately 4.6km southwest of the Site.

Plate 11	Luftwaffe target photograph of RAF Scatsa, February 1941

Source: NARA *Not to Scale*

4.2.3 Bombing Densities and Incidents

Table 1 gives details of the overall bombing statistics recorded for the Local Authority (LA) Districts of the Site and surrounding districts. These were categorised as Small Burghs (SB), Large Burghs (LB) and County LAs. WWII bomb density levels are defined below:

<5 bombs per 405ha is a Very Low regional bombing density.

5-15 bombs per 405ha is Low.

15-50 bombs per 405ha is Moderate.

50-250 bombs per 405ha is High.

>250 bombs per 405ha is Very High.

Table 1 Bombing statistics

Area	Bombs Recorded				
	High Explosive	Parachute Mines	Other	Total	Bombs per 405ha (1000 acres)
Zetland LA	**72**	**0**	**0**	**72**	**0.2**

Note that Table 1 excludes the figures for Incendiary Bombs (IBs). Discrepancies between this list and other records, such as bomb clearance records, demonstrate that this data is likely to under-represent actual bombing.

Details of the nearest recorded bombing incidents to the Site are given in the following section.

1940 (date unspecified)

1No. HE bomb fell on RN Saxa Vord, approximately 0.8km north of the Site.

24th February 1941

2No. HE bombs fell near the Loch of Lamba Ness, on the Site.

2No. HE bombs fell near the RAF Skaw camp entrance, on the Site. 1No. of these was recorded as an Unexploded Bomb (UXB) and removed.

26th March 1941

4No. HE bombs fell in the sea off Lamba Ness, approximately 0.1km north of the Site.

27th March 1941

2No. 250kg HE bombs fell on open ground at RAF Skaw, on the north-central part of the Site.

15th October 1941

2No. 500kg HE bombs fell on open ground near the RAF Skaw accommodation camp, on the Site.

4th January 1942

2No. HE bombs fell in sea near Lamba Ness, approximately 0.1km south of the Site.

Plate 12 is an aerial photograph of the southern part of the Site, dated the 19th September 1944. No bomb damage has been identified on or in the vicinity of the southern part of the Site.

Plate 12	Aerial photograph of the southern part of the Site, 19th September 1944

Source: NCAP *Not to Scale*

Legend	Site boundary (blue line)

Plate 13 is an aerial photograph of the central part of the Site, dated the 19th September 1944. No bomb damage has been identified on or in the vicinity of the central part of the Site.

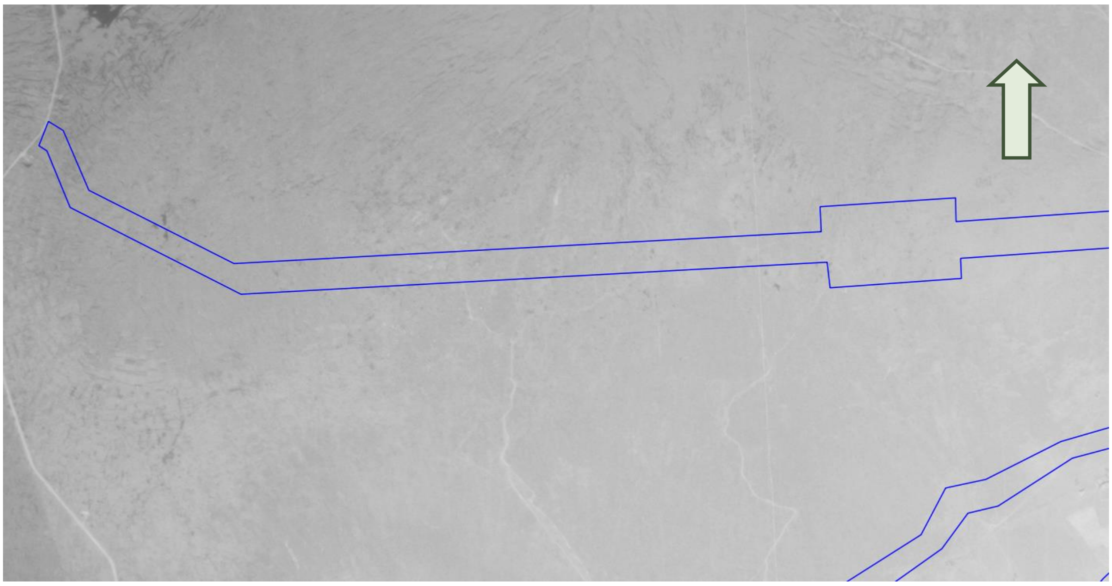
Plate 13	Aerial photograph of the central part of the Site, 19th September 1944

Source: NCAP *Not to Scale*

Legend	Site boundary

Plate 14 is an aerial photograph of the western part of the Site, dated the 19th September 1944. No bomb damage has been identified on or in the vicinity of the western part of the Site.

Plate 14	Aerial photograph of the western part of the Site, 19th September 1944



Source: NCAP *Not to Scale*

Legend	Site boundary

Isolated bomb damage was identified on and in the vicinity of the Site at RAF Skaw (see Plates 3-5).

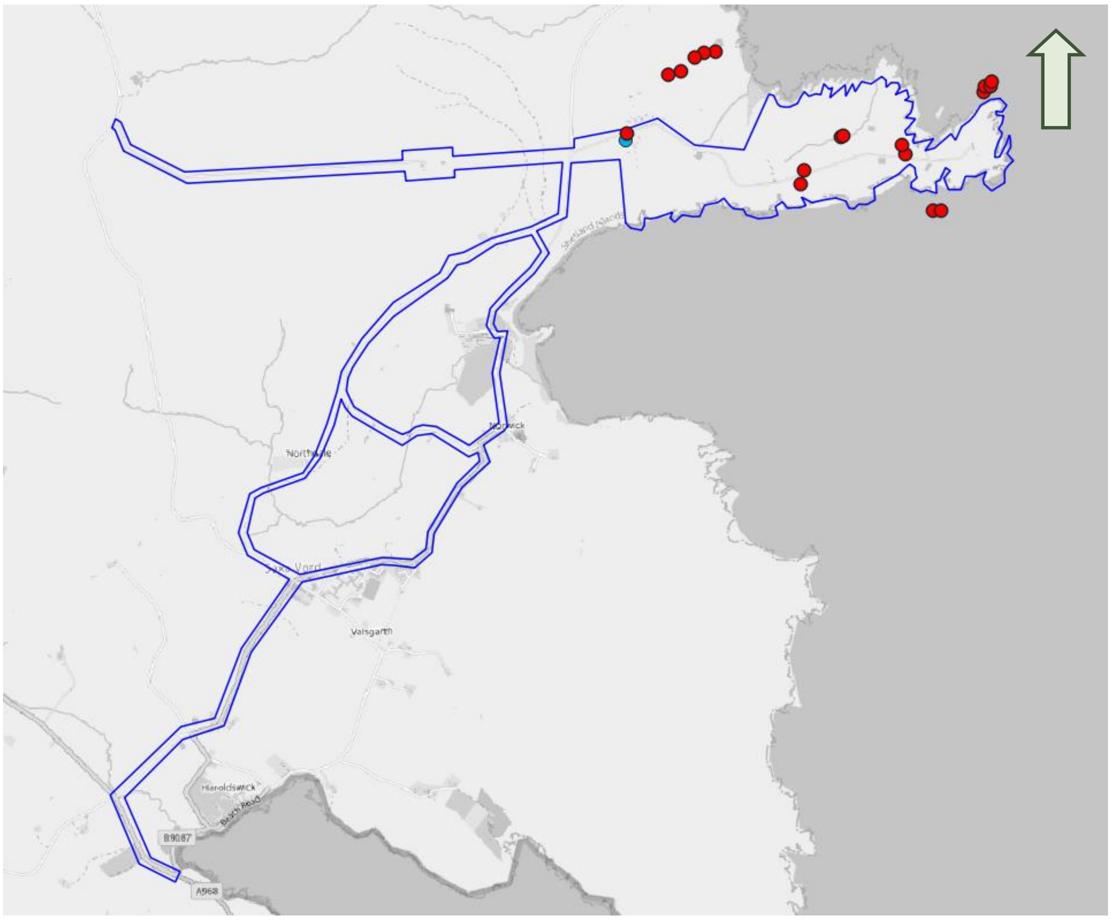
It should be noted that during WWII, many Unexploded Bombs (UXBs) were mapped and subsequently removed as and when conditions and demands on Bomb Disposal teams allowed. Their removal was not always accurately recorded and sometimes records were later destroyed. In practice, most UXB were probably removed and only a much smaller number were actually registered as officially abandoned bombs.

Figure 3 is a map showing the approximate location of recorded bomb impacts in the immediate vicinity of the Site.

The map has been compiled from a number of different sources, including air raid incident reports, historical aerial photographs and bomb census maps.

The bomb map is also given in the accompanying P9238-20-R1-MAP01-A.

Figure 3 Compiled bomb impact map for the vicinity of the Site

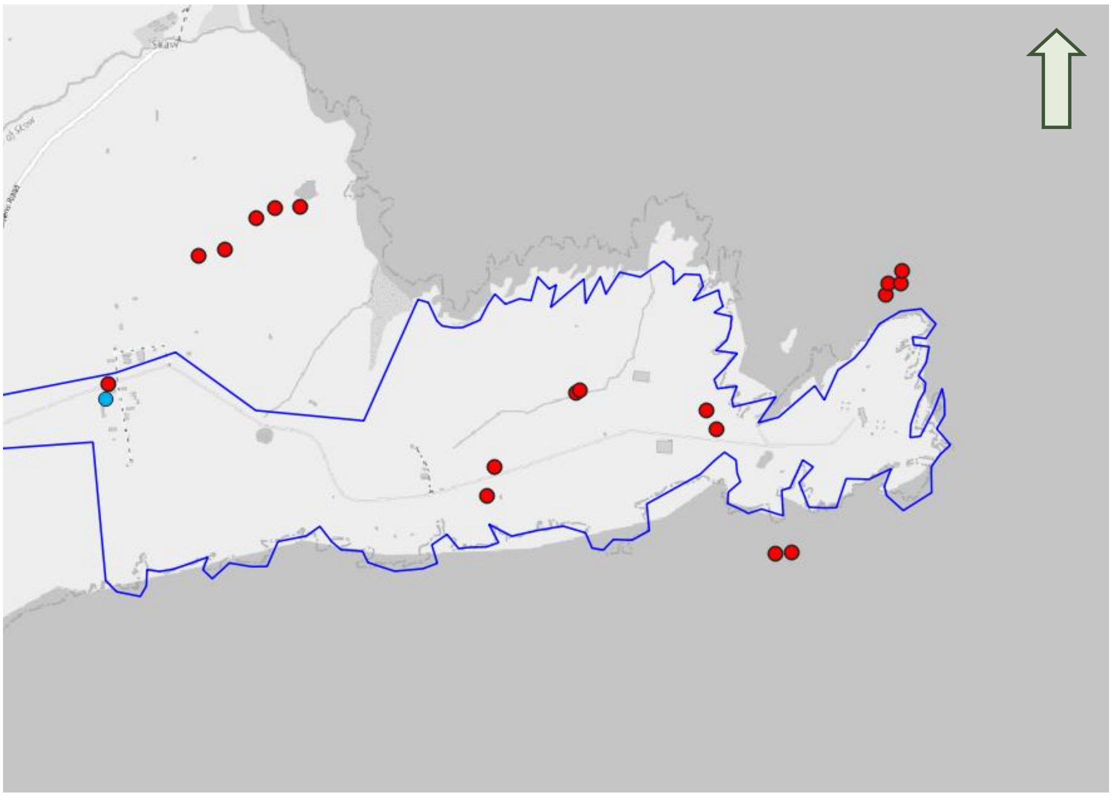


Source: OpenStreetMap *Not to Scale*

Legend	Site boundary (blue line)	HE bomb (red circle)	UXB (blue circle)

Figure 4 is a compiled bomb map showing the approximate location of recorded bomb impacts in the immediate vicinity of the eastern part of the Site.

Figure 4	Compiled bomb impact map for the vicinity of the Site (detail)



Source: OpenStreetMap *Not to Scale*

Legend	Site boundary	HE bomb	UXB

Potential UXO Hazard

Records have been found indicating that 8No. HE bombs fell on the Site. 1No. was recorded as a UXB and was removed.

No significant bomb damage or cratering likely to mask the impact of a UXB has been identified on the Site on historical aerial photography.

Raids involved single aircraft dropping small numbers of bombs and no significant damage was recorded to the Station. Given the continuous military presence on the eastern part of the Site during WWII, it is considered unlikely that a UXB would have fallen unnoticed.

WWII bombing is not considered to provide a source of UXO hazard to the Site.

4.2.4 Geology and Bomb Penetration Depths

It is important to consider the geological materials present at the time that a bomb was dropped in order to establish its maximum penetration depth.

At the time of writing, no Site-specific ground investigation data was available.

British Geological Survey (BGS) 1:50,000 Sheet 131 Unst and Fetlar (Solid & Drift) and BGS borehole records from nearby investigations have been consulted to get an indicative overview of the Site geology.

The geology of the Site is understood to consist of Blown Sand, Diamicton, and Lacustrine Deposits, overlying the Skaw Intrusion, Norwick Phyllite Formation, and Shetland Ophiolate Complex.

Table 2 provides an estimate of average maximum bomb penetration depths for the Site assuming WWII ground conditions of 0.5m of sand, over more than 20m of weak rock.

Table 2	Estimated average maximum bomb penetration depths	
Estimated average bomb penetration depths for anticipated geology		
Bomb Weight	50kg	2.5m
	250kg	3.5m
	500kg	6.0m

These calculations can be refined on receipt of Site-specific information.

The estimated bomb penetration depths given in Table 2 are from the WWII ground level and are based on the following assumptions:

a) High level release of the bomb resulting in an impact velocity of 260m/s (>5,000m altitude).

b) A strike angle of 10 to 15 degrees to the vertical.

c) That the bomb is stable, both in flight and on penetration.

d) That no retarding units are fitted to the bomb.

e) That the soil type is homogenous.

A high altitude release of a bomb will result in ground entry at between 10° and 15° to the vertical with the bomb travelling on this trajectory until momentum is nearly lost. The bomb will then turn abruptly to the horizontal before coming to rest. The distance between the centre of the entry hole and the centre of the bomb at rest is known as the 'offset'. A marked lateral movement from the original line of entry is common.

Low-level attacks may have an impact angle of 45° or more, which will frequently lead to a much greater amount of offset movement during soil penetration.

The average offset is one third of the penetration depth, i.e. an offset of 2m may be expected for a 50kg bomb in dry silts and clays. If hard standings or Made Ground were present during WWII, bomb penetration depths would have been significantly reduced but offset distances may have been up to four times greater.

5 EXPLOSIVE ORDNANCE CLEARANCE ACTIVITIES

Official UK bombing statistics have been compiled from both British and German sources. There were differences in the way the figures were originally reported and collated which has led to discrepancies in the summary data.

Based on data from 1939 to 1945, War Office statistics indicate that 200,195No. HE bombs exploded within Great Britain. Additionally, 25,195No. HE bombs (representing 11%) were recorded as UXBs. However, records from the Royal Engineers who were responsible for bomb disposal at the time indicate that as of 27th February 1946 upwards of 45,000No. UXBs were disposed of.

On average 8.5% of UXBs later self-exploded. In some cases the bombs had delayed action fuzes or were never intended to explode, their purpose being to cause inconvenience and fear. Given the discrepancy in records and the fact that UXBs are still being found unexpectedly, it is clear that the original figures are understated and provide only an approximation of the number of potential UXBs in the UK.

War Office statistics also show that between October 1940 and May 1941 most of the UXBs (93%) were either 50kg or 250kg. It should be noted that details of the recovery and the size of the UXB were not always accurately reported.

The larger WWII UXBs are often difficult to recover due to both penetration depths and the presence of two or more fuzes, combined with more sensitive fillings of explosive mixtures including Amatol and Trialen.

5.1 Abandoned Bombs

For further information on abandoned bombs, and the potential UXO hazard associated with them, follow the link below:

- Abandoned Bombs

No records have been found indicating that any officially abandoned bombs are located on the Site.

5.2 EOC Tasks

Zetica holds no records of post-WWII EOC tasks having taken place in the vicinity of the Site.

6 UXO HAZARD ASSESSMENT

6.1 UXO Hazard Level

The definitions for the levels of UXO hazard are provided below.

Definitions of UXO Hazard Level for a Site	
Hazard Level	**Definition**
Very Low	There is positive evidence that UXO is not present, e.g. through physical constraints or removal.
Low	There is no positive evidence that UXO is present, but its occurrence cannot be totally discounted.
Moderate	There is positive evidence that ordnance was present or that other uncharted ordnance may be present as UXO.
High	There is positive evidence that UXO is present.
Very High	As high, but requires immediate or special attention due to the potential hazard.

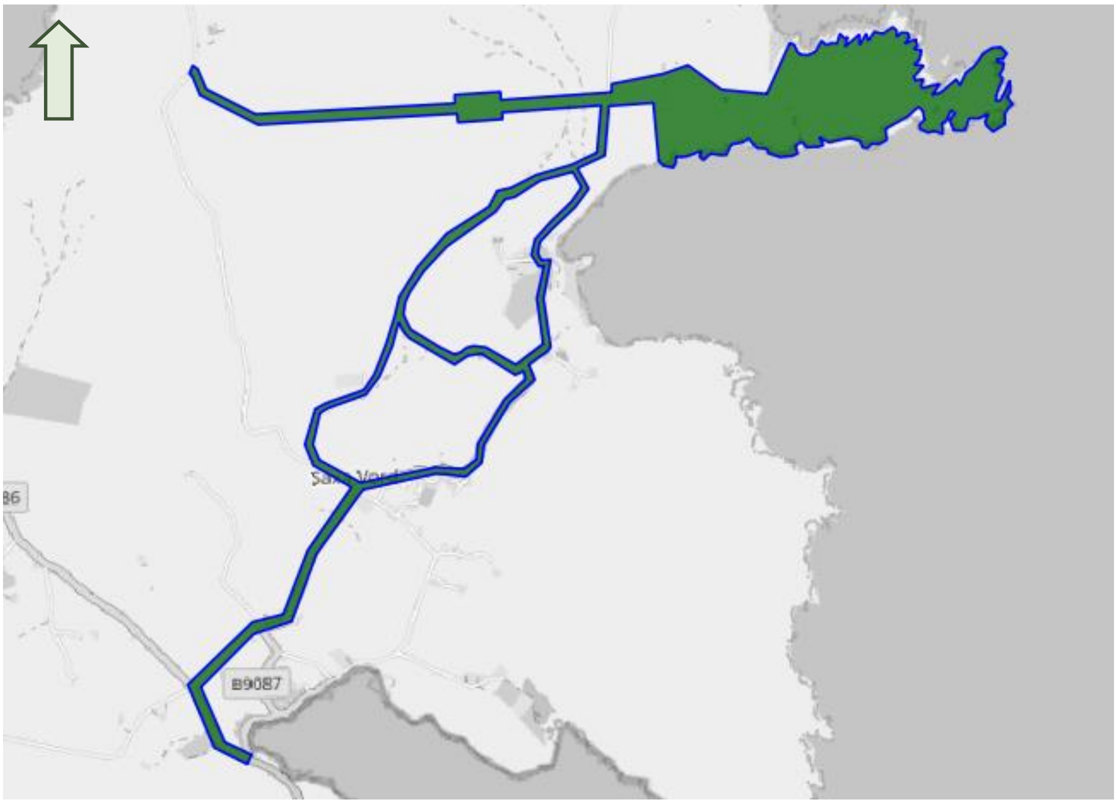
During WWII, RAF Skaw, a radar station, was located on the eastern part of the Site.

No records of significant HE bombing or military activity associated with RAF Skaw likely to provide a significant source of UXO hazard has been found.

Given this, it is considered that the Site has a low UXO hazard level, as shown in Figure 5 below.

The UXO hazard zone plan of the Site is also given in the accompanying P9238-19-R1-MAP01-B.

Figure 5	UXO hazard zone plan of the Site



Source: OpenStreetMap *Not to Scale*

Legend	Very Low	Low	Moderate
	High	Very High	Site boundary

It should be noted that the potential for encountering Small Arms Ammunition (SAA) or close combat munitions on any former military establishment as a result of localised disposal or spillage cannot be totally discounted. As such, staff should be suitably sensitised to the risk of encountering UXO.

7 UXO RISK ASSESSMENT

7.1 Proposed Works

It is understood that initial works on the Site will include intrusive ground investigation, including excavated trial pits and peat probing.

7.2 Risk Assessment Methodology

A UXO risk assessment has been undertaken for the proposed works, taking into consideration the identified UXO hazard.

Firstly, the probability of encountering UXO (PE) has been considered and rated for the different construction techniques, as detailed below.

Probability of Encounter (PE)	Rating
Frequent, highly likely, almost certain.	5
Probable, more likely to happen than not.	4
Occasional, increased chance or probability.	3
Remote, unlikely to happen but could.	2
Improbable, highly unlikely.	1
Impossible	0

Secondly, the probability of detonating a UXO (PD) has been considered and rated for the different construction techniques, as detailed below.

Probability of Detonation (PD)	Rating
Frequent, highly likely, almost certain.	5
Probable, more likely to happen than not.	4
Occasional, increased chance or probability.	3
Remote, unlikely to happen but could.	2
Improbable, highly unlikely.	1
Impossible	0

Next, the probability of encountering and detonating the UXO (PE x PD) have been used to generate an overall likelihood rating (P).

P = PE x PD	LIKELIHOOD of Encounter and Detonation	Rating
21 to 25	Frequent, highly likely, almost certain.	5
16 to 20	Probable, more likely to happen than not.	4
6 to 15	Occasional, increased chance or probability.	3
2 to 5	Remote, unlikely to happen but could.	2
1	Improbable, highly unlikely.	1
0	Impossible	0
P ranges from 25, a certainty of UXO being encountered and detonated on the Site by engineering activity, to 0, a certainty that UXO does not occur on the Site and will not be detonated by engineering activity.		

The likelihood of encountering and detonating UXO during site works is multiplied by the severity of such an event occurring (P x S), in order to provide a risk level using the following matrix.

Severity (S)	Rating
Multiple fatalities	5
Major injury, long term health issues, single fatality.	4
Minor injury, short term health issues, no fatalities.	3
First aid case but no lost time or ill health.	2
Minor injuries, no first aid.	1
No injuries.	0

UXO Risk Matrix

		SEVERITY (S)					
LIKELIHOOD (P)		5	4	3	2	1	0
	5	25	20	15	10	5	0
	4	20	16	12	8	4	0
	3	15	12	9	6	3	0
	2	10	8	6	4	2	0
	1	5	4	3	2	1	0
	0	0	0	0	0	0	0

7.3 UXO Risk Level

The UXO risk assessment for proposed works on the Site is given in Table 3.

Table 3 UXO risk assessment for the Site

Potential UXO Hazard	Anticipated Works	PE	PD	P = PE x PD	Likelihood	Severity	Risk Rating	UXO Risk
UXB	Excavations	1	1	1	1	5	5	Low
	Ground Investigations	1	1	1	1	4	4	Low
Close Combat Munitions	Excavations	1	1	1	1	4	4	Low
	Ground Investigations	1	1	1	1	3	3	Low
Other UXO	Excavations	1	1	1	1	4	4	Low
	Ground Investigations	1	1	1	1	3	3	Low
SAA	Excavations	1	1	1	1	2	2	Low
	Ground Investigations	1	1	1	1	2	2	Low
PE (Probability of Encounter), PD (Probability of Detonation), P (Overall Probability)								
SAA (Small Arms Ammunition)								

8 RISK MITIGATION PLAN

Key findings: No significant sources of UXO hazard have been identified on the Site.

Key actions: UXO awareness briefing.

8.1 UXO Risk Summary

Table 4 summarises the UXO risk for proposed works on the Site and recommended actions.

Table 4 Summary of UXO risk and mitigation recommendations

Proposed Works	UXO Risk	Recommended Mitigation
Excavations		**UXO awareness briefing -** Given the Site's military history it is recommended that a formal UXO awareness briefing is provided to staff involved in excavation.
Ground Investigations		**UXO awareness briefing** – as above

In summary, it is recommended that staff involved in site works are provided with a formal UXO awareness briefing so that they take appropriate action in the event of a suspect find.

8.2 Risk Mitigation Techniques

Should you wish to provide staff involved in site works with increased awareness regarding the potential (albeit low) for UXO encounter, this can be done through a formal briefing.

8.2.1 UXO Awareness Briefing

Typically ~1hour in duration, these briefings will be expected to provide site workers with:-

- Background to the potential UXO hazards that could be encountered.
- Awareness of how the UXO hazard could present a risk.
- Knowledge of what to do in the event that a suspect item is encountered.

The briefing is to be provided along with back-up materials such as UXO awareness posters, emergency contact numbers and other background information to assist site workers in becoming familiar with what potential UXO can look like.

The materials can also be used by key staff to pass on the relevant points of the induction to others who visit or work on the Site.

By providing the UXO awareness briefing, it ensures that in the unlikely event that UXO is encountered:-

- All site staff take appropriate action.
- A support mechanism and points of contact are established.
- The likelihood of harm to people or property is reduced.
- Significant delays to site work are prevented.

8.3 What Do I Do Next?

If you wish to proceed with UXO risk mitigation, Zetica would be happy to assist. Just contact us via phone (01993 886682) or email (uxo@zetica.com) and we can provide a proposal with options and prices.

If you have requirements to identify other buried hazards (such as mapping utilities or obstructions) we can provide these surveys.

If proposed works on the Site change, or additional works are planned, contact Zetica for a re-assessment of the UXO risk and the risk mitigation requirements.

APPENDICES

Appendix 1 Anticipated Ordnance Types

The probability of encountering UXO on the Site is considered to be low. As with any similar site in the UK, there is always a background risk of finding ordnance and potential types to be encountered are detailed below. For a more comprehensive set of ordnance data sheets, see http://zeticauxo.com/downloads-and-resources/ordnance-data-sheets/.

Information Data Sheet

Category Small Arms Ammunition

Type Various

Description Small Arms Ammunition (SAA) is one of the more recognisable categories of ordnance which is primarily designed for anti-personnel use. SAA include items such as bullets, generally up to a calibre (diameter) of 20mm.

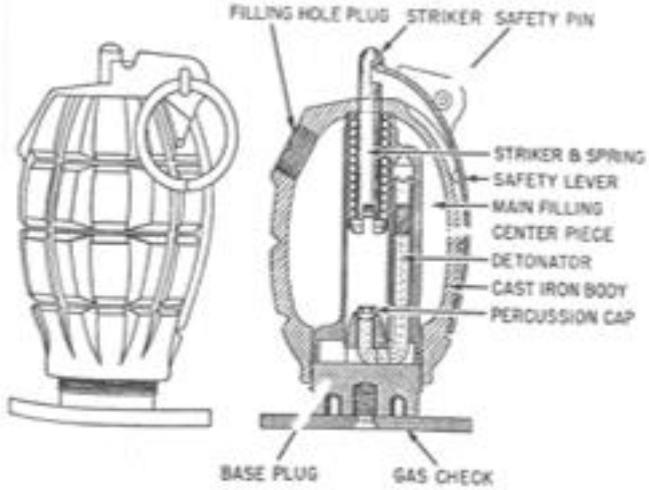
Generally small arms ordnance has a relatively low risk as UXO, although the larger calibre categories may have the same detonation risk as larger high explosive ordnance.

SAA is often associated with discarded ammunition boxes around firing practice ranges and training areas and is often found scattered across former military airfields as a result of aircraft crashes and localised disposal.

Information Data Sheet

Category Grenades (British)

Type No. 36 Hand Grenade ('Mills Bomb')



Variants	-	**Dimensions**	101.6mm x 61mm (4" x 2.4")
Weight	2 lbs	**Delay**	4 seconds
Filling	Baratol	**Material**	Cast Iron

Description Lemon-shaped, cast-iron body filled with high explosive. Three holes in the body; one in the base for priming, one near the top for filling; one on the top holding striker.

Function Used as a defence against enemy personnel.

Information Data Sheet

Category Projectiles (British)
Type 40mm Shell

Variants -

Body Dimensions 40mm x 310mm (1.6" x 12.2")

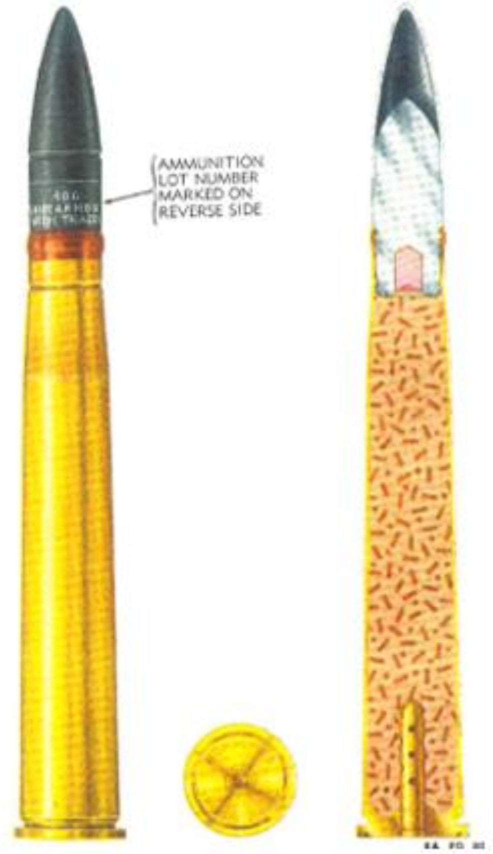
Weight 4.57lb (1.96lb for projectile)

Fuze Point-detonating fuze

Composition Steel casing

Description Steel-cased cartridge and projectile with copper expansion ring around base of projectile to allow release on firing.

Function Used as a rapid-fire defence against enemy aircraft, fired from fixed batteries and mobile mountings.



Information Data Sheet

Category Bomb (Luftwaffe)
Type Sprengbombe-Cylindrisch (SC) 50kg

Variants 8

Body Dimensions 762 x 200mm (30" x 7.9")

Weight 55kg (122lbs)

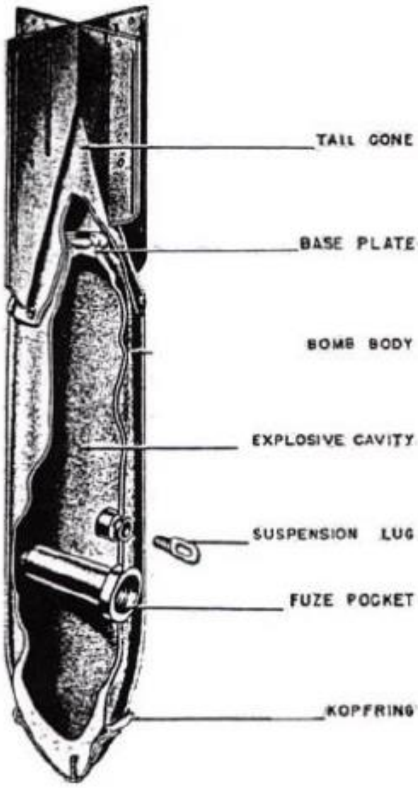
Charge Weight 25kg (54lbs)

Fuze Single electric impact fuze. Some have short time delay

Composition Sheet steel

Description Thick nose welded to a steel body. Nose may be attached to Kopfring (a triangular section steel ring) or spike. Suspension bolt in eye/body and sheet metal tail attached to body with rivets/screws. Originally painted green-grey with a yellow stripe on the tail. Cast TNT, Amatol or Trialen filling.

Function Designed to maximise shock waves through air, water and earth and for general demolition. Used against easily damageable targets, including roads, aircraft hangars, rolling stock and small buildings. Spike bombs/ 'Stabo' (SC 50 with spikes attached to nose) were used against rail lines and country roads, with Kopfring used against naval targets.



Information Data Sheet

Category Bomb
Type Sprengbombe-Cylindrisch (SC) 250kg

Variants 8

Body Dimensions 1194mm x 368mm (47" x 14.5")

Weight 249-264 kg (548-582lbs)

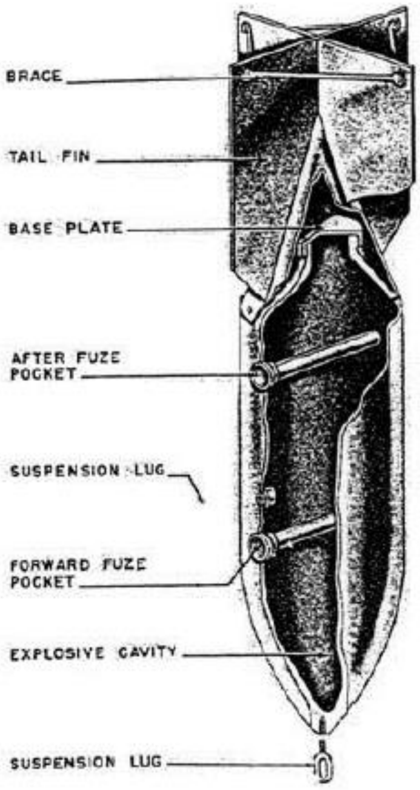
Charge Weight 130-145 kg (287-320lbs)

Fuze Electric impact fuze/electric clockwork time fuse & electric anti-disturbance fuze

Composition Sheet steel with stays

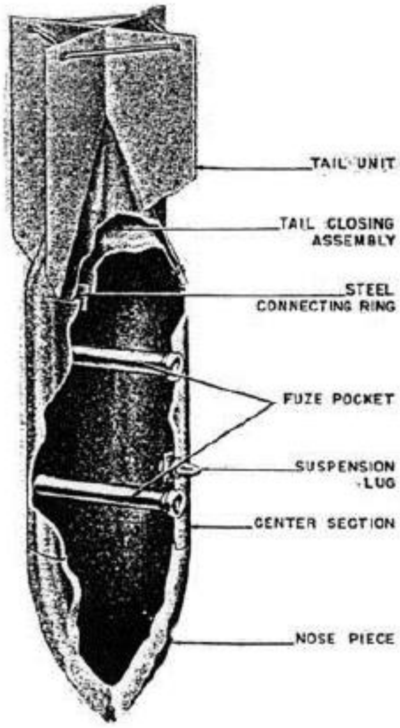
Description Thick nose welded to steel body. Nose may be attached to Kopfring (triangular section steel ring) or spike. Sheet metal tail attached to body with rivets/ screws. Suspension eye bolt in the nose/body. Originally painted green-grey with a yellow stripe on the tail. TNT; amatol; TNT and aluminium powder, naphthalene, ammonium nitrate and wax/ wood meal filling.

Function Designed to maximise shock waves through air, water and earth and general demolition. Used against railway installations, large buildings, ammunition depots and below-ground installations (to 8m). Spike bombs/ 'Stabo' (SC 50 with spikes attached to nose) used against rail lines and country roads.



Information Data Sheet

Category Bomb
Type Sprengbombe-Cylindrisch (SC) 500kg

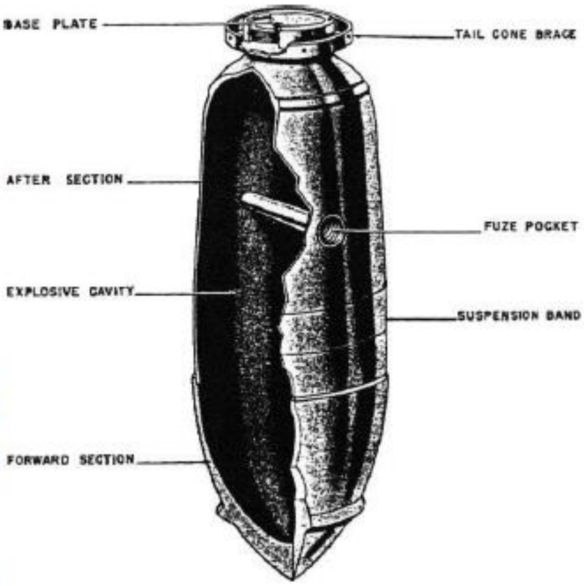


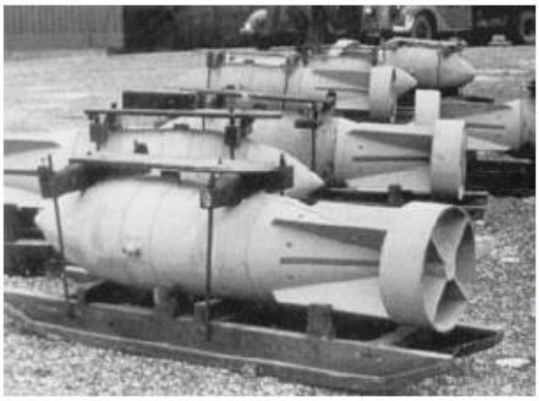
Variants	-
Body Dimensions	1414–1486mm x 470mm (55.7-58.5" x 18.5")
Weight	500kg (1,100lbs)
Charge Weight	220kg (484lbs)
Fuze	Electric impact fuze/electric clockwork time fuse & electric anti-disturbance fuze.
Composition	Sheet steel with stays or drum
Description	Thick nose welded to steel body. Nose may be attached to Kopfring (triangular section steel ring). Tail either steel sheet or drum-shaped. Suspension band. Originally painted green-grey/ buff (some later versions sky blue) with yellow stripe on tail. Filled with amatol, TNT or trialen.
Function	Designed to maximise shock waves through air, water and earth and for general demolition. Used against railway property, large buildings, shipping and below-ground installations.

Information Data Sheet

Category Bomb
Type Sprengbombe-Cylindrisch (SC) 1,000kg (HERMANN)

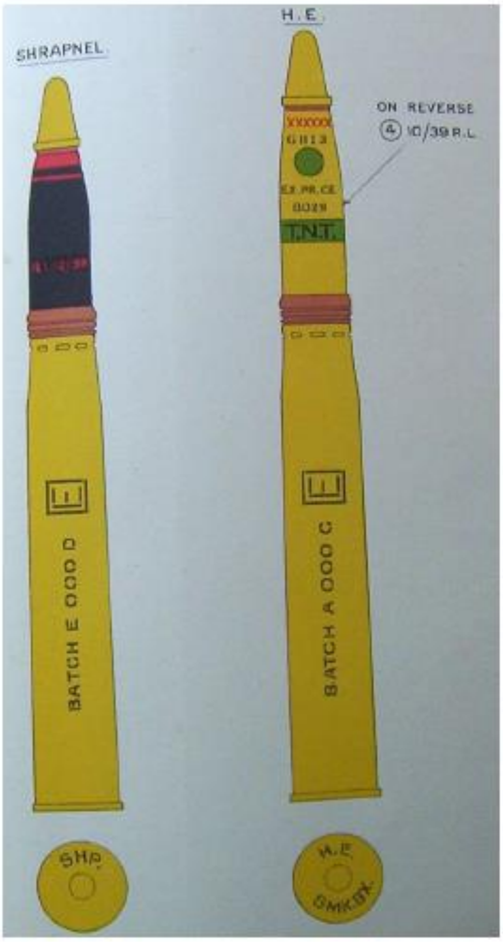
Variants	3
Body Dimensions	1742-1905mm x 648–660mm (68.6-75" x 25.5-26")
Weight	1,000-1,088kg (2,204-2,398lbs)
Charge Weight	529-619kg (1,166-1,364lbs)
Fuze	Electric impact fuze/ electric clockwork time fuze & electric anti-disturbance fuze
Composition	Magnesium alloy with drum
Description	Thick nose welded to steel body. Nose attached to Kopfring (triangular section steel ring). Drum-shaped tail made of magnesium alloy. Suspension band. Originally painted sky-blue. Filled with amatol, TNT/aluminium/wood meal or trialen.
Function	Designed to maximise shock waves through air, water and earth and for general demolition.





Information Data Sheet

Category Projectile
Type 3.7" Anti-Aircraft Shell



Variants 6

Body Dimensions 94mm x 360mm (3.7 x 14.7")

Weight 12.7kg (28lb)

Fuze Mechanical time fuze

Composition Cast steel

Description Brass cartridge case. Square-based shell with tapered nose, filled with Amatol, TNT or RDX/TNT. MK6 had forward centring bands and a wider driving band.

Function Used as a defence against enemy aircraft, fired from fixed batteries and mobile mountings. Could fire approximately 20 rounds per minute with a maximum ceiling of 41,000ft and horizontal range of 20,600 yards.

Information Data Sheet

Category Projectile

Type 4.5" Shell (Mark II – Anti-Aircraft)

Variants -

Body Dimensions 114mm x 566mm (4.5" x 21.9")

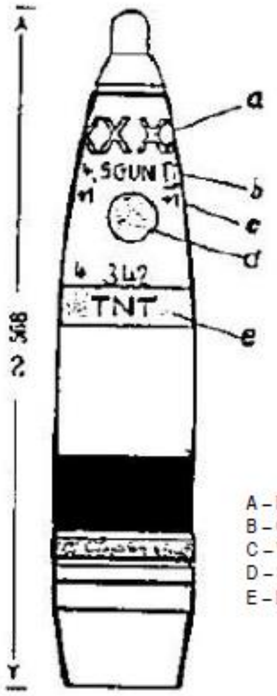
Weight 24.9kg (55lb)

Fuze Mechanical time fuze

Composition Cast steel

Description Square-based, tapered-nosed shell filled with TNT or Amatol. Steel casing, rotating band of either copper or gilding metal located 3.5" in front of the base end with single groove.

Function Used as field artillery and adapted for use in anti-aircraft defence from fixed batteries. Rate of fire of 8 rounds per minute, maximum ceiling of 44,000ft and horizontal range of 22,800 yards.



A – Missile Identification
B – Gun and Bullet Type
C – Weight
D – Smoke pot
E – Explosives Ring

Appendix 2 Sources of UXO Hazard

The sections below provide background information on the potential sources of UXO hazard (albeit low) affecting the Site. For a more comprehensive set of UXO information sheets, see http://zeticauxo.com/downloads-and-resources/uxo-information-sheets/.

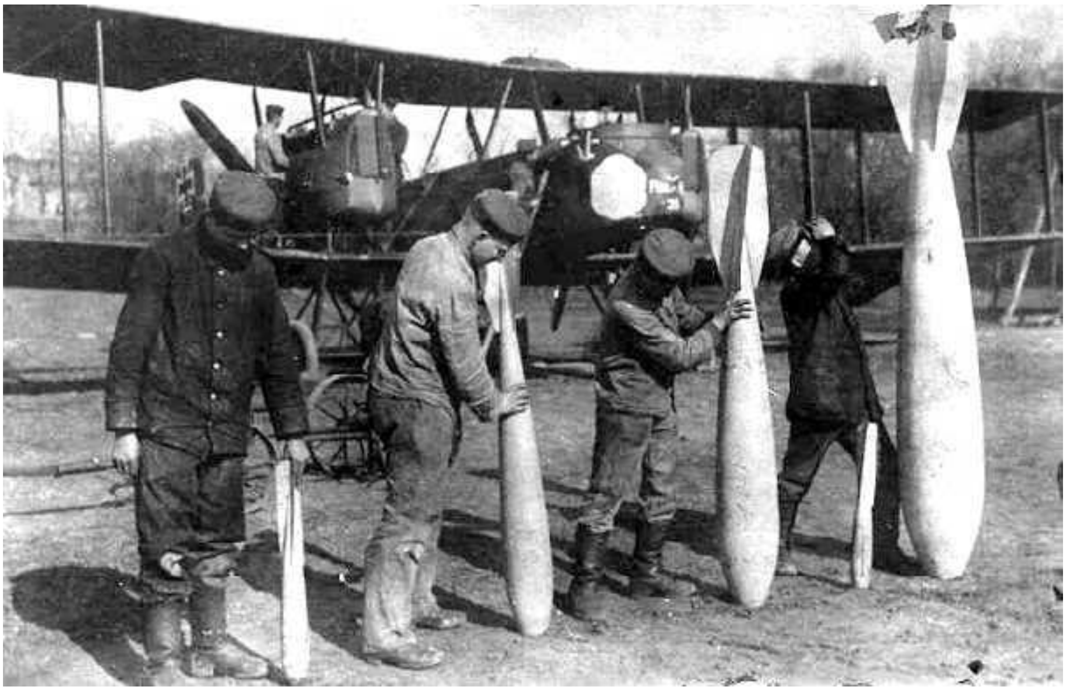
Appendix 2.1 WWI Bombing

It is not generally realised that during World War One (WWI) significant bombing took place across some areas of the UK. An estimated 9,000No. German bombs were dropped on Britain during the course of 51No. airship and 52No. aircraft raids. It was the first time that strategic aerial bombardment had been used. More than 1,400No. people were killed during these raids.

Most air raids were carried out on London and Southeast England. Areas along the East Coast were also targeted regularly due to their proximity to the European continent. Bombing raids further inland were rare and West England and Wales were out of reach for German aircraft of the time.

Aerial bombing during WWI initially relied on visual aiming, with bombsights not developed until later in the war. The inaccuracy inherent in this method meant that bombs often fell some way from their intended targets.

The first recorded raid against England occurred on the 21st December 1914 when 2No. high explosive bombs fell near the Admiralty Pier at Dover. Zeppelin raids intensified during 1915 and 1916, with aircraft raids becoming more frequent after 1917. The last raid of WWI took place on the 19th May 1918, when 38 Gotha and 3 Giant aircraft bombed London and surrounding districts, dropping a total of more than 2,500lbs of bombs.



The potential of coming across an Unexploded Bomb (UXB) from WWI is far less likely than a WWII UXB given the lower bombing densities during raids in the Great War.

Some areas which were subjected to sustained bombing raids, such as parts of London and coastal towns, recorded a higher number of UXB. In these areas, where there has been no significant development for the last century, the potential of a UXB remaining from WWI cannot be totally discounted.

Appendix 2.2 WWII Bombing

Bombing raids began in the summer of 1940 and continued until the end of WWII. Bombing densities generally increased towards major cities or strategic targets such as docks, harbours, industrial premises, power stations and airfields. In addition to London, industrial cities and ports, including Birmingham, Coventry, Southampton, Liverpool, Hull and Glasgow, were heavily targeted, as well as seaside towns such as Eastbourne and cathedral cities such as Canterbury.

The German bombing campaign saw the extensive use of both High Explosive (HE) bombs and Incendiary Bombs (IBs). The most common HE bombs were the 50kg and 250kg bombs, although 500kg were also used to a lesser extent. More rarely 1,000kg, 1,400kg and 1,800kg bombs were dropped.

The HE bombs tended to contain about half of their weight in explosives and were fitted with one or sometimes two fuzes. Not all HE bombs were intended to explode on impact. Some contained timing mechanisms where detonation could occur more than 70 hours after impact.

Incendiary devices ranged from small 1kg thermite filled, magnesium bodied Incendiary Bombs (IBs) to a 250kg 'Oil Bomb' (OB) and a 500kg 'C300' IB. In some cases the IBs were fitted with a bursting charge. This exploded after the bomb had been alight for a few minutes causing burning debris to be scattered over a greater area. The C300 bombs were similar in appearance to 500kg HE bombs, although their design was sufficiently different to warrant a specially trained unit of the Royal Engineers to deal with their disposal.

Anti-Personnel (AP) bombs and Parachute Mines (PMs) were also deployed. 2No. types of anti-personnel bombs were in common use, the 2kg and the 12kg bomb. The 2kg bomb could inflict injury across an area up to 150m away from the impact. PMs (which were up to 4m in length) could be detonated either magnetically or by noise/vibration.

Anti-shipping parachute mines were commonly dropped over navigable rivers, dockland areas and coastlines. The Royal Navy was responsible for ensuring that the bombs were made safe. Removal and disposal was still the responsibility of the Bomb Disposal Unit of the Royal Engineers.

In 1944, the Germans introduced new weapons; the V1, a 'flying bomb' and guided missile, and the V2, a ballistic missile rocket that travelled at such speed that no one could see or hear its approach. London was the main target for these attacks.

WWII bomb targeting was inaccurate, especially in the first year of the war. A typical bomb load of 50kg HE bombs mixed with IBs which was aimed at a specific location might not just miss the intended target but fall some considerable distance away.

It is understood that the local Civil Defence authorities in urban areas had a comprehensive system for reporting bomb incidents and dealing with any Unexploded Bombs (UXB) or other UXO. In more rural areas, fewer bombing raids occurred. It is known that Air Raid Precaution (ARP) records under-represent the number and frequency of bombs falling in rural and coastal areas. Bombs were either released over targets or as part of 'tip and run' raids where bomber crews would drop their bombs to avoid anti-aircraft fire or Allied fighter aircraft on the route to and from other strategic targets. Bombs dropped as a result of poor targeting or 'tip and run' raids on rural and coastal areas often went unrecorded or entered as 'fell in open country' or 'fell in the sea'. The Luftwaffe are thought to have dropped approximately 75,000 tons of bombs on Britain throughout the Second World War and an estimated 11% of all bombs dropped during the war failed to detonate.

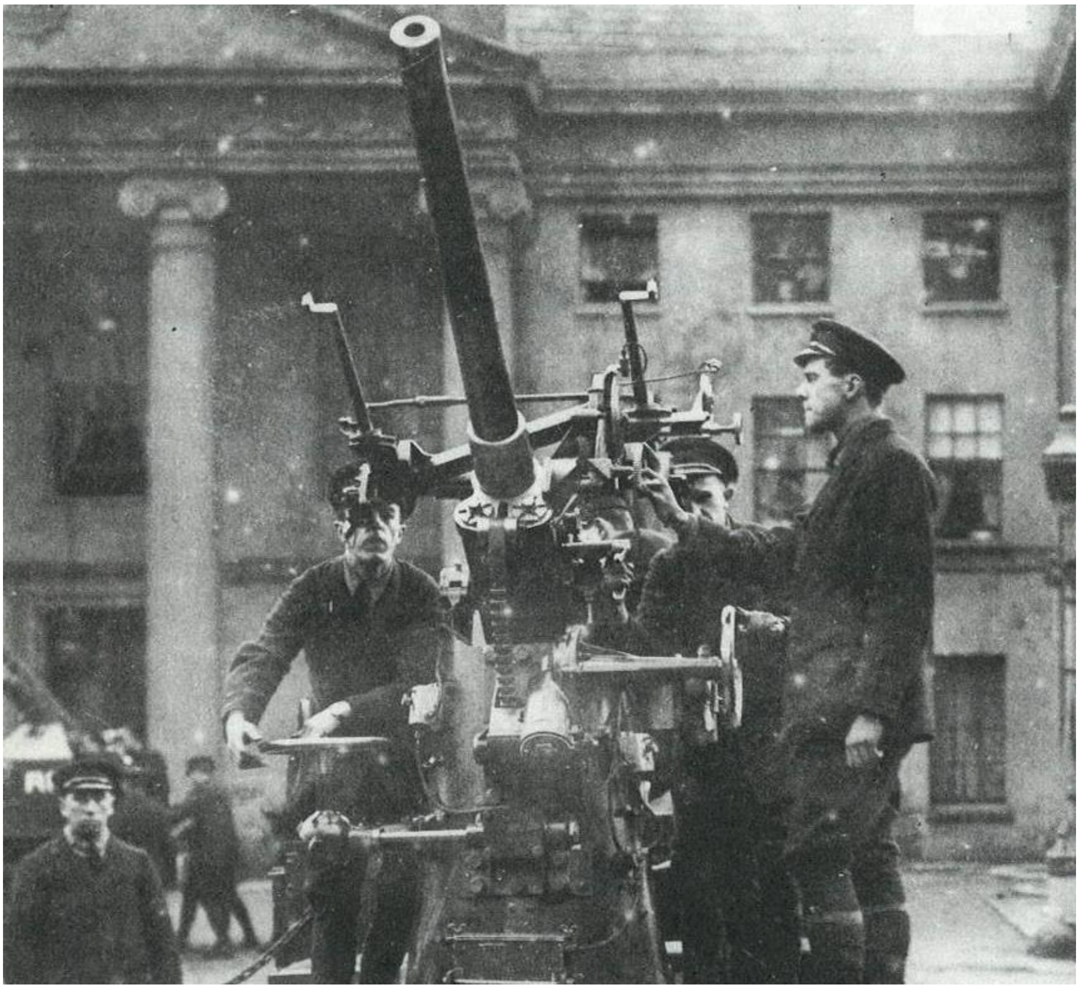
The potential for a UXB hazard to exist on a site depends on a variety of factors. Were there strategic targets in the surrounding area? Was the site bombed? Could a UXB impact have been missed? Even in rural areas, the potential for UXB cannot be totally discounted and therefore it is essential that detailed local bombing records are obtained when assessing the UXB hazard on any site.

Appendix 2.3 Anti-Aircraft Guns

As aerial bombardment first began during WWI, Anti-Aircraft (AA) gun batteries were established were gradually established throughout much of England to counter German bombing raids. By June 1916, there were approximately 271No. AA guns and 258No. searchlight installations defending London alone.

Common AA defences during WWI included 3-inch, 75 millimetre, 6-pounder and 1-pounder guns. Many of these guns were mobile, being mounted on lorry chassis. They were driven about following the course of an airship and fired from any area of open land.

During WWI, Unexploded AA (UXAA) shells, could land up to 13km from the firing point, although more typically fell within 10km.



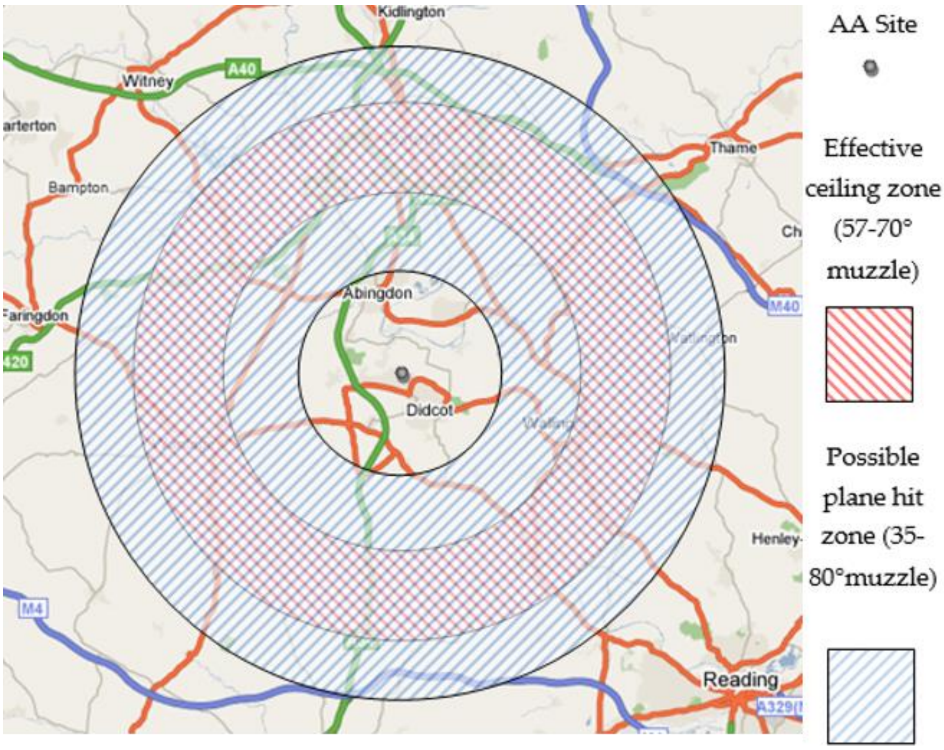
AA gun batteries were used extensively during WWII to counter the threat posed by enemy aircraft. In many instances, AA shells caused damage to Allied territory and in some areas caused significant numbers of civilian fatalities.

During WWII, AA shells could land up to 27km from the firing point, although more typically fell within 15km. These could be distributed over a wide area.

3No. types of AA batteries existed:

- **Heavy Anti-Aircraft (HAA)** batteries of large guns (typically 3.7”, 4.5” and 5.25” calibre) designed to engage high flying bomber aircraft. These tended to be relatively permanent gun emplacements.
- **Light Anti-Aircraft (LAA)** weaponry, designed to counter low flying aircraft. These were often mobile and were moved periodically to new locations around strategic targets such as airfields. They typically fired 40mm shells and machine gun ammunition.
- **Rocket batteries (ZAA)** firing 3” or 3.7” AA rockets with a maximum altitude of 5,800m and a ground range of 9km were typically permanent emplacements.

Unexploded AA (UXAA) shells were a common occurrence during WWII. As the figure below demonstrates, shells were unlikely to fall in the immediate vicinity of a gun battery but in the surrounding area. This would be dependent upon the angle of fire and the flight height of the attacking aircraft.



AA batteries were deliberately targeted by the Luftwaffe and therefore areas surrounding a gun battery may have a greater risk of UXB being present.

Munitions stores were also established around AA batteries. These stored the shells for the batteries and small arms ammunition for troops manning the position. Such stores were typically removed at the end of WWII, although some disposal may have occurred in the immediate vicinity of the gun battery.

Appendix 3 Recent UXO Finds

UXO finds in the UK are a regular occurrence, although they almost never result in an accidental detonation.

It is still important to note that explosives rarely lose effectiveness with age. In some instances, mechanisms such as fuzes and gaines can become more sensitive and more prone to detonation, regardless of whether the device has been submersed in water or embedded in silt, clay or similar materials.

The effects of an accidental UXO detonation are usually extremely fast, often catastrophic and invariably traumatic to any personnel involved. Such occurrences are largely restricted to current theatres of war and overseas minefields, with occasional events in mainland Europe.

The sections below provide a brief summary of recent significant UXO finds in the UK. To keep up to date with the latest UXO finds, visit http://zeticauxo.com/news/.

On the 4th September 2017, 1No. 50kg UXB was found in a ragstone quarry at Kings Hill near West Malling in Kent. It was destroyed in situ in a controlled explosion by an EOD team.

On the 11th February 2018, 1No. 500kg UXB was found in King George V Dock in London, resulting in the temporary closure of the adjacent London City Airport. The UXB was freed from a silt bed and towed along the River Thames to Shoeburyness where it was destroyed in a controlled explosion.

On the 26th February 2018, an EOD team destroyed numerous items of ordnance including shells and 20mm ammunition which had been exposed by storms on Selsey beach. A similar operation was required after more UXO finds on the beach in April 2018.

On the 31st March 2018, 2No. 870lb British PMs were found in waters off Guernsey. They were destroyed in controlled explosions.

On the 20th May 2018, a 1,000kg German sea mine washed ashore at Elmer beach near Bognor Regis, West Sussex. A 1 mile exclusion zone was enforced before an EOD team towed the device out to sea for a controlled explosion.

On the 24th May 2018, numerous ordnance-related items were found on a proposed residential development in Burntwood, Staffordshire.

On the 10th July 2018, a suspected 1,000kg German UXB was found by scuba divers near Teignmouth Pier in Devon. The UXB was towed out into open sea by a RN EOD team for a controlled explosion.

On the 30th August 2018, a 2,000lb German PM was trawled up by a fishing vessel off Mersea in Essex. The PM was moved to an area of open sea where it was destroyed in a controlled explosion by a RN EOD team.

On the 29th November 2018 a large naval projectile was found at Wembury Point, Plymouth. It was destroyed in a controlled explosion.

During January and February 2019 a military EOD was called out to deal with several items of UXO washed up at Medmerry Beach in Selsey. The site of a former gunnery range, it followed on from several similar incidents in 2018.

On the 21st January 2019 a suspected 1,000lb torpedo was brought into Brixham Harbour by a fishing trawler. It was towed back out to sea and destroyed by a Naval EOD team.

On the 6th February 2019 3No. WWII projectiles were found on Chalkwell Beach near Southend-on-Sea, Essex. They were destroyed in a controlled explosion.

On the 19th February 2019 6No. projectiles were found on the beach at Lilstock, Somerset.

On the 14th March 2019 an unexploded pipe mine was found at the former RAF Manston airfield near Ramsgate, Kent. It was destroyed in a controlled explosion.

On the 21st March 2019 2No. unexploded shells were found on a building site in Brighton. They were removed by an EOD team.

On the 25th March 2019 an unexploded shell was found in Stechford, Birmingham. It was removed to a field and destroyed in a controlled explosion.

On the 22nd May 2019 70No. Self-Igniting Phosphorus (SIP) grenades were found during development works at Tongland Dam in Dumfries & Galloway, Scotland. They were destroyed in a controlled explosion.

On the 23rd May 2019 a 250kg German UXB was found by workers on a building site at Kingston University in London (see plate below). The UXB could not be safely removed and was consequently destroyed in situ by an EOD team.

On the 27th May 2019 24No. SIP grenades were found in a field near Sibton in Suffolk. An EOD team constructed a 2ft deep trench into which the grenades were placed before being destroyed in a controlled explosion.

On the 7th June 2019 a 50kg German fragmentation UXB was found at a building site in Kings Hill at the former RAF West Malling airfield. It was destroyed in a controlled explosion by an EOD team the following day. On the 26th September 2019 another 50kg German UXB was found at Kings Hill and was destroyed in a controlled explosion the next day.

On the 20th September 2019 a suspected 250kg German UXB was found on a construction site in Bordon, Hampshire. It was destroyed in a controlled explosion by an EOD team.

In September 2019 a German PM was found by divers off Southend-on-Sea, Essex. It was towed out to open water off Shoeburyness by a Royal Navy EOD team and destroyed in a controlled explosion.

On the 3rd February 2020, a 500kg German UXB was found on a building site in Soho, London. It was removed by an EOD team.

Appendix 4 Glossary and Definitions

Abandoned Explosive Ordnance (AXO)	Abandoned Explosive Ordnance is explosive ordnance that has not been used during an armed conflict, that has been left behind or disposed of by a party to an armed conflict, and which is no longer under control of that party. Abandoned explosive ordnance may or may not have been primed, fuzed, armed or otherwise prepared for use.
Close Combat Munitions	Items of ordnance thrown, propelled or placed during land warfare, to include grenades, mortars, projectiles, rockets and land mines.
Demil	Derived from the term ‘Demilitarisation’, it refers to the break down and the recycling or disposal of ordnance components.
Detonation	The high-speed chemical breakdown of an energetic material producing heat, pressure, flame and a shock wave.
Device	This term is used for any component, sub-assembly or completed ordnance, which may or may not have an explosive risk. It can apply to detonators, primers, gaines, fuzes, shells or bombs.
Explosive	The term explosive refers to compounds forming energetic materials that under certain conditions chemically react, rapidly producing gas, heat and pressure. Obviously, these are extremely dangerous and should only be handled by qualified professionals.
Explosive Ordnance (EO)	Explosive Ordnance is all munitions containing explosives, nuclear fission or fusion materials and biological and chemical agents. This includes bombs and warheads, guided and ballistic missiles, artillery, mortar, rocket, small arms ammunition, mines, torpedoes, depth charges, pyrotechnics, cluster bombs & dispensers, cartridge & propellant actuated devices, electro-explosive devices, clandestine & improvised explosive devices, and all similar or related items or components explosive in nature.
Explosive Ordnance Clearance (EOC)	Explosive Ordnance Clearance is a term used to describe the operation of ordnance detection, investigation, identification and removal, with EOD being a separate operation.
Explosive Ordnance Disposal (EOD)	Explosive Ordnance Disposal is the detection, identification, on-site evaluation, rendering safe, recovery and final disposal of unexploded explosive ordnance.
Explosive Ordnance Reconnaissance (EOR)	Explosive Ordnance Reconnaissance is the detection, identification and on-site evaluation of unexploded explosive ordnance before Explosive Ordnance Disposal.
Explosive Remnants of War (ERW)	Explosive Remnants of War are Unexploded Ordnance (UXO) and Abandoned Explosive Ordnance (AXO), excluding landmines.

Explosive Substances and Articles (ESA)	Explosive substances are solid or liquid substances (or a mixture of substances), which are either: • capable by chemical reaction in itself of producing gas at such a temperature and pressure and at such a speed as to cause damage to the surroundings. • designed to produce an effect by heat, light, sound, gas or smoke, or a combination of these as a result of a non-detonative, self-sustaining, exothermic reaction. Explosive article is an article containing one or more explosive substances.
Fuze	A fuze is the part of an explosive device that initiates the main explosive charge to function. In common usage, the word fuze is used indiscriminately, but when being specific (and in particular in a military context), fuze is used to mean a more complicated device, such as a device within military ordnance.
Gaine	Small explosive charge that is sometimes placed between the detonator and the main charge to ensure ignition.
Geophysical survey	A geophysical survey is essentially a range of methods that can be used to detect objects or identify ground conditions without the need for intrusive methods (such as excavation or drilling). This is particularly suited to ordnance as disturbance of ordnance items is to be avoided where ever possible.
Gold line	This is the estimated limit of blast damage from an explosive storage magazine. It usually means that development within this zone is restricted.
High Explosive	Secondary explosives (commonly known as High Explosives (HE)) make up the main charge or filling of an ordnance device. They are usually less sensitive than primary explosives. Examples of secondary explosives are: Nitro glycerine (NG), Trinitrotoluene (TNT), AMATOL (Ammonia nitrate + TNT), Gunpowder (GP), and Cyclotrimethylenetrinitramine (RDX).
Munition	Munition is the complete device charged with explosives, propellants, pyrotechnics, initiating composition, or nuclear, biological or chemical material for use in military operations, including demolitions. This includes those munitions that have been suitably modified for use in training, ceremonial or non-operational purposes. These fall into three distinct categories:- • inert - contain no explosives whatsoever. • live - contain explosives and have not been fired. • blind - have fired but failed to function as intended.

Primary Explosive	Primary explosives are usually extremely sensitive to friction, heat, and pressure. These are used to initiate less sensitive explosives. Examples of primary explosives are: Lead Azide, Lead Styphnate, and Mercury Fulminate. Primary explosive are commonly found in detonators.
Propellants	Propellants provide ordnance with the ability to travel in a controlled manner and deliver the ordnance to a predetermined target. Propellants burn rapidly producing gas, pressure and flame. Although usually in solid form they can be produced in liquid form. Examples of propellants are: Ballistite often found in a flake form and Cordite used in small arms ammunition.
Pyrotechnic	A pyrotechnic is an explosive article or substance designed to produce an effect by heat, light, sound, gas or smoke, or a combination of any of these, as a result of non-detonative, self-sustaining, exothermic chemical reactions.
Small Arms Ammunition (SAA)	SAA includes projectiles around 12mm or less in calibre and no longer than approximately 100mm. They are fired from a variety of weapons, including rifles, pistols, shotguns and machine guns.
Unexploded Anti-Aircraft (UXAA) Shell	UXAA shells are army ordnance commonly containing HE, though they can also contain pyrotechnic compounds that produce smoke. Most commonly, these were 3.7” and 4.5” HE shells, although they ranged from 2” to 5.25” calibre.
Unexploded Bomb (UXB)	UXB is a common term for unexploded air-dropped munitions.
Unexploded Ordnance (UXO)	UXO is explosive ordnance that has been either primed, fuzed, armed or prepared for use and has been subsequently fired, dropped, launched, projected or placed in such a manner as to present a hazard to operations, persons or objects and remains unexploded either by malfunction or design.
V1	The Vergeltungswaffe-1, V-1, also designated Fieseler Fi 103/FZG-76, known colloquially in English as the Flying Bomb, Buzz Bomb or Doodlebug, was the first guided missile used in WWII and the forerunner of today's cruise missile.
V2	The Vergeltungswaffe 2 (V-2) (‘Reprisal Weapon 2’) was the first ballistic missile. It was used by the German Army primarily against Belgian and British targets during the later stages of WWII. The V-2 was the first man-made object launched into space, during test flights that reached an altitude of 189km (117 miles) in 1944.

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