

LT17 Orkney - Mainland HVAC 220 kV Subsea Link

LT17 Orkney - Mainland HVAC 220 kV Subsea Link Environmental Appraisal

Scottish and Southern Energy Networks

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ACRONYMS

AA	Appropriate Assessment
AC	Alternative Current
AIS	Automatic Identification System
ANM	Active Network Management
AoS	Area of Search
BAP	Biodiversity Action Plan
BP	Best Practice
BT	British Telecom
CAR	Controlled Activities Regulations
CBP	Cable Burial Plan
CBRA	Cable Burial Risk Assessment
CCME	Canadian Council of Ministers of the Environment
CEFAS	Centre for Environment, Fisheries and Aquaculture Science
CEMP	Construction Environment Management Plan
CES	Consents and Environmental Specification
CFE	Controlled Flow Excavation
CFP	Common Fisheries Policy
CLB	Cable Lay Barge
CLV	Cable Lay Vessel
CMS	Construction Method Statement
CPT	Cone Penetration Testing
CSV	Cable Support Vessel
dB	Decibel
DBA	Desk Based Assessment
DDV	Drop-down Video
DECC	Department of Energy and Climate Change
DEFRA	Department for Environment, Food and Rural Affairs
DP	Dynamic Positioning
DSV	Dive Support Vessel
EA	Environmental Appraisal
EIA	Environmental Impact Assessment
EM	Embedded Mitigation
EMEC	European Marine Energy Centre

EMF	Electromagnetic Fields
EOD	Explosives and Ordnance Disposal
EPS	European Protected Species
ESCA	European Subsea Cables Association
EU	European Union
EUNIS	European Marine Habitat Classification Scheme
EWIP	East-West Interconnector Project
FCS	Favourable Conservation Status
FEAST	Feature Activity Sensitivity Tool
FLMAP	Fisheries Liaison and Mitigation Action Plan
FLO	Fisheries Liaison Officer
FLOWW	Fishing Liaison with Offshore Wind and Wet Renewables Group
GES	Good Environmental Status
GIS	Geographic Information System
GPS	Global Positional System
HDD	Horizontal Directional Drilling
HES	Historic Environment Scotland
HPDE	High Density Polyethylene
HRA	Habitats Regulations Appraisal
HVAC	High Voltage Alternating Current
HVDC	High Voltage Direct Current
ICES	International Council for the Exploitation of the Sea
IMO	International Maritime Organisation
INNS	Invasive Non-Native Species
IROPI	Imperative Reasons of Overriding Public Interest
IUCN	International Union for the Conservation of Nature
JNCC	Joint Nature Conservation Committee
kHz	Kilohertz
KP	Kilometre Post
kV	Kilovolt
LAT	Lowest Astronomical Tide
LARS	Launch and Recovery System
LSE	Likely Significant Effect
MarLIN	Marine Life Information Network
MBES	Multibeam Echosounder

MCA	Maritime Coastguard Agency
MCAA	Marine and Coastal Access Act
MESH	Mapping European Seabed Habitats
MFE	Mass Flow Excavators
MHWM	Mean High Water Mark
MHWS	Mean High water Springs
MLWS	Mean Low water Springs
MMO	Marine Management Organisation
MMO	Marine Mammal Observer
MMPP	Marine Mammal Protection Plan
MoD	Ministry of Defence
MPA	Marine Protected Area
MPS	Marine Policy Statement
MSFD	Marine Strategy Framework Directive
MSBL	Mean Seabed Level
MS-LOT	Marine Scotland Licensing Operations Team
MSP	Marine Spatial Plan
MSS	Marine Scotland Science
mW	Megawatt
NAFC	North Atlantic Fisheries College
NCA	Nature Conservation Assessment
NCMPA	Nature Conservation Marine Protection Area
NMFS	National Marine Fisheries Service
NMP	National Marine Plan
NMPi	National Marine Plan Interactive
NPF	National Planning Framework
NRC	National Research Council
NSA	National Scenic Area
OAS	Obstacle Avoidance Sonar
OSPAR	Convention for the Protection of the Marine Environment of the North-East Atlantic
Pac	Pre-application Consultation
PAD	Protocol for Archaeological Discoveries
PAH	Polycyclic Aromatic Hydrocarbon
PAM	Passive Acoustic Monitoring
PE	Polyethylene

PLGR	Pre-lay Grapnel Run
PMF	Priority Marine Features
PSA	Particle Size Analysis
pSPA	proposed Special Protection Area
PTS	Permanent Threshold Shift
PU	Polyurethane
RAG	Red Amber Green
ROV	Remote Operating Vehicle
RPL	Route Positioning List
RPZ	Registered Power Zone
RSPB	Royal Society for the Protection of Birds
RYA	Royal Yachting Association
SAC	Special Area of Conservation
SBP	Sub-bottom Profiler
SCANS	Small Cetaceans in the European Atlantic and North Sea
SCR	Scottish Colony Register
SEL	Sound Exposure Level
SEPA	Scottish Environment Protection Agency
SHE	Scottish Hydro Electric
SHEPD	Scottish Hydro Electric Power Distribution plc
SHET	Scottish Hydro Electric Transmission
SMRU	Sea Mammal Research Unit
SMS	Safety Management System
SNH	Scottish Natural Heritage
SoM	Schedule of Mitigation
SOPEP	Ship Oil Pollution Emergency Plan
SPA	Special Protection Area
SPP	Scottish Planning Policy
SRI	Subsea Rock Installation
SROV	Surveyor Remote Operated Vehicle
SSE	Scottish and Southern Energy
SSEN	Scottish and Southern Energy Networks
SSEN	Scottish and Southern Electricity Networks
SSS	Side Scan Sonar
SSSI	Site of Special Scientific Interest

TCE	The Crown Estate
Te	Tonne
TJP	Transition joint pit
TO	Transmission Owner
TOC	Total organic carbon
TPH	Total petroleum hydrocarbon
TROV	Trenching ROV
TSV	Trenching Support Vessel
TTS	Temporary Threshold Shift
UFEN	UK Fisheries Economics Network
UK	United Kingdom
UKAEA	UK Atomic Energy Authority
UKBAP	UK Biodiversity Action Plan
UKCS	United Kingdom Continental Shelf
UKHO	UK Hydrographic Office
UNCLOS	United Nations Convention of the Law of the Sea
UXO	Unexploded Ordinance
VC	Vibrocore
VMS	Vessel Monitoring Systems
WFD	Water Framework Directive
WROV	Work-class Remote Operating Vehicle
XLPE	Cross-linked Polyethylene
ZoI	Zone of Influence
µPa	Micropascal

1 INTRODUCTION

1.1 Introduction

In line with Part 4 of the Marine (Scotland) Act 2010, Scottish Hydro Electric Transmission plc (SHE Transmission) is submitting an application for a Marine Licence for the installation of a 220 kV Alternating Current (AC) cable system between the island of Orkney and Caithness on the Scottish mainland (Orkney – Mainland HVAC 220 kV Subsea Link) (the "Project"). The Project is intended to transmit energy produced by a number of renewable energy generation schemes on, and within the waters around Orkney.

The purpose of this report is to provide information on the potential effects of the proposed works on key environmental receptors in support of the Marine Licence application.

1.2 Background and Project need

SHE Transmission, part of the SSE plc group of companies, is the licensed electricity Transmission Owner (TO) in the north of Scotland. It owns the 5,000 km network of high voltage underground cables and overhead lines that provides electricity to people across northern Scotland and connects northern Scotland to central and southern Scotland and the rest of Great Britain. SHE Transmission is also responsible for maintaining and investing in this transmission network, which covers around 70% of Scotland.

SHE Transmission is currently looking at taking forward a number of strategic projects which are aimed at expanding the transmission network across northern Scotland. These projects, which involve both network reinforcements and upgrades, have been identified as being required to facilitate the substantial increase in renewable energy generation in the north of Scotland and the subsequent increasing demand for renewable energy connections and hence to support the growth of the low carbon economy.

1.2.1 Orkney Connection Project

The aim of the Orkney Connection Project is to develop a transmission network in Orkney in order to provide increased capacity to accommodate increased generation from renewable energy in the Orkney area. This involves:

> Development and reinforcement of the onshore grid including substations; and

> Development of a subsea connection between Orkney and Mainland Scotland to enable the export of increased generation connecting on Orkney (called the "Orkney – Mainland Subsea Link".

In addition to the Orkney – Mainland Subsea Link (the subject of this specific report), as part of the Orkney Connection Project SHE Transmission will also develop a number of inter-island connections (cables and overhead lines) to enable the various generation projects to connect to the 220 kV link. The extent of this infrastructure will depend on which generation projects progress to construction and the design is currently being finalised. Further information on the Orkney to Mainland Scotland element of the Orkney Connection Project is provided in the remainder of this document, whilst the inter-island connections will be the subject of a separate Marine Licence application(s).

1.2.2 Orkney to Mainland Scotland Transmission Connection

The need for a transmission link from Orkney is centred around the development and connection of a significant volume of new renewable generation on the archipelago. The area benefits from abundant wind, marine and tidal energy resources which have long been the subject of development as far back as the 1980s. The Orkney Local Development Plan adopted in 2017 sets out the Local Authority's vision and spatial strategy for the development of land in Orkney over the next ten years, including its aspirations with regards to renewable energy generation.

Policy 7c (i) of the plan states, *"The development of renewable and low carbon energy schemes, including the onshore infrastructure and/or buildings required for offshore marine renewable energy developments, and related transmission infrastructure, will be supported where it has been demonstrated that the proposal will not result in significant adverse effects on known constraints, either individually or cumulatively."*

At present there is no transmission infrastructure as the local demand and existing renewable generation is connected via the distribution network owned and operated by Scottish Hydro Electric Power Distribution (SHEPD). The local network is connected to the transmission system on the Scottish mainland at Thurso Grid Supply Point (GSP) via two 33 kV circuits which are at present fully utilised in providing export for local renewable generation. The renewable export potential has been maximised by the use of an innovative Active Network Management (ANM) system as part of what is known as the Orkney Registered Power Zone (RPZ). The system acts to curtail participating generator outputs based on measured power flow constraints within the Orkney network and on the two circuits to the Scottish mainland. Due to the heavy constraints that now exist within the Orkney RPZ, SHEPD is not currently permitting any new generation to connect to the distribution network.

However, given the highly attractive renewable resources there remains much interest in developing generation projects on both a large and small scale across the Orkney archipelago. These projects include both onshore wind schemes and the development of large scale marine projects. The scale of the generation seeking to connect extends into the 100s of MW which drives the development of a transmission solution to facilitate large scale renewable generation export to the Scottish mainland and onwards towards the major demand centres in the south.

This need is backed up by Scotland's Third National Planning Framework (NPF3) published in 2014 and is the spatial expression of the Government Economic Strategy and plans for infrastructure investment. Within NPF3 is a strategy focussing on low carbon; as part of this, there is a recognition of the requirement for infrastructure developments. Delivery of infrastructure developments will be assisted by three national developments including:

An Enhanced High Voltage Energy Transmission Network

Section 6.5 of the NPF3 states that, *"An Enhanced High Voltage Energy Transmission Network is needed to facilitate renewable electricity development and its export. The specific projects required for this network are set out in the Electricity Networks Strategy Group and will continue to evolve as new opportunities emerge. Key connections include links to Orkney, Shetland and the Western Isles, and interconnectors to emerging international grid networks. Improvements to the distribution network are also important to many remote areas.*"

SHE Transmission has therefore sought to find an optimal solution for the connection of all contracted generation and in order to provide a transmission connection that will facilitate the connection of renewable generation a marine cable linking Mainland Orkney and Mainland Scotland is required.

The main elements of the Project are as follows:

- A new substation at Finstown;
- An underground cable linking Finstown substation to a cable landing site west of Stromness;
- A marine cable linking Mainland Orkney and Mainland Scotland;
- An underground cable linking the Dounreay West Substation to a cable landing site at Dounreay; and
- Construction of Dounreay West Substation, linking to the existing 275kV network.

Public Consultation took place initially in November 2017 regarding the above elements and further Pre-Application Consultation (PAC) was undertaken during September to October 2018.

1.2.3 Orkney – Mainland Subsea Link

The Orkney – Mainland Subsea Link Project will be a single subsea circuit comprising a 220 kV AC cable system with Horizontally Directionally Drilled (HDD) landfalls at Warebeth, Orkney and Dounreay, Caithness (Figure 1.1). The total length of the subsea cable route between is approximately 53 km.

A number of options were considered for this cable route as detailed in Section 3 – Route selection and alternatives.

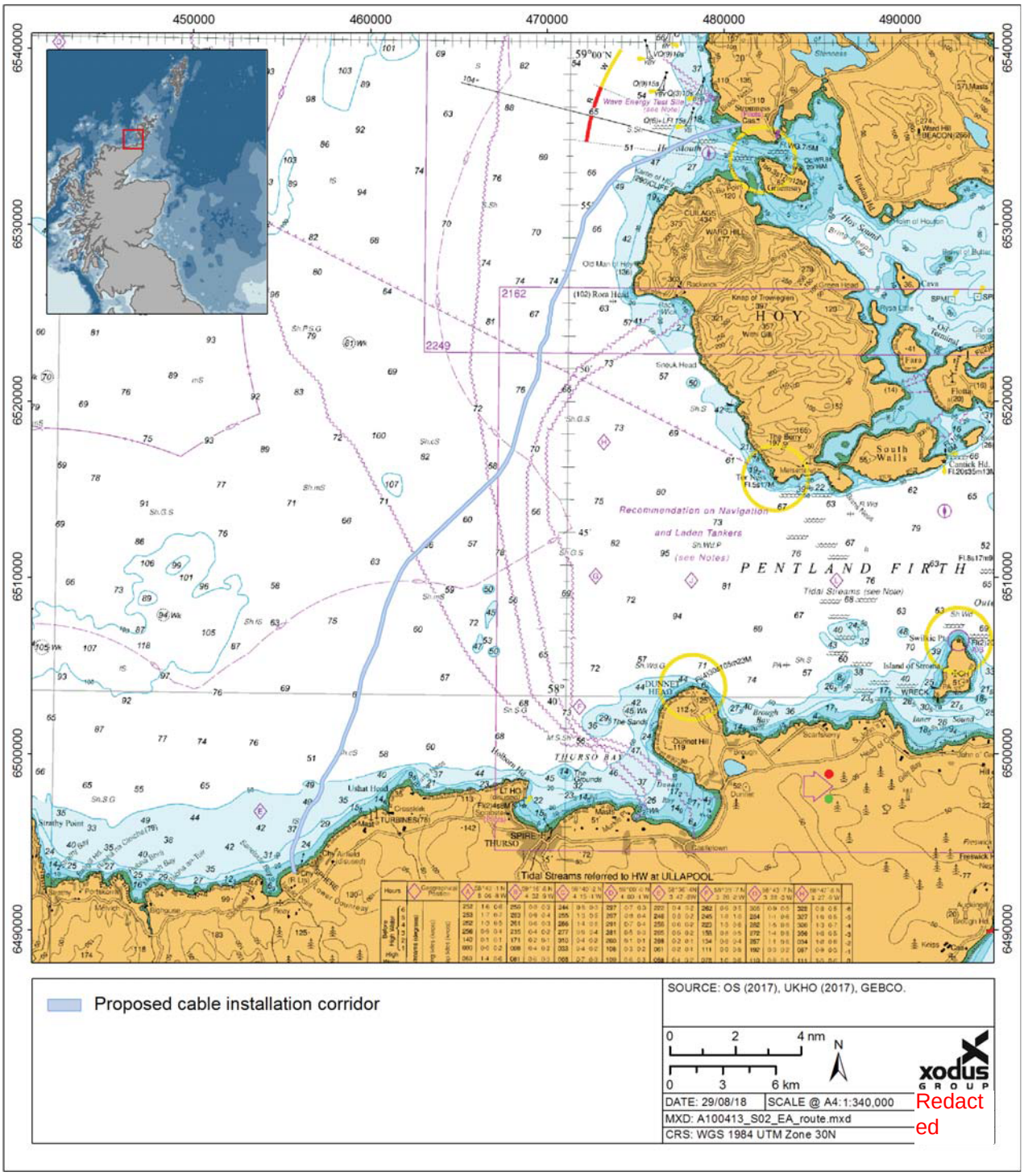
1.2.4 Project definitions

Project definitions for key terminology used in the Environmental Appraisal (EA) is outlined below:

Term	Definition in the context of the project
Orkney Connection Project	Proposed new transmission infrastructure within Orkney and between Orkney and the Scottish mainland, to accommodate increased generation from renewable energy projects in Orkney.
Orkney to Mainland Scotland Transmission Project	Proposed new transmission connection between Orkney and the Scottish mainland incorporating: a new substation at Finstown; an underground cable linking Finstown substation to a cable landing site west of Stromness; A marine cable linking Mainland Orkney and Mainland Scotland; a new cable route between the Dounreay marine cable landing point and the new substation at Dounreay; and Construction of a new substation at Dounreay
Orkney – Mainland Subsea Link	Proposed 220kV subsea cable between Warebeth, Orkney and Dounreay, Caithness.
Cable survey corridor	1 km wide corridor, within which geophysical[1] and benthic surveys were conducted.
Cable installation corridor	200 m wide corridor, approximately central to the cable survey corridor.
Potential cable route	Approximate centre line of the installation corridor, along which geotechnical samples have been taken. The final cable route within the cable installation corridor will be determined once the installation contractor is in place.

[1] Magnetometer (MAG) survey corridor was a 40 m wide corridor within the installation corridor, within which the MAG survey was conducted.

Figure 1.1 Proposed cable installation corridor for Orkney – Mainland HVAC 220kV Subsea Link



1.3 Consenting strategy

1.3.1 Overall strategy

The different aspects of the Orkney – Mainland Subsea Link are afforded consent under different legislation. The overall consenting strategy for the Project and its different components are summarised in Table 1-1 below. The text in bold in Table 1-1 represents the Project component which is the subject of this EA.

Table 1.1 Overall consenting strategy for SHE Transmission works in Orkney

Project component	Relevant legislation & consent	Notes
Construction of a new substation at Dounreay and associated cable to the subsea cable landfall (to Mean Low Water)	Planning permission under Town and Country Planning (Scotland) Act 1997	Confirmed non-EIA development, application for consent to be submitted to The Highland Council (THC) supported by voluntary EA
Subsea cable (220 kV) between Dounreay, Caithness landfall and Warebeth, Orkney landfall (Mean High Water to Mean High Water)	Marine Licence under the Marine (Scotland) Act 2010	Marine Licence application and Harbour Works Licence supported by an EA
Onshore underground cable from Warebeth landfall to Finstown and construction of new substation at Finstown (from Mean Low Water)	Planning permission under Town and Country Planning (Scotland) Act 1997	Cable to be installed as Permitted Development (voluntary EA to be produced), new substation at Finstown is EIA Development. Application for consent to be submitted with EIA Report to Orkney Islands Council (OIC).
Subsea cable connections between the islands of Orkney required as part of the transmission network to connect generation projects to 220 kV link (Mean High Water to Mean High Water)	Marine Licence(s) under the Marine (Scotland) Act 2010 Works Licence(s) under the Orkney County Council Act 1974 (and associated (Orkney Islands Council Harbour Revision Order 1989) for any cables in the Orkney Harbour Area	Separate Marine Licence applications with supporting EAs will be submitted for the inter-island subsea cables that are required to connect the various generation projects to the 220 kV link. Works Licence applications for any works in the Orkney Harbour Area
Onshore cable connections (underground cables and overhead lines) required as part of the transmission network to connect generation projects to 220 kV link (Mean Low Water to Mean Low water)	Planning permission under Town and Country Planning (Scotland) Act 1997 Consent under s.37 of Electricity Act 1989 EIA/EA to support applications	Overhead Lines (OHL) require s.37 consent, switching stations require T&CP permission. Both to be screened for EIA

1.3.2 Scope and objectives of the supporting environmental information

Under Part 4 of the Marine (Scotland) Act 2010, a Marine Licence is required for the installation and operation of submarine cables in Scottish waters. However, submarine cables do not require a formal Environmental Impact Assessment (EIA) as they are not listed on either Schedule 1 or Schedule 2 of the Marine Works (EIA) Regulations 2007 (as amended).

Although a formal EIA is not required for submarine cables, Marine Scotland advises, in their Guidance for Marine Licence Applicant Version 2 June 2015, that "*applicants for Marine Licences for submarine cables should consider the scale and nature of their projects and give consideration to the need for a proportionate environmental assessment*".

For larger projects, where there is potential for the subsea cable to impact key environmental receptors, it is recommended by Marine Scotland (Marine Scotland, 2015) that an assessment of potential impacts on these receptors is carried out. Results from this assessment, along with other relevant information about the Project should then be provided to support the Marine Licence application.

The information provided in this EA has been defined following consultation to determine the type, and scope, of studies to be undertaken to support the application for a Marine Licence (Xodus, 2018). The Advice on the Proposed Content of the Environmental Assessment to Support a Marine Licence Application received from Marine Scotland Licensing Operations Team (MS-LOT) as part of a consultation exercise is discussed further in Section 5 – Stakeholder engagement.

Further information on the key receptors for which assessment was considered appropriate to support the Marine Licence application is provided in this document. The rationale for why these receptors were taken forward for assessment, and justification for those for which detailed assessment was not undertaken, is provided in Section 7 – Impact assessment methodology.

Further documentation, that will be provided as part of the Marine Licence application, is outlined in Table 1-2. It should be noted that provision of some of the documents in support of the Marine Licence application requires the appointment of the installation contractor to allow incorporation of the final design information. Where this is the case e.g. for the Construction Method Statement (CMS), these documents will be provided to MS-LOT, for their approval, prior to any works commencing. This is in line with the MS-LOT advice outlined in Section 6.3.1 of the Advice on the Proposed Content of the Environmental Assessment to Support a Marine Licence Application.

Table 1.2 Supporting documents

Document	When provided
Pre-Application Consultation (PAC) Report	At time of Marine Licence application
Operations and Maintenance (O&M) Requirements	After appointment of the installation contractor and prior to works commencing
Decommissioning Plan	After appointment of the installation contractor and prior to works commencing
CMS	After appointment of the installation contractor and prior to works commencing
Cable Burial Plan (CBP)	After appointment of the installation contractor and prior to works commencing
Construction Environmental Management Plan (CEMP)	After appointment of the installation contractor and prior to works commencing
Fisheries Liaison and Mitigation Action Plan (FLMAP)	After appointment of the installation contractor and prior to works commencing
Communication Strategy	After appointment of the installation contractor and prior to works commencing

1.4 Sources of data and information

The information provided within this EA has been gathered from existing literature, project specific data, consultation with stakeholders and statutory bodies as well as from specialist studies and surveys undertaken to inform the Project (see Table 1-3).

The key sources of data and information utilised are also listed at the beginning of each impact assessment chapter.

Table 1.3 Specialist studies

Title	Date	Author
Orkney Interconnector Cable Burial Risk Assessment	June 2018	Cathie Associates
LT00017 Orkney Subsea Cable Routing Study (Draft)	July 2017	Xodus
Caithness Mainland to Orkney Subsea Link – LT17 Marine Geophysical Survey	May 2018	MMT
Caithness Mainland to Orkney Subsea Link – LT17 Geotechnical Report	May 2018	MMT
Caithness Mainland to Orkney Subsea Link – LT17, Benthic Survey	May 2018	MMT
LT17 Orkney to Mainland Subsea Link Navigational Risk Assessment	Sept 2018	Xodus

1.5 Project team

The EA has been produced on behalf of SHE Transmission by Xodus Group. The Project team roles and competencies are outlined in Table 1-4.

Table 1.4 Project team

Organisation and role	Project role and competency
SHE Transmission Licensed electricity Transmission Owner	Responsible for maintaining and investing in this transmission network Redacted > Responsible for the installation of the cable and management of the projects and contractors Redacted > Responsible for obtaining and managing consents relating to the marine environment on behalf of SHE Transmission Plc > Over 18 years' experience of Maritime works for a variety of sectors, including Defence, Oil and Gas and Cable's > Institution of Environmental Sciences (IES) Full Member
Xodus Group Project management and environmental appraisal lead	Redacted > Qualified environmental professional and experienced project manager with over 25 years marine environmental consultancy experience > Marine Biology BSc (Hons) > Chartered Biologist
	Redacted > Over 25 years' experience working as an environmental (EIA) consultant

Organisation and role	Project role and competency
	> Institute of Environmental Management and Assessment (IEMA) Associate Member > MSc Marine Resource Management > BSc (Hons) Physical Geography
ORCA Marine Archaeology specialists	Redacted > Qualified archaeologist and experienced project manager with over 20 years' historic environment consultancy experience, including over 10 years marine historic environment consultancy experience > Archaeology BA (Hons), PG Cert Post-Excavation Studies ORCA – Registered Archaeological Organisation with the Chartered Institute for Archaeologists
	Redacted > Over 25 years' diving and maritime archaeology experience with over 15 years collecting and interpreting marine geophysical survey data > Over 10 years' marine historic environment consultancy experience > Nautical Archaeology Society Tutor

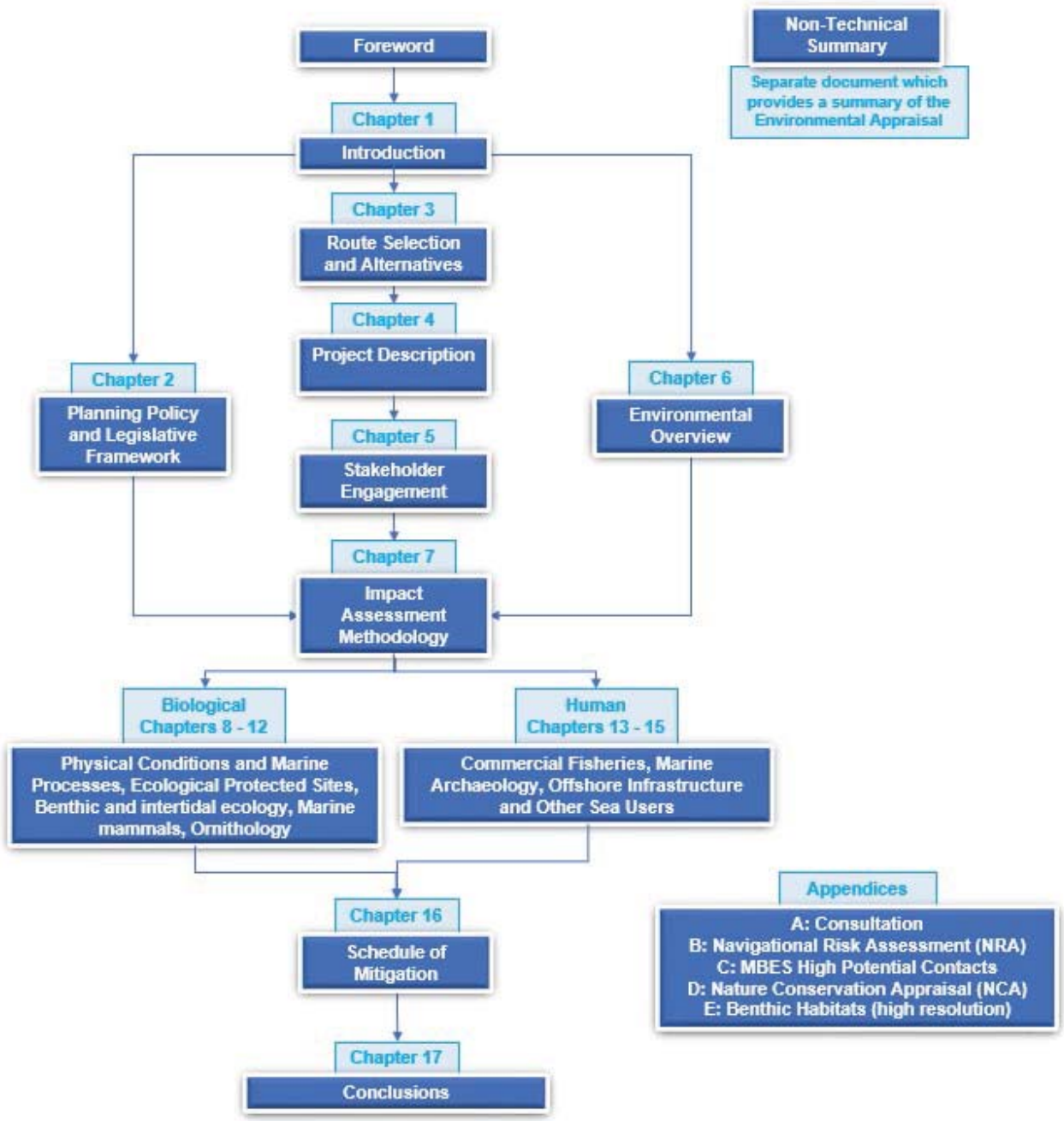
1.6 Document structure

The structure of this EA document is presented in Table 1.5.

Table 1.5 Structure of the EA document

Chapter	Title
Non-technical Summary	
1	Introduction
2	Planning policy and legislative framework
3	Route selection and alternatives
4	Project description
5	Stakeholder engagement
6	Environmental overview
7	Impact assessment methodology
8	Physical conditions and marine processes
9	Ecological protected sites
10	Benthic and intertidal ecology
11	Marine mammals
12	Ornithology
13	Commercial fisheries
14	Marine archaeology
15	Offshore infrastructure and other sea users
16	Schedule of mitigation
17	Conclusions
18	References
Appendix A	Consultation
Appendix B	Navigational Risk Assessment
Appendix C	MBES High Potential Contacts
Appendix D	Nature Conservation Appraisal
Appendix E	Benthic Habitats (high resolution)

Figure 1.2 Structure of the EA



2 PLANNING POLICY AND LEGISLATIVE FRAMEWORK

2.1 Introduction

The following sections present the key policy and legislative context for the Project. The international and European policy context is presented, followed by the key UK and Scottish policy relevant to the Project. Where specific policy or legislation exists with respect to technical assessments, this is set out in the relevant sections of technical sections.

2.2 Marine planning framework

2.2.1 Marine Strategy Framework Directive (MSFD)

The EU Marine Strategy Framework Directive 2008/56/EC (MSFD) was formally adopted in July 2008 and was transposed into UK Legislation under the Marine Strategy Regulations 2010 on 15th July 2010. The Directive is the environmental pillar of the Integrated European Maritime Policy which focuses on the development of a coherent, co-ordinated and integrated approach to the management of marine environment through marine planning. The MSFD constitutes a vital environmental component of the European Union's (EU) future maritime policy and is designed to achieve full economic potential of oceans and seas in harmony with the marine environment (MSFD, 2015).

The main requirement of the MSFD is for Member States to prepare national strategies, including marine spatial plans (MSP), to manage their seas to achieve Good Environmental Status (GES) by 2020. In December 2012, the UK Marine Strategy Part 1 was published. This included an assessment of UK marine waters; proposals on defining GES and developing targets and indicators for achieving and monitoring GES. In July 2014, Part 2 of the Marine Strategy was published by the UK government to establish and implement coordinated monitoring programmes for the ongoing assessment of the environmental status of marine waters around the UK (DEFRA, 2014). Part 3 of the Marine Strategy was established at the end of 2015, setting out a programme of measures to enable the achievement of GES.

2.2.2 UK Marine Policy Statement

The UK Marine Policy Statement (MPS) was published in March 2011, under Section 44 of the Marine and Coastal Access Act (MCAA) 2009, in order to provide a framework for marine spatial planning, specifically for the preparation of Marine Plans and to ensure that marine resources are used in a sustainable way (HM Government, 2011). The MPS applies to all UK waters and has been adopted by the UK Government, the Scottish Government, the Welsh Assembly Government and the Northern Ireland Executive. The function of the MPS is to provide the framework for preparing Marine Plans and taking decisions affecting the marine environment. All national and regional marine plans must be in conformity with the MPS.

The objectives of the MPS are to:

- Promote sustainable economic development; enable the UK's move towards a low-carbon economy, in order to mitigate the causes of climate change and ocean acidification and adapt to their effects;
- Ensure a sustainable marine environment which promotes healthy, functioning marine ecosystems and protects marine habitats, species and our heritage assets; and
- Contribute to the societal benefits of the marine area, including the sustainable use of marine resources to address local social and economic issues.

The MPS emphasises the importance of renewable energy and recognises the importance of considering marine renewable projects in marine planning, stating that "Contributing to securing the UK's energy

objectives, while protecting the environment, will be a priority for marine planning". The MPS states that in examining and determining applications for all energy infrastructure, the following must be considered:

- The national level of need for energy infrastructure;
- The positive wider environmental, societal and economic benefits of low carbon electricity generation;
- That the renewable energy resources can only be exploited where the resource exists and where economically feasible; and
- The potential for inward investment on energy related manufacturing and deployment activity and employment opportunities and regeneration of local and national economies, supporting the objective of developing the UK's low carbon manufacturing capability.

2.2.3 The Marine Acts

The UK Marine and Coastal Access Act 2009 provides executive devolution to Scottish Ministers of marine planning, licensing and conservation powers in the offshore zone (12 to 200 nm). The Marine (Scotland) Act 2010 created a new legislative and management framework for the marine environment within Scottish territorial waters (0 to 12 nm).

These Acts put in place a national system for the management and protection of the marine and coastal environment, including provisions for marine planning, as well as marine nature conservation and marine licencing.

2.2.4 Scottish National Marine Plan

Under the Marine and Coastal Access Act 2009 and the Marine (Scotland) Act 2010 the Scottish Government is required to prepare a National Marine Plan (NMP) for Scottish territorial waters and the offshore zone. The Scottish Government adopted the Scottish NMP in early 2015 (Scottish Government, 2015) to provide an overarching framework for marine activity in Scottish waters, with an aim to enable sustainable development and the use of the marine area in a way that protects and enhances the marine environment whilst promoting both existing and emerging industries. This is underpinned by a core set of general policies which apply across existing and future development and use of the marine environment. Sectoral policies are also outlined in the NMP where a particular industry brings with it issues beyond those set out in the general policies. For cable projects, in addition to the general planning policies, the policies covering sea fisheries and submarine electricity cables are of particular relevance.

SHE Transmission has taken all the relevant aspects of the policies outlined below into consideration with regards to the cable installation, operation and decommissioning activities and the assessment of potential environmental and socio-economic impacts. Discussion on how compliance and alignment with the NMP has been achieved is provided in Section 17 – Conclusions.

2.2.4.1 General planning

The general planning policies of particular relevance to the Project include:

- General planning - there is a presumption in favour of sustainable development and use of the marine environment when consistent with the policies and objectives of the NMP;
- Economic benefit -sustainable development and use which provides economic benefit to Scottish communities is encouraged when consistent with the objectives and policies of this NMP;
- 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 NMP;

- Climate change - marine planners and decision makers must act in the way best calculated to mitigate, and adapt to, climate change;
- Natural heritage - Development and use of the marine environment must:
    - Comply with legal requirements for protected areas and protected species;
    - Not result in significant impact on the national status of Priority Marine Feature (PMF); and
    - Protect and, where appropriate, enhance the health of the marine area.
- Noise - development and use in the marine environment should avoid significant adverse effects of manmade noise and vibration, especially on species sensitive to such effects;
- Engagement - early and effective engagement should be undertaken with the general public and interested stakeholders to facilitate planning and consenting processes; and
- Cumulative impacts - cumulative impacts affecting the ecosystem of the NMP area should be addressed in decision-making and NMP implementation.

2.2.4.2 Sea fisheries

With respect to sea fisheries, the NMP sets out a number of policies. Those that are relevant to the Project include:

Fisheries 1: Taking account of the EU's Common Fisheries Policy (CFP), Habitats Directive, Birds Directive and MSFD, marine planners and decision makers should aim to ensure:

- Existing fishing opportunities and activities are safeguarded wherever possible;
- Protection for vulnerable stocks (in particular for juvenile and spawning stocks through continuation of sea area closures where appropriate);
- That other sectors take into account the need to protect fish stocks and sustain healthy fisheries for both economic and conservation reasons; and
- Mechanisms for managing conflicts between fishermen and/or between the fishing sector and other users of the marine environment.

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; and
- 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.

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; and
- 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 socioeconomic impacts.

2.2.4.3 Submarine cables

With respect to submarine cables, the NMP sets out a number of key objectives. Those that are relevant to the Project include:

- Protect submarine cables whilst achieving successful seabed user co-existence;
- Achieve the highest possible quality and safety standards and reduce risks to all seabed users and the marine environment; and
- Support the generation, distribution and optimisation of electricity from traditional and renewable sources to Scotland, UK and beyond.

There are four marine planning policies laid out in the NMP which relate to submarine cables:

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 consideration 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.

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; and
- Consideration of the need to reinstate the seabed, undertake post-lay surveys and monitoring and carry out remedial action where required.

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.

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 and align with those in Scottish Planning Policy (SPP) and Local Development Plans.

2.2.5 Scottish marine regions

The Scottish NMP (Section 2.2.4) sets the wider context for planning within Scotland, including what should be considered when creating local, regional marine plans. Eleven Scottish Marine Regions have been created which cover sea areas extending out to 12 nm. Regional Marine Plans are being developed by Marine Planning Partnerships, allowing more local ownership and decision making about specific issues within their area. Relevant to this report are the North Coast Scottish Marine Region and the Orkney Islands Scottish Marine Region. Both of these regions are covered by the Pentland Firth and Orkney Waters Marine Spatial Plan (pilot) published in 2016.

2.2.6 Pilot Orkney Waters and Pentland Firth Marine Spatial Plan (MSP)

The pilot Pentland Firth and Orkney Waters MSP sets out an integrated planning policy framework to guide marine development, activities and management decisions, whilst ensuring the quality of the marine environment is protected. It is anticipated that this pilot MSP will provide a useful basis for the preparation of two separate regional marine plans for Orkney and the North Coast Scottish Marine Regions.

The pilot MSP has been prepared to align closely with the Scottish NMP, NMPF3 and Scottish Planning Policy (SPP). This is reflected in the plans guiding principles, aims and objectives all of which underpin the overarching vision to ensure that the Pentland Firth and Orkney Waters is a clean, healthy, safe, attractive and productive marine and coastal environment that is rich in biodiversity and managed sustainable to support thriving and resilient local communities.

Section 4 of this plan sets out a number of general policies which have been developed specifically to ensure that the Plan is contributing to both high level government targets and helps meet our commitment to local sustainable development as outlined in the objectives. Those policies that are most relevant to this Project include: supporting sustainable social and economic benefits; safeguarding the marine ecosystem; climate change, nature conservation designations; protected species; wider biodiversity; landscape and seascape; geodiversity; water environment; coastal processes and flooding; historic environment; integrating coastal and marine development; noise and marine non-native species.

There are also a number of sectoral policies which are specifically relevant to particular types of development or activity. Of direct relevance to this Project is Sectoral Policy 8: Pipelines, Electricity and Telecommunications Infrastructure which includes specific reference to the Orkney 132 kV reinforcement works. Specific policy requirements relating to the development of subsea cables reflect those outlines in the Scottish NMP discussed above.

2.3 Onshore planning policy

The proposed Project which is the subject of this EA, does not include any infrastructure on the seabed above the Mean High Water Mark (MHWM). Both cable landfalls are to be HDD and not surface laid over the foreshore. Therefore, onshore planning and policy are not relevant to the application.

2.4 Nature conservation legislation

2.4.1 Habitats and Birds Directive

Council Directive 92/43/EEC on the Conservation of natural habitats and of wild fauna and flora, also known as the 'Habitats Directive', provides for the conservation of natural habitats and of wild flora and fauna including in offshore areas. The EC Directive on the conservation of wild birds (Birds Directive) applies to the conservation of all species of naturally occurring wild birds including in offshore areas. Both Directives have been transposed into Scottish Law by The Conservation (Natural Habitats &c.) Regulations 1994 (as amended) (the Habitats Regulations) and in the offshore marine area by the Conservation of Offshore Marine Habitats and Species Regulations 2017 (the Offshore Habitats Regulations). Both the Habitats Directive and the Birds Directive form a network of European designated sites referred to as Natura 2000 sites.

European sites protected under this legislation include Special Protected Areas (SPA), Special Area of Conservation (SAC) and RAMSAR sites. The European Habitats Directive (92/43/EEC) aims to promote the maintenance of biodiversity by requiring EU Member States to maintain or restore representative natural habitats and wild species at a favourable conservation status (FCS), through the introduction of robust protection for those habitats and species of European importance.

As part of these protection measures, Member States are required to undertake assessments to determine whether a plan or project is likely to have an adverse effect on the integrity of a European site. This process of Habitats Regulations Appraisal (HRA) is discussed in more detail below.

2.4.1.1 Habitats Regulations Appraisal

The European Commission guidance 'Assessment of plans and projects significantly affecting Natura 2000 sites' outlines a staged assessment process, which are cumulatively referred to as a Habitats Regulation Appraisal. In the UK the four stages are commonly referred to as:

- Stage One: Screening
- Stage Two: Report to Inform Appropriate Assessment
- Stage Three: Assessment of Alternative Solutions; and
- Stage Four: Assessment of 'Imperative Reasons of Overriding Public Interest' (IROPI)

HRA in Scotland is undertaken in line with the Scottish Natural Heritage (SNH) guidance document 'Habitats Regulations Appraisal: Guidance for Plan-making Bodies in Scotland' (Tyldesley *et al.,* 2015).

The purpose of HRA Screening is to identify aspects of the project/plan for which it is not possible to rule out the risk of significant effects on a European site (referred to as likely significant effect (LSE)), either alone or in-combination with other projects. A likely effect is one that cannot be ruled out on the basis of objective information. The Court of Justice of the EU has recently ruled (case C-3232/17) that it is not appropriate, at the screening stage, to take account of measures intended to avoid or reduce the harmful effect of a plan or project. Previously, it was considered suitable to consider limited form of mitigation at the screening stage.

European Sites and features which will be subject to an Appropriate Assessment (AA) are those for which LSEs could not be ruled out during the screening exercise. A European Site is progressed to the AA Stage (Stage 2 of the HRA) where it is not possible to exclude a LSE to one or more qualifying features of that site in view of the Conservation Objectives. A project provides a report to inform the AA which takes consideration of the impacts of a project, alone and in-combination with other plans and projects, on the integrity of a European Site, with regard to the site's structure and function and its Conservation Objectives. A competent authority shall then carry out an AA on the implications for a site in view of that sites conservation objectives, before deciding to undertake or give any consent, permission or other authorisation for a plan or project.

The need for AA extends to plans or projects out with the boundary of the site in order to determine their implications for the interests protected within the site. Competent authorities (in this case Marine Scotland)

need to identify the qualifying interests and the conservation objectives for each European site involved in an AA.

The 2017 EIA Regulations introduce a new requirement for a coordinated procedure where a project is simultaneously subject to an assessment under the EIA Regulations and also the HRA. It is thought that this coordinated procedure will provide greater flexibility for developers around the phasing and timing of EIA and an 'appropriate' assessment (if required) under HRA.

2.4.2 NCMPA appraisal

It is an offence to intentionally or recklessly kill, remove, damage, or destroy any protected feature of a Nature Conservation MPA (NCMPA). Marine Scotland must be sure that consenting/licensing decisions do not cause a significant risk to the conservation objectives of any NCMPA. To ensure that Marine Scotland has sufficient information available to make such a decision, this document presents information on the potential interaction with NCMPAs.

Under section 83 pf the Marine Scotland (2010) Act and section 126 of the Marine and Coastal Access Act 2009, Marine Scotland is required to consider whether a licensable activity is capable of affecting (other than insignificantly) a protected feature in a NCMPA or any protected ecological or geomorphological process on which the conservation of any protected feature of an NCMPA is dependant. If MS-LOT believe there is or may be a significant risk of a project hindering the achievement of the conservation objectives then they must notify the relevant conservation bodies, SNH in the case of this Project (where NCMPAs are within 12 nm of the coast).

2.4.3 Nature Conservation Assessment (NCA)

HRA and NCMPA Appraisal, together known as a nature Conservation Assessment (NCA) have been carried out to accompany the Marine Licence application. Potential impacts to ecologically protected sites are assessed within Appendix D – Nature Conservation Assessment. Where no LSE is predicted or potential impact to qualifying features in the case of NCMPAs, the sites have been screened out of further assessment in this report. Where LSE or potential impacts to qualifying features can't be ruled out, a more detailed impact assessment has been carried out and presented later on in this report.

2.4.4 European Protected Species (EPS) and Wildlife licensing requirements

For any EPS, the Conservation (Natural Habitats, &c.) Regulations 1994 which apply out to 12 nm, and the Conservation of Offshore Marine Habitats and Species Regulations 2017, which apply beyond 12 nm, make it an offence to deliberately or recklessly capture, kill, injure, harass or disturb any such animal. It is also an offence to deliberately or recklessly obstruct access to a breeding site or resting place of any such animal, or otherwise to deny the animal use of the breeding site or resting place. In addition, it is an offence to disturb such an animal in a manner that is, or in circumstances which are, likely to significantly affect the local distribution or abundance of the species to which it belongs. For cetaceans (dolphins, porpoises and whales) only, there is a more general offence of deliberately or recklessly disturb any individuals belonging to this group. The damage or destruction of a breeding site or resting place of any EPS of animal is an offence of strict liability. An EPS Licence is required for any activity that might result in disturbance to an EPS.

Basking sharks are protected under Schedule 5 of the Wildlife and Countryside Act (1981 as amended) which prohibits the killing, injuring or taking by any method of those wild animals listed on Schedule 5 of the Act. The Nature Conservation (Scotland) Act 2004, Part 3 and Schedule 6 make amendments to the Wildlife and Countryside Act (1981 as amended), strengthening the legal protection for threatened species to include 'reckless' acts. The Act makes it an offence to intentionally or recklessly disturb basking sharks. Licensing requirements under the Wildlife and Countryside Act (1981 as amended) are similar to those for EPS protected under Annex IV of the Habitats Directive. Marine Scotland will determine specific licensing requirements as part of the application determination.

3 ROUTE SELECTION AND ALTERNATIVES

3.1 Strategic route selection

A five-stage process was followed in 2017 for the selection of strategic route options for a marine cable connecting mainland Orkney to mainland Scotland as follows:

1. Baseline information and connection components reviewed.
2. Rationalisation of technically feasible components utilising key assumptions.
3. Identification of strategic options based on the above.
4. Assessment of strategic options.
5. Identification of a preferred option.

Strategic Route Options were built upon geographic combinations of the following components:

- New Substation Location in Orkney (including GSP).
- Onshore Transmission infrastructure on Orkney.
- Subsea Cable Corridor between landfall options.
- Landfall Options in Caithness.
- Onshore Transmission infrastructure on Caithness.
- Upgraded or new substation on Caithness.

The process for route selection is shown Figure 3.1.

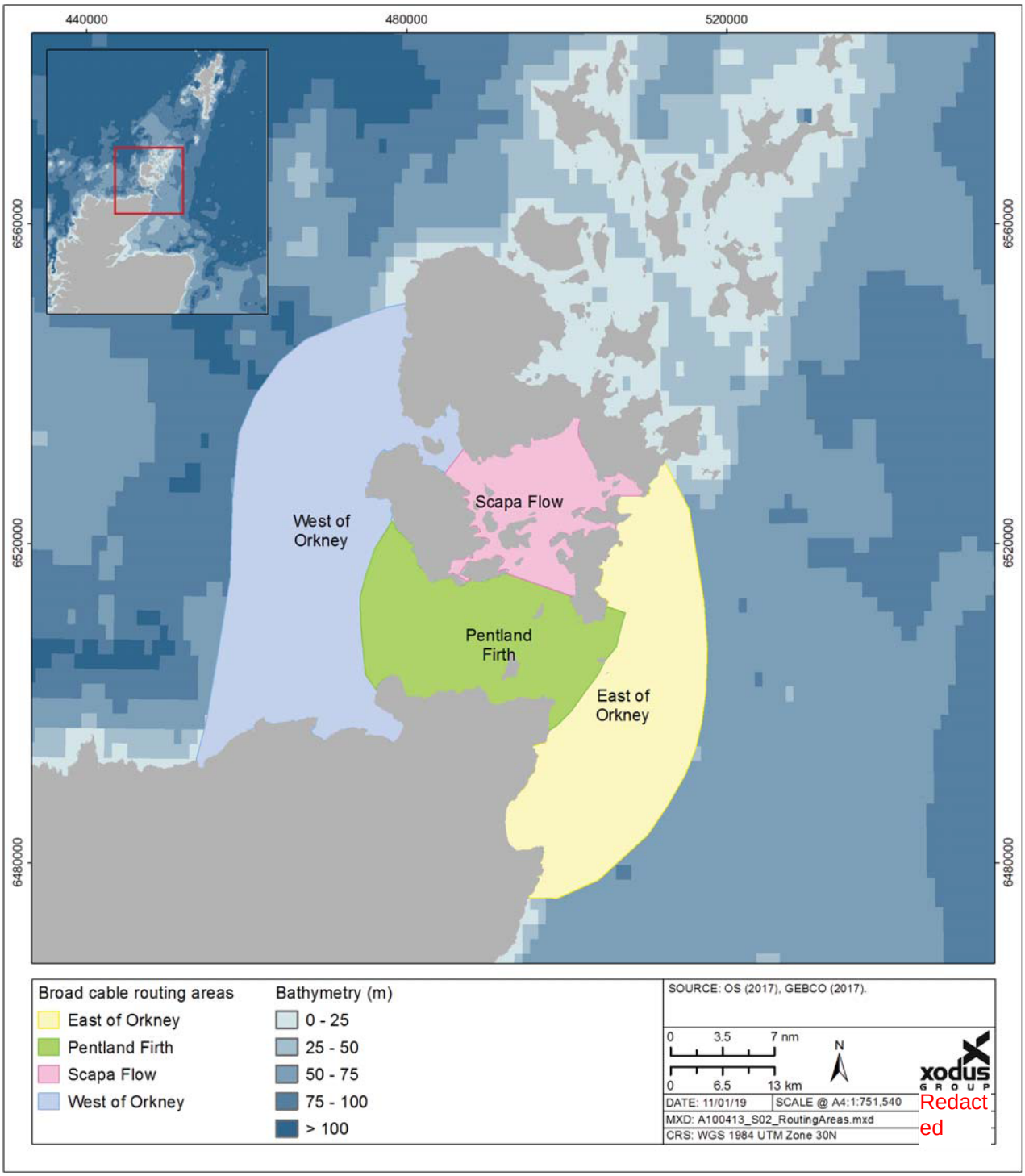
Figure 3.1 Process for route selection



3.2 Broad scale routing areas

Four broad scale routing areas were considered as part of the route development as shown in Figure 3.2.

Figure 3.2 Broad scale routing areas considered as part of route development



The main routing constraints and considerations for each of the four broad scale routing areas are outlined in Table 3-1.

Table 3.1 Routing constraints and considerations for each of the four broad scale routing areas

East of Orkney	Scapa Flow
> Would require additional onshore infrastructure in Caithness > Important trawl and dredge fisheries in the area > Seabed on east coast scoured from tidal outflow leading to primarily rocky seabed with thin gravel or sandy veneer	> World renowned site of cultural heritage and the former British Admiralty base. Scapa flow contains many significant wrecks, including blockships, The German Grand Fleet, the war graves of HMS Royal Oak and HMS Vanguard, as well as numerous merchant vessels and aircraft, and the Churchill barriers > Internationally significant anchorage, safe harbour and ship-to-ship transfer area > Numerous additional obstructions, including submarine cables, pipelines and aquaculture sties > PMF's present, including Maerl beds, flame shell beds, horse mussel beds, seagrass and seapens > World renowned SCUBA diving location
Pentland Firth	**West of Orkney**
> Contains some of the strongest tidal flows in the UK > Recognised International Shipping Lane > Within the core area of the Pentland Firth, between Hoy, South Ronaldsay and Caithness, there is limited to no potential to bury the cable > Seabed primarily comprises gullied and fissured bedrock > Absence of sediment would require significant rock armouring to protect cable from tidal load and emergency anchoring > Mobile sandwaves on the periphery of the Pentland Firth present additional technical challenges to cable installation	> Existing infrastructure at Dounreay has sufficient capacity, reducing the cost, time and environmental impact of the proposed connection > Seabed conditions more favourable for cable burial (gently sloping seabed comprising mainly sandy and gravelly sediments) > Limited environmental constraints > High levels of shipping traffic passing through the area (en-route to and from the Pentland Firth) > Relatively short route between Orkney Mainland and Caithness

3.3 Desk study and site visits

The initial landfall and cable route options identified as part of the Orkney Connection Project were subject to high level appraisal as part of a Geographical Information System (GIS) desk-based study. Findings from this desk-based appraisal were then used to inform a more detailed appraisal of the potential landfall locations during a site visit by the Project team to Orkney held between the 10th and 13th October 2017.

Based on findings from the desk study and additional information acquired during the site visits it emerged that there were a number of potential challenges associated with some of the proposed landfall locations /

areas of search and associated subsea cable routes. For the subsea cable route corridors between Orkney and mainland Scotland these included:

- Challenges with installing a cable within, or across, the Pentland Firth due to very strong currents, the presence of solid bedrock across most of the seabed and high levels of shipping activity at landfall locations.
- Challenges with installing a cable within, or across, Scapa Flow due to high levels of shipping activity, including large oil and gas tankers and other cargo vessels, presence of moorings for semi-submersibles and oil and gas tankers and other cargo vessels, presence of a number of protected wrecks and presence of a number of PMFs, potential Annex 1 Habitat and designated sites.
- Challenges with shallow water (e.g. less than 5 m depth in certain locations), strong tidal currents, environmental designations, ferry routes, wrecks and existing infrastructure on the seabed (cables) between Hoy and Orkney mainland south coast (around Stenness and Bay of Ireland).

Based on the challenges, it emerged during the site visits that wider areas of search needed to be investigated with respect to potential landfall locations in order to facilitate development of alternative subsea cable route options.

3.4 West of Orkney landfall options

Landfall options in the West of Orkney cable routing area are limited due to a combination of factors including waves and tides, and the coastal conditions they generate in combination with the geology, which give rise to predominantly bedrock shelves and cliffs. The presence of suitable embayments and associated soft landings for a cable are therefore limited.

The main constraints and considerations for landfall options in the West of Orkney cable routing area are outlined in Table 3-2.

3.5 Workshop

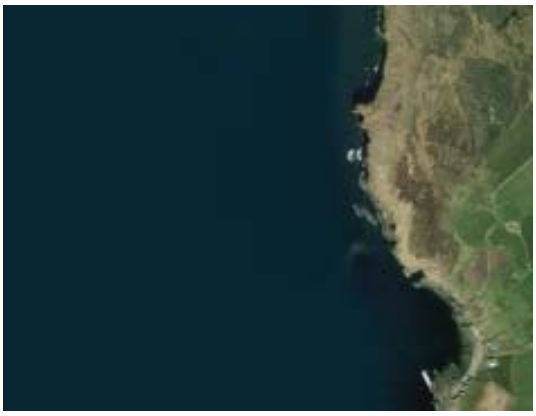
A workshop was held on 2nd November 2017 for the Project team to review the findings from the desk studies and site visits (from both a marine and onshore perspective) in order to identify a preferred shortlist of options to be taken forward for more detailed appraisal.

Drawing on experience from other SHE Transmission Projects a RAG (Red Amber Green) approach to evaluating the potential Strategic Options was adopted. This approach allows a high-level assessment to be made on key criteria and identifies key areas of risk and relevant constraints associated with each Strategic Option.

The Strategic Options to be assessed were agreed based on the key assumptions below:

- Utilise High Voltage Alternating Current (HVAC) technology for the connection.
- Avoid the core area of the Pentland Firth.
- Minimising the need for additional infrastructure on Caithness by the utilisation of existing infrastructure.
- Centrally located substation on Mainland Orkney.
- Landfall options on Caithness and Orkney drive the strategic option locations.
- Utilise a cable solution for the connection on Orkney mainland.

Table 3.2 Landfall constraints and considerations for the West of Orkney area

Billia Croo, Orkney	
> Existing European Marine Energy Centre (EMEC) > Potential conflict with future wave developers in the area > Existing infrastructure on seabed	
Warebeth, Orkney	
> Wide, shallow bay > Direct access to onshore location	

Rackwick, Orkney	
> Technically feasible landfall > Requires additional onshore infrastructure on Hoy and second cable to reach Mainland Orkney	
Mesletter, Orkney	
> Very challenging landfall due to position on northern edge of Pentland Firth	
Dounreay, Mainland Scotland	
> Existing onshore infrastructure with sufficient capacity > Western route offers opportunity to maximise cable burial	

3.6 Detailed appraisal

Based on the outcome from the detailed appraisal of the shortlisted options it was concluded that the following subsea cable route option would be subject to a marine survey (geophysical, geotechnical and environmental):

- West coast route option:
    - Dounreay to Billia Croo (Warebeth).

3.7 Preferred route option

The preferred route option between Dounreay and landfall at Warebeth, Orkney, as shown in Figure 3.1, was selected on the following basis:

- It achieves the maximum potential for cable burial.
- It avoids major seabed hazards (e.g. sand wave fields, areas of exposed bedrock).
- It requires a limited number of cable crossings.
- Potential impacts on marine wildlife are limited.
- Potential interactions with other sea users (fisheries, shipping and navigation) are also minimised.

3.8 Marine survey

A marine survey of the preferred Dounreay to Warebeth subsea cable route option was undertaken between February and May 2018. The objective of the survey was to acquire geophysical, geotechnical and environmental data from a 1,000 m wide corridor along the full extent of the preferred cable route to find the most suitable route and to determine the acceptability as well as confirming the viability of the route selected during the desktop study.

The scope of the surveys included the following:

- Nearshore geophysical survey (multibeam echo sounder (MBES), side scan sonar (SSS)/sub-bottom profiler (SBP) and towed magnetometer.
- Offshore geophysical survey (surveyor remote operated vehicle (SROV), MBES, SSS/SBP.
- Offshore Unexploded Ordnance (UXO) survey (work class ROV (WROV) - gradiometer).
- Nearshore UXO survey (towed magnetometer).
- Environmental Survey (benthic grab samples and drop-down video (DDV).
- Geotechnical Survey (Vibrocore (VC) and Cone penetration test (CPT).
- Cable Crossings Surveys (WROV – gradiometer).
- Shallow water survey (MBES).
- Landfall topographic survey.
- Landfall magnetometer survey.

3.9 Cable Burial Risk Assessment (CBRA)

Having carried out initial re-routing based on results and data from the marine survey, a CBRA was carried out, utilising the carbon trust methodology, for the refined subsea cable route.

The main objective of for the CBRA was to ensure that, based on information from both the desk-based study and survey data, cable burial can be achieved, using a variety of installation tools, if necessary, along as much as possible of the preferred cable route. Where the CBRA identified that due to seabed conditions, cable burial is not possible, i.e. where it is necessary to lay the cable directly on the seabed, alternative options for protecting the cable were also considered. The installation and additional protection measures are outlined in Section 4 – Project description.

4 PROJECT DESCRIPTION

4.1 Introduction

SHE Transmission proposes to install a 220 kV Alternating Current (AC) cable system between Orkney Mainland and Caithness on the Scottish mainland (Orkney – Mainland Subsea Link).

This section provides a description of the Project detailing the physical construction of the cable and the method of installation, operation, maintenance and decommissioning of the cable.

Routing considerations and alternatives are outlined in Section 3 – Route selection and alternatives.

4.2 Project overview

The Orkney to Mainland Scotland Transmission Connection is a proposed HVAC link, delivering a minimum capacity of 220 MW, which will allow the transfer of electricity between Finstown substation via a landfall at Warebeth, on the west coast of Orkney Mainland and Dounreay West substation, Caithness on the north coast of the Scottish Mainland.

The cable will be brought ashore through pre-installed Horizontal Directional Drilling (HDD) ducts, bridging the shallow coastal and intertidal areas by drilling through the bedrock. Once the cables emerge from the HDD duct they will be laid on the seabed and buried in seabed sediment where possible.

If the subsea cable cannot be buried, for example due to hard seabed conditions, the presence of sensitive environmental habitats/species or at the crossings of other assets, it will be protected by alternative methods, for example High Density Polyethylene (HDPE) ducting, Cast Iron Shells (CIS), rock placement or concrete mattressing.

In limited areas where there is hard seabed or outcropping bedrock mechanical trenching may be used to create a slot trench in which the cable and its protection system will be laid.

In addition to the subsea cable, there are terrestrial elements of the Orkney to Mainland Scotland Transmission connection. These include:

- A new substation at Finstown;
- An underground cable linking the Finstown substation to a cable landing site at Warebeth, west of Stromness;
- An undergrounded cable linking the Dounreay West Substation to a cable landing site at Dounreay; and
- The construction of Dounreay West Substation, linking to the existing 275kV network.

This document considers the marine components of the route up to Mean High Water Springs (MHWS) at both HDD landfalls. The onshore aspects of the Project above MHWS are not considered in this document and will be subject to separate assessment as appropriate.

4.3 Cable type and proposed route

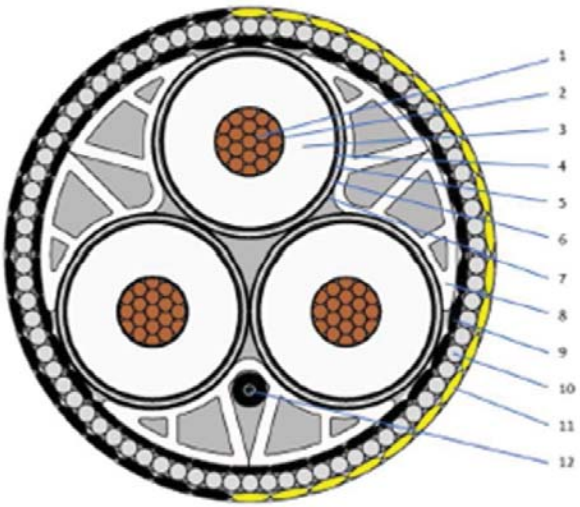
4.3.1 Cable specification

Electricity will be transmitted using HVAC submarine cable technology. The proposed submarine cable consists of a three-core design with copper stranded conductors, cross-linked polyethylene (XLPE) insulation, water blocking / screening tape, polyethylene sheath and galvanized steel wire armour with an outer serving. An armoured optical fibre is included within the three-core cable.

The three-core design minimises the electric and magnetic fields produced by the cable during operation.

For similar HVAC systems, the cable is approximately 250-300 mm in diameter and weighs approximately 100 -150 kg/m. The exact cable design is not known at this stage and will depend on which Installation Contractor is appointed. A typical HVAC cable structure is shown below in Figure 4.1.

Figure 4.1 Typical HVAC subsea cable construction



No.	Description
1	Conductor
2	Conductor screen
3	Insulation
4	Insulation screen
5	Water Blocking
6	Metal sheath
7	Inner sheath
8	Fillers
9	Armour bedding
10	Armouring
11	Serving
12	OF cable

4.3.2 Proposed cable route

The subsea cable route is approximately 53 km long. It follows a broadly southwest alignment from Warebeth, Orkney across the western approaches to the Pentland Firth to Dounreay, Caithness.

4.3.3 Cable crossings.

The routing studies have considered the crossings of existing infrastructure, with the following principal criteria:

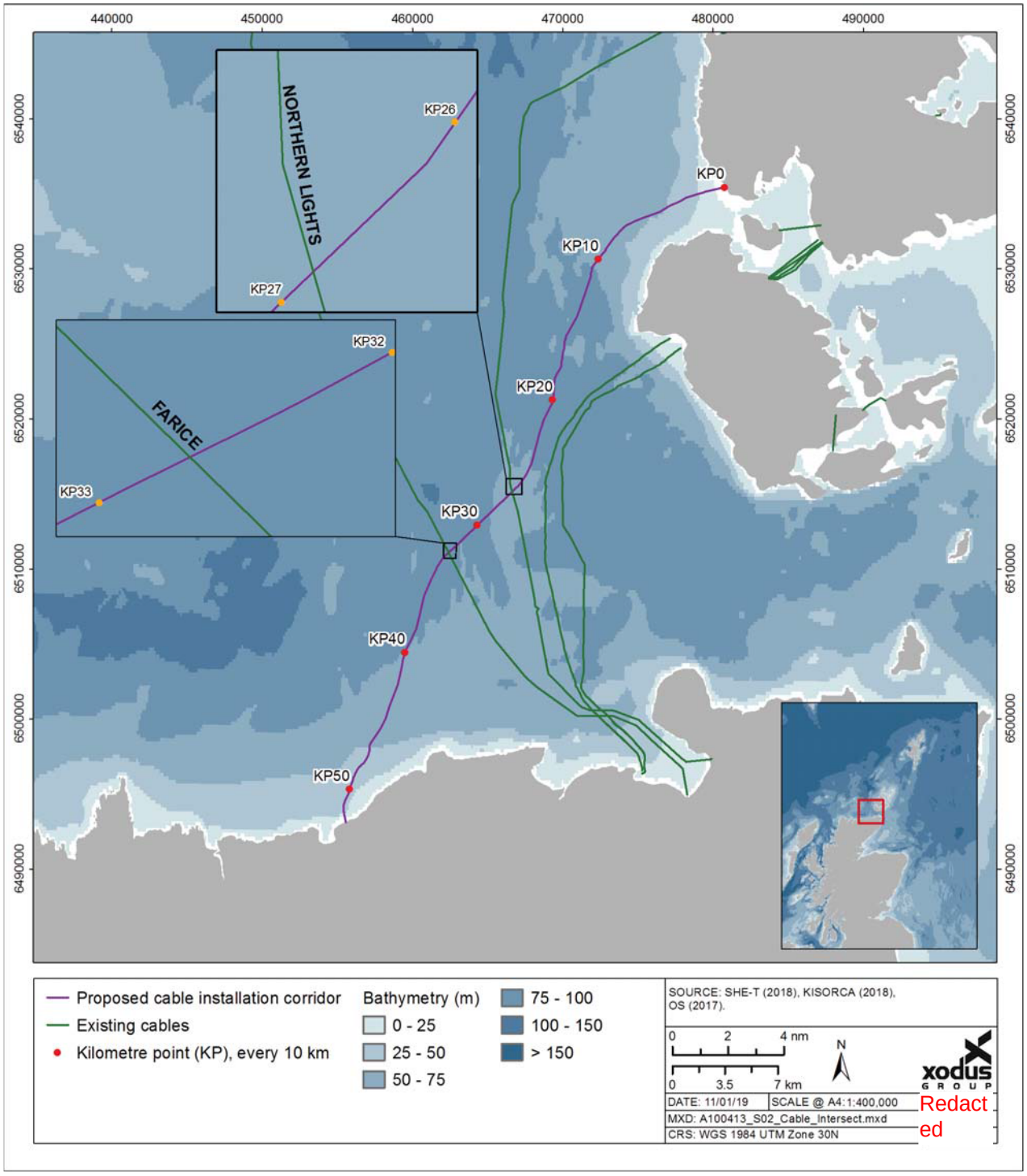
- Avoid or minimise the number of cable crossings;
- Ensure the angle of crossing is perpendicular (i.e. as close to 90^{o} as practicable);
- Assess crossing design to pass over the existing assets;
- Post-installation, the crossing shall be suitably protected (with rock placement or similar); and
- Crossing proposals to be acceptable to the operators of existing assets (it is normal practice to have cable Crossing Agreements in place).

The cable route crosses existing telecoms infrastructure in two locations:

- Farice-1 telecoms cable at KP32.7.
- British Telecom (BT) Northern Lights telecoms cable at KP26.8.

The locations of the cable crossings are shown in Figure 4.2.

Figure 4.2 Overview of cable crossing locations



The crossing of third party infrastructure is made with agreement of the owners following a negotiated formal Crossing Agreement. The Crossing Agreement describes the rights and responsibilities of the parties and the detailed physical design of the crossing. The design addresses the need to protect both the cables and the third-party infrastructure and other aspects such as crossing angle and vertical separation.

Prior to marine cable installation, the selected contractor for the burial and protection scopes of work will propose a suitable crossing design in sufficient time such that SHE Transmission can enter into early discussion with third party asset owners on their requirements for crossing architecture and separation distances, with a view to finalising the design as the Project progresses through detailed design, in order to allow time to review and respond and make changes to the design where required.

4.3.4 Preliminary estimate for remedial works

The geology below the shallow marine sediments (where present) comprises glacial till and / or bedrock, which both exhibit undulating surfaces. Due to this, and the sediment mobility and erosion resultant from high currents, the glacial till and bedrock regularly outcrop along the installation corridor.

The thin nature or absence of marine sediments can create difficult conditions for burial. In these conditions, remedial works are required following cable lay.

Sections of the route which comprise the following are highlighted in Figure 4.3:

- Bedrock or hard till (outcropping or shallow); and
- Cable crossing requiring remedial works.

These sections include outcropping or shallow bedrock or hard till. Since the till is highly variable, unforeseen areas of high strength clay may outcrop and result in the burial tool becoming less suitable. Furthermore, for those areas of shallow bedrock, variability in bedrock depth may be encountered which differs from the geophysics interpretation. These are also areas which may result in difficult burial. The sections of route outlined in Figure 4.6 are therefore an indication of those areas which are at higher risk to these occurrences.

There are two cable crossings along the cable route, at KP 26.8 and KP 32.7. These crossing points have been highlighted in Figure 4.6. The presence of these cables prevents cable burial techniques being used in this area and hence a nominal 50 m length of external protection either side of the crossing has been assumed. Two of the likely remediation options include:

- Rock placement: This technique is one of the most established and proven methods of cable protection suitable for cable crossings, subject to detailed design. Rock placement can also be utilised along lengths of the cable where burial is not achievable, or addition protection is required (see Figure 4.4 and Figure 4.5).
- Mattressing: This involves prefabricated concrete block sections connected by polypropylene rope to form a semi-rigid structure which can be used for crossings over existing subsea cables (see Figure 4.6 showing cable laid over concrete mattresses on the SHE Transmission Kintyre Hunterson cable; a jetted cable trench can also be seen in the lower left area of the image).

Figure 4.3 Sections of cable route comprising potentially difficult burial which may require remedial works

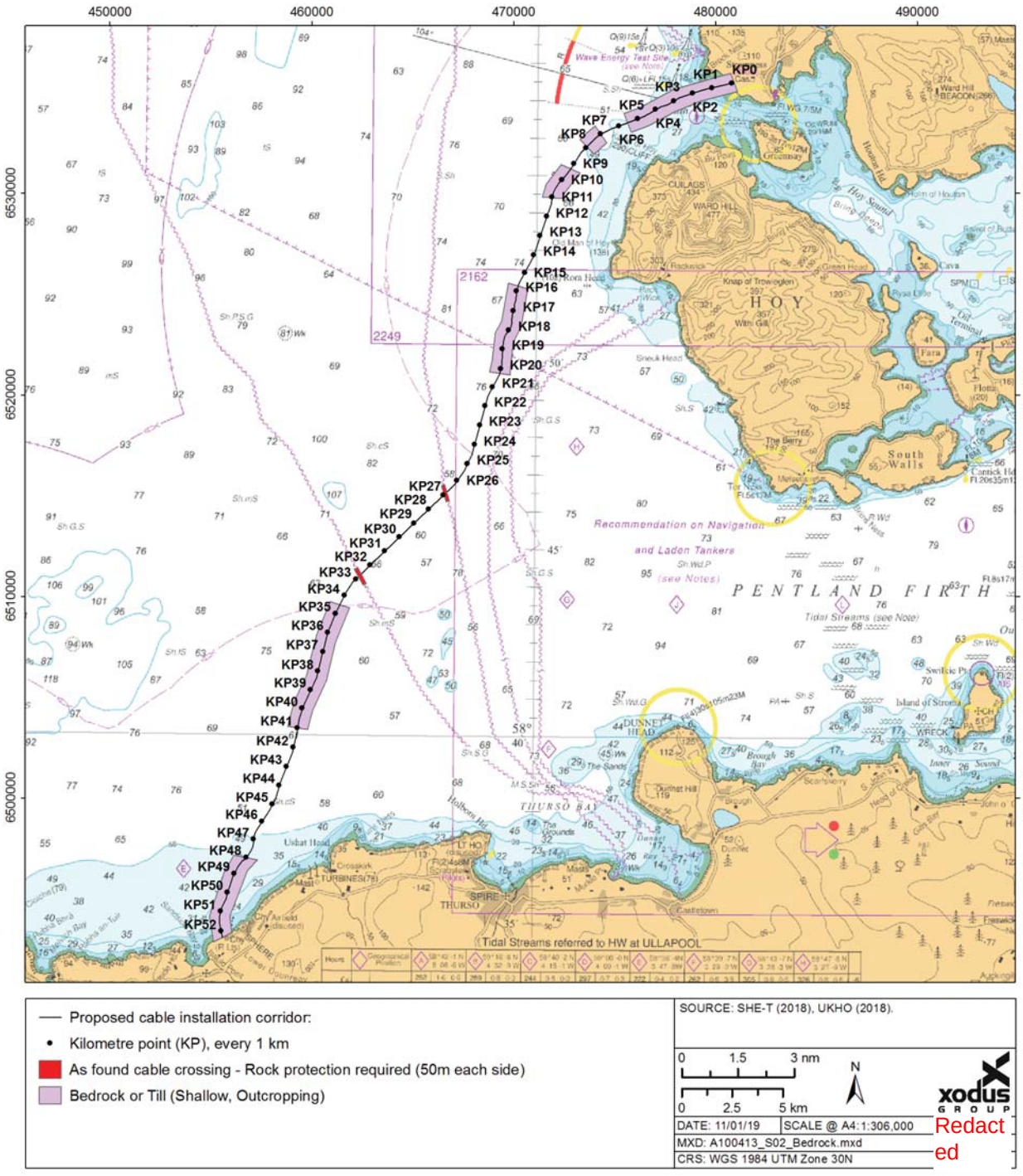


Figure 4.4 Example of rock placement along cable



Figure 4.5 Example image of rock placement over cable on seabed

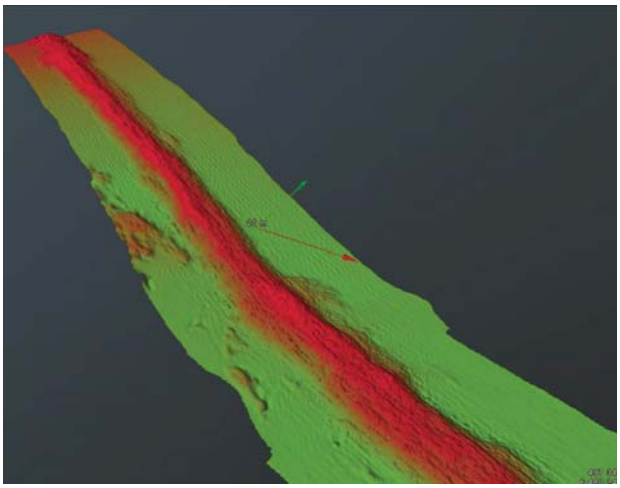


Figure 4.6 Example of cable laid over concrete mattresses on Kintyre-Hunterston Connection

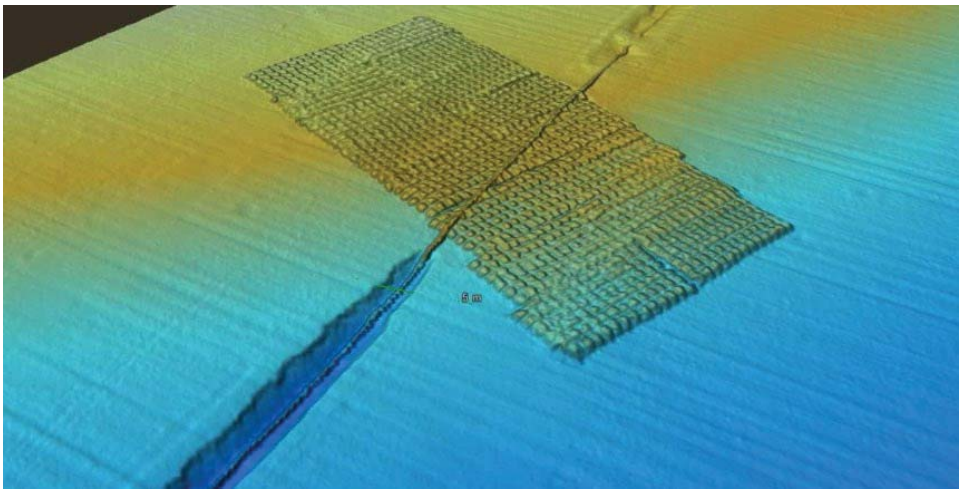


Table 4-1 details the sections which have been identified in the CBRA as areas where burial will be difficult or where cable crossings are present which may require alternative means of cable protection and/or remedial works, but it should be noted that, due to variability in the soil conditions, further remedial works may be required in other areas.

A total cable length of 5,300 m has been identified as potentially requiring external protective measures. Additional remedial works may also be required in areas of difficult burial (Figure 4.3).

Table 4.1 Sections of cable route where remedial works may be required

KP range requiring remedial works	Reason why remedial works are required
0.00 to 2.10	Outcropping bedrock
2.30 to 2.50	Outcropping bedrock
3.30 to 3.40	Outcropping bedrock
15.60 to 18.10*	Shallow/potentially outcropping till and bedrock
26.75 to 26.85	Cable crossing protection required
32.65 to 32.75	Cable crossing protection required
51.8 to 52.10	Outcropping bedrock

*Attempt may be made to bury in this zone however there remains residual risk of requirement for external protection.

4.4 Installation programme overview

The pre- and post- cable installation surveys, preparatory works and cable installation activities will take place over a period of approximately three years from 2020 to 2022. An indicative installation programme is provided in Table 4-2:

Table 4.2 Indicative installation programme

Cable installation activity	Indicative time period*
HDD works	June 2020 – March 2021
UXO/PLGR	May 2022 – June 2022
Cable lay	June 2022 – July 2022
Trenching	June 2022 – August 2022
Rock placement	July 2022 – August 2022
Nearshore works	July 2022 – October 2022

* Please note these times may vary dependent on weather and other factors.

4.5 Offshore works - planning stage surveys

A range of geological and environmental surveys were conducted along the proposed cable corridor. The cable corridor survey area is approximately 1000 m wide routed between Warebeth, Orkney and Dounreay, Caithness between February and May 2018.

The geophysical surveys were performed to map the seabed bathymetry, topography, key features and shallow seabed types along the route. This allowed a preliminary route to be identified.

The geotechnical investigation performed a more detailed survey along the route to confirm the soils and identify more closely any anomalies or objects along the proposed route.

The collection of the survey data was used to inform the selection of appropriate burial and protection requirements as outlined in the supporting CBRA (Cathie Associates, 2018).

The final cable installation route will be optimised, by the installation contractor, taking account of any seabed features and sensitive habitats. This may also be informed by a further pre-installation route survey which will be completed by the cable installation contractor prior to commencement of cable installation (see Section 4.7.1).

4.5.1 Geophysical survey

The geophysical survey methods used a range of non-intrusive techniques including the following:

- MBES (Multi-Beam Echo Sounder) to determine seabed depth and topography;
- SSS (Side Scan Sonar) to identify seabed features and heights;
- SBP (Sub-bottom Profiler) to determine shallow seabed composition and layers; and
- Magnetometer runs to identify magnetic strength (mainly metallic objects).

The results of the geophysical survey were used to create a range of digital charts and models which were used to refine the route prior to the geo-technical survey. The results from the magnetometer survey were also used to identify areas clear from magnetic anomalies, i.e. UXO, prior to intrusive sampling.

4.5.2 Geo-technical survey

Using the output from the Geophysical survey, the following detailed Geotechnical investigations were undertaken:

- Vibrocoring to recover soil samples for analysis onshore.
- CPT (Cone Penetration Testing) to determine soil strength.
- Benthic surveys, using a combination of grab samples and still/video photography.
- Visual inspections using an ROV (Remote Operated Vehicle) to identify the condition of existing cables and to inspect targets i.e. potential UXO.

4.6 Offshore works - Pre-lay preparation

4.6.1 UXO identification and clearance

The objective of an Unexploded Ordnance (UXO) survey is to identify any ferrous objects which may be UXO and thus a hazard to the installation operations. This is normally performed once the cable route is well defined as the survey work required to clear a corridor is onerous.

The contractor appointed by SHE Transmission will undertake a UXO survey along the cable route using either a passive magnetometer or gradiometer system or an active acoustic or electromagnetic system.

Any targets observed will be investigated further by ROV to identify them, potentially removing small quantities of seabed, if required, to aid identification.

Where realistic UXO threats are identified the cable will be micro routed to avoid them. Where this is not possible the UXO may require to be cleared. Where UXO clearance is required specialist Explosives and Ordnance Disposal (EOD) contractors will be engaged. Subsea UXO are usually cleared using a demolition charge to either initiate detonation of the UXO or to break the UXO into insignificant parts.

Should UXO clearance be required, specific engagement and consent will be sought from the appropriate regulator.

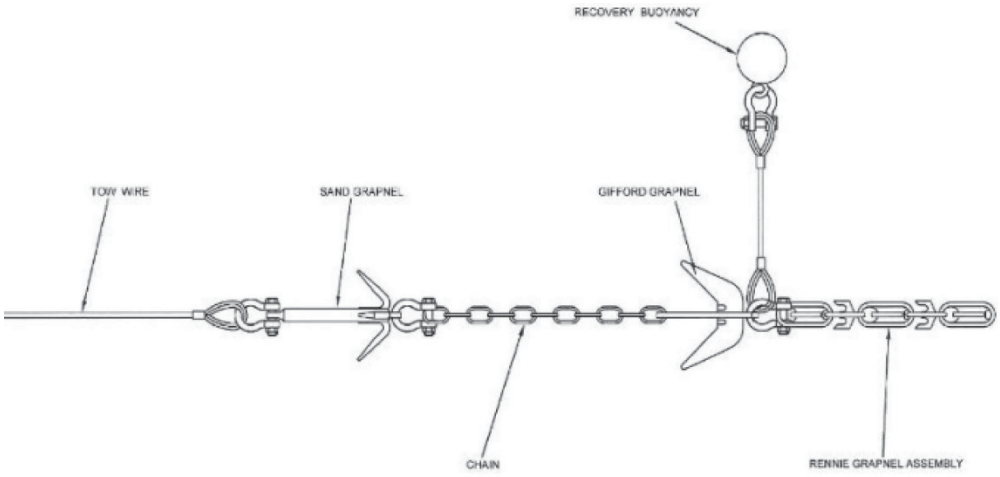
4.6.2 Route clearance

The route will be cleared of debris using the methods described below:

4.6.2.1 Pre-lay grapnel run.

A pre-lay grapnel run (PLGR) ensures that the cable route is free from obstructions such as discarded or lost fishing gear and wires/cables that could affect the cable installation. A typical arrangement is illustrated in Figure 4.7.

Figure 4.7 Typical pre-lay grapnel arrangement



The grapnel hooks will normally penetrate up to 1m into the seabed, subject to soils, and are towed along the centreline of the cable route. Debris recovered by the grapnel will be collected on board and disposed of appropriately through licenced onshore facilities.

The grapnel will not be deployed within 100 m of any cables and pipelines (including redundant ones, unless agreement is in place for their removal).

4.6.2.2 Boulder clearance

If there are large stones or boulders along the route which could interfere with cable laying, a boulder clearance plough may be towed along the relevant parts of the route. The plough is typically 10-15m wide. The plough will push boulders and other surface debris to the side of the route.

If the boulders are more isolated and/or fewer in number, clearance may be undertaken using an 'Orange peel' grab to relocate individual boulders to the side of the route.

4.6.2.3 Pre-sweeping (sand waves)

Where there are sand waves along the route which could present a barrier to the safe lay and burial of the cable a plough or mass flow excavator system will be used to pre-sweep or 'flatten' the seabed sufficient to allow safe burial of cable.

This operation is used in very localised and specific areas and is normally an alternative to rock-dumping or other means or other means of stabilising and protecting the cable.

4.6.3 Crossing preparation

Any cable or pipeline crossing areas will be prepared to allow the cable to smoothly transition over the existing infrastructure. This crossing arrangement is normally in the form of rock bags, grout bags, rock berm or concrete 'link-lok' mattresses to lift the cable over the infrastructure.

The installation of the crossing is normally performed by a small Dynamically Positioned (DP) Construction Vessel using a crane to deploy the components, which are guided into place by either divers or ROV.

4.6.4 Landfall preparation

The landfall locations at Warebeth (Orkney) and Dounreay have been selected, balancing a range of cost, technical and environmental factors. A review of potential options at each landfall was carried out by JACOBS

on behalf of SHE Transmission, considering both open cut and HDD techniques. An HDD landfall is the preferred option at each landfall as it:

- Minimises impact on the intertidal and nearshore areas;
- Protects the cable in high energy environments;
- Reduces the requirement for cable protection in shallow water; and
- Allows the landfall to be created prior to cable installation.

4.6.4.1 HDD construction

The HDDs bores will be drilled from a position on land approximately 100m behind MHWS and exit onto the seabed approximately 750 m to 1,000 m offshore.

A duct, approximately 750 to 1000 mm in diameter will be pushed through the HDD bore, to provide a continuous conduit for the cable to be pulled through.

HDD uses drilling fluid (sometimes referred to as mud) which is pumped down the inside of the drill string to provide power to the down hole motor, driving the drill bit. The drilling fluid then passes through nozzles on the drill bit helping to wash cuttings of rock away from the drill bit. The drilling fluid then flows up the annulus, between the drill string and the rock, back to the entry pit on the surface. The return flow of drilling fluid serves two functions, it carries rock cuttings back to the surface while balancing the formation pressure in the rock, preventing the ingress of water into the bore. To achieve this the composition of the drilling fluid is careful monitored so that it is thick enough to carry the cuttings but not so heavy that it exerts excessive pressure in the hole. Once the drilling fluid returns to the surface it is sieved and filtered to remove the cuttings prior to re-use. The drilling fluids will be biodegradable or environmentally benign i.e. bentonite based.

When the bore passes through fractured or porous sections or where drilling fluid is lost to formation a cement plug may be pumped into the bore and allowed to set prior to be being re-drilled. This cement plug stabilises and strengthens the rock and prevents losses of drilling fluid.

Where the drill emerges onto the seabed there will be a loss of drilling fluid and cuttings into the marine environment, this loss will be approximately equal to the volume of the bore that forms a hydrostatic head above sea level. Steps will be taken to clean out the bore prior to pop-out such that losses are minimised, or the drilling fluid may be swapped from bentonite based to biodegradable alternative, i.e. Purebore. Thereby minimising loss of solids.

Following completion of the drilling work a duct or liner, in either Steel or plastic, will be installed into the bore. There are two main methods by which this will be achieved as follows:

1. The liner will be pushed from onshore through the bore emerging onto the seabed. Once the liner has emerged onto the seabed a messenger wire will be installed and attached to a cap on the seaward end of the duct.
2. The liner will be fabricated offsite and floated to the seaward end of the HDD. The buoyancy of the floating liner will be adjusted such that the landward ends sinks slowly as the liner is pulled into the HDD bore by a winch wire. Once in place a messenger wire and cap will be installed.

Should it be necessary rock bags, concreate mattresses or grout bags may be used to stabilise the HDD pop-out and liner. Additionally, Mass Flow Excavation (MFE) or similar excavation tools may be used at the pop-out to lower the liner into the seabed facilitating the transition from HDD to trench.

4.6.4.2 Transition joint pit (TJP)

The subsea cable will be joined to the onshore cable in a Transition Joint Pit (TJP) located above the high-water mark at the cable landfalls. Detail on the TJP, and associated works connected with the onshore aspects of the Project above MHWS, is presented in the EA and ES produced to support the planning

applications, under the Town and Country Planning (Scotland) Act 1990, to Orkney Islands Council and The Highland Council. No further assessment of these features is therefore undertaken in this report.

4.7 Offshore works - cable installation

4.7.1 Pre-lay survey

A pre-lay survey is normally performed by the Installation Contractor shortly prior to the cable laying operation, to ensure that there is no debris present along the route, that has appeared since the previous surveys.

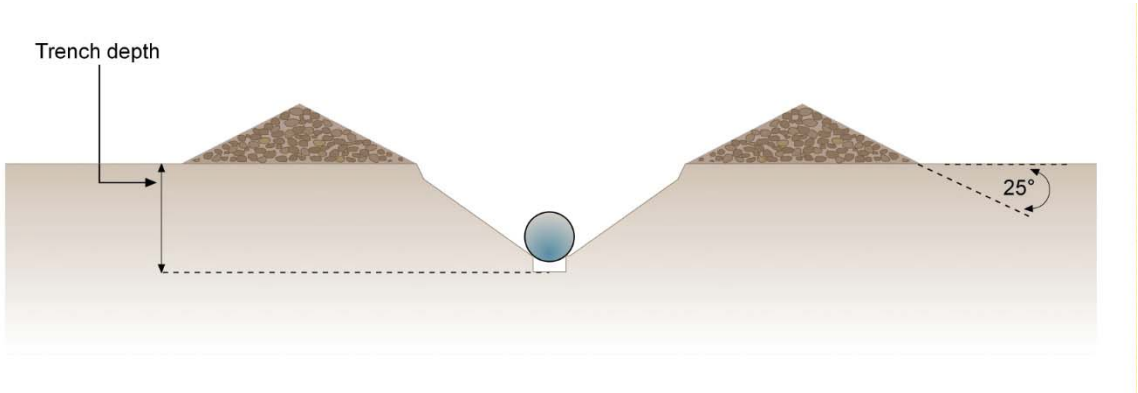
4.7.2 Pre-trenching

A potential installation option is to pre-cut a 'V' shaped trench along the cable route to facilitate achievement of the target burial depth as well as reducing the risk of cable damage during installation.

Pre-lay trenching is often undertaken in areas of potential high-strength cohesive or difficult soils where the capability of jetting trenchers may be restricted. In this case it may be preferable to utilise a plough to create a pre-cut trench in which the cable can be subsequently laid.

By cutting the trench prior to laying the cable the risk of damage to the cable from trenching equipment is significantly reduced. The laying of the cable is slightly more difficult as the cable should be laid in the deepest part of the shallow sloping 'V' profile as illustrated in Figure 4.8.

Figure 4.8 Typical 'V' shaped trench or ploughed trench profile



Once the cable has been laid, the cover on the cable can be either natural backfill, which may take weeks or months to be achieved, or alternatively a backfill plough may be used to push the spoil heaps either side back into the trench. This leaves a flattened seabed and gives a consistent depth of cover.

4.7.3 First end landfall installation

The cable will be pulled into the HDD duct from the vessel using the following outline procedure:

- HDD exit surveyed, and cap removed;
- Pull-in wire pulled onto the vessel whilst paid out from the onshore winch;
- Cable first end connected to the pull-in wire using a pulling head;
- Deploy cable whilst pulling in on the shore winch;

- Guide the cable end into the HDD duct and commence pulling onshore; floats and / or a lowering rig may be used to support and guide the cable into the HDD duct
- When cable end appears in the TJP, clamp cable to anchor the onshore end; and
- Vessel commences laying the rest of the cable.

The vessel will remain on location throughout the pull-in operation on DP with an ROV at the touchdown point or the HDD exit to observe the pull-in. The vessel will maintain position during the clamping of the cable onshore and once it is safe to proceed (i.e. onshore securing activities complete) will the vessel move off paying out cable.

Cable protection systems such as CIS may be installed at both shore ends as the cable is laid away from the Cable Laying Vessel (CLV). This will further protect and stabilise the cable in the shallower nearshore areas.

At the Warebeth landfall the cable may be laid in a rock cut trench along a section of harder seabed present between the HDD pop-out and the location where the soils become suitable for burial at approximately 25 m water depth. The cable will be protected by a duct placed within the trench along this section of the seabed.

4.7.4 Laying operations

The cable will be installed by one of a number of CLVs on the market (see Figure 4.9).

Figure 4.9 Example CLVs





The vessel will be DP and will not use anchors. The typical laying speed can vary between 200 m/hr to 800 m/hr, subject to the vessel equipment, weather and accuracy of lay required.

The vessel will lay the cable from the turntable/carousel over a chute, using a tensioner to control the pay-out, whilst the vessel moves along the RPL on DP. An ROV is usually positioned at the touchdown point of the cable to confirm that the cable is being laid along the route and under the designed tension (the tension is generally just sufficient to prevent loops).

The cable will not be buried as it is laid, since this would slow down the laying speed significantly and introduce a range of risks in the operation including the potential of damage to the cable and exposure to weather risk.

4.7.5 Cable jointing

Subject to the vessel selected and the final cable design and as-manufactured length's, there may be a requirement for a cable joint. In addition, if there is an unplanned marine emergency the cable may have to be cut and subsequently re-joined.

Such a join would be performed by laying down the end of the cable (or first cable) complete with protection and a marking arrangement. The vessel will return (or re-load the second cable) and recover the previously

laid down first end. The cable jointing or splicing operation will be performed onboard and the lay re-commence once the joint is successfully made up.

The jointing operation will result in the vessel remaining in-position on DP for period of typically between 3 and 5 days.

4.7.6 Second end pull-in

A second end pull in will be performed using the following outline method:

- The CLV will deploy a loop of cable sufficient to reach the TJP plus a surplus;
- The cable loop will be kept afloat using floats and small work boats;
- The cable will be attached to the pulling head and winch wire;
- The work boats will guide the cable end to the HDD bellmouth where the floats will be removed in sequence; and
- As the cable is pulled ashore through the HDD duct a lowering rig and additional ROV's may be used to help stabilise the cable.

Cable protection systems such as CIS may be installed at both shore ends as the cable is laid away from the CLV. This will further protect and stabilise the cable in the shallower nearshore areas.

There will be some overage of the cable to ensure that there is sufficient length to reach the TJP allowing for manufacturing and lay tolerances. This overage will be laid down in a loop on the seabed and where possible trenched to the target depth.

4.7.7 Guard vessel

Where necessary a guard vessel(s) may be used to perform the following function;

- Alert other sea users of the CLVs presence (over and above the CLV's own procedure);
- Guard the unprotected (pre-burial) cable route from fishing;
- Guard any free ends of the cable on the seabed, whilst CLV re-loads;
- Guard the cable between lay and burial; and
- A guard boats will be placed approximately 1 every 15 km.

4.8 Offshore works - cable protection

It is proposed to bury the cable along the majority of the submarine cable route for protection purposes and to reduce the risks associated with potential fishing gear interaction and anchoring. This is in line with NMP Policy for submarine cables (see Section 2.2.4.3).

Where burial is not feasible, either at crossings with existing cables, or where seabed sediments are too firm to achieve burial to the target burial depth (as currently predicted in the CBRA) and summarised in Section 4.3.4 above, it will be necessary to protect the cable by other means such as rock, CIS, split duct or concrete mattress placement.

The exact details of the installation technique will be confirmed when the contract for installation is awarded. It is envisaged that a variety of installation and burial techniques may be required due to the variable nature of the seabed along the cable route corridor; these options are outlined in the following section.

4.8.1 Cable burial options

The ability to bury the cable is heavily dependent upon the soils on which the cable is resting. Two principal methods are available to bury the cable, namely trencher and plough (see Figure 4.10).

Figure 4.10 Typical trencher and plough

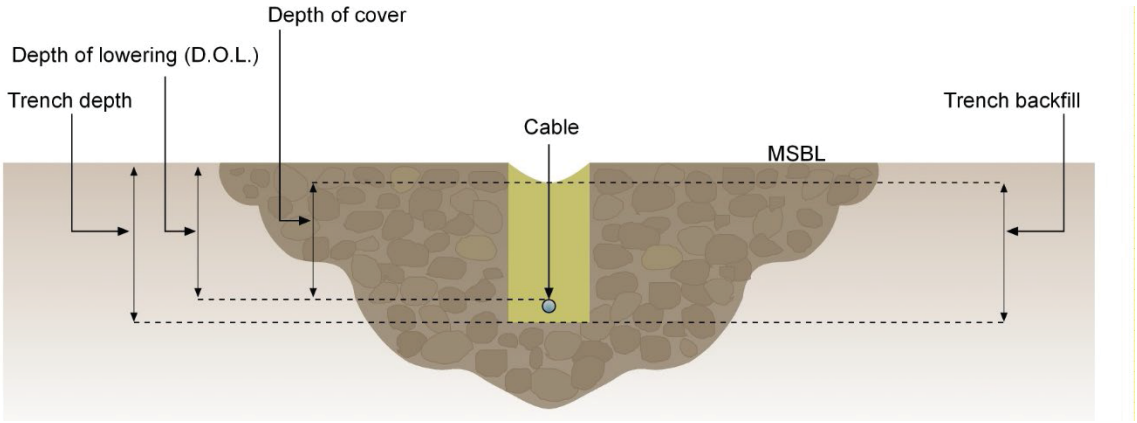




Very soft or loose soils can be jetted using a trencher, fluidising the seabed locally and letting the cable sink into the seabed. The trencher can be fitted with a variety of swords and water jet nozzles to control how the trench is cut and the volume of material that is removed. A depressor can also be fitted to help push the cable into the fluidised sediment. Harder soils may require mechanical cutting to form a trench into which the cable will drop into (see Figure 4.11). In very hard soils and some types of rock a mechanical trencher may be used to cut a slot shaped trench into the seabed into which the cable will be installed.

The protection of the cable is afforded by a combination of the depth of lowering into the seabed and the depth of cover achieved by the resettlement of fluidised sediment, Natural sediment movement will also backfill the trench over time.

Figure 4.11 Typical trench profile

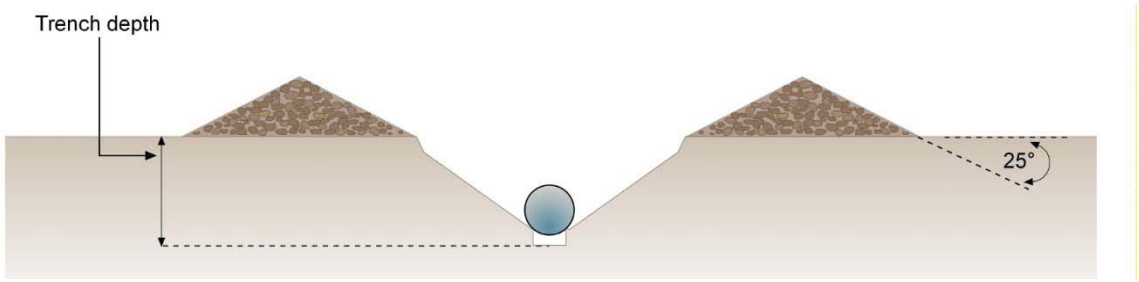


Alternatively, a plough can be used to create a pre-cut trench or for post lay trenching.

Pre-lay trenching creates a V shaped trench in the seabed, using one or more passes to achieve the required depth of lowering. The cable is then laid into the trench. The trench may be backfilled using either imported material i.e. rock or using a backfill tool, where the previously excavated material is pushed back into the trench.

Post-lay trenching, the cable is picked up by the trencher and fed through the plough into the trench as the tool is pulled through the seabed. The excavated material then falls back into the trench burying the cable.

Figure 4.12 Pre-cut trench profile



The typical burial depth of the cable is between 0.6 m and 1.8 m to the top of cable subject to the protection requirements.

The main impact of both burial methodologies is the disturbance of the seabed with some potential suspended deposits in the water column, which can affect turbidity.

The trenchers are driven by a set of tracks which will have a footprint greater than the trench width; however, generally the pressure on the seabed is very low as the trenchers are designed to run across soft soils.

Similarly, a plough will rest on a set of skids whose width is greater than that of the trench.

In both cases the footprint of the tool will be less than that of the boulder clearance plough, should one be used.

It may not be possible to trench or plough in areas of rock and rock protection or mechanical trenching may be required in such locations.

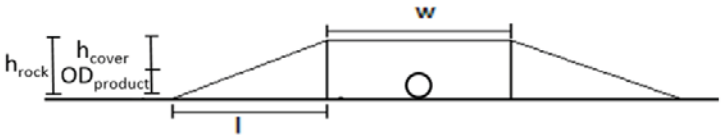
4.8.2 Cable protection – rock placement

Where the cable cannot be buried, or the required depth of burial cannot be achieved, rock is usually placed to protect the cable from damage and from the effects of waves and currents.

Depending on the water depth rock is normally placed by a specialist rock Installation Contractor from a DP Fall Pipe Vessel. Typical rock gradings range from 1” to 3” to 1” to 5” for water depths >80 m to much larger rock (e.g. 3” to 9”) in shallow waters where hydrodynamic conditions can be more onerous.

The typical cross section design of rock placement over the cable is to adopt 1 in 3 side slopes with a 1 m wide crest and the height approximately equal to the depth of lowering or depth of cover required. An example is presented in Figure 4.13.

Figure 4.13 Example of typical rock placement cross section



Cover height, *hcover* (m)	0.5
Product OD (m)	0.3
Rock height (hcover + Product OD) (m)	0.8
Rock dump width of berm top, *w* (m)	1
Rock dump slope length *l* (m)	2.4
Rock dump bulk density (Te/m3)	1.9
Rock dump requirement (Te/m)	5.168

Steeper or shallower side slopes can also be achieved depending on agreement with the rock installation Contractor and stakeholders and subject to detailed design. For example, a steeper side slope may reduce the overall footprint of the rock but may not be acceptable to other sea users. For the purposes of the EA, a worst-case 7 m rock berm width has been used to allow for flexibility in the final design.

Rock placement can, in some specific cases, also be used to restore the seabed level, for example, if seabed intervention activities have resulted in a seabed condition which is unsuitable for other users of the sea. However, this type of remedial work requires detailed engineering to ensure the as-left seabed state is improved.

Rock placement vessels (Figure 4.14) feature a large hopper to transport the rock, and a mechanism for deployment of the rock on site. The usual mechanisms depending on water depth and location are:

- Fall Pipe Vessel (FPV) – a retractable chute is used to control the flow of rock to the seabed.
- Rock Side Dumping Unit (RSDU) – rock is pushed or tipped over the side of the vessel, either along the side of the hopper or through an angle chute;
- Flexible fall pipe – a retractable chute is used to control the flow of rock to the seabed; and
- Grab placement – rock is placed using a crane and grab, generally is very shallow water only.

The base case for the rock placement is a fall pipe vessel, subject to the water depth, where in shallow water a RSDU or split hopper or side dumping may be required.

Figure 4.14 Example rock placement vessel



4.8.3 Cable protection – alternative options

In addition to rock placement there are a number of alternatives that are used in more localised areas.

*4.8.3.1 **Protection** mattresses*

Concrete mattresses (Figure 4.15) are frequently used to protect subsea cables and can also be used to construct crossings over existing subsea cables and pipelines. They are flexible and thus follow the contours of the seabed.

Typically, concrete mattresses are deployed using a crane and positioned using either diver or ROV with typically placement of 3 - 4 mattress per hour being achievable, thus they are not designed for coverage of long routes.

Figure 4.15 Concrete mattress



4.8.3.2 Sand / grout / rock bags

Smaller bags filled with either sand, grout (which sets in water to the profiled shape) or rock bags can also be used to provide very localised protection, where most mechanical means such as trenchers cannot reach.

Such items typically range from circa 25 kg to 1,000 kg in weight and are normally placed by divers and / or ROV to provide fill-in protection.

4.8.3.3 Cable physical protection

Additional protection can be provided around the cable in the form of articulated half shells, which allow the cable to follow the contour of the seabed. These are often used in higher current areas and can be installed on the cable during the laying operation, thus not requiring any post-lay intervention.

These systems are not typically used to protect long lengths of cable due to the time taken t to attach them to the cable. They are generally made of either polyurethane (PU) or cast iron (Figure 4.16).

Figure 4.16 Cast iron casing



PU casings are typically manufactured in lengths of up to 2 m and the half sections joined using Titanium, alloy or nylon circumferential bands. Cast iron casing is typically in lengths of 0.4 m to 0.5 m and connected by two or more bolts per two-piece shell section.

4.9 Offshore works - as-built survey

Following the completion of the installation activities, the Installation Contractor will compile an ‘As-Built’ report, part of which is the as-built drawings, imagery and video evidence that the asset has been safely installed.

Core to this report is the final route survey to confirm depth of burial and the position of the cable. This will be used as the baseline for subsequent surveys and to identify any movement of the cable, whether it be settling or exposure through scour.

4.10 In-service operations

4.10.1 Cable surveys

The operational surveys of the cable will generally consist of the measurement of the cable depth of burial, position and seabed local profile. The objective is to determine whether the seabed has changed significantly, whether the cable is exposed or has moved and the status of any protection on or around the cable.

Subsequent surveys will use the as-built survey as a baseline to understand the behaviour of the cable and seabed, enabling any changes to be understood and quantified.

The surveys may also include a benthic survey to monitor any changes in the marine environment.

The surveys will typically consist of a combination of ROV video footage, MBES to record the local seabed profile and SBP to locate the cable depth.

4.10.2 Electro-magnetic fields

The AC cable produces no external electric field due to the presence of a metallic outer sheath and the cancelling effect of the cores.

An AC power cable generates a magnetic field that is directly proportional to the conductor current and reciprocally proportional to the distance of the cable.

Guidelines for maximum magnetic field is published in ICNIRP[2] Guidelines for limiting exposure to time varying electric and magnetic fields (1 Hz to 100 kHz) (ICNIRP, 2010). Table 4 of the ICNIRP Guidelines specifies for general exposure the magnetic field at 50 Hz, B = 200 μT.

The cable is expected to produce a magnetic field of between 7.5 to 15 μT at 1 m distance from the cable surface at the maximum operating current.

The background geomagnetic field along the north coast of Scotland is approximately 48 to 49 μT. The magnetic fields generated by the Orkney – Mainland Subsea Link cable are therefore expected to attenuate to background levels within around 1 m.

It is also proposed to bury the cable or for rock to be placed over the cables where burial cannot be achieved at crossings or in areas of harder seabed and therefore minimal or no magnetic fields are expected to be detectable outside of 1 m at the seabed.

4.10.3 Cable heat

The cable is expected to a have a maximum operating conductor temperature of up to 90 ºC. The rate of heat dissipation into the environment from the cable will depend upon the amount of power passing through the cables, the cable design, current flowing and depth of burial.

Negligible heating effects are expected to surrounding seawater due to the very high heat capacity of water and insulation of the soil. However, when the cables are in operation and where the cables are buried, there will be some heating of the surrounding sediment.

Meißner *et al.* (2007, cited in OSPAR, 2009) reference published data on heating effects from a buried intertidal submarine cable which indicated that the temperature increase did not exceed 1.4 ºC 20 cm depth

[2] International Commission on Non-ionizing Radiation Protection

above a cable with capacity 166 MW. Protection of the cables by burial or with rock placement is therefore expected to result in a negligible heating effect of the surrounding environment.

4.10.4 Remediation and maintenance activities

Once installed, submarine cables generally do not require any routine maintenance other than confirming that there are no areas of exposure or significant movements indicative of external influence.

The subsea cable will be monitored from onshore for electrical integrity to provide early indications of fault conditions.

During the first few years of asset life surveys will be performed to confirm the depth of burial of the cable, the stability of any rock berms and protection arrangements. The surveys will utilise standard geophysical survey equipment / ROVs.

All subsequent surveys will be based on an assessment of risk, based on previous surveys, metocean conditions and threat.

When a subsea cable is damaged, whether as a result of cable failure or where it has been injured by fishing gear, anchors or dropped objects, a repair will be required. An offshore cable repair in the water depths typical of this route would follow the steps below:

- Identify fault or damage location;
- Excavate the seabed to expose cable;
- Cut the cable and lift one end onto the vessel;
- Joint on additional new cable length;
- Recover second end and joint to new cable;
- Lay down both joints and repair section in a ‘hairpin’ or “omega” loop; and
- Bury and/or protect cable.

The repair vessel would be expected to be on location for between 2 and 3 weeks.

In the nearshore areas or where the cable faults within the HDD, the cable will be excavated, cut and jointed as described above. The new section of cable will then be pulled ashore in a similar manner to a first end pull in through either a spare or re used HDD duct.

4.11 Decommissioning

4.11.1 Introduction

Cables in the UK territorial waters are installed on Crown Estate land and therefore a lease or licence is generally entered into for a set term, in this case, 40 years. An Initial Decommissioning Plan (IDP) will be developed and appended to the Crown Estate’s licence agreement entered into by SHE Transmission for this Project.

There may be an option for the cable to be left in place if the environment is best served by doing so, effectively recognising that recovering cables may lead to more damage to the environment or other seabed interests than leaving them in place. This acknowledges that the recovery and disposal of redundant cables is both difficult and expensive. SHE Transmission will retain liability for any residual cable sections in perpetuity. An Out of Service Deed will be entered into by SHE Transmission and the Crown Estate to reflect this, should the cable be left in-situ.

The case for cable recovery will need to be the subject of an environmental and economic assessment in the years leading up to decommissioning.

4.11.2 Decommissioning options

All offshore cables, sections of offshore cables or cable ends which are exposed at the time of decommissioning, or likely to become exposed, will be recovered unless studies show that they will not pose an enduring threat to other seabed users or that further burial or coverage can negate such circumstances. This will be determined by examination of the data on the seabed / cable stability and position from all surveys performed, prior to decommissioning of the site.

The principal options for the cable are to either:

- Leave in-situ buried;
- Leave in-situ and provide additional protection where exposed;
- Remove sections of the cable which present a risk; and
- Remove entire cable.

Any sub-sea trenches left after cable removal will be filled by natural tidal action. Exposed cable ends will be covered or buried to a suitable depth. In the event that natural backfilling of the trench does not occur, remedial backfilling may be undertaken to restore the seabed, subject to trench depth and profile.

Prior to decommissioning, a contingency plan will be developed for resolving the potential issue of cables becoming exposed post decommissioning.

4.11.3 Offshore operations

Cable removal, where undertaken, will generally involve pulling the cable out of the seabed and reeling onto a carousel for onshore transfer and disposal. The strength of the soils and depth of burial will dictate whether the cable is likely to be 'stripped-out' of the seabed along sections of the route, or whether operations to remove material burying the cable is required prior to recovery. Typically, the most efficient way to remove excessive overburden is a mass-flow excavator, as other means of deburial risk damaging the cable and making recovery even more difficult.

For removal of short sections of the cable between sections that are left in-situ, the most efficient method is to expose the cable locally and cut whilst on the seabed, allowing recovery to the vessel. The end of the cable remaining on the seabed will be buried.

These options will general involve the displacement of seabed material and leave a trench profile on the seabed, which subject to assessment may require to be smoothed out or left to backfill naturally.

Should the decision be to leave the cable in-situ, minor remedial work may be required to bury the cable or provide addition rock protection. This will be determined based on the mobility of the seabed and/or cable over the design life as indicated by the operational surveys.

4.11.4 Disposal of cable

The cable, or sections of, will be disposed on land by the 'reverse' manufacturing' principal whereby the components will be stripped out for either recycling or disposal.

4.12 Marine installation footprint / zone of influence

The footprint of marine cable installation activities and/or the zone of influence (ZOI) (i.e. spatial extent over which the Project is predicted to have an impact on the receiving environment based on worst-case assumptions) is presented in

Table 4-3. It should be noted that although the cable installation corridor (within which consent for installation of the submarine cable will be applied for) is 200 m wide, cable installation will only require a small part of this width.

Table 4.3 Marine installation footprint / zone of influence

Construction Activity	Footprint / Zone of Influence
Cable installation corridor	53 km long by 200 m wide
HDD Landfall	5 m by 5 m at duct 'pop-out' on seabed
DP cable lay vessel	500 m safety exclusion zone. If followed by burial, vessel safety zone can result in 500 m x 1,000 m zone
Other support vessels	500 m safety exclusion zone
Pre-lay geophysical survey	Up to 2 km at any time
Seabed preparation: Pre-sweeping of sandwaves	20 m wide along areas of sandwaves
Seabed preparation: Pre-lay grapnel	1 m width and 0.5 – 1 m penetration towed along centreline
Seabed preparation: Boulder clearance by 'Orange peel' grab	Localised to boulders within 5 – 10 m of corridor, subject to burial machine type
Seabed preparation: Boulder clearance plough	10 – 15 m width depending on type of plough
Construction Activity	**Footprint / Zone of Influence**
Seabed preparation: Pre-cut trenching system	Trench 1 – 3 m wide, soils spoils each side total width 8 – 10 m
Cable installation: Ploughing	Displacement ploughs, trench up to 5m width, plough footprint up to 15 m Non-displacement plough trenches between 0.3 - 1.0 m trench width and plough footprint of 5 –10 m
Cable installation: Jet trenching	Trench 0.5-1 m width, footprint of trencher 5 – 10 m
Cable installation: Mechanical trenching	Trench 0.5-1 m width, footprint of trencher 5 – 10 m
Cable protection material: Rock placement	5 - 8 m wide rock berm along areas of rock protection by 0.5 - 1 m high
Cable protection: Concrete mattresses	6 m wide x 3 m wide
Cable protection: Cast iron shells	Width of cable and thickness of shell
Cable protection: Composite Lining Sleeve	Width of cable and thickness of lining Sleeve
Disturbance of sediment	Coarser fractions up to and including fine sand, ejected from the trench will be raised a few metres from the seafloor, and are expected to be re-deposited within 10 m or less of the cable trench. Finer silt fractions will remain in suspension for longer with levels expected to fall to ambient levels within 70 m with fine deposition

	occurring out to a maximum of 2 km from the trench. Far field deposition is predicted to be below 1 mm
Operation of cables	Heating of sediments in very immediate vicinity of cables EMF detectable in immediate vicinity of cables to 1 m

4.13 Permanent Deposits

The permanent deposits which will be installed in the seabed as part of the Project are outlined in Table 4.4.

Table 4.4 Permanent Deposits

Deposit	Detail		
Cable	Diameter: 255 mm	Length: 53 km	Weight: 98 kg/m
Rock	Length: 5,900 m (estimate)	Volume: 11,210 m^3	Size: 2” to 5” crushed rock as per SSEN Specification Though size at this time not known
Concrete mattresses	Size: 6 x 3 x 0.3 m (assumed dimensions)	Number: 32	Location KP26.75 to KP26.85 & KP32.65 to KP32.75. PE cable protection sleeve will be installed over the cable (100 m for each crossing).
Split pipe	Size: CIS – 500 mm x 300 mm	Type: Cast Iron shells / split pipe or HDPE split duct	Length: CIS and or Tekmar 2000 m (4000 shells)
Concrete bags or grout bags	Size: 25 kg bags	Number: 2,000 bags	Location: HDD pop-out locations and areas where shells are installed and nearshore areas
HDD bore	Number: 4 Diameter: 700 mm	Location: 2 at Warebeth landfall and 2 at Dounreay landfall (1 for main connection and 1 spare at each end)	Length: Dounreay 900 m; Warebeth 1,050 m
HDD liner	Material: HPDE Diameter: 560 mm	Length: Dounreay 900 m; Warebeth 1,050 m	Accessories: Bell mouth Masterlink seal with messenger wire installed until cable pull
HDD grout	No grouting has been specified at this time	-	-

5 STAKEHOLDER ENGAGEMENT

5.1 Introduction

Consultation has been a key element in the development of the proposals and plan for the Orkney to Mainland Scotland Transmission Project. This section provides a summary of the consultation undertaken during the development of the Project and consultation relevant to the Environmental Scoping and EA.

5.2 Approach to scoping and consultation

Consultation has been undertaken with statutory consultees, stakeholders and the public during key stages of the Project. Consultation, including scoping on additional studies required to inform the Marine Licence application, has had the following aims:

- To provide statutory and non-statutory consultees, as well as local communities and other stakeholders, with the opportunity to inform the development of the Project and the design submitted as part of the Marine Licence application;
- To provide statutory consultees with the opportunity to comment on the proposed approach to, and scope of the EA; and
- To provide statutory consultees with the opportunity to provide comment on specialist studies commissioned to inform the EA.

5.3 Consultation on the content of the EA

Whilst standalone submarine cables projects are not listed as “EIA” projects under Schedule 1 or 2 of The Marine Works (EIA) (Scotland) Regulations 2017, the Scottish Ministers require an application for a Marine Licence to be accompanied by an assessment of the environmental effects detailing the assessments carried out, in this case termed an EA. The Scottish Ministers offer to ‘scope’ such an assessment in a similar manner to EIA projects to ensure the required information is considered during the pre-application process.

The consultation process provided a focus and mechanism for consulting with stakeholders on the content of, and methodology for the EA. In order to ensure that this EA covers the main issues of concern, a report (Report Identifying Additional Studies Required to Support Orkney – Mainland Subsea Cable Marine Licence Application, Xodus Reference: A100413-S02) was produced and submitted to the Scottish Ministers on the 19th July 2018. The objective of the report was to provide sufficient information on the Project and the environment in which it would be constructed and operated, so that the regulators (with the assistance of statutory and other consultees) could advise which issues should be the focus of the EA.

A response was received from Marine Scotland – Licensing Operations Team (MS-LOT) on the 26th November 2018, as to the content and level of detail of information to be provided in the EA. The response was informed by a 30 day consultation process which commenced on the 31st July 2018. The following bodies were consulted, those marked in bold provided a response:

- Caithness West Community Council;
- Crown Estate Scotland;
- Dounreay;
- European Marine Energy Centre;
- Fisheries Management Scotland;
- **Highland Council;**

- Highland Council Harbours Authority;
- Highland and Islands Enterprise;
- **Historic Environment Scotland (HES)**;
- Joint Nature Conservation Committee (JNCC);
- Kirkwall Fishery Office;
- Marine Safety Forum;
- Marine Planning and Policy;
- **Maritime Coastguard Agency (MCA)**;
- **Ministry of Defence (MoD)**;
- **Northern Light House Board**;
- Orkney Fisheries Association (OFA);
- Orkney Islands Council (OIC);
- **Royal Society for the Protection of Birds Scotland (RSPB);**
- **Royal Yachting Association Scotland (RYA);**
- **Scottish Environment Protection Agency (SEPA)**;
- **Scottish Fishermen's Federation (SFF)**;
- **Scottish Natural Heritage (SNH)**;
- Scottish Wildlife Trust;
- Scrabster Fishery Office;
- Stromness Community Council;
- **UK Chamber of Shipping**; and
- Whale and Dolphin Conservation Society.

5.3.1 Responses received

A total of 11 responses were received as part of the MS-LOT consultation. The purpose of the consultation was to obtain advice and guidance from each consultee or advisor as to which potential effects should be included or excluded from the EA. The full MS-LOT response is provided in Appendix A along with a completed gap analysis template. A summary of the Scottish Ministers' advice on whether topics should be included or excluded along with the main points raised by consultees is provided in Table 5.1.

Table 5.1 Scottish Minister's opinion on whether topics should be included or not in the EA

Topic	Included Y / N	Reason for inclusion / exclusion from the EA and summary of response from consultees	How / where addressed
Physical conditions and marine processes	N	All concerns regarding this receptor will be addressed through the benthic and intertidal chapter.	**NOT considered further within EA**
		The Scottish Ministers are satisfied by the assessments carried out by the applicant and have concluded that any impacts on this receptor will be covered in benthic and intertidal ecology chapter.	A baseline description of physical conditions and marine processes is provided in Section X – Physical conditions and marine processes. Potential impacts assessed in Section 10 – Benthic and intertidal ecology.
Protected sites	Y	Multiple consultees raised potential impacts on designated sites which require further assessment.	**Considered further within EA**
		The Highland Council support the view that the North Caithness Cliffs SPA and Hoy SPA should be assessed.	The potential impact to the North Cliffs SPA and Hoy SPA has been assessed in Section 9 – Protected sites and species and Appendix D – Nature Conservation Appraisal.
		The RSPB support the need for further assessment on the impact on protected sites and in particular, suggest clarification on the works location relative to Scapa Flow pSPA.	The potential impact to protected sites, including Scapa Flow pSPA is assessed in Section 9 – Protected sites and species and Appendix D – Nature Conservation Appraisal.
		SNH also support the view that protected sites should be included in the EA and recommends a list of potential impacts required to be assessed is included. SNH also recommend an assessment of cumulative impacts on other projects be carried out as part of the Habitats Regulations Appraisal.	Potential impacts is provided within Section 9 – Protected sites and species. The potential cumulative impact has been considered within Appendix D – Nature Conservation Appraisal.
Benthic and intertidal ecology	Y	European protected bedrock reefs have been identified in the cable corridor and there is the potential for priority marine features which requiem further assessment.	**Considered further within EA**
		Both RSPB and SEPA support the view that benthic and intertidal ecology require further assessment.	The potential impact on benthic and intertidal ecology is assessed within Section 10 – Benthic and intertidal ecology.
		SNH have requested clarity on whether or not non-priority marine features have been identified along the cable route and emphasised the importance of addressing the impact on these features should any be identified.	The potential impact on non-priority marine features has been assessed in Section 10 – Benthic and intertidal ecology.

Topic	Included Y / N	Reason for inclusion / exclusion from the EA and summary of response from consultees	How / where addressed
		Scottish Ministers agree with the applicant and the views of the consultees regarding further assessment on the bedrock reefs. Further surveys should also be carried out to determine the presence or absence of priority marine features and to assess any impacts should they be identified.	The potential impact on bedrock reefs and PMFs is assessed in Section 10 – Benthic and intertidal ecology.
Fish ecology	N	Potential impacts on Atlantic salmon from underwater noise, suspended sediment and electromagnetic field emissions require assessment. There is also potential for disturbance to basking sharks.	**Considered further within EA**
		Due to the high mobility of fish and short duration of works, the potential impact to fish ecology (direct impact to spawning and nursery grounds, underwater noise, electromagnetic field (EMD) emissions, potential collision risks and sediment disturbance) was not considered to require further assessment within the EA. Further consideration regarding fish ecology is contained within the Nature Conservation Appraisal.	Considered further within Nature Conservation Appraisal, Appendix D.
		SNH raised concerns regarding the potential effects of the works on Atlantic salmon from underwater noise, suspended sediment release and electromagnetic field emissions. SNH also noted that salmon from a number of SACs are likely to pass through the works area and therefore SNH recommend that further assessment of the impacts on this species is required. It is also recommended that the potential disturbance to basking sharks during cable installation is assessed.	The potential impact to Atlantic salmon is considered in Section 5.4 of the NCA, Appendix D. The potential impact to basking sharks is considered in in Section 7 – Impact assessment methodology (Table 7 1).
		Scottish Ministers agree with SNH regarding the consideration of potential impacts on species specifically protected by legislation or as a feature of a designated sites.	Species specifically protected by legislation or as a feature of designated sites are considered within the NCA, Appendix D.
Ornithology	Y	Cable corridor crosses three designated sites for birds and there are further potential impacts at landfall locations which require assessment.	**Considered further within EA**
		The RSPB agreed that the potential impact to ornithology should be considered within the EA. They also request that the potential impact from marine traffic and accidental fuel spillage are assessed.	The potential impact of vessel traffic on ornithology is considered in Section 12 – Ornithology. The ecological impact of accidental release of pollution has been considered in Section 7 – Impact assessment methodology (Table 7 1).
		Both the RSPB and SNH request further assessment of the impact on birds at the landfall points.	The potential impacts on ornithology at both landfall points is assessed in Section 12 – Ornithology.

Topic	Included Y / N	Reason for inclusion / exclusion from the EA and summary of response from consultees	How / where addressed
		SNH support the applicant's proposal to assess the potential impact on designated sites.	The potential impact on designated sites is assessed in Section 12 – Ornithology and within the NCA, Appendix D.
		Scottish Ministers agree that ornithology should be included within the EA to assess the impact on designated sites and at the landfall locations.	The potential impacts on protected sites with ornithology as qualifying features is assessed in Section 12 – Ornithology.
Marine Mammals	Y	The cable is in an area of high usage by pinnipeds and potential for otters along the coastline. Also, potential for underwater noise to disturb cetaceans.	**Considered further within EA**
		The applicant identified several species of cetaceans that occur within the vicinity of the proposed cable route, however the encounter rate is low or very low. As such, it was considered that significant impact on these species was unlikely. The applicant identified that habitat usage by pinnipeds is very high around the landfall in Orkney and medium in Caithness. Due to the declining population around Orkney, further assessment is required. The applicant also proposed further assessment on the potential impact on otters is also required.	The potential impacts of the works on marine mammals is assessed in Section 11 – Marine mammals.
		The RSPB support the need for further assessment of marine mammals.	The potential impacts of the works on marine mammals is assessed in Section 11 – Marine mammals.
		SNH support the need for assessment of the impact of underwater noise on cetaceans and pinnipeds from vessels and also geophysical surveys and USBL beacons. SNH also supports the requirement of an assessment of the impact of the proposed works on otters.	The potential impact of underwater noise on cetaceans and pinnipeds is assessed in Section 11 – Marine mammals. The potential impact of the proposed works on otters is assessed in Section 11 – Marine mammals.
		Scottish Ministers agree with the applicants' proposal for further assessment regarding otters and pinnipeds. Additionally, the protected nature of cetaceans means that the impacts of underwater noise on these species requires assessment in line with the SNH advice.	An assessment of the potential impacts of the Project on marine mammals in accordance with SNH advice is contained within Section 11 – Marine mammals.
Commercial Fisheries	Y	Cable route is in an area which is important for commercial fisheries. The potential impacts on this sector require further assessment.	**Considered further within the EA**

Topic	Included Y / N	Reason for inclusion / exclusion from the EA and summary of response from consultees	How / where addressed
		The applicant has identified that the proposed cable route is located in waters that are important to the commercial fishing industry and that the impact of the cable laying activity on the sector requires further assessment. The main impact pathways have been identified as temporarily restricting access to the fishing grounds and on the abundance and distribution of target species.	The potential impact on commercial fisheries is assessed within Section 14 – Commercial fisheries.
		The Scottish Fishermen's Federation emphasised the need for further assessment of the impacts on commercial fisheries including the use of traps, scallop fishing and the potential loss of access post lay.	The potential impact on the use of traps, scallop fishing and loss of access post lay is assessed within Section 14 – Commercial fisheries.
		Scottish Ministers agree with the applicant regarding the need for further assessment of the impact on commercial fisheries.	The potential impact of the Project on commercial fisheries is assessed within Section 14 – Commercial fisheries.
Shipping and Navigation	Y	Navigational risk assessment and detailed cable burial plan required.	**Considered further within the EA**
		The applicant has identified that vessel density is low along the majority of the cable route and at the landfall points. However, a short section of the proposed cable route where shipping density is high due to fishing and cargo routes (running east to west through Pentland Firth) has been identified. As the slow-moving cable lay vessel will be transiting perpendicular to the main flow of traffic, there is a risk of collision and the applicant proposed the need to carry out a navigational risk assessment.	Considered further within the Navigational Risk Assessment provided in Appendix B.
		The RYA, MCA and NLB support the requirement of a navigational risk assessment.	Considered further within the Navigational Risk Assessment, Appendix B.
		The MCA highlight the need for further details of the burial and cable protection plan and how this will be achieved.	Further details regarding the cable protection requirements are detailed within Section 4 – Project description. A Cable Burial Plan will be developed following appointment of the installation contractor and prior to works commencing.

Topic	Included Y / N	Reason for inclusion / exclusion from the EA and summary of response from consultees	How / where addressed
		The RYA highlight the need for further assessment in particular of the activities round the entrance to Hoy Sound and the impact this may have on recreational boaters and also for consideration to be given to the methods of communicating the proposed works to the recreational boating community.	The potential impacts of the works on recreational boaters is assessed within Section 4.3 of the NRA, provided in appendix D The potential impact on recreational users within the vicinity of the cable route is assessed within Section 15 – Offshore infrastructure & other sea users.
		UK Chamber of Shipping echo the views of the other consultees with regards to potential impacts on navigation and anchoring activity and the need to see further detail on the cable burial plan.	A Cable Burial Plan will be developed following appointment of the installation contractor and prior to works commencing.
		Scottish Ministers agree that a navigational risk assessment should be carried out to address the potential impacts on navigation and anchoring. Additionally, a detailed cable burial and protection plan should be submitted to support the navigational risk assessment.	Further details regarding the cable protection requirements are detailed within Section 4 – Project description. A Cable Burial Plan will be developed following appointment of the installation contractor and prior to works commencing
Marine Archaeology	Y	Potential wrecks and other deposits close to the route so further surveys are required.	**Considered further within the EA**
		The applicant identified that there are no chartered wrecks along the proposed cable route, however there are a number of potential wrecks and other deposits close to the route. As such, a desk-based assessment has been proposed to be carried out, and to collect further survey data to try and identify any potential unknown sites prior to confirming the final routing of the cable.	The potential impact of the Project upon marine archaeology is assessed in Section 14 – Marine archaeology.
		HES support the conclusion of the applicant regarding further assessment of marine archaeology.	The potential impact of the Project upon marine archaeology is assessed in Section 14 – Marine archaeology.
		Scottish Ministers support the views of both the applicant and the consultees regarding carrying out a marine archaeology assessment.	The potential impact of the Project upon marine archaeology is assessed in Section 14 – Marine archaeology.
Other Sea Users	Y		**Considered further within the EA**

Topic	Included Y / N	Reason for inclusion / exclusion from the EA and summary of response from consultees	How / where addressed
Other Sea Users		The applicant identified a number of other sea users who have interests in the vicinity of the cable route. The applicant concluded that the potential impacts from loss of access and collision require further assessment.	The potential impacts of the proposed works on other sea users is assessed within Section 15 – Offshore infrastructure and other sea users.
		The Highland Council identified the nuclear site as also having a potential interest and recommended that they are included in the list of other sea users who should be considered within the EA.	Consideration of the nuclear sites interests has been assessed in Section 15 – Offshore infrastructure and other sea users.
		Scottish Ministers support the need for further assessment and potential consultation with the other sea users that have been identified by the applicant and consultees to try and minimise any impact of the proposed works.	The potential impacts of the proposed works on other sea users is assessed within Section 15 – Offshore infrastructure and other sea users.

5.4 Meetings

A number of meetings/consultation events have been held with primary advisors and key consultees during the Project to date as outlined in Table 5.2.

Table 5.2 Consultation meetings held with stakeholders

Meeting	Date	Topic
Orkney Harbour Authority	October 2016	Route selection
SNH and MS-LOT	November 2016	Project update
Public consultation	February 2017	Wider project
RSPB	April 2017	Project and offshore route selection
SFF and OFA, Scottish Inland Fisheries Conference (SIFC) Inverness	April 2017	Subsea routes and fishing activity
Orkney Harbours	May 2017	Project, subsea routes and harbours
Community Liaison Group	May 2017	Wider project
HES	October 2017	Project update
HES	December 2017	Project update and designated wrecks
Consultation Event	February 2018	Wider project
OFA and OIC Marine Services	March 2018	In-survey update
Public consultation	April 2018	Wider project
Dounby and Orkney Country Show	August 2018	Wider project
SNH	August 2018	Survey output and route selection
Public Consultation	September 2018 – October 2018	Pre-application Consultation Events Orkney and Dounreay

5.5 Public consultation

In Scotland, public consultation for marine cable projects is a legal requirement under the Marine Licensing (Pre-application Consultation) (Scotland) Regulations 2013.

SHE Transmission has undertaken a number of Pre-application consultation (PAC) events for the Orkney Connection Project during September/October 2018 as outlined in Table 5-3.

The public consultation events covered the onshore and offshore aspects of the Project and presented exhibition boards that provided information regarding the need for the Project, an overview of the works, the Project timeline, the subsea route selection process and routing considerations, landfall locations as well as the consenting process.

The public consultation events were advertised through a number of media forums including; an advertisement in two local newspapers, the Caithness Courier and the Orcadian on the 8th and 9th August 2018, respectively within the “Public Notices” section; a dedicated webpage was set up by Scottish and Southern Electricity Transmission Plc (SSEN) which hosted information about the Project; the events were publicised via the SSEN Facebook and Twitter feed; and emails were sent to 11,388 residents in Orkney and Dounreay. As such, over 400 members of the public attended the events.

Brochures were available to take away from the event providing a summary of the Project as well as SHE Transmission contact details to follow up on any further questions. A PAC report has been provided separately in support of the Marine Licence application.

Table 5.3 Orkney Connection Project Pre-application Consultation

Date	Location	Time
24/09/18	Stromness Community Centre	1400 – 1800
25/09/18	St Margaret's Hope Cromarty Hall	1400 – 1800
26/09/18	Hoy North Walls Community School	1500 – 1900
26/09/18	Flotta Community Centre	0930 – 1330
27/09/18	Finstown Firth Community Centre	1400 – 1800
28/09/28	Kirkwall Ayre Hotel	1400 – 1800
02/10/18	Thurso Forss Business Park	1400 - 1800

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6 ENVIRONMENTAL OVERVIEW

6.1 Overview of Project Area

This section presents an overview of the key receptors within the vicinity of the Project. This sets the overall scene for the environment within the vicinity of the Project and enables those persons determining the Marine Licence application to put specific issues into the overall context of the Project environment.

6.1.1 Physical environment (including seabed conditions)

The north coast of Scotland and Orkney waters are a highly energetic region with strong tidal currents in the channels and the potential of large waves from the North Atlantic. Much of the coastline comprises of hard rock geology with sand beaches confined to embayment and sheltered regions. Within the offshore environment there are large areas of mobile sediment but in the nearshore region, substrate is commonly swept bed-rock or boulders and cobbles. The tidal conditions observed within the Pentland Firth area are controlled by the hydraulic gradient between the Atlantic and the North Sea (Easton *et al.,* 2012).

The maximum recorded water depths along the proposed subsea cable corridor was 91 m Lowest Astronomical Tide (LAT) (MMT, 2018a). The slope is mostly gentle throughout the proposed cable route, with some moderate slope over sandy features. The slope reaches a maximum of 49.6° on the rocky Caithness landfall, and some steep slopes were also observed near the Orkney landfall (MMT, 2018a). Water depths generally increase southwards. Several larger seabed features are present, generating some moderate and steep slopes. Towards the southern end of the surveyed corridor water depths gradually decrease, with mostly very gentle and gentle slopes (MMT, 2018b).

The underlying bedrock of the cable route comprises mudstones, siltstones and sandstones deposited approximately 419 Ma[3]. Overlying this bedrock is Diamicton (unconsolidated) till deposited up to 3 Ma during the Quaternary period (MareMap, 2018).

Throughout the subsea cable corridor the prominent seabed features are outcrops of Diamicton with alternating patches of rippled sand, gravelly sand and sandy gravel with a general north-south orientation.

Strong winds are the main characteristic of the Orkney climate. Prevailing winds come from between the west and south-east for the majority of the year, with the windy months being October to March (Barne *et al*., 1997). The North Atlantic and the North Sea tidal systems influence the tides in Orkney, producing a net flow of water from west to east.

The Warebeth landfall is located within the Stromness Heaths and Coast SSSI/SAC, which is designated for coastal geomorphology, non-marine Devonian stratigraphy maritime cliff.

Further detail regarding the physical environment along the proposed subsea cable route corridor is provided in Section 8 – Physical conditions and marine processes and further detail on seabed conditions and key seabed features is provided in Section 10 – Benthic and intertidal ecology.

6.1.2 Benthic and intertidal ecology

The area in the vicinity of the proposed subsea cable route supports a rich and diverse range of benthic habitats and species. Of greatest significance are those identified by SNH and the Joint Nature Conservation Committee (JNCC) as PMFs. In total 81 PMFs have been identified in the seas around Scotland, 33 of which are benthic or intertidal (SNH, 2016).

The list of PMFs is derived from an evaluation of Scotland marine biodiversity interests that are on existing conservation lists including Annexes I and II of the Habitats Directive, the OSPAR[4] list of threatened or declining habitats and species and UK Post-2010 Biodiversity Framework (2012) priority species (JNCC, 2016). These are marine features that have been identified as requiring protection through the designation of

[3] Mega-annum, million years

[4] The Convention for the Protection of the Marine Environment of the North East Atlantic.

NCMPAs under the Marine (Scotland) Act 2010 (for territorial waters) and the Marine and Coastal Access Act (2009) (from 12 nm – 200 nm).

There are no designated conservation sites with benthic features in the immediate vicinity of the proposed cable route. The nearest conservation site designated for benthic features is the North-West Orkney NCMPA, located 9.5 km from the proposed cable route. This site is designated for sandeels and for seabed features including sandbanks, sand wave fields and sediment wave fields. Due to its distance from the cable route the NCMPA will not be impacted by the cable installation and operation. The proposed cable route crosses areas of potential Annex I sandbanks directly offshore of both the Orkney and the Caithness landfalls (JNCC, 2017a).

From the EUSeaMap broad-scale seabed habitat classification, the seabed in the offshore section of the proposed cable is mostly composed of coarse sediments, with an area of 'deep circalittoral sand'. Offshore of the Orkney landfall, the seabed habitat is a high energy infralittoral/circalittoral rock. The section of proposed cable towards the Caithness landfall crosses an area of fine sand and muddy sand, and the seabed nearer the landfall is classified as 'moderate energy infralittoral rock'.

MMT was commissioned to undertake an environmental survey along the proposed cable route between Orkney and the Scotland mainland between February and May 2018. The survey involved seabed imagery sampling, sediment grab sampling, particle size analysis (PSA), and hydrocarbons and metals analyses (MMT, 2018b). A total of 21 habitats were identified along the survey corridor, with two listed on the Annex I of the EC Habitats Directive, bedrock and stony reefs.

Further details on seabed conditions and key seabed features is provided in Section 10 – Benthic and intertidal ecology.

6.1.3 Fish ecology

Most fish species are highly mobile. It is therefore highly unlikely that cable installation activities and the presence of the cable would have any impact on the majority of fish species. It is only those species that are either directly dependent upon the seabed environment for important life-stages (e.g. spawning) or are considered to be sensitive to noise generated during cable installation or EMF emitted from the installed cable that could potentially be impacted by the Project and considered further here.

6.1.3.1 Spawning and nursery grounds

Spawning periods for most species are not fixed and fish may spawn either earlier or later from year to year. In addition, mapped spawning areas represent the widest known distribution given current knowledge and should not be seen as rigid unchanging descriptions of presence and absence (Coull *et al.,* 1998). Whilst most species spawn into the water column of moving water masses over extensive areas, benthic spawners have very specific habitat requirements, and as a consequence, their spawning grounds are relatively limited and potentially vulnerable to seabed disturbance and change.

There are two key species of commercial and conservation importance that depend on the seabed either throughout, or at key stages, in their life-cycle; sandeel and herring. Although, data from Coull *et al.* (1998) and Ellis *et al.* (2012) indicates that there is potential for sandeel to spawn throughout the Pentland Firth, the intensity of spawning is considered to be low (Ellis *et al.,* 2012). This spawning ground is one of the two protected features of the North-West Orkney NCMPA (the other feature being sandbanks, sand wave fields and sediment wave fields). The NCMPA plays an important role in supporting wider populations of sandeels in Scottish waters.

With regard to herring, Coull *et al*. (1998) indicate that there is potential for this species to spawn in the area within the vicinity of the proposed cable route and throughout the Pentland Firth, however, the Updated Fisheries Sensitivity Maps Report (Scottish Government, 2014), suggests that the probability of the presence of 0 group fish (fish in their first year of life) in the Project study area is low.

Other than sandeel, the number of other fish species with spawning grounds in the Project study area is limited to lemon sole and whiting. However, a number of other fish species utilise the area of the proposed cable route for nursery grounds including saithe, anglerfish, blue whiting, cod, hake, lemon sole, ling and mackerel. Haddock nursery grounds extend across the southern part of the proposed cable route (waters off north coast mainland Scotland) only.

6.1.3.2 Noise sensitive species

The ability of fish to detect sound depends on whether or not they have a swim bladder and whether the swim bladder is located near to a fish's ear. Hawkins and Popper (2014) have divided fishes into several different categories based on the structures associated with hearing. The functional groups include:

- Low sensitivity to noise - fishes without a swim bladder (these can only detect kinetic energy – e.g., sharks, common skate complex, mackerel, whiting);
- Medium sensitivity to noise - fishes with a swim bladder that is far from the ear and thus not likely to contribute to pressure reception, so the fishes are primarily kinetic detectors (e.g., salmon, sea trout) and eggs and larvae that are less mobile than adult fish and therefore not able to readily move away from the noise source; and
- High sensitivity to noise - fishes with a swim bladder or other air bubble that is close to the ear and enables sound pressure to be detected, broadening the hearing range and increasing hearing sensitivity (e.g., herring, sprat, cod).

Based on information obtained through the cable routing processes there is potential for a number of noise sensitive species such as cod, herring, whiting and Atlantic salmon to be present along the subsea cable route.

6.1.3.3 Elasmobranch and electro-sensitive species

Species of fish that are most vulnerable to the effects of EMF are elasmobranch species (sharks and rays), which possess specialised electroreceptors; and other electro-sensitive species (usually migratory species), which are able to detect induced voltage gradients associated with water movements and geomagnetic emissions (e.g. Atlantic salmon).

There is also potential for a number of elasmobranch species to be present in the Project study area. These include common skate complex, spotted ray, spurdog, thornback and tope shark.

There is potential for a number of electro-sensitive species (migratory) to be present in, or transit through the Project study area. Key species include Atlantic salmon, sea trout and European eel. Atlantic salmon and sea trout are diadromous in that they spend most of their lives at sea, only returning to freshwater rivers to spawn. European eels are also diadromous; however, the adults migrate out to sea to spawn with the larvae making the return journey back to freshwater.

There is evidence to suggest that both Atlantic salmon and European eel use the Pentland Firth as a key migration route between freshwater rivers on the north and east coast of Scotland and deeper offshore waters around Iceland and the north Atlantic Ocean (Malcolm *et al.,* 2010). More recent research (Godfrey *et al.,* 2014a, 2014b and Guerin *et al*., 2014) suggests that Atlantic salmon may also migrate through waters to the north and east of Orkney in addition to the Pentland Firth.

6.1.3.4 Basking sharks

Basking sharks are the second largest fish in the world, reaching up to 12 m in length (average length is usually 6 - 8 m). They are widely distributed in cold and temperate waters and feed predominately on plankton and zooplankton e.g. barnacles, copepods, fish eggs and deep-water oceanic shrimps by filtering large volumes of water through their wide-open mouth. They typically move very slowly (around 4 miles per hour). In the winter, they dive to great depths to get plankton while in the summer they are mostly near the surface, where they appear to be basking (Orkney.com, 2016). Hotspots for basking shark sightings include Eynhallow Sound (between the northeast coast of Orkney mainland and Rousay) and off the Old Man of Hoy (waters to the east of the north of Hoy).

Basking sharks were hunted in Scotland up to 1995. However, they are now protected in UK waters principally under Schedule 5 of the Wildlife and Countryside Act 1981 and under the Nature Conservation (Scotland) Act 2004. The biggest risk to basking sharks from the Project is potential collision with vessels involved in cable installation. Given that basking sharks are slow to mature and have a long gestation period, the species can be slow to recover if populations are rapidly depleted.

6.1.4 Ornithology

The waters off Caithness and Orkney are important at different times of the year for a number of bird species. Birds from designated sites represent birds of highest sensitivity and importance. Five relevant SPA's and NCMPAs (including proposed and candidate sites) were identified as having qualifying features of ornithological interests; Hoy SPA, North Caithness SPA, Scapa Flow proposed Special Protection Area (Pspa), Caithness and Sutherland Peatlands SPA, and Orkney Mainland Moors SPA.

The proposed cable route crosses the Hoy SPA and the North Caithness Cliffs SPA at the Dounreay landfall. The Warebeth landfall is located close to the western edge of the Scapa Flow pSPA. Together, they protect a number of bird species, including the following seabird species: red-throated diver, great skua, puffin, guillemot, kittiwake, great black-backed gull, Arctic skua, Arctic tern, fulmar, great northern diver, black-throated diver, Slavonian grebe, European shag, common eider, long-tailed duck, common goldeneye, red-breasted merganser and razorbill.

With regards to birds on the shore at the cable landfalls, all wild birds in the UK are protected under the Wildlife and Countryside Act 1981 (as amended) and under this Act it is an offence to intentionally or recklessly: kill, injure, take, damage, interfere, disturb or harass wild birds listed on Schedule 1 and 1A. This applies to their nests, eggs and young. Onshore bird surveys have been carried out at the cable landfalls (ERM, Ltd 2019).

The breeding seasons for the most common seabird species found in the Scottish marine environment are listed in Table 6-1.

Table 6.1 Seabirds breeding seasons and nest occupancy periods in the Scottish marine environment (SNH, 2017)

Protected seabird species	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Arctic tern												
Common guillemot								M M	M	M		
Kittiwake												
Arctic Skua												
Fulmar												
Great skua												
Red-throated diver									M	M	M	M
Razorbill								M	M	M	M	
European shag												
Slavonian grebe												
Common eider							M	M	M			
Long-tailed duck												
Velvet scoter												
Red-breasted merganser								M	M	M		
Black-headed gull												
Great black-backed gull												
Black guillemot								M	M	M	M	
Common gull												
Lesser black-backed gull												
Cormorant												
Puffin		M	M									
Black-headed gull												
Northern gannet												
Common tern												
Storm petrel												

Key:

Black = breeding season

Dark blue = breeding site attendance

Light blue = non-breeding period

White = not present in significant numbers

M = flightless moult period

Consideration of the potential impact of the Project upon ornithology has been detailed further in Section 12.

6.1.5 Marine mammals

Marine mammals are afforded varying levels of protection under different international and national legislation depending upon their genus. Within UK waters, cetaceans (whales, dolphins and porpoises) and otters *Lutra lutra* are protected through the listing of EPS under Annex IV of the Habitats Directive and are provided full protection within Scottish territorial waters through the Conservation (Natural Habitats, &C.) Regulations 1994 (as amended). Bottlenose dolphin, harbour porpoise, grey and harbour seals, and otters gain additional

protections through Annex II of the Habitats Directive, which requires their consideration in the designation of Special Areas of Conservation (SACs). Pinnipeds (seals) are protected through provisions set out in Annex V of the Habitats Directive, which defines them as species of community interest, in addition to their required consideration for the designation of SACs as defined in Annex II.

Additionally, all marine mammal species which regularly occur within Scottish waters are designated as PMFs by SNH (SNH, 2016).

There are two designated seal haul outs near the proposed cable route, approximately 1.8 km and 3.5 km from the Orkney landfall. No seal haul-out sites have been designated in the vicinity of the Dounreay landfall.

Further assessment on marine mammals is presented in Section 11 – Marine mammals.

6.1.5.1 Cetaceans

Nineteen species of cetacean are known to occur in the Northern North Sea (Evans *et al.,* 2001; Reid *et al.*, 2003). There are several cetaceans which regularly occur in the waters of the Pentland Firth and Orkney, these include: harbour porpoise *Phocoena phocoena*, bottlenose dolphin *Tursiops truncatus*, short-beaked common dolphin *Delphinus delphis*, white-beaked dolphin *Lagenorhynchus albirostris*, white-sided dolphin *Lagenorhynchus acutus*, Risso's dolphin *Grampus griseus*, long-finned pilot whale *Globicephala melas* killer whale *Orcinus orca*, and minke whale *Balaenoptera acutorostrata* (NMPi, 2018; Hammond *et al.*, 2017; Reid *et al.*, 2003; Barne *et al.*, 1997). Of these, harbour porpoise, bottlenose dolphins, white-beaked dolphins, Risso's dolphin, killer whale, and minke whale regularly occur within the vicinity of the proposed cable route (Evans *et al.*, 2011).

Marine Scotland survey data shows the encounter rate was very low for bottlenose dolphins and white-beaked dolphins, and low for minke whales and harbour porpoise (NMPi, 2018). Density estimates from the most recent Small Cetaceans in the European Atlantic and North Sea (SCANS-III) surveys indicated harbour porpoise as the most abundant species within the vicinity of the proposed cable route with an estimated density of 0.152 animals/km^2 (Hammond *et al*., 2017). When scaled across the 53 km cable route length this isa low number, with potentially only 2 – 8 animals likely to be around or near the cable-lay route (JNCC, 2016).

The area in which the proposed cable route is located has low to very low cetacean density and is not considered to be significant for feeding, breeding, nursery or migrating cetaceans (Hammond *et al*., 2004; NMPi, 2018; Reid *et al*., 2003).

6.1.5.2 Pinnipeds

There are two species of pinniped which occur in UK waters: grey and harbour seals. Grey and harbour seals forage in both inshore and offshore waters depending upon the seasonal distribution of their prey. However, both species tend to be concentrated close to shore, particularly during the pupping and moulting seasons which occur between May and August (Hammond *et al*., 2004).

Orkney and its islands are a stronghold for both grey and harbour seals. Grey seals have larger foraging ranges than harbour seals. Although capable of travelling hundreds of kilometres during foraging bouts, grey and harbour seals in northeast Scotland generally forage within approximately 40 km and 30 km of their haul-outs, respectively (McConnell *et al.,* 2001; Tollit *et al.*, 2001). Fine-scale data on the density of seals at-sea indicate that habitat usage is very high (greater than 5 seals/km^2) around where the cable route makes landfall in Orkney, and medium (greater than 3 seals/km^2) near where the cable route makes landfall on the Scottish mainland (Russell *et al*., 2017). As expected from known seal behaviour, seal density is very low (less than 1 seal/km^2) for the majority of the cable route occurring in deeper, offshore waters.

Harbour seal populations in the Orkney islands have been in continued decline due to a variety of factors, including: climate change, increased predation from other species, increased prey competition and potential direct mortality (e.g. shooting).

Given the conservation significance of harbour and grey seals, further assessment has been undertaken and is presented in Section 11 – Marine mammals.

6.1.5.3 Otters

Otters are semi-aquatic marine mammals which utilise both marine and freshwater as foraging habitat. They occupy dens (known as holts) situated along coastlines and riverbanks. Although there are no designated sites for otters in the vicinity of the cable route, it is an offence to deliberately or recklessly capture, kill, injure, disturb or harass EPS, including cetaceans, seals and otters. Otters are also protected under the Wildlife and Countryside Act 1981, which also classifies as an offence any act of obstruction of access or destruction to their breeding, resting or sheltering places. Otter activity has been recorded to the east of the proposed cable route at Dounreay and the Orkney landfall is considered to be suitable habitat for otters.

Given the potential importance of the area of the proposed cable route to otters, further assessment has been undertaken and is presented in Section 11 – Marine mammals.

6.1.6 Commercial fisheries

The proposed cable route is located in waters that are exploited by commercial fisheries. Marine Scotland uses Vessel Monitoring System (VMS) data to determine fishing effort and landings for each International Council for the Exploitation of the Sea (ICES) rectangle within Scottish waters and the UK Continental Shelf (UKCS). Recently published fisheries effort data suggests that the region along the proposed cable route is particularly important to passive gear fisheries (Scottish Government, 2017). Gear use is dominated by traps (70%), though some demersal and pelagic fishing also occurs within the area in the form of trawls (7%), dredges (3%), hooks and lines (10%) and other miscellaneous gear types (10%) (Scottish Government, 2018).

Fishing takes place year-round within ICES rectangle 46E6, with no clear seasonality in fisheries landings (Scottish Government, 2018). In 2016, haddock, crabs, scallops and cod comprised nearly 75% of the total live weight (2,414 tonnes) of fisheries landings from the region (Scottish Government, 2017). These four species are of commercial importance due to their high value, particularly scallops and crabs, and landings of those species from this region collectively contributed nearly £3 million to the UK economy in 2016. The most deployed gear type in terms of fishing day effort were traps, deployed for a total of 1,410 fishing days in 2017, representing 68% of the total fishing effort for that year. The remaining effort was associated with miscellaneous gear, hooks and lines, trawls, and dredges mainly.

Preliminary landings data for 2017 reveal that a net of approximately £4.18 million was landed from ICES rectangle 46E6 in 2017 (Scottish Government, 2018). This figure is well above the UK average of roughly £3.5 million per annum per ICES rectangle, suggesting the area's importance to the local and national commercial fishing sector (Scottish Government, 2018).

Aquaculture is an important industry in Orkney. The majority of the licensed aquaculture sites are for finfish (e.g. salmon and trout), although there are also some licensed shellfish sites. Most aquaculture sites are located within Scapa Flow (nine sites) and Wide Firth (12 sites north east of Kirkwall) where conditions are considered to be most favourable for aquaculture activities. The nearest aquaculture site is located 8 km south-east of the cable corridor, in the nearshore area off the north east coast of Hoy.

Given the potential importance of the area of the proposed cable route to commercial fisheries, further assessment has been undertaken and is presented in Section 14 – Commercial fisheries.

6.1.7 Shipping and navigation

Analysis of Automatic Identification System (AIS) vessel track data (for non-recreational and recreational) collected for the Pentland Firth and Orkney Waters was undertaken by Cathie Associates (Cathie Associates, 2018). The AIS dataset covered the Orkney islands for a 2-year period between 2016 and 2018.

Vessel density was found to be low along most of the cable route, with between 0 – 50 tracks recorded near the landfalls, 50 – 100 tracks for most of the offshore section, except between KP30 and KP40 where shipping density was high (approximately 10-15 km northwest of Thurso), reaching 1,000 to 2,500 tracks. This is due to fishing and cargo routes running east to west across the Pentland Firth. Shipping was also moderate offshore of Orkney (between approximately KP1 and KP4, near the exit of the Hoy mouth), with areas associated with 500 – 750 tracks (Appendix B – Navigational Risk Assessment).

Cargo and tankers comprised over 45% of the vessels crossing the proposed cable route, whilst fishing vessels and passenger vessels represented 26% and 11% of those, respectively. The remaining vessels included unknown vessel types, offshore industry vessels, government ships and pot/dredging vessels (Cathie Associates, 2018). The mainland Scotland to Orkney passenger ferry route between Scrabster and Stromness (west route) (MV *Hamnavoe)* is in proximity to the installation corridor.

There are no designated anchorage areas along the proposed cable route, however there are some areas in the vicinity of the route where vessels have been recorded at anchor between kilometre point (KP) 35 and KP38 (Cathie Associates, 2018). The Pentland Firth is also recognised as an international shipping lane.

There are a number of recreational sailing routes along the north Caithness coast and in and around Orkney with yachts visiting main harbours and marinas of Scrabster, Kirkwall, Stronmess and Westray. Recreational sailing trips were significantly higher during the summer months than winter months.

Due to potential impacts on shipping and navigational safety, further assessment has been undertaken and is presented in Appendix B – Navigational Risk Assessment.

6.1.8 Marine archaeology

Studies at Dunnet Bay have shown the presence of a series of intercalated sand and peat layers, including intertidal peats containing remnant tree stumps or submerged forest (McIllvenny *et al.,* 2013, 104). Intertidal peats have been recorded some 5 km to the northeast of Warebeth in the Bay of Ireland (Timpany *et al.,* 2017). There is moderate potential for submerged landscape peat and associated archaeological sites to be present in the intertidal (and onshore) zones in both Caithness and Orkney.

There are no historic MPAs within the vicinity of the Project. The nearest known wrecks to the proposed cable route are the *Marandra* (motor fishing vessel) located less than 1 km south from the Orkney landfall, and the *Arnisdale* (motor fishing vessel), located 1.2 km north-east of the Caithness landfall.

Further assessment on marine archaeology has been undertaken and is presented in Section 13 – Marine archaeology.

6.1.9 Offshore infrastructure and other sea users

There are a number of other sea users in the vicinity of the proposed cable route. These include:

- Renewable energy projects (operational / consented / planned);
- Cables and pipelines, including SSE assets and telecommunications;
- Other infrastructure - oil and gas;
- Potential UXO and munitions;
- Disposal sites;
- Recreational activities; and
- Nuclear receptor (Dounreay).

6.1.9.1 Renewable energy projects

The EMEC wave test facility at Billia Croo, the Dounreay Tri demonstration project, the Katanes floating energy park and the Brough Head Wave Farm are located in the vicinity of the Project (<10 km). Additional projects located further afield (>10 km) are detailed in Section 15 – Offshore infrastructure & other sea users. Additionally, in relation to the Crown Estate Scotland's (CES) further leasing round an 'Area of Search' (AoS) for offshore wind energy projects has been identified by Marine Scotland off the coast of Caithness, the eastern edge of which overlaps with the proposed subsea cable corridor.

6.1.9.2 Subsea cables

There are a two telecoms cables that cross the proposed cable corridor. These are outlined in Table 6-2.

Table 6.2 Subsea cables that cross the proposed cable route

Location	Cable	Type	Description
West Orkney	FARICE (BT)	Telecommunications	Telecoms cable between Iceland, Faroe Islands and Scotland (Dunnet Bay, Caithness).
West Orkney	Northern Lights (BT)	Telecommunications	Telecoms cable between mainland Scotland and Orkney (Dunnet Bay, Caithness and Bay of Skaill, West Coast Orkney).

Both the Pentland Firth West and Pentland Firth East power cables are in close proximity to the proposed installation corridor at 1.7 km and 1 km respectively. Consideration of the potential impact of the Project on subsea cables is detailed within Section 15 – Offshore infrastructure & other sea users.

6.1.9.3 Other infrastructure – oil and gas

The nearest oil and gas installation is the Well 11/25, located 46.13 km SE in 11/25 Quad/Block.

Consideration of the potential impact of the Project on other offshore infrastructure is provided within Section 15 – Offshore infrastructure & other sea users.

6.1.9.4 Recreational activities

Sailing, yachting, canoeing and sea angling are all recreational activities which occur off the north coast of Scotland. Within the vicinity of the Dounreay landfall there are the following recreational clubs; Pentland Firth Yacht Club, Pentland Canoe Club, and Dounreay Fly Fishing club. Within the vicinity of the Warebeth, Orkney landfall there is the Stromness Sailing Club and the Orkney Islands Sea Angling Association.

Consideration of the potential impact of the Project on other sea users is provided within Section 15 – Offshore infrastructure & other sea users.

6.1.9.5 Disposal sites

The build-up of sediment in port areas and navigation channels can lead to a significant reduction in water depths which can have adverse effect the safety of operations in these areas. Maintenance dredging is therefore important for maintaining safe port operations and keeping waterways navigable by removing sediment from the seabed in these locations and safely disposing of the dredged material to a licensed disposal site. The nearest dredge disposal sites are Dounreay Microsite and Stromness A, located 304 m east and 2.2 km north-west of the proposed cable route respectively.

Due to potential impacts on other sea users, further assessment has been undertaken and is presented in Section 15 – Offshore infrastructure & other sea users.

7 IMPACT ASSESSMENT METHODOLOGY

7.1 Overview

The Orkney to Mainland Subsea Link Project is exempt from the requirement to conduct a statutory EIA (see Section 1.3). However, a proportionate assessment of environmental impacts has been undertaken to support the application for a Marine Licence. The assessment that has been undertaken systematically identifies the potential impacts of the Project. It requires a detailed understanding of the Project e.g. proposed installation, operation and maintenance, and decommissioning activities, and the environment within which the Project will be located. Potential impacts have been evaluated to determine how the Project could affect the environment and the significance of those impacts. Where potential impacts are likely to be significant, specific mitigation measures have been identified for implementation either through design or directly during the different phases of the Project.

The impact assessment process has been informed by the following steps:

> A report identifying studies required as part of the Orkney to Mainland Scotland Transmission cable link Marine Licence application was issued to stakeholders for comment. This report identified baseline sensitivities, potential impact mechanisms and proposed areas for further assessment. It also identified environmental topics which could be scoped out of the EA.

> Comments were received from stakeholders, and the proposed approach to the EA was updated to reflect the comments (this is summarised in Section 5 –Stakeholder engagement.

This approach has resulted in an agreed scope of impact assessment that is focused on the keys areas of potential environmental impact.

7.2 Impacts requiring further assessment

A key part of the impact assessment process is determining the impacts that require further assessment as part of a proportionate assessment. Table 7-1 summarises the key environmental receptors, the potential impacts on them and the mitigation and management that will be embedded into the Project in order minimise impacts

For specific receptors, additional assessment of potential impact is required. Where further study is required this has been noted and the location of the information provided.

Table 7.1 Potential impacts from routine activities

Potential impacts	Sensitivity of environmental receptor	Embedded management and mitigation	Further assessment required to determine impact significance and/or identify management / mitigation measures? (also see Table 5.1 Scottish Ministers' advice on topics to be included in the EA).
Physical environment			
Direct disturbance and removal of feature due to substratum loss.	Based on information presented from the Scottish Government Feature Activity Sensitivity Tool (FEAST) (Scottish Government, 2015a), most features of geodiversity importance are considered to be of medium to high sensitivity due to the fact that most features are relicts and once damaged are unlikely to recover to their former state. However, for direct damage to have an impact on the integrity of the structure, scale and nature of the impact would need to be of sufficient magnitude to result in a physical alteration of the feature.	Most geological features, are, from a technical perspective, considered to be a hazard to cable installation. This is on the basis that in most cases, cable burial using conventional methods (e.g. trenching) is not possible where geological features are present. Consequently, cables have to be surface laid in these areas and protected using measures such as concrete mattresses. In absence of any intrusive works (e.g. trenching of the seabed) the potential for any direct impacts on geological features of interest along the subsea cable route and within the wider Project area will be minimal.	A baseline description of the physical environment only is provided in Section 8 – Physical conditions and marine processes. Impacts related to direct disturbance of the seabed are covered in Section 10 – Benthic and intertidal ecology.
Benthic and intertidal habitats and species			
Direct loss of, or disturbance to, benthic habitats and communities	The biotopes linked to potential Annex I rocky/stony reefs have a low sensitivity to direct disturbance, temporary increase in siltation rate changes and smothering.	Cable installation activities are reduced as much as possible and overall represent a short term, transient activity.	Yes, further assessment undertaken in Section 10 – Benthic and intertidal ecology to consider the potential impacts in greater detail and

Potential impacts	Sensitivity of environmental receptor	Embedded management and mitigation	Further assessment required to determine impact significance and/or identify management / mitigation measures? (also see Table 5.1 Scottish Ministers' advice on topics to be included in the EA).
Temporary increase in suspended sediments **Introduction of new substrate**	The introduction of new hard substrate to the seabed will not generate a significant reef effect as the cable will be buried where possible and there is evidence that reef effect is not significant in rocky areas, where the cable will be surface laid and covered by cable protection (see Section 10.8). The CBRA currently indicates a total length of 2900 m of the cable route that will need remedial protection with further sections of the route comprising potentially difficult burial which may require remedial works (see Section 4.7.3).	Micro-routing will be used where feasible to avoid potential Annex I reef habitats that are potentially encountered.	incorporate the seabed survey data into the assessment. Installation footprints and Zone of Influence are outlined in Section 4.13 of the Project Description
Increased risk of introducing or spread of Invasive Non-Native Species (INNS)	The biotopes linked to potential Annex I rocky/stony reefs have a low sensitivity to introduction of INNS. There is evidence that kelp is highly sensitive to marine invasive species. However, no kelp beds, as listed on the list of PMFs in Scottish waters, have been identified in the Project area.	Non-native marine species management plan.	Yes, further assessment undertaken (see Section 10) to consider the potential impacts in greater detail.
Accidental release of pollution	A significant release of pollution is likely to lead to impacts on benthic communities.	Potential for accidental fuel release from vessels is very low. In the event of an accidental fuel release occurring appropriate standard practice management	No further assessment required. The likelihood of release is very low and management plans will be in place.

Potential impacts	Sensitivity of environmental receptor	Embedded management and mitigation	Further assessment required to determine impact significance and/or identify management / mitigation measures? (also see Table 5.1 Scottish Ministers' advice on topics to be included in the EA).
		procedures will be implemented accordingly. Standard pollution prevention measures are laid out in the Schedule of Mitigation (SoM)/CEMP and for all vessels over 400 GT (gross tonnage) a Ship Oil Pollution Emergency Plan (SOPEP) will be in place.	
Ornithology - seabirds			
Disturbance and/or displacement of qualifying interests of protected sites due to vessel presence	Sensitivity of seabirds to vessel presence has been shown to vary from low to high depending on the species (Wade *et al.*, 2016). Some species such as northern fulmar, gulls and skuas are particularly unsensitive and have been shown to associate with marine works.	Cable installation activities from the vessel are reduced as much as possible and overall represent a short term, transient activity. Lighting on-board the cable installation vessel will be kept to the minimum level required to ensure safe operations	Yes, further assessment undertaken (see Section 12 – Ornithology) to consider the potential impacts in greater detail.
Disturbance and/or displacement of qualifying interests of protected sites due to increased turbidity in the water column	Sensitivity to turbidity is only relevant to visual foragers. Peregrine falcon feeds on other seabirds and northern fulmar, skuas and gulls are opportunistic scavengers and therefore are unlikely to be sensitive to changes in turbidity.	Cable installation activities from the vessel are reduced as much as possible and overall represent a short term, transient activity.	Yes, further assessment undertaken (see Section 12 – Ornithology) to consider the potential impacts in greater detail on sensitive species.
Indirect effects on qualifying interests of protected sites due to changes in distribution of prey items	Habitat flexibility and sensitivity to effects on food supply range from low to high depending on the species (Wade *et al.,* 2016; Cook and Burton, 2010).	Cable installation activities from the vessel are reduced as much as possible and overall represent a short term, transient activity.	Yes, further assessment undertaken see Section 12 – Ornithology) to consider the potential impacts in greater detail.

Potential impacts	Sensitivity of environmental receptor	Embedded management and mitigation	Further assessment required to determine impact significance and/or identify management / mitigation measures? (also see Table 5.1 Scottish Ministers' advice on topics to be included in the EA).
Indirect effects on prey species due to EMF during cable operation or disturbance of prey items from maintenance or repair vessels	Habitat flexibility and sensitivity to effects on food supply range from low to high depending on the species (Wade *et al.,* 2016; Cook and Burton, 2010).	The magnetic fields generated by the cable are expected to attenuate to background levels within around 1 m. It is also proposed to bury the cable or for rock to be placed over the cables where burial cannot be achieved at crossings or in areas of harder seabed and therefore no magnetic fields are expected to be detectable at the Mean seabed or outside cable protection	Yes, further assessment undertaken (see Section 12- Ornithology) to consider the potential impacts in greater detail.
Accidental pollution	All species are considered to show a level of sensitivity to accidental pollution events.	Potential for accidental fuel release is very low. In the event of an accidental fuel release occurring appropriate standard practice management procedures will be implemented accordingly. Standard pollution prevention measures are laid out in their SoM/CEMP and for all vessels over 400 GT (gross tonnage) a SOPEP will be in place.	No further assessment required. The likelihood of release is very low and management plans will be in place.
Fish and shellfish, including migratory fish and elasmobranchs			
Interaction with spawning/nursery grounds	Data from Coull *et al.,* (1998), Ellis *et al.*, (2012) and the Scottish Governments Updated Fisheries Sensitivity Maps indicates that it is unlikely that any key spawning grounds are present in the project vicinity.	Cable installation activities from the vessel are reduced as much as possible and overall represent a short term, transient activity. Cable installation activities will take place within a minimal consented installation corridor of 200 m within which the widest impact footprint from ploughing or trenching is 15 m wide and rock placement 7 m wide, resulting in a total area affected of 0.78 km^2 if assumed that the cable can be trenched or ploughed into the seabed. This is considered to be	No further assessment required. Impacts to Atlantic salmon and freshwater pearl mussel protected species have been further assessed within Appendix D – Nature Conservation Appraisal.

Potential impacts	Sensitivity of environmental receptor	Embedded management and mitigation	Further assessment required to determine impact significance and/or identify management / mitigation measures? (also see Table 5.1 Scottish Ministers' advice on topics to be included in the EA).
		a minimal area compared to the wider habitats available for spawning/nursery grounds.	
Disturbance and possible alteration of migration routes due to vessel noise, noise generated during cable installation and sediment suspension during cable installation	Most fish species are highly mobile. It is therefore highly unlikely that cable installation activities and cable presence would have any impact on the majority of fish species. Potential for a number of noise sensitive species such as cod, herring, whiting and Atlantic salmon to be present along the subsea cable route.	Cable installation activities from the vessel are reduced as much as possible and overall represent a short term, transient activity that will emit limited noise in a manner likely to obstruct movements. Sediment suspension will be limited in temporal and spatial scale (Xodus, 2018) and will not occur to the extent that movement over longer migration routes would be compromised.	No further assessment required, impacts are considered to be highly limited and receptors highly mobile. Previous assessment for the Western Isles Connection Project (Xodus, 2018) demonstrates that the greatest impact from trenching sediment disturbance is restricted to the immediate vicinity of the trench (less than 10 m either side).
Electro Magnetic Field (EMF) impacting migration	There is potential for a number of elasmobranch species to be present in the Project study area. These include common skate complex, spotted ray, spurdog, thornback and tope shark. There is also potential for a number of electro-sensitive species (migratory) to be present in, or transit through the Project study area. Key species include Atlantic salmon, sea trout and European eel.	The magnetic fields generated by the cable are expected to attenuate to background levels within around 1 m. It is also proposed to bury the cable or for rock to be placed over the cables where burial cannot be achieved at crossings or in areas of harder seabed and therefore no magnetic fields are expected to be detectable at the seabed	No further assessment required. Given the cable will be buried or protected across the length of the route the potential for significant impacts is minimal.

Potential impacts	Sensitivity of environmental receptor	Embedded management and mitigation	Further assessment required to determine impact significance and/or identify management / mitigation measures? (also see Table 5.1 Scottish Ministers' advice on topics to be included in the EA).
Collision risk for basking sharks	Basking sharks are widely distributed in cold and temperate waters. The recordings from Northern Scotland and Orkney are widely scattered occurring across the year, although particularly on the west coast of Scotland during summer and in the vicinity of the Project.	There are a limited number of slow moving vessels involved in the Project, which will be present for a short period of time.	No further assessment required. There are a limited number of slow moving vessels involved in the Project and the area is not known for particular concentrations of basking shark. If required a separate basking shark licence will be applied for.
Accidental pollution	All species are considered to show a level of sensitivity to accidental pollution events.	Potential for accidental fuel release is very low. In the event of an accidental fuel release occurring appropriate standard practice management procedures will be implemented accordingly. Standard pollution prevention measures are laid out in their SoM/CEMP and for all vessels over 400 GT (gross tonnage) a SOPEP will be in place.	No further assessment required. The likelihood of release is very low and management plans will be in place.
Marine mammals – cetaceans			
Temporary disturbance / displacement due to noise emissions from cable installation vessels and cable installation activities (offshore)	Certain species e.g. harbour porpoise, have high sensitivity to noise. However, the Project area is not considered to be significant for feeding, breeding, nursery or migration for cetacean species. The mobile nature of cetaceans and the short term, transient works reduces the potential for interaction	Cable installation activities from the vessel are reduced as much as possible and overall represent a short term, transient activity. Marine Mammal Observers (MMO) and Passive Acoustic Monitoring (PAM) will be deployed on all vessels making emitting noise which could cause a disturbance to marine mammals.	Yes, further assessment required (see Section 11) to consider the potential impacts in greater detail. Protected features of SACs have been assessed within Appendix D – Nature Conservation Appraisal in relation to the Habitats Directive.

Potential impacts	Sensitivity of environmental receptor	Embedded management and mitigation	Further assessment required to determine impact significance and/or identify management / mitigation measures? (also see Table 5.1 Scottish Ministers' advice on topics to be included in the EA).
	between the Project and sensitive receptors.		
Collision risk	The Project area is not considered to be significant for feeding, breeding, nursery or migration for most cetacean species. The mobile nature of cetaceans and the short term, transient works reduces the potential for interaction between the Project and sensitive receptors.	Cable installation activities from the vessel are reduced as much as possible and overall represent a short term, transient activity. Implementation of a MMPP to minimise impacts on cetaceans. This involves the deployment of a MMO, and the use of PAM for works carried out in poor visibility and at night time. Should any cetacean be detected within 500 m of the cable laying vessel, operations will be delayed until their passage, or the transit of the vessel.	No further assessment required. There are a limited number of slow moving vessels involved in the Project.
Increased sedimentation affecting ability to forage	The Project area is not considered to be significant for feeding, breeding, nursery or migration for most cetacean species. The mobile nature of cetaceans and the short term, localised, transient works reduces the potential for interaction between the Project and sensitive receptors.	Cable installation activities from the vessel are reduced as much as possible and overall represent a short term, transient activity.	Yes, further assessment required to consider the potential impacts in greater detail.
Magnetic fields interfering with navigation	Cetaceans are strongly linked with the use of geo-navigation by detection of variation in magnetic fields, although are primarily pelagic therefore interaction with rapidly	The magnetic fields generated by the cable are expected to attenuate to background levels within around 1 m. It is also proposed to bury the cable or for rock to be placed over the cables where burial cannot be achieved at crossings or in areas of harder seabed	No further assessment required. The limited extent of the impact and the mobile nature of the receptor results in no further assessment required.

Potential impacts	Sensitivity of environmental receptor	Embedded management and mitigation	Further assessment required to determine impact significance and/or identify management / mitigation measures? (also see Table 5.1 Scottish Ministers' advice on topics to be included in the EA).
	attenuating EMF fields on the seabed is limited.	and therefore no magnetic fields are expected to be detectable at the seabed	
Accidental pollution	All species are considered to show a level of sensitivity to accidental pollution events.	Potential for accidental fuel release is very low. In the event of an accidental fuel release occurring appropriate standard practice management procedures will be implemented accordingly. Standard pollution prevention measures are laid out in their SoM/CEMP and for all vessels over 400 GT (gross tonnage) a SOPEP will be in place.	No further assessment required. The likelihood of release is very low and management plans will be in place.
Marine mammals – pinnipeds			
Temporary disturbance / displacement due to noise from cable installation vessels and cable installation activities (offshore)	Seals are less sensitive to underwater noise than certain cetacean species. Sensitivity will be higher during the seal breeding season (harbour seals breed June and July and grey seals between end of September and December) and during moulting season (August for harbour seal, January to April for grey seal). There are two designated haul out sites in proximity to the proposed installation corridor, at 1.8 km and 3.5 km from the Project.	Cable installation activities from the vessel are reduced as much as possible and overall represent a short term, transient activity. Marine Mammal Observers (MMO) and Passive Acoustic Monitoring (PAM) will be deployed on all vessels making emitting noise which could cause a disturbance to marine mammals.	Yes, further assessment required. Despite the low likelihood of potential impact, two designated seal haul-outs are located in the vicinity of the proposed cable route and further assessment has therefore been undertaken (see Section 11 – Marine mammals).

Potential impacts	Sensitivity of environmental receptor	Embedded management and mitigation	Further assessment required to determine impact significance and/or identify management / mitigation measures? (also see Table 5.1 Scottish Ministers' advice on topics to be included in the EA).
Collision risk	Orkney is considered to be a stronghold for harbour seal and grey seal populations. Harbour seal population is particularly sensitive due to its recent and ongoing population decline. The mobile nature of pinnipeds and the transient works reduces the potential for interaction between the Project and sensitive receptors.	Cable installation activities from the vessel are reduced as much as possible and overall represent a short term, transient activity. Slow speed of the vessels limits collision probability. A MMPP will be in place to minimise impacts on seals (as well as cetaceans).	No further assessment required. There are a limited number of slow moving vessels involved in the Project.
Increased sedimentation affecting ability to forage	Seals can be found inhabiting areas of near-persistent turbidity (e.g. the southern North Sea and The Wash, and the Thames Estuary on the south-east coast of England), so it appears unlikely that increased turbidity would place significant constraints on the foraging success of these species. The mobile nature of pinnipeds and the short term, localised, transient works reduces the potential for interaction between the Project and sensitive receptors.	Cable installation activities from the vessel are reduced as much as possible and overall represent a short term, transient activity.	Yes, further assessment required to consider potential effects in more detail.
Potential disturbance at haul out sites	There are two designated haul out sites in which lie 1.8 km and 3.5 km from the proposed installation corridor.	The cable will be installed using HDD therefore disturbance to haul-out areas will be limited.	Yes, further assessment required. There are two designated haul-out sites in proximity to the cable route.

Potential impacts	Sensitivity of environmental receptor	Embedded management and mitigation	Further assessment required to determine impact significance and/or identify management / mitigation measures? (also see Table 5.1 Scottish Ministers' advice on topics to be included in the EA).
		Cable installation activities at the landfalls are reduced as much as possible and overall represent a short-term transient activity.	
Accidental pollution	All species are considered to show a level of sensitivity to accidental pollution events.	Potential for accidental fuel release is very low. In the event of an accidental fuel release occurring appropriate standard practice management procedures will be implemented accordingly. Standard pollution prevention measures are laid out in their SoM/CEMP and for all vessels over 400 GT (gross tonnage) a SOPEP will be in place.	No further assessment required. The likelihood of release is very low and management plans will be in place.
Marine mammals - otters			
Disturbance of otter holts at landfalls	There are no designated sites with otter as a qualifying feature within the vicinity of the proposed cable route. Otter activity has been recorded to the east of the cable route at Dounreay and the Orkney landfall is considered to be suitable habitat for otters.	The cable will be installed using HDD therefore disturbance to otter holts will be minimal. Cable installation activities at the landfalls are reduced as much as possible and overall represent a short-term transient activity.	Yes, further assessment is required as otter activity has been recorded in the proximity of the cable route.
Accidental pollution	All species are considered to show a level of sensitivity to accidental pollution events.	Potential for accidental fuel release is very low. In the event of an accidental fuel release occurring appropriate standard practice management procedures will be implemented accordingly. Standard pollution prevention measures are laid out in their SoM/CEMP and for all vessels over 400 GT (gross tonnage) a SOPEP will be in place.	No further assessment required. The likelihood of release is very low and management plans will be in place.

Potential impacts	Sensitivity of environmental receptor	Embedded management and mitigation	Further assessment required to determine impact significance and/or identify management / mitigation measures? (also see Table 5.1 Scottish Ministers' advice on topics to be included in the EA).
Commercial fisheries			
Temporary loss of access to fishing grounds	Some fishing activity is located within the proposed cable route, although there are alternative fishing areas in the vicinity of the Project.	The installation vessels will adopt a rolling Safety Zone of 500m radius around each vessel so that disruption will not affect the entire route. SHE Transmission is committed to ensuring all protection works (including rock placement) are completed within as short a timeframe as possible of laying, in order to open up the areas to fishermen again, however fishing with bottom contact gear will be prevented from occurring over exposed sections of cable from completion of the PLGR to the completion of cable burial and/or protection. Notices to Mariners, and notices in the Kingfisher Bulletin, will be issued in good time to advise fishermen of where and when the installation activities will be operating. A FLO will also be appointed. Further details will be provided in the FLMAP prior to the commencement of installation works.	Yes, further assessment required to consider potential effects in more detail (see Section 14 – Commercial fisheries).
Sediment redistribution	No aquaculture sites are located in the vicinity of the Project (nearest located 8 km away). Data from Coull *et al.,* (1998), Ellis *et al.*, (2012) and the Scottish Governments Updated Fisheries Sensitivity Maps indicates that it is unlikely that any key spawning	Cable installation activities from the vessel are reduced as much as possible and overall represent a short term, localised, transient activity.	No further assessment required. Sediment suspension will be limited in temporal and spatial scale. The Xodus (2018) Trenching Sediment Disturbance Technical Note demonstrates with impacts from sediment disturbance considered to be restricted to the immediate vicinity of the trench (less than 10 m either side).

Potential impacts	Sensitivity of environmental receptor	Embedded management and mitigation	Further assessment required to determine impact significance and/or identify management / mitigation measures? (also see Table 5.1 Scottish Ministers' advice on topics to be included in the EA).
	grounds are present in the Project vicinity.		
Snagging risk	The proposed cable route is not considered of significant importance to dredge and demersal (seabed) fishing gear.	The likelihood of the impact is considered low due to the relevant mitigation measures and regular surveys which will ensure the seabed is in an over trawlable condition.	Yes, further assessment required to consider potential effects in more detail (see Section 14 – Commercial fisheries).
Permanent loss of access to fishing grounds	Some fishing activity is located within the proposed cable route, although there are alternative fishing areas in the vicinity of the Project.	The cables will be trenched and allowed to naturally back fill or buried for the majority of their length. The designed protection levels and associated trench depths have taken demersal fishing gear into consideration and trenching will occur to a depth which will not be penetrated by fishing gear. All protection will be designed to have a smooth overtrawlable profile, with the rock grade utilised suitable for the nature of fishing activity typically undertaken in the area. As such mobile fishing vessels will not be excluded from the cable corridor during the operational phase. Static gear such as pots are also not anticipated to be affected during the operational phase, since the cable protection design accounts for the placement of static gear over the cable. The International Regulations for Preventing Collisions at Sea 1972 (COLREGs) will apply.	No further assessment required. Due to the Project design there will be no permanent loss of access to fishing grounds over the lifetime of the Project.
Changes in distribution of target species	Some fishing activity is located within the proposed cable route although there are alternative fishing areas near the Project.	Cable installation activities from the vessel are reduced as much as possible and overall represent a short term, localised, transient activity.	Yes, further assessment required to consider potential effects in more detail (see Section 14 – Commercial fisheries).

Potential impacts	Sensitivity of environmental receptor	Embedded management and mitigation	Further assessment required to determine impact significance and/or identify management / mitigation measures? (also see Table 5.1 Scottish Ministers' advice on topics to be included in the EA).
	Most fish species are highly mobile. It is therefore highly unlikely that cable installation activities and cable presence would have any impact on the majority of fish species.		
Shipping and navigation			
Loss of access to anchorage areas	There are no designated anchorage areas along the proposed cable route, however there are some areas in the vicinity of the route where vessels have been recorded at anchor between KP35 and KP38 along the cable installation corridor (Cathie Associates, 2018).	Cable installation activities from the vessel are reduced as much as possible and overall represent a short term, transient activity. Implementation of a rolling safety zone (500 m radius) around the CLV. Notices to Mariners will be issued prior to cable installation, along with a notification in the Kingfisher Bulletin. All vessels will be fitted with AIS so that they can be easily detected by other vessels transiting through the area. Provision of details of the schedule for cable lay activities to local ports, ship operators, fishermen and recreational sailing organisations. Use of guard vessels in order to ensure other vessels remain outside the area of operations and to reduce collision risk and potential snag risk to the cable.	With respect to navigational safety, further assessment is included within Appendix B Navigational Risk Assessment, as required by the MCA.
Change in shipping/ferry routes during cable installation/ maintenance/ decommissioning	Vessel density is low along most of the route, except between KP30 and KP40, where shipping density was high, due to fishing and cargo routes running east to west across the Pentland Firth.		

Marine archaeology			
Direct damage to or destruction of known marine historic environmental assets including geophysical anomalies or UXO, and submerged landscapes	There are a number of wrecks that potentially may be located in the area covered by the proposed installation corridor (200m width), including HMD Orsino, and SS Navarra. There is clearly moderate potential for submerged landscape peat and associated archaeological sites to be present in the intertidal (and onshore) zones in both Caithness and Orkney. There is low potential for UXO in the development area.	The cable route has been re-routed where at all possible to specifically avoid all potential and known wrecks and features of archaeological importance in the area. If by any chance avoidance is not possible, an appropriate mitigation / management strategy will be proposed to eliminate or reduce any adverse impacts to an insignificant level in accordance with the Protocol for Archaeological Discoveries (PAD).	Yes, further assessment is required to further consider potential impacts (see Section 13 – Marine archaeology).
Direct damage to or destruction of unknown marine historic environment assets including geophysical anomalies or UXO	There is the potential for unknown sites, features or submerged deposits of archaeological importance to be located along the marine survey corridor.		
Direct damage to or destruction of known or unknown marine historic environment assets including geophysical anomalies or UXO during maintenance works	There is the potential for unknown sites, features or submerged deposits of archaeological importance to be located along the marine survey corridor.		
Indirect damage to or destruction of known or unknown marine historic environment assets including	Marine features are potentially vulnerable to erosion due to scouring by currents or waves, and scour processes that can ultimately lead to the complete failure and collapse of structures on the seafloor.		

geophysical anomalies or UXO			
Offshore infrastructure and other sea users			
Disruption to renewable energy projects planned routes and access to working areas	The EMEC Wave Test Facility is located in proximity to the installation corridor. There is currently one AfL area awarded for an offshore wind project in the vicinity of the proposed cable route, the Dounreay Tri project, developed by Dounreay Tri Ltd.	A rolling safety zone of 500 m radius will be designated around any working vessels. Where avoidance is not possible (e.g. with respect to cables), Crossing Agreements with asset owners will be put in place to ensure protection of the third-party assets.	Yes, further assessment is required in relation to renewable energy projects (see Section 15 – Offshore Infrastructure and Other Sea Users). No other projects are in the vicinity of the Project and require further assessment.
Disruption or damage to existing subsea cables	There are a number of subsea cables located within or passing through the area covered by the proposed installation corridor. These include both electric and telecommunications cables.	Where avoidance is not possible (e.g. with respect to cables), crossing agreements with asset owners will be put in place to ensure protection of the third-party assets.	No further assessment is required. Crossing Agreements will be in place.
Disruption to aggregate extraction and disposal sites	The nearest dredge disposal sites are Dounreay microsite and Stromness A, located 304 m east and 2.2 km north-west respectively of the proposed cable route.	Cable installation activities from the vessel are reduced as much as possible and overall represent a short term, transient activity. A rolling safety zone of 500 m radius will be designated around any working vessels.	Yes, further assessment is required due to the proximity of sites to the Project (see Section 15 – Offshore infrastructure & other sea users.
Disruption of damage to oil and gas assets	There are no oil and gas assets in the vicinity of the Project.	N/A	No further assessment required.
Disruption to recreation activities	The main recreational activities that could be impacted during the construction phase are sailing, canoeing and fishing.	Cable installation activities from the vessel are reduced as much as possible and overall represent a short term, transient activity. Provision of details of the schedule for cable lay activities to local ports, ship operators, fishermen and recreational sailing organisations.	Yes, further assessment required to understand the potential impacts in further detail.

Population and human health			
Population and human health factors	The 2017 change to EIA legislation gave effect to the amended European Union EIA Directive which clarifies that 'population and human health' factors should be included in the environmental topics considered by EIA.	N/A	As a result of the limited scale of the proposed activities, and given that the proposed activities are routine and are well-controlled by industry-standard procedures, no potential impacts on public health have been identified. Therefore, no further discussion on population and human health factors is presented within the EA.

Based upon the findings of the initial assessment and consultation responses presented in Table 7-1 the following environmental topics have been identified for further, more detailed, assessment:

- Physical conditions and marine processes;
- Protected sites and species (Section 9 and Appendix D – Nature Conservation Appraisal);
- Benthic ecology (Section 10);
- Marine mammals (Section 11);
- Ornithology (Section 12);
- Marine archaeology (Section 13);
- Commercial fisheries (Section 14); and
- Other infrastructure and other sea users (Section 15).

7.3 Assessment methodology for impacts requiring further consideration

This EA provides an assessment of potential impacts due to the effects of the Project on receptors in the environment. The terms effect and impact are different, as one drives the other. Effects are measurable physical changes in the environment (e.g. volume, time and area) arising from project activities, while impacts consider the response of a receptor to an effect. Impacts can be defined as direct or indirect, beneficial or adverse.

In order to implement a systematic assessment of impacts between the different receptors an overall approach to the assessment of impacts in order to determine their significance has been implemented. The process considers:

- Sensitivity and value of a receptor;
- Magnitude of effect; and
- Determination and qualification of the significance of the impact.

Whilst it is important to have a common approach to impact assessment across a project, there are definitions and issues specific to each impact associated with the Project that the impact assessment must take into account. To that end, and to ensure that this section does not become a lengthy description of the specifics of each impact, the method for assessing significance is outlined in more detail in the relevant impact assessment section of this report.

7.3.1 Sensitivity and value

The sensitivity of a receptor is a function of its capacity to accommodate change and reflects its ability to recover if it is impacted. Sensitivity of a receptor is based on the following factors:

- Tolerance to change;
- Recoverability;
- Adaptability; and
- Value.

The scale of sensitivity is as follows; negligible, low, medium, high, very high. As mentioned above, in carrying out individual assessments, a more specific scale of increasing sensitivity will be defined where this is appropriate.

7.3.2 Magnitude of effect

The magnitude of an effect can be characterised by considering the following factors:

- Duration of the effect;
- Size and scale;
- Timing/seasonality; and
- Frequency.

Categorisation of the magnitude of impact will vary for specific topics. The magnitude categories used are negligible, minor, moderate and major.

7.3.3 Significance of impact

The significance of potential effects has been determined by a combination of the sensitivity and value of a receptor and the magnitude of an effect. The general framework for assessing the significance of potential effects is outlined below (Table 7-2).

Table 7.2 Significance of impact

Magnitude	Sensitivity/value				
	Negligible	Low	Medium	High	Very high
Negligible	Negligible	Negligible	Negligible	Minor	Minor
Minor	Negligible	Negligible	Minor	Minor or moderate	Moderate
Moderate	Negligible	Minor	Moderate	Moderate	Major
Major	Minor	Minor or moderate	Moderate	Major	Major

Where a range of significance effect is presented in Table 7-2 expert judgement will be used to consider the final impact. In general, moderate or major impacts are classified as significant and will require additional mitigation and further assessment of the residual effect.

Certain measures are incorporated into the Project design as adherence to best practices (BP) or embedded mitigation / management measures in accordance with standard industry practice.

7.4 Cumulative impact assessment

The consideration of cumulative (and in-combination impacts) is an important aspect of environmental assessments. Cumulative impacts act together with other impacts (including those from any concurrent or planned future third-party activities) to affect the same receptors as the proposed Project.

Cumulative impacts need to be considered throughout the EA process and for all stages of the Project. A list of projects has been identified, which together with the proposed Project may result in potential cumulative impacts. These are summarised in Table 7-3.

Table 7.3 List of projects considered in cumulative assessment

Type	Project name	Developer/Operator	Phase	Distance from cable corridor (km)
Marine renewables	Brough Head Wave Farm	Brough Head Wave Farm Ltd	Planned	4.8
Marine renewables	Dounreay Tri project	Dounreay Tri Ltd	Consented – on hold	7.2
Marine renewables	EMEC Wave Test Facility	The European Marine Energy Centre Ltd	Operational	0.7

Type	Project name	Developer/Operator	Phase	Distance from cable corridor (km)
Marine renewables	Brims Tidal Array	Brims Tidal Array Limited	Planned	14.0
Marine renewables	Inner Sound	MeyGen Limited	Planned	26.0
Marine renewables	Ness of Duncansby	Duncansby Tidal Power Limited	Planned	31.7
Marine renewables	Katanes Floating Energy Park	Floating Power Plant	Planned	9
Telecommunications	FARICE	Farice	Operational	0
Telecommunications	Northern Lights	BT	Operational	0
Power cable (33 kV)	Pentland Firth 1	SSE	Operational	1.7
Power cable (33 kV)	Pentland Firth 2	SSE	Operational	1
Dredge Soil Disposal	Scrabster Extension		Open	12.1
Dredge Soil Disposal	Dounreay Microsite		Open	0.2
Dredge Soil Disposal	Scapa		Open	26.2
Dredge Soil Disposal	Stromness A		Open	2.4

The general principle for the cumulative impact assessment is to consider only those projects that are at EIA scoping stage (i.e. for which an EIA Scoping Report and requests for an EIA Scoping Opinion have been submitted or equivalent level of information for projects not required to complete an EIA) and beyond (at the date the assessment is undertaken). Consultation has been undertaken with MS-LOT to identify projects are either close to submitting their EIA Scoping Reports, are directly relevant to the proposed Project and have suitable information available to allow a robust assessment and are therefore advised to be considered within the cumulative impact assessment.

Details of the projects considered within the cumulative impact assessment have been provided within each environmental assessment topic section. Only other projects that share a relevant pathway of effect with the Project are considered in the cumulative assessment. The decision on which projects share a pathway of effect is based on the results of the specific impact assessment together with the expert judgement of the specialist consultant undertaking the impact assessment.

The assessment of these projects is dependent upon the level of information available at the time of undertaking the cumulative assessment. Different levels of information are available for different projects, as such the cumulative impact assessment is generally a qualitative assessment.

Each of the EA environmental topic chapters contains a sub-section which provides an assessment of the relevant cumulative impacts of projects considered relevant to the topic section in question.

7.5 Whole project overview

The Project, comprising the Orkney to Mainland Subsea Link, is one element of the Orkney to Mainland Scotland Transmission Connection, which also separately comprises:

- A new substation in Finstown, Orkney;
- A 14.5 km underground cable across the west mainland of Orkney linking the Finstown substation to the cable landfall at Warebeth;
- A 1.0 km new cable route between the Dounreay cable landfall and a new substation at Dounreay; and
- A new substation at Dounreay.

In the absence of the above, there would be no means by which the proposed new transmission infrastructure would be able to operate, and in the absence of the Orkney to Mainland Subsea Link Project, there would be no requirement for the onshore elements described above.

The offshore and onshore aspects of the Project are seeking consent/permission under different licencing/planning regimes and thus separate applications will be made, supported by separate EA Reports.

7.6 Transboundary impact assessment

Given the location and nature of the Project, impacts are not expected to result in significant impact to any receptor in a different country to that in which the activities will take place. On this basis, no further assessment of transboundary impact is presented.

8 PHYSICAL CONDITIONS AND MARINE PROCESSES

8.1 Introduction

This section provides baseline information on the physical processes and sediment dynamics present along the proposed subsea cable corridor.

All potential impacts to physical conditions and marine processes from marine cable installation, maintenance and repair, operation and decommissioning have been scoped out of the EA. This section therefore presents information for contextual reference and to inform the appraisal of other topic areas.

8.2 Legislation and policy context

As well as the legislation and policy context outlined in Section 2 - Planning policy and legislative framework the key legislation in relation to the physical conditions and marine processes is summarised below. Key legislation includes:

- European Directive 2000/60/EC of the European Parliament and of the Council of 23 October 2000 establishing a framework for Community action in the field of water policy – commonly referred to as the Water Framework Directive (WFD).
- European Directive 2008/56/EC of the European Parliament and of the Council of 17 June 2008 establishing a framework for community action in the field of marine environmental policy (MSFD) European Commission, 2008).
- Water Environment and Water Services (Scotland) Act 2003 (HMSO, 2003).
- The Water Environment (Controlled Activities) (Scotland) Regulations 2011. Scottish Statutory Instrument 2011 No. 209 (HMSO, 2009), as amended.

8.3 Consultation

Scoping and consultation have been ongoing throughout the Project and played an important role in ensuring the scope of the baseline and impact assessment have been appropriate to the Project and the requirements of the regulators and their advisors.

A summary of the consultation activity undertaken to date is provided in Section 5 – Stakeholder Engagement. As detailed in Section 7.3.3 of the Marine Scotland Advice, the potential impact to physical environment and seabed conditions should be excluded from the EA. As such, the following section provides a baseline description of the physical environment of the Project area only.

The potential impacts on benthic and intertidal ecology had been addressed in Section 10 – Benthic and intertidal ecology.

8.4 Existing baseline description

8.4.1 Geomorphology

The north coast of Scotland and Orkney waters are a highly energetic region with strong tidal currents in the channels and the potential for large waves from the North Atlantic. Much of the coastline comprises of hard rock geology with sand beaches confined to embayment and sheltered regions. Within the offshore environment there are large areas of mobile sediment but in the energetic channels and nearshore region, substrate is commonly swept bed-rock or boulders and cobbles. The tidal conditions observed within the Pentland Firth area are controlled by the hydraulic gradient between the Atlantic and the North Sea (Easton *et al.,* 2012).

8.4.2 Bathymetry

The bathymetry in the vicinity of the cable route is shown in Figure 8.1 and Figure 8.2. SHE Transmission commissioned MMT to undertake a geophysical and geotechnical survey along the proposed cable corridor between February and May 2018.

The maximum recorded water depth along the proposed cable route was 91 m Lowest Astronomical Tide (LAT) at Kilometre Point (KP) 32.02 (MMT, 2018a). In the offshore sections between KP2.0 and KP49.2, water depth ranged between 28.9 m and 91 m LAT (MMT, 2018b). The slope is mostly gentle throughout the cable corridor, with some moderate slope over sandy features between KP30 and KP40. The slope reaches a maximum of 49.6º on the rocky Scottish mainland landfall at KP52.05, and some steep slopes were also present near the Orkney landfall (MMT, 2018a). Depths generally increase southwards to about KP20. Several larger seabed features are present, generating some moderate and steep slopes, particularly between KP 28.7 and KP 35.5. Towards the southern end of the surveyed corridor, from KP35.5 onwards, depths gradually decrease, with mostly very gentle and gentle slopes (MMT, 2018b).

8.4.3 Geology

The underlying bedrock of the cable route is undifferentiated Devonian mudstones, siltstones and sandstones deposited approximately 419 Ma. A chart showing the depth below the seabed of the bedrock along the proposed cable route from the survey (MMT 2018b) is presented in Figure 8.3. Overlying this bedrock is Diamicton till; a superficial deposit deposited up to 3 Ma during the Quaternary period. This comprises of predominantly undifferentiated gravelly sands and sandy gravel deposited in a period dominated by ice age conditions (MareMap, 2018) and was observed during the survey (MMT 2018b) as shown within Figure 8.4. At the mainland Scotland landfall, the geology comprises of undifferentiated Pre-Quaternary rocks, whilst at the Orkney landfall, the superficial deposits comprise of undifferentiated slightly gravelly sand, and sandy gravel deposited during the Quaternary period (BGS, 2018).

There are four Sites of Special Scientific Interest (SSSI) with designated features of a geological and geomorphological nature located within 2 km of the cable corridor (see Table 8-1). The cable corridor also overlaps with a National Scenic Area (NSA) with scientific qualities including geology and topography.

Figure 8.1 Overview of the bathymetry in the nearshore areas at Warebeth and Dounreay Orkney landfall (MMT, 2018a)

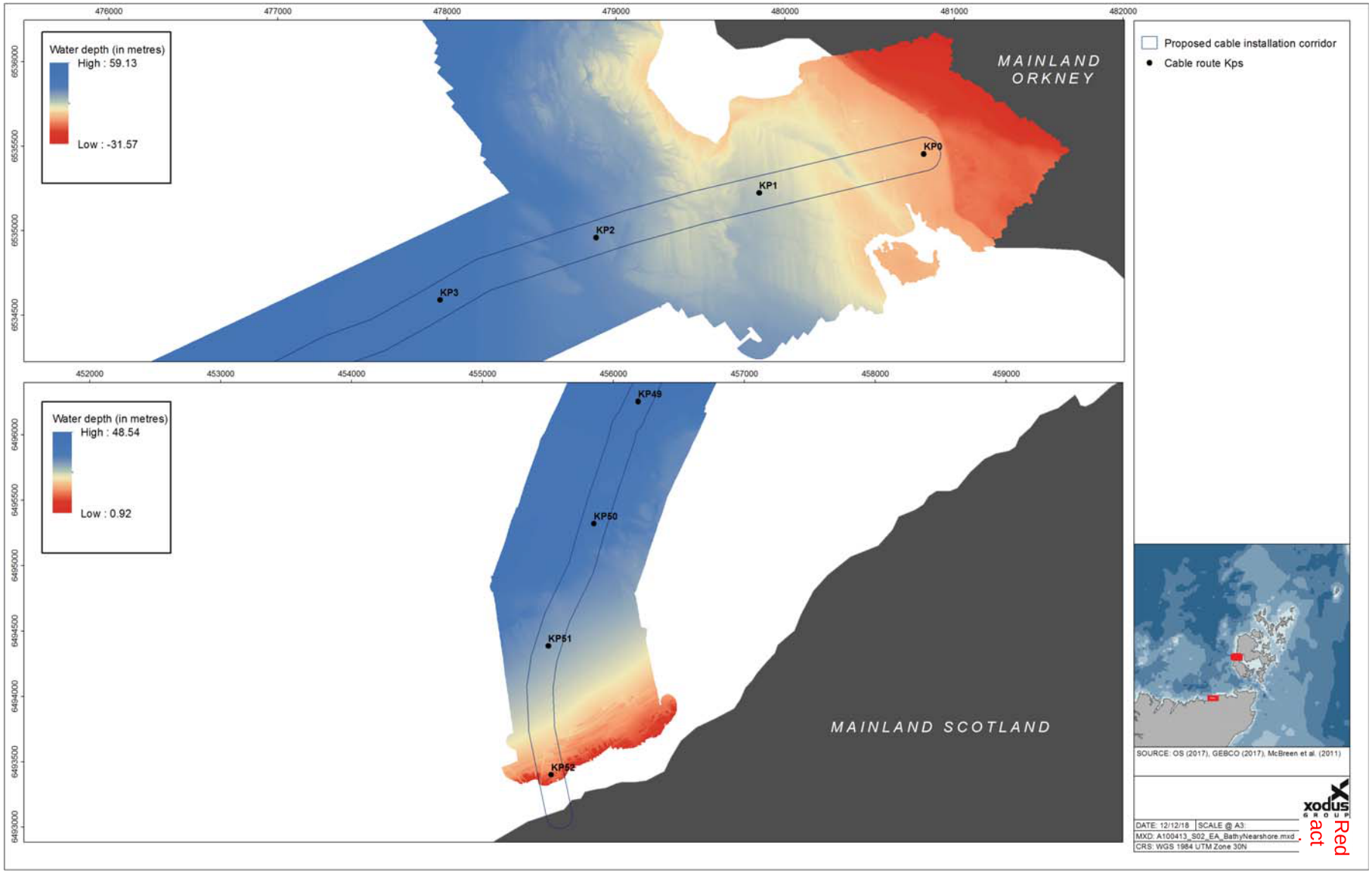


Figure 8.2 Bathymetry over moderate and steep slopes seabed features (MMT, 2018b)

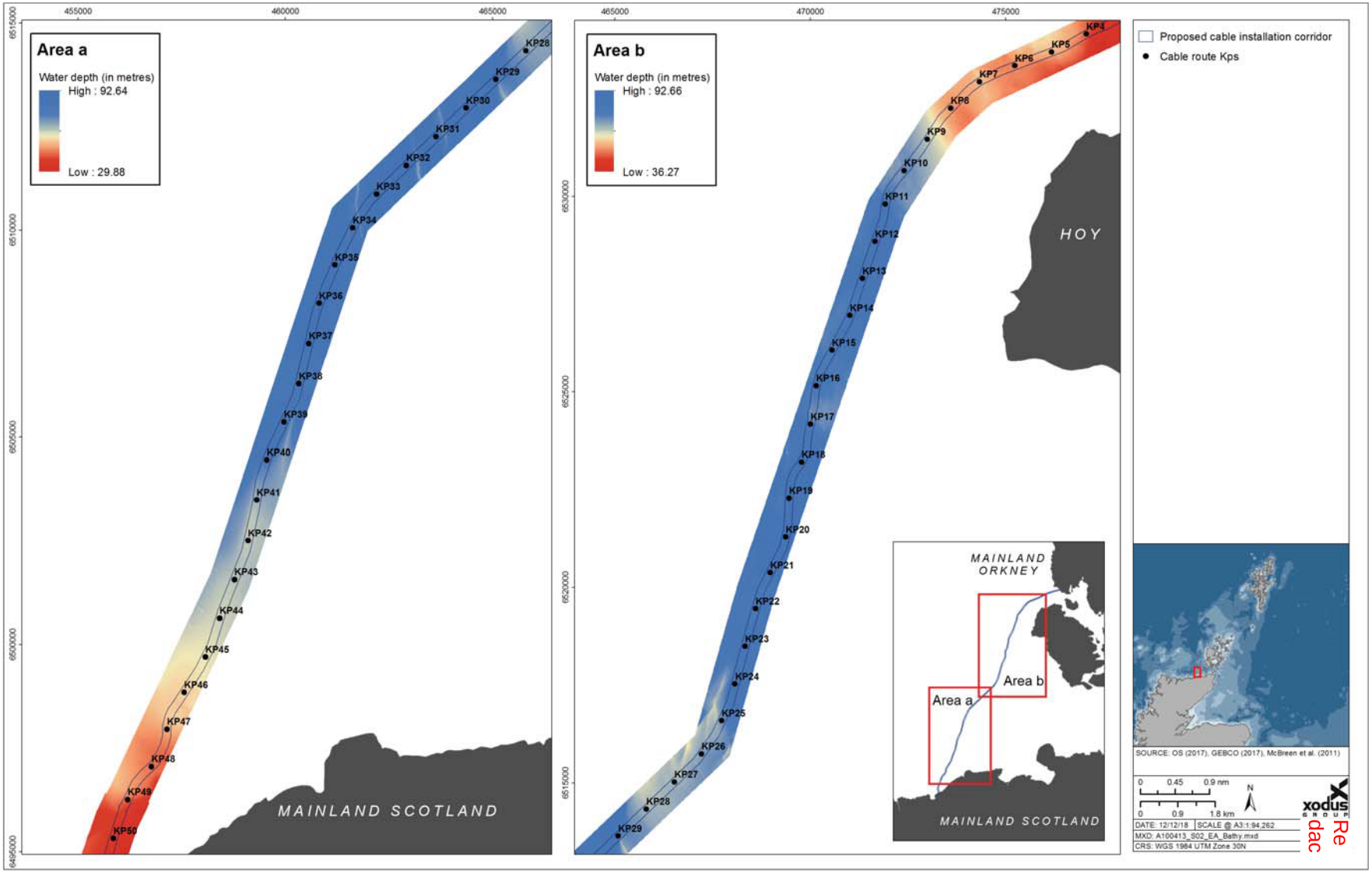


Figure 8.3 Shallow geology sub-geo contour classed as 'hard surface' (MMT, 2018b)

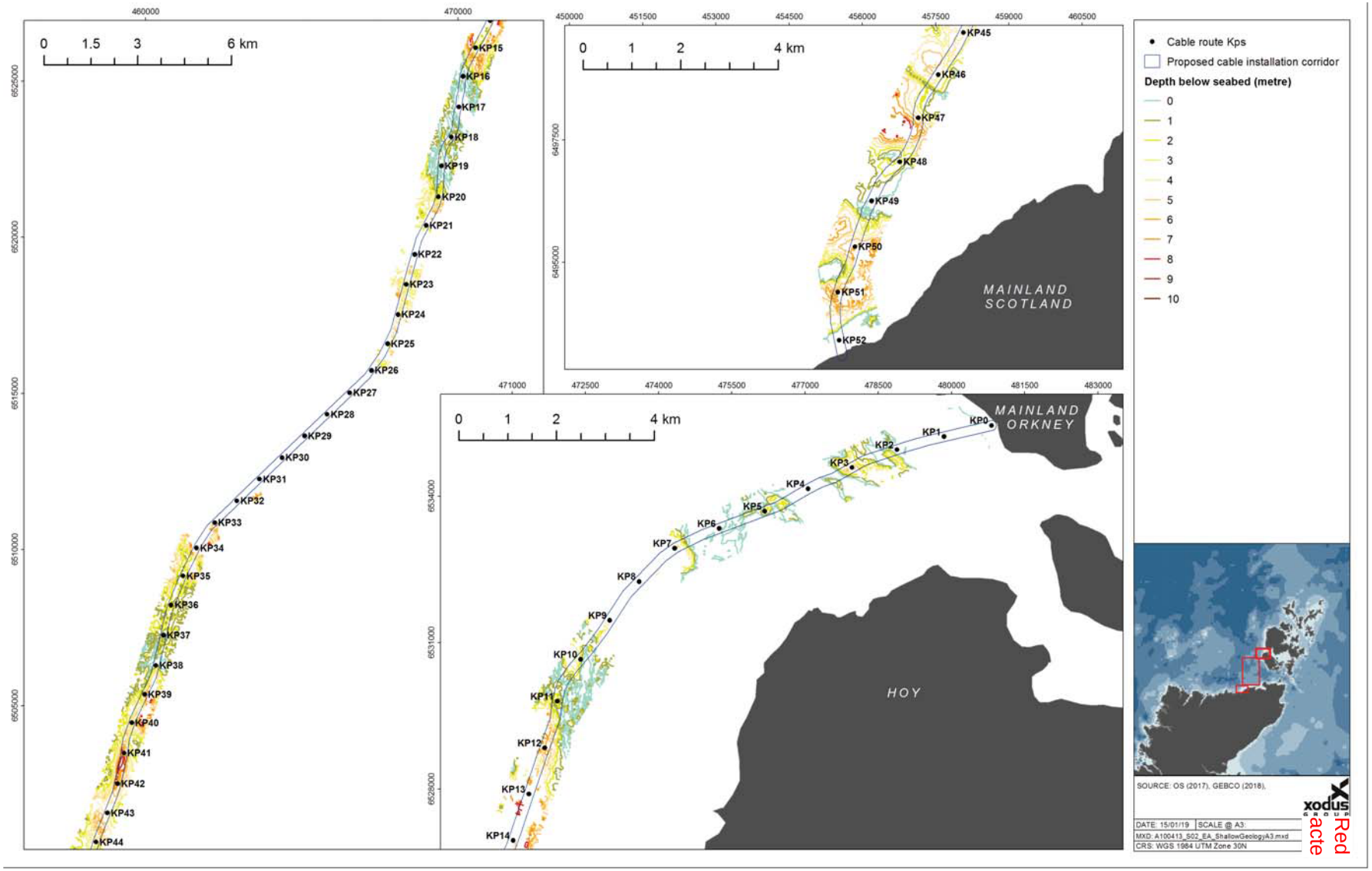


Figure 8.4 Seabed classification along the proposed installation corridor (MMT 2018b)

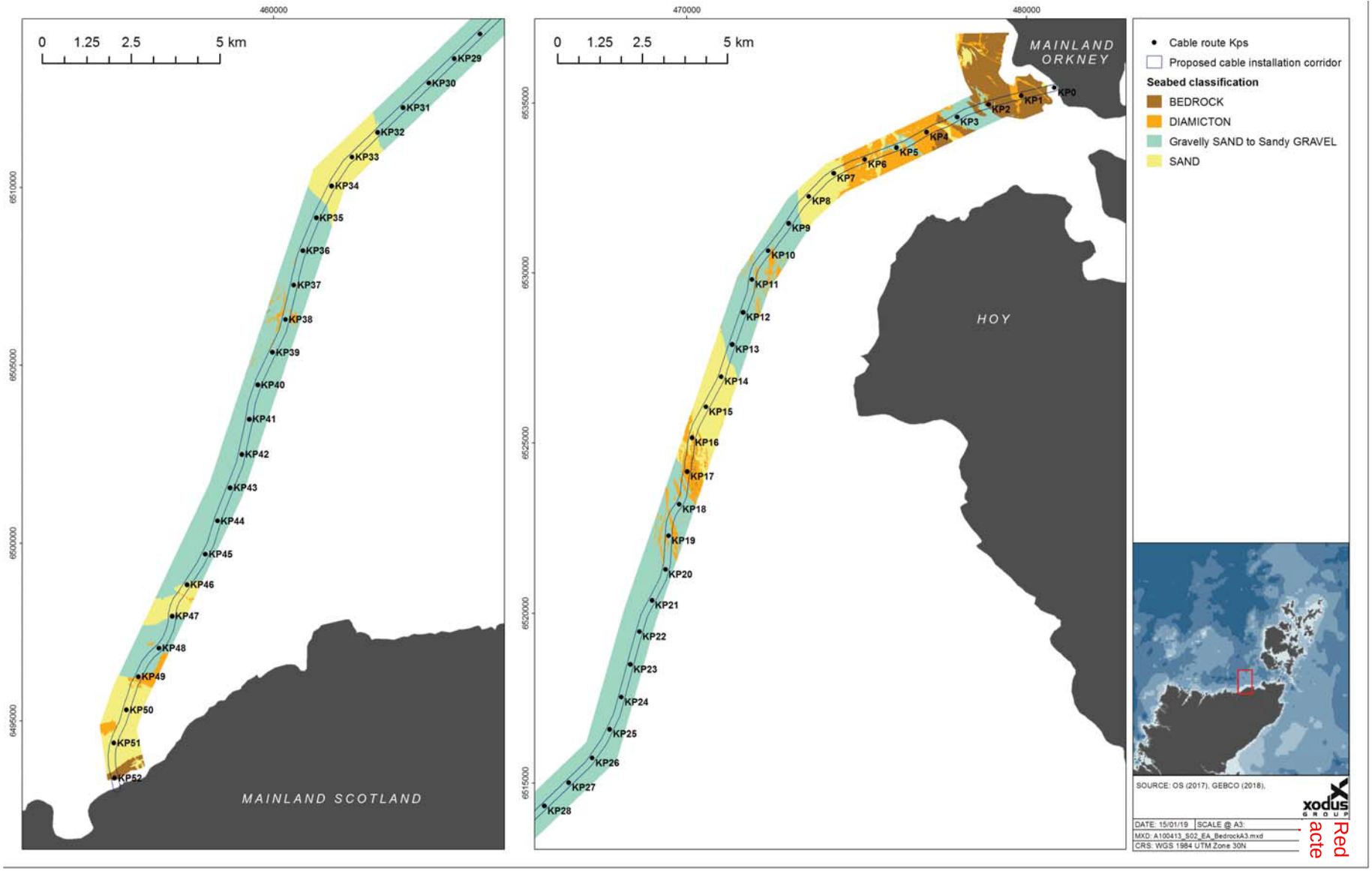


Table 8.1 Statutorily protected sites for consideration in this assessment.

Site Name	Designation	Overview Description	Reason for selection / connectivity to the project	Distance from the Project (Km)
Stromness Heaths and Coast	SSSI	Stromness Heaths and Coast SSSI covers a long stretch of coast from the southern end of the Bay of Skaill to the golf course in Stromness. This stretch of land is situated on the high exposed cliffs of the west coast and the notified features are of stratigraphy and geomorphology. The maritime cliff habitat is also a notified feature. Notified natural features: Coastal geomorphology, providing the best examples of the distinctive sandstone and flagstone cliffs Biological: maritime grassland and maritime heath on the clifftops	Site overlaps with the marine environment (to Mean Low Water Springs (MLWS)) and is located within 2 km of the Project.	0
Sandside Bay	SSSI	Sandside Bay SSSI lies just north of Reay, on the north coast of Caithness. The site is in two parts. The main part of the site includes the foreshore, dunes, dune slacks and the banks of the Burn of Isauld. The second part of the site is an area of herb-rich grassland within the golf course. Sandside Bay SSSI is one of two coastal sites designated to represent dune and links habitats in Caithness.	Site overlaps with the marine environment (to MLWS) and is located within 2 km of the Project.	0.7
Red Point Coast	SSSI	Red Point Coast SSSI is a 6 km stretch of coastline between Sandside Bay in Caithness and Melvich Bay in Sutherland. The site has been designated for the nationally important geology, coastal vegetation and breeding seabirds. The site contains two geological features: ancient lake margin sediments from the Middle Devonian (around 390 million years ago) and Quaternary sediments deposited by Ice Age glaciers (around 22,000 years ago). The cliff-top vegetation includes large colonies of Scottish primrose *Primula scotica* and the cliffs themselves support colonies of breeding seabird guillemot.	Site overlaps with the marine environment (to MLWS) and is located within 2 km of the Project.	1.7
Muckle Head and Selwick	SSSI	The site is nationally important for its Quaternary earth science interest. Both Muckle Head and Selwick represent excellent examples of 'raised beach' deposits. These deposits are 6 to 12 m above present-day sea-level and were formed at a time when the ice caps had melted, and consequently the sea-level was higher. The raised beach deposits underlie a 'glacial till' which was deposited during a subsequent glaciation period	Site overlaps with the marine environment (to MLWS) and is located within 2 km of the Project.	2.0

Site Name	Designation	Overview Description	Reason for selection / connectivity to the project	Distance from the Project (Km)
Hoy and West Mainland	NSA	Extends along the north of the Island of Hoy and the west of the Orkney mainland. The Scenic Qualities of the site are described as a palimpsest of geology, topography, archaeology and land use, an archaeological landscape of World Heritage Status, the spectacular coastal scenery, sandstone and flagstone as an essence of Orkney, a long-settled and productive land and sea, the contrast between the fertile farmland and the unimproved moorland, a landscape of contrasting curves and lines, land and water in constantly changing combinations under the open sky, the high hills of Hoy, the townscape of Stromness, its setting and its link with the sea and the traditional buildings and crofting patterns of Rackwick.	Overlaps with the Project area	0

8.4.4 Seabed features

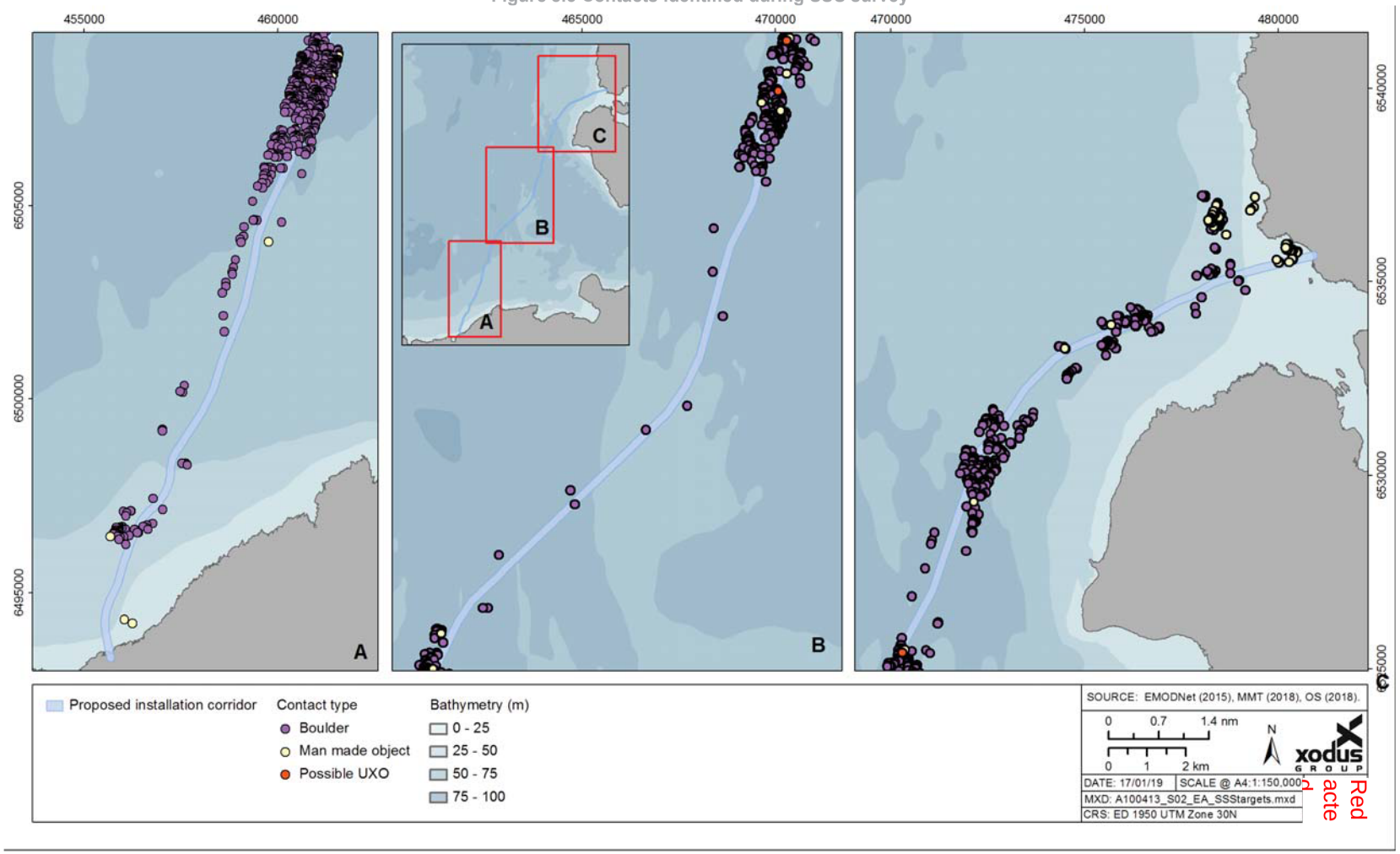
The overall shallow geology along the cable route comprises of superficial sediments including sand, gravelly sand to sandy gravel generally observed as a thinly layered unit as shown in Figure 8.4. Strong internal reflectors within this layer are indicative of sand dunes/bedforms marking a change in depositional environments (MMT, 2018).

These superficial deposits overlay either Diamicton or bedrock. In places, the sandy superficial unit is approximately 5 m thick. The Diamicton often outcrops along the route, displaying a distinct undulating eroded surface. The Diamicton overlays bedrock which only outcrops occasionally within the cable route corridor (MMT, 2018).

Throughout the survey corridor, there are outcrops of Diamicton with alternating patches of rippled sand, gravelly sand and sandy gravel with a general north-south orientation. At KP29.29, a relic bedform starts to occur which dominates the seabed in conjunction with small ripples and large ripples up to KP49.74. These relic bedforms are orientated in a manner that differs from the ripples and mega ripples observed throughout the cable route corridor. This indicates that the relic bedforms formed during a period with different currents/wave activity compared to that of present activity. Within this area, elongated outcrops of Diamicton orientated in a NE-SW direction are present and have been interpreted as lateral moraines. There are also a few locally occurring boulder fields present from KP36.29 to the northern end of the offshore section of the cable route.

From the SSS survey, a total of 1,359 contacts were identified within the survey corridor; 1,275 of these were classified as boulders (MMT, 2018). The identified contacts are shown within Figure 8.5.

Figure 8.5 Contacts identified during SSS survey



Red acted

Two active cables cross the cable route corridor in two separate locations. Further detail regarding these features are considered within Section 15 – Offshore infrastructure & other sea users.

8.4.5 Metocean conditions

Strong winds are the main characteristic of the Orkney climate. Prevailing winds come from between the west and south-east for 60% of the year, with the windy months being October to March. Wind speeds greater than 8 m/s occur 30% of the year, with an hourly mean speed of 4 m/s recorded during the period 1965 – 1973 (Barne *et al.,* 1997). The dominant wave direction within the area of the proposed cable route is between 240˚ and 320˚ which accounts for over two thirds of the offshore climate (Ramsay and Brampton, 2000).

The North Atlantic and North Sea tidal systems influence the tides in Orkney, producing a net flow of water from west to east. Tidal current speeds are between 1 to 2 m/s around Orkney, with higher velocity in the Pentland Firth and Hoy Sound of up to 4.5 m/s (Barne *et al.,* 1997). The tidal range at mean spring varies between 2.5 and 3 m, with variations in tidal estuaries and bays. The mean wave height in the east coast of Orkney is higher than 0.5 m for 75% of the year and higher than 1.5 m for 10% of the year while the west of Orkney is characterised by a mean wave height exceeding 1 m for 75% of the year.

8.4.6 Water and sediment quality

The north coast of Scotland is influenced by the North Atlantic Drift current, which carries oceanic water north and east through the Faroe – Shetland Channel to the Norwegian coast. This flow exerts a relative warming influence in winter and a cooling influence in summer. Average temperatures along the north coast are 12.5˚C – 13.0˚C in summer and 6.5˚C – 7.0˚C in winter. The salinity of the sea in the coastal areas between Cape Wrath and the Pentland Firth (34.85 parts per thousand) is slightly below that of normal sea water (35 parts per thousand), owing to the mixing of Atlantic water with low-salinity coastal waters (Barne *et al.,* 1996).

The chemical composition of the water present within the majority of proposed cable route area would be expected to be similar to that recorded for typical unpolluted coastal/offshore North Sea water. The SEPA is responsible for producing and implementing River Basin Management Plans (RBMPs) under the Water Environment and Water Services (Scotland) Act, 2003. River basins comprise all surface waters (including transitional (estuaries) and coastal waters) extending to three nautical miles seaward from the Scottish territorial baseline. Any proposed development within these waters must have regards for the requirements of the WFD to ensure that all surface water bodies achieve 'Good Ecological Status (GES)' and that there is no deterioration in status. Five classifications of water quality status are defined: High (near natural), Good, Moderate, Poor and Bad; and each classification is accorded a degree of confidence (high, medium or low) in the overall quality assessment. The mainland Scotland landfall and associated cable route is located within the Strathy Point to Dunnet Head RMBP area; this water body is classified as having an overall status of Good with Medium confidence (SEPA, 2018). The Orkney mainland landfall and associated cable route is located within the Tor Ness to Breck Ness RMBP area; this water body is classified as having an overall status of Good with High confidence (SEPA, 2018).

The two closest designated bathing waters to the installation corridor are at Dunnet Bay and Thurso, which are approximately 20.5 km and 12.1 km.

During the benthic survey carried out by MMT, a total of 11 grab sample sites and nine transects were investigated. One transect was located in the Orkney nearshore area, and the remaining samples and transect were located in the offshore area. At all sites sampled with the grab sampler, a sample for PSA and chemical composition of heavy metals (Total Organic Carbon (TOC), Polycyclic Aromatic Hydrocarbon (PAH) and Total Petroleum Hydrocarbon (TPH)) was retrieved. The detected concentrations of heavy metals were generally low at all sample sites, with concentrations below the assessed threshold levels for the examined metals. Concentrations of PAH are below Canadian Council of Ministers of the Environment (CCME) and OSPAR quality guideline levels, and for most PAHs below the detection limit of the analysis, except at three sites, where Phenanthrene was detected at up to 4 micro-grams/kg DW. Concentrations for TPH did not exceed the Dutch intervention value for TPH in aquatic sediments. Fine sediments such as silt and clay are in general, more prone to absorbing pollutants.

Sand-sized fragments of irradiated nuclear fuel (particles) were discovered on the foreshore at Dounreay in November 1983. A routine monitoring programme was initiated by UK Atomic Energy Authority (UKAEA) covering both the foreshore and nearby public beaches including Sandside Bay, Scrabster and Thurso. The detection of particles in offshore sediments in 1997 resulted in the imposition by the then Scottish Office of a 2 km radius fishing exclusion zone, centred on the old diffuser chamber, under the Food and Environment Protection Act 1985 (see Figure 14.2 in Section 14 – Commercial fisheries) (SEPA, 2012).

A recent review of the status of the marine environment of the northern coastal area of Scotland identified no significant concerns relating to hazardous substances, eutrophication, oil/chemical spills, algal toxins and microbiology of bathing and shellfish waters (Baxter *et al.,* 2011). Both landfall ends of the proposed cable route run through areas of water with a status of good, with medium certainty (Dounreay landfall) and high certainty (Warebeth, Orkney landfall).

Stromness is recognised as a Potentially Vulnerable Area to flooding and has just become part of the SEPA flood warning system5. The area extends from Birsay Bay in the north to Waulkmill Bay in the south and including the Warebeth landfall. The area is predominantly vulnerable to coastal flooding. However, the proposed works will not increase the potential of coastal flooding within the Stromness area.

[5] http://apps.sepa.org.uk/frmstrategies/pdf/pva/PVA_03_04_Full.pdf

9 PROTECTED SITES AND SPECIES

9.1 Introduction

This section of the report provides further detail on the protected sites and their qualifying features in the vicinity of the Project.

Protected sites and features (Natura 2000 sites and NCMPAs) are assessed within the Appendix D: Nature Conservation Appraisal (NCA) undertaken in accordance with the Habitats Directive and the Marine (Scotland) Act 2010. Relevant protected features are also assessed within Section 10 – Benthic and intertidal ecology, Section 11 – Marine mammals and Section 12 – Ornithology. Only sites with marine elements or those with assumed connectivity have been considered. This section provides an overview of the protected sites and features considered throughout the environmental assessments.

No impact is anticipated on landscape, visual or seascape due to the nature of the Project as a subsea cable. Therefore, Natural Scenic Areas (NSAs), of which the Hoy and West Mainland NSA is in proximity to the proposed cable installation corridor, have not been considered within this EA. Marine archaeological and historical designated sites are considered in Section 13 – Marine archaeology.

9.2 Legislation and policy context

As well as the legislation and policy context outlined in Section 2 - Planning policy and legislative framework Table 9.1 outlines the key legislation in relation to the potential impacts on ecologically protected sites from the marine cable installation, maintenance and repair, operation and decommissioning.

Table 9.1 Legislation relevant to ecologically protected sites

Protected site	Legislation
SPA/SAC (Natura 2000)	> The EU Habitats Directive implemented through the Conservation (Natural Habitats, &c.) Regulations 1994 (as amended in Scotland)
Ramsar	> The Convention on Wetlands of International Importance especially as Waterfowl Habitat (the 'Ramsar Convention')
NCMPA	> Marine (Scotland) Act 2010 > Marine and Coastal Access Act 2009
SSSI	> Nature Conservation (Scotland) Act 2004 > the Wildlife and Countryside Act 1981 (as amended)
Seal haul-out	> Marine (Scotland) Act 2010 > The Protection of Seals (Designation of Haul-out Sites) (Scotland) Order 2014

9.3 Protected site identification

The identification of the protected sites that would require assessment was undertaken in consultation with SNH and MS-LOT. The identification process was undertaken based on filtering of qualifying interests / features and associated protected sites in a process based on:

> Identifying the range of impacts that the Project could have on qualifying interest(s) of a site (impact pathways); and

> Determining connectivity with the sites.

The following criteria, based on the above, was used to identify the sites that require assessment:

- SPAs and NCMPAs (including proposed and candidate sites) with breeding seabirds qualifying features with foraging ranges (as identified by Thaxter *et al.,* (2012)), that overlap with the proposed cable corridor;
- SACs (including proposed and candidate sites) with harbour seal interests within 50 km of the proposed cable corridor and breeding grey seal within 20 km of the proposed cable corridor;
- Designated seal haul outs that overlap with or are located within 500 m of the proposed cable corridor;
- SACs (including proposed and candidate sites) with otter interests that overlap with or are located within 500 m of the proposed cable corridor;
- SACs and NCMPAs (including proposed and candidate sites) with cetaceans as qualifying features within 50 km of the proposed cable corridor;
- SACs with Atlantic salmon and freshwater pearl mussel (which is dependent on salmonids) who's migrating smolts or adult salmon are likely to cross the proposed cable corridor;
- SACs (including proposed and candidate sites) and NCMPAs with seabed / benthic protected features that that overlap with or are located within 2 km of the proposed cable corridor; and
- SSSIs which overlap with the marine environment (to MLWS) that overlap with or are located within 2 km of the proposed cable corridor.

The sites which have the potential to be impacted by the proposed Project, based on the selection criteria above are presented in Table 9.2.

9.4 Protected Sites

There are a number of ecological protected sites with marine components located along, and in the immediate vicinity of the subsea cable route and landfall locations.

Throughout Caithness (north coast Scottish mainland) and Orkney there is an extensive network of protected sites designated for their coastal and marine features nature conservation importance. These include:

- **Special Protection Areas (SPAs)** designated under the Birds Directive for the protection of rare, threatened or vulnerable bird species listed in Annex I of the Birds Directive, and also for regularly occurring migratory species.
- **Proposed SPAs (pSPAs)**. More recently, the Scottish Government has identified a suite of an additional 15 proposed SPAs (pSPAs) for marine birds. These pSPAs have been identified specifically for the protection of at sea territories for 45 species of rare and vulnerable seabirds which depend on the marine environment for a large part of their lifecycle.
- **Special Areas of Conservation (SACs)** designated under the Habitats Directive for marine and coastal habitats and species of European importance.
- **Nature Conservation Marine Protected Area (NCMPAs)** designated under the Scotland (Marine) Act 2010 for the protection of nationally important habitats, species, geology and undersea landforms not covered under existing and proposed marine SPAs and SACs.
- **Sites of Special Scientific Interest (SSSIs)** designated under the Nature Conservation (Scotland) Act 2004 for nationally important habitats, species, rocks and landforms, or a combination of such natural features that are considered to best represent Scotland's natural heritage.

In addition to the above nature conservation designations, there are a number of other protected sites and areas that require consideration with respect to subsea cable routing. These include:

- **Seal haul-out sites:** Seals are also protected at designated seal haul-outs, which are coastal habitat locations that seals use to breed, pup, moult and rest. Almost 200 seal haul-out sites have been designated through the Protection of Seals (Designation of Haul-Out Sites) (Scotland) Order 2014. In 2017, this order

was amended with the addition of new haul-out sites. All haul-outs on Scottish land are now protected under Section 117 of the Marine (Scotland) Act 2010. The Act is designed to support the protection of seals when they are at their most vulnerable to human interactions, and to provide additional protection from their intentional or reckless harassment; and

- **National Scenic Areas (NSA)** are areas of outstanding scenic value that are representative of Scotland's finest landscapes. There is only one NSA in the Project study area, the Hoy and West Mainland NSA. This designation extends across most of Hoy except areas in the south east of the Island and across a large area of western mainland Orkney.

The sites with ecological features which have been considered in the EA are detailed in Table 9.2 and presented in Figure 9.1.

Table 9.2 Overview of the protected sites and features relevant to the Project

Site name	Designation	Overview description[6]	Distance from the Project. (km)
North Caithness Cliffs (mainland Scotland)	SPA	The site comprises most of the sea-cliff areas between Red Point and Duncansby Head on the north mainland (Caithness) coast, and the western cliffs on the island of Stroma. Cliff ledges, stacks and geos provide ideal nesting sites for important populations of seabirds. The seabirds nesting on the North Caithness cliffs feed outside the SPA in the surrounding waters of the Pentland Firth, as well as further afield. The site qualifies under Article 4.1 of the Directive (79/409/EEC) by supporting populations of peregrine during the breeding season, and under Article 4.2 of the Directive (79/409/EEC) by supporting populations of guillemot during the breeding season: Under Article 4.2 of the Directive (79/409/EEC) the site qualifies for supporting a seabird assemblage of international importance. During the breeding season, the area regularly supports 110,000 individual seabirds including puffin, razorbill, kittiwake, fulmar and guillemot.	0
Hoy (Orkney)	SPA	The site covers the northern and western two-thirds of the island of Hoy. Most of the site is moorland. On the west coast, Old Red Sandstone cliffs, stacks and crags, provide important breeding sites for a number of seabird species, especially gulls and auks, whilst moorland areas support large numbers of breeding birds. The divers and seabirds that breed on the sites feed in the rich waters around Hoy, outside the SPA. The SPA includes a 2km seaward extension into the marine environment to include the seabed, water column and surface. The site qualifies under Article 4.1 of the Directive (79/409/EEC) by supporting populations of peregrine *Falco peregrinus* and red-throated diver *Gavia stellata* during the breeding season, and under Article 4.2 of the Directive (79/409/EEC) by supporting populations of great skua *Catharacta skua* during the breeding season. Under Article 4.2 of the Directive (79/409/EEC) the site qualifies for supporting a seabird assemblage of international importance. Where during the breeding season, the area regularly supports 120,000 individual seabirds including: puffin *Fratercula arctica*, guillemot *Uria aalge*, kittiwake *Rissa tridactyla*, great black-backed gull *Larus marinus*, Arctic skua *Stercorarius parasiticus*, fulmar *Fulmarus glacialis* and great skua.	0

[6] Where a site overlaps with both the marine and terrestrial environment the description focus's largely on the marine and coastal features of the site, as these have the potential to interact with the marine components of the Project, which are the subject of this Environmental Appraisal Document.

Site name	Designation	Overview description[6]	Distance from the Project. (km)
Scapa Flow (Orkney)	pSPA	The proposed site is an enclosed sea area 370.66 km^2. It is sheltered by Orkney mainland to the north, Hoy, South Walls and Flotta to the west and south and Burray and South Ronaldsay to the east. The Flow is linked to the Pentland Firth on the south through the Sound of Hoxa, and to the Atlantic Ocean on the west through Hoy Sound. The site is proposed as it qualifies under Article 4.1 of the Directive (79/409/EEC) by supporting non-breeding populations of great northern diver *Gavia immer*, black-throated diver *Gavia arctica* and Slavonian grebe *Podiceps auritus* and breeding populations of red-throated diver. Under Article 4.2 of the Directive (79/409/EEC) the site qualifies for supporting a seabird assemblage of international importance for the following migratory species: common eider *Somateria mollissima*, long-tailed duck *Clangula hyemalis* common goldeneye *Bucephala clangula*, red-breasted merganser *Mergus serrator* and European shag *Phalacrocorax aristotelis.*	0.2
Caithness and Sutherland Peatlands (mainland Scotland)	SPA	This site is located across the northernmost parts of mainland Scotland and contains a large proportion of peatlands, which form one of the largest and most intact areas of blanket bog in the world. The peatlands include an exceptionally wide range of vegetation and surface pattern types (pool systems), some of which are unknown elsewhere. This range of structurally diverse peatland and freshwater habitats supports a wide variety of breeding birds including internationally important populations of raptors, wildfowl and waders. The site qualifies under Article 4.1 of the Directive (79/409/EEC) by supporting populations of black-throated diver *Gavia arctica*, golden eagle *Aquila chrysaetos*, golden plover *Pluvialis apricaria*, hen harrier *Circus cyaneus*, merlin *Falco columbarius*, red-throated diver *Gavia stellate*, short-eared owl *Asio flammeus*, wood sandpiper *Tringa glareola* during the breeding season, and under Article 4.2 of the Directive (79/409/EEC) by supporting populations of common scoter *Melanitta nigra*, dunlin *Calidris alpina schinzii*, greenshank *Tringa nebularia*, wigeon *Anas penelope* during the breeding season.	4
Orkney Mainland Moors (Orkney)	SPA	This site comprises four areas of moorland on Orkney mainland. The predominant habitats include extensive areas of blanket bog, acid grassland, wet and dry heath, raised-mire and calcareous valley mire. The presence of extensive moorland provides nesting opportunities for an assemblage of moorland breeding birds alongside several scattered oligotrophic lochans which provide important breeding areas for red-throated diver. The site qualifies under Article 4.1 of the Directive (79/409/EEC) by supporting populations of red-throated diver and short eared owl during the breeding season and hen harrier during the breeding season and over winter.	7

Site name	Designation	Overview description[6]	Distance from the Project. (km)
Marwick Head (Orkney)	SPA	The site lies on the west coast of mainland Orkney and comprises of a 2 km section of high, eroded Old Red Sandstone cliffs rising to 85 m and backed by cliff-top maritime grassland. The site is of importance as a nesting area for large numbers of guillemot and kittiwake, both of which feed outside the SPA in surrounding marine areas. The site qualifies under Article 4.1 of the Directive (79/409/EEC) by supporting populations of guillemot during the breeding season. Under Article 4.2 of the Directive (79/409/EEC) the site qualifies for supporting a seabird assemblage of international importance by supporting populations of guillemot and kittiwake during the breeding season.	15
Pentland Firth	pSPA	The Pentland Firth proposed SPA includes the waters of the central and eastern Pentland Firth, between the southern entrance to Scapa Flow in Orkney and the Caithness coast. It extends some 20 km east into the North Sea off John O'Groats. The site qualifies under Article 4.1 of the Directive (79/409/EEC) by supporting populations of Arctic tern during the breeding season. It also supports regularly migratory populations of European importance of Common guillemot (*Uria aalge*) and Arctic skua *Stercocarius parasiticus*.	16
Rousay (Orkney)	SPA	Rousay is an island off the north-east coast of mainland Orkney. The site consists of two parts located at the north-west and north-east ends of the island, where sea-cliffs grade inland to areas of maritime heath and grassland. The site holds a diverse assemblage of breeding seabirds that feed in the waters around Rousay outside the SPA, as well as further away. The site qualifies under Article 4.1 of the Directive (79/409/EEC) by supporting populations of Arctic tern during the breeding season. Under Article 4.2 of the Directive (79/409/EEC) the site qualifies for supporting a seabird assemblage of international importance by supporting populations of guillemot, kittiwake, Arctic skua, fulmar and Arctic tern during the breeding season.	24
Pentland Firth Islands	SPA	The Pentland Firth Islands are located between the Orkney Islands and the mainland coast of north-east Scotland. They are a group of two main islands, Swona and Muckle Skerry, and a group of rocky skerries in the Pentland Firth. The islands contain a variety of habitats, including cliffs, rocky shores, maritime heath, moorland rough grassland marsh and open freshwater. They provide strategic nesting localities for Arctic tern which feed outside the SPA in the rich surrounding waters of the Pentland Firth. The site qualifies under Article 4.1 of the Directive (79/409/EEC) by supporting populations of Arctic tern during the breeding season.	28

Site name	Designation	Overview description[6]	Distance from the Project. (km)
Copinsay (Orkney)	SPA	Copinsay lies 4 km off the east coast of mainland Orkney and consists of the island of Copinsay and three islets (Corn Holm, Ward Holm and Black Holm). The three holms are vegetated, and a storm beach connects them to Copinsay at low water. Copinsay is formed of Old Red Sandstone with the largely horizontal bedding planes providing ideal breeding ledges for seabirds especially on the sheer cliffs of the south-east of Copinsay which reach to over 60 m. The seabirds feed outside the SPA in the nearby waters, as well as more distantly. Under Article 4.2 of the Directive (79/409/EEC) the site qualifies for supporting a seabird assemblage of international importance by supporting populations of guillemot, kittiwake, great black-backed gull *Larus marinus* and fulmar during the breeding season.	34
West Westray (Orkney)	SPA	The site is located on the west coast of the island of Westray, one of the most northerly of the Orkney islands. The site comprises an 8 km length of Old Red Sandstone cliffs, together with adjoining areas of species-rich maritime grassland and heath. The cliffs support large colonies of breeding auks and kittiwake, whilst the grassland and heathland areas support breeding colonies of skuas and terns. The seabirds feed in the surrounding waters outside the site. The site qualifies under Article 4.1 of the Directive (79/409/EEC) by supporting population of Arctic tern *Sterna paradisaea* during the breeding season and under Article 4.2 of the Directive (79/409/EEC) by supporting populations of common guillemot during the breeding season. Under Article 4.2 of the Directive (79/409/EEC) the site qualifies for supporting a seabird assemblage of international importance by supporting populations of razorbill, kittiwake, Arctic skua, fulmar, guillemot and Arctic tern during the breeding season.	37
Calf of Eday (Orkney)	SPA	The Calf of Eday is a small, uninhabited island located to the north of the island of Eday in the Orkney. The island has a rocky coastline with cliffs on the north and east coasts. The site is of importance as a nesting area for breeding seabirds, which feed in surrounding waters outside the SPA and use most of the island for loafing. Under Article 4.2 of the Directive (79/409/EEC) the site qualifies for supporting a seabird assemblage of international importance by supporting populations of guillemot, kittiwake, great black-baked gull, cormorant *Phalacrocorax carbo* and fulmar during the breeding season.	44
Papa Westray (North Holm and Hill) (Orkney)	SPA	Papa Westray is a small island lying close to Westray in the northern Orkney islands. The island rises to 48 m above sea level at North Hill and is surrounded by a rocky coastline backing onto maritime sedge heath. The islands are an important breeding site for both Arctic tern and Arctic skua. The terns feed outside the SPA in the waters surrounding the islands. The site qualifies under Article 4.1 of the Directive (79/409/EEC) by supporting population of Arctic tern during the breeding season and under Article 4.2 of the Directive (79/409/EEC) by supporting populations of Arctic skua during the breeding season.	50

Site name	Designation	Overview description[6]	Distance from the Project. (km)
East Caithness Cliffs (mainland Scotland)	SPA	The site is located on the east coast of Caithness. The site comprises most of the sea-cliff areas between Wick and Helmsdale. The cliffs are formed from Old Red Sandstone and are generally between 30-60 m high, rising to 150 m at Berriedale. Cliff ledges, stacks and geos provide ideal nesting sites for internationally important populations of seabirds, especially gulls and auks. The seabirds nesting on these cliffs feed outside the SPA in inshore waters as well as further away. The cliffs also provide important nesting habitat for peregrine. The cliffs overlook the Moray Firth, an area that provides rich feeding areas for fish-eating seabirds. The site qualifies under Article 4.1 of the Directive (79/409/EEC) by supporting population of peregrine during the breeding season and under Article 4.2 of the Directive (79/409/EEC) by supporting populations of guillemot, herring gull, kittiwake and razorbill during the breeding season. Under Article 4.2 of the Directive (79/409/EEC) the site qualifies for supporting a seabird assemblage of international importance by supporting populations of puffin *Fratercula arctica,* black-backed gull, cormorant, fulmar, razorbill, guillemot, kittiwake, herring gull *Larus argentatus* and shag *Phalacrocorax aristotelis* during the breeding season.	40
River Thurso (mainland Scotland)	SAC	The River Thurso drains a moderately large peatland catchment in Caithness and flows north through a short section of agricultural land before entering the Pentland Firth at the town of Thurso. The site is designated for the Annex II species Atlantic salmon where it supports a higher proportion of multi sea-winter Atlantic salmon than is found in many rivers further south in the species' range. This is aided by the northerly location of the river and the cooler ambient water temperature, resulting in slower-growing juveniles which smolt at an older age, and tend to return as older multi sea-winter salmon. In addition to these multi sea-winter fish, grilse also return to the River Thurso, meaning that the river supports the full range of salmon life-history types.	12
River Naver (mainland Scotland)	SAC	The River Naver and its major tributary, the Mallart, flow from a large peatland catchment northward to its mouth on the north coast of Scotland. The site is designated for the Annex II species Atlantic salmon and the freshwater pearl mussel as its primary features. The site supports a high-quality Atlantic salmon population and, along with the Rivers Borgie and Thurso, is representative of the northerly part of the species' range in the UK. The northern location of the River Naver and the cooler ambient water temperature results in the Atlantic salmon producing a higher proportion of slower-growing parr which smolt at an older age. These fish often return as multi sea-winter salmon (which have spent more than one year at sea). The full range of Atlantic salmon life-history types return to the system, with grilse, spring and summer salmon all being present. Fresh water pearl mussels rely on juvenile salmon (and brown trout) to facilitate mussel larval dispersion and thus the freshwater pearl mussel population in the river Naver is dependent on the Atlantic salmon population that also inhabit the river.	26

Site name	Designation	Overview description[6]	Distance from the Project. (km)
River Borgie (mainland Scotland)	SAC	The site encompasses the river Bogie which is located in Sutherland in the north Scotland, from the inland Loch Slaim to the mouth of the river at Torrisdale Bay. The site is designated for the Annex II species the freshwater pearl mussel *Margaritifera margaritifera* as its primary feature, alongside Atlantic salmon *Salmo salar* and otter *Lutra lutra* Annex II species as qualifying features, but not the primary reason for site selection. Freshwater pearl mussel at this site are found throughout the main stem of the Borgie, from just above the estuary to the outflow of Loch Slaim, the lowest of a series of lochs on the river. Fresh water pearl mussels rely on juvenile salmon (and brown trout) to facilitate mussel larval dispersion and thus the freshwater pearl mussel population in the river Bogie is dependent on the Atlantic salmon population that also inhabit the river.	29
Sanday (Orkney)	SAC	Sanday is a large, low-lying island situated in the north-east of the Orkney archipelago. The island has a complex coastline characterised by extensive sandy beaches, sheltered inlets and exposed rocky headlands. The site is designated for the presence of Annex I habitats 'Reef', 'Sandbanks which are slightly covered by sea water all the time' and 'Mudflats and sandflats not covered by seawater at low tide' The site is also designated for the Annex II species harbour seal *Phoca vitulina,* where the coastal waters of Sanday hold the largest colony of harbour seals at any relatively discrete site in Scotland. Around 1,450 adults haul out on the intertidal reefs to pup, moult and rest. This represents around 17% of the Orkney, 5% of the UK and 2% of the EU populations of the species.	49
Papa Westray (Orkney)	NCMPA	The site located in the north west of the Orkney Islands, to the east of Westray. It extends 2 km into the sea around the existing North Hill and the Holm of Papa Westray terrestrial SSSIs, including almost all of Papa Westray apart from the southern tip and the small island of Holm of Papa. Counts undertaken in 2013 estimated 570 breeding black guillemots across the MPA (average based on two counts - the results of the two discrete counts undertaken in 2013 are displayed on the map overleaf) (Swann, 2013). The protected features also include Marine Geomorphology of the Scottish Shelf Seabed geodiversity interests.	48
Selwick (Orkney)	Seal haul-out site	Designated under Section 117 of the Marine (Scotland) Act 2010. Harbour seal.	1.8
Bay of Ireland (Orkney)	Seal haul-out site	Designated under Section 117 of the Marine (Scotland) Act 2010. Harbour seal.	3.5
Stromness Heaths and Coast (Orkney)	SSSI	Stromness Heaths and Coast SSSI covers a long stretch of coast from the southern end of the Bay of Skaill to the golf course in Stromness. This stretch of land is situated on the high exposed cliffs of the west coast and the notified features are of stratigraphy and geomorphology. The maritime cliff habitat is also a notified feature. Notified natural features: > Coastal geomorphology, providing the best examples of the distinctive sandstone and flagstone cliffs. > Biological: maritime grassland and maritime heath on the clifftops.	0

Site name	Designation	Overview description[6]	Distance from the Project. (km)
Muckle Head and Selwick	SSSI	The site is nationally important for its Quaternary earth science interest. Both Muckle Head and Selwick represent excellent examples of 'raised beach' deposits. These deposits are 6 to 12 m above present-day sea-level and were formed at a time when the ice caps had melted, and consequently the sea-level was higher. The raised beach deposits underlie a 'glacial till' which was deposited during a subsequent glaciation period.	2.0
Sandside Bay	SSSI	Sandside Bay SSSI lies just north of Reay, on the north coast of Caithness. The site is in two parts. The main part of the site includes the foreshore, dunes, dune slacks and the banks of the Burn of Isauld. The second part of the site is an area of herb-rich grassland within the golf course. Sandside Bay SSSI is one of two coastal sites designated to represent dune and links habitats in Caithness.	0.7
Red Point Coast	SSSI	Red Point Coast SSSI is a 6 km stretch of coastline between Sandside Bay in Caithness and Melvich Bay in Sutherland. The site has been designated for the nationally important geology, coastal vegetation and breeding seabirds. The site contains two geological features: ancient lake margin sediments from the Middle Devonian (around 390 million years ago) and Quaternary sediments deposited by Ice Age glaciers (around 22,000 years ago). The cliff-top vegetation includes large colonies of Scottish primrose *Primula scotica* and the cliffs themselves support colonies of breeding seabird guillemot.	1.7

9.5 Protected sites that do not require further consideration

There are four SSSI in the vicinity of the Project that are designated, among other terrestrial features, for geological/geomorphological features: the Stromness Heaths and Coast SSSI; the Muckle Head and Selwick SSSI; Sandside Bay SSSI and the Red Point Coast SSSI.

- The Stromness Heaths and Coast SSSI is located along the Orkney coast where the installation corridor makes landfall (Warebeth). However, it is proposed to install the cable at the landfall using a HDD technique, for which the exit point on the seabed is likely to be located between 750 m to 1000 m offshore.
- Muckle Head and Selwick SSSI, is situated on the north coast of Hoy, and comprises of two areas of raised beach deposits, both of which are overlain by head (debris formed by frost action on slopes) and till (glacial deposit). These deposits are 6 to 12 metres above present-day sea level and were formed at a time when the ice caps had melted and consequently the sea level was higher (i.e. before the last glaciation). The site is located 2 km from the installation corridor and therefore there is no pathway for effect.
- Sandside Bay SSSI is designated for coastal sand dunes and associated herb-rich grassland. This assessment is focused upon the marine aspects of the Orkney to Mainland Scotland Transmission Connection, and as a HDD technique will be utilised at the landfall with a pop out location likely to be up to 1 km offshore there is no pathway for effect with the SSSI.
- Red Point Coast SSSI is designated for non-marine Devonian (geology), Quaternary of Scotland (geology), Maritime Cliffs (vegetation) and Scottish primrose. This EA is focused upon the marine aspects of the Orkney to Mainland Scotland Transmission Connection, and as a HDD technique will be utilised at the landfall with a pop out location likely to be up to 1 km offshore there is no pathway for effect with the SSSI. There are also a number of seabird features, however these have been assessed as features of the North Caithness Cliffs SPA and hence have not been considered twice.

Considering that the Project does not overlap directly with any geological features and the limited zone of influence of the Project it is not considered that significant effects on geological features will occur as a result

of the Project, and therefore protected sites designated for geological features have not been considered further.

Figure 9.1 Protected sites relevant to the Project



10 BENTHIC AND INTERTIDAL ECOLOGY

10.1 Introduction

This section of the report provides further detail on benthic and intertidal habitats and species located along, and in the vicinity of, the proposed cable corridor and landfall locations, presents results from an assessment of potential impacts on key sensitive habitats and species and outlines management and mitigation measures that will be undertaken in order to ensure impacts are minimised. The impact assessment focuses on habitats that are designated features of conservation sites located in the vicinity of the cable route and that have the potential to be impacted.

The key legislation and policy guidance relating to the conservation of benthic and intertidal habitats and species is also outlined.

10.2 Legislation and policy context

As well as the legislation and policy context outlined in Section 2 - Planning policy and legislative framework the key legislation in relation to the benthic and intertidal ecology is summarised below. In order to identify impacts of the proposed activities on protected sites, it is necessary to identify habitats and species of conservation importance that could potentially be present along the proposed cable corridor.

There are a number of different statutes and guidance that are relevant to benthic and intertidal ecology. These include:

- European Habitats Directive (Directive 92/43/EEC);
- The Habitats (Scotland) Regulations 1994 (as amended) which implements species protection requirements of the Habitats Directive in Scotland, on land and in inshore waters (within 12 nm);
- Marine (Scotland) Act 2010 and Marine and Coastal Access Act (2009); and
- The UK Biodiversity Action Plan (BAP) priority species list.

10.2.1 European Habitats Directive

The European Habitats Directive lists 15 marine and coastal habitats and eight marine species in Annexes I and II respectively. To meet the requirements outlined in Article 3 of the European Habitats Directive, SACs have been designated in UK waters to contribute to the European network of important high-quality conservation sites that will make a significant contribution to conserving these species and habitats. The marine and coastal habitats listed in Annex I of the Directive that are potentially present in the Project area are:

- Bedrock and stony reefs; and
- Sandbanks.

Annex I reefs occur where rocky areas or concretions made by marine animals arise from the surrounding seafloor. There are three types of Annex I reefs: bedrock reefs, stony reefs and biogenic reefs. Both stony and bedrock reefs have been identified along the cable route. These are defined by bedrock or stable boulders and cobbles creating a habitat that is colonised by a diversity of animals and plants (JNCC, 2014a).

Annex I sandbanks, also referred to as 'sandbanks slightly covered by seawater all of the time' are defined by permanently submerged sandbanks, generally within a maximum water depth of 20 m, with seabed sediments mainly composed of sand, and which can be non-vegetated or vegetated with *Zostera marina* (sea grass) and/or free-living species of the *Corallinaceae* family (maerl). The Project area overlaps with areas identified as potential Annex I sandbanks (JNCC, 2017a).

10.2.2 Marine (Scotland) Act 2010

On behalf of the Scottish Government; JNCC, SNH and Marine Scotland have together developed recommended lists of PMFs in Scotland's seas (SNH & JNCC, 2014). The list of PMFs has not been developed in accordance with any specific legislation, agreement or convention; it was developed to guide policy decisions regarding the conservation of Scotland's seas, through the identification of priority species and habitats.

The list of recommended PMFs in Scotland's offshore waters was adopted in 2014 and contains 81 habitats and species considered to be of conservation importance (SNH & JNCC, 2014). Howson *et al*. (2012) have also developed an equivalent list for Scotland's territorial waters which comprises 56 PMFs, including eight habitats and species groups, 11 individual habitats and 37 individual species. The geophysical and environmental survey undertaken along the proposed cable route in 2018 (MMT, 2018a, 2018b) did not identify the presence of PMFs in the cable survey corridor, although bedrock habitat that could potentially support PMF kelp beds was identified. There are no other known PMF at the Dounreay and Orkney landfalls (NMPi, 2018).

10.2.3 Biodiversity Action Plan (BAPs)

The UK Biodiversity Action Plan (UKBAP) was launched in 1994 as a means of meeting the UK's obligations under the Biodiversity Convention (signed by the UK and over a hundred other countries at the Rio Earth Summit in 1992) to "develop national strategies, plans or programmes for the conservation and sustainable use of biological diversity". The stated goal of the UK BAP is to "conserve and enhance biological diversity within the UK, and to contribute to the conservation of global diversity through all appropriate mechanisms".

UK BAP priority species were those identified as being the most threatened and requiring conservation action under the UK BAP. As a result of devolution, and new country-level and international drivers and requirements, much of the work previously carried out by the UK BAP is now focused at a country-level rather than a UK-level, and in July 2012 the UK BAP was succeeded by the UK Post-2010 Biodiversity Framework'. The UK list of priority species, however, remains an important reference source and has been used to help draw up statutory lists of priorities in Scotland.

10.3 Consultation

Scoping and consultation have been on-going throughout the Project and played an important part in ensuring the scope of the baseline and impact assessment have been appropriate to the Project and the requirements of the regulators and their advisors.

A summary of consultation activity undertaken to date is provided Section 5 – Stakeholder engagement. Comments from the Scoping Opinion relevant to benthic and intertidal ecology are provided in Table 10.1, together with responses to the comments and reference to the relevant sections where specific comments have been addressed.

Table 10.1 Scoping comments relevant to benthic and intertidal ecology

Name of organisation	Key concerns	Response	Section within which the specific issue is addressed
SNH	It is encouraged that the minimum target burial depth of 1 m be continued. It is also suggested that the extent of unburied or unprotected cable should be quantified and effect of the resulting increased exposure to EMF assessed.	A CBRA has been produced for the Project which specifies the burial required to protect the cable. This follows Carbon Trust guidance for burial and in some areas of the route ground conditions and risk to the cable is such that burial to less than 1 m may be acceptable. The CBRA also quantifies the sections of the cable route which may require additional cable	Section 4 – Project description

Name of organisation	Key concerns	Response	Section within which the specific issue is addressed
		protection due to difficulties in burial. No section of the cable will be surface laid without additional cable protection. This has been reflected within the assessments of EMF on various ecological receptors.	
SNH	It is agreed that further assessment of impacts on benthic ecology will be required. It is not clear from the Scoping Report whether PMFs have been recorded during the survey of the cable routes - if PMFs have been recorded, impacts on these features should be assessed.	Impacts on benthic ecology are assessed within Section 10 - Benthic and Intertidal Ecology of the EA. No PMFs were identified during the survey of the installation corridor although bedrock habitat with the potential to support PMF kelp beds was noted between KP51.82 and KP52.06 (see Table 10.2).	Section 10.5 - Benthic and intertidal ecology, existing baseline description
The Highland Council Comhairle na Gaidhealtached	It would be helpful to know which sections of the cable will be surface laid, and which will be buried and the corresponding seabed conditions to ensure any impacts on PMF's are minimised.	The aim of cable installation will be to bury the cable across its entire length. However, this is not always possible due to ground conditions or existing infrastructure. The CBRA outlines the sections of cable that potentially may require cable protection due to difficulties in burial. No section of the cable will be surface laid without additional cable protection. A separate CBP and CMS will be provided to MSLOT prior to marine cable installation activities commencing. Section 4 - Project Description of the EA provides initial information on cable burial and protection requirements and impacts to PMFs are assessed in Section 10 - Benthic and Intertidal Ecology.	Section 4 – Project description

10.4 Data sources

This section draws on a number of data sources including published papers, industry-wide surveys and site-specific investigations. A key data source available for Scottish offshore waters is the National Marine Plan interactive (NMPi) website (NMPi, 2018) which underpins the Scottish NMP (Scottish Government, 2015). Data sources used to inform this environmental description include:

- UKSeaMap 2016 (JNCC, 2017a);
- National Marine Plan Interactive (NMPi, 2018);
- Scottish Natural Heritage (SNH) website;

> Joint Nature Conservation Committee (JNCC) website;

> The Marine Life Information Network (MarLIN) (Jasper and Hill, 2015); and

> The Scottish Government Feature Sensitivity Tool (FEAST) (Scottish Government, 2013).

Additionally, MMT was commissioned by SHE Transmission to undertake geophysical, geotechnical and environmental surveys between February and May 2018 along the cable survey corridor. The geophysical and the benthic survey reports (MMT, 2018a, 2018b) were the main sources of information used to prepare the benthic environmental baseline and impact assessment. Note: Intertidal surveys have not been undertaken as it is proposed to install the cable at the landfall using a HDD technique, for which the exit point on the seabed is to be located between 750 m to 1000 m offshore.

10.5 Existing baseline description

10.5.1 Overview of benthic and intertidal ecology within the Project area

UKSeaMap 2016 provides a full coverage predictive seabed habitat map for the sublittoral area across the UK, according to the standard European marine habitat classification scheme (EUNIS), apart from deep sea habitats for which a new classification has been applied. Along with the predictive habitat map, UKSeaMap provides a confidence map. A layer showing coastal physiographic features is also available through UK SeaMap. This map is an output of predicted habitat models and builds upon previous projects including UK SeaMap 2010, UKSeaMap 2006, EUSeaMap 2012 and Mapping European Seabed Habitats (MESH) 2008. The predictive seabed habitat map shows the distribution of 44 habitats across over 858,000 km^2 of the UK waters (JNCC, 2017a).

The EUSeaMap broad-scale seabed habitat classification, which uses the EUNIS classification, shows that the seabed in the offshore section of the cable is mostly composed of coarse sediments, with an area of 'deep circalittoral sand' (A5.27) (Figure 10.1). Offshore of the Orkney landfall, the seabed habitat is a high energy infralittoral/circalittoral rock (A3.1 and A4.1). The section of cable towards the Caithness landfall crosses an area of fine sand and muddy sand (A5.25 and A5.26), and the seabed nearer the landfall is classified as 'moderate energy infralittoral rock' (A3.2).

The benthic survey conducted by MMT between February and May 2018 comprised seabed sediment sampling, video transects and seabed imagery. The sampling equipment used for chemical and particle size distribution (PSD) sampling was a 0.1 m^2 Day grab. A 0.1 m^2 Hamon grab was used for infaunal sampling. A video and still camera system mounted on either an ROV or drop-down frame was used obtain the video and still imagery. The sampling locations were identified using the geophysical data referenced against existing datasets, such as GEMS and MMT in house knowledge. Sites were selected so that each acoustically distinct area was ground proofed such that it could be defined to the appropriate EUNIS level. Sampling locations are shown in Figure 10.2. A total of 11 sampling stations were selected for grab and video sampling, however no grab samples were recovered from Station S01 due to the sediments deemed too coarse, and no samples were recovered from Stations S10 and S11 due to their proximity to the Dounreay Nuclear Power Development exclusion zone (MMT, 2018b). Station S10 was also located outside the transverse gradiometer corridor, which prevented the grab sampling equipment to reach the station.

The nearshore geophysical survey, conducted in water less than 20 m LAT, was carried using a range of towed and hull or pole mounted survey systems, including MBES, SSS, SBP and magnetometer. The nearshore survey area overlapped with the offshore survey, in water deeper than 20m lowest astronomical tide (LAT), and extended between kilometre post (KP) 0 and KP 2.052 at Orkney and KP49.258 to KP52.317 at Dounreay (MMT, 2018a). The survey results are presented in the following sections. All KPs extend to the landfall (negative KPs) that starts at the northern end of the proposed route on the coast of Orkney and increase towards the Scottish mainland on the south (from KP52.06 onwards).

Figure 10.1 EUSeaMap 2016 Broad-scale seabed habitat classification (JNCC, 2017b)

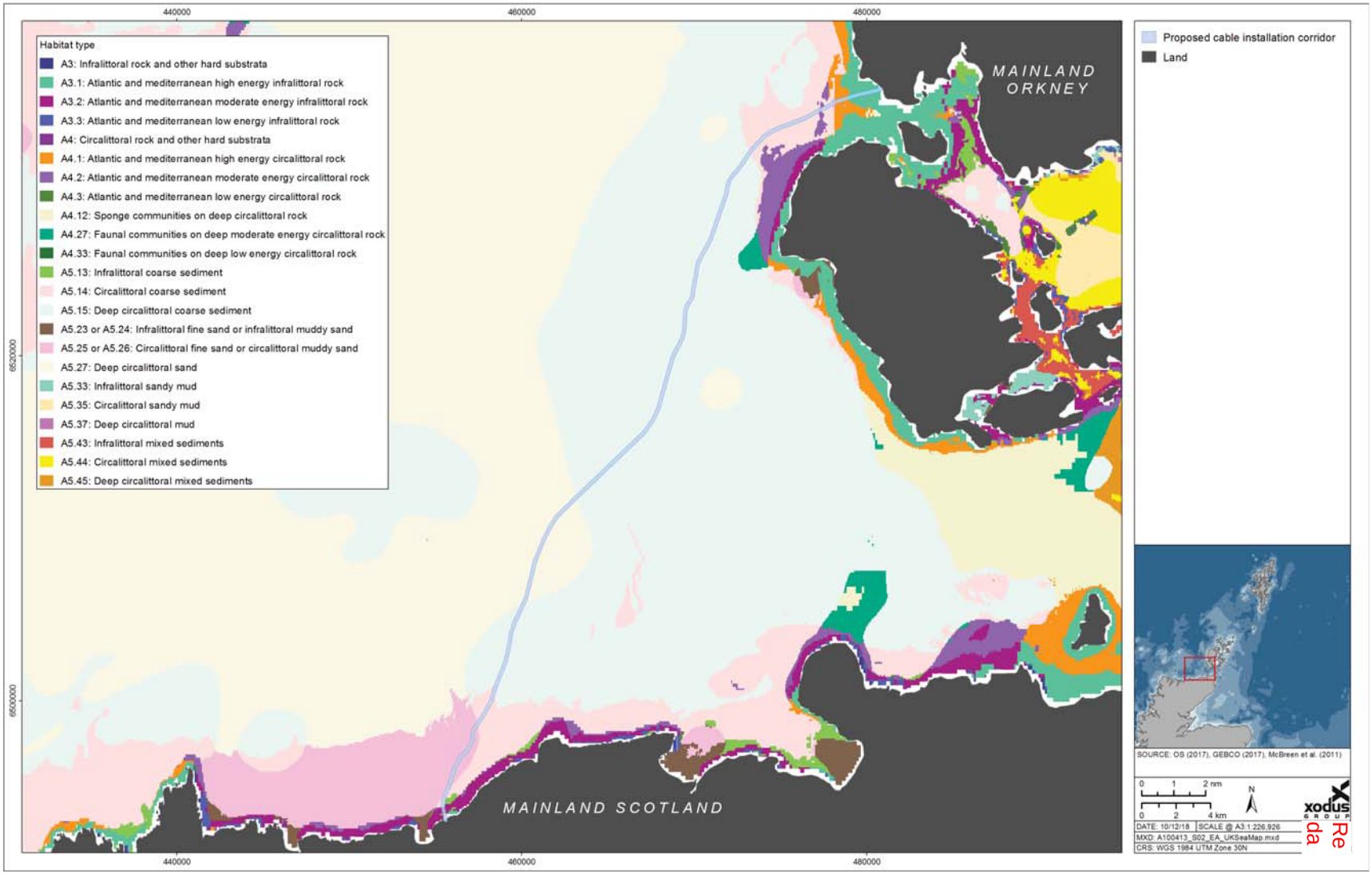
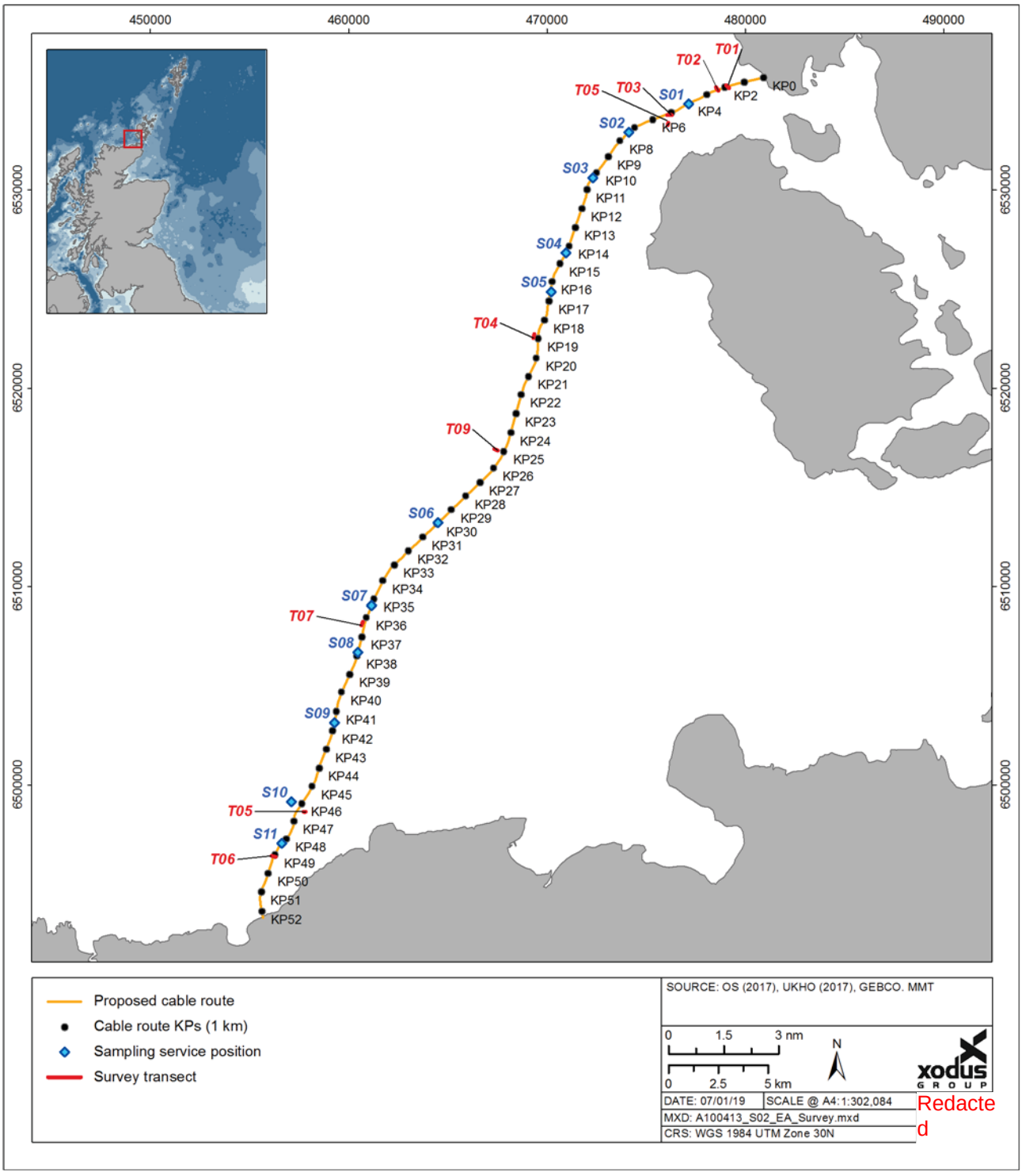


Figure 10.2 Location of sediments sampling stations and video transects (MMT, 2018b)



10.5.2 Site characteristics – landfalls and nearshore

10.5.2.1 Orkney landfall and nearshore (Warebeth)

Warebeth lies on the south west coast of mainland Orkney, approximately 2 km west of Stromness. The site comprises a small narrow stretch of sandy beach located within Warebeth Bay. The beach is surrounded to the north and south by cliffs and rocky outcrops which are characteristic of much of the coastline in this area. Access from offshore would be through a gap between areas of outcropping rock (Figure 10.3). Based on a review of BGS soils maps it appears that the seabed conditions on the approach to the landfall comprise a layer of sandy gravel with underlying bedrock.

It is proposed to install the cable at the landfall using a HDD technique, for which the exit point on the seabed is to be located approximately 1,050 m from the landfall origin of the cable at KP-0.208. Some very steep slopes occur on the approach to the Orkney landfall, however the slope between KP0.8 and KP1.1 where the cable will pop-out, remains below 10°. From the cable pop-out location (approximately KP0.842) the route runs over uneven rock surface with several moderate to steep slopes reaching a maximum slope of 24.9° in the Orkney nearshore area at KP1.5 (Figure 10.4). Between KP0.43 and KP0.49 an approximately 5 m deep channel runs through the rocky seabed (MMT, 2018a). An overview of the seabed features recorded in the nearshore area at Warebeth is presented in Figure 10.5.

From KP0.22 to KP2.05 along the survey corridor the seabed consisted predominantly of high energy bedrock pavement, occasionally covered with a thin veneer of sand and occasional cobbles and boulders. In this section, north and south of the survey corridor in the nearshore survey area, the A3.125 habitat was dominant with occasional intrusions of 'infralittoral mixed sediments' (A5.43) and 'infralittoral fine sand' (A5.23) (MMT, 2018b). At KP1.050 where the cable HDD pop out is located the seabed sediments consist of bedrock habitat (A4.2144/A4.2142) as shown on Figure 10.5. The bedrock appeared quite barren as observed at T01 (Figure 10.6)and was dominated in places by encrusting calcareous red algae. This transect was characterised by barren patches of bedrock with grazing chitons and *Gibbula* sp., and sediment affected sparse kelp occurrences with encrusting coralline algae, foliose reds, rare *Alcyonium digitatum*, *Asterias rubens*, *Echinus* sp., *Urticina* sp., *Crossaster papposus* and *Calliostoma zizyphinum*. Transect T01 was classified as 'Mixed kelps with scour-tolerant and opportunistic foliose red seaweeds on scoured or sand-covered infralittoral rock' (A3.125) and meets the criteria for Annex I bedrock reefs.

Figure 10.3 Satellite image of landfall location on Orkney

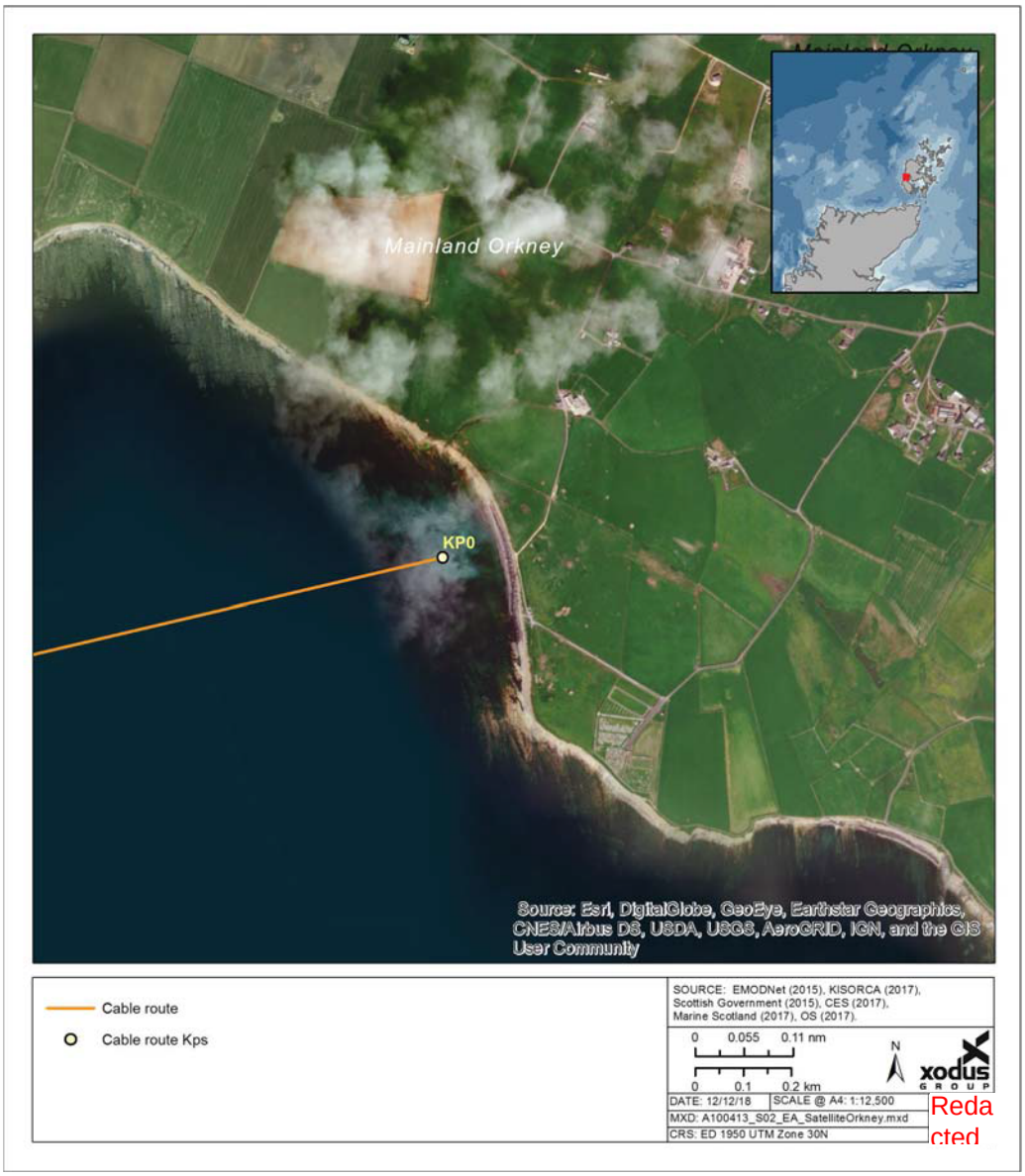


Figure 10.4 Seabed slope features in the Warebeth and Dounreay nearshore areas (MMT, 2018)

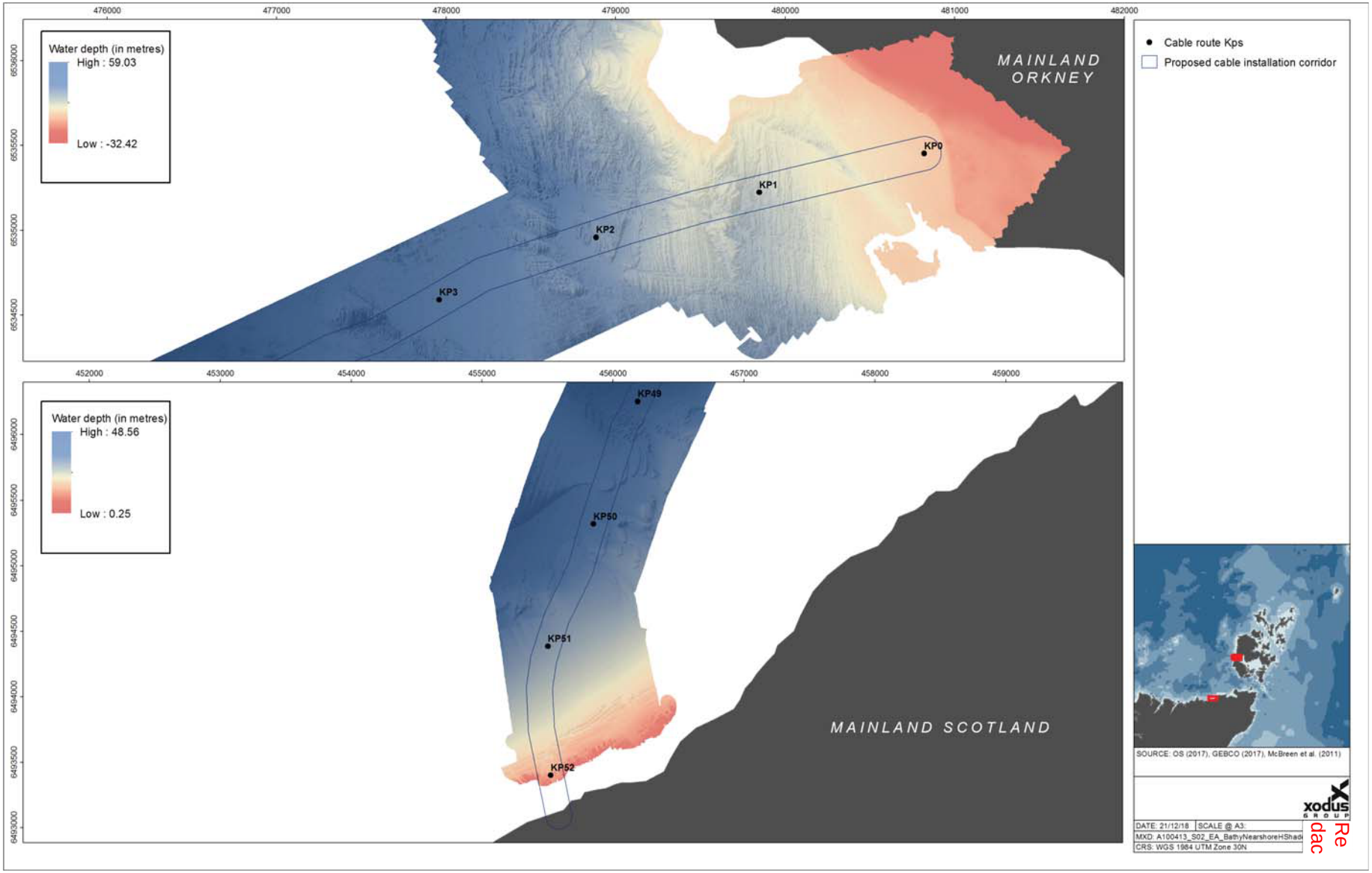


Figure 10.5 Habitats identified offshore of the Orkney landfall (KP0 to KP7) (MMT, 2018b)

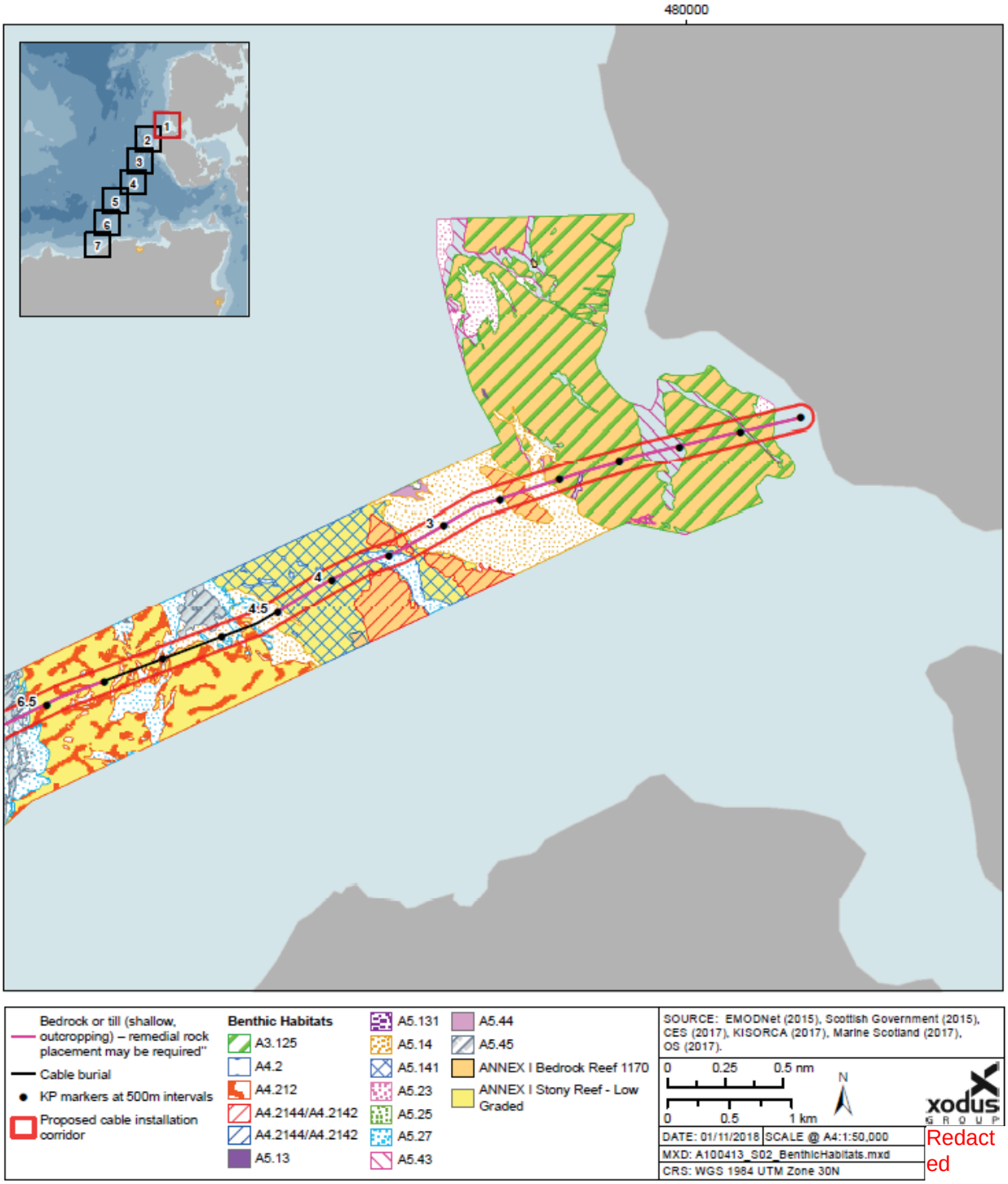
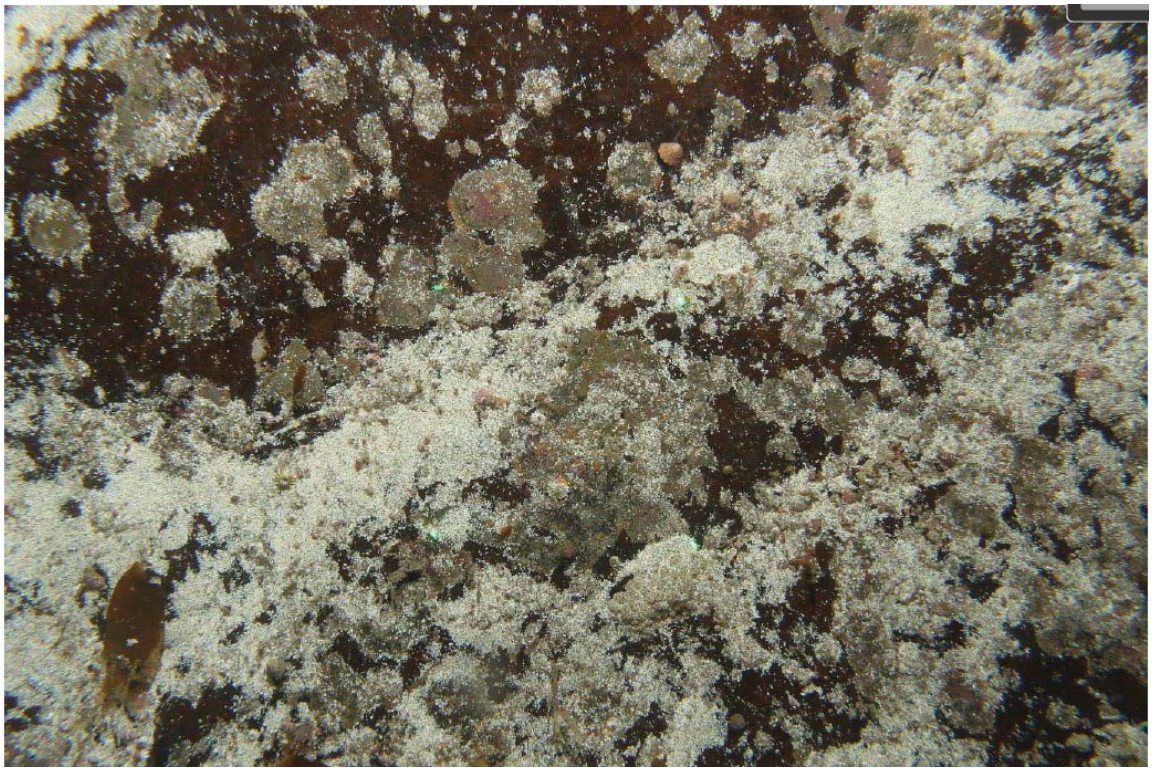


Figure 10.6 Example seabed image taken at Transect T01 showing barren bedrock with patches of sand and encrusting calcareous red algae (MMT, 2018b)



10.5.2.2 Mainland landfall and nearshore (Dounreay)

At the Dounreay landfall located on the north coast of Scotland in Caithness, the proposed cable route crosses a rocky section of coastline comprising exposed wave cut platforms (Figure 10.7). It is proposed to install the cable at the landfall using a HDD technique, for which the exit point on the seabed is to be located approximately 900 m from the landfall at KP52.32.

Towards the mainland Scotland landfall, the water depth decreases from KP35 onward and the slopes are mostly very gentle or gentle, occasionally moderate (Figure 10.4). Few steep slopes occur over sandy seabed features between KP49.29 and KP51.82. In the vicinity of KP51.42, at the approximate cable pop-out location, the slope angle remains below 2°. Uneven rocky seabed starts at KP51.82 and continues to the end of the route with some very steep slopes including the highest slope value of 49.6° along the whole route at KP52.06 at the limit of the survey data (MMT, 2018a).

In the Dounreay nearshore area, starting at KP49.26, the habitat was classified as 'circalittoral fine sand' (A5.25) between KP49.26 to KP51.82. The HDD cable installation will end at approximately KP51.42, therefore the cable will pop-out in fine sand habitat. A section of 'circalittoral mixed sediments' (A5.44) was identified between KP50.28 and KP50.89 at the outermost edge of the survey corridor (Figure 10.8). Between KP51.82 and KP52.06 the seabed consisted predominantly of 'Atlantic and Mediterranean moderate energy infralittoral rock' (A3.2), which meets the criteria for Annex I bedrock reefs. This bedrock area is located in shallow (<20 m), tide-swept water, which makes this bedrock area a potential kelp bed as defined on the list of PMFs in Scottish waters (MMT, 2018b). Kelp beds, with a dense growth of *Laminaria hyperborea* and foliose red seaweeds, are widely recorded around all coasts of Scotland, and exist on bedrock and boulders in a range of wave exposure regimes and tidal conditions (Tyler-Walters et al., 2016).

Figure 10.7 Satellite image of landfall location at Dounreay

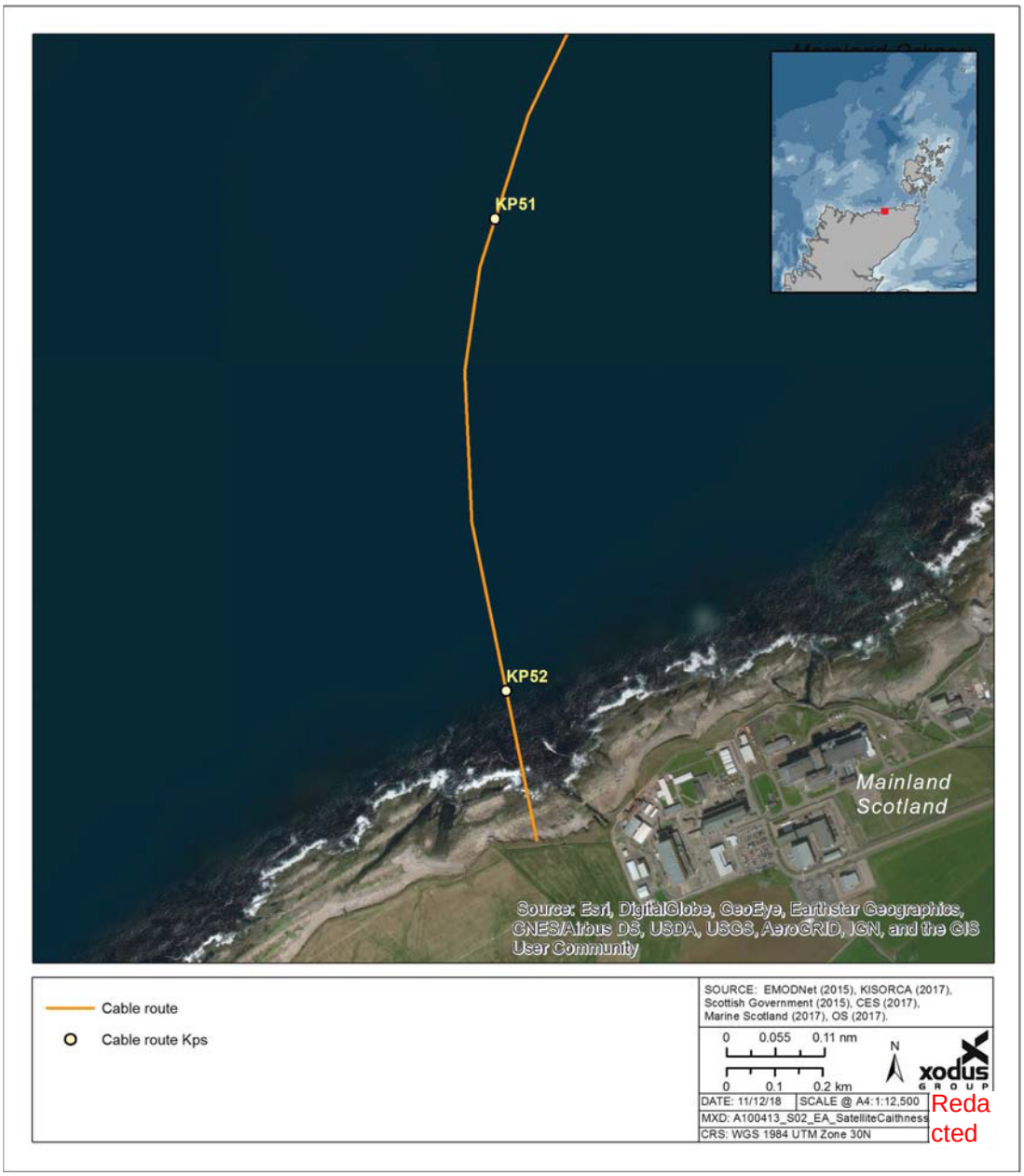
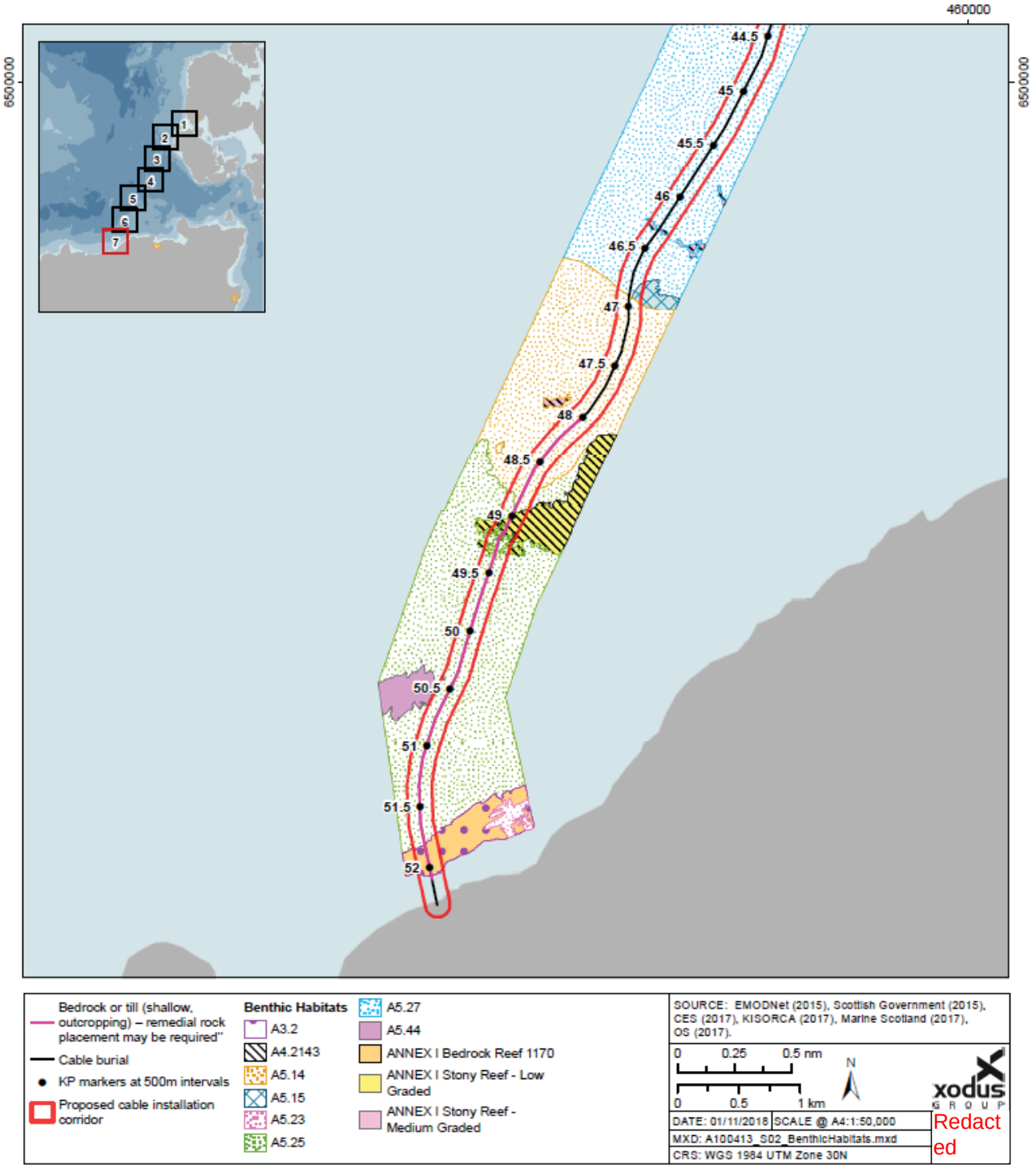


Figure 10.8 Habitats identified offshore of the Caithness landfall (KP45 to KP52) (MMT, 2018b)

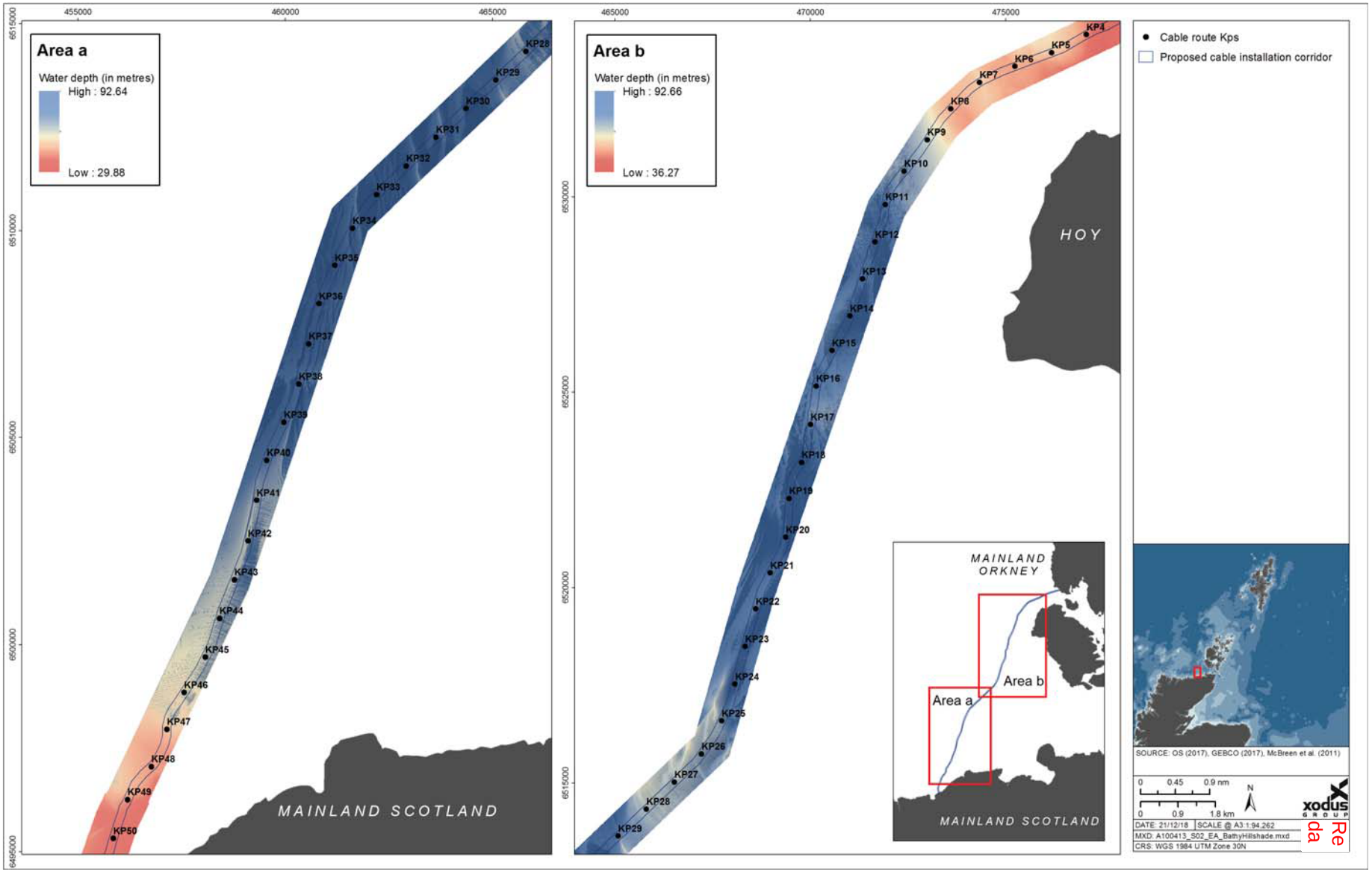


10.5.3 Site characteristics – offshore area

The offshore section of the survey area comprises the section of the proposed cable route between KP2.05 and KP49.26.

The lowest water depth along the cable route is 91 m at KP32.03. The slopes were mostly very gentle or gentle throughout the survey corridor, with some moderate slopes occurring over sandy features between KP30 and KP40 as shown in Figure 10.9. Small seabed features were observed throughout the survey corridor, including ripples and boulders. The following sections describe the habitats found across the entire offshore survey route.

Figure 10.9 Seabed slope along the offshore section of the survey corridor (MMT, 2018b)



10.5.3.1 From KP2 to KP7

From KP2.05 to KP2.10, the dominant habitat was 'mixed kelp with scour-tolerant and opportunistic foliose red seaweed on scoured or sand-covered infralittoral rock' (A3.125) with patches of 'infralittoral mixed sediments' (A5.43) and 'infralittoral fine sand' (A5.23). From KP3.28 the seabed was interpreted to be predominantly composed of coarse sediments and classified as 'circalittoral coarse sediments' (A5.14).

Transect T02 crossed the route at KP2.376 and was located on outcropping bedrock. The dominant fauna on the bedrock was *A. digitatum* (as seen on Figure 10.10), hydroids, barnacles, serpulid tubes, *Urticina* sp., *Gibbula* sp., *C. zizyphinum*, *Ophiuroidea*, *C. papposus*, *Echinus* sp., *A. rubens* and *Caryophyllia smithii*. Occasional coarse sands and clean cobbles/boulders were noted in the deeper gullies as well as a patch of bedrock pavement that was almost entirely covered in crustose coralline red algae. Transect T02 was classified as the habitat complex comprising 'brittlestars on faunal and algal encrusted exposed to moderately wave-exposed circalittoral rock' (A4.2144) and 'Alcyonium digitatum, Pomatoceros triqueter, algal and bryozoan crusts on wave-exposed circalittoral rock' (A4.2142) and meets the criteria for Annex I bedrock reef. This habitat was also found on outcropping bedrock occurring north and south of the proposed cable route between KP2.676 and KP4.136 with a few scattered patches classified as 'deep circalittoral sand' (A5.27) across the survey corridor (Figure 10.11).

The sediments recovered at Station S01 and the surrounding area between KP3.28 and KP4.47 was classified as 'Pomatoceros triqueter with barnacles and bryozoan crusts on unstable circalittoral cobbles' (A5.141) and meets the criteria for low graded Annex I stony reef. From KP4.47 to KP4.77 the habitat 'circalittoral coarse sediment' (A5.14) was interrupted by sections of 'deep circalittoral sand' (A5.27) mainly north of the proposed route (Figure 10.11).

Between KP4.766 and KP6.667, the survey corridor was dominated by tide-swept, dense aggregations of cobbles and boulders. The intermediate sediments consisted of pebbles and shell gravel. Transect T03 located at KP4.766 was dominated by *C. smithii*, serpulid tubes, Ophiuroidea, gastropods, Polyplacophora, Anomiidae and crustose coralline red algae. There were dense aggregations of cobbles and boulders with small sporadic elements of 'deep circalittoral mixed sediments' (A5.45). Between KP4.766 and KP5.443, a few sections were classified as rippled 'deep circalittoral sand' (A5.27) and ‘deep circalittoral mixed sediments' (A5.45). From KP5.443 rippled 'deep circalittoral sand' (A5.27) reoccurred north and south of the proposed route (MMT, 2018b). Transect T08 at KP6.667 had a similar seabed composition as T03 but with more frequent boulder occurrences, and similar faunal composition, being dominated by *C. smithii* but with lower frequencies of occurrence in the different groups. Transects T03 and T08 and the surrounding area from KP4.766 and KP6.667 were classified as *'Caryophyllia smithii,* sponges and crustose communities on wave-exposed circalittoral rock' (A4.212). This area was also assessed to meet the criteria for a low graded Annex I stony reef. Figure 10.10 shows example images of the typical habitats identified at transects T03 and T08.

Figure 10.10 Example images at Transects T02, T03 and T08 (MMT, 2018b)







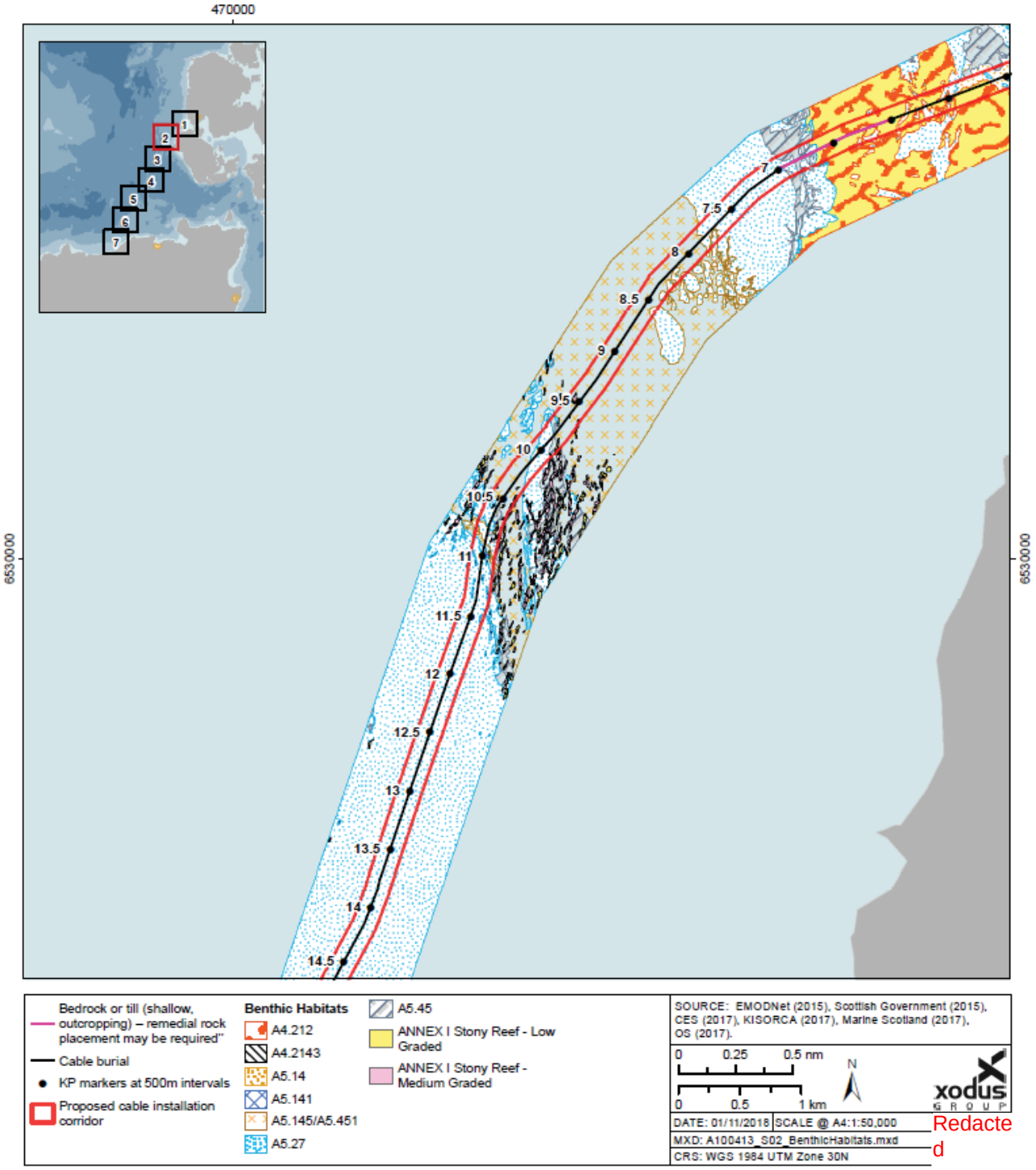
10.5.3.2 From KP7 to KP12

The habitat A5.27 continued but appeared in patches towards KP8.5. From KP7.863 the habitat '*Branchiostoma lanceolatum in circalittoral coarse sand with shell gravel' / 'Polychaete-rich deep Venus community in offshore mixed sediments'* (A5451/A5.145) dominated up to approximately KP10.559 (Figure 10.11).

Up to approximately KP10.5 the main habitat type was *Branchiostoma* lanceolatum in circalittoral coarse sand with shell gravel' / 'Polychaete-rich deep Venus community in offshore mixed sediments' (A5.145/A5.451). The outcropping diamicton was scattered across the survey corridor between KP9.450 and KP11.4 and was characterised by large boulders and frequent epifauna presence. The diamicton was classified as '*Alcyonium digitatum* with *Securiflustra securifrons* on tide-swept moderately wave-exposed circalittoral rock' (A4.2143), with areas qualifying as either low graded or medium graded Annex I stony reefs (MMT, 2018b).

From KP10.983, the survey corridor was dominated by rippled habitat 'deep circalittoral sand' (A5.27) up to approximately KP15.684 (Figure 10.11).

Figure 10.11 Habitats identified in the offshore area of the proposed cable route (KP7 to KP12) (MMT, 2018b)



Redacted

10.5.3.3 From KP12 to KP30

Between KP12 and KP15.684, as noted in the above section, the survey corridor was dominated by rippled habitat *'deep circalittoral sand'* (A5.27). From KP15.684 to KP19.951 the seabed was very variable with a mixture of sediments, cobbles and boulders in coarse sand and gravel (Figure 10.12). At the beginning of this section the seabed was classified as 'Polychaete-rich deep Venus community in offshore mixed sediments' (A5.451) along the route, extending across the survey corridor in a south-easterly direction until KP17.512. This habitat was identified at the sampling station S05, as seen on Figure 10.13. The outcropping diamicton classified as A4.2143 was scattered across the survey corridor in this section and qualified as Annex I stony reef. The habitat 'Atlantic and Mediterranean low energy circalittoral rock' (A4.3) was also found between KP16.487 and KP17.631 and qualified as Annex I bedrock reef. Transect T04 was located west of the route centre line, between KP18.7 and KP19 on top of the outcropping diamicton, which was dominated by cobbles and large boulders with a thin layer of sand occasionally covering the rocky substrate as seen on the example seabed image in Figure 10.13.

Between KP17.505 and KP29.291 the habitat 'deep circalittoral sand' (A5.27) dominated the survey corridor, with some occasional sections of outcropping diamicton A4.2143 between KP17.505 and KP20.298, qualifying as low to medium graded Annex I stony reefs.

From KP20.5 to KP29.29, the predominant habitat was 'deep circalittoral sand' (A5.27) (Figure 10.12 and Figure 10.14).

Figure 10.12 Habitats identified in the offshore area of the proposed cable route (KP12 to KP22) (MMT, 2018b)

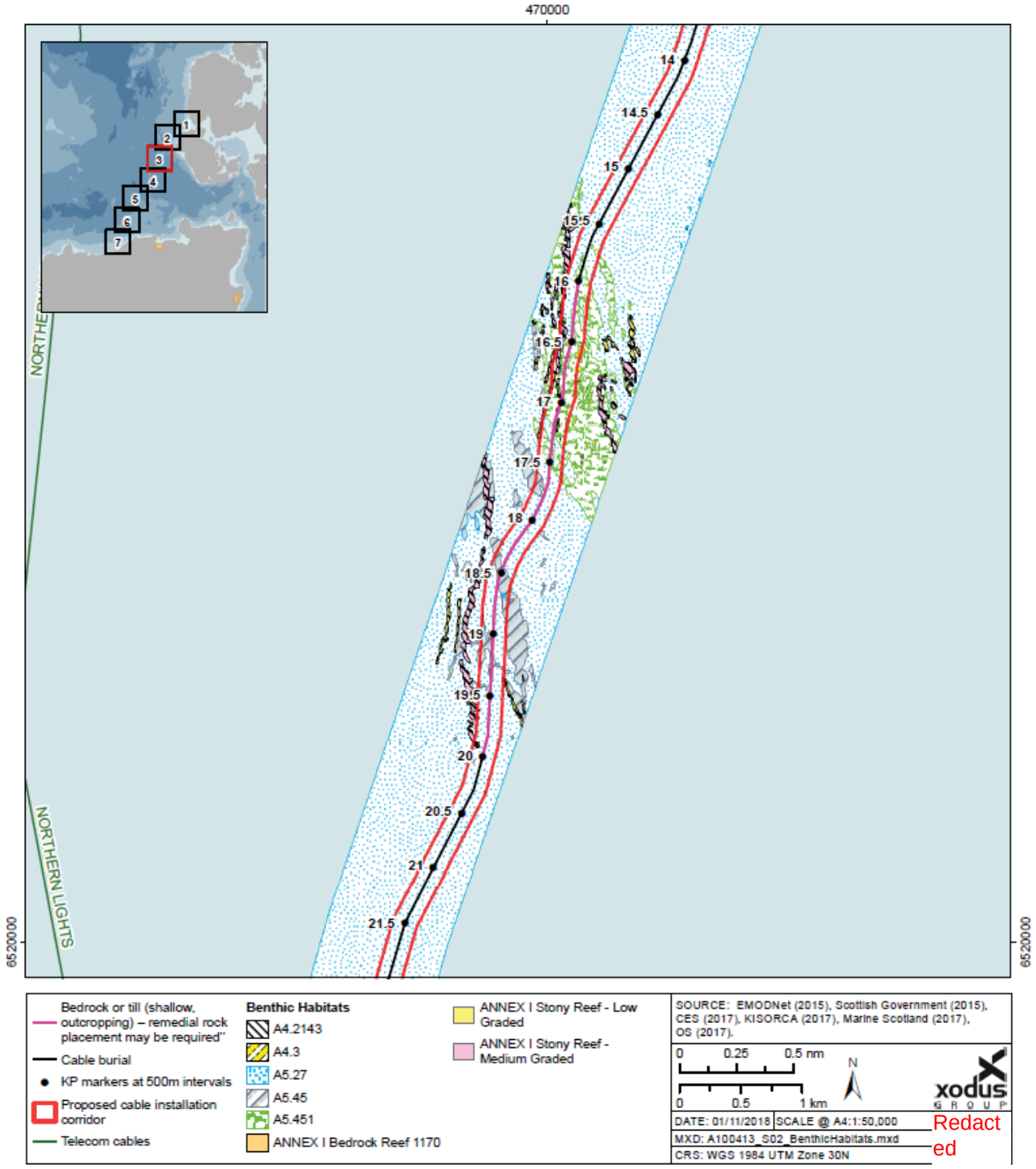


Figure 10.13 Example images at sampling station S05 and transect T04 (MMT, 2018b)

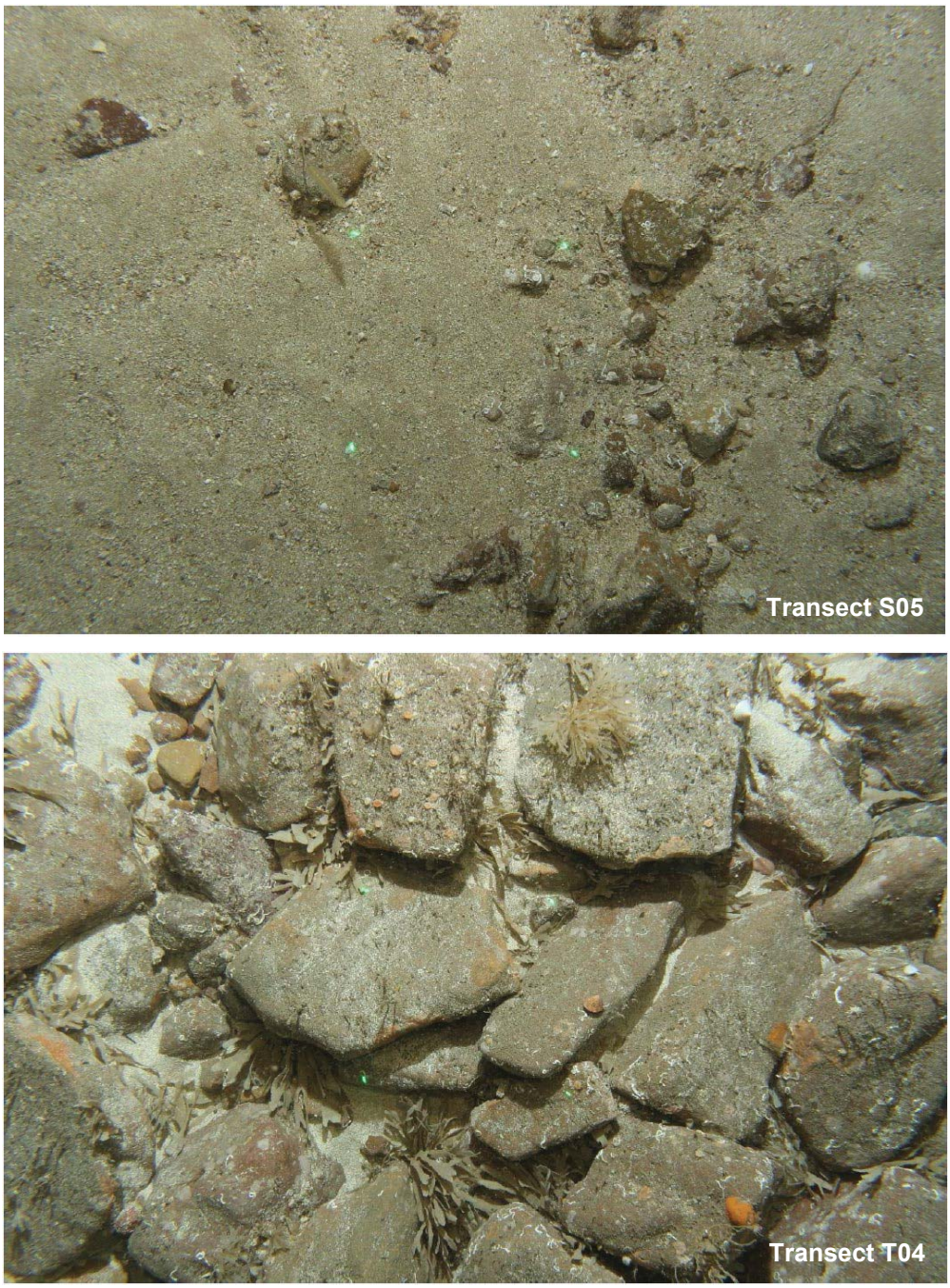
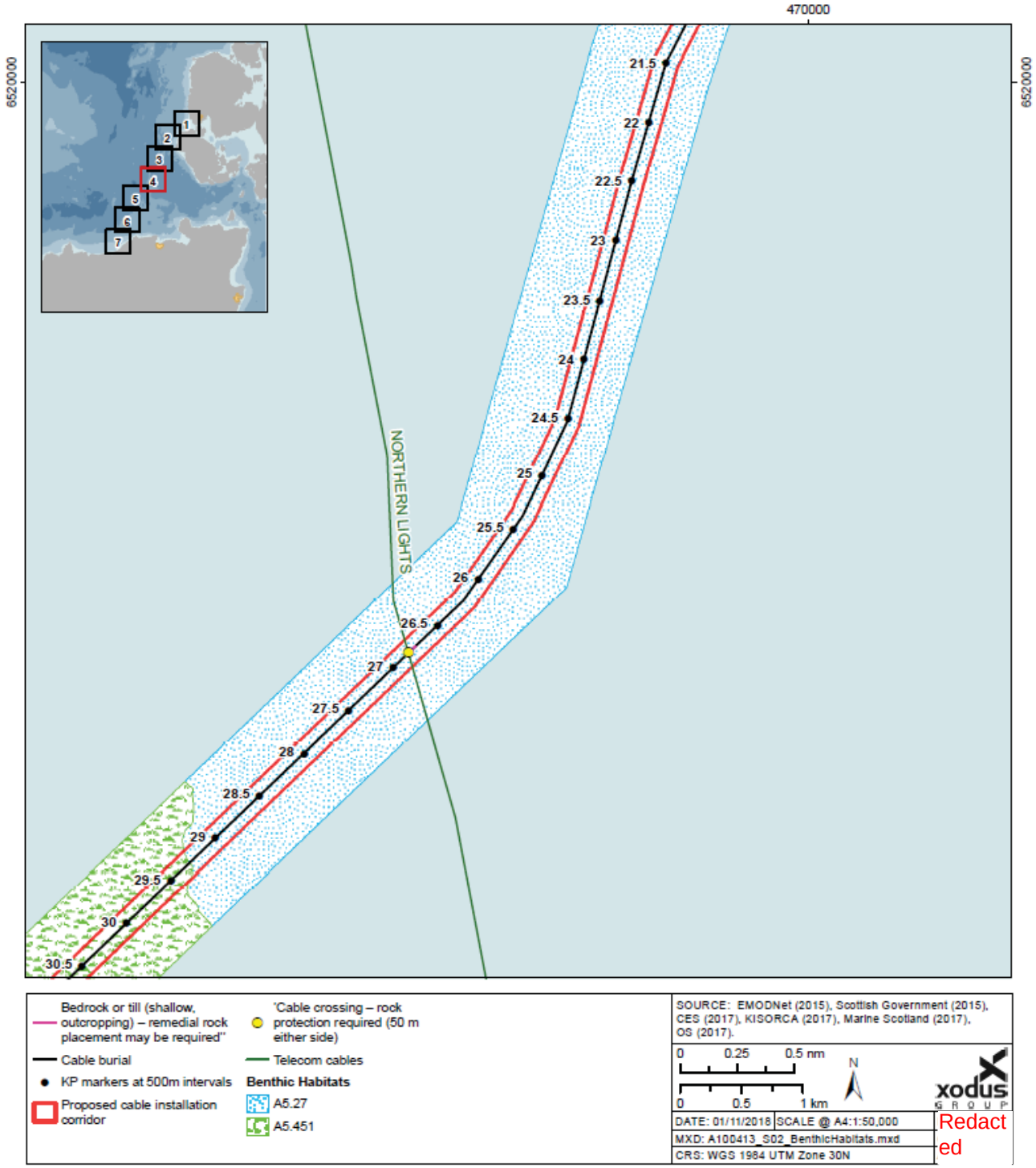


Figure 10.14 Habitats identified in the offshore area of the proposed cable route (KP22 to KP30) (MMT, 2018b)



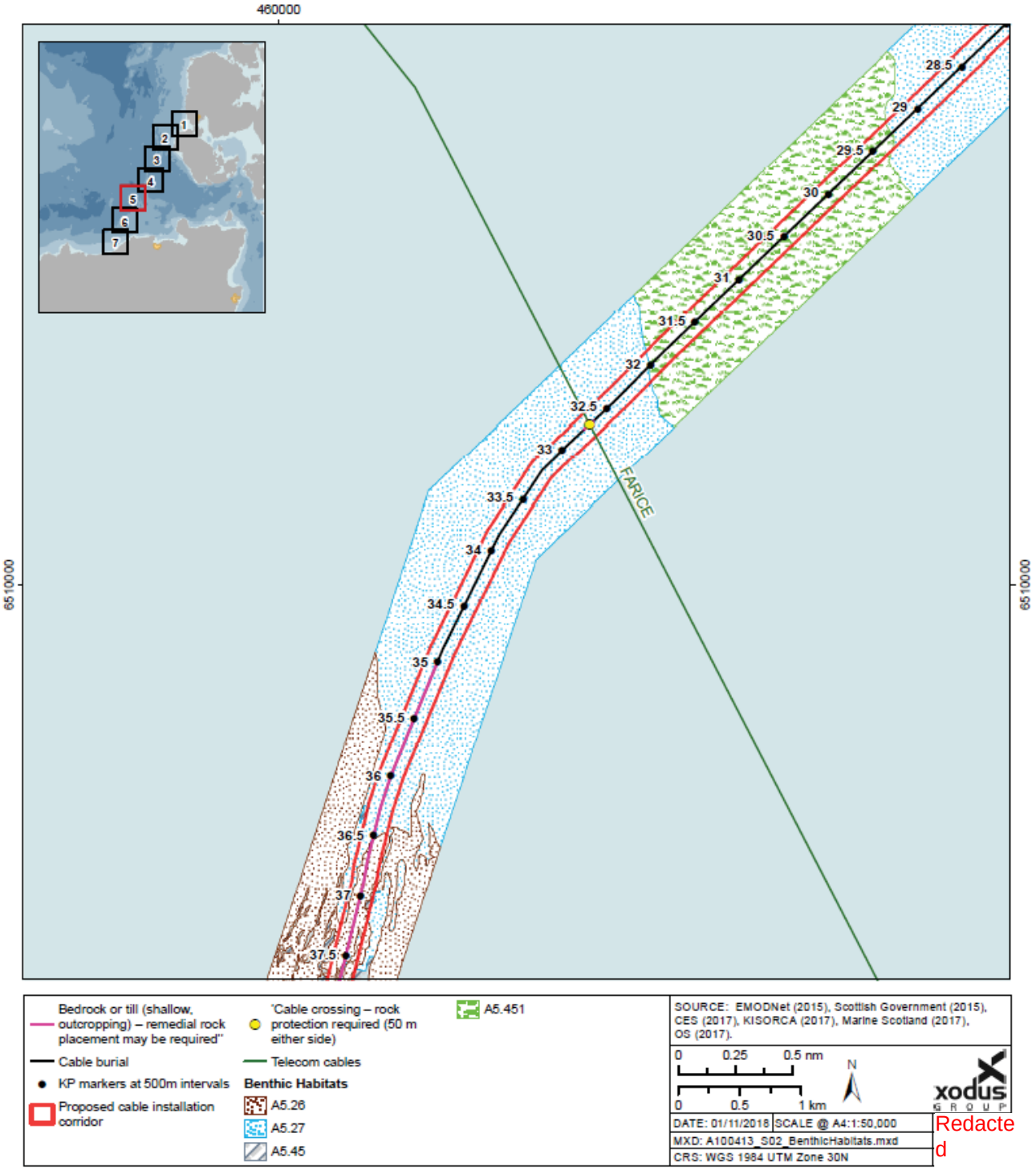
10.5.3.4 From KP30 to KP45

From KP29.29 to KP32.02 the 'deep circalittoral sand' habitat was interrupted by a section of 'Polychaete-rich deep Venus community in offshore mixed sediments' (A5.451). The 'deep circalittoral sand' (A5.27) habitat that started at KP32 continued up to KP36.5. From KP35.1 however, slightly silty sand was interpreted, and classified as 'circalittoral muddy sand' (A5.26), extended towards the proposed cable route and dominated the survey corridor from KP36.56 to KP38.2 (Figure 10.15 and Figure 10.16).

Towards the mainland Scotland landfall, the water depth decreases from KP35 onward and the slopes are mostly very gentle or gentle, occasionally moderate.

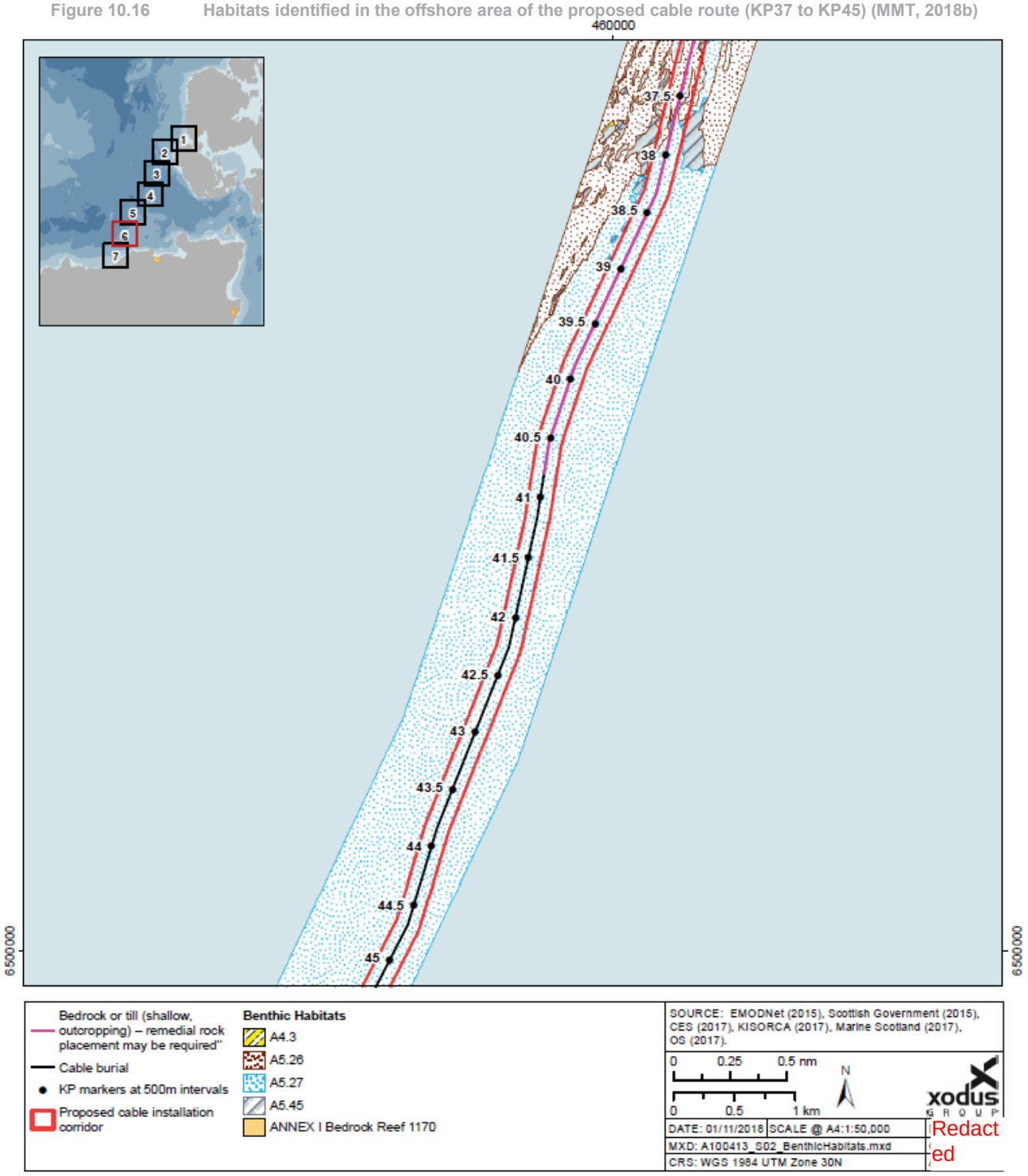
From KP38.2, the seabed type splits into predominantly 'circalittoral muddy sand' (A5.26) west of the proposed cable route and 'deep circalittoral sand' (A5.27) to the east (Figure 10.16). Smaller patches with 'Atlantic and Mediterranean low energy circalittoral rock' (A4.3) qualifying as Annex I bedrock reef were interpreted between KP36.83 and KP39.74 but were mainly present to the west of the survey corridor. The habitat 'deep circalittoral sand′ then continued to dominate until KP46.918 (MMT, 2018b).

Figure 10.15 Habitats identified in the offshore area of the proposed cable route (KP30 to KP37) (MMT, 2018b)



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Figure 10.16 Habitats identified in the offshore area of the proposed cable route (KP37 to KP45) (MMT, 2018b)



10.5.3.5 From KP45 to KP52

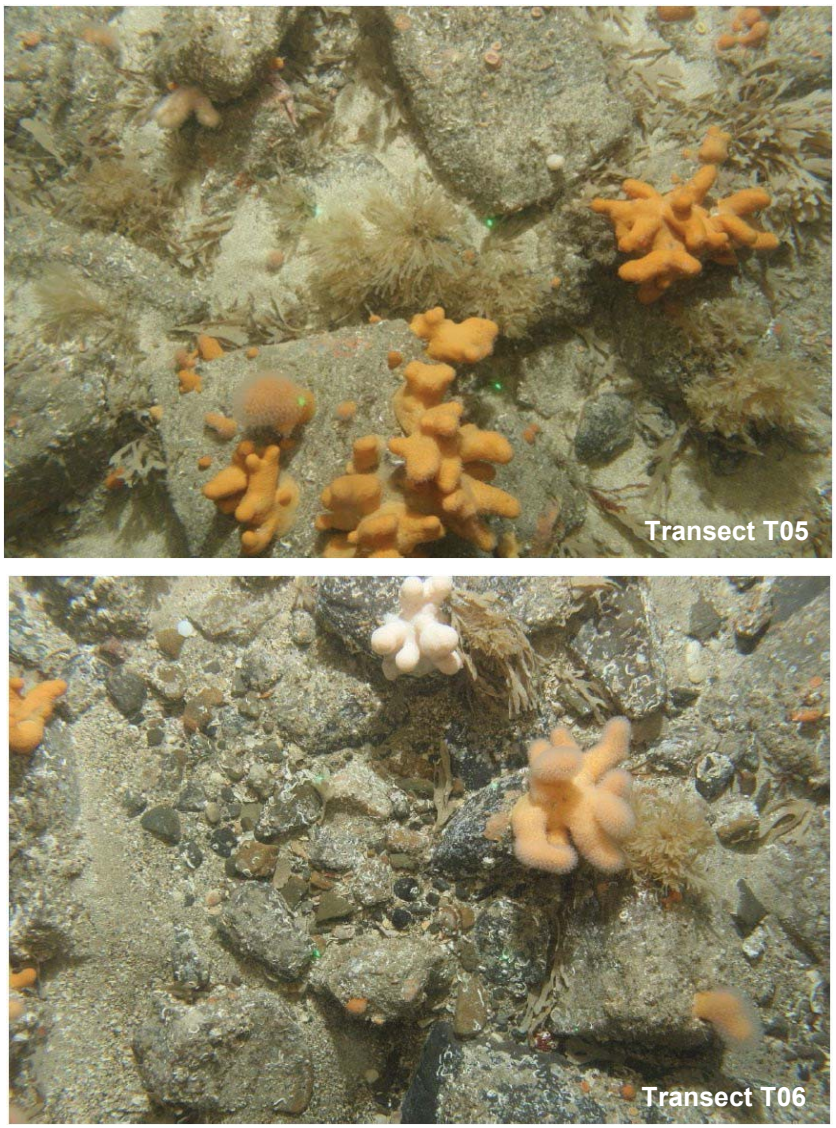
The habitat 'deep circalittoral sand' then dominated until KP46.918 (Figure 10.16) (MMT, 2018b). However, at KP46.180 where the Transect T05 was undertaken, a matrix of cobbles and boulders with intermediate sand and fine shell gravel was identified. The top image on Figure 10.17 is an example image taken at T05 showing individuals of *Alcyonium digitatum* and *Securiflustra securifrons* on cobbles with patches of sand. The seabed was classified in part as *'Alcyonium digitatum* with *Securiflustra securifrons* on tide-swept moderately wave-exposed circalittoral rock' (A4.2143) with occasional patches of 'circalittoral fine sand' (A5.25). Areas adjacent to the transect were also interpreted as A4.2143, which met the criteria for medium graded Annex I stony reef.

From KP46.919 to KP48.934 the seabed was classified as 'circalittoral coarse sediments' (A5.14) and composed of coarse sand and shell gravel. An area that qualified as medium graded Annex I stony reef was located west of the proposed cable route at KP47.888.

Between KP47.901 and KP49.384, three seabed habitat classifications were interpreted to be dominant. 'Circalittoral coarse sediments' (A5.14) was dominant along the proposed cable route with 'circalittoral coarse sediments' (A5.14) localised to the east of the route. 'Circalittoral fine sand' (A5.25) occurred predominantly west of the proposed cable route before KP49.5 but represents the entire survey corridor after that point (Figure 10.8) (MMT, 2018b). This habitat extended to the end of the offshore area, at KP49.258 and continued in the nearshore area up to KP51.817 (Figure 10.8) (MMT, 2018b).

The video transect T06, undertaken near KP46 as seen on Figure 10.2, was classified in part as '*Alcyonium digitatum* with *Securiflustra securifrons* on tide-swept moderately wave-exposed circalittoral rock' (A4.2143), which met the criteria for low graded Annex I stony reef habitat, with occasional patches of 'circalittoral fine sand*'* (A5.25)*"* (MMT, 2018b). The bottom image in Figure 10.17 was taken at Transect T06 and shows individuals of *Alcyonium digitatum* and *Securiflustra securifrons* on a rocky seabed with patches of sand.

Figure 10.17 Example images from Transects T05 and T06 (MMT, 2018b)



10.5.3.6 Summary of habitats identified during the surveys

The habitats identified along the survey corridor are summarised in Table 10.2 along with the corresponding EUNIS habitat code and their conservation status.

As noted in Section 6.1.2, published data suggest that the proposed cable route crosses areas of potential Annex I sandbanks directly offshore of both the Orkney and the Caithness landfalls (JNCC, 2017a). However, the survey data revealed that the sandy areas found within the offshore survey area cannot be considered to constitute the Annex I habitat 'sandbanks which are slightly covered by sea water all the time', as they do not consist of sandy sediments located at depths of less than 20 m and are not considered to be distinct banks, i.e. elongated, rounded or any other “mound” shape (European Commission, 2013). The PMF habitat 'offshore subtidal sands and gravels' are areas of sandy sediment in offshore areas. According to Tyler- Walters et al. (2016) this type of habitat is only considered being a PMF when located outside of Scottish territorial waters. Thus, the subtidal sands and gravels identified in the survey corridor are not considered to represent a potential PMF.

The presence of stony and rocky areas along the cable route represented potential reef habitats. However, the reefiness assessment indicated that these habitats presented a low to medium reefiness, with no indication of the presence of stony or bedrock reefs as defined under Annex I of the Habitats Directive (MMT, 2018b).

The 'Atlantic and Mediterranean moderate energy infralittoral rock' habitat identified offshore of the Caithness landfall presented a potential habitat for the PMF kelp beds. However, no kelp beds were observed in this habitat (MMT, 2018b).

Table 10.2 Habitats along the proposed Orkney to Caithness cable route (MMT, 2018b)

Habitat type	Habitat code (EUNIS)	Potential Annex I habitat (low to medium graded)	Potential PMF
Atlantic and Mediterranean moderate energy infralittoral rock	A3.2	Bedrock reef	Potential habitat for the PMF Kelp beds
Mixed kelps with scour-tolerant and opportunistic foliose red seaweeds on scoured or sand-covered infralittoral rock	A3.125	Bedrock reef	×
Atlantic and Mediterranean moderate energy circalittoral rock	A4.2	×	×
Caryophyllia smithii, sponges and crustose communities on wave-exposed circalittoral rock	A4.212	Stony reef	×
Alcyonium digitatum with *Securiflustra securifrons* on tide-swept moderately wave-exposed circalittoral rock	A4.2143	Stony reef	×
Alcyonium digitatum, Pomatoceros triqueter, algal and bryozoan crusts on wave-exposed circalittoral rock	A4.2142	Bedrock reef	×
Brittlestars on faunal and algal encrusted exposed to moderately wave-exposed circalittoral rock	A4.2144	Bedrock reef	×
Atlantic and Mediterranean low energy circalittoral rock	A4.3	Bedrock reef	×
Infralittoral coarse sediment	A5.13	×	×
Sparse fauna on highly mobile sublittoral shingle (cobbles and pebbles)	A5.131	×	×
Circalittoral coarse sediment	A5.14	Stony reef	×
Pomatoceros triqueter with barnacles and bryozoan crusts on unstable circalittoral cobbles	A5.141	Stony reef	×
Branchiostoma lanceolatum in circalittoral coarse sand with shell gravel/Polychaete-rich deep Venus community in offshore mixed sediments	A5.145/A5.451	×	×

Habitat type	Habitat code (EUNIS)	Potential Annex I habitat (low to medium graded)	Potential PMF
Deep circalittoral coarse sediment	A5.15	×	×
Infralittoral fine sand	A5.23	×	×
Circalittoral fine sand	A5.25	×	×
Circalittoral muddy sand	A5.26	×	×
Deep circalittoral sand	A5.27	×	×
Infralittoral mixed sediments	A5.43	×	×
Circalittoral mixed sediments	A5.44	×	×
Deep circalittoral mixed sediments	A5.45	Bedrock reef	×
Polychaete-rich deep Venus community in offshore mixed sediments	A5.451	×	×

10.6 Assessment Criteria

The general assessment methodology is outlined in Section 7 - Impact assessment methodology. Specific criteria relating to benthic ecology have been developed for the sensitivity/value of a receptor and the magnitude of impacts.

The sensitivity of a receptor has been considered in terms of the tolerance to change, recoverability, adaptability and value. Expert judgement has been employed to consider the final sensitivity of a particular receptor. Definitions of sensitivity are provided in Table 10.3.

Table 10.3 Sensitivity of receptor

Sensitivity/value	Definition
Negligible	Receptor is generally tolerant to a particular effect. Receptor is not considered vulnerable regardless of value/importance and is expected to recover or adapt within a short timescale. Value: Locally important receptors with low vulnerability and medium to high recoverability.
Low	Receptor has some tolerance to a particular effect. Receptor is considered to have a low vulnerability and is expected to recover or adapt. Value: Locally important receptors with medium to high vulnerability and low recoverability. Regionally important receptors with low vulnerability and medium to high recoverability. Nationally and internationally important receptors with low vulnerability and high recoverability.
Medium	Receptor has a low tolerance to a particular effect. Receptor has some potential for recovery and adaptation over long timescales. Locally important receptors with high vulnerability and no ability for recovery. Regionally important receptors with medium to high vulnerability and low recoverability. Nationally and internationally important receptors with medium vulnerability and medium recoverability.
High	Receptor has a very low tolerance to a particular effect. Receptor has low potential for recovery or adaptation. Value: Regionally important receptors with high vulnerability and no ability for recovery. Nationally and internationally important receptors with high vulnerability and low recoverability.

Sensitivity/value	Definition
Very high	Receptor has no tolerance to a particular effect and no ability to recover or adapt. Value: Nationally and internationally important receptors with high vulnerability and no ability for recovery.

The magnitude of the impact has been considered in terms of the size and spatial extent, duration and timing/seasonality and frequency of the impact in question. Expert judgment has been employed to consider and evaluate the likely impact on the species, population or habitat identified. Definitions of magnitude are provided in Table 10.4.

Table 10.4 Definitions of magnitude

Magnitude	Definition
Negligible	Very slight change from baseline conditions. Impact is highly localised and short term resulting in very slight or imperceptible changes to site characteristics
Minor	Minor shift from the baseline conditions. Impact is localised and temporary/short term with minor detectable change to site characteristics or a minor change to a small proportion of the receptor population. Low frequency impact occurring occasionally or intermittently.
Moderate	Partial loss or alteration to one or more key elements/features of the baseline conditions. Impact occurs over a medium scale or spatial extent with short to medium term change to site characteristics or affecting a moderate proportion of the receptor population. Impact will occur repeatedly or continuously over a moderate period of time or at moderate frequency/intensities for short periods of time.
Major	Total loss or major alteration to key elements/features of the baseline conditions. Impact occurs over a large scale or spatial extent resulting in widespread, long term or permanent changes in site characteristics or affecting a large proportion of receptor population. Impact will occur repeatedly or continuously over a long period of time.

Following the identification of receptor sensitivity/value and magnitude of the effect, the significance of the impact is determined using the assessment matrix and expert judgement. The matrix used to identify the significance of an impact is presented within Section 7.3.3. Impacts categorised as moderate or major are considered to be significant, minor or negligible impacts are not considered to be significant.

10.7 Identification of potential impacts

Table 10.5 indicates the direct and indirect impacts assessed in the benthic and intertidal ecology section and indicates the Project activities to which they relate. Cumulative impacts are discussed in Section 10.10.

Table 10.5 Potential impacts on benthic ecology during the cable installation, operation, repair and maintenance, and decommissioning phases

Project activities	Indicative duration of activity*	Potential impacts on benthic epifauna and infauna				
		Temporary habitat loss and physical disturbance	Permanent loss of habitat	Temporary increase in suspended sediment concentrations and associated deposition	Introduction of new substrate	Increased risk of introducing or spread INNS
HDD at landfall	1 month	✓	×	✓	×	×
Seabed preparation: Pre-sweeping of sandwaves	1 week	✓	×	✓	×	×
Seabed preparation Pre-lay grapnel (seabed clearance)	2 weeks	✓	×	✓	×	×
Seabed preparation: Boulder clearance	1 week	✓	×	✓	×	×
Cable installation Option 1: Jet trencher	6 weeks	✓	×	✓	×	×
Cable installation Option 2: Pre-trench/backfill plough	3 weeks	✓	×	✓	×	×
Cable installation Option 3: Jet trencher & mechanical trencher	6 weeks	✓	×	✓	×	×
Decommissioning: Cable removal	Not defined at this stage	✓	×	✓	×	×
Cable protection: Rock protection	2 weeks	×	✓	×	✓	✓
Cable protection: Concrete mattresses	1 week	×	✓	×	✓	✓
Cable protection: Cast iron shells	1 week	×	✓	×	✓	✓
Cable protection: Composite sleeving	1 week	×	✓	×	✓	✓

*Note: Tick symbol denotes there is a potential impact for the given activity. *Maintenance & repair and Decommissioning impacts are considered to be less than those for installation.*

* Activity durations are estimates at this stage

10.7.1 **Sensitivity of key features of conservation importance**

The only potentially sensitive features identified during the 2018 environmental survey was potential Annex I bedrock and stony reefs (MMT, 2018b). The sensitivity of seabed habitats or biotopes identified as potential Annex I habitats are presented in Table 10.6. Mixed kelp and red seaweeds were observed in the Orkney nearshore area; however, these were not classified as kelp beds as defined on the list of PMFs in Scottish waters. In the nearshore area of the mainland Scotland cable end, the presence of bedrock in shallow (<20 m), tide-swept water, represented kelp bed habitat (Tyler-Walters *et al*., 2016), however no kelp was observed. Therefore, although some kelps were observed near Orkney, the absence of known kelp beds in the Project area allowed scoping out of any impacts on this feature.

Table 10.6 Sensitivity of benthic features associated with potential Annex I habitat (Scottish Government, 2013; Jasper and Hill, 2015)

Sensitive feature identified by MMT (2018b)		Sensitivity / recoverability to potential impacts associated with subsea cables works based on information from the FEAST and MarLIN			
		Temporary/permanent habitat loss and physical disturbance	**Temporary increase in suspended sediment concentrations and associated deposition**	**Increased risk of introducing or spread of invasive non-native species (INNS)**	**Accidental release of pollution**
Habitats identified as potential Annex I bedrock/stony reefs	*Alcyonium digitatum* with *Securiflustra securifrons* on tide-swept moderately wave-exposed circalittoral rock *Alcyonium digitatum*, *Pomatoceros triqueter*, algal and bryozoan crusts on wave-exposed circalittoral rock Brittlestars on faunal and algal encrusted exposed to moderately wave-exposed circalittoral rock *Caryophyllia smithii*, sponges and crustose communities on wave-exposed circalittoral rock	Low / High Abrasion/mobilisation of rocky substrata can cause local mortality of the resident communities. Recoverability is high if disturbance remains localised.	Low / High *Alcyonium digitatum* colonies can attain a height of up to 20 cm (Edwards, 2008), *Securiflustra securifrons colonies* can attain a height of 10 cm (Porter, 2012) so would still be able to feed in the event of sediment deposition. *Pomatoceros triqueter* are an encrusting species and would thus likely be smothered. Due to the high tidal energy within these biotopes, 5 cm of deposited sediment is likely to be removed from the biotope within a few tidal cycles. If 30 cm of sediments deposit, it is likely to be removed from the biotope within a year.	Low / Low There is no evidence regarding known invasive species which may pose a threat to this biotope.	Not sensitive Oil pollution is mainly a surface phenomenon, its impact upon circalittoral turf communities is likely to be limited.
	Pomatoceros triqueter with barnacles and bryozoan crusts on unstable circalittoral cobbles	Low / High The species characterising this biotope occur on the rock surface and therefore have no protection from surface abrasion. The impact of surface abrasion will depend on the footprint, duration and magnitude of the pressure. The persistence of the assemblage may depend on rapid recovery rather than high resistance.	Not sensitive to small siltation rate changes due to the sediments being removed rapidly from the biotope and that scour tolerance of the animal species and encrusting corallines would prevent significant mortality.	Not sensitive The high levels of scour in this biotope will limit establishment of all but the most scour resistant INNS from this biotope and no direct evidence was found for effects of INNS on this biotope	Bryozoans may be intolerant to effects of oil spills and possibly hydrocarbons, however little evidence is available.
	Mixed kelps with scour-tolerant and opportunistic foliose red seaweeds on scoured or sand-covered infralittoral rock	Medium / High Abrasion/mobilisation of rocky substrata can cause local mortality of the resident communities. However, the rapid growth rates of the species associated with this biotope means that the resilience is generally high.	Low / High Smothering at the time spores of colonising species are settling might reduce their abundance significantly, which may affect the biotopes associated with kelp. Silt settling onto algal fronds will reduce photosynthesis, and in turn cause a reduction in growth rate, but will not cause mortality. Recoverability of this biotope is high.	High / Low *Undaria pinnatifida* is the major marine non-native species affecting kelp species by competition in the UK. The biotope is unlikely to fully recover until *Undaria pinnatifida* is fully removed from the habitat.	Not sensitive This biotope is predominantly recorded in the subtidal area; therefore, these habitats are not likely to come into contact with freshly released oil, but only to sinking emulsified oil and oil adsorbed onto particles. The mucilaginous layer coating of laminarians may protect them from smothering by oil.
	Atlantic and Mediterranean low energy circalittoral rock	Low / High Abrasion/mobilisation of rocky substrata can cause local mortality of the resident communities.	Low / High A thin deposit of sediments over the rocky substrate will not affect the habitat type and will be removed within a few tidal cycles.	Not sensitive No biotopes of conservation importance have been recorded within this habitat.	Not sensitive No biotopes of conservation importance have been recorded within this habitat. Oil pollution is

Sensitive feature identified by MMT (2018b)		Sensitivity / recoverability to potential impacts associated with subsea cables works based on information from the FEAST and MarLIN			
		Temporary/permanent habitat loss and physical disturbance	Temporary increase in suspended sediment concentrations and associated deposition	Increased risk of introducing or spread of invasive non-native species (INNS)	Accidental release of pollution
	Circalittoral coarse sediment Deep circalittoral mixed sediments	Low / High Mobilisation of sediments can cause local displacement or mortality of the resident communities.	Low / High Remobilisation and settlement of sediments will not change the seabed type.		mainly a surface phenomenon; therefore, these habitats are not likely to come into contact with freshly released oil, but only to sinking emulsified oil and oil adsorbed onto particles. Exposure to oil is thus likely to be limited.

10.8 Embedded mitigation and management measures

As part of the Project design process a number of embedded mitigation and management measures and best practice measures as outlined in Table 10.7. have been included to reduce the potential impact on benthic ecology. There is a commitment to deliver these measures and therefore they are considered part of the Project design.

The assessment of magnitude, sensitivity and significance in Section 10.9 includes the incorporation of these measures.

Table 10.7 Best practice (BP) and embedded mitigation and management measures (EM)

ID	Measure	Justification
BP1	A final CEMP and an Emergency Spill Response Plan will be developed and implemented for the installation phase. A non-native species management plan / biosecurity plan for vessels will be developed as part of the CEMP.	Measures will be adopted to ensure that the potential for release of pollutants from construction, operation and decommissioning is minimised. A document detailing how the risk of potential introduction and spread of INNS will be minimised is to be produced. The plan will outline measures to ensure vessels comply with the International Maritime Organization (IMO) ballast water management guidelines and with the Ballast Water Management Policy for Scapa Flow (Orkney Islands Council, 2017). It will consider the origin of vessels and contain standard housekeeping measures for such vessels as well as measures to be adopted in the event that a high alert species is recorded. Compliance with the General Policy 9 of the Pilot Pentland Firth and Orkney Waters Marine Spatial Plan will also be ensured (Scottish Government, 2016).
BP2	Control measures and shipboard oil pollution emergency plans (SOPEP) will be in place and adhered to under MARPOL Annex I requirements for all vessels. In the event of an accidental fuel release occurring appropriate standard practice management procedures will be implemented accordingly.	Measures will be adopted to ensure that the potential for release of pollutants from construction, operation and decommissioning is minimised.
BP4	Vessels will be equipped with waste disposal facilities (sewage treatment or waste storage) to IMO MARPOL Annex IV Prevention of Pollution from Ships standards.	Measures will be adopted to ensure that the potential for release of pollutants from construction, operation and decommissioning is minimised.
EM1	The duration of cable installation activities from the vessel will minimised as much as possible.	To ensure the disturbance of the seabed is kept to a minimum.
EM2	Deployment of anchors/anchor chains on the seabed will be kept to a minimum.	To ensure the disturbance of the seabed is kept to a minimum.
EM6	Rock protection and/or mattresses will only be deployed where adequate burial cannot be achieved to protect the cable or at crossings of other cables.	Cable burial is always the first-choice approach to protecting the cable.

10.9 Assessment of impacts

10.9.1 Potential impacts during cable installation, maintenance and repair, and decommissioning

10.9.1.1 Temporary direct loss of, or disturbance to, benthic habitats and communities

The various seabed preparation, cable installation and protection methods in direct contact with the seabed have the potential to impact on the benthic species and habitats directly within the actual Project footprint.

The total length of the proposed cable route is 53 km from the Orkney landfall to the mainland Scotland landfall. Table 10.8 presents the overall area of seabed impact from the proposed seabed preparation and cable installation activities. The activities that result in the greatest area of impact, excluding the installation vessel anchoring system, are pre-sweeping of sandwaves (0.66 km^2) and cable installation options 2 and 3 which are mechanical trenching and pre-trenching/backfill ploughing, resulting in a footprint of 0.78 km^2 in the worst-case scenario. However, trenching activities will partly occur within the footprint of sandwaves sweeping, therefore the total footprint of the two overlapping activities is only approximately 1 km^2. The HDD method will only impact the substrate and biota at the exit point on the seabed and therefore there will be no seabed impacts in the nearshore areas at Warebeth and Dounreay.

The proposed cable route will cross a variety of benthic habitats and biotopes as described in Section 10.5. The impact footprint on the habitats encountered along the cable route has thus been estimated and put into the context of the total footprint of activities. The only potentially sensitive features identified within the survey corridor were areas of potential bedrock and stony reef habitats, as listed on Annex I of the EC Habitats Directive corridor (MMT, 2018b). These may be impacted by cable protection methods which include rock placement, concrete mattresses, grout bags, cast iron shells and composite sleeving. However, only a small area of potential Annex I reef habitat (0.07 km^2) will be potentially affected due to the small footprint of cable installation activities. When compared to the area of similar habitat available in the 1,000 m wide survey corridor (0.55 km^2), only 12% of this habitat will be potentially impacted by the Project activities in the survey corridor. Since cable burial is not possible in areas of harder seabed, the footprint will be limited to the width of the protection method (cast iron shells, sleeving or rock placement) in these areas.

Abrasion and mobilisation of rocky substrata can cause local mortality of the resident communities, and therefore local loss of the associated biotopes identified in Table 10.6. However, none of the biotopes or species observed have been identified as being of specific conservation concern (e.g. in terms of the Habitats Directive or the list of Scottish PMFs), and it is likely that any species mortality will be insignificant in relation to the natural cycles of mortality and re-growth occurring to either side of the cable. Further, it is likely that species from the same biotopes to either side will start to colonise the cable rock protection and become established on it over a number of years. This is supported by the sensitivity and recoverability assessment presented in Table 10.6, which shows that recoverability of the biotopes identified along the proposed cable route is high if disturbance remains localised.

Furthermore, seabed disturbance will be minimised, where possible by minimising the duration and extent of cable installation activities (see Table 10.7). The cable installation activities are expected to be short-term (a few weeks / months) and the potential for recovery of potential stony/bedrock reef from habitat loss and physical disturbance is expected to be high.

Apart from the areas of potential Annex I bedrock and stony reefs, the proposed cable route is dominated by granular sediment types. None of the sediment habitats identified during the geophysical and environmental surveys in 2018 are considered of conservation importance, therefore the disturbance of sediments during cable installation, operation and decommissioning activities are more likely to result in indirect impacts, including increase in suspended sediments and re-settlement, rather than in significant loss of habitat or disturbance of species. These impacts have been considered in Section 10.9.1.2 – Temporary increase in suspended sediments.

Assessment of significance

The proposed cable installation, maintenance and decommissioning activities will result in a direct long-term footprint of only a very limited area of seabed, 1.03 km^2. Although very small areas of potential low to medium-graded Annex I stony and bedrock reefs could be affected, the great majority of this area is occupied by biotopes of no specific conservation concern which are present on a wider scale throughout this area of the North Sea. There are no conservation sites with benthic features in the immediate vicinity of the proposed cable route. In addition, no PMF appear to have a significant presence here. On this basis, the subtidal and intertidal habitats and species potentially affected by the Project are considered to be of medium sensitivity to disturbance/loss; the magnitude of effect as justified above is considered minor resulting in a minor level of impact and not significant.

As the impact is not significant no mitigation measures are required. Measures considered as part of the Project design are listed in Table 10.7.

Sensitivity/value	Magnitude of effect	Level of impact
High	Low	Minor

Impact significance – NOT SIGNIFICANT

Table 10.8 Footprint of cable installation methods along the proposed cable route

Cable installation and protection method	Activities resulting in seabed impact (and assumptions made for seabed impact calculations)	Habitat type (MMT, 2018b)	Length of cable going through each of the habitats (m)	Area of seabed impact on biotope/habitat (km^2)
HDD landfall	HDD installation resulting in duct 'pop-out' on the seabed at a distance of 900 m and 1,050 m offshore of Dounreay and Warebeth, respectively. Footprint of 5 m x 5 m	A3.125 (also potential bedrock reef) A5.25	10	0.00005
Cable lay	Cable width 255 mm diameter	All habitats along the cable route	54,369	0.013 (see footnote [7])
Seabed preparation: Pre-sweeping of sandwaves	20 m wide along areas of sandwaves	A4.212, A4.2143, A5.14, A5.141, A5.145/A5.451, A5.26, A5.27, A5.45, A5.451	43,350 (Based on CBRA)	0.22 (0.65 km^2 already accounted within the footprint of Option 1, 2 and 3)
Seabed preparation: Pre-lay grapnel	Towed along centreline 1 m width corridor	A3.125, A3.2, A4.212, A4.2443, A4.2144/A4.2142, A5.14, A5.141, A5.25, A5.26, A5.27, A5.43, A5.45, A5.451, including potential bedrock and stony reefs	51, 800	0.05 (see footnote [7])

[7] The footprint of this activity is already accounted within the larger footprint of the cable installation methods listed in this table and therefore has not been added to the total footprint to avoid overestimation.

Cable installation and protection method	Activities resulting in seabed impact (and assumptions made for seabed impact calculations)	Habitat type (MMT, 2018b)	Length of cable going through each of the habitats (m)	Area of seabed impact on biotope/habitat (km^2)
Seabed preparation: Boulder clearance plough (worst-case)	15 m width	A4.212, A5.14, A5.141, A5.25, A5.27, including potential stony reef	2,000 (Based on CBRA)	0.03
Cable installation Option 1: Jet trenching	Footprint up to 10 m wide	A3.125, A3.2, A4.212, A4.2143, A4.2443, A4.2144/A4.2142, A5.14, A5.141, A1.145/A5.541, A5.25, A5.26, A5.27, A5.43, A5.45, A5.451, including potential bedrock and stony reefs	48,372	0.5 (see footnote [8])
Cable installation Option 2: Pre-trench/backfill plough	Footprint up to 15 m wide	A3.125, A3.2, A4.212, A4.2143, A4.2443, A4.2144/A4.2142, A5.14, A5.141, A1.145/A5.541, A5.25, A5.26, A5.27, A5.43, A5.45, A5.451, including potential bedrock and stony reefs	48,372	0.78

[8] The footprint of this activity is already accounted within the larger footprint of the cable installation methods listed in this table and therefore has not been added to the total footprint to avoid overestimation.

Cable installation and protection method	Activities resulting in seabed impact (and assumptions made for seabed impact calculations)	Habitat type (MMT, 2018b)	Length of cable going through each of the habitats (m)	Area of seabed impact on biotope/habitat (km^2)
Cable installation Option 3: Jet trenching & mechanical trenching	Footprint up to 10 m wide for jet trencher Footprint up to 15 m wide for mechanical trencher (worst-case)	A3.125, A3.2, A4.212, A4.2143, A4.2443, A4.2144/A4.2142, A5.14, A5.141, A1.145/A5.541, A5.25, A5.26, A5.27, A5.43, A5.45, A5.451, including potential bedrock and stony reefs	48,372	0.78 (worst-case) (see footnote[9])
Cable protection material: Rock placement	8 m wide rock berm along areas of rock protection	A3.125, A3.2, A4.2144/A4.2142, A5.14, A5.141, A5.25, A.27, A5.43, including potential bedrock and stony reefs	5,300	0.04 (see footnote [9])

[9] The footprint of this activity is already accounted within the larger footprint of another cable installation method listed in this table, therefore this number has not been added to the total footprint to avoid overestimation.

Cable installation and protection method	Activities resulting in seabed impact (and assumptions made for seabed impact calculations)	Habitat type (MMT, 2018b)	Length of cable going through each of the habitats (m)	Area of seabed impact on biotope/habitat (km^2)
Cable protection: Concrete mattresses	6 m wide x 3 m high (Crossings only) 32 concrete mattresses in total	A5.27	Not identified at this stage	0.0005 (see footnote [10])
Cable protection: Cast iron shells	500mm (length) x 300mm (width) Up to 4,000 shells	Not identified at this stage	2,000	0.002
Cable protection: Composite sleeving	300 mm diameter	Not identified at this stage	200 m (100 m at each crossing)	0.0006
Cable protection: concrete/grout bags at pop-out locations and where shells are installed	2,000 bags of 25 kg each. Each bag is approximately 500mm x300mm x 100mm.	A3.125 (also potential bedrock reef) A5.25 Other habitats may be impacted by concrete/rock bags deposits where cast iron shells are installed, however the exact locations are not identified at this stage.	Not identified at this stage	<0.001
			Total area of impact	**1.03**

[10] The footprint of this activity is already accounted within the larger footprint of another cable installation method listed in this table, therefore this number has not been added to the total footprint to avoid overestimation.

10.9.1.2 Permanent habitat loss

Permanent loss of rocky substrata, including the habitats that have been identified as potential Annex I reefs, will occur due to the presence of surface laid or partially buried cable with additional cable protection (rock placement or concrete mattressing or rock bolted duct) on this habitat. However, these areas presented low to medium reefiness, thus not qualifying as Annex I habitat. The biotopes associated with rocky subtrata identified during the MMT survey display a medium to high recoverability to habitat loss provided that the loss of habitat remains localised (see Table 10.6). Considering the small footprint of the cable infrastructure (1.03 km^2), the area of habitat that will be lost, although permanent, will remain localised and will not cause long-term impacts to the associated benthic communities and therefore will not compromise the conservation objectives of the potential Annex I reefs.

Permanent loss to sandy, coarse of mixed sediments habitats will also occur. Considering the small footprint of activities and that none of the biotopes associated with these sediment types identified within the survey corridor are of conservation importance, the impact of permanent habitat loss is not considered significant. The localised loss of habitat will cause a loss of biotopes however this impact will remain localised and will not change the ecology of the site.

Assessment of significance

Although permanent loss of habitat will occur within habitats presenting low to medium resemblance to Annex I reef, this will remain localised and is not anticipated to cause adverse effects on existing benthic communities. The impact is therefore assessed as minor and not significant.

As the impact is not significant no mitigation measures are required. Measures considered as part of the Project design are listed in Table 10.7.

Sensitivity/value	Magnitude of effect	Level of impact
High	Low	Minor
Impact significance – NOT SIGNIFICANT		

10.9.1.3 Temporary increase in suspended sediments and associated deposition

There are areas of sediment along the proposed cable route where it will be possible to install the cable by jet trenching (possibly in combination with mechanical trenching in areas of harder sediment) or ploughing.

Jetting is a method of fluidizing the sediment by injecting water at high pressure below the sediment surface. When the water pressure is removed, the sediment resettles over the cable. Due to the high pressure involved this process could be expected to result in some mortality to the organisms present in the sediment. There is also potential for a secondary indirect impact as a result of sediment suspension/turbidity. This would be in addition to any natural suspended sediment loading in the water column due to tidal currents that flow through the Pentland Firth. Ploughs are passive burial tools equipped with a share that engages the seabed with the plough being towed by its support vessel across the seabed to form a trench. Backfill is provided by the wedge of soil lifted during the trenching process being placed back on to the product and, or, trench wall collapse or if pre-cut trenching by using a backfill plough technique. Effects on surrounding sediment habitat could occur due to the displacement and redistribution of sediment during trenching and ploughing operations which would result in deposition of a layer of sediment over the immediate area physically smothering species present. Suspension and deposition of fine particles may have an effect on low mobility filter feeders by impacting their ability to feed, however the benthic communities in sandy sediments will be generally adapted to high sediment loading and have a high tolerance to smothering.

Sediments disturbed by trenching activities (including jet trenching, ploughing or mechanical trenching) are considered to typically re-settle within the immediate vicinity of the trench, less than 10 m either side, for sand or coarser sediments (Gooding *et al*., 2012). Since most of the sediments along the proposed cable route are sand, coarse or mixed sediments, and assuming these will re-settle within less than 10 m either side of the cable and along the length of route that will be trenched (i.e. 48.4 km), the total area of indirect disturbance is 0.97 km^2.

Since the cable at the Warebeth and Dounreay landfalls will be installed by HDD, with the cable pop-out location anticipated to be at approximately 1,050 m and 900 m offshore, respectively, it is anticipated that there will be little sediment disturbance in the nearshore areas during the proposed works. This includes where there is the potential for the presence of radioactive material in sediments due to the location of the nuclear site near the Doureay landfall (see Section 8.4.6O. The use of HDD and localised disturbance of sediments by trenching therefore means the potential for re-suspension and dispersal of radioactive material is also expected to be very limited.

There is potential for sediment re-suspension to occur during the deployment and retrieval of vessel anchors, although this is expected to be limited as DP installation vessels will be used. Seabed disturbance will therefore be minimised, where possible, through deploying anchors only when required and minimising the duration and extent of cable installation activities (see Table 10.7).

Assessment of impact significance

Given that the only habitats that were considered as potentially sensitive in the Project area were rocky areas or areas comprising coarse sediments, sediment re-suspension in these habitats will be limited, with a non-significant impact.

Approximately 48.4 km of the proposed cable route goes through areas of sediments, and cable installation activities within these sediments will result in a small indirect footprint (approximately 1.03 km^2). The biotopes associated with finer sediments along the proposed cable route were not classified of conservation importance. Considering the small area of indirect impact and the quick dispersal and re-settlement of sediments due to the currents through the Pentland Firth, no significant impacts on these habitats are anticipated.

Mitigation measures considered as part of the Project design are listed in Table 10.7.

Sensitivity / value	Magnitude of effect	Level of impact
Medium	Negligible	Negligible

Impact significance – NOT SIGNIFICANT

10.9.2 Potential impacts during operation

10.9.2.1 Introduction of new substrate

The introduction of new substrate (i.e. cable protection) in the marine environment will usually be followed by rapid colonisation by benthic organisms (Peterson & Malm, 2006; BERR, 2008).

Submarine cable structures are expected to have limited reef effect when located in an environment made of hard substrate (i.e. rocky seabed), and have showed no significant difference in benthic communities with the surrounding environments in this seabed type. However, on soft sediments unburied cables seem to generate a significant reef effect, with anemones being more abundant on the cable than in the surrounding soft bottom after 8 years and fish species being more abundant in the vicinity of the cable than in the surrounding area (Taormina *et al*., 2018). OSPAR (2009) reports that the reef effect can lead to the introduction of non-local fauna and thus to an alteration of the natural benthic communities. However, they recognised that this effect is very localised although long-term (OSPAR, 2009).

In areas of soft sediments along the proposed cable route, burial is the preferred option. Benthic species will not be able to settle on any buried cables, therefore no reef effect is anticipated in these areas. In the Orkney and Caithness nearshore areas, up to approximately 1 km of cable will be installed by HDD. At Dounreay the HDD pop-out is located approximately 900 m from the landfall, where the biotope 'mixed kelp with scour-tolerant and opportunistic foliose red seaweed on scoured or sand-covered infralittoral rock' (A3.125) is present. At Warebeth the cable will pop out at a distance of 1,050 m from the landfall where the seabed sediments consist of 'circalittoral fine sand' (A5.25). In these sections of cable, there will be no additional hard substrate deposited as part of the cable installation works, apart from the locations where the cable will pop-out. In the offshore sections of cable, the seabed is mostly rocky, therefore limited reef effect is expected in the rocky areas. In areas where the target burial depth cannot be achieved, rock placement will be required. These deposits will introduce additional hard substrate, thus increasing the surface on which benthic communities can settle, however these will remain localised and therefore no significant reef effect is anticipated.

Assessment of significance

Although a reef effect may be observed along the proposed cable route years after cable installation, this will remain localised and is not anticipated to cause adverse effects on existing benthic communities. The impact is therefore assessed as minor and not significant.

As the impact is not significant no mitigation measures are required. Measures considered as part of the Project design are listed in Table 10.7.

Sensitivity/value	Magnitude of effect	Level of impact
High	Low	Minor
Impact significance – NOT SIGNIFICANT		

10.9.2.2 Increased risk of introducing or spreading invasive non-native species (INNS)

INNS are species that have been introduced, either intentionally or unintentionally, to areas outside their natural range. They out-compete and replace natural native flora and fauna, and in doing so, can negatively affect native species and in turn regional ecosystems and economies. In Scottish waters, there are seven marine INNS of flora and fauna that are widespread and well established. Additionally, four INNS have a limited distribution in UK waters, with some species occurring in patchy locations around the UK and others being restricted to the British Isles.

The activities that may introduce INNS into Scottish waters and that are relevant to the proposed activities include shipping, as INNS can get attached to installation or survey vessels hulls or may be present in ballast water. The discharge of ballast water whilst within Scapa Flow is prohibited unless in accordance with the Ballast Water Management Policy for Scapa Flow (Orkney Islands Council, 2017).

A non-native species management plan / biosecurity plan for vessels will be developed as part of Construction Environment Management Plan (CEMP) to be provided to MS-LOT prior to marine installation activity commencing. The adoption of the management plan will ensure any risks linked to the introduction of INNS is reduced as much as possible (see Table 10.7).

Assessment of significance

The implementation of an INSS management plan will reduce the risk of introduction of INNS to low. The impact is therefore assessed as minor and not significant.

As the impact is not significant no mitigation measures are required. Measures considered as part of the Project design are listed in Table 10.7.

Sensitivity/value	Magnitude of effect	Level of impact
High	Low	Minor
Impact significance – NOT SIGNIFICANT		

10.10 Cumulative Impacts

Cumulative impacts are those resulting from the combined effects of the Project with other subsea cable projects through space and time, in the context of natural variability. It also includes the combined effects with commercial fisheries and other sea users generating similar effects.

As described in Section 15, there are two other projects overlapping with the proposed cable route corridor, namely the Dounreay Tri Floating Wind Demonstration Project and the Katanes Floating Energy Park. If the Project was to commence during a period in which the work on the overlapping cable route was being carried out, the overlapping areas will have the capacity to accommodate the predicted interaction between the installation vessels of the Project and other sea users of the identified receptors due to the embedded mitigation measures noted in Section 15.7.

The main commercial fishing gear in the Project area are traps and pots (as described in Section 14 - Commercial fisheries), which do not interact with the seabed. Additionally, bottom trawling activities are prohibited in the nearshore waters off the Dounreay landfall, under the Food and Environment Protection Act 1985 (NMPi, 2018). The nearshore waters around the north coast of Hoy and off the Orkney landfall are also designated for seasonal fishing restriction, with mobile or active fishing gear prohibited between 1st May and 30th September (NMPi, 2018). Due to the limited use of bottom fishing gear in the Project area, no cumulative benthic impacts with fisheries are anticipated.

10.11 Conclusion

Physical disturbance by trenching and cable laying activities and smothering of benthic habitat and species via sediment re-suspension and settlement are likely to occur within the footprint of the proposed works. The only seabed features identified as potential conservation importance are areas of boulders and cobbles, which had a low to medium resemblance to the Annex I stony or bedrock reef habitats. However, no habitat of high reefiness was identified. The detailed impact assessment and calculations of areas of benthic features impacted by the various cable installation methods show that the total area of impact is small (1.03 km^2), and that the proportion of potential Annex I habitats impacted is small compared to the overall area of the feature present within wider cable installation corridor.

Consequently, there will be no significant impact on benthic environment in the Project area.

Table 10.9 Summary of impact assessment

Potential impact			Assessment				Additional requirements	
Project activity	**Potential impact**	**Receptor**	**Sen/Val**	**Mag**	**Level of impact**	**Significance**	**Proposed mitigation measures**	**Residual impact**
Installation/ maintenance & repair/ decommissioning								
HDD at landfall	Temporary habitat loss/disturbance of habitat	Potential low grade Annex I stony reef and bedrock reef	High	Low	Minor	Not significant	N/A	N/A
		Non-specific biotopes	Low	Negligible	Negligible	Not significant	N/A	N/A
Anchors for CLB	Temporary habitat loss/disturbance of habitat	Potential low grade Annex I stony reef and bedrock reef	High	Low	Minor	Not significant	N/A	N/A
		Non-specific biotopes	Low	Negligible	Negligible	Not significant	N/A	N/A
Seabed preparation: Pre-sweeping of sandwaves	Temporary habitat loss /disturbance of habitat	Potential low grade Annex I stony reef and bedrock reef	High	Low	Minor	Not significant	N/A	N/A
		Non-specific biotopes	Low	Negligible	Negligible	Not significant	N/A	N/A
	Temporary increase in suspended sediment	Potential low grade Annex I stony reef and bedrock reef	Medium	Negligible	Negligible	Not significant	N/A	N/A
		Non-specific biotopes	Low	Negligible	Not significant	Negligible	N/A	N/A
Seabed preparation: Pre-lay grapnel	Temporary habitat loss /disturbance of habitat	Potential low grade Annex I stony reef and bedrock reef	High	Low	Minor	Not significant	N/A	N/A
		Non-specific biotopes	Low	Negligible	Negligible	Not significant	N/A	N/A
	Temporary increase in suspended sediment	Potential low grade Annex I stony reef and bedrock reef	Medium	Negligible	Negligible	Not significant	N/A	N/A
		Non-specific biotopes	Low	Negligible	Not significant	Negligible	N/A	N/A

Potential impact			Assessment				Additional requirements	
Project activity	**Potential impact**	**Receptor**	**Sen/Val**	**Mag**	**Level of impact**	**Significance**	**Proposed mitigation measures**	**Residual impact**
Seabed preparation: Boulder clearance by 'Orange peel' grab	Temporary habitat loss /disturbance of habitat	Potential low grade Annex I stony reef and bedrock reef	High	Low	Minor	Not significant	N/A	N/A
		Non-specific biotopes	Low	Negligible	Negligible	Not significant	N/A	N/A
Seabed preparation: Boulder clearance plough	Temporary habitat loss /disturbance of habitat	Potential low grade Annex I stony reef and bedrock reef	High	Low	Minor	Not significant	N/A	N/A
		Non-specific biotopes	Low	Negligible	Negligible	Not significant	N/A	N/A
	Temporary increase in suspended sediment	Potential low grade Annex I stony reef and bedrock reef	Medium	Negligible	Negligible	Not significant	N/A	N/A
		Non-specific biotopes	Low	Negligible	Not significant	Negligible	N/A	N/A
Seabed preparation: Pre-cut trenching	Temporary habitat loss /disturbance of habitat	Potential low grade Annex I stony reef and bedrock reef	High	Low	Minor	Not significant	N/A	N/A
		Non-specific biotopes	Low	Negligible	Negligible	Not significant	N/A	N/A
	Temporary increase in suspended sediment	Potential low grade Annex I stony reef and bedrock reef	Medium	Negligible	Negligible	Not significant	N/A	N/A
		Non-specific biotopes	Low	Negligible	Not significant	Negligible	N/A	N/A
Cable installation: Ploughing (including backfill plough)	Temporary habitat loss /disturbance of habitat	Potential low grade Annex I stony reef and bedrock reef	High	Low	Minor	Not significant	N/A	N/A
		Non-specific biotopes	Low	Negligible	Negligible	Not significant	N/A	N/A
Cable installation: Jet trenching	Temporary habitat loss /disturbance of habitat	Potential low grade Annex I stony reef and bedrock reef	High	Low	Minor	Not significant	N/A	N/A
		Non-specific biotopes	Low	Negligible	Negligible	Not significant	N/A	N/A

Potential impact			Assessment				Additional requirements	
Project activity	**Potential impact**	**Receptor**	**Sen/Val**	**Mag**	**Level of impact**	**Significance**	**Proposed mitigation measures**	**Residual impact**
	Temporary increase in suspended sediment	Potential low grade Annex I stony reef and bedrock reef	Medium	Negligible	Negligible	Not significant	N/A	N/A
		Non-specific biotopes	Low	Negligible	Not significant	Negligible	N/A	N/A
Cable installation: Mechanical trenching	Temporary habitat loss /disturbance of habitat	Potential low grade Annex I stony reef and bedrock reef	High	Low	Minor	Not significant	N/A	N/A
		Non-specific biotopes	Low	Negligible	Negligible	Not significant	N/A	N/A
	Temporary increase in suspended sediment	Potential low grade Annex I stony reef and bedrock reef	High	Low	Minor	Not significant	N/A	N/A
		Non-specific biotopes	Low	Negligible	Negligible	Not significant	N/A	N/A
Operation								
Cable protection: Rock protection	Permanent loss of habitat through cable protection	Potential low grade Annex I stony reef and bedrock reef	High	Low	Minor	Not significant	N/A	N/A
		Non-specific biotopes	Low	Negligible	Negligible	Not significant	N/A	N/A
	Introduction of new substrate	Potential low grade Annex I stony reef and bedrock reef	High	Low	Minor	Not significant	N/A	N/A
		Non-specific biotopes	Low	Negligible	Negligible	Not significant	N/A	N/A
	Increased risk of introducing or spread INNS	Potential low grade Annex I stony reef and bedrock reef	Low	Negligible	Negligible	Not significant	N/A	N/A
		Non-specific biotopes	Low	Negligible	Negligible	Not significant	N/A	N/A
Cable protection: Concrete mattresses	Permanent loss of habitat through cable protection	Potential low grade Annex I stony reef and bedrock reef	High	Low	Minor	Not significant	N/A	N/A
		Non-specific biotopes	Low	Negligible	Negligible	Not significant	N/A	N/A
	Introduction of new substrate	Potential low grade Annex I stony reef and bedrock reef	High	Low	Minor	Not significant	N/A	N/A

Potential impact			Assessment				Additional requirements	
Project activity	**Potential impact**	**Receptor**	**Sen/Val**	**Mag**	**Level of impact**	**Significance**	**Proposed mitigation measures**	**Residual impact**
		Non-specific biotopes	Low	Negligible	Negligible	Not significant	N/A	N/A
	Increased risk of introducing or spread INNS	Potential low grade Annex I stony reef and bedrock reef	Low	Negligible	Negligible	Not significant	N/A	N/A
		Non-specific biotopes	Low	Negligible	Negligible	Not significant	N/A	N/A
Cable protection: Cast iron shells	Permanent loss of habitat through cable protection	Potential low grade Annex I stony reef and bedrock reef	High	Low	Minor	Not significant	N/A	N/A
		Non-specific biotopes	Low	Negligible	Negligible	Not significant	N/A	N/A
	Introduction of new substrate	Potential low grade Annex I stony reef and bedrock reef	High	Low	Minor	Not significant	N/A	N/A
		Non-specific biotopes	Low	Negligible	Negligible	Not significant	N/A	N/A
	Increased risk of introducing or spread INNS	Potential low grade Annex I stony reef and bedrock reef	Low	Negligible	Negligible	Not significant	N/A	N/A
		Non-specific biotopes	Low	Negligible	Negligible	Not significant	N/A	N/A
Cable protection: Composite sleeving	Permanent loss of habitat through cable protection	Potential low-grade Annex I stony reef and bedrock reef	High	Low	Minor	Not significant	N/A	N/A
		Non-specific biotopes	Low	Negligible	Negligible	Not significant	N/A	N/A
	Introduction of new substrate	Potential low grade Annex I stony reef and bedrock reef	High	Low	Minor	Not significant	N/A	N/A
		Non-specific biotopes	Low	Negligible	Negligible	Not significant	N/A	N/A
	Increased risk of introducing or spread INNS	Potential low grade Annex I stony reef and bedrock reef	Low	Negligible	Negligible	Not significant	N/A	N/A
		Non-specific biotopes	Low	Negligible	Negligible	Not significant	N/A	N/A

11 MARINE MAMMALS

11.1 Introduction

This section assesses the potential impacts of noise emissions, sediment suspension, and disturbance at landfall sites from the proposed Orkney–Mainland Subsea Cable Link Project on marine mammals. The species considered within the section are cetaceans, pinnipeds and otters. Impacts to both individual marine mammals, and to protected sites with marine mammals as a qualifying feature are addressed below. The assessment of noise impacts on marine mammals is supported by modelling outputs from a previous underwater noise impact assessment which was undertaken by acoustic specialists on behalf of SHE Transmission for the Caithness to Shetland HVDC Project (SRSL, 2016). This section also outlines the management and mitigation measures which will be undertaken to ensure potential impacts on individual animals and protected sites are minimised.

Where relevant, any limitations related to the baseline conditions, data sources or scientific understanding/interpretation have been highlighted.

An overview of the species of marine mammal likely to be found in the vicinity of the Project is provided in Section 11.5 below.

11.2 Legislation and policy context

As well as the legislation and policy context outlined in Section 2 - Planning policy and legislative framework the important legal drivers which support the protection of marine mammals against potential impacts from underwater noise are those which pass The EU Habitats Directive into UK and Scottish law; these include:

- The Wildlife & Countryside Act 1981 (as amended);
- Nature Conservation (Scotland) Act 2004;
- The Convention on Biological Diversity (1992); and
- The Convention on the Conservation of European Wildlife and Natural Habitats (Bern Convention).

All species of cetacean (whales, dolphins and porpoises) occurring in UK waters are listed in Annex IV of the Habitats Directive as species of community interest in need of strict protection, known as EPS, and are fully protected in Scottish territorial waters (out to 12 nautical miles). Bottlenose dolphin and harbour porpoise are additionally listed in Annex II of the Habitats Directive as species whose conservation requires the designation of Special Areas of Conservation (SACs), which is enforced through Schedule 2 of the Habitats Regulations.

Although not afforded the strict protection as EPS through the Habitats Directive, pinniped species (seals) occurring in UK waters are listed in Annex V as species of community interest whose taking in the wild is subject to management measures outlined in Schedule 3 of the Habitats Regulations. Grey and harbour seals are also listed in Annex II of the Habitats Directive as requiring protection through the designation of SACs through implementation of Schedule 2 of the Habitats Regulations. Grey and harbour seals gain additional protection in Scottish waters under Part 6 of the Marine (Scotland) Act 2010 with recognises 194 seal haul-out sites along Scotland's coastline as important seal habitat requiring protection.

Otter are listed on Annex IV of the Habitats Directive and Schedule 2 of the Habitats Regulations and classed as EPS protected under the Conservation (Natural Habitats, c&,) Regulations 1994 (as amended).

11.3 Consultation

Throughout the Orkney–Mainland Subsea Cable Link Project, on-going scoping and consultation have played an integral role in ensuring the baseline and impact assessment have been relevant to the Project and meet the requirements of the regulators and their advisors.

Comments taken from consultation with Scottish Natural Heritage which are relevant to marine mammals are provided in together with responses to those comments, and references to the relevant sections where the comments have been addressed.

Table 11.1 Comments relevant to marine mammals

Name of organisation	Key concerns	Response	EA section wherein specific issue is addressed
SNH	The Marine Licensing application] indicates that the main potential impact on cetaceans and pinniped is disturbance due to underwater noise from vessels involved in the installation of the subsea cable and cable trenching activities. Noise from geophysical surveys and USBL beacons should also be assessed.	Geophysical survey noise and USBL noise has been taken into account for the assessment of impacts to marine mammals.	Section 11.9.3 – injury or disturbance from noise emissions.
SNH	For the assessment of the impact of underwater noise on cetaceans we recommend thresholds for injury published in 2016 by the US National Oceanic and Atmospheric Administration (NOAA) https://www.fisheries.noaa.gov/national/marine-mammal-protection/marine-mammal-acoustic-technical-guidance. We consider that these thresholds reflect the most comprehensive and up to date scientific knowledge relating to the risk of auditory injury to marine mammals.	The data presented in this chapter utilise injury and disturbance criteria provided by the most recently updated NOAA (2018) Guidance. This guidance has been considered in the assessment of short- and long-term noise impacts to marine mammals.	Section 11.6 — Assessment criteria
SNH	We agree that further assessment work is required to assess the potential impacts of the proposal on otters. The Dounreay decommissioning Phase 3 EIA recorded considerable otter activity to the east of the cable route and the Orkney landfall is in an area which provides suitable habitat for foraging and breeding, resting or sheltering places. The SHE Transmission Species Protection Plan on otters provides guidance on licensing requirements and further guidance can also be found on the SNH website: https://www.nature.scot/professional-advice/safeguarding-protected-areas-and-species/licensing/species-licensing-z-guide/otters-and-licensing.	These documents will be considered as appropriate in the assessment of potential impacts to otters.	Section 11.9.2– Potential disturbance at landfall sites.

11.4 Data sources

In addition to the data used to inform the environmental baseline described in Section 6, the data and information used to inform the assessment of potential impacts of the Orkney–Mainland Subsea Cable Link Project on marine mammals are listed in Table 11-2.

Table 11.2 Data and information sources

Data / information source	Description
Baseline information	
Evans *et al.*, (2011). Abundance and behaviour of cetaceans and basking sharks in the Pentland Firth and	A review of sightings information for cetaceans and basking sharks in the Pentland Firth and Orkney waters.

Data / information source	Description
Orkney Waters. Report by Hebog Environmental Ltd & Sea Watch Foundation.	
Reid *et al.,* (2003). Atlas of cetacean's distribution in north-west European waters. Joint Nature Conservation Committee, Peterborough.	Account and snapshot of distribution of all 28 species of cetacean species that are known to occur in the waters off north-west Europe.
Hammond *et al.,* (2017). Estimates of cetacean abundance in European Atlantic waters in summer 2016 from the SCANS-III aerial and shipboard surveys.	Summary of design-based estimates of abundance for cetacean species for which sufficient data were obtained during SCANS-III.
Pollock *et al.,* (2000). The distribution of seabirds and marine mammals in the Atlantic Frontier, north and west of Scotland.	Seasonal distribution patterns of all seabirds and marine mammals encountered.
SCOS. (2017). Scientific Advice on Matters Related to the Management of Seal Populations: 2017	Scientific advice on matters related to the management of seal populations for the year 2017
Sources used to inform impact assessment	
Marine Scotland, (2014). The protection of Marine European Protected Species from injury and disturbance - Guidance for Scottish Inshore Waters.	Advice for marine users planning to carry out an activity in the marine environment which has the potential to deliberately or recklessly kill, injure or disturb a marine EPS.
JNCC ,(2017). Guidelines for minimising the risk of injury to marine mammals from geophysical surveys.	Mitigation strategies to minimise the impacts of noise generated from seismic survey methods on marine mammals.
National Marine Fisheries Service (NMFS, 2018a). Revision to: Technical Guidance for Assessing the Effects of Anthropogenic Sound on Marine Mammal Hearing (Version 2.0): Underwater Thresholds for Onset of Permanent and Temporary Threshold Shifts.	Technical guidance supported by scientific review on how to identify the SELs, for various marine mammal groups and sound types, at which point exposure would cause auditory injury to occur.
SRSL (2016). Caithness to Shetland HDVC: Assessment of the Source and Effects of Anthropogenic Noise in the Marine Environment. Report.	Modelling of noise emissions and their potential impacts on marine mammals from cable installation and vessel activities which are also relevant to this Project.

Quantification of ambient, or background, noise is an important component of establishing a baseline against which to measure potential anthropogenic noise sources. As project-specific background noise data is currently unavailable, the assessment of underwater noise in this section utilises pre-determined ambient noise spectra defined by Wenz (1962). It is apparent from AIS data that ongoing vessel traffic contributes to ambient noise levels in this region (NMPi, 2018). It has therefore been considered in the noise impact assessment provided in the Sections below.

11.5 Existing baseline description

11.5.1 Cetaceans

Nineteen cetacean species have been recorded in the region covered by the Project area (Evans *et al.,* 2011; Reid *et al.*, 2003). There are several cetacean species known to frequent or seasonally visit the waters West of Orkney and off the north coast of Scotland, they include; harbour porpoise (*Phocoena phocoena*), bottlenose dolphin (*Tursiops truncatus*), short-beaked common dolphin (*Delphinus delphis*), white-beaked dolphin (*Lagenorhynchus albirostris*), white-sided dolphin (*Lagenorhynchus acutus*), Risso's dolphin (*Grampus griseus*), long-finned pilot whale (*Globicephala melas*), killer whale (*Orcinus orca*), and minke whale (*Balaenoptera acutorostrata*) (NMPi, 2018; Hammond *et al.*, 2017; Reid *et al.*, 2003; Barne *et al.*, 1997). Of these, the harbour porpoise, bottlenose dolphins, white-beaked dolphins, Risso's dolphin, killer whale, and minke whale regularly occur within the project area (Evans *et al.,* 2011).

Harbour porpoise are the most abundant cetacean species found in Scottish waters and can be seen throughout the Pentland Firth and Orkney waters (Reid *et al.* 2003; Hammond *et al.* 2017; NMPi, 2018). They often form small groups of two to three individuals, though may occasionally form larger foraging groups (SNH, 2014). The European population of harbour porpoise is listed in the Inernational Union for the Conservation of Nature (IUCN) Red List of Threatened Species as '*Least Concern'* (IUCN, 2018), and have a '*Favourable Conservation Status'* (FCS) in UK waters (Pinn, 2010).

Bottlenose dolphins also frequent the waters of the Pentland Firth and surrounding the Orkney Islands, with numbers peaking in the summer months (Evans *et al*., 2011; NMPi, 2018). They are predominantly a nearshore species, hugging the 20-50 m depth contours, though they have been seen offshore on occasion (Evans *et al*., 2011). Forming groups of 8-12 individuals, they do sometimes form larger groups of up to 80 individuals for social and breeding interactions (Evans *et al*., 2011). Bottlenose dolphins are considered '*data deficient*' on the IUCN Red List of Threatened Species (IUCN, 2018).

White-beaked dolphins frequent the deeper waters off the Pentland Firth year-round, often occupying depths of 50 – 10 m (Reid *et al*., 2003; Evans *et al.,* 2011). They are usually found in small groups of 10 or less but have also been observed in large groups of 50 and more. White-beaked dolphins have a conservation status of '*Least Concern'* in the IUCN Red List of Threatened Species (IUCN, 2018).

Risso's dolphins are globally distributed between the tropical and temperate latitudes of both hemispheres. Small numbers of the species occupy the coastal waters surrounding the UK, with the greatest numbers occurring along the northwest coast of Scotland and the northern isles (Reid *et al.,* 2003; Evans *et al.*, 2011; NMPi, 2018). Sightings of this species peaks in the summer months, though they have been recorded in Orkney in every month except December (Evans *et al.* 2011). In the Pentland Firth and around Orkney, they form smaller groups of up to 8 individuals, with a maximum of 16 individuals sighted in a single group (Evans *et al.,* 2011). The species is listed as '*data deficient*' on the IUCN Red List of Threatened Species (IUCN, 2018).

Killer whales are large delphinids[11] which occur globally in both nearshore and offshore waters. The species distribution in the UK is largely confined to northern and western Scotland. Sightings within northern Scotland are concentrated between the Pentland Firth and Orkney and tend to peak along the coastlines in the summer months, as the animals go offshore during the winter (Evans *et al*., 2011). Killer whales form small groups of 1 to 10 individuals, though sometimes gather in groups of up to 20 (Evans *et al*., 2011). Within the UK, killer whales are recognised as '*conservation dependant*,' meaning that without a viable conservation programme, the species is likely to become '*vulnerable*' or '*endangered*' within five years (Evans *et al*., 2011).

Minke whales have a highly cosmopolitan distribution and are present throughout the Pentland Firth and Orkney Islands year-round, with sightings predominantly occurring in the summer months (Reid *et al.,* 2003; Hammond *et al.,* 2017). They prefer water depths of up to 200 m and are often solitary or found in pairs, however they may form larger groups of up to 15 individuals when foraging (Reid *et al.,* 2003). Minke whales have a conservation listing of '*Near threatened*', meaning they are near qualifying for being listed as '*Vulnerable*' on the IUCN Red List of Threatened Species (Evans *et al*., 2011).

The distribution, density and abundance of the cetacean species which regularly occur in the Project area is described in Table 11-3 below.

Table 11.3 Cetacean species potentially present within the Orkney–Mainland Subsea Cable Link

Species & scientific name	General distribution	Density estimates within the project area (individuals/km^2)	Estimated population abundance in the Pentland and Orkney waters; and the North Sea (no. of individuals)	References
Harbour porpoise *Phocoena phocoena*	Individuals can be found in nearshore and offshore waters	0.152	16,822; 336,223	Evans *et al.,* (2011); Hammond (2017)
Bottlenose Dolphin *Tursiops truncatus*	Predominantly nearshore species	0.004	637; 2,222	Evans *et al.,* (2011) Hammond (2017)
White-beaked dolphin *Lagenorhynchus acutus*	Predominantly nearshore species	0.021	2,722; 16,562	Evans *et al.,* (2011); Hammond (2017)

[11] A diverse family of marine mammals with the typical characteristics of toothed whales.

Species & scientific name	General distribution	Density estimates within the project area (individuals/km^2)	Estimated population abundance in the Pentland and Orkney waters; and the North Sea (no. of individuals)	References
Risso's dolphin *Grampus griseus*	Individuals can be found in nearshore and offshore waters	< 0.051	1,569; N/A	SNH (2017); Evans *et al.,* (2011)
Killer whale *Orcinus orca*	Predominantly offshore species with seasonal visits inshore	N/A	30; 2,437	Evans *et al.,* (2011)
Minke whale *Balaenoptera acutorostrata*	Individuals can be found in nearshore and offshore waters	0.010	1,319; 9,237	Evans *et al.,* (2011); Hammond (2017)

11.5.2 Pinnipeds

Two species of seal inhabit the waters of the Pentland Firth and West of Orkney: the grey seal (*Halichoerus grypus*) and the harbour seal (*Phoca vitulina*) (Scottish Government, 2016; Jefferson *et al.*, 2015). The coastlines and nearshore marine environments of this region form important breeding and foraging habitat for both species (Pollock *et al.,* 2000).

The undisturbed coastlines in Orkney make excellent habitat for seal haul-outs, which is why over a quarter of the harbour seals in the UK can be found in this region. The majority of seal haul-outs are situated between the northern islands and along their eastern shores, avoiding steep, west-facing cliffs (Barne *et al.*, 1997). The nearest seal haul-outs are located 1.8 km away in Selwick (north Hoy) and 3.5 km away at the Bay of Ireland (Orkney), both of which support grey and harbour seals. However, there are no seal haul-outs which fall within the project footprint (see Figure 9.1). Incidental marine mammal records from the onshore landfall surveys have shown the presence of pinnipeds to the west of the Warebeth landfall site (ERM Ltd, 2019).

While grey seal numbers have been steady, or potentially increasing, in recent decades, harbour seal numbers have suffered general declines in recent years around Scotland (SCOS, 2017). Seals are particularly vulnerable to human disturbance at their haul-outs during their pupping and moulting seasons. The pupping season of harbour seals falls between June and early July, with the subsequent moulting season taking place in August. Grey seal pupping takes place from mid-September through to January, with their moulting period falling thereafter until early April (Bowen, 2016).

As seals are central-place foragers, they utilise their haul-outs as a terrestrial 'base' for their important life history events (i.e. pupping & moulting, etc.) and to rest between their offshore foraging trips (Pollock, 2000). Both species are associated with shallower shelf waters less than 200 m in depth (Pollock, 2000), with harbour seals in northeast Scotland generally foraging between the 10-50 m depth contour (Tollit *et al*., 1998) and grey seals in the same region predominantly foraging between 50-90 m (McConnell *et al*., 2001). Grey seals generally make longer return foraging trips than do harbour seals (Pollock, 2000). The mean return-trip foraging range (i.e. foraging trips which start and end at the same haul-out) for grey seals in northeast Scotland is 39.8 km (McConnell *et al*., 2001), while it is approximately 30 km for harbour seals (Tollit *et al.*, 2001).

The mean at-sea distribution of harbour seals and grey seals across the Project area ranges between 0.62 – 30.83 individuals and 6.18 – 49.36 individuals per 25 km^2, respectively (NMPi, 2018; Scottish Government, 2016). These values are low to moderate in comparison to the western isles of Orkney and the west coast of the UK (NMPi, 2018).

11.5.3 Otters

Otters are small, semi-aquatic mammals which inhabit riverine, brackish and coastal environments throughout the UK. Although land mammals, this species depends upon both freshwater and marine environments for

food and resources. Their coastal marine habitat comprises low, peat-covered coastlines with shallow, seaweed rich marine waters and a consistent freshwater supply (DECC, 2016).

Habitat loss, hunting and pollution have reduced the historic range of this species throughout the UK and Europe. Scotland remains a stronghold for otters within Europe, with the greatest densities occurring in Shetland and the northern and western parts of the country (Barne *et al.*, 2016). Otters are known to occur in coastal areas around Orkney and incidental marine mammal records from the onshore landfall surveys have noted their presence to the west of the Warebeth landfall (ERM Ltd, 2019). The islands provide suitable habitat for otters to forage, shelter, breed, and rest. Dounrey, where the Orkney–Mainland Subsea Cable Link is known to host otter holts. Indeed, the River Borgie, approximately 29 km from the landfall site at Dounreay, is a designated site for coastal otters (NMPi, 2018).

11.6 Assessment criteria

The general assessment methodology is outlined in Section 7 - Impact assessment methodology. Specific criteria relating to marine mammals have been developed for the sensitivity/value of a receptor and the magnitude of impacts.

The sensitivity of a receptor has been considered in terms of the tolerance to change, recoverability, adaptability and value. Expert judgement has been employed to consider the final sensitivity of a particular receptor. Definitions of sensitivity are provided in Table 11-4.

Table 11.4 Definitions of sensitivity

Sensitivity/value	Definition
Negligible	Receptor is generally able to adapt and tolerant a particular effect without an effect on survival or reproduction rates. Receptor is able to return to previous habitat/ activities almost immediately. Species of no conservation concern.
Low	Receptor has some tolerance and/or adaptability to a particular effect, so that survival rates and reproductive rates are unlikely to be affected. Receptor is able to recover from the effect. Species which contribute to a national site (e.g. Marine Protected Area (MPA)), which are present in regionally important numbers, which are on Annex II of the European Habitats Directive, which are listed as EPS, which are listed in Schedule V of the Wildlife and Countryside Act, which are listed as priority species in the UKBAP or which are otherwise of conservation interest (e.g. Local BAP, PMF species).
Medium	Receptor has a low capacity to tolerate or adapt to a particular effect so that reproductive and survival rates may be affected. The receptor has some ability to recover from the effect. Species that are of least concern on the IUCN Red List but which form qualifying interests of internationally designated sites or which are present in internationally important numbers.
High	Receptor has a very low capacity to tolerate or adapt to a particular effect so that reproductive and survival rates are likely to be affected. The receptor has a low ability to recover from the effect. Species that are near-threatened or vulnerable on the IUCN Red List.
Very high	Receptor has no capacity to tolerate or adapt to a particular effect and no ability to recover. Species that are endangered or above on the International Union for Conservation of Nature and Natural Resources (IUCN) Red List of Threatened Species ('Red List').

The magnitude of the impact has been considered in terms of the size and spatial extent, duration and timing/seasonality and frequency of the impact in question. Expert judgment has been employed to consider and evaluate the likely impact on the species, population or habitat identified. Definitions of magnitude are provided in Table 11-5.

Table 11.5 Definition of magnitude

Magnitude	Definition
Negligible	Very short term, recoverable effect on the behaviour and/or distribution in a very small proportion of the population. No potential for the any changes in the individual reproductive success or survival therefore no changes to the population size or trajectory.
Minor	Short-term and/or intermittent and temporary behavioural effects in a small proportion of the population. Reproductive rates of individuals may be impacted in the short term (over a limited number of breeding cycles). Survival and reproductive rates very unlikely to be impacted to the extent that the population trajectory would be altered.
Moderate	Temporary changes in behaviour and/ or distribution of individuals at a scale that would result in potential reductions to lifetime reproductive success to some individuals although not enough to affect the population trajectory over a generational scale. Permanent effects on individuals that may influence individual survival but not affecting enough individuals to alter population trajectory over a generational scale.
Major	The impact would affect the behaviour and distribution of sufficient numbers of individuals, with sufficient severity, to affect the FCS and/ or the long-term viability of the population at a generational scale.

Following the identification of receptor sensitivity/value and magnitude of the effect, the significance of the impact is determined using the assessment matrix and expert judgement. The matrix used to identify the significance of an impact is presented within Section 7.3.3. Impacts categorised as moderate or major are considered to be significant, minor or negligible impacts are not considered to be significant.

11.7 Identification of potential Impacts to marine mammals

Following the establishment of the baseline conditions of the Project and its surrounding area, and the identification of the Project activities, it is possible to assess the potential social and environmental impacts of the Project. A range of potential impacts to marine mammals were considered during the scoping phase. After careful review, it was determined that underwater noise emissions, increased sediment suspension, and disturbance at landfall sites in relation to installation, maintenance and decommissioning were the only impact mechanisms requiring further consideration. No impacts during the operation phase require further consideration. The details of the Project activities and their relationships with these impact mechanisms are summarised in Table 11-6.

Table 11.6 Potential impacts of project activities on marine mammals

Project activity	Project phase			Impacting factors				Potential impacts on marine mammals
	I	O	D	Source frequencies (kHz)[12]	Sound pressure level (dB re 1 µPa at 1 m)[10]	Area covered by activity	Indicative activity durations	
Vessels								
DP cable lay vessel	✓	X	X	<1 - 10	186.8	< 500 m from vessel	1 month	Injury or disturbance from noise emissions.
Post lay burial vessel	✓	X	X	<1 - 10	183.0-190.4	< 500 m from vessel	6 weeks	Injury or disturbance from noise emissions.
Rock placement vessel	✓	X	X	<1 - 10	183.9-184.1	< 500 m from vessel	2 weeks	Injury or disturbance from noise emissions.
Guard vessel	✓	X	✓	< 1	159.8	< 500 m from vessel	3 months	Injury or disturbance from noise emissions.
Survey vessel	✓	X	X	< 1	159.8	< 500 m from vessel	2 months	Injury or disturbance from noise emissions.
Pre-lay geophysical survey								
Single-beam Echosounder (SBES)[13]	✓	X	X	70 - 300	218 - 232	Up to 2 km at any time	2 months	Injury or disturbance from noise emissions.
Multi-beam Echosounder (MBES)	✓	X	X	70 - 300	218 - 232	Up to 2 km at any time	2 months	Injury or disturbance from noise emissions.
Side-scan Sonar (SSS)	✓	X	X	300 - 600	210	Up to 2 km at any time	2 months	Injury or disturbance from noise emissions.
Sub-bottom Profiler (SBP)	✓	X	X	0.5 - 100	198 - 238	Up to 2 km at any time	2 months	Injury or disturbance from noise emissions.

[12] Noise emissions measurements taken from SRSL (2016).
[13] Information on noise emissions for SBES taken for available data on MBES supplied in SRSL (2016).

Cable installation								
Cable lay	✓	X	X	N/A	N/A	<0.01 km^2	1 month	Injury or disturbance from noise emissions. Increased sedimentation affecting ability to forage.
Pre-trench /back fill plough	✓	X	X	N/A	N/A	Up to 0.78 km^2	3 weeks	Injury or disturbance from noise emissions. Increased sedimentation affecting ability to forage.
Jet trencher	✓	X	X	N/A	N/A	Up to 0.5 km^2	6 weeks	Injury or disturbance from noise emissions. Increased sedimentation affecting ability to forage.
Jet trencher & mechanical trenching	✓	X	X	N/A	N/A	Up to 0.78 km^2	6 weeks	Injury or disturbance from noise emissions. Increased sedimentation affecting ability to forage.
HDD landfall	✓	X	X	N/A	N/A	<0.001 km^2	1 month	Disturbance at the landfalls.
Cable protection								
Rock placement	✓	✓	✓	N/A	N/A	0.001 km^2	2 weeks	Injury or disturbance from noise emissions.

11.8 Embedded mitigation and management measures

As part of the Project design process a number of embedded mitigation and management measures have been proposed to reduce the potential impact on marine mammals and adhere to environmental best practice. There is a commitment to deliver these measures and therefore they are considered part of the Project design.

The assessment of magnitude, sensitivity and significance in Section 11.9 includes the incorporation of these measures.

Table 11.7 Best practice (BP) and embedded mitigation and management measures (EM)

ID	Measure	Justification
BP1	A CEMP and an Emergency Spill Response Plan will be developed and implemented for the installation phase. A non-native species management plan / biosecurity plan for vessels will be developed as part of the CEMP.	Measures will be adopted to ensure that the potential for release of pollutants from construction, operation and decommissioning is minimised.
BP2	Control measures and shipboard oil pollution emergency plans (SOPEP) will be in place and adhered to under MARPOL Annex I requirements for all vessels. In the event of an accidental fuel release occurring appropriate standard practice management procedures will be implemented accordingly.	Measures will be adopted to ensure that the potential for release of pollutants from construction, operation and decommissioning is minimised.
BP4	Vessels will be equipped with waste disposal facilities (sewage treatment or waste storage) to IMO MARPOL Annex IV Prevention of Pollution from Ships standards.	Measures will be adopted to ensure that the potential for release of pollutants from construction, operation and decommissioning is minimised.
BP5	Vessel crew will be made aware of all marine mammals they might encounter and will employ best practice measures for boat control near wildlife as informed by the *Scottish Marine Wildlife Watching Code* and *Guide to Best Practice for Watching Marine Wildlife*.	To minimise the potential risk of injury to marine mammals.
BP6	JNCC guidelines for minimising the risk of disturbance and injury to marine mammals from seismic surveys (JNCC, 2017) will be implemented throughout the survey period.	Compliance with the JNCC guidelines is considered best practice and will, in most cases, reduce the risk of injury to marine mammals from deliberate seismic activities to negligible levels. Although these guidelines do not deal with disturbance directly, the mitigation measures are deemed appropriate for assisting in the reduction of noise-related disturbance to marine mammals as well.
EM3	Marine Mammal Observers (MMO) and Passive Acoustic Monitoring (PAM) will be deployed on all vessels making emitting noise which could cause a disturbance to marine mammals.	To reduce the risk of physical injury and disturbance to marine mammals.

11.9 Assessment of impacts during cable installation, maintenance and

11.9.1 Increased suspended sediment

Subsea cable installation activities have the potential to increase levels of suspended sediments within the water column, known as turbidity, as sediment particles are disturbed from the seabed. The spatial extent of such increases to turbidity can vary dramatically depending upon particle size and oceanographic processes. Fine particles take longer to fall out of suspension and are easily transported by currents, thus they are likely to travel further from the area of disturbance and generate a greater area of disturbance.

Seabed sediment disturbance from cable installation activities has the potential to generate localised, short term increases in turbidity. The magnitude of the potential impact depends on the variability of ambient turbidity

and the environmental variable acting upon introduced sediment suspension from project activities. The cable will be trenched for up to approximately 48.4 km of its length, over this area the sediments are coarse in nature (see Section 10). Therefore, it is likely that there will be sediment resuspension over the majority of the cable route. However, the Benthic and Intertidal Ecology assessment undertaken as part of this EA (see Section 10) has determined that any increase in turbidity or suspended sediment levels is expected to be temporary and spatially restricted, given the high-energy environment within which the sediment will be resuspended. Therefore, any elevated turbidity in the immediate vicinity of the cable burial will be very short lived.

Increases in suspended sediments beyond ambient levels may reduce light penetration within the water column and, therefore, reduce visibility for marine mammals occupying those waters. Seals and otters are most likely to be affected by such changes in visibility, as they are dependent upon visual cues to track prey (Scottish Executive, 2007). Grey and harbour seals have been identified as having a high sensitivity to reductions in light penetration, while cetaceans and otters have a moderate sensitivity to this impact (Dunstone and Gorman, 1998). Nonetheless, seals can be found inhabiting areas of near-persistent turbidity (e.g. the southern North Sea and The Wash, and the Thames Estuary on the south-east coast of England), so it appears unlikely that increased turbidity would place significant constraints on the foraging success of these species. In addition to using their eyesight to find prey and navigate, seals are also able to forage in turbid and unlit waters using tactile cues from their highly-sensitive whiskers, or vibrissae (Mills and Renouf, 1986). There is evidence that harbour seals use their vibrissae to sense very low frequency vibrations and minute movements in water, such as those generated by small fish (Dehnhardt *et al.*, 1998). For these reasons, temporary, localised sediment suspension increases are unlikely to have any significant impacts to pinnipeds.

Much like pinnipeds, semi-aquatic carnivore species, such as otters, forage underwater using a combination of vision and tactile features (Carss, 1995). Piscivorous species like the Eurasian otter have enhanced facial sensitivity, including extended vibrissae, which help them detect vibrational changes in the water column whilst foraging for mobile prey. When waters are turbid or murky, otters utilise their vibrissae to supplement the lack of available visual information (Carss, 1995). In this way, they have adapted to be less sensitive to changes in visibility from increased sediment suspension than other species (Dunstoneand Gorman, 1998), and are therefore unlikely to be affected by this impact factor.

Cetaceans supplement deficits in their ocular abilities with auditory information, including sophisticated call signatures and, for the toothed species such as dolphins and porpoises, the employment of echolocation when foraging. Consequently, these taxa are unlikely to be directly impacted by temporary increases in turbidity in the marine habitat and the sensitivity of the receptors is considered to be low.

Assessment of significance
Given the anticipated limited duration, localised extent and high reversibility of sediment suspension the magnitude is considered to be negligible. As seals are known to inhabit environments regularly subjected to elevated turbidity, and pinnipeds and cetaceans forage predominantly using vibrations and echolocation, marine mammal sensitivity to increased suspended sediment is considered low.
As the impact is not significant no mitigation measures are required. Measures considered as part of the Project design are listed in Table 11-7.

Sensitivity/value	Magnitude of effect	Level of impact
Low	Negligible	Negligible
Impact significance – NOT SIGNIFICANT		

11.9.2 Potential disturbance at landfall sites

The marine mammal species which are potentially impacted by cable lay operations at landfall sites are seals and otters. Potential impacts to these species include habitat loss and disturbance.

11.9.2.1 Pinnipeds

Although they occupy the marine environment for the majority of the year, grey and harbour seals do utilise the coastal environment during their most sensitive life-history periods: breeding, pupping and moulting. They

form breeding colonies and haul-outs for these purposes along rocky, often remote coastlines around the UK, though sometimes colonies may extend onto sandbanks and up cliffs (Nordstrom, 2006). Disturbance at these important terrestrial habitats, either from human interaction or vessel presence, has the potential to cause acute distress, which may lead to individuals vacating the site and returning to the water. At pupping sites, this behavioural response to stressors has the potential to impact pup survival, as it can disrupt nursing and lead to energetic deficits in pre-weaned pups (NMFS, 2018b).

Fortunately, the landfall sites which have been selected for the Orkney–Mainland Subsea Cable Link project do not include designated grey or harbour pinniped pupping sites or haul-outs. Two haul-out sites are in proximity to the installation corridor Selwick located 1.8 km away and Bay of Ireland located 3.5 km away. The nearest SAC for pinnipeds is the Sanday SAC, which has been designated for the protection of harbour seals (see Section 9.3). This site is located approximately 49 km from the cable corridor.

Cable lay operations at landfall sites will be a spatially constrained activity occurring over the period of up to a few weeks. The Project is not anticipated to have any adverse impacts to the FCS of seals within the vicinity of the Project. The cable will be installed using HDD at the landfall, there will be no direct disturbance to the coastline. Vessels will be stationary 750 m to 1000 m offshore while the cable is pulled through the HDD Duct.

Assessment of significance

There are no sites designated for the conservation of pinnipeds within the immediate of the Project, although pinnipeds may be present in the vicinity of the Project. The sensitivity of otters is considered to be medium.

There will be no direct disturbance to the coastline as the cable will be installed using HDD. Installation vessels will be located 750 m to 1000 m offshore and therefore the disturbance to pinnipeds at the landfall is considered to be negligible.

As the impact is not significant no mitigation measures are required. Measures considered as part of the project design are listed in Table 11-7.

Sensitivity/value	Magnitude of effect	Level of impact
Medium	Negligible	Negligible
Impact significance – NOT SIGNIFICANT		

11.9.2.2 Otters

Otters are particularly sensitive to anthropogenic changes to their habitats. This species occurs in a variety of semi-aquatic environments, including along riverbanks, in marshes, wetlands and at tidal inlets. Their habitat use in coastal areas is largely dependent on the presence of freshwater features (Roos *et al.*, 2015). As such, the location of their holts (or dens) is fairly restricted and anthropogenic changes to their habitat may have dramatic repercussions, including localised extinctions. However, in Shetland otters have been found to regularly breed under ferry terminals and under jetties of oil terminals, so it is considered that there is a degree of adaptability to anthropogenic disturbance (Chanin, 2000).

There are no designated sites for the conservation of otters within the immediate vicinity of the Project. The closest site is the River Borgie SAC, approximately 29.5 km from the landfall site at Dounreay.

In proximity to the Dounreay landfall otter activity has been recorded along the Dounreay burn and suitable habitat has been recorded onshore from the landfall suggesting occasional used on the terrestrial and coastal area (Dounreay Tri Limited, 2016). The Orkney landfall at Warebeth, along with the majority of the Orkney coastline, provides suitable habitat for otter foraging, breeding resting and sheltering (SNH, 2018).

This assessment is focused upon the marine aspects of the Project from MHWM to MHWM. The cable installation at both landfalls is being conducted through HDD, therefore there will be no direct disturbance to the coastline due to the installation. The marine HDD exit point is located between 750 m to 1000 m from the coastline therefore there will be minimal disturbance on otter populations at either landfall from coastal vessel

presence. The Project vessels will be largely stationary, with the cable laying vessel itself being stationed approximately 750 m to 1000 m from the shore.

Assessment of significance

Disturbance to marine mammals at landfall sites from project activities is anticipated to be limited to otters. Otters are sensitive to anthropogenic changes but do show adaptability to the presence of infrastructure developments. There are no sites designated for the conservation of otters within the immediate of the Project. The sensitivity of otters is considered to be medium.

There will be no direct disturbance to the coastline as the cable will be installed using HDD. Installation vessels will be located 750 m to 1000 m offshore and therefore the disturbance to coastal otters is considered to be negligible.

As the impact is not significant no mitigation measures are required. Measures considered as part of the project design are listed in Table 11-7.

Sensitivity/value	Magnitude of effect	Level of impact
Medium	Negligible	Negligible
Impact significance – NOT SIGNIFICANT		

11.9.3 Injury or disturbance from noise emissions

11.9.3.1 Potential noise sources

Naturally-occurring underwater sound, known as ambient sound, is generated by hydrographic processes, such as rain or breaking waves, and biological processes, such as the movement of schooling fish, the popping of corals, and long-range communication between baleen whales. There are also man-made, anthropogenic sounds being introduced into the marine environment at increasing levels. Sources of anthropogenic sound include: shipping, oil and gas exploration and production, pilling for renewable energy projects, aircraft and military activity, and recreational vessel activity.

Many marine species use sound to understand their surroundings, track prey and communicate. In terms of marine mammals, cetaceans are considered 'sound specialists', using sound as their primary sense for undertaking the majority of their intrinsic biological, social and ecological processes. Toothed whales, dolphins and porpoises even echolocate, creating an image of their environment, conspecifics and potential prey through the production and interpretation of reflected sound (Ketten, 1992; Schevill and McBride, 1956).

Exposure to natural sounds in the marine environment may elicit behavioural responses in marine mammals; for example, harbour seals have been shown to respond to the calls of killer whales with anti-predator behaviour (Deecke *et al*., 2002). Additionally, marine mammals may respond to anthropogenic sounds in ways which we are only beginning to understand. The potential direct impacts of introduced sound on marine mammal species can cause physiological changes such as stress response (Romano *et al.,* 2004), and behavioural changes such as the masking of communication (Ellison *et al*. 2011) or displacement of the animals from the vicinity of the sound source (Bailey *et al*. 2010; Madsen *et al.* 2006). Furthermore, there are potential indirect impacts elicited by introduced noise, including impacts to foraging success from the displacement of prey species and impacts to reproductive success from masked communication or stress (NRC, 2005; Croll *et al.,* 2001).

In addition to potential behavioural impacts of noise, marine mammals exposed to an adequately high sound source may experience a temporary shift in hearing ability, termed a temporary threshold shift (TTS) (Ellison *et al*. 2011; Finneran *et al*., 2005). In some cases, the source level may be sufficiently high such that the exposed animal may experience physical damage to their auditory organs and the shift may not be reversed, known as a permanent threshold shift (PTS) (Southall *et al.*, 2007). For the purposes of this assessment, PTS has been interpreted as the sound level above which injury to an animal may occur.

Noise sources which are likely to occur during the installation of the Orkney–Mainland Subsea Cable Link subsea cable and which have the potential to cause injury or disturbance to marine mammals are limited to the following: vessels; cable burial activities; and geophysical survey activities. These noise sources are detailed in the subsequent sections.

11.9.3.1.1 Vessels and cable installation

Vessels and installation activities

Cable lay operations will occur over a 24-hour period to maximise us of periods of good weather and vessel availability, it is also not desirable to stop operations such as cable lay once they have started. The only anticipated interruptions to subsea cable installation activities would be for potential joints that need to be made along the submarine cable route or at the landfalls. However, these interruptions are not planned as part of normal operations. Cable laying can progress at speeds of up to 500 m per hour in variable weather conditions, depending on the operational limitations of the CLV being used. In severe weather, cable lay activities are likely to be paused for safety reasons in which case the cable would be cut for later recovery and jointing. Guard vessels will also be employed to ensure other vessels remain outside the operational area and to reduce collision risk during the cable lay operations.

The following types of vessels are likely to be used in the cable lay and survey activities associated with the Orkney–Mainland Subsea Cable Link:

- Cable lay vessel;
- Post-lay burial vessel;
- Rock placement vessel;
- Guard vessel;
- Small craft; and
- Geophysical/Geotechnical survey vessel.

There are a variety of tools currently available on the market to support cable trenching and burial, each with different suitability depending on the trenching and backfill requirements, the geotechnical conditions along the route and the cable type (see Section 4 – Project description). Cable installation activities include:

- Pre-cut ploughing;
- Cable installation;
- Mechanical jetting and cutting (i.e. trenching);
- Boulder clearance and backfilling;
- HDD at landfalls; and
- Rock placement.

Mechanical cutting and jetting are in some cases referred to collectively as “trenching” in order to differentiate them from ploughing based methodologies. Water jetting includes several subcategories such as ROV, mass flow excavator, jet sled and vertical injector. Rock placement and / or concrete mattresses will be deployed as part of the construction process at cable crossing points and in areas where burial to the target burial depth cannot be met due to hard seabed conditions being encountered. It should be noted that cable installation operations come with associated use of tools and activities (e.g. rock placement, use of mass flow excavator, etc.).

The vessel and cable installation activities described above will not all take place simultaneously. Rather, activities are likely to be phased; for example, rock placement is likely to take place as an isolated activity once the cable has been installed. Consequently, cable installation activities will be made up of various combinations of activities and vessels.

Likely sound emissions from vessels and installation activities

The primary sources of sound from vessels are: propellers, other machinery, and propulsion through water (e.g. Ross, 1976; Wales and Heitmeyer, 2002). In general, vessel sound is continuous and characterised by narrowband tonal sounds at specific frequencies and / or broadband sounds. Acoustic broadband source levels typically increase with increasing vessel size and is strongest at frequencies below 1 kHz. Smaller vessels (< 50 m) generally have source levels between 160 – 175 dB (re 1µPa), medium size vessels (50 - 100 m) between 165 – 180 dB (re 1µPa), and large vessels (> 100 m) between 180 – 190 dB (re 1µPa) (Richardson *et al.*, 1995). However, sound levels vary considerably depending on the size, configuration and number of engines the vessel has, the gear being used, and the speed at which the vessel is travelling.

Information regarding underwater noise emissions from cable installation and cable protection activities is very limited and little to no specific data exists. While some cable installation activities, such as rock placement, may introduce noise to the marine environment, studies have indicated that noise emissions from such activities are generally masked by the CLV's themselves (Nedwell and Edwards, 2004). As such, further assessment of noise impacts from cable installation activities will be limited to vessel activities, which generate the greatest noise emissions for this aspect of the Project.

11.9.3.1.2 Geophysical survey

The geophysical surveys will use a variety of multiple-pulse seismic technologies to assess the seabed habitat; including the following survey equipment:

- Single Beam Echosounders (SBES);
- Multi-beam Echosounder (MBES);
- Side scan sonar (SSS); and
- Sub-bottom profiler (SBP) (towed from a Remotely Operated Towed Vehicle (ROTV)).

These geophysical survey techniques use multiple-pulsed sounds to image the seabed and its strata. All survey tools, MBES, SSS, SBP etc. can be either hull mounted, towed or mounted on ROV's ROTV's. dependent on vessel and water depth. SBES, MBES, SSS, and SBP systems are comparable to pinger systems which exploit the seabed's reflective properties to collect data from reflected pulsed-sound emissions. Although similar in principle to air gun arrays used in seismic surveys, these technologies have considerably lower source levels and their noise emissions are more directional in nature. These systems do generate pulsed sounds with shorter inter-pulse intervals than seismic airgun arrays (i.e. a more rapid succession of 'clicks'), which may elevate the cumulative exposure of marine mammals to noise. However, animals outside the narrow 'beam' of sound generated by this survey equipment are highly unlikely to be injured by these noise emissions. Moreover, the deployment of ROTVs bring these sound sources closer to the seabed, thereby reducing the likelihood of marine mammals occurring within the 'beam' of sound.

The source of underwater noise which poses the greatest potential risk of injury or disturbance to marine mammals is the SBP, which generates sound within the hearing sensitivity range of most cetaceans and pinnipeds. SBP's are powerful low frequency sonar transmitters used to characterise the upper layers of the sediment or rock under the sea floor (i.e. strata). Low frequency sounds attenuate more slowly than their high frequency counterparts, meaning low frequency noise emissions travel further within the marine environment. This technology also emits noise at higher source levels than the SBES, MBES, or SSS survey techniques, and is likely to mask sounds emitted by the ROTV it will be towed from. These properties may increase the potential for SBP systems to impact noise sensitive marine species in the vicinity of the survey.

11.9.3.2 Quantification of potential noise impacts

11.9.3.2.1 Quantification of injury impacts

Previously undertaken propagation modelling for the Caithness to Shetland HVDC Project (SRSL, 2016), has been used to inform this assessment. It includes a set of impact ranges within which potential injury and disturbance effects may occur. It should be noted that the identified impact ranges are not definitive, rather the modelled thresholds are those which are most *likely* to cause an impact, but this may not always be the case. Exposure levels at PTS onset, individual variations in hearing ability, and uncertainties regarding behavioural response and swim speed / direction all complicate the assessment of noise emissions impacts. The impact ranges presented below are thus representative of potential impact ranges and are designed to inform decision making, given data on PTS in marine mammals are as yet unavailable.

Criteria for measuring injury to cetaceans from acoustic emissions have been proposed by several sources (Southall *et al.,* 2007; Lucke *et al.*, 2008; Scottish Government, 2013; NMFS, 2018a). Guidance from the JNCC (JNCC, 2017) and Marine Scotland (Marine Scotland, 2014) on the minimisation of injury from seismic noise emissions both recommend using the injury criteria proposed by Southall *et al*. (2007). The assessment herein utilises the more conservative criteria which have been recently defined by the US National Oceanic and Atmospheric Administration (NOAA) (NMFS, 2018a; herein referred to as the 'NOAA (2018) guidelines'), per the recommendations provided in consultation with SNH (see Section 11.3). The NOAA (2018) guidelines incorporate recent data on high frequency cetacean hearing, including those of harbour porpoise and beaked whales known to occur throughout the Northern North Sea.

The NOAA (2018) guidelines injury and disturbance threshold criteria are defined for two categories of sound:

- **Impulsive sound**—sound comprising one or more discreet acoustic events in a 24-hour period (e.g. from a MBES, SSS, or SBP); and
- **Non-impulsive sound**—continuous sound emissions which are discrete and not constrained to 24-hour periods (e.g. vessel engines, ROV propeller, etc.).

PTS onset thresholds for non-impulsive sounds are derived from weighted cumulative sound exposure levels (SEL_{cum}), while the derivation of PTS from impulsive sound can be from SEL_{cum} or peak sound pressure metrics (whichever generates the largest isopleth in calculating PTS onset is the recommended threshold) (NMFS, 2018a). These metrics consider available data on marine mammal hearing abilities, which also provide a method for weighting values when injury threshold data is unavailable, known as mammal hearing weighted (M-weighted) SELs and linear (i.e. un-weighted) peak pressure levels, respectively.

The M-weighting function is designed to represent the bandwidth for specific groups of marine mammals that share similar sensitivities to noise. The groups include low-, mid- and high-frequency cetaceans (whales, dolphins, and porpoises) and pinnipeds (seals) in water. Hearing groups are defined by their relative hearing frequency sensitivities in Table 11-8 below.

Table 11.8 Auditory bandwidths estimated for marine mammals found in the project vicinity (Southall *et al.*, 2007; Scottish Government, 2013; NMFS, 2018a)

Hearing group	Estimated auditory bandwidth
Pinnipeds in water (information for phocid seals only)	50 Hz to 86 kHz
Low-frequency cetaceans (deep diving species – e.g. sperm whale, minke whale, pilot whale, etc.)	7 Hz to 35 kHz, with peak sensitivity around 100 – 200 Hz
Mid-frequency cetaceans (small dolphins – e.g. bottlenose dolphin, Risso's dolphin, common dolphin, Atlantic white-sided dolphin, etc.)	150 Hz to 160 kHz, with peak sensitivity above 10 kHz; Except for killer whales: 50 Hz to 100 kHz
High-frequency cetaceans (only harbour porpoise within UK waters)	275 Hz to 160 kHz

Because direct measurements of PTS are unavailable, criteria for assessing injury to marine mammals from acoustic emissions are derived from measurements of TTS onset in different hearing groups and adding

hearing-group specific buffer values to determine the likely onset of PTS from impulsive and non-impulsive sounds. The resulting PTS values used as injury threshold criteria are precautionary and enable a worst-case assessment of potential injury to cetaceans from noise emissions; they are summarised in Table 11-9 below. Whilst hearing-group specific injury criteria are unavailable, an indiscriminate, albeit highly precautionary, injury criteria of 180 dB (SEL) has been proposed by the U.S. Government for injury from impulsive sounds. Moreover, any potential injuries to marine mammals will be captured by the mitigation measures presented in Section 11.8.

Table 11.9 Criteria considered for the onset of injury to marine mammals (NMFS, 2018)

Hearing Group	Injury Criteria		
	Peak pressure (dB re 1 µPa)		Cumulative SEL (dB re 1 µPa^{2}s) (M-weighted)
	Impulsive	Non-impulsive	Impulsive
Pinnipeds (only seals are within UK waters)	218	201	185
Low-frequency cetaceans (deep diving species – e.g. minke whale, pilot whale, etc.)	219	199	183
Mid-frequency cetaceans (small dolphins – e.g. bottlenose dolphin, common dolphin, white-beaked dolphin, etc.)	230	198	179
High-frequency cetaceans (only harbour porpoise are within UK waters)	202	173	155

11.9.3.2.2 Quantification of disturbance impacts

Guidance from Marine Scotland (2014) describes disturbance as activities which are likely "to significantly affect the local distribution or abundance of the species to which it belongs." The relevant European Commission (2007) guidance suggests that a disturbance must significantly impact the local distribution or abundance of a species, even if those impacts are temporary. The JNCC (2017) guidance regards "any action that is likely to increase the risk of long-term decline of the population(s) of (a) species … as disturbance under the (Species) Regulations." In this way, a disturbance must not adversely impact the FCS of a population.

To consider the potential of vessels and cable lay activities resulting in a disturbance offence, it is necessary to consider the likelihood that the marine mammals in the area are likely to respond to activities in such a way as to result in a significant population-level effect. Assessment of population-level impacts from a temporary disturbance is complicated by the variability of disturbance factors and the environmental factors influencing them (e.g. the complex nature of sound propagation in moving water), the inconsistency of behavioural responses by free ranging animals, and the availability of robust population estimates for marine mammals in the Northern North Sea.

The preeminent method for assessing a potential disturbance is to compare the circumstances of the situation with empirical studies (Southall *et al.,* 2007). To identify potential disturbance of marine mammals from noise emissions, a quantitative approach has been adopted which compares disturbance thresholds developed from measurements of TTS to the available noise emissions data (NMFS, 2018a). Behavioural response to stimuli which generate a disturbance are assessed on two levels: low level disturbance (i.e. the onset of a potential behavioural change) and potential strong behavioural reaction (i.e. one which might generate a significant impact to an individual or population). Table 11-10 summarises the threshold criteria for disturbance from continuous and multiple pulsed sounds (NMFS, 2018a; Stone, 1998).

Table 11.10 Disturbance threshold criteria for continuous and pulsed sounds (NMFS, 2018a; Stone, 1998).

Type of sound / criteria metric	Effect	Threshold (dB re 1 µPa)
Non-impulsive sound		
RMS sound pressure level, dB re 1 µPa	Potential strong behavioural reaction	120
Impulsive sound		
RMS sound pressure level, dB re 1 µPa	Potential strong behavioural reaction	160
	Low-level marine mammal disturbance	140

Where there is a possibility of disturbing an individual animal within the Scottish Territorial Seas (up to 12 nm), it is necessary to apply for a Marine EPS Licence to ensure that an offence is not committed. In issuing a Marine EPS Licence, Marine Scotland must consider whether the FCS of any species will be affected.

11.9.3.3 Assessment of potential noise impacts

Underwater noises generated by the activities described in Section 11.9.2 have the potential to affect marine mammals in different ways depending on its noise level and characteristics. Richardson (1995) defined four zones of noise influence which vary with distance from the source and level; these are listed in order of increasing magnitude below:

- *The zone of audibility:* This is the area within which the animal can detect the sound. Audibility itself does not implicitly mean that the sound will have an impact on the animal;
- *The zone of masking*: This is defined as the area within which noise can interfere with detection of other sounds such as communication or echolocation clicks. This zone is very hard to estimate due to a paucity of data relating to how marine mammals detect sound in relation to masking levels (for example, humans can hear tones well below the numeric value of the overall noise level);
- *The zone of responsiveness:* This is the area within which the animal responds either behaviourally or physiologically. The zone of responsiveness is usually smaller than the zone of audibility because audibility does not necessarily evoke a reaction; and
- *The zone of injury and hearing loss:* This is the area where the sound level is high enough to cause tissue damage in the animal's hearing mechanism. This can be classified as either temporary (TTS) or permanent (PTS). At even closer ranges, and for very high intensity sound sources (e.g. underwater explosions), physical trauma or even death is possible.

For this assessment, it is the zone of responsiveness (i.e. the area at which potentially significant disturbance, or a strong behavioural reaction, could occur) and the zone of injury and hearing loss which are of concern. The zones of masking and audibility are not considered to generate long-term or significant disturbance to marine mammals, particularly given the temporary nature of the Project activities. The type and magnitude of sounds generated by the Project are not considered sufficiently high to cause fatality, however, injury and disturbance must be considered.

For noise impacts associated with the geophysical survey, ROTV-towed and hull-mounted SBES, MBES, SSS, and SBP technologies have been assessed for their SEL_{cum}. These technologies have been considered in tandem with the vessels that they would be deployed from, as well as alongside any vessels that may be accompanying them during transit. Based on the assumptions made by the Equal Energy Hypothesis (described in NMFS (2018a)), it is recommended that the SEL_{cum} from overlapping impulsive noise sources be taken from the activity with the greatest SEL_{cum} rather than measured additively, due to the effects of sound masking and the potentially overlapping accumulation periods.

Due to environmental and physical constraints, different survey and cable installation techniques are anticipated to be deployed at different depths. For noise associated with the Project, a variety of survey and cable installation activities have been assessed for deep and shallow water environments using known

information about the seabed geometry along the cable route (SRSL, 2016); these activities are outlined in Table 11-11 below.

Table 11.11 Project activities and their relevant modelling criteria (SRSL, 2016).

Activity Number	Project Activity	Distance between sources (m)	Physical environment
1	Transiting survey vessel with operating MBES attached to the vessel hull	0	Deep water
2	ROTV towed operating SSS and SBP	0	Deep water
3	Transiting survey vessel with operating MBES attached to the vessel hull, and SSS and SBP towed behind	150	Deep water
4	Transiting survey vessel with operating MBES attached to the vessel hull, and SSS and SBP towed behind	2000	Deep water
5	Transiting support vessel	0	Shallow water
6	Boulder clearance or backfill	0	Variable
7	Pre-cut ploughing	0	Variable
8	Cable laying	0	Variable
9	Rock placement	0	Variable
10	Transiting survey vessel with operating MBES, SSS, and SBP attached to the vessel hull	0	Shallow water
11	Transiting survey vessel with operating MBES, SSS, and SBP attached to the vessel hull next to a transiting support vessel	0	Shallow water
12	Transiting survey vessel with operating MBES, SSS, and SBP attached to the vessel hull in front of a transiting support vessel	250	Shallow water

To identify the potential zones of injury and disturbance from Project activities, three-dimensional sound fields were modelled for 10 km either side of the cable route. Only sound sources between 25 Hz and 100 kHz were assessed. This constraint reflects the peak hearing sensitivities of marine mammals likely to occur in the vicinity of the Project area. These outputs were then weighted with the NOAA (2018) thresholds. Model assumptions included: no seabed or sea surface roughness; a linear sound speed profile; and stationary animals and operations during emission. For further details on the modelling methodology used herein, refer to the Caithness-to-Shetland HDVC Noise Assessment Report by SRSL (2016).

Cumulative impacts of Project activities with other users are discussed in Section 11.10.

11.9.3.3.1 Zone of Injury and Hearing Loss

Estimated noise emissions levels from survey and cable lay activities vary in their exceedance of the marine mammal noise injury criteria thresholds laid out by the NOAA (2018) Guidance (see 11.9.3.2.1). Table 11-11 presents the estimated SEL_{cum} for the Project activities.

Table 11.12 Estimated Cumulative SEL values of animals at three different distances from the sound source based on noise modelling using NOAA (2018) Thresholds for PTS from impulsive noise (SRSL, 2016).

Activity Number	Distance from Source (m)	SEL_{cum} injury zone radius[14]			
		LF cetacean (183 dB re 1 μPa^2s)	MF cetacean (179 dB re 1 μPa^2s)	HF cetacean (155 dB re 1 μPa^2s)	Pinnipeds (185 dB re 1 μPa^2s)
1	500	**194.5**	170.4	**193.2**	175.3
	1000	**194.3**	170.3	**193.0**	175.2
	2000	**194.3**	170.3	**193.0**	175.2
2	500	156.8	166.4	**161.0**	167.1
	1000	156.8	166.4	**161.0**	167.1
	2000	156.8	166.4	**161.0**	167.1
3	500	**193.6**	170.1	**192.3**	174.7
	1000	179.6	158.7	**178.3**	161.1
	2000	141.7	151.3	145.9	152.0
4	500	160.1	154.9	**158.9**	155.1
	1000	157.6	152.8	**156.5**	153.5
	2000	157.6	152.8	**156.5**	153.0
5	500	125.4	146.2	130.2	145.1
	1000	124.1	146.2	129.6	145.1
	2000	124.1	146.2	129.6	145.1
6	500	124.0	149.2	128.2	142.2
	1000	118.6	148.0	122.9	140.4
	2000	118.6	148.0	122.9	140.4
7	500	116.3	150.7	122.0	140.8
	1000	111.2	148.9	118.4	139.2
	2000	111.2	148.9	118.4	139.2
8	500	128.6	156.6	133.3	148.9
	1000	123.2	155.2	128.1	147.2
	2000	123.2	155.2	128.1	147.2
9	500	135.9	154.8	140.0	149.9
	1000	130.4	153.7	134.7	147.0
	2000	130.4	153.7	134.7	147.0
10	500	**201.9**	175.1	**200.1**	180.2
	1000	**201.9**	175.1	**200.1**	180.2
	2000	**201.9**	175.1	**200.1**	180.2
11	500	**201.9**	175.1	**200.1**	180.2
	1000	**201.9**	175.1	**200.1**	180.2
	2000	**201.9**	175.1	**200.1**	180.2
12	500	**193.6**	166.8	**191.8**	171.9
	1000	170.6	144.1	168.9	149.0
	2000	149.6	135.8	147.8	134.6

The injury radii described above represent a worst-case scenario in which the marine mammal is stationary at the prescribed distance from the sound source. The narrow nature of the emissions beams of geophysical survey technologies greatly reduces the likelihood of an animal experiencing this level of exposure.

As described in Section 11.9.3.1.1, studies of cable-lay operations have indicated that noise emissions from rock placement and other such activities are generally masked by the CLV's themselves (Nedwell and Edwards, 2004). Most of the activities planned are likely to create localised noise emissions which are masked by the operational vessels in the area. Therefore, impacts from vessel noise will be limited.

[14] Values in red exceed the threshold for the given hearing group.

The modelling outputs indicated that none of the permutations of the Project activities generated SEL_{cum} values which exceed the thresholds for the onset of injury for mid-frequency cetaceans or phocid seals (Table 11-12). The majority of cetacean species anticipated to occur within the project area, including bottlenose dolphins, white-beaked dolphins, Risso's dolphins, and killer whales, all have hearing capabilities which place them within the range for mid-frequency hearing. Still, there were several instances in which modelled noise emissions exceeded the NOAA (2018) guidelines threshold criteria for PTS in high-frequency and low-frequency cetaceans.

The NOAA (2018) guideline thresholds were exceeded at all three distances for both high and low-frequency hearing groups for the following activities: (1) transiting survey vessel with operating MBES attached to the vessel hull in deep water; (2) transiting survey vessel with operating MBES, SSS, and SBP attached to the vessel hull in shallow water; and (3) transiting survey vessel with operating MBES, SSS, and SBP attached to the vessel hull next to a transiting support vessel in shallow water. The thresholds were also exceeding for both species at the 500 m distance for: (1) transiting survey vessel with operating MBES attached to the vessel hull, and SSS and SBP towed 150 m behind in deep water (also exceeded thresholds at the 1000 m distance for high-frequency cetaceans); and (2) transiting survey vessel with operating MBES, SSS, and SBP attached to the vessel hull 250 m in front of a transiting support vessel in shallow water. Finally, two activities exceeded the threshold for the onset of injury in high-frequency cetaceans at all three distances: (1) ROTV towed operating SSS and SBP in deep water; and (2) transiting survey vessel with operating MBES attached to the vessel hull, and SSS and SBP towed behind at 2000 m in deep water.

The embedded mitigation measures for the geophysical survey include the implementation of an MMPP which will dramatically reduce the risk of injury. The activities which exceeded the NOAA (2018) guideline thresholds for injury at 500 m will be reduced to negligible once the implementation of a 500 m marine mammal monitoring zone is implemented. Best practice measures and embedded mitigation measures in relation to marine mammals are outlined in Table 11-7, which will minimise the risk of injury to marine mammals.

Harbour porpoise largely remain at greatest risk from the proposed Project activities (i.e. the threshold value for this species was exceeded for seven different Project activities) and thus form a worst-case basis for this risk assessment. For the two project activities occurring in deep water, the sound emissions will have a greater vertical penetration than they would in shallow waters (i.e. the sound emission would spread spherically for longer). As harbour porpoise are relatively shallow divers (Westgate *et al.*, 2011), individuals would likely maximise their surface movement to move quickly away from sound sources. Indeed, captive harbour porpoise are known to swim freely at speeds of 4.2 m/s and would likely swim much faster in the open ocean if disturbed (Seiji *et al.*, 2001). The SEL_{cum} for an animal moving away from a sound source would be dramatically reduced by the increasing distance placed between the individual and the emission source, and the attenuation of the sound itself over that distance, collectively reducing the overall exposure levels.

As the beam of sound for the geophysical survey techniques is directed downward into the seabed, the model's assumption of a stationary individual being exposed to noise emissions from a stationary source at its peak emissions level is automatically violated. Moreover, behavioural data from this species indicates that harbour porpoise actively maintain great distance from impulsive noise sources, including high-powered piling activity at windfarm sites in the Northern North Sea (Brandt *et al*., 2011), which generate higher sound emissions levels that are non-directional.

Based on the available noise propagation modelling (SRSL, 2016), it is highly unlikely that noise from Project activities will lead to injury of marine mammals (i.e. via PTS) from cumulative exposure to impulsive noise. As discussed above, cable installation activities are anticipated to be masked by the cable installation vessel noise emissions and are therefore not anticipated to lead to any injuries of marine mammals. For these reasons, it is anticipated that noise-related impacts to cetaceans would be minimised to negligible.

Assessment of significance
The sensitivity of all marine mammal species to noise above thresholds that will cause physical injury is assessed as high, because of the permanence of auditory and non-auditory injuries acquired from noise emissions.

Considering the results of the noise propagation modelling, the magnitude of potential noise-related impacts from Project activities are considered to be negligible for pinnipeds and cetaceans, due to anticipated behavioural responses to impulsive noise by the high- and low-frequency species. Implementation of the mitigation measures will reduce the potential impact significance and ensure no animals are injured during the geophysical survey or cable installation activities.

However, as there is potential for disturbance from some of the Project activities, an EPS Licence application is recommended.

Species	Sensitivity/value	Magnitude of effect	Level of impact
Cetacean	High	Negligible	Minor
Pinniped	High	Negligible	Minor
Impact significance – NOT SIGNIFICANT			

11.9.3.3.2 Zone of Disturbance

In addition to measuring injury impacts to marine mammals, it is important to identify the potential risk of disturbance and its impacts on the conservation status of species which occur in the vicinity of the project. The JNCC *et al.* (2010) Guidance proposes that a disturbance offence may occur in two main instances. The first disturbance offence relates to any activities which pose the risk of animals incurring sustained or chronic disruption of their normal behaviour, including feeding, breeding, resting or nesting. The second disturbance offence occurs when animals are displaced from an area, with their subsequent redistribution being significantly different from "that occurring due to natural variation."

Marine Scotland guidance (2014) on disturbance in inshore waters recommends a precautionary approach considering the uncertainties surrounding marine mammal behaviours and their inherent variability. Information on temporary auditory threshold shifts (TTS) have been used to inform the assessment of disturbance impacts to marine mammals (see Section 11.9.3.2.2). Disturbance thresholds have been developed using pre-existing data on marine mammal hearing (see Table 11-10). For the purposes of assessing disturbance impacts from noise emissions from vessels and cable installation activities, the threshold developed for the potential onset of strong disturbance from non-impulsive sound should be employed (i.e. 120 dB re 1 µPa (rms)); however, the likelihood of a significant strong behavioural reaction increases dramatically at 140 dB re 1 µPa. The threshold for the onset of strong disturbance from impulsive sounds defined in Table 11-10 has been employed as a likely indicator of significant disturbance in marine mammals (i.e. 160 dB re 1 µPa (rms)).

Using these thresholds, the distances from project activities at which marine mammals are likely to be disturbed can be determined. Previous modelling work undertaken by Xodus Group Ltd. for the proposed Western Isles Connection Project generated estimates of the spatial ranges over which these disturbance events might take place; they are disseminated in Table 11-13 below.

Table 11.13 Estimated ranges for potential and likely strong disturbance from vessels and cable installation activities to marine mammals swimming slowly away at a speed of 1.5 m/s (Xodus, 2018)

Project Activity	Estimated disturbance range	
	Potential strong behavioural disturbance (120 dB re 1 µPa)	Likely strong disturbance (140 dB re 1 µPa)
Cable lay vessel	4,847 m	474 m
Post lay burial vessel	918 m	98 m
Rock placement vessel	4,847 m	474 m
Guard vessel	1,466 m	141 m
Small craft	571 m	56 m
Seismic survey vessel	1,022 m	100 m
Rock placement	4,847 m	474 m
Backfill	918 m	98 m
Cumulative activities		
CLV plus guard vessel	5,064 m	495 m
Post lay burial plus guard vessel	1,717 m	168 m
3 x small boats and survey vessel (working at the same location)	1,431 m	140 m

The results of the disturbance assessment of vessel and cable installation activities are provided in Table 11-13 below. As discussed in Section 11.9.3.1.1 above, the cable installation activities (i.e. rock placement, backfilling and trenching) are all expected to generate sound which will be masked by their relevant vessels. Therefore, a precautionary approach has been adopted and their disturbance ranges have been taken to be those of the vessels employed for their execution.

It is important to place the results in the context of the ambient noise of the environment in which they occur. For instance, the 120 dB re 1 µPa (rms) criterion for disturbance from continuous noise is within the probable range of background noise for the Pentland Firth, given the high vessel traffic in the region (NMPi, 2018; Wenz, 1962). It is therefore important to understand that exceeding the criteria for potential onset of disturbance effects does not in itself mean that disturbance will occur. For this reason, the ranges identified above for the potential onset of marine mammal disturbance should be viewed as the maximum likely extent within which behavioural change might occur.

The potential onset of disturbance does not necessarily equate to significant disturbance, in which the FCS of a population is likely to become compromised. Disturbance within the identified ranges could become an issue for marine mammals if they were excluded from the area or if important biological functions (e.g. foraging, breeding, etc.) were disrupted in the area for a sustained period.

The potential onset of disturbance occurs up to 5 km from the various continuous noise emissions sources (Table 11-13). However, the likelihood of a strong disturbance event occurring greatly increases if the continuous noise emissions threshold is elevated to 140 dB re 1 µPa (rms), as this would be above ambient noise levels (Wenz, 1962). For this reason, this value is considered to have a definition that is better aligned with what could be considered disturbance under the relevant regulations for disturbance (see Section 11.6). Best practice measures and embedded mitigation measures in relation to marine mammals are outlined in Table 11-7, which will minimise the risk of disturbance to marine mammals.

Installation activities are expected to take place over a relatively short period (see Table 11-6) and vessels will not be in one location for the whole period but will rather traverse the cable route, meaning noise emissions will only occur within a singular location for a brief period. Furthermore, there is the potential that there may be

gaps between some of the installation activities, such that the cable lay may take place a few weeks before burial activities and/or rock placement may take place a few weeks after the burial has been completed.

Given the large expanse of comparable marine habitat surrounding the vessel and cable installation operations, it is highly unlikely that Project activities would compromise regional movements, breeding, feeding or other life functions of concurrent marine mammals. Moreover, as noise from vessel and cable installation activities are continuous sounds and will remain relatively constant over several days, marine mammals may become habituated to the introduced sounds over time, thereby reducing the significance of the disturbance (Deeke, *et al.,* 2002; Nowacek *et al.*, 2004). On this basis, there are anticipated to be no residual impacts from disturbances to marine mammals at the population level.

Assessment of significance

The sensitivity of marine mammals is considered to be medium for cetaceans and low-medium for pinnipeds. Cetaceans are considered to be of medium sensitivity as there is the potential for disturbance to affect foraging and resting activities and increase energetic costs. Harbour seals display some tolerance to distribution to foraging activities, although juveniles are considered to be more sensitive due to higher energetic costs. Grey seals are considered to be of low sensitivity due to their wide foraging range and ability to move large distances between haul-out areas and foraging regions.

Considering that strong disturbance is only likely to occur within close proximity to project activities (<500 m) and that the works are short-term, transient and intermittent the magnitude of the effect is considered to be negligible.

As the impact is not significant, no mitigation measures are required. Measures considered as part of the Project design are listed in Table 11-7.

Species	Sensitivity/value	Magnitude of effect	Level of impact
Cetacean	Medium	Negligible	Minor
Pinniped	Low/medium	Negligible	Minor

Impact significance – NOT SIGNIFICANT

Impulsive Noise sources

While underwater noise emissions from geophysical surveys are unlikely to cause physical injury to seals, they may cause disturbance, particularly if they fall within their generalised hearing range of 50 Hz to 86 kHz (NMFS, 2018). Disturbance, often in the form of displacement, can occur over varying distances and timescales. Noise emissions have the potential to cause permanent displacement if individuals swim away from the noise source and do not return. However, contemporary data suggests that even with high-intensity emissions, such as those from pile driving activity, harbour seals are likely to return to the region of the noise source once the emissions have ceased (Brasseur *et al.,* 2010).

Harbour seals have been shown to display evasive behaviours in response to underwater sounds with frequencies around 12 kHz (Kastelein *et al.*, 2006). As this is in line with the frequency range of the SBP, it is important to minimise disturbance to pinniped species by this geophysical survey equipment. Embedded mitigation will provide protection against potential impacts to seals near the proposed survey operations.

Disturbance can lead to an animal avoiding their main feeding and breeding grounds, which can have longer term effects the on health and breeding ability of that animal (Kastelein *et al.*, 2006). Due to the fact that the geophysical survey will take place over a short period of time, long-term effects on harbour and grey seal populations are highly unlikely.

For impulsive sounds, the NOAA (2018) guidelines recommend a threshold of 160 dB re 1 µPa (rms) to identify when activities are likely to instigate significant behavioural changes in marine mammals. Behavioural changes at these levels may include visible startle response, extended cessation or modification of vocal behaviour, brief cessation of reproductive behaviour or brief / minor separation of females and dependent offspring. The data available for mid-frequency cetaceans indicate that some significant response was

observed at a sound pressure level of 120 – 130 dB re 1µPa (rms), although most cetaceans in this category did not display behaviours of this severity until exposed to a level of 170 – 180 dB re 1µPa (rms). Furthermore, other mid-frequency cetaceans within the same study were observed to have no behavioural response even when exposed to a level of 170 – 180 dB re 1µPa (rms).

The radius for the onset of behavioural change from impulsive noise using a 160 dB re 1 µPa (rms) threshold criteria is predicted to be approximately 330 m from the source at any point in time, which falls within the 500 m monitoring zone outlined in the embedded mitigation measures. Behavioural changes such as those described above do not necessarily imply that they will have detrimental effects on the animals involved. For example, some whales are known to continue calling in the presence of pulse sounds, such as those from seismic arrays, since the vocalisations can be heard between pulses (Greene and McLennan, 2000; Madsen *et al*., 2002). Furthermore, the potential area and duration of disturbance to marine mammals will be highly limited by the scope of the project. Pre- and post-installation survey activities are expected to take place over a short period prior and following cable installation activities, and the use of impulsive noise during cable installation will be limited to some MBES and imaging sonar by ROVs / ROTVs and project vessels to monitor the placement of installation equipment and the view the installation work. The sonar imaging equipment on the ROVs / ROTVs will emit very low levels of sound due to the small distances between their sound source and the equipment they are monitoring reducing the signal-to-noise ratio and thus the need for high-powered sonar to get data. As the survey vessel will be moving slowly along the length of the cable route, sound sources will not be static, as assumed in the models; therefore, the cumulative SEL values are likely to be much lower as the sound source slowly retreats from animals in its vicinity. Moving a few hundred metres away from the sound source would see noise emissions drop to below those which could cause disturbance. Given the large area of similar sea habitat around the area within which the geophysical survey will take place, geophysical survey activities are unlikely to compromise regional movements, breeding, feeding or other life functions of marine mammals.

Additionally, the embedded mitigation measures for the geophysical survey include the implementation of an MMPP which will further reduce the risk of significant disturbance (see Table 11-7). On this basis, there are not anticipated to be any population-level impacts to marine mammals due to geophysical survey.

Assessment of significance

The sensitivity of marine mammals is considered to be medium for cetaceans and low/medium for pinnipeds. Cetaceans are considered to be of medium sensitivity as there is the potential for disturbance to affect foraging and resting activities and increase energetic costs. Harbour seals display some tolerance to distribution to foraging activities, although juveniles are considered to be more sensitive due to higher energetic costs. Grey seals are considered to be of low sensitivity due to their wide foraging range and ability to move large distances between haul-out areas and foraging regions.

Considering the results of the noise propagation modelling and that the survey activity is short term, transient and reversible in nature the magnitude of the impact is considered to be minor.

As the impact is not significant no mitigation measures are required. Measures considered as part of the Project design are listed in Table 11-7.

Species	Sensitivity/value	Magnitude of effect	Level of impact
Cetacean	Medium	Minor	Minor
Pinniped	Low/medium	Minor	Minor

Impact significance – NOT SIGNIFICANT

11.10 Cumulative impacts

Cumulative impacts are those resulting from the combined effects of the Project with other projects through space and time, in the context of natural variability. It also includes the combined effects with other sea users generating similar effects.

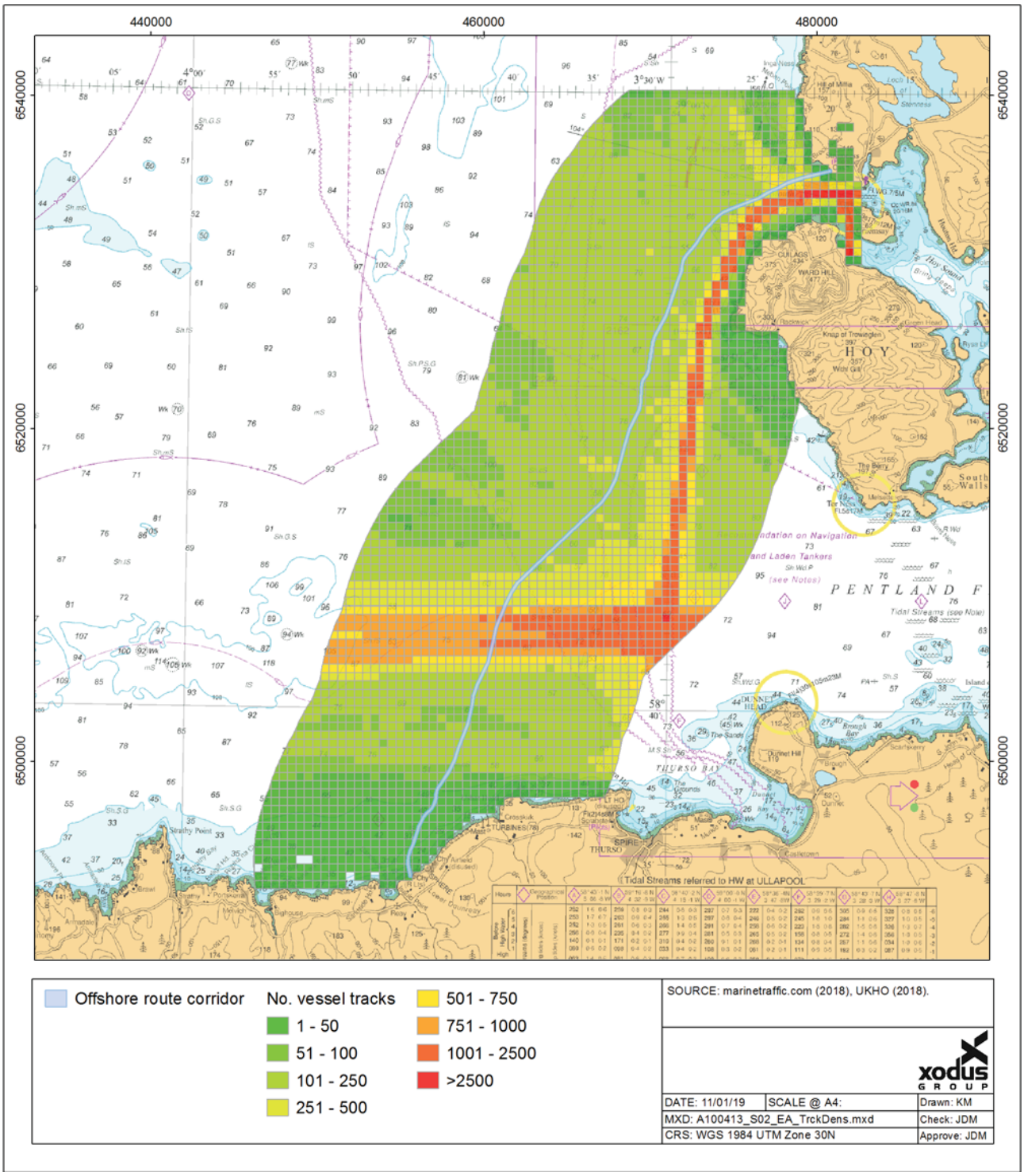
No shared pathway for effect has been identified for suspended sediment with other projects. The impact itself is of limited temporal and spatial extent and is not considered significant from the perspective of the Project.

There is a pathway for effect for disturbance at the Dounreay landfall due to the proximity of the Dounreay Tri project landfall and the Katanes Floating Energy Park potential landfall (one of two potential options being considered). The Dounreay Tri floating OWF is current on hold following Dounreay Tri Ltd. entering administration in 2017, therefore the likelihood of the project moving forward in a timeframe that overlaps with the Project is low. The Katanes Floating Energy Park received an EIA Screening Opinion from Marine Scotland in 2017. As such there is limited information available publicly to inform a cumulative assessment. Due to the cable installation being conducted by HDD and Project vessels remaining offshore (see Section 11.9.3.1.1) there is limited scope for cumulative impacts at the landfall site and any potential impact is not considered to be significant.

Cumulative impacts from underwater noise could result from several sources, including: spatial and temporal overlap with other sea users, such as shipping or fishing vessels, and the installation and maintenance of nearby marine renewable energy projects (see Table 7-3).

Available data suggests that the proposed cable route intersects an area of high vessel traffic emanating from ports at Thurso, John O' Groats, and Flotta (NMPi, 2018). The relative ship density is presented in Figure 11.1, offering a high-level overview of vessel activity in the study area during the summer months. Shipping traffic is likely to occur across the entirety of the cable route but is most prevalent along its eastern end, following a similar track to the proposed cable corridor (NMPi, 2018). This region of the cable route would likely be an area of heightened ambient noise levels with potential cumulative noise exposure levels elevated by the spatial overlap in vessel traffic.

Figure 11.1 Summer shipping density in the study area



To mitigate against potential cumulative impacts from noise emissions from multiple vessels, there will be a rolling 500 m safety zone in existence around the Project vessels. Therefore, overlapping underwater noise disturbance zones from project and non-project vessels are not likely to introduce sufficient noise to result in injury as the noise sources will not overlap significantly. Moreover, as there are relatively high levels of prevailing vessel / shipping activity in the area (Section 11.9.3.1.1), overall noise emissions from additional vessels is not expected to deviate from ambient noise levels.

Whilst there is the potential for mild disturbance from vessel presence, the cable lay activities are not expected to exclude marine mammals from available marine habitat in the region of the Project. As such, these activities are unlikely to result in significant cumulative impacts from their overlap with other projects occurring at the same time (e.g. piling activity at windfarms). As the cable lay activities are scheduled to be completed within a short period of time, there will be little opportunity for temporal overlap with other projects.

Consequently, the potential for cumulative impacts to occur due to spatial and temporal overlap with other sea users or other project activities nearby is extremely low. No cumulative impacts from noise emissions are expected to result from any of the project activities. As such cumulative impacts from underwater noise are considered negligible.

11.11 Decommissioning

SHE Transmission recognises the importance of considering the decommissioning process at an early stage, and should decommissioning be undertaken, the operation will be conducted according to the standard industry protocol at the agreed time. If the cable is retrieved, there is potential for disturbance to marine mammals during retrieval in the decommissioning phase, similar or less to that experienced during the installation phase. However, the least environmentally damaging option and the usual approach for submarine cables is to leave the cable *in-situ* and this is the expected approach for the Orkney–Mainland Subsea Cable Link Project.

11.12 EPS risk assessment

All species of cetacean and otters occurring in UK waters are listed in Annex IV of the Habitats Directive as EPS, meaning that they are species of community interest in need of strict protection, as directed by Article 12 of the Directive.[15] This protection is extended to Scottish territorial waters (out to 12 nautical miles) under the Conservation (Natural Habitats, &c.) Regulations 1994 (as amended).

The information presented in the environmental baseline above (Section 11.5) indicates that cetaceans likely to be found in the Project area include: harbour porpoise, bottlenose dolphins, white-beaked dolphins, Risso's dolphin, killer whale, and minke whale regularly occur within the Project area (Evans *et al.,* 2011). Furthermore, otters may be found within the vicinity of the landfall sites for the project.

Regulation 39(1) of these Regulations make it an offence to:

a) Deliberately or recklessly capture, injure or kill a wild animal of a EPS;

b) Deliberately or recklessly:

   i. Harass a wild animal or group of wild animals of an EPS;

   ii. Disturb such an animal while it is occupying a structure or place which it uses for shelter or protection;

   iii. Disturb such an animal while it is rearing or otherwise caring for its young;

   iv. Obstruct access to a breeding site or resting place of such an animal, or otherwise to deny the animal use of the breeding site or resting place;

   v. Disturb such an animal in a manner that is, or in circumstances which are, likely to significantly affect the local distribution or abundance of the species to which it belongs;

[15] Note: seals are not included in this protection regulation.

vi. Disturb such an animal in a manner that is, or in circumstances which are, likely to impair its ability to survive, breed or reproduce, or rear or otherwise care for its young; or

vii. Disturb such an animal while it is migrating or hibernating.

Further protection is afforded through an additional disturbance offence given under Regulation 39(2) which states that "it is an offence to deliberately or recklessly disturb any dolphin, porpoise or whale (cetacean)".

Where there is the possibility for disturbance to occur, an EPS Risk Assessment must be carried out and the need for a Marine EPS Licence to disturb EPS will be subsequently determined.

In addition to disturbance of breeding, migrating or rearing young outlined under Regulation 39(1), the Marine Scotland (2014) guidance specifies disturbance as occurring if the activity is likely 'to significantly affect the local distribution or abundance of the species to which it belongs'. The relevant European Commission (EC) guidance (2007) suggests that, for a significant effect on the local distribution or abundance of a species to occur, disturbance would need to produce more than a transient effect. Although the effect of the disturbance does not need to be permanent, it would need to have a significant effect at the time to fall within this specific disturbance offence.

The purpose of a EPS Risk Assessment is to determine whether, when considering appropriate mitigation as present in the MMPP, there is still potential for the marine survey activities to cause deliberate harm or inadvertently cause disturbance to cetaceans. Where there is still potential for an offence to occur, a Marine EPS licence may be required; the requirement for a Marine EPS Licence will be determined by the MS-LOT with advice from Marine Scotland Science (MSS) and SNH based on information provided in the EPS Risk Assessment and MMPP. MS LOT's consideration of whether a licence will be required will comprise three tests:

1. To ascertain whether the licence is to be granted for one of the purposes specified in the Regulations;
2. To ascertain whether there are no satisfactory alternatives to the activity proposed (that would avoid the risk of offence); and
3. That the licensing of the activity will not be detrimental to the maintenance of the population of the species concerned at a FCS.

It must be noted that the definition of the potential for *significant disturbance* to an individual EPS in inshore waters is considered an offence. As demonstrated in the impact assessment outlined above, injury to cetaceans is considered unlikely. However, Project activities have the potential to disturb a small number of cetaceans. Consequently, SHE Transmission will engage with MS LOT to understand the need to apply for a Marine EPS licence in due course.

11.13 Conclusion

Underwater noise, disturbance at the landfall sites and suspended sediment are considered the impact mechanisms most likely to affect mammals in the Project area. Previous noise modelling used to inform the assessment demonstrates that once the proposed mitigation is implemented, injury to marine mammals should be reduced. While there may be some disturbance, this is likely to be limited in space and time and should only affect a few individuals.

Considering the transitory nature of the Project activities, there are not anticipated to be any significant impacts to individuals or populations of marine mammals in the Project area—both at sea or on land from activities connected with marine cable installation.

A summary of the impact assessment and its conclusions is provided in Table 11-14 along with the mitigation measures relevant to each activity assessed.

Table 11.14 Impact summary and assessment for marine mammals occurring within the vicinity of the Project

Potential impact			Assessment			
Project activity	**Potential impact**	**Receptor**	**Sen/Val**	**Mag**	**Level of impact**	**Significance**
Vessels						
HDD at landfall	Potential disturbance at landfall sites	Otter	Medium	Low	Negligible	Not significant
DP cable lay vessel	Injury from underwater noise emissions	Cetaceans	High	Negligible	Negligible	Not significant
		Pinnipeds	High	Negligible	Negligible	Not significant
	Disturbance from underwater noise emissions	Cetaceans	Medium	Negligible	Negligible	Not significant
		Pinnipeds	Low/Medium	Negligible	Negligible	Not significant
Anchored CLB	Increased suspended sediment	Cetaceans	Low	Negligible	Negligible	Not significant
		Pinnipeds	Low	Negligible	Negligible	Not significant
		Otters	Low	Negligible	Negligible	Not significant
	Injury from underwater noise emissions	Cetaceans	High	Negligible	Negligible	Not significant
		Pinnipeds	High	Negligible	Negligible	Not significant
	Disturbance from underwater noise emissions	Cetaceans	Medium	Negligible	Negligible	Not significant
		Pinnipeds	Low/Medium	Negligible	Negligible	Not significant
Rock placement vessel and other support vessels	Injury from underwater noise emissions	Cetaceans	High	Negligible	Negligible	Not significant
		Pinnipeds	High	Negligible	Negligible	Not significant
		Cetaceans	Medium	Negligible	Negligible	Not significant

Potential impact			Assessment			
Project activity	**Potential impact**	**Receptor**	**Sen/Val**	**Mag**	**Level of impact**	**Significance**
	Disturbance from underwater noise emissions	Pinnipeds	Low/Medium	Negligible	Negligible	Not significant
Seabed preparation: Pre-sweeping of sandwaves	Increased suspended sediment	Cetaceans	Low	Negligible	Negligible	Not significant
		Pinnipeds	Low	Negligible	Negligible	Not significant
Seabed preparation: Pre-lay grapnel	Increased suspended sediment	Cetaceans	Low	Negligible	Negligible	Not significant
		Pinnipeds	Low	Negligible	Negligible	Not significant
		Otters	Low	Negligible	Negligible	Not significant
Seabed preparation: Boulder clearance by 'Orange peel' grab	Increased suspended sediment	Cetaceans	Low	Negligible	Negligible	Not significant
		Pinnipeds	Low	Negligible	Negligible	Not significant
		Otters	Low	Negligible	Negligible	Not significant
Seabed preparation: Boulder clearance plough	Increased suspended sediment	Cetaceans	Low	Negligible	Negligible	Not significant
		Pinnipeds	Low	Negligible	Negligible	Not significant
		Otters	Low	Negligible	Negligible	Not significant
Seabed preparation: Pre-cut trenching	Increased suspended sediment	Cetaceans	Low	Negligible	Negligible	Not significant
		Pinnipeds	Low	Negligible	Negligible	Not significant
		Otters	Low	Negligible	Negligible	Not significant
Cable installation: Ploughing (including backfill plough)	Increased suspended sediment	Cetaceans	Low	Negligible	Negligible	Not significant
		Pinnipeds	Low	Negligible	Negligible	Not significant
		Otters	Low	Negligible	Negligible	Not significant
Cable installation: Jet trenching	Increased suspended sediment	Cetaceans	Low	Negligible	Negligible	Not significant
		Pinnipeds	Low	Negligible	Negligible	Not significant
		Otters	Low	Negligible	Negligible	Not significant

Potential impact			Assessment			
Project activity	**Potential impact**	**Receptor**	**Sen/Val**	**Mag**	**Level of impact**	**Significance**
Cable installation: Mechanical trenching	Increased suspended sediment	Cetaceans	Low	Negligible	Negligible	Not significant
		Pinnipeds	Low	Negligible	Negligible	Not significant
		Otters	Low	Negligible	Negligible	Not significant
Decommissioning: Cable removal	Increased suspended sediment	Cetaceans	Low	Negligible	Negligible	Not significant
		Pinnipeds	Low	Negligible	Negligible	Not significant
		Otters	Low	Negligible	Negligible	Not significant
Pre-lay geophysical survey						
SBES	Injury from underwater noise emissions	Cetaceans	High	Negligible	Negligible	Not significant
		Pinnipeds	High	Negligible	Negligible	Not significant
	Disturbance from underwater noise emissions	Cetaceans	Medium	Medium	Minor	Not significant
		Pinnipeds	Low/Medium	Low/Medium	Minor	Not significant
MBES	Injury from underwater noise emissions	Cetaceans	High	Negligible	Negligible	Not significant
		Pinnipeds	High	Negligible	Negligible	Not significant
	Disturbance from underwater noise emissions	Cetaceans	Medium	Medium	Minor	Negligible
		Pinnipeds	Low/Medium	Low/Medium	Minor	Negligible
SSS	Injury from underwater noise emissions	Cetaceans	High	Negligible	Negligible	Not significant
		Pinnipeds	High	Negligible	Negligible	Not significant
	Disturbance from underwater noise emissions	Cetaceans	Medium	Medium	Minor	Negligible
		Pinnipeds	Low/Medium	Low/Medium	Minor	Negligible
SBP	Injury from underwater noise emissions	Cetaceans	High	Negligible	Negligible	Not significant
		Pinnipeds	High	Negligible	Negligible	Not significant
		Cetaceans	Medium	Medium	Minor	Negligible

Potential impact			Assessment			
Project activity	**Potential impact**	**Receptor**	**Sen/Val**	**Mag**	**Level of impact**	**Significance**
	Disturbance from underwater noise emissions	Pinnipeds	Low/Medium	Low/Medium	Minor	Negligible

12 ORNITHOLOGY

12.1 Introduction

This section of the report provides further detail on ornithology in the vicinity of the proposed marine cable corridor and landfall locations, presents results from an assessment of potential impacts on key sensitive species and outlines management and mitigation measures that will be undertaken in order to ensure impacts are minimised.

The impact assessment focuses on species that are designated features of conservation sites located in the vicinity of the proposed works and that have the potential to be impacted. The key legislation and policy guidance relating to the conservation of birds is also outlined. Where relevant any limitations related to the baseline characterisations, data sources or scientific understanding / interpretation have been highlighted.

A Nature Conservation Appraisal (NCA) has been conducted in parallel to the EA, which is presented in Appendix D.

12.2 Legislation and policy context

As well as the legislation and policy context outlined in Section 2 - Planning policy and legislative framework the key legislation in relation to the marine mammals is summarised below. An integral aspect of the assessment of potential impacts on ornithology is the identification of species of conservation importance in the Project area and assessment of potential impacts on such species. There are a number of different statutes and guidance that are relevant in this regard these are listed below. Key legislation for ornithological interest includes:

- Conservation (Natural Habitats, &c.) Regulations 1994 (as amended in Scotland);
- The Conservation of Offshore Marine Habitats and Species Regulations 2017;
- Wildlife and Countryside Act 1981 (as amended); and
- Nature Conservation (Scotland) Act 2004.

12.3 Consultation

Scoping and consultation have been on-going throughout the Project and played an important part in ensuring the scope of the baseline and impact assessment have been appropriate to the Project and the requirements of the regulators and their advisors.

A summary of consultation activity undertaken to date is provided Section 5 – Stakeholder engagement.. Comments from the Scoping Opinion relevant to ornithology are provided in Table 12-1, together with responses to the comments and reference to the relevant sections where specific comments have been addressed.

Table 12.1 Scoping comments regarding ornithology

Name of organisation	Key concerns	Response	Section within which the specific issue is addressed
SNH	With regards to potential impacts on SPAs, the following potential impacts should be assessed: Installation Noise disturbance and/or displacement of qualifying interests due to vessel presence, noise or light pollution	Impacts to ornithology have been assessed within Section 12.9 - Ornithology of the EA and effects on SPAs have been assessed within Appendix D: Nature Conservation Appraisal. All impacts listed have been	Section 12.9 – Assessment of impacts.

Name of organisation	Key concerns	Response	Section within which the specific issue is addressed
	Disturbance and/or displacement of qualifying interests due to increased turbidity in the water column Indirect effects on qualifying interests due to changes in distribution of prey items Operation Disturbance and/or displacement of qualifying interests due to vessel presence, noise or light pollution during maintenance activities.	considered within these sections.	
SNH	Due to the potential for localised disturbance to birds at each of the landfalls, further clarification regarding activities located above MHWS would be welcomed i.e. HDD. If activities which fall above MHWS are not classed as permitted development, or are not covered in a separate planning application, it is recommended that they are assessed as part of the marine licence application study.	This application focuses on the marine aspects of the Project from MHWS to MHWS. Onshore aspects related to the HDD methodology are not considered in the EA to support the Marine Licence application."	Section 4 – Project Description.
SNH	Installation at the Dounreay landfall could cause disturbance to seabird qualifying species of the North Caithness Cliffs SPA, species associated with the Caithness Lochs SPA as well as a breeding colony of Arctic terns (not an SPA feature). A pre-construction breeding bird survey and mitigation measures may be required.	Appendix D: Nature Conservation Appraisal has considered potential impacts to SACs and SPAs. The potential effect on the North Caithness Cliffs SPA has been considered.	Appendix D: NCA.
The Highland Council Comhairle na Gaidhealtached	Once the chosen landfall site method of installation is determined, an assessment of the impacts on the North Caithness Cliffs SPA will be required. Advice from the nuclear sites in close proximity may be helpful regarding any potential impacts.	The cable landfall will be installed using HDD techniques at the landfalls for which the exit point on the seabed is located approximately 750 m to 1000 m offshore. Potential effects on the North Caithness Cliffs SPA is considered within Appendix D: Nature Conservation Appraisal.	Section 4 – Project Description. Appendix D: NCA.
RSPB	A figure clearly showing how the preferred route passes through Scapa Flow pSPA (it is indicated that the site is 0 km away from the route) should be included. If there is an overlap, an assessment on the benthic impacts of the cable burial on food resources and availability should be carried out as the area is important for wintering birds as a foraging area. This assessment is in addition to disturbance and displacement during construction and maintenance. (This is missing from table 2.3)	The proposal installation corridor does not pass through the Scapa Flow pSPA. At its closest point the installation corridor is 0.2 km from the pSPA, at the landfall. A full ornithological assessment is provided in Section 12.9 - Ornithology of the EA.	Section 9 – Protected sites and species (Figure 9.1).

Name of organisation	Key concerns	Response	Section within which the specific issue is addressed
RPSB	Other potential impacts on birds that should be assessed with regards to cable installation, maintenance and decommissioning include disturbance and displacement from marine traffic on the sea surface. (This is missing from table 2.2).	A full ornithological assessment is available in Section 12.9 - Ornithology of the EA.	Section 12.9 – Assessment of impacts.
RSPB	Any bird survey data collected at sea should be sufficient to characterise day to day variability in bird activity as well as seasonal variability.	The ornithological assessment has focused on the protected species surrounding the Project. Existing data has been used to characterise the distribution of these species. Survey data has been collected at the landfall which has been presented in relation to the onshore application.	Section 12.5 – Existing baseline environment.
RSPB	Rigorous assessment of the impacts of an accidental fuel spillage on marine ecology and birds should be carried out.	The ecological impact of accidental release of pollution has been scoped out of further assessment - see MS-LOT Opinion and SNH response and Table 7.1 of the EA. Potential for accidental fuel release is very low. In the event of an accidental fuel release occurring appropriate standard practice management procedures will be implemented accordingly. Standard pollution prevention measures are laid out in Section 17 - SoM of the EA and for all vessels over 400 GT (gross tonnage) a SOPEP will be in place.	See Section 7 - Impact assessment methodology (Table 7-1).
RSPB	Further information on the landfall area should be detailed. Although this will be addressed in a separate application, improved maps of planned infrastructure above and below the MHWS could be beneficial in indicating where the subsea cable ends and the landfall begins.	A description of the Project is provided in Section 4 - Project Description of the EA. The installation of the cable at the landfall will utilise HDD techniques with the exit point on the seabed located between 750 m to 1000 m offshore.	Section 4 - Project Description.

Name of organisation	Key concerns	Response	Section within which the specific issue is addressed
Marine Scotland	An assessment of the impact on designated sites and at the landfall locations should be included within the EA.	The installation of the cable at the landfall will utilise HDD techniques with the exit point on the seabed located between 900 m to 1050 m offshore. Impacts to ornithology have been assessed within Section 12.9 - Ornithology of the EA and effects on SPAs have been assessed within Appendix D: Nature Conservation Appraisal. All impacts listed have been considered within these sections.	Section 12.9 – Assessment of impacts.

12.4 Data sources

This section draws on a number of data sources including published papers, industry-wide surveys and site-specific investigations. A key data source available for Scottish offshore waters is the NMPi website (NMPi, 2018) which underpins the Scottish NMP (Scottish Government, 2015). Key data sources used to inform this environmental description include:

- Protected site information; JNCC and Natural England websites;
- Seabird foraging ranges (Thaxter *et al.,* 2012);
- LT17 Orkney-Mainland Scoping response;
- Vulnerability of seabird populations (Furness *et al.,* 2013; Wade *et al.,* 2016);
- Seabird Population Trends and Causes of Change: 1986-2015 Report (JNCC, 2016);
- An atlas of seabird distribution in north-west European waters (Stone *et al.,* 1995);
- The distribution of seabirds and marine mammals in the Atlantic Frontier, north and west of Scotland (Pollock *et al.,* 2000);
- Potential impact of benthic disturbances (Cook and Burton, 2010); and
- Displacement and habituation of seabirds in response to marine activities (MMO, 2018).

12.5 Existing baseline environment

This section describes and evaluates the importance of the submarine cable corridor and adjacent waters for breeding, migratory and over-wintering populations of marine birds. Whilst it is recognised that the waters off Caithness and Orkney are important at different times of the year for a number of bird species, birds from designated sites represent priority populations, which have been selected as requiring conservation measures and therefore represent birds of highest sensitivity and importance. This section therefore focuses on establishing how important the submarine cable corridor is to bird species from potential and existing designated sites. Arctic tern have also been included within the assessment due to the proximity of colonies near the Warebeth landfall.

The species considered are those considered relevant to the Project, terrestrial-based species have not been considered within this assessment. Survey data has been collected at the Warebeth landfall which has been presented in relation to the onshore application (ERM Ltd, 2019).

12.5.1 Designated sites

Throughout Caithness (north coast Scottish mainland) and Orkney there is an extensive network of protected sites designated for their coastal and marine ornithological importance. These include:

- **Special Protection Areas (SPAs)** designated under the Birds Directive for the protection of rare, threatened or vulnerable bird species listed in Annex I of the Birds Directive, and also for regularly occurring migratory species. With respect to the coastal and marine environment, in 2009, marine extensions were classified for a number of SPAs located along the Caithness and Orkney coasts that are designated for seabird breeding colonies. The size of the extension depends on key qualifying features of the site and range from 1 km seaward extensions for SPAs with razorbill, guillemot and puffin, 2 km extensions for SPAs with gannet and fulmar and 4 km extensions for SPAs with Manx shearwater.
- **Proposed SPAs (pSPAs)**. More recently, the Scottish Government has identified a suite of an additional 15 proposed SPAs (pSPAs) for marine birds. These pSPAs have been identified specifically for the protection of at sea territories for 45 species of rare and vulnerable seabirds which depend on the marine environment for a large part of their lifecycle.
- **Sites of Special Scientific Interest (SSSIs)** designated under the Nature Conservation (Scotland) Act 2004 for nationally important habitats, species, rocks and landforms, or a combination of such natural features that are considered to best represent Scotland's natural heritage.

Relevant SPAs and NCMPAs (including proposed and candidate sites) with breeding seabirds qualifying features were identified through the overlap of foraging ranges (as identified by Thaxter *et al.,* (2012)), with the proposed cable corridor. Through consultation it has been confirmed that the Project has the potential to effect designated sites/species where the cable crosses the designated site or passes within 5 km of the cable route. Table 12-2 outlines the sites and species that the Project has the potential to effect. A full HRA Screening assessment of protected sites and species, including those sites from further afield, is included in Appendix D: Nature Conservation Appraisal.

Table 12.2 Designated sites and species that the Project has the potential to effect

Protected site	Approximate distance from cable corridor at closest point	Qualifying Article	Qualifying species of ornithological interest	Population
Hoy SPA	0	Article 4.1	Red-throated diver	56 pairs, 6.0% of the breeding GB population
			Peregrine	6 pairs, 0.5% of the breeding GP population
		Article 4.2 (migratory)	Great skua	1, 900 pairs, 14% of the breeding world population
		Assemblage qualification (Article 4.2)	Great black-backed gull	570 pairs, 3% of the GB population
			Guillemot	13,400 pairs, 2% of the GB population
			Kittiwake	3,000 pairs, 0.6% of the GB population
			Fulmar	35,000 pairs, 6% of the GB population
			Puffin	3,500 pairs, 0.7% of the GB population

Protected site	Approximate distance from cable corridor at closest point	Qualifying Article	Qualifying species of ornithological interest	Population
			Arctic skua	59 pairs, 2% of the GB population
North Caithness SPA	0	Article 4.1	Peregrine	6 pairs, 0.5% of the breeding GP population
		Article 4.2 (migratory)	Guillemot	26,994 pairs, 1.2% of the breeding East Atlantic population
		Assemblage qualification (Article 4.2)	Kittiwake	15, 630 individuals The area regularly supports 110,000 individual seabirds
			Fulmar	13,310 pairs
			Puffin	1,750 pairs
			Razorbill	3,302 pairs
Scapa Flow pSPA	0.2 km	Article 4.1	Red-throated diver	81 pairs, 7.6% of GB population
			Great northern diver	506 individuals, 20.2% of GB population
			Slavonian grebe	135 individuals, 12.3% of GB population
			Black-throated diver	57 individuals, 9.6% of GB population
		Article 4.2 (migratory)	Goldeneye	219 individuals, 1.1% of the GB population
			Common eider	1,994 individuals, 3.3% of GB population
			Long-tailed duck	1,393 individuals, 12.7% of GB population
			Red-breasted merganser	539 individuals, 6.4% of GB population
			European shag	2929 individuals, 1.5% of the biogeographic population
Caithness and Sutherland Peatlands SPA	5 km	Article 4.1	Red-throated diver	89 pairs, 9.5% of the breed GP population
Orkney Mainland Moors SPA	5 km	Article 4.1	Red-throated diver	15 pairs, 1.6% of the breeding GP population

12.5.1 Breeding seabirds

The protection status of seabirds considered within this appraisal is presented in Table 12-3.

Table 12.3 Protection status of seabirds

Species	Annex I of EU Birds Directive (2009/147/EEC)	Schedule 1 of the Wildlife and Countryside Act (as amended)	UK birds of conservation concern (Eaton *et al.,* 2015)
Arctic skua	X	X	Red
Arctic tern	✓	X	Amber
Northern fulmar	X	X	Amber
Great black-backed gull	X	X	Amber
Great skua	X	X	Amber
Guillemot	X	X	Amber
Kittiwake	✓	X	Red
Razorbill	X	X	Amber
Peregrine	✓	✓	Green
Puffin	X	X	Red
Red-throated diver	✓	✓	Green
Black-throated diver	✓	✓	Amber
Goldeneye	X	X	Amber
Common eider	X	X	Amber
Great northern diver	✓	✓	Amber
Long-tailed duck	X	✓	Red
Red-breasted merganser	X	X	Green
Slavonian grebe	✓	✓	Red
European shag	X	X	Red

In Britain, the traditional breeding distribution of red-throated diver occurs in north and west Scotland, in particular across Shetland, Orkney, the Western Isles, Sutherland and Wester Ross. An estimated 1,300 pairs of red-throated diver breed in Britain, with the majority of pairs found in the north and west of Scotland (Musgrove *et al.,* 2013; Balmer *et al.,* 2013). The wintering population around Britain has been estimated at 17,000 individuals (O'Brien *et al.,* 2008). As noted in Table 12-2 red-throated diver is listed as a breeding feature of Hoy SPA, Caithness and Sutherland Peatlands SPA, Scapa Flow pSPA and Orkney Mainland Moors SPA.

Northern fulmar are one of the most common seabirds in northern Britain and are present year-round, with no pronounced migration after becoming adult and an estimated breeding population of 499,081 pairs (Mitchell *et al.,* 2004). The largest breeding colonies are located off the north and west coasts of Scotland, where the majority of British colonies occur (Stone *et al.,* 1995), with birds often present at these colonies outside of the breeding season (see Table 12-4). Since the mid-19th century fulmar numbers and distribution around the UK have increased considerably (Pennington *et al.,* 2004). This increase has been linked to an increase in food discarded by commercial fishing. However, since Seabird 2000 when the UK breeding population was last estimated, the population is predicted to have decreased by 31% (JNCC, 2016).

Arctic skua is a passage migrant in spring and autumn in the North Sea, and a scarce UK breeding species, restricted to Shetland, Orkney, north Scotland and the Western Isles (Forrester *et al.,* 2007). Seabird 2000 estimated the Scottish breeding population at 2,136 pairs a decrease in 37% from the 1985-1988 seabird colony register (SCR) census (Mitchell *et al.,* 2004).

Puffins are one of the most abundant seabird species in Britain. Seabird 2000 recorded 579,500 apparently occupied nests at breeding colonies around Britain, 493,042 of which were recorded in Scotland (Mitchell *et al.,* 2004). A 19% increase was noted from the SCR census in 1985-1988. Lesser sandeel is the commonest prey item for puffins, followed by sprat, herring and a wide range of young gadoid fish (Harris, 1984). During the breeding season puffin are aggregated around their colonies. During post-breeding, however, the birds

disperse towards the north-western North Sea before spreading out more widely throughout the winter months; this has been sent to encompass the whole of the North Atlantic (Harris et al., 2010; Jessopp *et al.,* 2013)).

Razorbill is one of the most common seabirds in Britain, breeding in large colonies with other seabirds on suitable coastal cliffs. Seabird 2000 recorded 164,557 individuals at breeding colonies around Britain, of which 139,186 were recorded in Scotland (Mitchell *et al.,* 2004). The Seabird 2000 data noted a 21% increase in the population from the SCR census. As noted in Table 12-2 razorbill is a non-breeding feature of North Caithness SPA.

Guillemot is one of the most abundant seabird species in Britain, breeding in large colonies on suitable coastal cliff habitat. Seabird 2000 recorded 1,322,830 individuals at breeding colonies in Britain, of which 1,167,841 were recorded in Scotland (Mitchell *et al.,* 2004). The Seabird 2000 data noted a 31% increase in the population since the SCR census.

Kittiwake is one of the most common seabirds in the UK, breeding in large colonies on coastal cliff habitat. Seabird 2000 recorded 366,835 pairs in the UK, of which 282,213 were recorded in Scotland (Mitchell *et al.,* 2004). The Seabird 2000 data showed a 25% decrease in the population from the SCR census. Kittiwakes mostly prey on small fish such as sandeels as well as fishery discards (Forrester *et al.,* 2007). Between April and July, kittiwakes are dispersed widely around the coast of Britain, with relatively high densities around the coast of Scotland where the main breeding colonies are located (Stone *et al.,* 1995). From August to October, kittiwakes begin to disperse across the North Sea, although the predominant distribution still reflects the location of breeding colonies. From November to March, birds are dispersed over much larger areas of the North Sea, and in the southern parts, numbers peak during this period. This reflects the kittiwake's preference for pelagic habitats in winter.

Great black-backed gull is a common resident species in the UK, occurring in coastal areas. Seabird 2000 recorded 17,394 pairs in Britain, of which 14,773 were recorded in Scotland (Mitchell *et al.,* 2004). Great black-backed gulls are omnivorous, foraging at sea, on estuaries and beaches, and less commonly at rubbish dumps (Forrester *et al.,* 2007). Since Seabird 2000 to 2015 there has been a 11% decrease in the UK breeding population.

Great skua regularly occur in the North Sea on spring and autumn passage, with some birds remaining for the winter months (Stone *et al.,* 1995). Great skuas breed on Shetland, Orkney and the Western Isles (Balmer *et al.,* 2013), with an estimated population of 9,634 pairs during Seabird 2000 (Mitchell *et al.,* 2004). Since Seabird 2000 when the UK breeding population of Great skua was last estimated, the population is predicted to have increased by 18% (JNCC, 2016).

Table 12-4 outlines the key seasonal periods for relevant breeding seabirds within the Project area. The filled cells indicate two-week periods when it would be expected to encounter a species in significant numbers.

Table 12.4 Extent of the breeding season for breeding seabirds (adapted from SNH, 2017)

Species	Breeding season dates																							
	J		F		M		A		M		J		J		A		S		O		N		D	
Arctic skua																								
Fulmar																								
Great black-backed gull																								
Great skua																								
Guillemot															M	M	M		M					
Kittiwake																								
Razorbill																M	M		M		M			
Peregrine																								
Puffin																								
Red-throated diver																		M	M		M		M	

Key	
Breeding period (strong association)	
Breeding site attendance	
Winter period	
Not present in significant numbers	
Flightless moult period	M

12.5.2 Non-breeding seabirds

Black-throated diver have a northly breeding distribution, in the UK breeding on Scottish lochs in north and west Scotland. The birds winter in coastal waters and are distributed mainly around the north and north west of Scotland. The main concentrations are centred within Sutherland, Wester Ross and the Outer Hebrides with breeding birds becoming scarcer southwards into Perthshire and Argyll as far south as Dumfries and Galloway In the UK black-throated diver has an estimated wintering population of 560 individuals.

Goldeneye is widely distributed in the non-breeding season on both freshwater and marine sites in the UK with an estimated population of 27,000 individuals (Musgrove *et al.,* 2013). The UK distribution is largely concentrated in the north — on or around the east coast of Scotland, notably the Moray Firth, as well as around Orkney (SNH, 2016).

Eider is the most common breeding species of seaduck in the UK, with a mainly sedentary breeding population of around 27,000 pairs (Musgrove *et al.,* 2013). The British wintering population is estimated at 60,000 individuals (Musgrove *et al.,* 2013) and the 1% threshold for national importance is 550 birds (Frost *et al.,* 2017). Eiders are an inshore species, usually found within 10 km of the coast. Their diet consists predominantly of blue mussels, as well as sea urchins, starfish and other marine invertebrates (Forrester *et al.,* 2007).

Approximately 2,600 individuals winter in the UK (Musgrove *et al.,* 2013) when its distribution shifts southward from their subarctic breeding grounds to include inshore UK waters. It is widely distributed with the majority of UK birds concentrated in north and west Scotland, particularly off Orkney, Shetland and the Outer Hebrides (Natural England, 2012).

The long-tailed duck UK population is estimated at 11,000 individuals with the 1% threshold for national importance being 110 birds. Long-tailed duck distribution is concentrated around Orkney and the Moray Firth between November and May (Stone *et al.,* 1995).

Approximately 2,600 pairs of red-breasted merganser breed in the UK, mainly in north and west Scotland (Forrester *et al.,* 2007), with 9,000 individuals wintering (Musgrove *et al.,* 2013). It is widely distributed at low

density around the coastal waters of the UK in the non-breeding season (Stone *et al.,* 2016) with concentrations close inshore (SNH, 2016).

Approximately 30 pairs of Slavonian grebe breed and 1,100 individuals winter in the UK, the latter being widely distributed round the entire UK coastline with particular concentrations in Scotland in the Firth of Forth, the Moray Firth, the Northern Isles, north-west Scotland including the Outer Hebrides and Kintyre (SNH, 2016).

Approximately 27,000 pairs of European shag breed and 110,000 individuals winter in the UK (Musgrove *et al.,* 2013) where they are widely distributed in coastal water around the western and northern coasts of the UK (Stone *et al.,* 1995). The greatest abundance is in the north and west of Scotland in particular the Moray Firth and the Firth of Forth (SNH, 2016).

The species occurs during winter round much of the British coastline. The maximum concentrations are to the north and west of Scotland, numbers being sparse or local south of Duncansby Head in Caithness and around the Clyde estuary. The northern and western seaboards of Scotland are the non-breeding strongholds of the great northern diver population of Great Britain.

12.6 Assessment criteria

The general assessment methodology is outlined in Section 7 - Impact assessment methodology. Specific criteria relating to ornithology have been developed for the sensitivity/value of a receptor and the magnitude of impacts.

The sensitivity of a receptor has been considered in terms of the tolerance to change, recoverability, adaptability and value. Expert judgement has been employed to consider the final sensitivity of a particular receptor. Definitions of sensitivity are provided in Table 12-5.

Table 12.5 Sensitivity / value of receptor

Sensitivity/value	Definition
Very high	Receptor has no tolerance to a particular effect and no ability to recover or adapt. Value: Nationally and internationally important receptors with high vulnerability and no ability for recovery.
High	Receptor has a very low tolerance to a particular effect Receptor has low potential for recovery or adaptation Value: Regionally important receptors with high vulnerability and no ability for recovery. Nationally and internationally important receptors with high vulnerability and low recoverability.
Medium	Receptor has a low tolerance to a particular effect. Receptor has some potential for recovery and adaptation over long timescales Locally important receptors with high vulnerability and no ability for recovery. Regionally important receptors with medium to high vulnerability and low recoverability. Nationally and internationally important receptors with medium vulnerability and medium recoverability.
Low	Receptor has some tolerance to a particular effect. Receptor is considered to have a low vulnerability and is expected to recover or adapt. Value: Locally important receptors with medium to high vulnerability and low recoverability. Regionally important receptors with low vulnerability and medium to high recoverability. Nationally and internationally important receptors with low vulnerability and high recoverability.
Negligible	Receptor is generally tolerant to a particular effect. Receptor is not considered vulnerable regardless of value/importance and is expected to recover or adapt within a short timescale. Value: Locally important receptors with low vulnerability and medium to high recoverability.

The magnitude of the impact has been considered in terms of the size and spatial extent, duration and timing/seasonality and frequency of the impact in question. Expert judgment has been employed to consider and evaluate the likely impact on the species, population or habitat identified. Definitions of magnitude are provided in Table 12-6.

Table 12.6 Definitions of magnitude

Magnitude	Definition
Major	The proposal would affect the conservation status with loss of ecological functionality. Recovery expected to be long term (e.g. 10 years) or irreversible following cessation of activity.
Moderate	Conservation status would not be affected, but the impact is likely to be significant in terms of ecological objectives or populations. Impact will occur repeatedly or continuously over a moderate period of time or at moderate intensity for short periods of time. Recovery expected to be medium term (e.g. 5 years) following cessation of activity.
Minor	Minor shift away from baseline but the impact is of limited temporal or physical extent. Low frequency impact occurring occasionally or intermittently and at low intensity. Recovery expected to be short-term (e.g. less than 1 year) following cessation of activity.
Negligible	Very slight change from baseline condition. Impact is highly localised and short term. Any recovery expected to be rapid following cessation of activity.

Following the identification of receptor sensitivity/value and magnitude of the effect, the significance of the impact is determined using the assessment matrix and expert judgement. The matrix used to identify the significance of an impact is presented within Section 7.3.3.

12.7 Identification of potential impacts

The potential impacts on seabird receptors are:

Installation / maintenance / decommissioning

> Disturbance and/or displacement of seabirds due to vessel presence;

> Disturbance and/or displacement of seabirds due to increased turbidity in the water column; and

> Indirect effects on seabirds due to changes in distribution of prey items.

Operation

> Indirect effects on prey species due to EMF during cable operation

The Project activities associated with each potential impact are summarised in Table 12-7.

Table 12.7 Potential impacts and associated project activities

Project activity	Potential impact	Footprint	Phase			Indicative Duration
			I	O	D	
HDD landfall	Disturbance and/or displacement of seabirds due to vessel presence	5 m by 5 m at duct 'pop-out' on seabed	✓	X	✓	3 days
DP cable lay vessel and support vessels	Disturbance and/or displacement of seabirds due to vessel presence	500 m safety exclusion zone around the cable installation vessel extending to 1000m astern of the vessel	✓	X	✓	1 month
Rock placement vessel and support vessels	Disturbance and/or displacement of seabirds due to vessel presence	500 m safety exclusion zone around the cable installation vessel.	✓	X	✓	2 weeks
Seabed preparation: Pre-sweeping of sandwaves	Disturbance and/or displacement of seabirds due to increased turbidity in the water column	Coarser fractions up to and including fine sand, ejected from the trench will be raised a few metres from the seafloor, and are expected to be re-deposited within 10 m or less of the cable trench Finer silt fractions will remain in suspension for longer with levels expected to fall to ambient levels within 70 m with fine deposition occurring out to a maximum of 2 km from the trench. Far field deposition expected to be below 1 mm	✓	X	X	1 week
	Indirect effects on seabirds due to changes in distribution of prey items	20 m wide along areas of sandwaves	✓	X	X	
Seabed preparation: Pre-lay grapnel	Indirect effects on seabirds due to changes in distribution of prey items	1 m width and 0.5 – 1 m penetration towed along centreline	✓	X	X	2 weeks
Seabed preparation: Boulder clearance plough	Indirect effects on seabirds due to changes in distribution of prey items	10 – 15 m width depending on type of plough	✓	X	✓	1 week
Cable installation: pre-trench / back fill plough	Indirect effects on seabirds due to changes in distribution of prey items	Displacement ploughs, trench up to 5m width, plough footprint up to 15 m Non-displacement plough trenches between 0.3 - 1.0 m trench width and plough footprint of 5 –10 m	✓	X	✓	3 weeks
Cable installation: Jet trencher	Indirect effects on seabirds due to changes in distribution of prey items	Trench 0.5 – 1 m width, footprint of trencher 5 – 10 m	✓	X	✓	6 weeks

Project activity	Potential impact	Footprint	Phase			Indicative Duration
			I	O	D	
	Disturbance and/or displacement of seabirds due to increased turbidity in the water column	Coarser fractions up to and including fine sand, ejected from the trench will be raised a few metres from the seafloor, and are expected to be re-deposited within 10 m or less of the cable trench Finer silt fractions will remain in suspension for longer with levels expected to fall to ambient levels within 70 m with fine deposition occurring out to a maximum of 2 km from the trench. Far field deposition is predicted to be below 1 mm	✓	X	✓	
Cable installation: Jet trencher & mechanical trenching	Indirect effects on seabirds due to changes in distribution of prey items	Trench 0.5-1 m width, footprint of trencher 5 – 10 m	✓	X	✓	6 weeks
Cable operation	Indirect effects on prey species due to EMF during cable operation	EMF detectable in immediate vicinity of cables to 1 m	X	✓	X	

12.8 Embedded mitigation and management measures

As part of the Project design process a number of embedded mitigation and management measures and best practice measures have been included to reduce the potential impact on ornithology. There is a commitment to deliver these measures and therefore they are considered part of the Project design.

The assessment of magnitude, sensitivity and significance in Section 12.9 includes the incorporation of these measures.

Table 12.8 Best practice and embedded mitigation and management measures (EM)

ID	Measure	Justification
BP1	A CEMP and an Emergency Spill Response Plan will be developed and implemented for the installation phase. A non-native species management plan / biosecurity plan for vessels will be developed as part of the CEMP.	Measures will be adopted to ensure that the potential for release of pollutants from construction, operation and decommissioning is minimised.
BP2	Control measures and shipboard oil pollution emergency plans (SOPEP) will be in place and adhered to under MARPOL Annex I requirements for all vessels. In the event of an accidental fuel release occurring appropriate standard practice management procedures will be implemented accordingly.	Measures will be adopted to ensure that the potential for release of pollutants from construction, operation and decommissioning is minimised.
BP4	Vessels will be equipped with waste disposal facilities (sewage treatment or waste storage) to IMO MARPOL Annex IV Prevention of Pollution from Ships standards.	Measures will be adopted to ensure that the potential for release of pollutants from construction, operation and decommissioning is minimised.
EM4	The presence of vessels adjacent to the shore areas will be minimised during sensitive periods for breeding birds and where possible will be limited to works in the location of the HDD pop-outs	Ensures that seabirds nesting along the sea cliffs and coastline will not be disturbed by the presence of Project vessels.
EM1	The duration of cable installation activities from the vessel will minimised as much as possible.	To minimise the potential disturbance from Project vessels.
EM5	The slow speed of installation vessels (maximum of a few knots per hour) will reduce impacts of disturbance and lighting on-board the cable installation vessel will be kept to the minimum level required to ensure safe operations.	To minimise the potential disturbance from Project vessels.

12.9 Assessment of impacts

12.9.1 Installation/ maintenance/ decommissioning

12.9.1.1 Physical disturbance and/or displacement due to vessel presence

Disturbance during the installation / maintenance / decommissioning of a subsea cable (vessel presence and activity) may displace birds from an area of sea, effectively amounting to habitat loss during the period of disturbance (Drewitt and Langston, 2006). Project activities may directly disturb / displace birds from foraging or loafing areas, thus causing the birds to move elsewhere and potentially affecting breeding productivity or survival rates of an individual or population. A single disturbance event does not have an immediate effect on the survival or productivity of an individual bird. Repeated disturbance or disturbance over an extended period can affect the survival and productivity of a bird.

Disturbance would be restricted to the export cable corridor footprint and at any one time to the immediate vicinity of the Project vessels when they are operating. When operating, the cable laying and trenching vessels will progress relatively slowly and thus seabirds of the species that regularly occur in the area are likely to show a relatively mild disturbance response to them compared to faster moving vessels (Ronconi and Cassady St. Clair, 2002). Disturbance associated with vessel presence / activity is of limited duration and also represents a transient impact as vessels move through an area. Impacts are spatially and temporally restricted and are considered unlikely to affect the breeding productivity or survival rates of an individual or population.

For the cable pull activity, the Project vessels will be largely stationary, with the cable laying vessel itself being stationed approximately 900 m to 1000 m from the shoreline. Therefore, any species nesting on the cliffs are not likely to flush from their nests due to the short-term presence of the CLV from the shoreline. Therefore, for most species sitting on a nest, they are unlikely to be flushed as a result of the vessels required for the cable pull.

For the cable pull and the cable laying activities, these will require work lights to be on the vessels during any night-time working. The lights will be directed towards the working area only.

In general, it is considered that effects are likely to last only for the duration of installation / maintenance / decommissioning activity, and therefore will be direct, but temporary, reversible and short-term in nature for a specific event. During the work period, birds may return to areas when activities are not currently occurring.

North fulmar, skuas and gulls are opportunistic scavengers that will forage within tens of metres of moving machinery, including vessels, and where feeding opportunities are recognised, close to humans when confident from experience to do so. Skuas have been found to be closely associated with marine fisheries and to scavenge behind fishing vessels (Votier *et al.* 2008). On several occasions during the construction of Lincs Offshore Wind Farm, gulls were clearly associated with the jack-up barge, the guard vessels and with the construction vessel while piling was in progress (RPS, 2012). All three species are considered to be species with low vulnerability to disturbance (Wade *et al.,* 2016), and as such have not been assessed further for this impact.

Divers

Magnitude

Red-throated diver are qualifying features of Hoy SPA, Scapa Flow pSPA, Caithness and Sutherland Peatlands SPA and Orkney Mainland Moors SPA. Black-throated diver are also a feature of Scapa Flow pSPA and Caithness and Sutherland Peatlands SPA and great northern diver are features of the Scapa flow pSPA. Red-throated diver are listed as green on the UK birds of conservation concern list, while black-throated diver are listed as amber (see Table 12-3).

Within the Hoy SPA, red-throated diver nest on the numerous small lochans found on the moorland, feeding in the waters around Hoy. Similarly, the Orkney mainland moors are designated for red-throated diver due to the several scattered oligotrophic lochans across the mainland moors, which provide important breeding areas. Within the Scapa Flow pSPA red-throated diver are mainly distributed along the Hoy Sound and along the south east coast of Hoy. Great northern diver is present across the entire Scape Flow pSPA. Densities detected by aerial surveys within the Scape Flow pSPA ranged from less than 0.1 birds/km^2 to 1.8 birds/km^2 with much of Scapa Flow supporting the higher densities (SNH, 2016b). Black-throated divers were noted most frequently in Scapa Flow around the shores of Hoy, Mainland and South Ronaldsay (SNH, 2016b).

Any disturbance due to Project activities associated with the cable corridor is likely to be in the direct vicinity of each of the vessels directly involved in the installation of the cable. The area of habitat disturbed due to vessel movements is considered to be small in the context of the foraging range of divers (red-throated diver mean max foraging range of 9 km, Thaxter *et al.,* 2012).

Installation activities are likely to only coincide with one breeding season, limiting repeated disturbance at this sensitive period. Consistent or repeated disturbance events can result in longer term avoidance of an area (MMO, 2018), however installation works, and subsequent maintenance works are

considered to be one-off, irregular events and therefore are not anticipated to result in long term avoidance. Mortality rates associated with the disturbance of birds due to installation activities are unknown with no evidence that displacement by vessels will result in direct mortality of individual birds.

Vessel activity will be highly localised as vessels will be slow moving (maximum of a few knots per hour) or static. Any disturbance will take place in the context of existing sources of disturbance such as commercial shipping, recreational boating etc, considering the high level of marine vessel traffic the Pentland Firth experiences (see Appendix B: NRA). The main existing traffic route is closer to the west coast of Hoy than the cable route and passes into Stromness port at the mouth of the Hoy Sound (see Appendix B: NRA). The presence of Project vessels in an already busy area for marine traffic is unlikely to be detectable above existing baseline levels, further reducing the potential for any impacts on seabirds. Lighting on-board cable installation vessels will be kept to the minimum level required to ensure safe operations. Given the wider area available, birds are likely to be able to find alternative feeding / loafing grounds in the short term.

The impact is predicted to be of local spatial extent, short term duration, intermittent and with high reversibility. It is predicted that the impact will affect the receptors directly although a very small number of individuals would be affected representing a small fraction of the regional population. The impact magnitude is therefore considered to be negligible.

Sensitivity

Diver species are considered to be a species that is highly vulnerable to vessel disturbance (Wade *et al.,* 2016). Divers can exhibit flushing on approach by a vessel and can be displaced to over 1000 m from a vessel (Topping and Petersen, 2011), although displacement ranges have been shown to vary depending on the level of traffic in the area (from <100 m to >1000 m) (MMO, 2018). Diver species are deemed to be of very high vulnerability, low recoverability and international value. The sensitivity of the receptor is therefore, considered to be high.

Seaducks

Magnitude

There are four protected species of seaduck in the vicinity of the Project; red-breasted merganser, common eider, goldeneye and long-tail duck. All are features of the Scapa Flow pSPA.

Common eider are present around the more shallow areas of Scapa Flow especially off the south-east coast of Hoy and right across the western and southern reaches of the Flow, and around the exposed southern and eastern coasts of South Ronaldsay. Density estimates derived from aerial surveys ranged from 0.2 – 19.4 birds/km^2. Long-tailed duck were recorded in wide areas of the shallower coastal fringes of Scapa Flow but were noticeably concentrated in two areas; in the west between north-east Hoy and Mainland, and to the east between Burray and east mainland. The maximum density recorded in aerial surveys was 15.7 birds km-^{2} and the mean peak count of 1,393 birds represents an average density across the pSPA of 3.76 birds km^2. Common goldeneye were widely distributed in the coastal areas of Scapa Flow but were noticeably concentrated in two broad areas in the west and east. Average density across the pSPA is 0.59 birds km^2 but the site maximum densities are considerably higher. Red-breasted merganser occurred mainly in coastal waters often in the narrower stretches between islands, notably between north-east Hoy and mainland, southeast Hoy and the north coast of South Ronaldsay. The population estimates derived from boat and shore-based counts give an average density across the site of 1.45 birds km^2 while the aerial survey data indicate considerable variation in densities across the site.

The cable landfall at Warebeth which is to the north-west of the Scapa Flow pSPA and at its closest point the cable corridor is located 0.2 km from the pSPA.

Any disturbance due to Project activities associated with the cable corridor is likely to be in the direct vicinity of each of the vessels directly involved in the installation of the cable. Thaxter *et al.,* (2012) suggested that common eider have a mean max foraging range of 80 km. The area of habitat potentially disturbed due to vessel movements is considered to be small in the context of the foraging range of seaducks.

Installation activities are likely to only coincide with one migratory season, limiting repeated disturbance at this sensitive period. Consistent or repeated disturbance events can result in longer term avoidance of an area (MMO, 2018), however installation works, and subsequent maintenance works are considered to be one-off, irregular events and therefore are not anticipated to result in long term avoidance. Mortality rates associated with the disturbance of birds due to installation activities are unknown with no evidence that displacement by vessels will result in direct mortality of individual birds.

Vessel activity will be highly localised as vessels will be slow moving (maximum of a few knots per hour) or static and such disturbance will take place in the context of existing sources of disturbance such as commercial shipping, recreational boating etc, considering the high level of marine vessel traffic that the Pentland Firth experiences (see Appendix B: NRA). The main existing traffic route passes into Stromness port at the mouth of the Hoy Sound part of the Scapa Flow pSPA (see Appendix B: NRA). The presence of Project vessels in an already busy area for marine traffic is unlikely to be detectable above existing baseline levels, further reducing the potential for any impacts on seabirds. Lighting on-board cable installation vessels will be kept to the minimum level required to ensure safe operations. Given the wider area available, birds are likely to be able to find alternative feeding / loafing grounds in the short term.

The impact is predicted to be of local spatial extent, short term duration, intermittent and with high reversibility. A very small number of individuals would be affected representing a small fraction of the regional population. The impact magnitude is therefore considered to be negligible.

Sensitivity

Seaducks are considered to be vulnerable to disturbance from vessel traffic and have limited habitat flexibility (Wade *et al.,* 2016; MMO, 2018). Certain species e.g. common eider and long tailed duck, have displayed a high-moderate degree of habituation to boat traffic (Schwemmer *et al.,* 2011). The seaduck species assessed, are deemed to be of moderate – high vulnerability, high recoverability and international value. The sensitivity of these receptors is therefore considered to be medium.

Slavonian grebe

Magnitude

Slavonian grebes occurred in the coastal areas of Scapa Flow, most numerously along the south-eastern shore of mainland and the northern shores of Burray and South Ronaldsay (SNH, 2016b). With the cable corridor located to the west of Hoy and landing towards the north west of the Hoy Sound, there is anticipated to be limited interaction with Slavonian grebe. Slavonian grebe are listed as red on the UK birds of conservation concern list (see Table 12-3).

Any disturbance due to Project activities associated with the cable corridor is likely to be in the direct vicinity of each of the vessels directly involved in the installation of the cable.

Installation activities are likely to only coincide with one season, limiting repeated disturbance. Consistent or repeated disturbance events can result to longer term avoidance of an area (MMO, 2018), however installation works, and subsequent maintenance works are considered to be one-off, irregular events and therefore are not anticipated to result in long term avoidance. Mortality rates associated with the disturbance of birds due to installation activities are unknown with no evidence that displacement by vessels will result in direct mortality of individual birds.

Vessel activity will be highly localised as vessels will be slow moving (maximum of a few knots per hour) or static. Any disturbance will take place in the context of existing sources of disturbance such as commercial shipping, recreational boating etc, considering the high level of marine vessel traffic the Pentland Firth experiences (see Appendix B: NRA). The main existing traffic route passes into Stromness port at the mouth of the Hoy Sound part of the Scapa Flow pSPA (see Appendix B: NRA). The presence of a Project vessels in an already busy area for marine traffic is unlikely to be detectable above existing baseline levels, further reducing the potential for any impacts on seabirds. Lighting on-board cable installation vessels will be kept to the minimum level required to ensure safe operations. Given the wider area available, birds are likely to be able to find alternative feeding / loafing grounds in the short term.

The impact is predicted to be of local spatial extent, medium term duration, intermittent and with high reversibility. A very small number of individuals would be affected representing a small fraction of the regional population. The impact magnitude is therefore considered to be negligible.

Sensitivity

Slavonian grebe is considered to be a species with medium vulnerability to disturbance and medium habitat flexibility (Wade *et al*., 2016) and has medium recoverability and international value. The sensitivity of the receptor is therefore, considered to be medium.

Puffin

Magnitude

Puffin are protected features of the Hoy SPA and the North Caithness SPA. The Old Red Sandstone cliffs on the west coast of Hoy and the coast of Caithness provide important breeding sites for puffin. Puffin are listed as red on the UK birds of conservation concern list (see Table 12-3).

Any disturbance due to Project activities associated with the cable corridor is likely to be in the direct vicinity of each of the vessels directly involved in the installation of the cable. Thaxter *et al.,* (2012) suggested that puffin have a mean max foraging range of 105.4 ± 46.0 km. Therefore, the area of habitat disturbed due to vessel movements is considered to be very small in the context of the foraging range of puffin.

Installation activities are likely to only coincide with one season, limiting repeated disturbance. Consistent or repeated disturbance events can result in longer term avoidance of an area (MMO, 2018), however installation works, and subsequent maintenance works are considered to be one-off, irregular events and therefore are not anticipated to result in long term avoidance.

Vessel activity will be highly localised as vessels will be slow moving (maximum of a few knots per hour) or static. Any disturbance will take place in the context of existing sources of disturbance such as commercial shipping, recreational boating etc, considering the high level of marine vessel traffic that the Pentland Firth experiences (see Appendix B: NRA). The main existing traffic route is closer to the west coast of Hoy than the cable route and passes into Stromness port at the mouth of the Hoy Sound (see Appendix B: NRA). The presence of a small number of Project vessels in an already busy area for marine traffic is unlikely to be detectable above existing baseline levels, further reducing the potential for any impacts on seabirds. Lighting on-board cable installation vessels will be kept to the minimum level required to ensure safe operations. Given the wider area available, birds are likely to be able to find alternative feeding / loafing grounds in the short term.

The impact is predicted to be of local spatial extent, medium term duration, intermittent and with high reversibility. It is predicted that the impact will affect the receptors directly although a very small number of individuals would be affected representing a small fraction of the regional population. The impact magnitude is therefore considered to be negligible.

Sensitivity

The species is deemed to be of moderate vulnerability to displacement and moderate habitat flexibility (Wade *et al.*, 2016). There has been an increase in national populations over the last decade (+19%), with a likely increase also occurring in Scotland. Puffin is deemed to be of medium vulnerability, low recoverability and international value. The sensitivity of the receptor is therefore, considered to be **medium**.

Razorbill

Magnitude

Effects of construction disturbance on razorbill are currently unclear; during construction surveys at Lynn and Inner Dowsing OWF there appeared to be no significant patterns of change in razorbill abundance between the wind farm and control sites (ECON, 2012). Leopold *et al.* (2010) found indications of disturbance to auks during some surveys at Egmond aan Zee, but numbers were too low to reach statistical significance.

Any disturbance due to Project activities associated with the cable corridor is likely to be in the direct vicinity of each of the vessels directly involved in the installation of the cable. Wade *et al.,* (2016) report that auks may be disturbed by boats at several hundreds of metres distance, although survey vessels have often approached to less than ten of metres before eliciting an evasion response, for example many birds are recorded within fifty metres during boat-based surveys at offshore wind farms.

Thaxter *et al.,* (2012) suggested that razorbill have a mean max foraging range of 48.5±35.0 km. Therefore, the area of habitat disturbed due to vessel movements is considered to be small in the context of the foraging range of razorbill.

Installation activities are likely to only coincide with one season, limiting disturbance repeated disturbance. Consistent or repeated disturbance events can result to longer term avoidance of an area (MMO, 2018), however installation works, and subsequent maintenance works are considered to be one-off, irregular events and therefore are not anticipated to result in long term avoidance.

Vessel activity will be highly localised as vessels will be slow moving (maximum of a few knots per hour) or static and such disturbance will take place in the context of existing sources of disturbance such as commercial shipping, recreational boating etc, considering the high level of marine vessel traffic that the Pentland Firth experiences (see Appendix B: NRA). The presence of Project vessels in an already busy area for marine traffic is unlikely to be detectable above existing baseline levels, further reducing the potential for any impacts on seabirds. Lighting on-board cable installation vessels will be kept to the minimum level required to ensure safe operations. Given the wider area available, birds are likely to be able to find alternative feeding / loafing grounds in the short term.

The impact is predicted to be of local spatial extent, short term duration, intermittent and with high reversibility. A very small number of individuals would be affected representing a small fraction of the regional population. The impact magnitude is therefore considered to be negligible.

Sensitivity

There has been an increase in UK razorbill populations over the last decade (+21%), although the Scottish population is relatively stable. The species is considered to be of moderate vulnerability to displacement and moderate habitat flexibility (Wade *et al.*, 2016). Razorbill may be particularly sensitive during the post-breeding period during moult and when attending young at sea. Razorbill is deemed to be of moderate vulnerability, medium recoverability and international value. The sensitivity of the receptor is therefore, considered to be medium.

Guillemot

Magnitude

Guillemot are protected features of the Hoy SPA and the North Caithness SPA, with the cliffs of both sites providing important nesting sites.

Effects of construction disturbance on guillemot are currently unclear; during construction surveys at Lynn and Inner Dowsing OWF there appeared to be no significant patterns of change in guillemot abundance between the wind farm and control sites (ECON, 2012). Leopold *et al.* (2010) found indications of disturbance to auks during some surveys at Egmond aan Zee OWF, but numbers were too low to reach statistical significance. Wade *et al.* (2016) report that auks may be disturbed by boats at several hundreds of metres distance, although survey vessels have often approached to less than ten of metres before eliciting an evasion response. For example, many birds are recorded within fifty metres during boat-based surveys at offshore wind farms.

Any disturbance due to Project activities associated with the cable installation is likely to be in the direct vicinity of each of the vessels directly involved in the installation of the cable. Thaxter *et al.,* (2012) suggested that guillemot have a mean max foraging range of 84.2 ± 50.1km. Therefore, the area of habitat disturbed due to vessel movements is considered to be small in the context of the foraging range of guillemot.

Installation activities are likely to only coincide with one season, limiting repeated disturbance. Consistent or repeated disturbance events can result to longer term avoidance of an area (MMO, 2018),

however installation works, and subsequent maintenance works are considered to be one-off, irregular events and therefore are not anticipated to result in long term avoidance.

Vessel activity will be highly localised as vessels will be slow moving (maximum of a few knots per hour) or static. Any disturbance will take place in the context of existing sources of disturbance such as commercial shipping, recreational boating etc, considering the high level of marine vessel traffic that the Pentland Firth experiences (see Appendix B: NRA). The main existing traffic route is closer to the west coast of Hoy than the cable route and passes into Stromness port at the mouth of the Hoy Sound (see Appendix B: NRA). The presence of a CLV and guard vessel in an already busy area for marine traffic is unlikely to be detectable above existing baseline levels, further reducing the potential for any impacts on seabirds. Lighting on-board cable installation vessels will be kept to the minimum level required to ensure safe operations. Given the wider area available, birds are likely to be able to find alternative feeding / loafing grounds in the short term.

The impact is predicted to be of local spatial extent, short term duration, intermittent and with high reversibility. It is predicted that the impact will affect the receptors directly although a very small number of individuals would be affected representing a small fraction of the regional population. The impact magnitude is therefore considered to be negligible.

Sensitivity

The species is considered to be of moderate vulnerability to displacement (Wade *et al.,* 2016). Birds may be particularly vulnerable at the end of the breeding period if they are undergoing moult and attending young that have restricted mobility. Guillemot is deemed to be of high vulnerability, medium recoverability and international value. The sensitivity of the receptor is therefore, considered to be medium.

Peregrine falcon

Magnitude

The peregrine falcon is not a marine-dependent species, but it is appropriate to assess the species due to the sea cliffs at both Hoy SPA and North Caithness SPA providing important nesting habitat for the species. Peregrine falcon is listed as green on the UK birds of conservation concern list.

In the vicinity of the Project, peregrine falcon nest upon sea cliffs such as those at North Caithness and the west coast of Hoy. Peregrine's predate on seabirds abundant in the vicinity of their home range and have been recorded hunting birds over 3 km from the coast (Sutton, 2015). The cable vessel will remain offshore from the shoreline (the HDD pop-out is located 900 m offshore from the Dounreay coastline and 1050 m offshore from the Warebeth coastline). Cable vessels are only likely to potentially affect peregrine falcon indirectly through the disturbance to potential prey species.

Vessel activity will be highly localised as vessels will be slow moving (maximum of a few knots per hour) or static. Any disturbance will take place in the context of existing sources of disturbance such as commercial shipping, recreational boating etc, considering the high level of marine vessel traffic that the Pentland Firth experiences (see Appendix B: NRA). The main existing traffic route is closer to the west coast of Hoy than the cable route and passes into Stromness port at the mouth of the Hoy Sound (see Appendix B: NRA). The presence of a CLV and guard vessel in an already busy area for marine traffic is unlikely to be detectable above existing baseline levels, further reducing the potential for any impacts on seabirds. Lighting on-board cable installation vessels will be kept to the minimum level required to ensure safe operations. Given the wider area available, birds are likely to be able to find alternative feeding / loafing grounds in the short term.

Any impact is predicted to be of local spatial extent, short term duration, intermittent and with high reversibility. It is predicted that there will be limited impact on peregrine falcon due to their limited use of the sea area and at most only a very small number of individuals would be affected representing a small fraction of the regional population. The impact magnitude is therefore considered to be negligible**.**

Sensitivity

Peregrines are known to vary in their response to disturbance depending on the individual and on the type of disturbance. Recreational activities such as water-skiing has been tolerated at a distance of 50 m and onshore birds have been known to nest in working quarries and other urban environments (Ruddock and Whitefield, 2007). Habituation is considered highly likely in this species, although it can take several years (Ruddock and Whitefield, 2007). The sensitivity of the receptor is therefore, considered to be medium.

European shag

Magnitude

The European shag is one species, which frequents the open deeper waters of Scapa Flow as well as the coastal areas. The Scapa Flow population was recorded at 2,929 birds (1.5% of the biogeographic population), which is the second largest population in Scotland, representing an average density of 7.98 birds km^2 (SNH, 2016b).

Any disturbance due to Project activities associated with the cable corridor is likely to be in the direct vicinity of each of the vessels directly involved in the installation of the cable. Thaxter *et al.,* (2012) suggested that shag have a mean max foraging range of 14.5 ± 3.5 km. Therefore, the area of habitat disturbed due to vessel movements is considered to be small in the context of the foraging range of shag.

Installation activities are likely to only coincide with one season, limiting disturbance. Consistent or repeated disturbance events can result to longer term avoidance of an area (MMO, 2018), however installation works, and subsequent maintenance works are considered to be one-off, irregular events and therefore are not anticipated to result in long term avoidance.

Vessel activity will be highly localised as vessels will be slow moving (maximum of a few knots per hour) or static. Any disturbance will take place in the context of existing sources of disturbance such as commercial shipping, recreational boating etc, considering the high level of marine vessel traffic that the Pentland Firth experiences (see Appendix B: NRA). The main existing traffic route passes into Stromness port at the mouth of the Hoy Sound part of the Scapa Flow pSPA (see Appendix B: NRA). The presence of a CLV and guard vessel in an already busy area for marine traffic is unlikely to be detectable above existing baseline levels, further reducing the potential for any impacts on seabirds. Lighting on-board cable installation vessels will be kept to the minimum level required to ensure safe operations. Given the wider area available, birds are likely to be able to find alternative feeding / loafing grounds in the short term.

The impact is predicted to be of local spatial extent, short term duration, intermittent and with high reversibility. It is predicted that the impact will affect the receptors directly although a very small number of individuals would be affected representing a small fraction of the regional population. The impact magnitude is therefore considered to be negligible.

Sensitivity

Shag is considered to be a species with high vulnerability to disturbance (Wade *et al*., 2016), of low recoverability and international value. The sensitivity of the receptor is therefore, considered to be high.

Arctic tern

Magnitude

Any disturbance due to Project activities associated with the cable corridor is likely to be in the direct vicinity of each of the vessels directly involved in the installation of the cable. Thaxter *et al.,* (2012) suggested that shag have a mean max foraging range of 24.2 ± 6.3 km. Therefore, the area of habitat disturbed due to vessel movements is considered to be small in the context of the foraging range of arctic tern.

Installation activities are likely to only coincide with one season, limiting disturbance. Consistent or repeated disturbance events can result to longer term avoidance of an area (MMO, 2018), however

installation works, and subsequent maintenance works are considered to be one-off, irregular events and therefore are not anticipated to result in long term avoidance.

Vessel activity will be highly localised as vessels will be slow moving (maximum of a few knots per hour) or static. Any disturbance will take place in the context of existing sources of disturbance such as commercial shipping, recreational boating etc, considering the high level of marine vessel traffic that the Pentland Firth experiences (see Appendix B: NRA). The main existing traffic route passes into Stromness port at the mouth of the Hoy Sound part of the Scapa Flow pSPA (see Appendix B: NRA). The presence of a CLV and guard vessel in an already busy area for marine traffic is unlikely to be detectable above existing baseline levels, further reducing the potential for any impacts on seabirds. Lighting on-board cable installation vessels will be kept to the minimum level required to ensure safe operations. Given the wider area available, birds are likely to be able to find alternative feeding / loafing grounds in the short term.

The impact is predicted to be of local spatial extent, short term duration, intermittent and with high reversibility. It is predicted that the impact will affect the receptors directly although a very small number of individuals would be affected representing a small fraction of the regional population. The impact magnitude is therefore considered to be negligible.

Sensitivity

Arctic tern is considered to be a species with low vulnerability to disturbance (Wade *et al.,* 2016) and are generally tolerance to anthropogenic disturbance (Cook and Burton, 2010). The sensitivity of the receptor is therefore considered to be low.

Assessment of significance

The sensitivity of bird receptors to physical disturbance from vessels ranges from low to high. As the impact is predicted to be predicted to be of local spatial extent, short term duration, intermittent and with high reversibility the magnitude of impact for all species is considered to be negligible. Therefore, the level of impact ranges from negligible to minor and is not considered a significant impact.

As the impact is not significant no mitigation measures are required. Measures considered as part of the Project design are listed in Table 12-8.

Species	Sensitivity/value	Magnitude of effect	Level of impact
Arctic skua	Negligible	Negligible	Negligible
Arctic tern	Low	Negligible	Negligible
Black-throated diver	High	Negligible	Minor
Common eider	Medium	Negligible	Negligible
European shag	High	Negligible	Minor
Fulmar	Negligible	Negligible	Negligible
Goldeneye	Medium	Negligible	Negligible
Great black-backed gull	Negligible	Negligible	Negligible
Great northern diver	High	Negligible	Minor
Great skua	Negligible	Negligible	Negligible
Guillemot	Medium	Negligible	Negligible
Kittiwake	Low	Negligible	Negligible
Long-tailed duck	Medium	Negligible	Negligible
Peregrine falcon	Medium	Negligible	Negligible
Puffin	Medium	Negligible	Negligible
Razorbill	Medium	Negligible	Negligible
Red-breasted merganser	Medium	Negligible	Negligible
Red-throated diver	High	Negligible	Minor
Slavonian grebe	Medium	Negligible	Negligible
Impact significance – NOT SIGNIFICANT			

12.9.1.2 Disturbance and/or displacement of seabirds due to increased turbidity in the water column

The cable installation technique has not yet been determined, as such there could be varying degrees of sediment disturbance and dispersal depending on the technique used and the substrate type. Jetting is considered to produce the worst-case scenario for the production of increased suspended sediment. Coarser fractions up to and including fine sand, ejected from the trench will be raised a few metres from the seafloor, and will be re-deposited within 10 m or less of the cable trench. Finer silt fractions will remain in suspension for longer with levels expected to fall to ambient levels within 70 m with fine deposition occurring out to a maximum of 2 km from the trench. Far field deposition is predicted to be below 1 mm. Once the cable has been trenched the sediment will resettle over the cable, or in the near vicinity of the cable.

The increase in suspended sediment has the potential to effect visual seabird foragers, yet because the increase will be temporary in nature and the suspended sediment will settle on the seabed (small spatial extent) it is not considered likely there will be a large effect on seabird foraging, especially considering the foraging range of seabirds and the alternate foraging habitat available. Furthermore, aside from seabirds who are known to forage around marine vessels and aren't considered within this assessment specifically (see section 12.9.1.1), due to temporary vessel disturbance during cable installation, it is unlikely that the majority of seabirds will be foraging in the direct vicinity of the cable

corridor. The impact is considered local spatial extent, short term duration, intermittent and with high reversibility and therefore of negligible magnitude.

Indirect impacts to the distribution of prey species is assessed in Section 12.9.1.3. This assessment focuses on visual foragers and on the potential impact to their foraging ability. Peregrine falcon will not be affected by this impact and has not been considered further. North fulmar, skuas and gulls are opportunistic scavengers and are not considered sensitive to changes in turbidity having been seen to scavenge around marine works previously (Votier *et al.,* 2008; RPS, 2012). The following species were identified as being moderate – high sensitivity to increases in turbidity; Slavonian grebe, guillemot, razorbill, eider, red-throated diver, arctic tern and puffin (Cook and Burton, 2010). The sensitivity of all relevant species is therefore considered medium to high.

Assessment of significance
The impact is considered local spatial extent, short term duration, intermittent and with high reversibility and therefore of negligible magnitude. The sensitivity of all species is considered to range from medium – high.

As the impact is not significant no mitigation measures are required. Measures considered as part of the Project design are listed in Table 12-8.

Sensitivity/value	Magnitude of effect	Level of impact
Medium/High	Negligible	Negligible/Minor
Impact significance – NOT SIGNIFICANT		

12.9.1.3 Indirect effects on seabirds due to changes in distribution of prey items

Magnitude of impact

The main impacts on prey species are likely to be as a result of construction noise and physical disturbance from cable installation. Given the mobile nature of fish, potential impacts associated with cable installation and operation are expected to be minimal on the basis that fish can avoid the main area of potential impact. Aside from Atlantic salmon a qualifying feature of SACs for which potential impacts have been considered further in the NCA, all other impacts to fish ecology has been scoped out of this assessment due to the minimal predicted impact (see Table 7-1). As such no significant impacts are predicted on fish prey items of seabirds.

Sediment disturbance will be limited to the vicinity of the cable installation operations and no impacts from the low levels of sediments disturbance by trenching activity are expected on fish or shellfish receptors. The Project will have a relatively limited footprint (maximum disturbance is 20 m width from sandwave clearance) within the cable installation corridor itself (width of 200 m) so loss of, or damage to supporting habitat is likely to be insignificant. Any disturbed sediment is expected to be rapidly dispersed by tidal currents. Data from Coull *et al.,* (1998), Ellis *et al.,* (2012) and the Scottish Governments Updated Fisheries Sensitivity Maps indicate that it is unlikely that any key spawning grounds are present in the Project vicinity. Potential impacts on any spawning grounds associated with direct seabed disturbance during cable installation will be limited to the working corridor.

With respect to underwater noise, given the limited number of vessels expected to be involved in any seabed preparation and cable installation activities (estimated two vessels – CLV and guard vessel) and the short duration and temporary nature of cable installation activities, the potential for significant impacts on prey species is considered to be minimal.

The magnitude of changes in habitat or abundance and distribution of prey, will be negligible compared to overall foraging range for each seabird species, the impact is predicted to be of local to regional spatial extent, short duration, irregular and of high reversibility. It is predicted that the impact will affect each receptor directly and indirectly. For all ornithological receptors, the impact magnitude is therefore considered to be negligible.

Sensitivity of receptors

Divers

The impact to divers will depend on the overlap of such activity with food resources at any particular time. Herring and sprat are amongst the most frequently recorded prey species of red-throated divers (Cramp & Simmons 1977 - 1994), although this species is considered to be an opportunistic feeder, taking a rather broad range of fish species (Guse *et al.,* 2009). The species however shows low flexibility in feeding habitats, being dependent on shallow feeding grounds with shellfish banks (Furness *et al.,* 2012; Wade *et al.,* 2016) and is considered to be moderately sensitive to impacts on food supply (Cook and Burton, 2010). When considering the above factors, it is determined that the sensitivity of diver species is considered to be high.

Seaducks

Numbers of seaduck affected will depend on the overlap of such activity with food resources at any particular time. Seaduck species show low flexibility in feeding habitats (Wade *et al.,* 2016). The common eider forages entirely on benthic species, especially shellfish. Therefore, common eider may be sensitive to detrimental impacts to benthic communities (Cook and Burton, 2010). The long-tailed duck is an opportunistic, generalist forager capable of a degree of ecological flexibility. Although the species has been considered to be sensitive to the deposition of suspended sediment (Cook and Burton, 2010). When considering the above factors, it is determined that the sensitivity of seaduck species is considered to be high.

Auks

The auks (puffin, razorbill and guillemot) foraging behaviour and prey species are similar and therefore for the purposes of this assessment are considered together. Auks primarily forage for sandeels, but they also consume a wide-range of mobile prey species. Guillemot, razorbill and puffin were all classified as being of moderate vulnerability to habitat/prey interactions and therefore likely habitat loss by Wade *et al.,* (2016). All species are considered to be of international conservation value. When considering the above factors, it is determined that the sensitivity of auks species is considered to be medium.

European shag

Shag feed on fish and shellfish and occupy two distinct foraging habitats, rocky sediments and sandy sediments (Wanless et al., 1998; Watanuki et al., 2008). Over rocky sediments, they forage at a wide range of depths, feeding on bottom living fish and shellfish whilst over sandy sediments they are more restricted in their range, tending to probe the sand for species such as sandeel (Watanuki et al. 2008). Wade *et al.,* (2016) considered European shag to have a medium habitat flexibility. When considering the above factors, it is determined that the sensitivity of European shag is considered to be medium.

Slavonian grebe

The Slavonian grebe feeds on small fish in generally shallow water. Slavonian grebes are further likely to be sensitive to the increases in turbidity and the indirect effects of the deposition of resuspended sediments which could potentially negatively impact on their food supply. For Slavonian grebe the habitat flexibility was considered to be high by Wade *et al.,* (2016) and moderately sensitive to effects on their food supply (Cook and Burton, 2010). When considering the above factors, it is determined that the sensitivity of Slavonian grebe is considered to be medium.

Great black-backed gull

Great black-backed gull are omnivorous opportunistic predators. For great black-backed gull the habitat flexibility was considered to be low by Wade *et al.,* (2016). When considering the above factors, it is determined that the sensitivity of great black-backed gull is considered to be low.

Kittiwake

Kittiwakes feed on mobile prey species such as herring and sandeels and are generally restricted to prey species available within the top metre of the sea surface (Coulson, 2011). Kittiwake forage across

the continental shelf. For kittiwake the habitat flexibility was considered to be high by Wade *et al.,* (2016). Kittiwake is of international conservation value and has low recoverability potential due to population declines. The sensitivity of kittiwake to this impact is considered to be medium.

Northern Fulmar

For fulmar the habitat flexibility was considered to be very high by Wade *et al.,* (2016). Fulmar also have extensive foraging ranges during the breeding season (Thaxter *et al.,* 2012) providing the species with sufficient alternative foraging opportunities, when compare to the localised impact of the Project works. Fulmar is of international conservation value. The sensitivity of the receptor to this impact is considered to be low.

Skuas

For skaus the habitat flexibility was considered to be high by Wade *et al.,* (2016). Skuas feed on fish, other birds and carrion. The sensitivity of skuas to this impact is therefore considered to be low.

Arctic tern

Artic tern feed on a wide-variety of small fish, crustaceans and zooplankton. The birds feed by diving into the water column to depths of no greater than 50 cm. Arctic tern have a foraging range of 24.2 ± 6.3 km (Thaxter *et al.,* 2012) and are considered to be highly vulnerable to reduced food availability. The sensitivity of the Arctic tern is considered to be high.

Peregrine falcon

Peregrine falcon is not a marine-dependent species, but it is appropriate to assess the species as it is associated with the seabirds on the cliffs. Peregrine falcons hunt for seabird eggs and chicks along the cliffs. Any adverse effects on the other seabirds of the sea cliffs would result in an adverse effect to the peregrine's prey species. As no effects are predicted, impacts to prey species are considered to be negligible.

Assessment of significance

The sensitivity of seabird receptors to indirect impacts to prey species ranges from low to high. No significant impacts are predicted on fish prey items of seabirds. The impact is predicted to be of local to regional spatial extent, short duration, irregular and of high reversibility, and hence negligible.

As the impact is not significant no mitigation measures are required. Measures considered as part of the Project design are listed in Table 12-8.

Species	Sensitivity/value	Magnitude of effect	Level of impact
Arctic skua	Low	Negligible	Negligible
Arctic tern	High	Negligible	Negligible
Black-throated diver	High	Negligible	Minor
Common eider	High	Negligible	Minor
European shag	Medium	Negligible	Negligible
Fulmar	Low	Negligible	Negligible
Goldeneye	High	Negligible	Minor
Great black-backed gull	Low	Negligible	Negligible
Great northern diver	High	Negligible	Minor
Great skua	Low	Negligible	Negligible
Guillemot	Medium	Negligible	Negligible
Kittiwake	Medium	Negligible	Negligible
Long-tailed duck	High	Negligible	Minor
Peregrine	Negligible	Negligible	Negligible
Puffin	Medium	Negligible	Negligible
Razorbill	Medium	Negligible	Negligible
Red-breasted merganser	High	Negligible	Minor
Red-throated diver	High	Negligible	Minor
Slavonian grebe	Medium	Negligible	Negligible

Impact significance – NOT SIGNIFICANT

12.9.2 Operational impacts

12.9.2.1 Indirect effects on prey species due to EMF during cable operation

Electromagnetic field (EMF) emissions are generated from the transmission of electricity through subsea cables. The cables produce EMF's which have both electric (E) measured in volts per metre (V m-1) and magnetic components (B) measured in micro tesla (μT). While the direct electric field is mostly blocked with the use of conductive sheathing, the magnetic field penetrates most materials and therefore are emitted into the marine environment with the resultant induced electric (iE) field.

It is commonly recommended that cable burial is used to increase the distance between the cable and the EMF sensitive species (Gill *et al.,* 2005; DECC, 2011). However, where burial is not an option due to nature of seabed cable protection, e.g. concrete mattresses or rock placement can also be used to increase the distance between marine species sensitive to EMF and the EMF source. Where cables are buried to a depth of 1 m, the predicted magnetic field strength at the seabed is expected to be below the earth's magnetic field (assumed to be 50 μT) (MORL, 2012) and not detectable by elasmobranch

or EMF sensitive species (fish and crustaceans). Given that the cable will be buried or protected for the majority of its length (in line with SHE Transmission overarching objective for installation of subsea cable) the potential for significant impacts due to EMF emissions are minimal and unlikely to occur.

In general, teleost fishes are not believed to be electrically sensitive except weakly electric fish, such as electric catfishes or knifefishes. There is significant evidence of teleost fishes possessing magnetic receptors and there is evidence that certain fish species orientate in relation to magnetic fields. However, it is not known whether their natural behaviour would be affected by EMF's from sub-sea cables. Bochert & Zettler (2004) found no significant effects of static magnetic fields upon flounder, *Platichthys flesus*. Swedpower (2003) found no measurable impact of subjecting salmon and trout to magnetic fields twice the magnitude of the geomagnetic field. The European eel (*Anguilla anguilla*), has been suggested to deviate temporarily from its migration course in the presence of a 5 µT magnetic field 60 m from a HVDC cable; however, the spatial resolution of the tracking was too low to draw any firm conclusions (Westerberg 2000; Ohman *et al.,* 2007). The temporary and small-scale nature of such effects would suggest it is unlikely that key functions such as breeding or feeding success would be adversely affected. Benthic species are more likely to encounter elevated magnetic fields and are possibly able to detect them even at distances at which they fall below the geomagnetic field (Westerberg 2000; Meyer *et al.,* 2004).

The only evidence of physiological effects on demersal fish relates to fish embryonic development, which has been shown to be delayed by AC magnetic fields of 1 to 100µT (Cameron *et al.,* 1985; Cameron *et al.,* 1993). There are no key spawning grounds present in the Project vicinity and therefore the potential for EMFs to affect eggs or embryos is considered low.

Assessment of significance

EMF have the potential to effect seabird prey species and in turn effect seabirds. Seabirds vary from low too high in their sensitivity to changes to prey availability depending on their diet and foraging behaviour (see Section 12.8.2.1). However, any changes to the distribution of seabird prey species and habitat during the operation of the Project as a result of EMFs is likely to be negligible when considering the size of the Project in relation to each species' total foraging range. Therefore, the sensitivity of all seabird species is considered to be low. The effect of EMF will be present along the entire submarine cable route for the lifetime of the operating cable, but only constitute a minor shift away from baseline conditions given the localised nature of the effect. Therefore, the magnitude of the impact is assessed as negligible.

As the impact is not significant no mitigation measures are required. Measures considered as part of the Project design are listed in Table 12-8.

Species	Sensitivity/value	Magnitude of effect	Level of impact
Arctic skua	Low	Negligible	Negligible
Arctic tern	Low	Negligible	Negligible
Black-throated diver	Low	Negligible	Negligible
Common eider	Low	Negligible	Negligible
European shag	Low	Negligible	Negligible
Fulmar	Low	Negligible	Negligible
Goldeneye	Low	Negligible	Negligible
Great black-backed gull	Low	Negligible	Negligible
Great northern diver	Low	Negligible	Negligible
Great skua	Low	Negligible	Negligible
Guillemot	Low	Negligible	Negligible
Kittiwake	Low	Negligible	Negligible
Long-tailed duck	Low	Negligible	Negligible
Peregrine	Low	Negligible	Negligible
Puffin	Low	Negligible	Negligible
Razorbill	Low	Negligible	Negligible
Red-breasted merganser	Low	Negligible	Negligible
Red-throated diver	Low	Negligible	Negligible
Slavonian grebe	Low	Negligible	Negligible

Impact significance – NOT SIGNIFICANT

12.10 Cumulative Impacts

Cumulative impacts are those resulting from the combined effects of the Project with other projects through space and time, in the context of natural variability. It also includes the combined effects with other sea users generating similar effects.

The consideration of projects located within the vicinity of the proposed cable route could result in potential cumulative or in-combination impacts is based on the results of the Project specific impact assessment together with the expert judgement of the specialist consultant.

The Dounreay Tri floating offshore wind demonstration project and its grid connection, and the Katanes Floating Energy Park and its grid connection share a pathway of effect with the Project. Dounreay Tri array site is located 7.2 km from the Project and the Katanes array site is located 9 km from the Project. Both projects cable routes however, have the potential to overlap with the Project.

The shared pathway of effect is through the temporary disturbance or displacement due to vessel presence, which may cumulatively disturb foraging seabirds. Section 12.7 concluded that for the Project alone, due to the local spatial extent, short term duration, intermittency and high reversibility of vessels

presence, the displacement/disturbance of seabirds is considered to be negligible. The Dounreay Tri floating OWF is current on hold following Dounreay Tri Ltd. entering administration in 2017, therefore the likelihood of the project moving forward in a timeframe that overlaps with the Project is low. Dounreay Tri floating offshore wind demonstration project environmental statement also considered the disturbance of birds within the ES as a negligible impact. The Katanes Floating Energy Park received an EIA Screening Opinion from Marine Scotland in 2017. As such there is limited information available publicly to inform a cumulative assessment. Due to the small scale of the Project disturbance to seabirds is likely to be limited. As such it is considered that the cumulative impact of temporary vessel disturbance/displacement is negligible.

12.11 Conclusion

Table 12-9 provides a summary of each impact assessment for each seabird receptor. The Project has the potential to effect birds through physical disturbance/ displacement, disturbance or displacement of seabirds due to increase turbidity, indirect effects on seabirds due to changes in distribution of prey species and indirect effect on prey species due to EMF. Seabird sensitivity ranges from negligible to high, however due to the local spatial extent, short term duration, intermittency and high reversibility of the majority of the Project effects. No significant impacts have been identified.

Table 12.9 Impact assessment summary for ornithological receptors

Project activity	Potential impact	Receptor	Assessment			
			Sen/Val	Mag	Level of impact	Significance
HDD Landfall DP cable lay vessel Anchored cable lay vessel or barge Rock placement vessel Other support vessels	Disturbance and/or displacement due to vessel presence	Arctic skua	Low	Negligible	Negligible	Not significant
		Fulmar	Low	Negligible	Negligible	Not significant
		Great black-backed gull	Low	Negligible	Negligible	Not significant
		Great skua	Low	Negligible	Negligible	Not significant
		Guillemot	Medium	Negligible	Negligible	Not significant
		Kittiwake	Low	Negligible	Negligible	Not significant
		Razorbill	Medium	Negligible	Negligible	Not significant
		Peregrine	Medium	Negligible	Negligible	Not significant
		Puffin	Medium	Negligible	Negligible	Not significant
		Red-throated diver	High	Negligible	Minor	Not significant
		Black-throated diver	High	Negligible	Minor	Not significant
		Goldeneye	Medium	Negligible	Negligible	Not significant
		Common eider	Medium	Negligible	Negligible	Not significant
		Great northern diver	High	Negligible	Minor	Not significant
		Long-tailed duck	Medium	Negligible	Negligible	Not significant
		Red-breasted merganser	Medium	Negligible	Negligible	Not significant
		Slavonian grebe	Medium	Negligible	Negligible	Not significant

Project activity	Potential impact	Receptor	Assessment			
			Sen/Val	Mag	Level of impact	Significance
		European shag	High	Negligible	Minor	Not significant
Seabed preparation: Pre-sweeping of sandwaves Cable installation: Jet trenching Cable installation: Mechanical trenching Cable installation: Ploughing	Temporary increase in suspended sediment concentrations on qualifying interests	Arctic skua	Medium-High	Negligible	Negligible/Minor	Not significant
		Fulmar	Medium-High	Negligible	Negligible/Minor	Not significant
		Great black-backed gull	Medium-High	Negligible	Negligible/Minor	Not significant
		Great skua	Medium-High	Negligible	Negligible/Minor	Not significant
		Guillemot	Medium-High	Negligible	Negligible/Minor	Not significant
		Kittiwake	Medium-High	Negligible	Negligible/Minor	Not significant
		Razorbill	Medium-High	Negligible	Negligible/Minor	Not significant
		Peregrine	Medium-High	Negligible	Negligible/Minor	Not significant
		Puffin	Medium-High	Negligible	Negligible/Minor	Not significant
		Red-throated diver	Medium-High	Negligible	Negligible/Minor	Not significant
		Black-throated diver	Medium-High	Negligible	Negligible/Minor	Not significant
		Goldeneye	Medium-High	Negligible	Negligible/Minor	Not significant
		Common eider	Medium-High	Negligible	Negligible/Minor	Not significant
		Great northern diver	Medium-High	Negligible	Negligible/Minor	Not significant
		Long-tailed duck	Medium-High	Negligible	Negligible/Minor	Not significant
		Red-breasted merganser	Medium-High	Negligible	Negligible/Minor	Not significant
		Slavonian grebe	Medium-High	Negligible	Negligible/Minor	Not significant
		European shag	Medium-High	Negligible	Negligible/Minor	Not significant
Pre-lay grapnel	Indirect effect on qualifying features due to	Arctic skua	Low	Negligible	Negligible	Not significant
		Fulmar	Low	Negligible	Negligible	Not significant

Project activity	Potential impact	Receptor	Assessment			
			Sen/Val	Mag	Level of impact	Significance
Seabed preparation: Boulder clearance plough Cable installation: Ploughing Cable installation: Jet trenching Cable installation: Mechanical trenching	changes in prey availability	Great black-backed gull	Low	Negligible	Negligible	Not significant
		Great skua	Low	Negligible	Negligible	Not significant
		Guillemot	Low	Negligible	Negligible	Not significant
		Kittiwake	Low	Negligible	Negligible	Not significant
		Razorbill	Low	Negligible	Negligible	Not significant
		Peregrine	Low	Negligible	Negligible	Not significant
		Puffin	Low	Negligible	Negligible	Not significant
		Red-throated diver	Low	Negligible	Negligible	Not significant
		Black-throated diver	Low	Negligible	Negligible	Not significant
		Goldeneye	Low	Negligible	Negligible	Not significant
		Common eider	Low	Negligible	Negligible	Not significant
		Great northern diver	Low	Negligible	Negligible	Not significant
		Long-tailed duck	Low	Negligible	Negligible	Not significant
		Red-breasted merganser	Low	Negligible	Negligible	Not significant
		Slavonian grebe	Low	Negligible	Negligible	Not significant
		European shag	Low	Negligible	Negligible	Not significant
Cable operation	Changes to prey availability (from EMF)	Arctic skua	Llow	Negligible	Negligible	Not significant
		Fulmar	Low	Negligible	Negligible	Not significant
		Great black-backed gull	Low	Negligible	Negligible	Not significant
		Great skua	Low	Negligible	Negligible	Not significant
		Guillemot	Low	Negligible	Negligible	Not significant
		Kittiwake	Low	Negligible	Negligible	Not significant

Project activity	Potential impact	Receptor	Assessment			
			Sen/Val	Mag	Level of impact	Significance
		Razorbill	Low	Negligible	Negligible	Not significant
		Peregrine	Low	Negligible	Negligible	Not significant
		Puffin	Low	Negligible	Negligible	Not significant
		Red-throated diver	Low	Negligible	Negligible	Not significant
		Black-throated diver	Low	Negligible	Negligible	Not significant
		Goldeneye	Low	Negligible	Negligible	Not significant
		Common eider	Low	Negligible	Negligible	Not significant
		Great northern diver	Low	Negligible	Negligible	Not significant
		Long-tailed duck	Low	Negligible	Negligible	Not significant
		Red-breasted merganser	Low	Negligible	Negligible	Not significant
		Slavonian grebe	Low	Negligible	Negligible	Not significant
		European shag	Low	Negligible	Negligible	Not significant

13 MARINE ARCHAEOLOGY

13.1 Introduction

This chapter describes the key characteristics of the marine historic environment along the potential cable route between Warebeth, Orkney and Dounreay, Caithness (Section 13.6), and presents results from an assessment of potential impacts of the Project on these characteristics (Section 13.7).

This chapter also provides a summary of relevant historic environment legislation (Section 13.2) and describes the criteria used to determine the importance or sensitivity of the identified historic environment assets (Section 13.7). Where potential direct or indirect impacts are identified (Section 13.7), recommendations have been made for mitigating and managing those impacts (Section 13.8).

Marine cultural heritage encompasses not only shipwrecks, but also other evidence of human exploitation of maritime resources, such as shipyards, piers, fish traps, anchor sites and submerged landscapes where human beings and early hominids previously lived or hunted on terrain which was at that time dry land, or where they exploited fish and shellfish on the coast which is now submerged (Marine (Scotland) Act 2010, Section 73, paragraph 5).

The chapter uses the following terms for different aspects of the cable corridor:

- Cable survey corridor – 1 km wide corridor, within which the MBES, SSS and SBP surveys were conducted, and the core area of the DBA;
- Installation corridor – 200 m wide corridor, approximately central to the cable survey corridor;
- Magnetometer survey corridor – 40 m wide corridor within the installation corridor, within which the MAG survey was conducted; and
- Potential cable route – approximate centre line of the installation corridor, along which the geotechnical samples were taken. The final cable route is yet to be determined.

13.2 Legislation and policy context

The Project is located within Scottish and UK Territorial Waters (within 12 nautical miles of land). As well as the legislation and policy context outlined in Section 2 - Planning policy and legislative framework there are a number of international legally binding conventions, EU Directives, UK and Scottish legislation, policy frameworks and guidance to consider in relation to the historic environment. Various EU EIA Directives have been incorporated in UK and Scottish legislation, all of which include the requirement to address potential impacts on the historic environment. Relevant guidance and legislation relating to the assessment of impacts on the marine historic environment are discussed below.

13.2.1 International/ EU legislation and policy

The following conventions promote the protection of underwater heritage, with provisions for appropriate recording and recovery if disturbance is unavoidable.

- The United Nations Convention of the Law of the Sea (UNCLOS);
- Annex to the UNESCO Convention on the Protection of the Underwater Cultural Heritage 2001; and
- The European Convention on the Protection of the Archaeological Heritage (revised), known as the Valletta Convention.

13.2.2 UK legislation and policy

Key UK legislation and policy includes:

- The Merchant Shipping Act 1995;
- The Protection of Wrecks Act 1973 (Section 1 of the Protection of Wrecks Act was repealed in Scotland on the 1st November 2013 and the eight wrecks around the coast of Scotland designated under this section of the Act are now protected by Historic Marine Protected Areas (HMPAs) as defined in the Marine (Scotland) Act 2010);
- The Protection of Military Remains Act 1986 has the principal concern to protect the sanctity of vessels and aircraft that are military maritime graves. Any aircraft lost while in military service is automatically protected under this Act; and
- The UK MPS (2011) states heritage assets should be conserved through marine planning in a manner appropriate and proportionate to their significance. Many heritage assets with archaeological interest are not currently designated as scheduled monuments or protected wreck sites but are demonstrably of equivalent significance.

13.2.3 Scottish legislation and policy

Relevant Scottish legislation and policy includes:

- The Marine (Scotland) Act 2010. This requires licensing activities in the marine environment to consider potential impacts on the marine environment including features of archaeological or historic interest and defines marine historic assets (Section 73);
- The Historic Environment Scotland (HES) Policy Statement 2016;
- Scottish Planning Policy (SPP) 2014;
- The Scottish Government's Planning Advice Note (PAN 2/2011) Planning and Archaeology 2011; and
- The Scottish Government's Planning Scotland's Seas: Scotland's NMP (March 2015).

HES Policy Statement 2016, SPP 2014, PAN 2/2011 and Scotland's NMP all contain the principle that licensing authorities should seek to identify significant underwater historic environment resources in the early stages of the planning process and preserve them in situ wherever feasible. Where this is not possible, licensing authorities should require developers to undertake appropriate recording of the assets before they are lost.

13.2.4 Local planning policy

The pilot Pentland Firth and Orkney Waters Marine Spatial Plan 2016 (PFOW MSP) has been adopted as non-statutory planning guidance by Orkney Islands Council and The Highland Council, and is a material consideration in the determination of relevant planning applications. General Policy 6: Historic Environment includes that development with potential to have an adverse effect on the significance of heritage assets will be expected to demonstrate that all reasonable measures will be taken to mitigate any loss of significance, and that any lost significance which cannot be mitigated is outweighed by social, economic, environmental, navigation or safety benefits.

The Orkney Local Development Plan (2017) along with The Orkney Local Plan's Supplementary Guidance: Historic Environment and Cultural Heritage 2017, and The Highland-wide Local Development Plan (2012) along with The Highland Council's Supplementary Guidance: Historic Environment Strategy (2013) contain similar principles to the PFOW MSP.

13.2.5 Codes of practice, professional guidance and standards documents

The following codes of practice, professional guidance and standards documents informed this assessment:



- The Chartered Institute for Archaeologists (CIfA) Codes, Standards and Guidance (various) http://www.archaeologists.net/codes/cifa ;
- The Crown Estate. (2010.) *Model clauses for Archaeological Written Schemes of Investigation: Offshore Renewables Projects*. Wessex Archaeology Ltd (Ref 73340.05) for The Crown Estate;
- English Heritage. (2012). *Ships and Boats: Prehistory to Present. Designation Selection Guide*. Swindon: English Heritage.
- Gribble, J. & Leather, S. for EMU Ltd. (2011). *Offshore Geotechnical Investigations and Historic Environment Analysis: Guidance for the Renewable Energy Sector*. Commissioned by COWRIE Ltd (project reference GEOARCH-09);
- The Joint Nautical Archaeology Policy Committee and Crown Estate. (2006). *Maritime Cultural Heritage & Seabed Development: JNAPC Code of Practice for Seabed Developmen*t. York: CBA;
- Plets, R., Dix, J., & Bates, R. (2013). *Marine Geophysics Data Acquisition, Processing and Interpretation: Guidance Notes*. Swindon: English Heritage Publishing;
- Wessex Archaeology. (2014). *Protocols for Archaeological Discoveries* http://www.wessexarch.co.uk/protocols-archaeological-discoveries-pad . Salisbury: Wessex Archaeology;
- Wessex Archaeology. (2006). *On the Importance of Shipwrecks: Final Report Volume 1*. Salisbury: Wessex Archaeology;
- Wessex Archaeology. (2011a). *Assessing Boats and Ships 1860-1913 Archaeological Desk-Based Assessment*. Salisbury: Wessex Archaeology;
- Wessex Archaeology. (2011b). *Assessing Boats and Ships 1914-1938 Archaeological Desk-Based Assessment*. Salisbury: Wessex Archaeology; and
- Wessex Archaeology. (2011c). *Assessing Boats and Ships 1939-1950 Archaeological Desk-Based Assessment*. Salisbury: Wessex Archaeology.

13.3 Consultation

Scoping and consultation have been on-going throughout the Project and played an important part in ensuring the scope of the baseline and impact assessment have been appropriate to the Project and the requirements of the regulators and their advisors.

A summary of consultation activity undertaken to date is provided Section 5 – Stakeholder engagement. Comments from the Scoping Opinion relevant to Marine Archaeology are provided in, together with responses to the comments and reference to the relevant sections where specific comments have been addressed.

Table 13.1 Scoping comments regarding Marine Archaeology

Name of organisation	Key concerns	Response	Section within which the specific issue is addressed
Historic Environment Scotland	Recommended that consultation is carried out with the relevant local authority's archaeological and conservation services who will also be able to comment on potential impacts to the historic environment. This may include heritage assets outwith our remit, such as category B and C listed buildings and unscheduled archaeology.	Consultation will be undertaken with OIC and THC historic environment services	Section 5 – Stakeholder Engagement

Name of organisation	Key concerns	Response	Section within which the specific issue is addressed
Historic Environment Scotland	Can confirm that there are no statutory designated sites within the HES remit located within the 1 km wide search area.	Confirmation is acknowledged	N/A
Historic Environment Scotland	It is agreed that further information is required to support the Marine Licence application. It is noted that a Marine Historic Environment Appraisal will be carried out by ORCA.	Potential impacts to marine archaeology have been assessed in Section 13.7- Marine Archaeology of the EA	Section 13.7 – Potential impacts.
Historic Environment Scotland	We are content that the information summarised in section 3.3.4 should be sufficient to provide an adequate assessment of effects.	Potential impacts to marine archaeology have been assessed in Section 13.7- Marine Archaeology of the EA	Section 13.7 – potential impacts.
Historic Environment Scotland	Guidance about national policy can be found in our 'Managing Change in the Historic Environment' series available online at www.historicenvironment.scot/advice-and-support/planning-and-guidance/legislation-and-guidance/managing-change-in-the-historic-environment-guidance-notes. Technical advice is available on our Technical Conservation website at http://conservation.historic-scotland.gov.uk/.	Noted. Section 13.2 of the EA outlines relevant guidance used to inform the assessment.	Section 13.7 – Legislation and policy context.
Marine Scotland	In support of the proposed assessments a survey should be carried out.	Potential impacts to marine archaeology have been assessed in Section 13.7 – Marine archaeology of the EA.	Section 13.7 – Potential impacts

13.4 Sources of information

A review was undertaken of existing literature, data sources and databases to identify known sites in the area, and the potential for unidentified marine cultural heritage sites and areas. Marine survey data (geophysical data) for the Project area was also reviewed to identify the potential presence of marine historic assets in the survey area. These reviews were combined to give an overview of the characteristics of the marine historic environment in the Project area.

13.4.1 Desk-based assessment

The results of a desk-based assessment (DBA) of potential submerged cultural heritage in the study area prepared by Scientific Underwater Logistics And Diving (SULA Diving) on behalf of ORCA is incorporated into this report along with the results of ORCA's studies. The appraisal was confined to a review of key existing data sources of known submerged sites along the 1 km wide cable survey corridor. Historic environment assets that could be sensitive to the Project, if present, may include shipwrecks, aircraft wrecks, submerged landscapes and other marine cultural features such as marine dumping and mine areas. The principal reference sources examined for this appraisal were:

> The National Record of the Historic Environment (NRHE) of Scotland, using the Canmore and Pastmap database websites (https://canmore.org.uk/ ; http://pastmap.org.uk/);

- Statutory lists, registers and designated areas, including List of Scheduled Ancient Monuments, Designated Wrecks and Historic Marine Protected Areas;
- UK Hydrographic Office (UKHO) wreck register and relevant nautical charts;
- Project Adair database for Orkney and the Pentland Firth held by ORCA Marine and in the process of being added to Canmore;
- Aviation Research Group Orkney and Shetland http://www.crashsiteorkney.com/orkney-projects;
- Flemming, N.C., (2003). *Strategic Environmental Assessment of Continental Shelf Area SEA4 in regard to prehistoric archaeological remains*. Prepared for the Dept of Trade & Industry;
- Larn, R., & Larn, B., (1998). *The Ship Wreck Index of Great Britain & Ireland Vol.4 Scotland*. London: Lloyds Register of Shipping;
- Lamb, G., (2007). *Sky over Scapa 1939-1945*. Kirkwall: Bellavista Publications;
- Whittaker, I.G., (1998). *Off Scotland: a comprehensive record of maritime and aviation losses in Scottish waters*. Edinburgh: C-Anne Publishing;
- Heath/Ferguson private wreck database, which contains material not published by Ferguson (see Ferguson, 1991) and has been added to by Heath and Ferguson as new discoveries of wreck sites have been made;
- Further information on wrecks was followed up in the National Archives Admiralty (ADM) files, based at Kew in Surrey, which have holds ship log books and casualty reports from wrecks (http://www.nationalarchives.gov.uk/);
- Public sector information licensed under the Open Government Licence v3.0 concerning available borehole and other geotechnical data by organisations such as the British Geological Survey;
- Other readily available archaeological and historical reports, databases, websites and publications were consulted for information about the study area and, where used, are cited in the report. They are listed in the reference section.

13.4.2 Field surveys

Data from geophysical and geotechnical surveys conducted by MMT in 2018 were reviewed to inform a robust assessment of the potential impacts of cable installation on the marine historic environment in the Project area. The surveys were reported in MMT's Marine Survey Report 102875-SSE-MMT-SUR-REP-SURVLT17 with Appendices, Geotechnical Report 102875-SSE-MMT-SUR-REP-GEOTECHLT17 with Appendices, and Environmental Survey Report 102875-SSE-MMT-SUR-REP-ENVSUR17 with Appendices. The objective of the surveys was to provide data to determine the acceptability and the viability of the proposed route, determining geological conditions and hazards affecting the planning, design and installation, and to allow the development of detailed engineering plans for construction whilst avoiding any possible sensitive habitats encountered. The survey data that were reviewed included:

- Side Scan Sonar (SSS);
- Multi-beam Echosounder (MBES) Bathymetry;
- Magnetometry (MAG);
- Unexploded Ordnance (UXO) survey;
- Sub-bottom profile (SBP) survey;
- Geotechnical survey.

13.5 Assessment Methodology

This assessment identifies, where possible, any marine sites or geophysical contacts/anomalies of archaeological or cultural heritage significance in the Project area and assesses whether there is potential for these sites to be affected by the Project. It also identifies the potential for unknown archaeology to be impacted by the Project. Where potential impacts are identified, recommendations for mitigating and managing these potential impacts are provided. It is assumed that standard mitigation by avoidance will be incorporated into the Project design where appropriate and possible.

13.5.1 Desk Based Assessment (DBA)

The DBA reviewed key existing data sources of known submerged sites within a 1 km wide survey corridor along the potential cable route (the study area, Figure 13.1). Any items identified outside, but relatively close to the corridor are also detailed in this report because the positions of many of these sites are unverified or Position Approximate[16], and descriptions of their circumstance of loss indicate they could be located within corridor and could therefore be impacted.

The DBA has been completed in accordance with the Chartered Institute for Archaeologists (CIfA) Standard and Guidance for historic environment desk-based assessment (revised January 2017).

13.5.2 Field surveys

The methods and resolution limitations of the subsea surveys were presented in MMT's reports and appendices referred to above (13.3) that accompanied the data files for review. All surveys were of sufficient standard and specification for archaeological review.

The MBES, SSS and SBP geophysical data was reviewed within a 1 km wide corridor (500 m on either side of) along the potential cable route (Figure 13.1) to identify and assess any anthropogenic anomalies by an experienced marine archaeologist. The magnetometer survey data was from a 40 m wide corridor along the potential cable route.

- MBES data was supplied as a series of geotiffs, these were imported directly into ArcGIS. The quality of the MBES data was suitable for detecting potentially anthropogenic anomalies, with little banding, rippling or other survey artefacts caused by swell and tidal effects. Identification of MBES contacts as probably anthropogenic was supported by correlating with SSS and magnetometer data;
- SSS data was supplied as individual geo-referenced images. The geo-referenced mosaics could be viewed in ArcGIS 10. The resolution of the geo-referenced SSS mosaics viewed in ArcGIS 10 was not always sufficient for providing a positive identification of a marine cultural feature. However, this was compensated for by verifying the locations of all contacts against the MBES data, which was also imported into ArcMap as geotiffs and placed as a background to the SSS images;
- The SBP data was provided as geo-png image files. The SBP survey tracks were supplied as polyline shapefiles and this enabled the start and end points of the SBP survey tracks to be ascertained;
- The magnetometer data was supplied as individual geotiffs, which gave location and magnetic strength information. These were cross checked against MBES and SSS datasets within the ArcGIS 780 LT17 Base Map.mxd project (see Section 13.6) for confirmation and interpretation of anomalies. Although many areas within the magnetometer survey data are noisy with magnetic responses, anthropogenic anomalies could still be detected.

The survey company MMT used the terminology 'contact' for MBES and SSS features, and 'anomaly' for features identified on the gradiometer (magnetometer) survey. In order to prevent confusion, this report keeps to that terminology. Many items identified by MMT as natural features of low potential



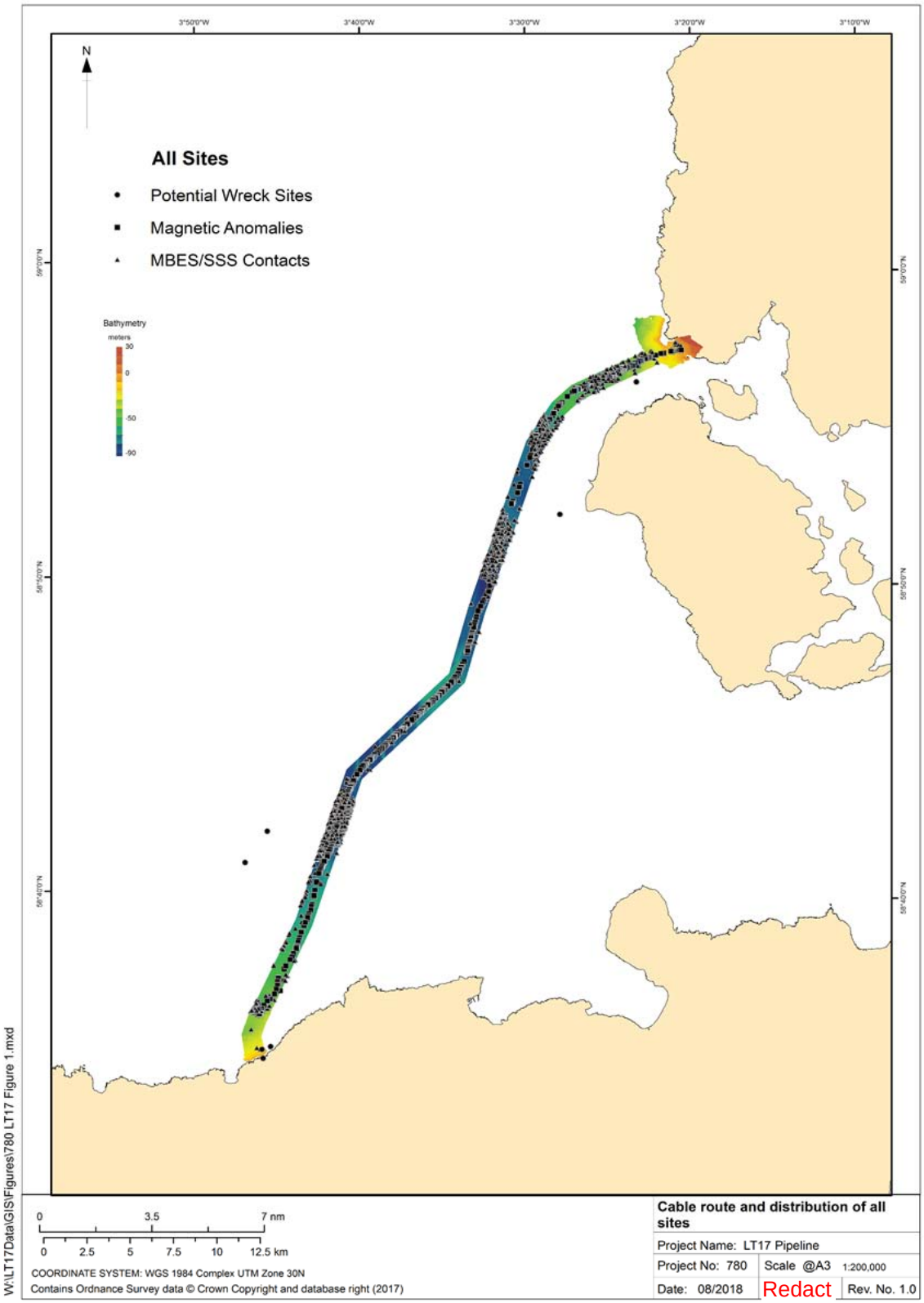
(Figure 13.1) were confirmed as such by this review and are not included further in this report. See Table 13-3 for how geophysical contacts and anomalies were evaluated.

Results from a total of 50 CPT and 49 offshore VC logs have been assessed from the geotechnical survey data (MMT Route Sections 1 – 7). The logs of the CPT and VC samples were assessed in order to gauge whether the deposits contained any sediments of palaeoenvironmental potential; in particular peats or sediments with high organic contents such as organic silts. The information for the VC and PCPT sample logs was all supplied by MMT. The nearest sample locations to the shoreline were located approximately 3 km from the proposed landfall site near Dounreay and 2 km from that at Warebeth. The proposed onshore locations of the sub-sea cable landfall areas are outwith the scope of this marine study.

13.5.3 Geographic Information Systems (GIS)

An ArcGIS project file, 780 LT17 Base Map.mxd, was created and assigned the coordinate system, WGS_1984_Complex_UTM_Zone_30N. Ordnance Survey Open Data, District 1:25000 and StreetView 1:10000 mapping was used for background mapping. All MMT survey data supplied in ArcGIS file format was added to this project file. This included survey track lines as shapefiles (*.shp), image files (*.tiff, *.png and *.jpg) representing GRAD, MBES, SBP and SSS data and text information converted from pdf format reports listing MMT logged anomalies and contacts recorded by MMT from the marine geophysics. This was converted to Excel, imported into ArcGIS and saved as shapefile point data. New shapefile point data was created for anomalies and contacts observed in each of the geophysical survey datasets (MBES, SSS, Magnetometer) in the ArcGIS 780 LT17 Base Map.mxd project. Bathymetric and terrain data supplied as xyz text files were processed in Fledermaus to generate a single mosaic geotiff and added to the GIS project file for detailed background mapping along the proposed cable route.

Figure 13.1 Distribution of all sites identified



13.5.4 Receptor evaluation

The importance of the marine historic environment asset is determined by the criteria as described in Table 13-2 based on the professional guidance and standards documents listed in Section 13.2.5 above. It should be noted that a site that has not been statutorily designated can still be of high importance / significance. Features that would require considerable further work to interpret them are recorded as of uncertain significance / importance.

Table 13.2 Definitions for importance / significance of the marine historic environment asset

Importance	Criteria
High	Archaeological and historical sites, submerged prehistoric landscapes and deposits, wrecks, wreck cargos, or areas of relative international or national importance, including world heritage sites, designated wrecks (designated under UK or Scottish legislation) or HMPAs. Shipwrecks dating to the prehistoric, Norse and Medieval periods, which are very rare; wreck cargos that contain rare artefacts or artefacts representative of a particular area or time period; and vessels, including aircraft lost in international conflicts which may have involved large losses of life. Shipwrecks involved in national or international trade, which were lost before 1913, a period during which the shipping industry was a major element in Britain's world influence, particularly if their cargo survives, or the remains provide evidence of changes in construction technology or vessel design would also be considered of high importance.
Medium	Archaeological and historical sites, wrecks, wreck cargos and areas of relative regional importance. This would involve shipwrecks, shipwreck cargos, anchorages and fishing areas from before 1913 that would have been involved in regional industry and trade. Wrecks and cargos considered representative of the changes in naval engineering or support the identification and preservation of the diversity of vessels from this period are considered of medium importance.
Low	Archaeological and historical sites, wrecks, wreck cargos and areas of relative local importance. Shipwrecks dating from after 1913 relating to fishing, ferrying or other coastwise trade. Wreck cargos of limited intrinsic, contextual or associative characteristics, or that are commonly recovered are considered of low importance / significance.
Negligible	Features that have been recorded but assessed as having little or no archaeological or historical interest, such as recent wrecks, or those wrecks whose structure or cargos have been so damaged that they no longer have any historical merit.
Uncertain	Features that cannot be identified without detailed work, but potentially of some interest. Also, for example, if the date of construction or rarity of a vessel is not known but is potentially of some interest. Find-spots, which may represent an isolated find, or could represent the location of a hitherto unknown site. Unidentified geophysical contacts/anomalies are also of uncertain importance and are evaluated further in Table 13-3.

The potential for geophysical contacts and anomalies to be anthropogenic, and perhaps therefore of heritage value is determined as described in Table 13-3. The survey company MMT used the terminology 'contact' for MBES and SSS features, and 'anomaly' for features identified on the magnetometer survey. In order to prevent confusion, this report keeps to that terminology. Figure 13.1 and Figure 13.2 do not show any contacts or anomalies of low geophysical potential, and none were identified of medium potential.

Table 13.3 Definitions for level of geophysical potential

Level of Geophysical Potential	Criteria
High	Contact/Anomaly appears anthropogenic (atypical in its context); or there is identifiable cultural material; or it is in the area of a known archaeological site, or another contact/anomaly identified to be of high potential
Medium	Contact/Anomaly lies in an area of intensive human activity such as near ports or areas of peat and other features relating to submerged landscapes, and is possibly anthropogenic, but which has no definite identification.
Low	Contact/Anomaly is likely to be a natural formation such as a sand dune, boulder or bedrock formation. It could also be a processing error of the geophysical data.

13.6 Site characterisation

13.6.1 Potential for submerged landscapes and prehistoric sites

Submerged landscapes are where human beings and early hominids previously lived or hunted on terrain which was at that time dry land, or where they exploited fish and shellfish on the coast which is now submerged.

The study area is within Zone 4 of the Strategic Environmental Assessment (SEA) of the Continental Shelf (Flemming, 2003). In the SEA, Flemming notes the potential for the survival of submerged landscapes and prehistoric sites in the study area is influenced by various physical factors, processes and topography with sheltered areas with lower seabed water movements, deep sediment deposits in rocky gullies and depressions and sea caves often providing conditions suitable for good site preservation (Flemming, 2003: 15 – 21).

The survival of submerged landscapes and in particular submerged peat deposits and woodland remains that contain organic microfossils (e.g. pollen, diatoms, foraminifera) and macrofossils (e.g. seeds, wood, buds, insects) are important resources in reconstructing former landscapes, the activities of past human communities and sea level change, shown most recently in Orkney Waters and the Pentland Firth by the ongoing research by the Rising Tide Project and Dr Scott Timpany (Bates *et al*., 2013; Timpany *et al*., 2017).

Recent research and modelling indicates that the relative sea level was perhaps 20 m lower 10,000 years ago, before rising comparatively quickly up to 7,000 years ago, slowing after that until by roughly 5,000 years ago, the coastlines of Orkney and Caithness are, with some later localised transgressions and variation, roughly as we see them now (Bates *et al.,* 2013; Dawson and Smith, 1997; Dawson & Wickham-Jones, 2007; McIllvenny *et al.,* 2013; Wickham-Jones & Bates, 2016). Relative sea level has continued to rise since prehistory.

Studies at Dunnet Bay have shown the presence of a series of intercalated sand and peat layers, including intertidal peats containing remnant tree stumps or submerged forest (McIllvenny *et al.,* 2013, 104). The lowest peat layer is represented by the intertidal peat which has been radiocarbon dated as forming in the Late Mesolithic period between 5770-5630 BC (6825±35 BP; GU-17511) and 4440-4270 BC (5500±40 BP; Beta-241440). The peat sequences from Dunnet Bay highlight the potential for peats to be present in the onshore and intertidal landing area of the proposed sub-sea cable.

Intertidal peats have been recorded some 5 km to the northeast of Warebeth in the Bay of Ireland (Timpany *et al.,* 2017). Intertidal peats in this location have been recorded at thicknesses between 0.2 to 2.2 m and overlie clay and gravel deposits. As at Dunnet Bay, the peat contains woodland remnants, of predominantly willow with some birch (Timpany *et al.,* 2017, 518). The intertidal peats in this location have been found to date from the Late Mesolithic, with a basal date for the peat of 4690-4519 BC (5750±30 BP; GU-39873). Recently returned radiocarbon dates from the thicker peat deposits in this location have shown that peat accretion continued into the Early Iron Age c. AD 600 (Timpany, pers comm.).

A sediment deposit that is also of interest from this area of northern Scotland is a layer of silty sand and marine shell that was laid down around 8200 BP and is evidence of the Storegga tsunami extreme event that has been recorded in sediment sequences from northern Shetland to north-east England (Smith *et al.,* 2004). This layer has been recorded in sediments in the lower Wick valley (Dawson and Smith, 1997), below the intertidal peat at Dunnet Bay (McIllvenny, 2009; McIllvenny *et al.,* 2013) and at Strath Halladale, close to the area of Dounreay (Dawson 1999).

Therefore, while there is no evidence so far from marine boreholes, there is clearly moderate potential for submerged landscape peat and associated archaeological sites to be present in the intertidal (and onshore) zones in both Caithness and Orkney, where there are sands and other sediments, as at the Warebeth beach landfall.

Despite the potential noted above, there is negligible potential for submerged landscape peat and associated archaeological sites to be present at Dounreay landfall, because the installation corridor makes landfall on exposed bedrock.

There is no useful borehole data for the Warebeth landfall, which appears to be on beach sediments. No landfall or intertidal borehole or test pit taken for this Project (if any has been taken) was available for the geotechnical report and this assessment. While archaeological sites are known at the coastal edge around Warebeth, this is part of the land-based assessment and is outwith the scope of this report. Therefore, until proven otherwise, it must be assumed that there is a low-moderate potential for submerged remains to survive below the beach deposits at Warebeth. It is to be noted that the HDD pop-out is located 1,050 m offshore and is likely to be on bedrock and therefore impacts to submerged remains in the coastal area are unlikely.

13.6.2 **Shipwrecks and aircraft wrecks**

This section discusses the shipwrecks and aircraft recorded in national and local inventories along the potential cable route, and the potential for as yet undiscovered remains to be present. Shipwreck inventories and documentary sources are usually biased towards the 18th century and later when more systematic reporting began (Pollard *et al*., 2014, 44). Therefore, there are few known historical records of medieval and earlier wrecks. The coastal archaeological evidence suggests exploitation of the marine environment within the Project area for fishing and transport purposes from prehistoric times.

As a maritime nation with a reliance on marine based trade and exchange, there have been countless shipwrecks around UK waters from all periods, many of which remain unreported. Especially with the strong tidal surges of the Pentland Firth and Hoy Sound, there is a high probability for unknown, unrecorded vessels to have sunk in the Project area over the centuries. If these have not been destroyed by the marine environment, the remains of such vessels and their associated artefacts may not always be visible in geophysical data due to being constructed from materials that do not provide strong geophysical or magnetic returns or buried beneath the surface of the seabed. However, based on results from the surveys conducted, the nature of the seabed as shown by the surveys and the likely narrow width of potential disturbance within the installation corridor, the risk of impacting unknown remains have been reduced overall to low, although the potential risk rises slightly in areas of sand where preservation by burial is more possible.

No marine cultural heritage statutory designations have been identified in the cable survey corridor. The nearest designated site, located 2.25 km to the east, is that of HMS *Pheasant*, which is protected under

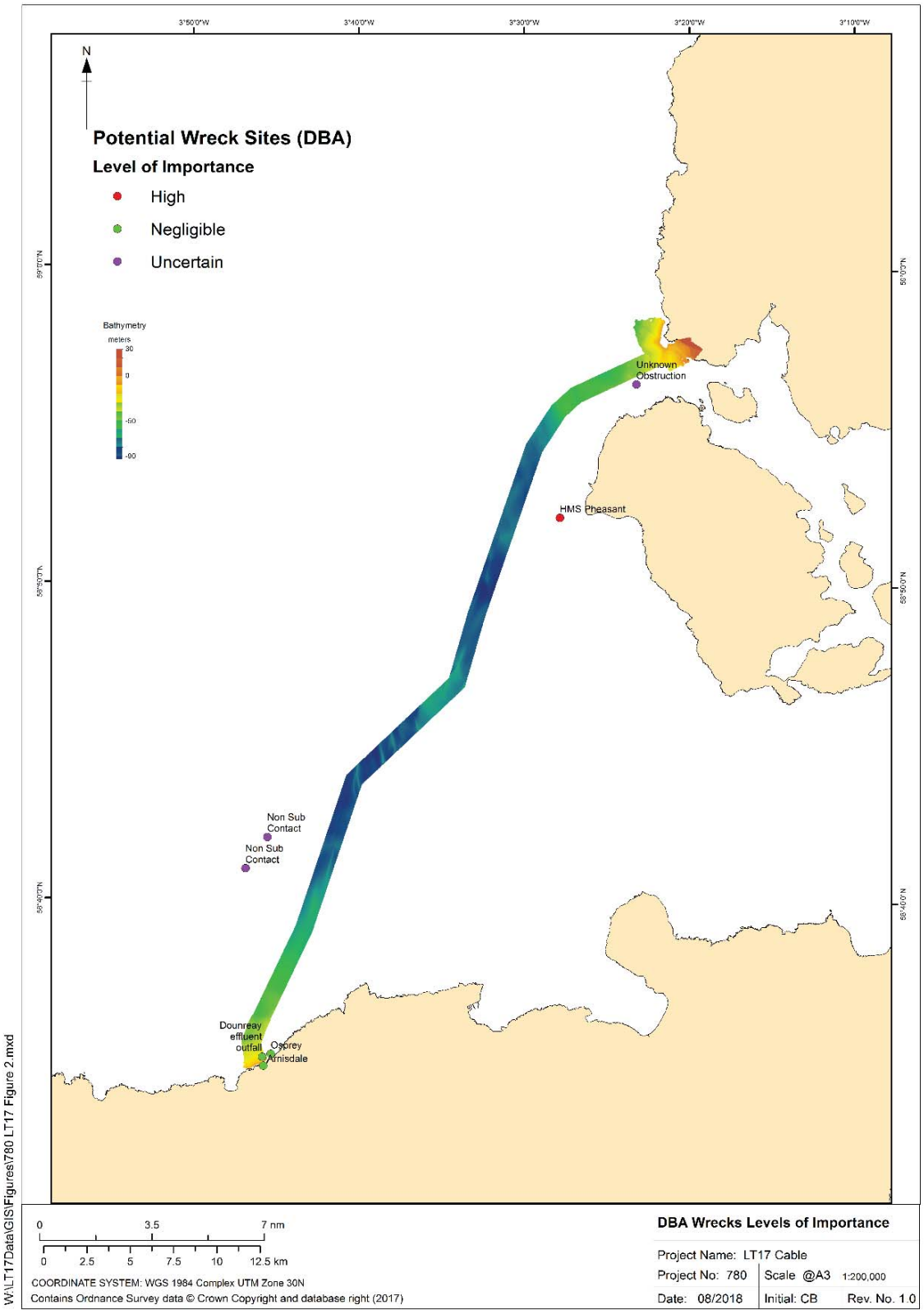
The Protection of Military Remains Act 1986 (Designation of Vessels and Controlled Sites) Order 2017 (see Figure 13.2).

The modern period of World War 1 (WW1) and World War 2 (WW2) has the greatest potential for the preservation of wrecks and aircraft sites. Not only is this due to their size, relative age and their metal construction but the reality that the area around northern Scotland, Orkney and Shetland was an active battlefield where the blockade of Germany during WW1 and WW2 was maintained and prosecuted by major elements of the Royal Navy using the base at Scapa, Orkney and squadrons based in Shetland. This blockade in turn was contested by Germany using surface raiders, U-Boats and mines.

There are twenty-six shipwreck sites listed on the Canmore database and Whittaker (1998) that may be in or close to the cable survey corridor (Table 13-4). There are also two non-sub contacts (sonar contact detected during wartime submarine searches that are not submarines), an unknown obstruction, and two items included because they are on the Canmore database (a sunken wave energy device and the Dounreay effluent outfall). The identity of these contacts is unclear – they have the potential to be shipwrecks or other anthropogenic features, or they can be natural. The two identified during this study have been declared as natural or non-existent by subsequent investigations and are listed as dead by the UKHO. Therefore, they are not discussed any further.

For most (24) of the shipwrecks, the precise locations of their sinking are unknown and therefore are not shown on Figure 13.2. However, descriptions included within details of their circumstance of loss indicate the possibility of being located within the cable survey corridor.

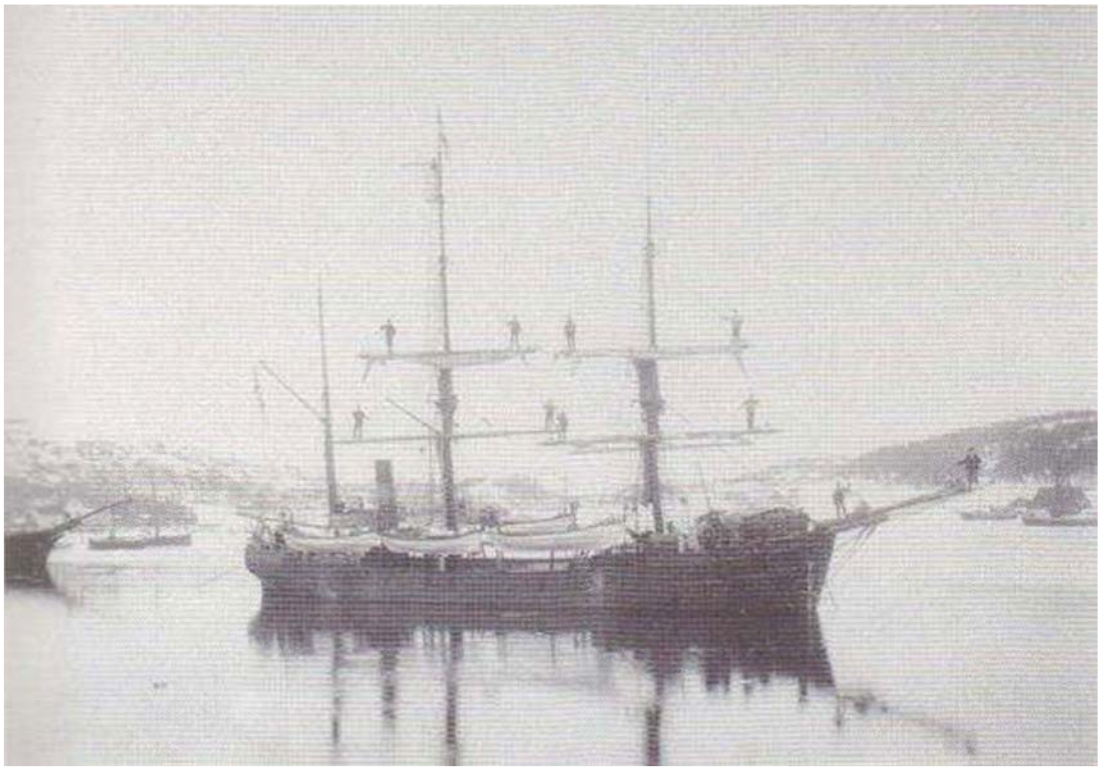
Figure 13.2 DBA Wrecks and sites with known locations



There are fifteen wrecks from the 18th and 19th centuries potentially lost within the cable survey corridor (see Table 13-4). If they survive, these wrecks are considered to be of high or medium importance, because of their date, being involved in international or regional trade, or as evidence of new and changing technologies (Wessex 2006, 2011a and b). These wrecks include:

- SS *Polarstjerne* was a Norwegian wooden cargo ship built in 1886, during the transition from sail to steam (see Figure 13.3). On voyage from Copenhagen to Greenland carrying gunpowder and other general cargo, the vessel caught fire six miles northwest from Thurso. The crew abandoned ship when a fire in the hold could not be contained, fearing that the cargo of gunpowder would explode. The crew sat off in two small boats until rescued two hours later by the SS *Queen*, which had seen the ship on fire, and they were landed at Lerwick. There were no reports of anyone seeing the vessel sink.

Figure 13.3 SS *Polarstjerne* (K Heath collection)



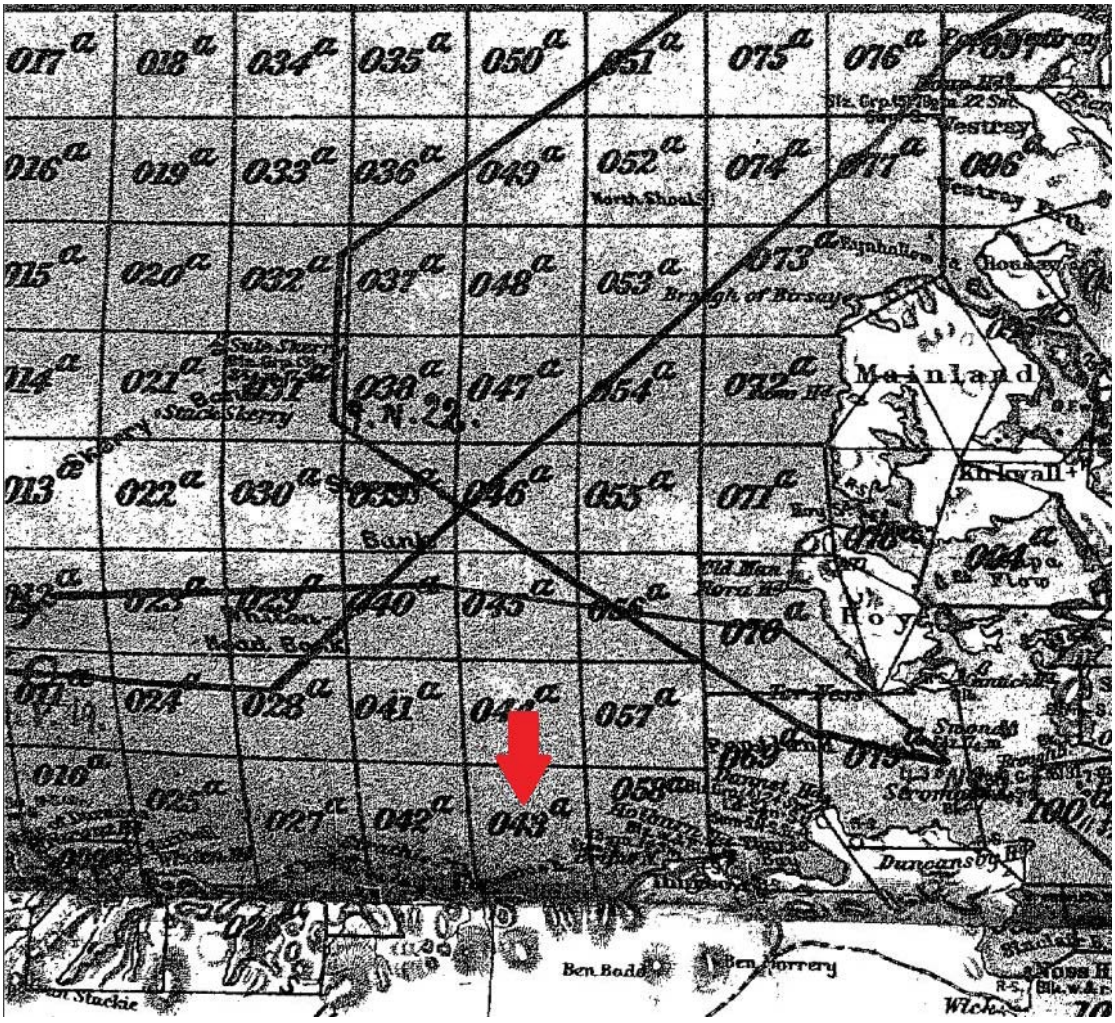
- *Generous Friend* was a Liverpool-registered vessel taken and burnt by two French privateers off Stromness in 1778, during the period Britain was at war with France due to their support of the Americans during the War of Independence.
- *St George* was a craft with a cargo of sugar, an international trade usually linked with dried fish, slavery and tobacco, lost between the Church of Stromness & Breckness in 1718.
- *Briton* was a 450-ton full rigged ship from Scarborough, with a cargo of timber involved in international trade that was wrecked at Dounreay.
- Many ships have been wrecked on Kirk Rocks off Warebeth (see Table 13-4), but a mixture of the strong seas and salvage activities mean that the likelihood of survival of anything other than small wreck debris in cracks in the bedrock is low (see Section 13.5.4 and Figure 13.7 and Figure 13.8 for potential items identified by geophysical survey).

There are four ship wrecks from WW1 and WW2 potentially lost within the study area. Two of these wrecks are considered to be of high importance (see Table 13-4), and if discovered would be protected

under The Protection of Military Remains Act 1986. The others were simply lost during the wartime period but not as a result of wartime action.

> The HMT *Orsino*, a requisitioned steam trawler, left Stromness for Loch Eriboll to patrol the swept channel off the north coast of Scotland on the 28th September 1916 but failed to reach her destination. In October 1916, a section of the wheelhouse with shell fragments embedded washed ashore in the Bay of Ireland near Stromness (ADM. 1/8468/232). Six men died in the attack by U55 and four were taken prisoner by the U Boat. Canmore has HMT *Orsino* listed as 'Between Loch Eriboll? and Stromness'; Between Loch Eriboll and the Islands'; Pentland Firth'' and its actual position remains unknown. U55's Kriegstagebücher (KTB) (War Day Book) shows that the attack took place in grid square 043 alpha (Figure 13.4). Although this is to the west of the cable corridor, it is possible that with the poor visibility, the U-boat was not 100% sure of her position (in pencil on the inner margin of the KTB page it states '10 miles from Thurso') and HMT Orsino may have been sunk in the area of the cable survey corridor. If identified, this vessel is of high importance as none of the six men killed in the attack were recovered and the vessel would be considered a war grave. However, nothing was identified on the geophysical survey data that was obviously the remains of the *Orsino*.

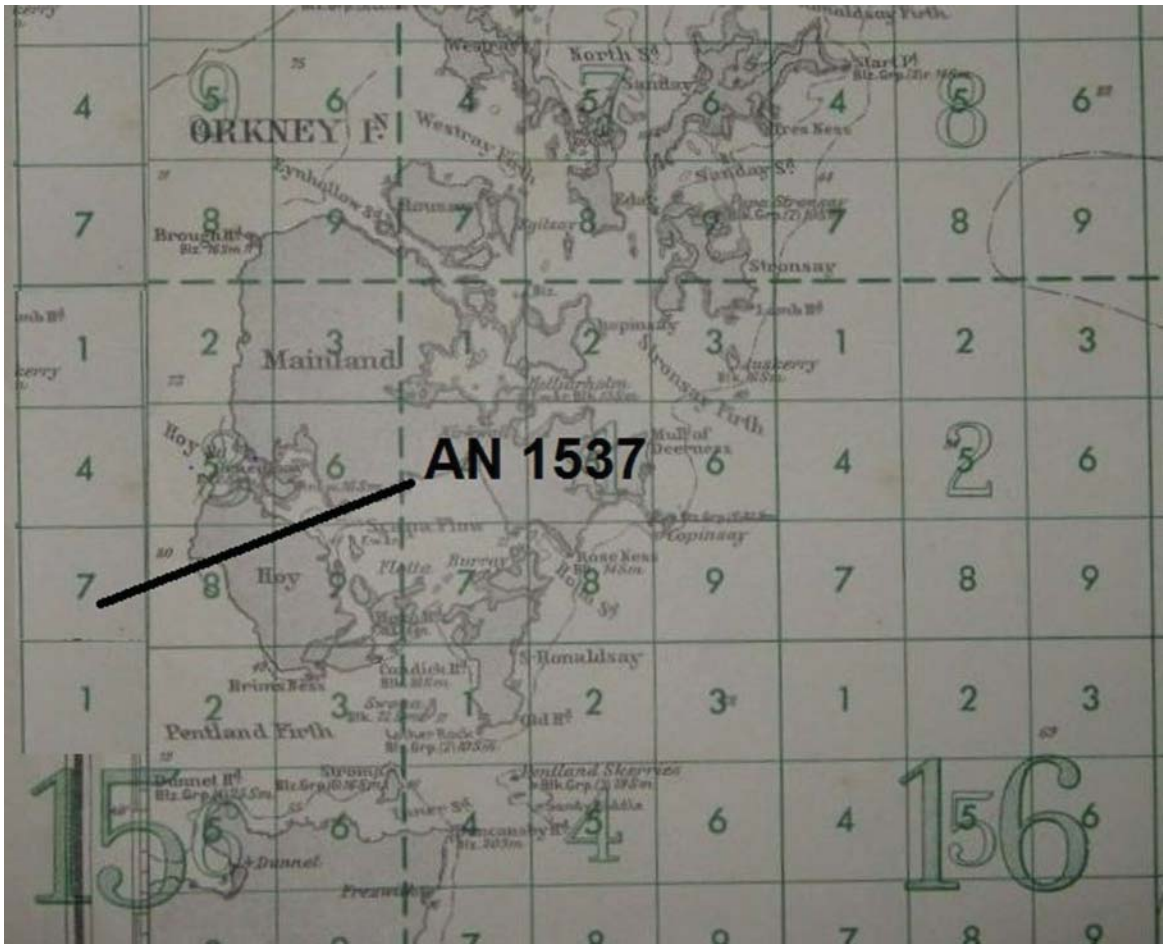
Figure 13.4 KTB chart from U33 showing grid squares. (ML U33 06/09).



> The SS *Navarra* was sunk by Kapitänleutnant Harald Jürst on U59 on 6th April 1940. Ten crew and two passengers were lost. The UKHO only have a PA (position approximate) for the sinking of the SS *Navarra* and the actual location is unknown. The KTB for U59 (NARA T1022-2970) reveals the

position given for the attack by the U-boat is grid square AN1537, roughly 1.5 km east of the cable survey corridor (Figure 13.5). However, nothing was identified on the geophysical survey data that was obviously the remains of the *Navarra*.

Figure 13.5 U-boat grid chart of Orkney showing square AN15-3-7



There are no recorded losses of aircraft along the actual cable route but there are known aircraft losses that could be in the proposed area due to the number of aircraft have gone ‘’missing’’ off the north coast of Scotland and to the west of Orkney (see Table 13.5). Any aircraft found is automatically protected under the Protection of Military Remains Act 1986 if lost on active service. Therefore, these would be considered of high importance if found, although this risk is considered to be low.

There are further shipwrecks all listed on the Canmore database and in Whittaker (1998) as being wrecked at Breckness and on Braga Skerry. However, these locations are just outside the northern edge of the corridor near the Warebeth landfall and are likely to have completely broken up. This, along with the review of the geophysical data, which has not identified likely wreckage from these vessels, indicates that the likelihood of these wrecks being located within the cable survey corridor is negligible-low. The impact is assessed in Section 13.7.2and the mitigation of reporting protocol is included in Section 13.8.

Table 13.4 List of possible shipwreck sites within or close to the cable corridor

Name	UKHO	Canmore	Description	Circumstance of loss	Date Lost	Proximity to installation corridor	Source	Importance
Briton		288537	Full rigged ship.	Wrecked at Dounreay	07/11/1780	Unknown	1, 6	High
Smyrna		221156	Snow.	Wrecked at Dounreay	10/10/1800	Unknown	1,2,6	Medium
Dauntless		221959	Iron Steam Trawler.	Wrecked at Dounreay, with 6 dead	18/11/1893	Unknown	1,2,6	Medium
Unknown		325248	Unknown	Vessel on fire 6 miles W of Thurso. Crew landed in own boats	23/08/1940	Unknown	1,6	Uncertain
Arnisdale	1152	288543	Motor Fishing Vessel	Went aground and broke up.	13/4/1994	680 m east	10	Negligible
Audrey		288544	Small fishing vessel	Stranded between Sandside Bay and Dounreay	30/07/1992	Unknown	1.6	Negligible
Dounreay effluent outfall	1122	321532 & 101986	Obstruction. Outfall end marked on chart as obstruction. Buoyed	N/A.	N/A	690 m east	10	Negligible
Osprey	1152	21537	Wave energy device	Device broke up in heavy weather, and partially sunk in the process. Some remains were salvaged.	5/9/1995	1140 m east	10	Negligible
Non-Sub Contact (North)	945		Now listed as dead. Contact recorded in 29/4/1945 Survey on 11/1/1985 found nothing.	N/A.	N/A.	4,100 m west	10	Uncertain
Non-Sub Contact (South)	939		Now listed as dead. Contact recorded in 29/4/1945. Survey on 11/1/1985 found peak of a gravel wave at depth of 69m in 84m depth of water	N/A.	N/A.	3,570 m west	10	Uncertain

Name	UKHO	Canmore	Description	Circumstance of loss	Date Lost	Proximity to installation corridor	Source	Importance
HMT Orsino		214438	Steam trawler. Requisitioned by Royal Navy as an armed Drifter.	Sunk by U-boat U55 between Loch Eriboll and Stromness. Six men were killed	28/09/1916	Unknown	1,2,6,11,12,13	High
SS Polarstjernen		222028	Wooden steamship.	Blew up after catching fire on route Copenhagen to Greenland '6 miles NW of Thurso'.	28/08/1897	Unknown. PA location is 2.15 km east.	1,2,6,16	High
SS Peter Berg	951	321491 & 101985	Iron steamship.	Foundered off Dunnet Head on route Glasgow to Kronstadt.	26/05/1906	Unknown. Charted 1.90 km east	1,2,3,4,7,8,10, 16	Medium
Unknown wreckage		288033	Wreckage trawled up '9 miles NW of Dunnet Head' on 29 September 1934.	Unknown	Unknown	Unknown	1,6,8	Uncertain
SS Navarra	413		Merchant steamship.	Torpedoed by U-boat U59 at AN1537 (Rora Head, Hoy) on route from Swansea to Oslo. 12 casualties.	06/04/1940	Unknown	1,2,3,10	High
Perseverance		327444	Brigantine	Foundered off Rora Head, Hoy or '9 miles north of Dunnet Head'.	03/09/1886	Unknown	1,8	Medium
Generous Friend		287559	Vessel	Taken and burnt by two French privateers off Stromness.	14/10/1778	Unknown	1,6,8,16	High
Unknown		287561 & 326668	Unknown craft '' off NW corner of Hoy''	Unknown	1861	Unknown	1,8	Uncertain
Unknown Obstruction	82868		Unknown Obstruction	Obstruction reported to UKHO by Northlink ferries.	Unknown	920 m west	10	Uncertain

Name	UKHO	Canmore	Description	Circumstance of loss	Date Lost	Proximity to installation corridor	Source	Importance
Bromby		270251	Schooner	Wrecked ashore "Near Breckness or Warebeth'. Master and 3 crew drowned.	09/11/1842	Unknown	1,5,6	Medium
Calcutta		273285	Barque.	Records indicate ashore at Breckness or Warebeth. Crew saved.''	12/12/1843	Unknown	1,5,6	High
Hannah or Hannibal		272525	Craft.	Wrecked on a rock in the entrance of Hoy Sound, on route Archangel to Leith,. Crew saved.'	10/09/1831	Unknown	1,2,9	High
St George		287340	Craft. Cargo sugar.	Vessel lost between the Church of Stromness & Breckness.	1718	Unknown	1	High
Betsy		287369	Full-rigged Ship	Wrecked in dense fog on the Kirk Rocks on route Riga for Liverpool. Crew of thirty saved.	06/02/1772	Unknown	1,5,6	High
William		224072	Brigantine	Driven on the Kirk Rocks during a gale on route Newfoundland for Leith	05/02/1810	Unknown	1,5,6	High
Peace		282413	Brig	Wrecked on Kirk Rocks on route from Baltic to Hull. One crewman lost.	23/12/1848	Unknown	1,5,6	High
(HMT) Lorenzo		287217	Steam trawler. Listed with Ferguson as being on Admiralty service.	Wrecked on Kirk Rocks, crew saved by Stromness Lifeboat	17/12/1914	Unknown	1,5,6	Low

Name	UKHO	Canmore	Description	Circumstance of loss	Date Lost	Proximity to installation corridor	Source	Importance
Carmania II		115960	Steam Trawler	Bound from Iceland to Grimsby, struck on Kirk Rocks during snow showers. Crew of twelve all saved.	14/02/1929	Unknown	1,2,5,6	Low
Jerv		287368	Steel whaler	Wrecked on Kirk Rocks	23/04/1965	Unknown	1,6	Negligible
MV Norholmen	1108	227515	MFV / trawler.	Vessel stranded on Kirk Rocks, came off and went ashore just below Warebeth graveyard.	23/11/1966	Unknown. Possibly 470 m south east.	1,2,5,6,8	Negligible
Marander	1111	227511 & 321526	Small MFV	Struck Kirk Rocks and was lost.	10/12/1980	Unknown	,2,6,7,8	Negligible

1 = Whittaker (1998); 2 = Larn & Larn (1998); 3 = Baird (2003); 4 = Ferguson (1988); 5 = Ferguson (1987); 6 = Canmore database; 7 = Ridley (1992); 8 = Project Adair database; 9 = Lloyds List; 10 = UKHO; 11 = Hepper (2006); 12 = Toghill (2004); 13 = Lloyds War Losses WW1; 14 = Lloyds War Losses WW2; 15 = Rohwer (1998) 16 = BNA Archive

Table 13.5 List of possible aircraft losses close to the cable corridor

Name	UKHO	Canmore	Description	Circumstance of loss	Date Lost	Proximity to development	Source	Importance
Supermarine Seafire IIC		326078	Supermarine Seafire IIC MA976 807 Sqn	Crashed into the sea 10 miles W of Hoy	18/09/1942	Unknown	!,2,3,4	High
Blackburn Skua II		287560	Blackburn Skua II L2951 771 Sqn	Crashed into the sea 6 miles West of Stromness. Both crew lost.	26/04/1944	Unknown	1,2,3,4	High
Fairey Albacore I		287558	Fairey Albacore I N4155 827 Sqn	Ditched 13 miles 232 degrees from Brough Head.	15/09/1942	Unknown	1,2,3,4	High
Grumman Avenger I		326084	Grumman Avenger I FN787 845 Sqn	Spun into the sea off Old Man of Hoy. 3 crew lost.	09/10/1943	Unknown	1,2,3,4	High
Junkers JU88		326071	German bomber	Shot down off Hoy.	02/04/1940	Unknown	1,2,3	High
Junkers JU88		326068	German bomber KG30 Sqn	Crashed off Hoy.	20/09/1939	Unknown	1,2,3	High
Supermarine Sea Otter		287564	Supermarine Sea Otter JM761 771 Sqn	While flying from Abbotsinch (Glasgow) to the airfield at Twatt (HMS Tern) with two crew and a gunnery officer as passenger, when she suffered an engine failure, the pilot madea forced landing in Hoy Sound hull was damaged and the Sea Otter sank.	26/04/1944	Unknown	1,2,3,4	High

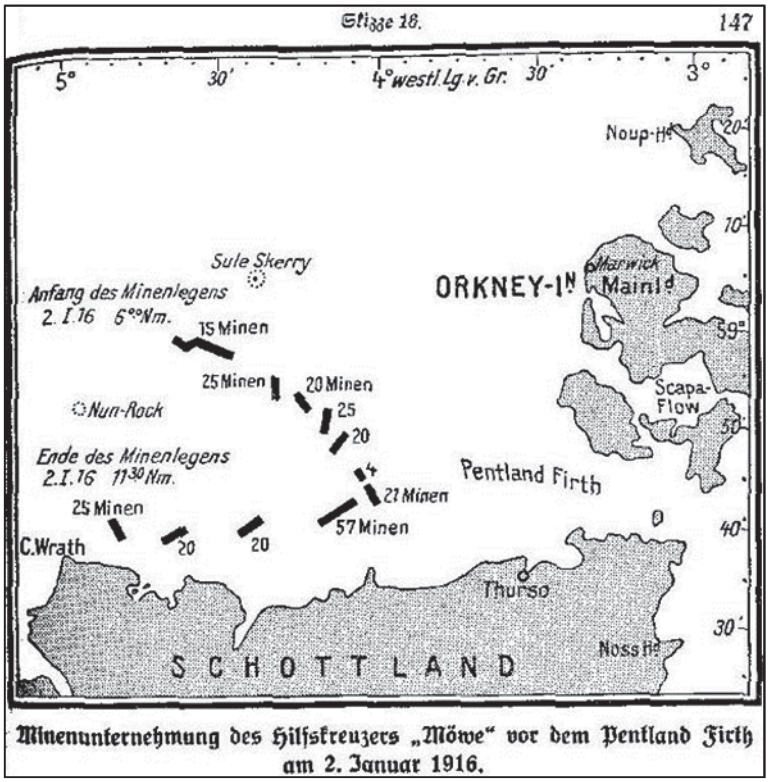
1 = Whittaker (1998); 2 = Royal Commission on the Ancient and Historical Monuments of Scotland (RCAHMS) - Canmore; 3 = Project Adair database; 4 = ARGOS

13.6.3 Historic minefields and Unexploded ordnance (UXO)

During both World Wars a large amount of ordnance, both offensive and defensive, was used in the seas around the Orkney Islands and the Pentland Firth. Some of these munitions still exist and are regularly found by divers or fishermen. These finds are taken very seriously by the MoD who immediately deploy a bomb disposal team to assess and deal with the items located. They are usually detonated where they are found as it is considered too dangerous to move them.

One of the largest German minefields was laid to the north of mainland Scotland by surface raider SMS Möwe in January 1916 (Figure 13.6). This was known to the British as the Whitten Head Field and had over 250 mines. By the end of April 1916, the Royal Navy had accounted for 70 of these mines and considered the field cleared. However, there is the possibility that live mines from the Whitten Head minefield could have drifted into the cable corridor either as a result of minesweeping operations or mines having broken free of their moorings; Mines associated with the Whitten Head Field have been found ashore on Orkney and in the Pentland Firth.

Figure 13.6 The Whitten Head Mine Field



The only reported U-Boat mine-laying activity near the cable route is off the Old Man of Hoy, with four mines laid by U-80 21st January 1917. The report in the KTB states the four mines were laid on high water slack 0.9 miles from land. On 1st March 1917, HMS *Pheasant*, an M class destroyer on patrol, struck one of these mines one mile off the Old Man of Hoy and sank with the loss of the entire crew of 89 men. The Bi-Monthly minesweeping reports show that the area was subsequently swept for mines on the 9th April 1917 and a further four mines in groups of two were found, indicating that there had been some further mine-laying. Two were a mile NW of the Old Man of Hoy and the other two were 1.5 miles west of Old Man of Hoy (ADM 116-1516 Bi monthly minesweeping reports). No further mines were reported after this.

The minesweeping reports, subsequent discoveries of mines and analysis of the magnetometer data indicate that there is low potential for unexploded historic ordnance in the development area.

It should be noted that this historical and cultural assessment of the potential for UXO in the study area does not replace the UXO identification study by MMT. It should be noted that this review of MMT's interpretation of MBES and SSS contacts resulted in various items identified by MMT as possible mines being re-identified as boulders (see below).

13.6.4 Geophysical Surveys

Multi-beam echo sounder (MBES) and side scan sonar (SSS) contacts

MMT supplied an extensive contact report of targets located with the MBES and SSS surveys. All of these 550 contacts were reviewed and assessed for any possible anthropogenic origin. ORCA reference numbers were assigned to these and to any other anthropogenic contacts that were observed by this review that were not in the MMT lists. Many unmarked boulder contacts were noted during this review, but these were not given new contact numbers, because they were clearly boulders. Most boulders seen on the MBES data had a corresponding SSS contact. No SSS contacts were seen that were not located and identified on the MBES survey, and so the contacts are discussed below and provided separately in Appendix C as MBES contacts only. No contacts with Medium geophysical potential were identified. Therefore, only contacts with High geophysical potential (i.e. probably anthropogenic) are listed, discussed and shown in Figure 13.7.

Twelve contacts (MMT_C 004 to MMT_C 015, see Figure 13.7 and Appendix C; MMT report codes S_LT17_SB_A1_3075 to S_LT17_SB_A1_3096) were listed as ''possible mines'' in the shallow water at the Warebeth end of the cable route. These were re-assessed by ORCA and identified as boulders. There were no offensive or defensive minefields in Hoy Sound during either WW1 or WW2. It is extremely unlikely that a collection of mines would end up in this position or survive in such a dynamic environment. By their very nature, any swept mines that were not sunk or destroyed by shells from the sweeping vessels and that drifted ashore would end up at the High-Water Mark, not in the shallow waters.

Four of the contacts considered to have High geophysical potential, i.e. probably anthropogenic, may be wreckage or debris. These are between 156 and 357 m from the potential cable route.

Of these, ORCA_C 089 (see Appendix C) is larger than other contacts within the survey area, being 18m long. It appears to be boat-shaped and has strong returns on both the MBES and the SSS surveys.

ORCA_C 317 and ORCA_C 318 are both irregular contacts with good returns on both the MBES and the SSS survey data. They are close to MMT contact S_LT17_SE_0037, perhaps part of a debris field.

ORCA_C 319 is a 7.1 m long linear feature, with good returns on both the MBES and the SSS survey data. It has the appearance of part-buried debris.

A further seven contacts (MMT_C 003, MMT_C 050, MMT_C 122, MMT_C 127, MMT_C 139, MMT_C 212, and MMT_C 734; see Appendix C and Figure 13.7) had very good returns on both the MBES and the SSS survey data. They all comprised distinct, sometimes isolated, irregular features on sand, from 1.7 by 1.1m to 7.3 by 3.1m in size. Although probably anthropogenic, further interpretation of these contacts without ground-truthing is uncertain. Four of these contacts are less than 100m from the potential cable route (MMT_C 122 is only 20 m west of the potential cable), whilst all the others are more than 200 m away.

MMT_C 035 comprised the Dounreay effluent outfall.

The MBES data shows the cable survey corridor to be predominantly sand, sand ripples, sand waves, gravel banks and rocky outcrops. The nearshore area of the cable route corridor at both ends comprises extensive areas of bedrock, as well as beach sand at Warebeth. The seabed topography is well-defined and matches with the data collected from the SSS surveys.

Magnetic anomalies

The magnetometer data was collected along a 40 m wide corridor along the installation corridor (see Figure 13.8). The magnetometer survey appears to stop 3,000 m from the landfall at Dounreay.

The 514 magnetic anomalies identified by MMT were reviewed and assessed for any possible anthropogenic origin. Most are considered to be of Low geophysical potential, i.e. geological features such as boulders, or are of High potential, but are cables and of no archaeological significance. Assessment of the spatial distribution of these anomalies does not reveal any patterns that are likely to document the presence of a wreck site, although a few anomalies (mentioned below) are likely to be metallic wreck debris.

In addition to the MMT anomalies, this assessment of the data highlighted 527 further anomalies. Most of these are small, widely dispersed and do not correspond to any of the MBES or SSS anomalies and are considered to be geological in nature.

Apart from the anomalies identified as cables, six magnetometer anomalies were considered to be of High geophysical potential.

One magnetometer anomaly (MMT_M 486) is in the same location as MBES contact MM_C 122, and is considered to be an anthropogenic object, such as wreck debris.

The other magnetometer anomalies (MMT_M 001, MMT_M 008, MMT_M 009, ORCA_M 001 and ORCA_M 002) are grouped towards the Warebeth end of the potential cable route and are within 10 – 45 m of the potential cable route. These are all considered to be anthropogenic, and are possibly metallic wreck debris on bedrock, or in cracks in the bedrock.

Sub Bottom Profile Survey

A total of 443 jpeg images were supplied by MMT of good quality SBP data. Nothing considered anthropogenic was seen on the images.

Figure 13.7 MBES and SSS contacts with High potential

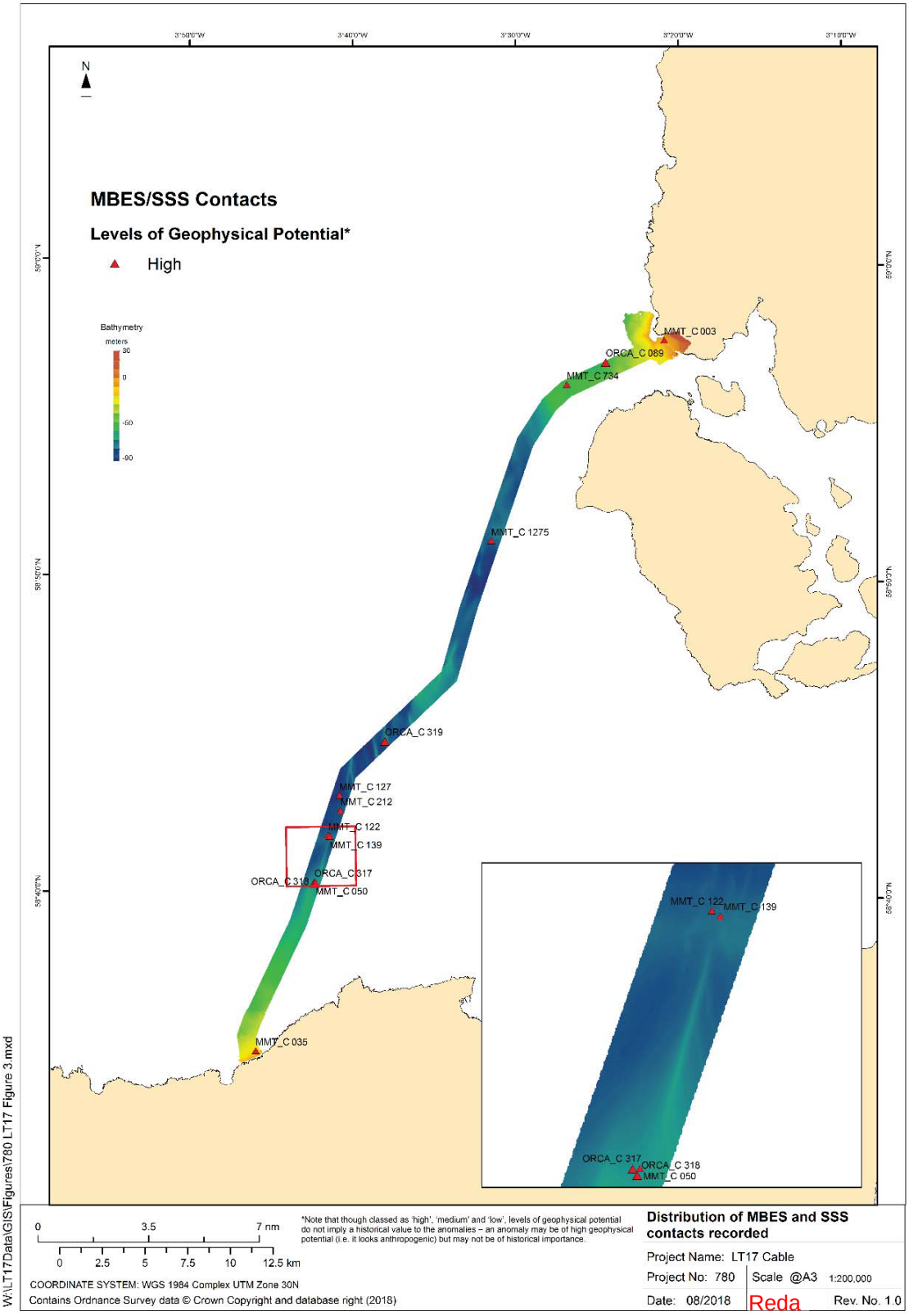
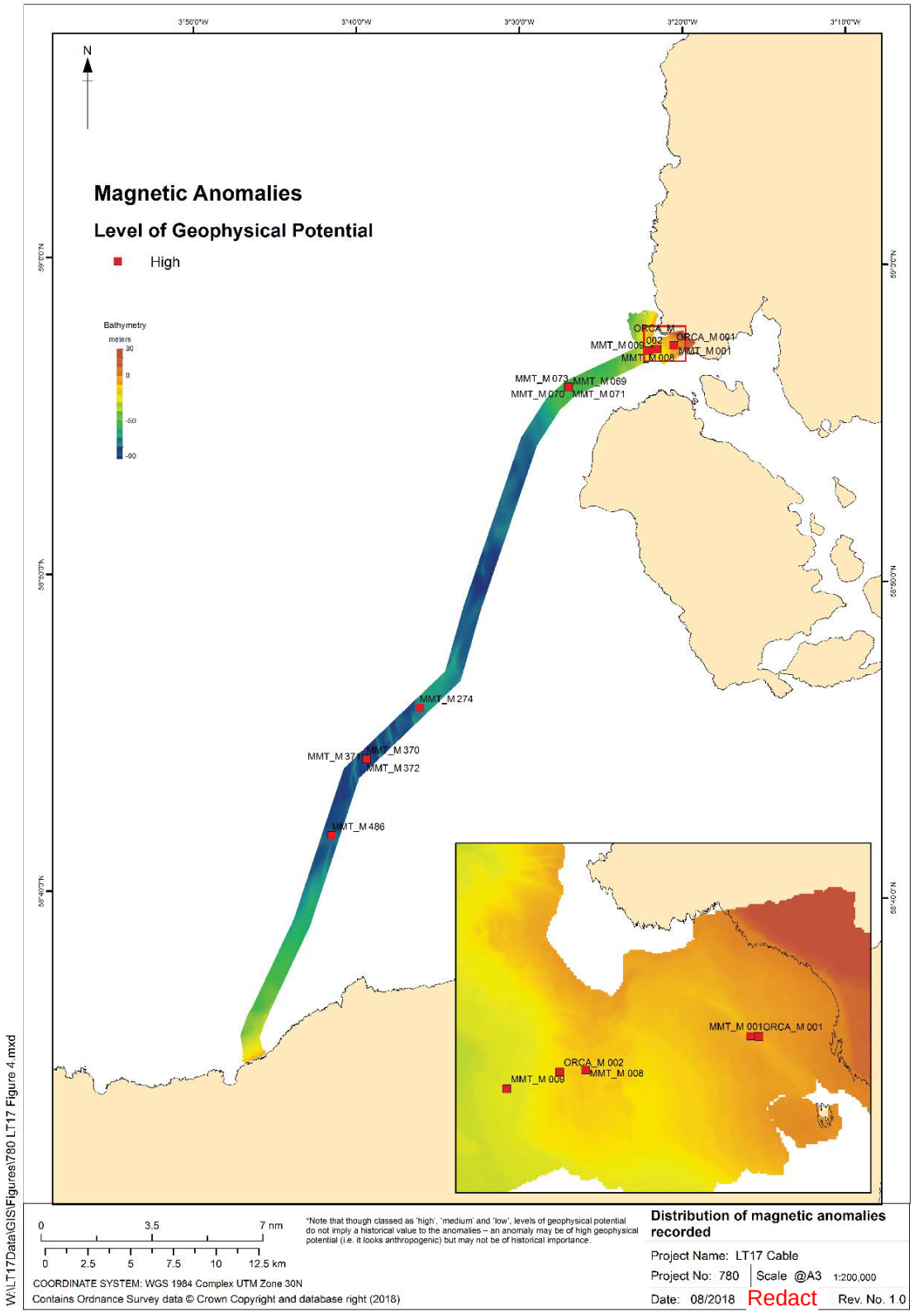


Figure 13.8 Magnetic anomalies with High potential



13.6.5 Geotechnical Surveys

The offshore geotechnical data comes from two main sources: CPT and VC results. For both types of investigation samples were taken at distances of 500 m with coincident locations every 2.5 to 3 km to allow correlation of the data sets (MMT 2018 Geotechnical Report, Figure 2).

A total of 49 VC samples were collected across the offshore cable route through a total of 67 attempts. The penetration depth of the offshore VC tests ranged from a maximum depth of 6.0m in VC004A to a minimum recorded penetration depth of 0.4m at VC0049. At five VC locations a depth of 5.5-5.9 m was attained (VC010, VC012, VC013, VC037 and VC039).

There is little variation in the VC sequences across the cable route with the general composition of the sediments dominated by minerogenic material of fine to coarse sands, silty sands, gravelly sands, sandy clays and gravels.

No organic sediments were recorded in any of the VC samples.

A total of 50 CPT samples were collected across the offshore cable route through a total of 69 attempts. The maximum penetration depth reached during the survey was 5.56m at CPT026 with the minimum recorded penetration depth being 0.44m at CPT005A (including re-attempts). A depth in excess of 5m was attained at 24 CPT locations, in particular between CPT019 to CPT031 and between CPT041 to CPT048.

The CPT sequences show good similarity to the VC samples being composed mainly of fine to coarse sands, silty sands, gravelly sands, clayey sands, sandy clays, gravelly clays and gravels. Marine sands and gravels were again the most common sediments encountered across the route

No organic sediments were recorded in any of the CPT samples.

13.7 Potential Impacts

The Project will be designed to avoid existing cultural heritage assets and charted wrecks where possible. The potential impacts to marine cultural heritage are identified below and summarised in Table 11.5.

13.7.1 Direct damage to or destruction of known marine historic environment assets including geophysical anomalies and unexploded ordnance

During construction and installation of the proposed cable, direct impacts to known cultural material on the seabed could be caused by vessel activities, seabed preparation and boulder clearance, ploughing trenching and jetting, resulting in the removal of marine cultural heritage or removal of material that forms the context of a site. Rock placement for cable protection could also impact by compressing any cultural material on which it is placed.

There are no shipwrecks or aircraft with known locations in proximity to the cable route. However, some geophysical contacts and anomalies have been identified that are probably anthropogenic and may be of archaeological importance (see Table 13-4; Figure 13.7and Figure 13.8; Appendix C). Most of the MBES/SSS contacts are more than 150 m from the potential cable route. However, contact MMT_C 122 is only 20 m west of the potential cable route, MMT_C 127 is 60 m west, MMT_C 139 is 85 m east and MMT_C 734 is 77 m west of the proposed cable route. Apart from the anomalies identified as cables, six magnetometer anomalies were considered to be of High geophysical potential. All are within 10-45 m of the potential cable route and are possibly metallic wreck debris. Therefore, there is a moderate likelihood of impact upon these items.

Therefore, potential impacts are predicted on geophysical items that could be of archaeological importance unless management or mitigation strategies are utilised (see Section 13.7).

13.7.2 Direct damage to or destruction of unknown marine historic environment assets including unexploded ordnance

During construction and installation of the proposed cable, direct impacts to unknown cultural material on the seabed could be caused by vessel activities, seabed preparation and boulder clearance, ploughing trenching and jetting, resulting in the removal of marine cultural heritage or removal of material that forms the context of a site. Rock placement for cable protection could also impact by compressing any cultural material on which it is placed.

The potential for such an impact has been reduced during Project development by analysis of the geophysical and geotechnical surveys, and although items have more chance of surviving if buried in sand, the dynamic nature of the waters and much of the seabed means the likelihood of survival of cultural remains near the surface is low. Therefore, the likelihood of impact is considered low.

Based on the results of the geotechnical surveys and the nature of the seabed (see Section 13.5), the risk of significantly impacting unknown submerged deposits is low.

The possible shipwreck and airplane sites identified in Section 13.5.2 have unknown locations. Eighteen of these sites are of high importance and four of medium importance. The potential for impacts on these has been reduced during Project development by analysis of the geophysical surveys and is further reduced by the dynamic nature of much of the seabed. Therefore, the likelihood of impacting them accidentally is considered low.

13.7.3 Direct damage to or destruction of known and unknown marine historic environment assets and unexploded ordnance

During operation and maintenance, it is possible that accidental direct impacts to unknown cultural material on the seabed could be caused by maintenance or inspection vessels dropping anchors on the seabed during routine inspections or preventative maintenance, or by the use of ROVs for monitoring purposes accidentally hitting an object. The likelihood of such impacts on known heritage assets (in terms of geophysical contacts and anomalies) is considered negligible-low, since the location of these assets is known and should be avoided. The likelihood of such impacts on unknown assets is low.

There is potential that movement of the cable could expose areas of seabed which could affect unknown sites of cultural heritage interest (if present) or identified geophysical contacts close to the cable, such as MMT_C 122. However, such movement will be prevented by burial or rock placement to keep the cable in place. Therefore, likelihood of such impacts is considered negligible.

13.7.4 Potential indirect damage to or destruction of known and unknown marine historic environment assets including unexploded ordnance

There is the possibility of indirect impacts on marine cultural heritage assets and their associated environment if the Project causes scour on the seabed. Scour occurs on the seafloor when sediment is eroded from an area in response to forcing by waves and currents (Quinn, 2006: 1419). It can be initiated by the introduction of an object to the seafloor such as a shipwreck or cable. Marine features such as shipwrecks and submerged landscape deposits are therefore made vulnerable to erosion due to scouring by currents or waves, and scour processes can ultimately lead to the complete failure and collapse of structures on the seafloor.

However, the potential for indirect impacts to cultural material on the seabed as a result of scouring or sediment deposition during operations and maintenance is considered to be negligible. This is because the cable will avoid known sites and there is a low likelihood of the cable being accidentally laid over unknown sites, and by the use of rock placement to prevent movement, which will prevent scour.

13.8 Mitigation

In general terms, it is preferable to manage the presence of cultural heritage sites by routing the cable and locating construction footprints to avoid them. However, where this is not possible various strategies

can be put in place, although few are required for this development due to there being few identified maritime heritage assets (in the form of geophysical contacts). The mitigation and management measures outlined below will result in the avoidance, reduction or offsetting of any potential impacts on cultural heritage by the Project.

13.8.1 Mitigation by design

The potential for significant impacts on marine cultural heritage has been reduced to low during the development and design of the Project by conducting a DBA, geophysical and geotechnical surveys to identify any marine historic environment assets. There are potentially items of marine heritage within the Project area and therefore there are potential impacts on cultural heritage.

However, avoidance of anthropogenic contacts and anomalies locations is feasible, since the features are small and isolated. Alternatively, ground-truthing the features by ROV during a pre-installation survey and inspection of the data by an experienced marine archaeologist would inform whether the features need to be avoided or confirm the need for micro-routing the final cable lay around them.

Rock placement will pin the cable in place to prevent any cable movement and potential scour over the lifetime of the cable.

13.8.2 Mitigation during installation

Avoidance of anthropogenic contacts and anomalies locations during installation is feasible, both by the cable itself and by boulder clearance, since the features are small and isolated.

In order to manage the potential for impacting unknown heritage, a reporting protocol should be instigated for the discovery of previously unknown marine cultural material during development. The reporting protocol produced by Wessex Archaeology (2014) for the Crown Estate would be sufficient (https://www.wessexarch.co.uk/archaeological-services/protocols-archaeological-discoveries-pad).

Should any cultural heritage sites be reported during the course of the Project, it is recommended that they are investigated by a qualified marine archaeologist as their potential for retaining cultural heritage information could be high.

Unknown cultural material could come from the presence of shipwrecks and airplanes of uncertain location. A pre-installation ROV survey and inspection of the data by an experienced marine archaeologist prior to cable lay or trenching to inform any micro-routing would avoid this potential impact. It should be noted that impact upon planes lost on military service automatically contravenes the Protection of Military Remains Act 1986, even if they were unknown prior to the impact.

There is potential for intertidal deposits below the beach at Warebeth, whereas landfall at Dounreay is over exposed bedrock. Any boreholes or test pits at the shore should be monitored archaeologically, so that any sediments with paleoenvironmental potential are noted, sampled, analysed and reported. However, if HDD is performed at landfall, then there will be no impact on any possible submerged deposits at Warebeth beach.

13.8.3 Mitigation during operation

Because the likelihood of impacts during this phase is considered negligible-low, it is suggested that a reporting protocol is kept in place in case anything of interest is observed during maintenance operations.

If any cultural heritage sites are reported, it is recommended that they are investigated by a qualified marine archaeologist as their potential for retaining cultural heritage information could be high.

The maintenance and inspection teams should be informed of the locations of any known assets so that they can avoid any accidental impacts upon them.

13.9 Residual Impacts

The reduction of potential impacts by the work already conducted during the design and development of the Project, combined with instigating the mitigation strategies outlined above will result in impacts of negligible-low significance on the marine historic environment.

Table 13.6 Residual impacts on archaeological receptors

Receptor	Sensitivity	Potential Impact	Likelihood of Significant Impact	Management / Mitigation	Residual Impact
Known marine heritage assets	Negligible-High	Direct: vessel activities, seabed preparation, trenching, post-lay jetting, rock placement	None	DBA has identified none with known locations present	None
Shipwrecks with unknown locations	Medium-High	Direct: vessel activities, seabed preparation, trenching, post-lay jetting, rock placement	Low	Geophysical surveys – none identified. Reporting protocol for accidental discoveries. Pre-installation ROV survey and inspection of data by experienced marine archaeologist prior to cable lay or trenching to inform any micro-routing. Use of rock placement to prevent cable movement and scour.	Low
Aircraft with unknown locations. Aircraft legally protected and must not be disturbed, even accidentally.	High	Direct: vessel activities, seabed preparation, trenching, post-lay jetting, rock placement. Indirect: cable movement, scour.	Low	Geophysical surveys – none identified. Reporting protocol for accidental discoveries. Pre-installation ROV survey and inspection of data by experienced marine archaeologist prior to cable lay or trenching to inform any micro-routing. Use of rock placement to prevent cable movement and scour.	Low
Geophysical anomalies	Low-High	Direct: vessel activities, seabed preparation, trenching, post-lay jetting, rock placement. Indirect: cable movement, scour.	Moderate	Geophysical surveys identified some that could be of archaeological importance. Avoidance of these locations by cable and boulder clearance. Pre-installation ROV survey and inspection of data by experienced marine archaeologist prior to cable lay or trenching to inform any micro-routing. Use of rock placement to prevent cable movement and scour.	Negligible
UXO	High	Direct: vessel activities, seabed preparation,	Low	Geophysical surveys – none identified. Reporting protocol for accidental discoveries.	Negligible

Receptor	Sensitivity	Potential Impact	Likelihood of Significant Impact	Management / Mitigation	Residual Impact
		trenching, post-lay jetting, rock placement. Indirect: cable movement, scour.		Use of rock placement to prevent cable movement and scour.	
Unknown submerged deposits	Low-High	Direct: vessel activities, seabed preparation, trenching, post-lay jetting, rock placement. Indirect: cable movement, scour.	Low	Geophysical and geotechnical surveys – likelihood any present negligible except at Warebeth beach. Archaeologically monitor boreholes or test pits at Warebeth so that any sediments with paleoenvironmental potential are noted, sampled, analysed and reported. If HHD is used for landfall, then there will be no impact on the beach and no mitigation strategy required here. Reporting protocol for accidental discoveries. Use of rock placement to prevent cable movement and scour.	Negligible
Unknown cultural material	Low-High	Direct: vessel activities, seabed preparation, trenching, post-lay jetting, rock placement. Indirect: cable movement, scour.	Low	Geophysical surveys conducted. Pre-installation ROV survey and inspection of data by experienced marine archaeologist prior to cable lay or trenching to inform any micro-routing. Reporting protocol for accidental discoveries. Use of rock placement to prevent cable movement and scour.	Negligible

13.10 Conclusions

Management and mitigation measures have been identified for the Project to ensure that impacts are avoided, or where they can't be avoided are minimised as far as possible. Some of this is embedded into the Project design and operational procedures, where as other is specific to the historic environment sensitivities in and around the proposed activities.

13.10.1 Key receptors

The environmental overview identified a number of receptors of concern that could be present in the area, and further assessment has been undertaken in order to identify potential impacts. The results of the assessment on are reported in this document.

No marine archaeological statutory designations have been identified that will be impacted. The key findings are:

- There is the potential for up to seven aircraft to be located within the cable corridor. It should be noted that impact upon planes lost on military service automatically contravenes the Protection of Military Remains Act 1986, even if they were unknown prior to the impact. The likelihood of direct impact on these is considered to be low;
- The likelihood of direct impact on a shipwreck with an unverified location is considered negligible-low since none have been identified in the assessment of the geophysical data;
- Geophysical contacts/anomalies were identified and have the potential to be of heritage significance. Avoidance is part of the Project design;
- The likelihood of direct and indirect impacts on unknown submerged deposits and unknown wrecks is considered negligible-low because none have been identified in the assessment of the geophysical and geotechnical data;
- A pre-installation ROV survey and inspection of the data by an experienced marine archaeologist prior to cable lay or trenching to inform any micro-routing would reduce or eliminate potential impacts, especially on geophysical contacts/anomalies identified close to the cable;
- The instigation of a reporting protocol for the accidental discovery of cultural remains is part of the Project mitigation.

Implementation of the suggested management and mitigation strategies will eliminate, reduce or manage any potential impacts on marine archaeology, resulting in a negligible-low impact on the features considered in this report.

14 COMMERCIAL FISHERIES

14.1 Introduction

This section assesses the potential effects of the Project on commercial fisheries, including salmon and sea trout fisheries, and aquaculture activities. This section also outlines the management and mitigation measures that will be undertaken to ensure any potential impacts are minimised.

Where relevant, any limitations related to the baseline conditions, data sources or understanding / interpretation have been highlighted.

14.2 Legislation and policy context

As well as the legislation and policy context outlined in Section 2 - Planning policy and legislative framework the following legislation, policy and guidance is of relevance to the assessment of potential effects on commercial fisheries, salmon and sea trout fisheries and aquaculture:

Legislation:

- EC Directive 2000/60/EC known as the 'Water Framework Directive' (or WFD) has the aim of preventing deterioration in ecological quality and where necessary improving the quality of our rivers, lochs, estuaries, coastal waters and groundwater.
- EC Regulation 1100/2007 the Eel Recovery Plan, aims to ensure recovery of European eel stocks. Scotland developed its own Eel Management Plan in 2010.
- EEC Designation (Variation) Order 1992. Variation to the Fishing Boats Order which designates, for, member States and the areas within British fishery limits within which, and descriptions of sea fish for which, fishing boats registered in each Member State may fish.
- The Sea Fish (Conservation) Act 1967 allows regulation of the size of fish landed, gear type that can be used, and restrictions on species that can be landed.
- The Sea Fish (Shellfish) Act 1967 allows local management of fisheries through the granting of several and/or Regulating Orders.
- The Inshore Fishing (Scotland) Act 1984 allows regulation of species fished, location and the methods as well as vehicles used.
- The Specified Crustaceans (Prohibition on Landing, Sale and Carriage) (Scotland) Order 2017. New landing controls for the Scottish crab and lobster fisheries came into effect on 25 February 2018.
- Aquaculture & Fisheries (Scotland) Act 2013. Came into force in 2013 to ensure that farmed and wild fisheries, and their interactions with each other, continue to be managed effectively, maximising their combined contribution to supporting sustainable economic growth with due regard to the wider marine environment.
- The Conservation of Salmon (Amendment) Scotland Regulations 2018. The regulations outline a system whereby the killing of Atlantic salmon in inland waters is managed on an annual basis by categorising the conservation status of their stocks.

Policy:

- Common Fisheries Policy (CFP). The CFP is a set of rules for managing European fishing fleets and for conserving fish stocks. Designed to manage a common resource, it gives all European fishing fleets equal access to EU waters and fishing grounds and allows fishermen to compete fairly.
- Draft Inshore Fisheries Management Plan, 2017 (Orkney Sustainable Fisheries Limited, 2017). The Management Plan has been developed to formulate local objectives that will contribute to the delivery of Marine Scotland's high-level objectives and help to ensure that local inshore fisheries are well managed, sustainable and profitable.

Guidance:

- Best Practice Guidance for Fishing Industry Financial and Economic Impact Assessments - guidelines based on outputs from a technical workshop organised by the UK Fisheries Economics Network (UFEN and Seafish, 2012);
- Fishing Liaison with Offshore Wind and Wet Renewables Group (FLOWW) Best Practice Guidance for Offshore Renewables Developments: Recommendations for Fisheries Liaison (January 2014);
- Guidance on Licensing and EIA requirements for offshore wind farms (Centre for Environment, Fisheries and Aquaculture Science (CEFAS), 2004); and
- Guidance on Commercial Fisheries Mitigation and Opportunities from Offshore Wind commissioned by Collaborative Offshore Wind Research into the Environment (COWRIE), (Blyth-Skyrme, 2010).

14.3 Consultation

Consultation has been on-going throughout the Project and played an important part in ensuring the extent and content of the baseline and impact assessment studies have been appropriate to the Project and the requirements of the regulators and their advisors.

Section 5 – Stakeholder Engagement summarises all consultation activities carried out to date. Relevant comments from MS-LOT's Opinion are summarised in Table 14-1 together with responses to the comments and reference to the relevant sections where specific comments have been addressed. The following stakeholders have been consulted in relation to commercial fisheries in the area of the proposed cable route:

- Maritime and Coastguard Agency (MCA);
- Northern Lighthouse Board (NLB);
- Stromness Harbour;
- Marine Safety Forum; and
- Fisheries representatives, namely:
    - Scottish Fishermen's Federation (SFF); and
    - The Scottish White Fish Producer's Association (SWFPA).

Table 14.1 Scoping comments relevant to Commercial Fisheries marine mammals

Name of organisation	Key concerns	Response	Section within which the specific issue is addressed
Scottish Fishermen's Federation	Traps are the most common gear however the fish and shellfish section nor the commercial fisheries section has addressed these fisheries adequately.	A full assessment on commercial fisheries is provided in Section 14.12 - Commercial Fisheries of the EA, including a full description of the baseline and an assessment of potential impacts.	Section 14.12 – Impact assessment.
Scottish Fishermen's Federation	Scallop fisheries should also be addressed in terms of sediment redistribution and any interference with spat.	"A full assessment on commercial fisheries is provided in Section 14.12- Commercial Fisheries of the EA, including a full description of the baseline and an assessment of potential impacts.	Section 14.12 – Impact assessment.

Name of organisation	Key concerns	Response	Section within which the specific issue is addressed
Scottish Fishermen's Federation	The loss of access post lay should be considered in case species do not return to the corridor.	The change in distribution of target species is assessed within Section 14.12.1.2 of the EA and the permanent loss of access to fishing is assessed in Section 14.12.2.1 of the EA. As the project impacts are limited spatially and temporary it is considered that disturbance to species is minimal and recolonisation of the disturbed area will occur.	Section 14.12.2 - Change in distribution of target species Section 14.12.2.1 – Potential Impacts during installation, maintenance and decommissioning

14.4 Data sources

Data and information used to inform the assessment of potential impacts of the Orkney – Mainland subsea cable on commercial fisheries, salmon and sea trout fisheries and aquaculture are listed in Table 14-2.

Table 14.2 Data and information sources

Data / information source	Description
Scottish Government Fisheries Statistics by ICES Rectangle (2013 - 2017)	Data on landings quantity (tonnes), value (£) and effort (days at sea) for vessels over 10 m in length by ICES Rectangle. Available at: http://www.gov.scot/Topics/Statistics/Browse/Agriculture-Fisheries/RectangleData
Marine Management Organisation (MMO) satellite tracking data (VMS) (2011 to 2015)	Vessel Monitoring System (VMS) data is a form of satellite tracking using transmitters on board fishing vessels. There is a legal requirement under Regulation (EU) No 404/2011 for all UK fishing vessels over 15 metres in length to be fitted with a UK Government-approved satellite tracking device.
Scottish Government NMPi various data sets and maps (2018)	Key mapped data sets / sources include: > Fishing statistics (landings (tonnes), sales (£) and effort (days) per ICES rectangle; and creel fishing effort; > Inshore fisheries mapping (ScotMap and North Atlantic Fisheries College (NAFC)) (monetary value (£) and number of vessels for crab and lobster pots, Nephrop trawls, Nephrop pots, scallop towed dredges, scallop divers and mackerel lines); and > Aquaculture sites in Scotland Data / maps available at: https://marinescotland.atkinsgeospatial.com/nmpi/
ScotMap data (Marine Scotland, 2014)	Spatial information on fishing activity of Scottish registered commercial fishing vessels under 15 m in overall length. Includes data on creel activity, *Nephrops* trawls, other trawls, dredges and mackerel line fishing
Local fisheries information	Information from local fishermen / fisheries groups acquired during consultation meetings and public events.

14.5 Sea fisheries controls

Marine Scotland is responsible for controlling the activities of all fishing vessels operating within the Scottish Zone, as defined by the Fishery Limits Act 1976 and the Scotland Act 1998. This covers the North Sea and West of Scotland out to 200 nm. Marine Scotland is also responsible for managing and controlling the activities of Scottish vessels wherever they may fish (Scottish Government, 2018).

Marine Scotland manage fishing vessels through the creation of policy and fisheries management rules (Scottish Government, 2018). These include:

- Licensing of fishing vessels and the maintenance of an overall cap on the capacity of the Scottish fishing fleet;
- Setting catch limits through the allocation of fish quota's and limits on time at sea;
- Minimum standards (known as 'Technical Conservation') in the way that fishing activity is conducted, for example by controlling the use of nets;
- Arrangements for the monitoring of fishing vessels while they are at sea; and
- Controls on the landing, sale, purchase, transport and traceability of sea fish.

In addition to these fisheries management rules, Marine Scotland also uses sea area restrictions or closures (either all year or seasonal) for one of several reasons (e.g. closed to all fishing; species restrictions; gear restrictions (static and mobile); or vessel size / capacity restrictions) to manage fishing activities in Scottish Waters (Marine Scotland, 2018).

With respect to management controls that are of relevance to this project (e.g. fishing vessel licensing, setting of quota's and limits on time at sea and area restrictions) the regulation of fisheries in the Northeast Atlantic, is, to a large extent, based on advice provided by the International Council for the Exploration of the Sea (ICES). Further information on these management controls is provided in the following sub-sections.

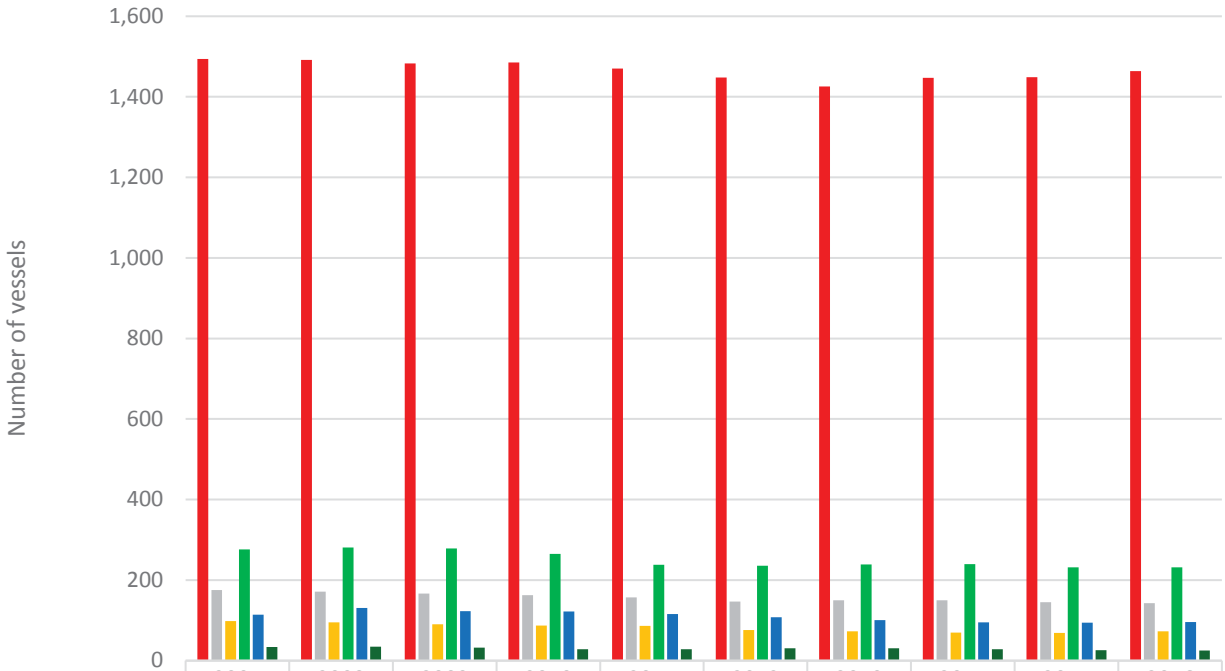
14.5.1 Fishing vessel licensing

14.5.1.1 Number of fishing vessels in Scotland

The number of active registered fishing vessels in Scotland in 2016 was 2,033, this represents a 0.9 per cent increase (19 vessels) since 2015 and a seven per cent decrease (160 vessels) since 2007.

Overall there has been a general decrease in all sizes of vessels in the time period 2007 to 2016. The greatest decreases have occurred in the 10 – 12 m category (18% reduction) and the 15 – 24 m category (16% reduction). From 2015 to 2016 there was a small increase (1.5%) in vessels of 12 – 15 m and a small increase (0.02%) in vessels of 24 – 40 m, all other vessel size categories either remained the same or decreased in this time period (Figure 14.1).

Figure 14.1 Number of Scottish fishing vessels by size group



	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
10 m & under	1,494	1,492	1,483	1,485	1,470	1,448	1,426	1,447	1,449	1,464
>10 -12	175	171	167	163	157	147	150	150	145	143
>12 -15	98	95	90	87	86	76	73	70	69	73
>15 -24	276	281	279	265	238	236	239	240	232	232
>24 -40	114	131	123	122	116	108	101	95	94	96
Over 40	34	35	32	28	28	31	31	28	26	25

14.5.2 Fisheries management areas and restrictions

14.5.2.1 Management areas

Inshore Fisheries

Scotland's inshore waters extend from the coast out to 12 nm (22.2 km), with a concentration of fishing taking place within 6 nm. In terms of the Project all of the cable route is within the 12 nm limit boundary. The EU is responsible for much of the legislation relating to sea fisheries, however the UK has exclusive rights to fish within 6 nm of its coastline. Fishing by non-UK vessels between 6 and 12 nm is restricted to countries with historic rights relating to specific fisheries (Scottish Government, 2018).

Regional Inshore Fisheries Groups (RIFGs) aim to improve the management of inshore fisheries in the 0 - 6 nm zone of Scottish waters, and to give commercial inshore fishermen a strong voice in wider marine management developments, there are two groups relevant to the Project. The North and East Coast RIFG, covers the mainland Scotland landfall and up to 22.2 km of the cable route and was developed in 2016. The aims of the group are set out in a Fisheries Management Plan, the latest version was published in 2017 (Inshore Fisheries Groups, 2018). The Orkney cable landfall and up to 22.2 km offshore from the landfall are covered by Orkney Sustainable Fisheries Ltd, the group employs a number of researchers as well as a recently appointed development manager with the aim of providing scientific evidence to inform the fishing industry (OSF, 2018).

The Inshore Fisheries Strategy sets out the Scottish Governments vision to support the development of a more sustainable, profitable and well-managed inshore fisheries sector in Scotland. With the aim of achieving this

by modernising the management of inshore fisheries in Scotland and reaping long-term sustainable rewards for the inshore sector, the marine environment and coastal communities. As part of the Strategy, an Inshore Fisheries Pilot Initiative has been developed with the aim of looking at alternative forms of inshore fisheries management. Marine Scotland sought proposals from the commercial fishing industry for sites to be considered for the pilot scheme. Orkney Fisheries Association (OFA) submitted three trials for consideration as Pilots (Use of fish trapping, quota management and scallop management). Following consideration of the Orkney proposals alongside other proposed Pilots, it was decided not to proceed with any of the Orkney proposals based on how consistent the proposals were with the criteria set out in the proposal form guidance and the responses received to the consultation (Scottish Government, 2018).

Fisheries Management Scotland and Salmon District Fishery Boards:

Fisheries Management Scotland was formed in 2016 as the single representative organisation for the District Salmon Fishery Boards and Fisheries Trusts in Scotland. The relevant DSFB for the mainland Scotland landfall area is the Caithness DSFB. The area comprises all the rivers of Caithness as well as coastal netting stations, the Pentland Firth lies to the north of the area and the Moray Firth to the east. The River Thurso, the River Borgie and the River Naver are SACs for Atlantic salmon located approximately 12 km, 29 km and 26 km from the mainland Scotland cable landfall respectively. There are currently no DSFBs or Fisheries Trusts in Orkney.

14.5.2.2 Restrictions

A number of restricted and management areas occur within the vicinity of the proposed cable route (Figure 1.1). In the area of the cable landfall at Douneray, there is an area where fishing is completely restricted by a Food and Environment Protection Act (FEPA) order, this is in order to protect human health. It is an offence to fish for or take any species of demersal or pelagic fish, molluscs and crustaceans in this designated area.

Approximately 36 km to the west of the proposed cable route lies the West of Scotland restricted area for trawling for cod, haddock and whiting. It is designated under EC Regulation No. 850/98 the conservation of fishery resources through technical measures for the protection of juveniles of marine organisms. Under this regulation, it is prohibited to fish at any time for any of these species in this restricted area. The cable landfall on mainland Orkney coincides with an area which has seasonal restrictions in place in order to conserve species and also to avoid gear conflict. The restriction is applicable from 30th May to 1st September and prohibits the use of fishing for sea fish with mobile gear within the area.

Under the Inshore Fishing (Prohibition of Fishing for Cockles) (Scotland) (No. 3) Order 2006, the entire length of the cable route and indeed all inshore Scottish waters are subject to a restriction for cockle harvesting. It is prohibited to collect cockles by any means in Scottish inshore waters at any time of the year.

New landing controls for the Scottish crab and lobster fisheries came into effect on 25 February 2018. Under the Specified Crustaceans (Prohibition on Landing, Sale and Carriage) (Scotland) Order 2017. These landing controls are applicable to a number of species landed from the Project area:

- A minimum landing size for brown crab (150 mm carapace width), velvet crab (70 mm carapace width), lobster (88 mm carapace increasing to 90 mm from 25 February 2019); and
- A prohibition on the selling or offering for sale of velvet crab measuring less than 70 mm carapace width, a prohibition on fishing boats carrying velvet crab measuring less than 70 mm carapace width and a prohibition on the landing of egg bearing velvet crab.

Of particular relevance to the Project given the prevalent inshore fishery restrictions on non-national vessels fishing the inshore waters of the UK, which mean that the UK has exclusive rights to fish within 6 nm of its coastline. Fishing by non-UK vessels between 6 and 12 nm is restricted to countries with historic rights relating to specific fisheries. Marine Scotland issue annual fishing quotas, the purpose of quota management arrangements is to enable the fishing industry to make full use of annual fishing opportunities while ensuring that quotas are not exceeded. The latest quota rules are available in the Marine Scotland Quota Management Rules, 2017. Quotas apportioned to Marine Scotland by the UK Government are divided into three amounts assigned to:

- Scottish over 10 m licensees in the membership of a UK Producer Organisation (“the Scottish sector”);

- Scottish over 10 m licensees not in the membership of a UK Producer Organisation ("the Scottish non-sector"); and
- Scottish 10 m and under licensees.

Marine Scotland may also grant responsibility for sectoral quota management. Sectoral management has been granted to ten Scottish Fish Producer Organisations (FPO), of relevance to the Project are the Orkney FPO and the Northern FPO (Marine Scotland, 2017).

14.5.2.3 Additional protection to PMFs

Unlike most industries, fisheries do not have to undertake an environmental assessment to determine any potential impacts as a result of their activities. Therefore, Marine Scotland commissioned SNH to identify locations where there is a need to consider additional management for bottom contacting mobile fishing gears to ensure there is no significant impact on the national status of PMFs within the 6 nm limit. The main aim of the SNH study was to ensure that the necessary fisheries management measures are in place to ensure protection of PMFs and comply with the relevant policy in the NMP. The current PMF list has 81 habitats and species and therefore prioritisation was undertaken which identified 11 habitats which are particularly sensitive to impact from bottom contacting mobile fishing gears. Consultation on the scope of the SNH study closed on the 31 August 2018. The next stage will be a Sustainability Appraisal which will assess potential social, economic and environmental impacts of any proposed management measures. The proposed cable route overlaps with areas being considered for the management of a number of the 11 sensitive habitats identified (Marine Scotland, 2018b). Although the results of consultation and Sustainability Assessments are yet to be determined it is considered probable that the SNH study will lead to increased management for fisheries using bottom contacting methods. Further details on the habitats under consideration for further management can be found in Section 10 - Benthic and intertidal ecology and Section 9 Protected Sites and Species.

14.6 Existing baseline description

14.6.1 Commercial fishing activities within the Project area

The proposed cable corridor transits ICES rectangle 46E6 (Figure 14.2). The ScotMap project provides spatial information on fishing activity in Scotland by vessels under 15 m in length.

Figure 14.3 displays the number of fishing vessels under 15 m operating in the vicinity of the proposed cable route (ScotMap, 2014). Fishing occurs along the entirety of the route for pelagic, shellfish and demersal species. For vessels under 10 m in length landings are dominated by shellfish species with both demersal and pelagic species only making a minor contribution to the landings value (

Figure 14.5). For the over 10 m vessels, pelagic species make a minimal contribution to the landings, with shellfish and demersal both contributing significantly with shellfish accounting for the greatest landings value from 2013 to 2017 (

Figure 14.5). The ScotMap project identified the following information on fisheries in the area of the proposed cable route:

- The waters in between the islands of Orkney and Orkney and the mainland are associated with high levels of fishing in comparison to the western part of the Pentland Firth; and
- Creel fishing occurs over a wide sea area but the waters closer to the coast account for the higher values of landings indicating remote communities rely on small areas of sea for vessel incomes.

Figure 14.2 Fishery Management Areas associated with Project area

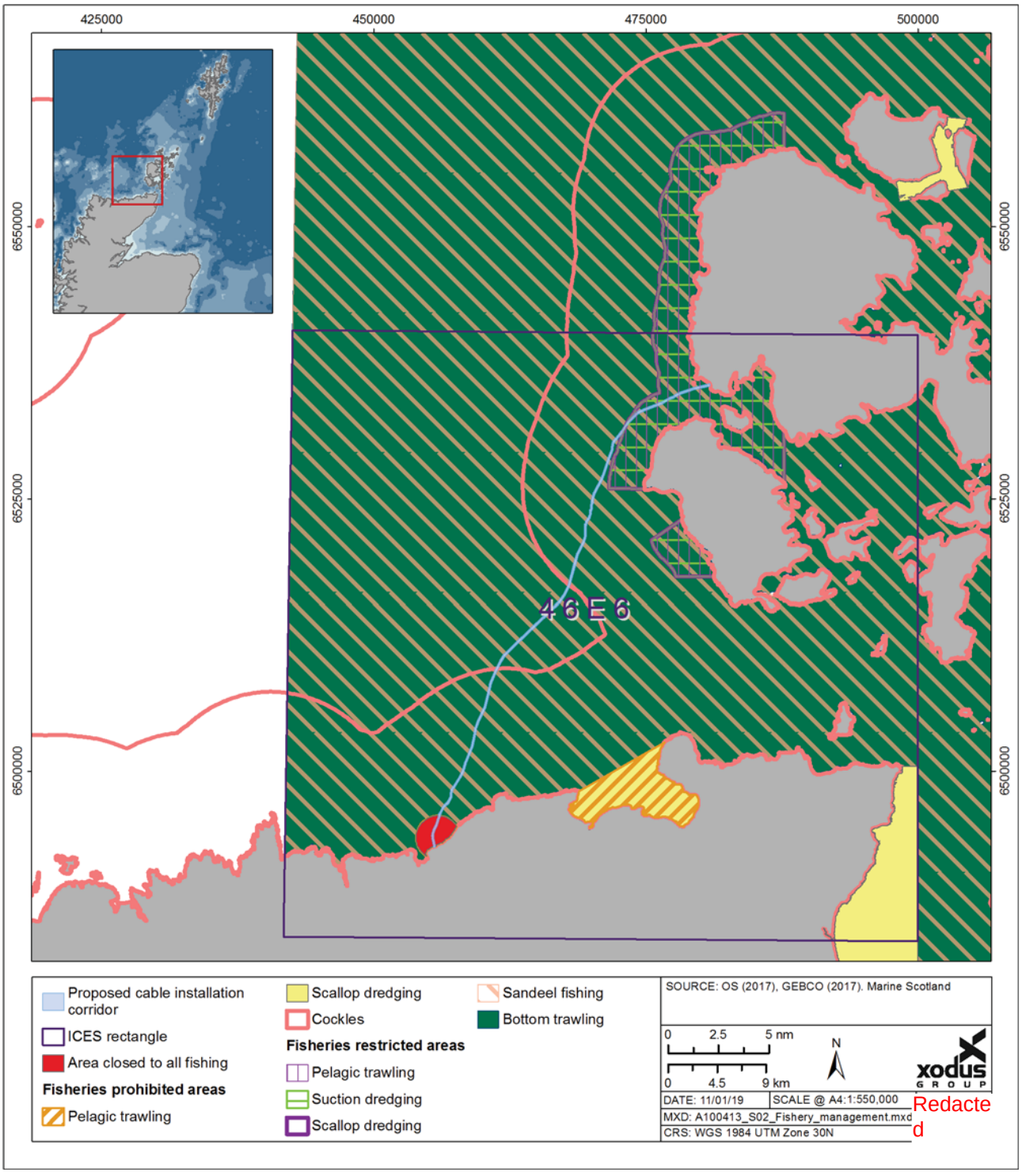


Figure 14.3 Number of vessels in the area under 15 m in length (Marine Traffic, 2018)

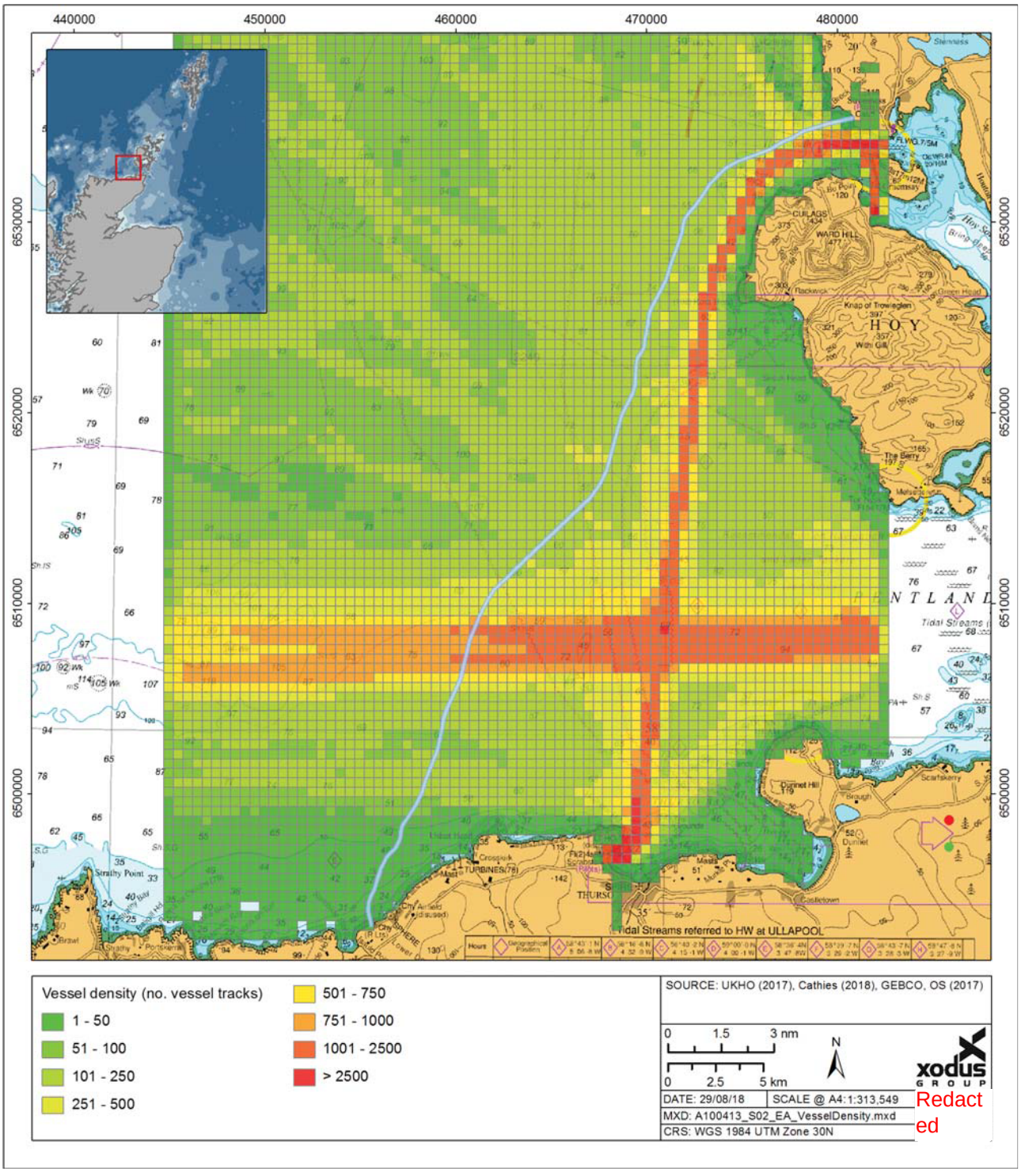


Figure 14.4 Number of vessels in the area under 15 m in length (Marine Traffic, 2018)

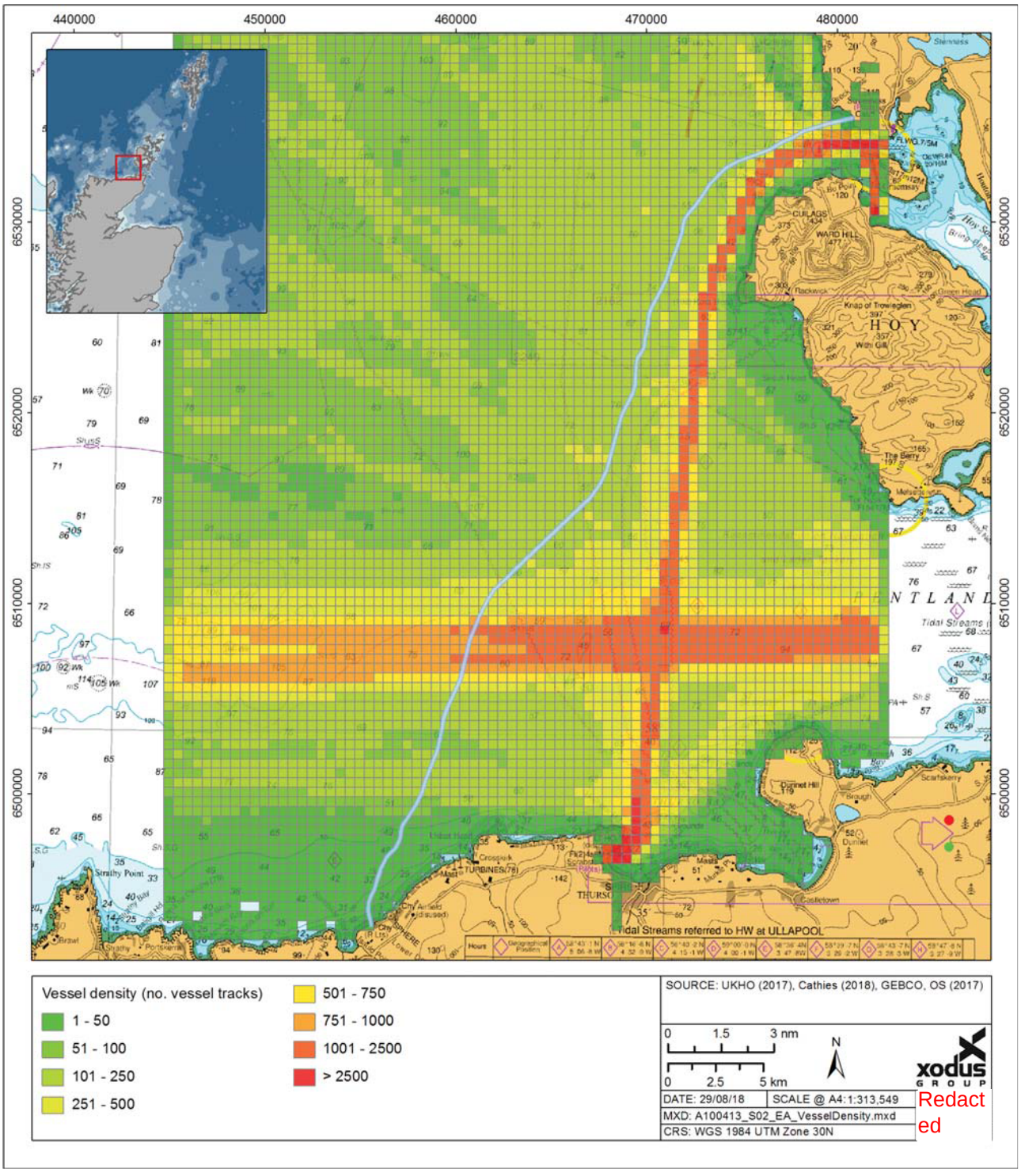
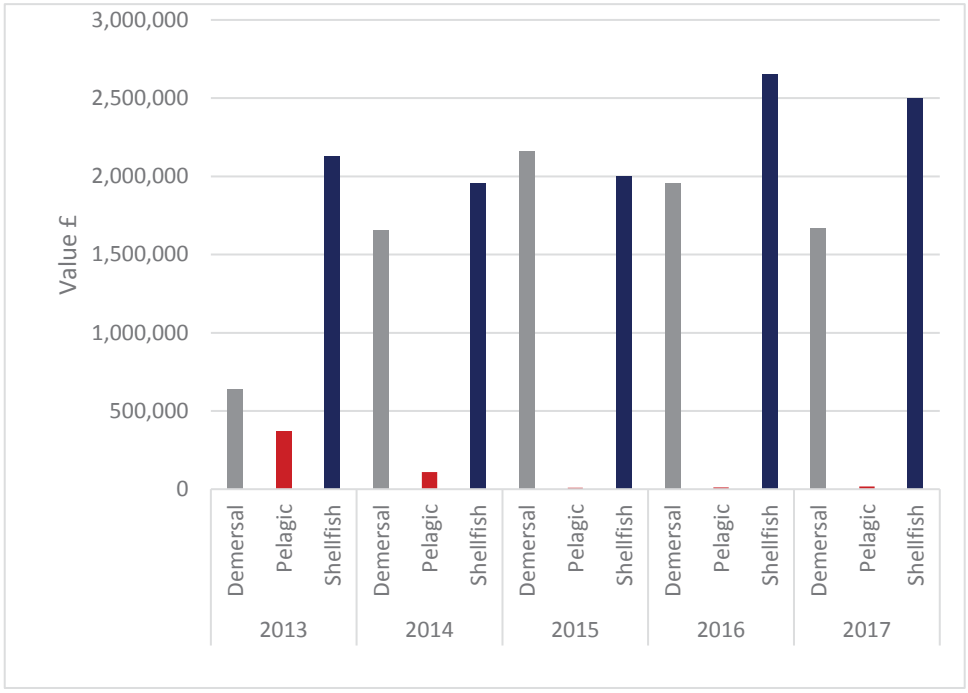
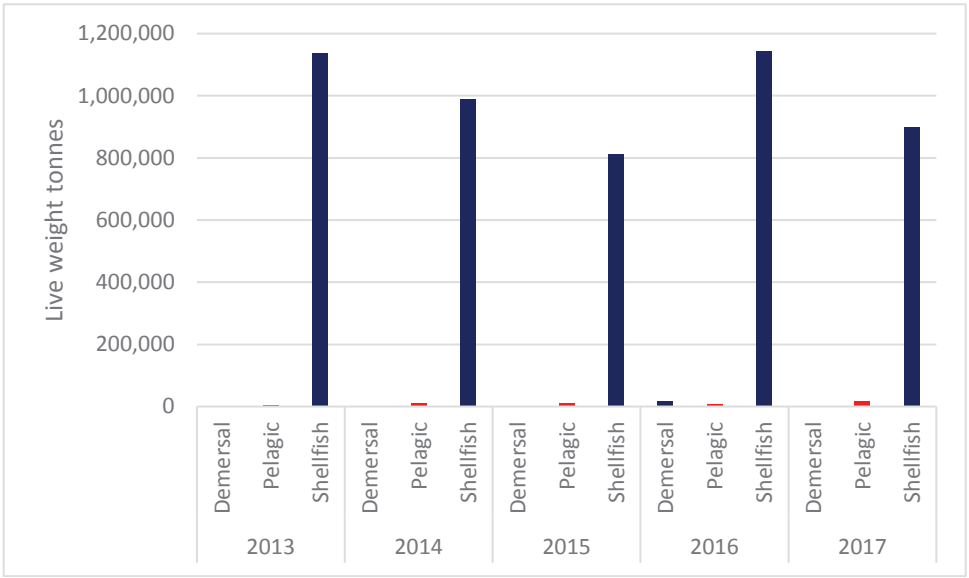


Figure 14.5 Landings value in £ (A) and landings weight in tonnes (B) by species type for vessels over 10 m in ICES rectangle 46E6 (average 2013-2017) (Scottish Government, 2018)

A



B



14.6.1.1 Target species

A range of species are targeted in ICES rectangle 46E6 by vessels of various sizes, 30 species were recorded in the landings data from 2013 to 2017 for vessels under 10 m (Table 14-3) and 56 species were recorded for vessels over 10 m in length.

Table 14-3 details all species landed from ICES rectangle 46E6 from vessels under 10 m. in the years from 2013 to 2017. It also details the average landings value and live weight for the species over this time period. Figure 14.6 presents the top landings species by value for each year from 2013 to 2017. Crab is the most valuable species in each year, with an average landings value of £443,172.67 per year and on average accounting for 44.27% of the annual landings value. Lobster and velvet crab are the second and third most valuable, accounting for 24.86% and 16.99% of landings value on average per year respectively.

Table 14-4 details all species landed from ICES rectangle 46E6 from vessels over 10 m in the years from 2013 to 2017. It also details the average landings value and live weight for the species over this time period. Figure 14.8 details the value of the top landed species for vessels over 10m. As with the vessels of under 10 m crab is the dominant species with an average annual landing value of £996,934 and accounting for on average 25.82% of the landings in each year. Crab is consistently the most valuable species over the years apart from 2015 when haddock was more valuable. Crab landings have increased in value each from 2013 to 2017 with the average landing value for 2017 being 52% higher than 2013. Haddock is another important species for vessels over 10 m with an average landings value of £651,485.13 and accounting for on average 16.87% of the annual landings value. Other notable species which contribute significantly to the landings value include lobster, velvet crab and monk or angler fish.

Figure 14.6 Top species by value landed by vessels under 10 m in ICES rectangle 46E6 (Scottish Government, 2018)

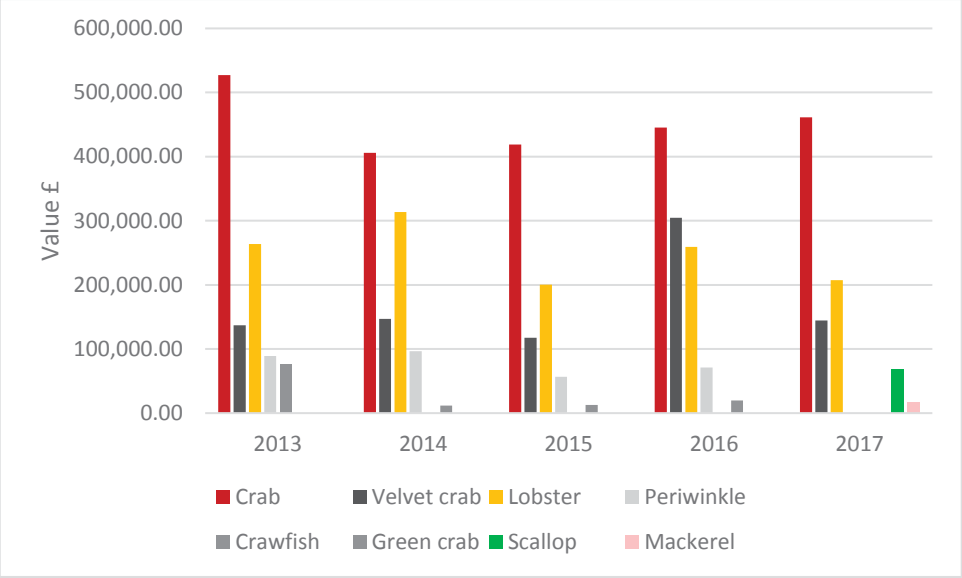


Table 14.3 Value and live weight of species by vessels under 10 m (average 2013 - 2017) in ICES rectangle 46E6 (Scottish Government, 2018)

Species	Value		Liveweight	
	£	%	Tonnes	%
Brown crab	443,172.67	44.27	320.97	66.72
Crabs - velvet (swim)	170,101.39	16.99	57.49	11.95
Crawfish	15,338.92	1.53	0.40	0.08
Green crab	12,742.55	1.27	18.75	3.90
Lobsters	248,822.49	24.86	21.98	4.57

Species	Value		Liveweight	
	£	%	Tonnes	%
Nephrops	2,658.18	0.27	0.76	0.16
Other crustaceans	38.06	0.00	0.00	0.00
Mixed clams	21.30	0.00	0.01	0.00
Periwinkles	63,514.36	6.34	28.93	6.01
Queen scallops	6,518.30	0.65	5.75	1.20
Razor clam	1,212.12	0.12	0.37	0.08
Scallops	19,952.45	1.99	7.89	1.64
Sea urchin	48.00	0.00	0.02	0.00
Squid	511.67	0.05	0.16	0.03
Whelks	1,908.27	0.19	2.15	0.45
Mackerel	10,510.66	1.05	13.55	2.82
Pollack	3,201.55	0.32	1.24	0.26
Saithe	73.56	0.01	0.11	0.02
Cockles	9.37	0.00	0.01	0.00
Cod	478.26	0.05	0.29	0.06
Common skate	2.40	0.00	0.00	0.00
Haddock	156.93	0.02	0.17	0.03
Ling	1.61	0.00	0.00	0.00
Long rough dabs	5.60	0.00	0.01	0.00
Megrim	6.76	0.00	0.00	0.00
Monks or anglers	2.24	0.00	0.00	0.00
Plaice	1.38	0.00	0.00	0.00
Thornback ray	5.00	0.00	0.01	0.00
Witch	4.99	0.00	0.00	0.00
Mussels	19.20	0.00	0.00	0.00
Horse mackerel	0.00	0.00	0.01	0.00

Figure 14.7 Top five species by value landed by vessels greater than 10 m in ICES rectangle 46E6 (Scottish Government, 2018)

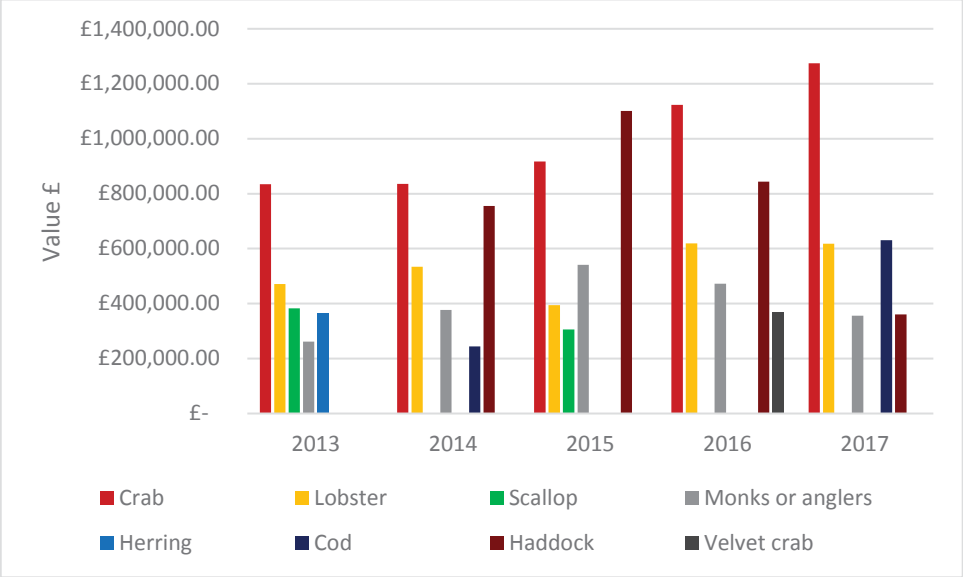


Table 14.4 Value and liveweight of species by vessels over 10 m in ICES rectangle 46E6 (average 2013-2017) (Scottish Government, 2018)

Species	46E6			
	Value		Liveweight	
	£	%	Tonnes	%
Brill	518.20	0.01	0.12	0.01
Catfish	37.60	0.00	0.02	0.00
Cockles	9.40	0.00	0.01	0.00
Cod	323,764.96	8.38	158.04	6.72
Conger eels	28.20	0.00	0.04	0.00
Brown crabs	996,934.01	25.82	697.81	29.66
Crabs - velvet (swim)	228,220.26	5.91	79.66	3.39
Cuckoo ray	464.11	0.01	0.66	0.03
Crawfish	15,338.92	0.40	0.40	0.02
Eels	2.06	0.00	0.00	0.00
Green Crab	18,787.85	0.49	27.43	1.17
Gurnard and latchet	280.12	0.01	0.50	0.02
Gurnards - grey	7,016.75	0.18	5.77	0.25
Gurnards - red	568.09	0.01	1.36	0.06
Haddock	651,485.13	16.87	515.27	21.90
Hake	40,780.67	1.06	10.29	0.44
Halibut	560.10	0.01	0.06	0.00

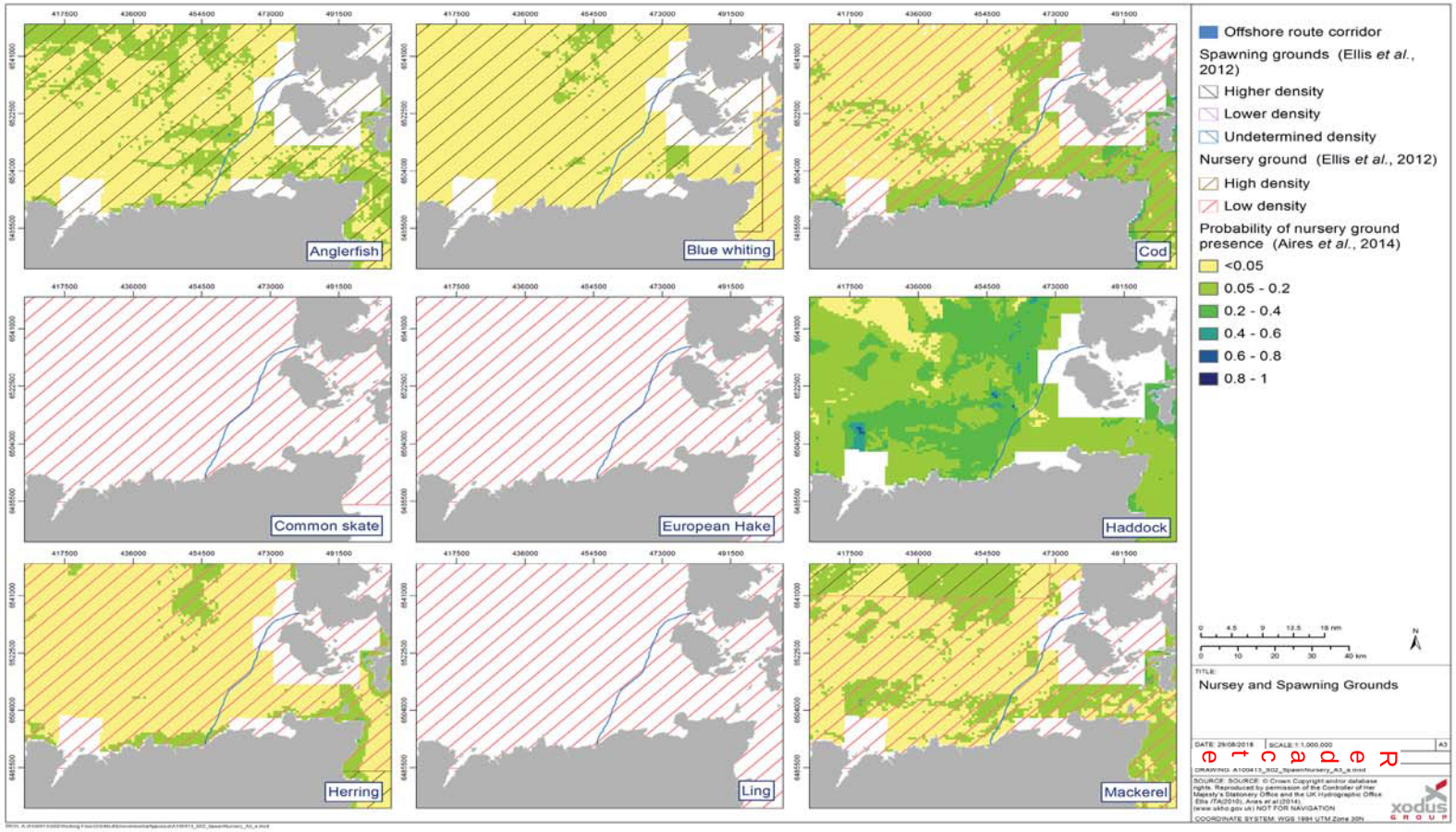
Species	46E6			
	Value		Liveweight	
	£	%	Tonnes	%
Herring	92,162.91	2.39	283.67	12.06
John Dory	4,320.66	0.11	0.67	0.03
Lemon sole	8,140.02	0.21	2.72	0.12
Ling	3,854.58	0.10	2.65	0.11
Lobsters	527,380.25	13.66	43.26	1.84
Mackerel	10,882.12	0.28	13.82	0.59
Megrim	43,629.15	1.13	17.91	0.76
Monks or Anglers	298,537.28	7.73	157.45	6.69
Nephrops (Norway Lobster)	12,327.77	0.32	2.77	0.12
Norway pout	63.00	0.00	0.70	0.03
Other or mixed demersal	39.69	0.00	0.00	0.00
Periwinkles	62,696.61	1.62	28.55	1.21
Plaice	5,578.15	0.14	7.91	0.34
Pollack	4,313.47	0.11	1.82	0.08
Queen scallops	9,049.56	0.23	8.14	0.35
Redfishes	14.14	0.00	0.02	0.00
Saithe	11,007.05	0.29	11.93	0.51
Scallops	291,264.40	7.54	120.11	5.11
Skates and rays	686.79	0.02	0.59	0.03
Sole	67.84	0.00	0.01	0.00
Spotted ray	2,620.14	0.07	2.62	0.11
Squid	33,376.86	0.86	9.27	0.39
Thornback ray	2,395.20	0.06	2.29	0.10
Turbot	3,972.39	0.10	0.45	0.02
Unidentified dogfish	128.59	0.00	0.87	0.04
Whelks	47,334.22	1.23	52.04	2.21
White skate	88.30	0.00	0.07	0.00
Whiting	99,719.17	2.58	81.92	3.48
Witch	954.66	0.02	1.05	0.04

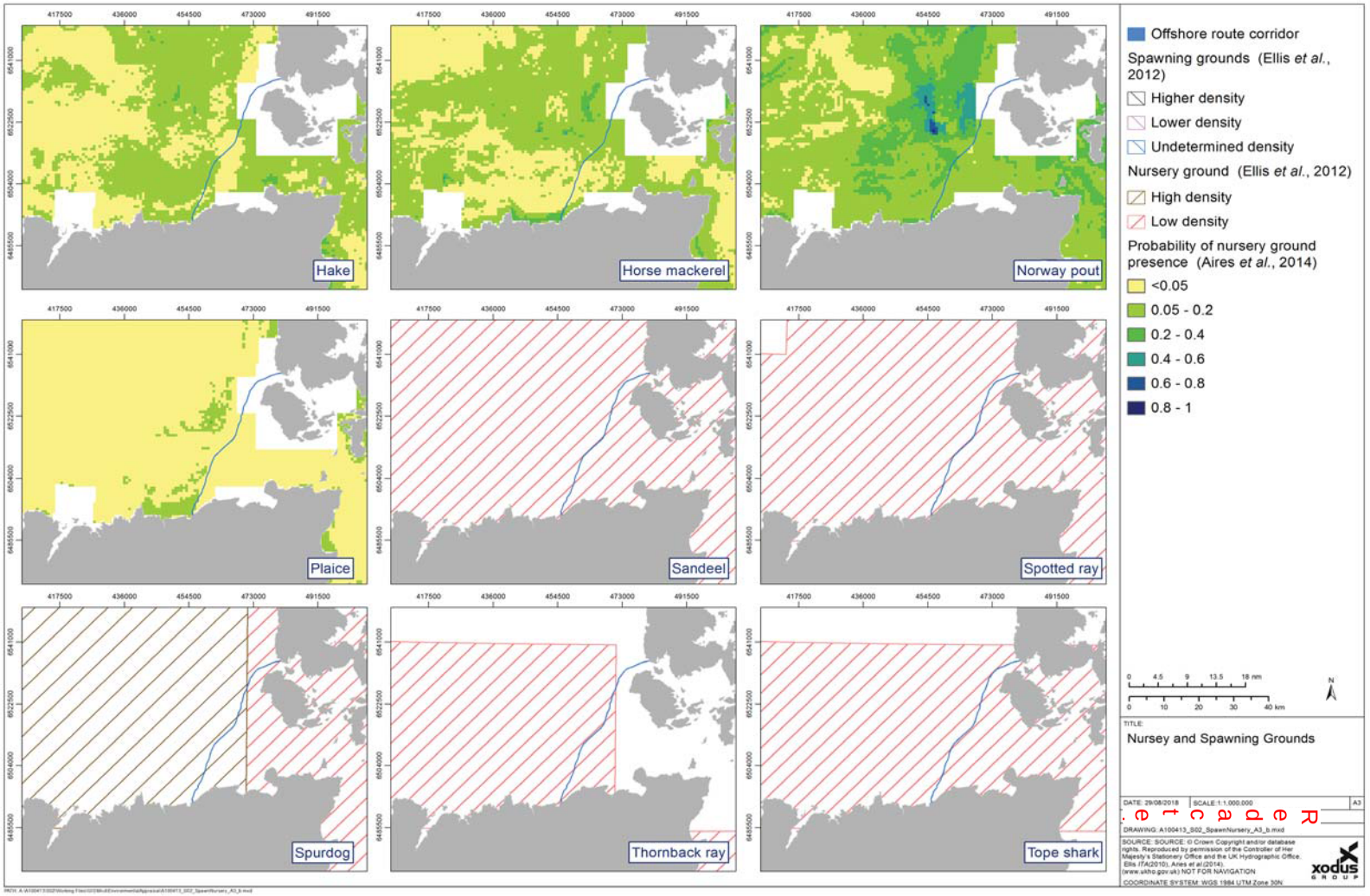
14.6.1.2 Spawning grounds

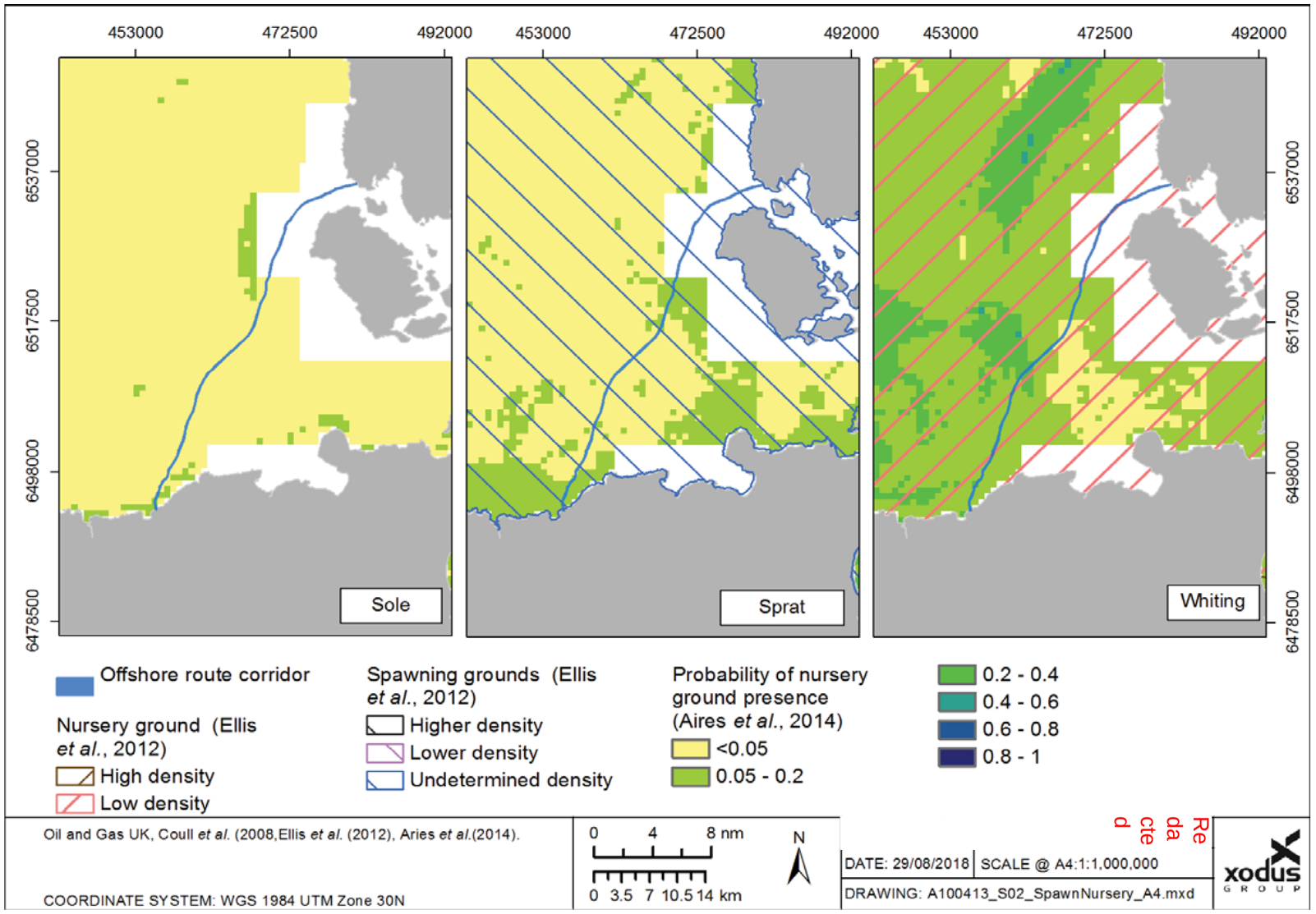
Two key species that are of commercial and conservation importance that depend on the seabed either throughout or at key stages in their life-cycle are herring and sandeel. The area of the proposed cable route is considered a nursery area for herring but does not support herring or sand eel spawning. The only species recorded to use the area for spawning is sprat. As indicated in Figure 14.8 a number of commercial species

use the area of the proposed cable route for nursery grounds including haddock, cod, mackerel and it is considered a high density nursery area for angler fish which, as discussed in Section 14.6.1.1, is one of the top five valuable species landed in ICES rectangle 46E6.

Figure 14.8 Spawning and nursery grounds (Coull et al., 1998; Ellis et al., 2012)



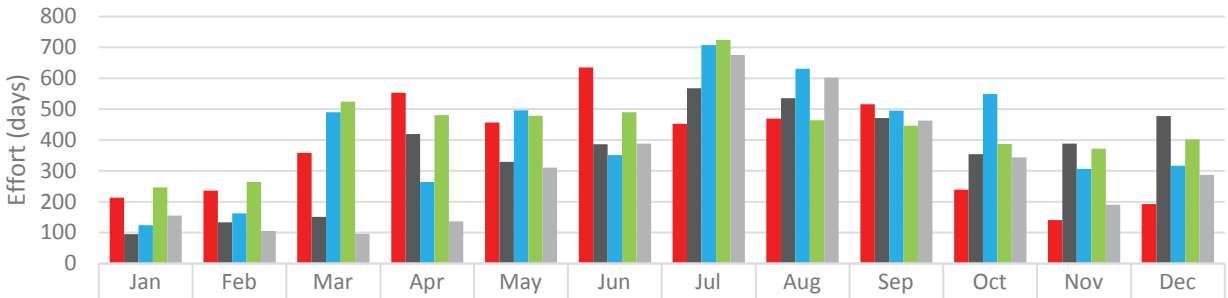

Hake
Horse mackerel
Norway pout
Plaice
Sandeel
Spotted ray
Spurdog
Thornback ray
Tope shark
Offshore route corridor
Spawning grounds (Ellis et al., 2012)
Higher density
Lower density
Undetermined density
Nursery ground (Ellis et al., 2012)
High density
Low density
Probability of nursery ground presence (Aires et al., 2014)
<0.05
0.05 - 0.2
0.2 - 0.4
0.4 - 0.6
0.6 - 0.8
0.8 - 1
Nursey and Spawning Grounds


453000
472500
492000
6537000
6517500
6498000
6478500
Sole
Sprat
Whiting
Offshore route corridor
Nursery ground (Ellis et al., 2012)
High density
Low density
Spawning grounds (Ellis et al., 2012)
Higher density
Lower density
Undetermined density
Probability of nursery ground presence (Aires et al., 2014)
<0.05
0.05 - 0.2
0.2 - 0.4
0.4 - 0.6
0.6 - 0.8
0.8 - 1
Oil and Gas UK, Coull et al. (2008,Ellis et al. (2012), Aries et al.(2014).
COORDINATE SYSTEM: WGS 1984 UTM Zone 30N
0 4 8 nm
0 3.5 7 10.5 14 km
N
DATE: 29/08/2018
SCALE @ A4:1:1,000,000
DRAWING: A100413_S02_SpawnNursery_A4.mxd
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14.6.1.3 Seasonal variation

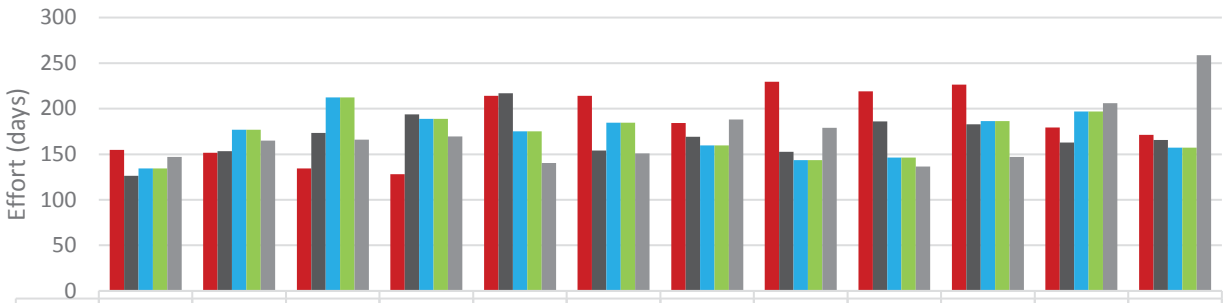
Fishing activity takes place all year round in ICES Rectangle 46E6. Figure 14.9 and Figure 14.10 shows the average number of days spent fishing by vessels over 10 m in length and under 10 m in length from 2013 to 2017. Fishing effort is consistent throughout the year, with a slight increase during summer months, fishing effort is lowest in January.

Figure 14.9 Monthly effort in ICES Rectangle 46E6 by vessels under 10 m (average 2013-2017) (Scottish Government, 2018)



	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
2013	213	236	358	553	457	635	453	469	516	239	141	193
2014	95	133	151	420	329	386	568	536	471	355	389	478
2015	124	162	490	264	496	351	708	631	495	549	307	317
2016	246	264	524	481	479	491	724	464	447	387	372	402
2017	155	106	96	137	311	388	676	602	464	344	190	287

Figure 14.10 Monthly effort in ICES Rectangle 46E6 by vessels over 10 m (average 2013 - 2017) (Scottish Government, 2018)



2013	155	152	134	128	214	214	184	229	219	226	180	171
2014	126	153	173	194	217	154	169	153	186	183	163	166
2015	134	177	212	189	175	185	160	144	146	186	197	157
2016	134	177	212	189	175	185	160	144	146	186	197	157
2017	147	165	166	169	141	151	188	179	137	147	206	259

14.6.1.4 Gear types

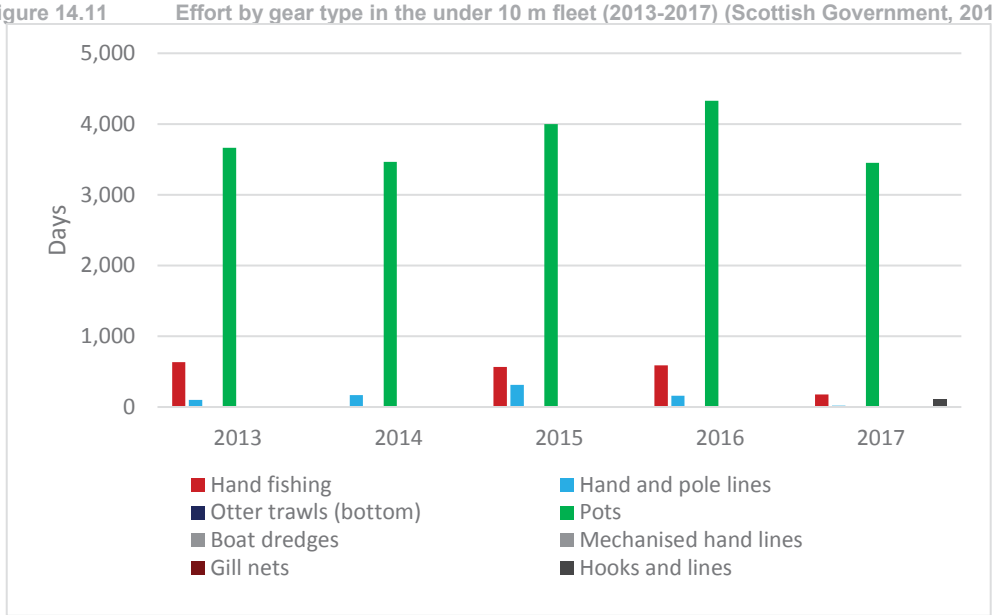
The types of gear utilised in the vicinity of the proposed cable route are detailed in Table 14-5. Figure 14.11 and Figure 14.12 show the effort associated with the gear types used in the area of the proposed cable route. It is worth noting that there are restrictions on certain gear types which are applicable to the proposed cable route. Some of these restrictions mean fishing is completely prohibited in a certain area with any gear type such as the Dounreay prohibited area (Figure 14.12). There is also a seasonal restriction on the use of any mobile gear in an area known as the Berry to Costa Head restricted area, this restriction is in place from 1st May to 30th September. The most utilised gear type for vessels of both under and over 10 in length is recorded as pots, the level of effort with this gear has remained relatively constant over the years 2013 to 2017

for vessels both under and over 10m. This correlates with the most valuable species discussed in Section 14.6.1.1 as crab is targeted utilising this gear type. Otter trawls and dredges are also utilised but to a much lesser extent and hand lines and hand fishing making a contribution to the under 10 m vessel types. A number of other gear types are utilised however they are recorded as disclosive data (dd), this indicates a very low level of effort for these gear types.

Table 14.5 Fishing vessel information for different fishing gears (Marine Scotland, 2014)

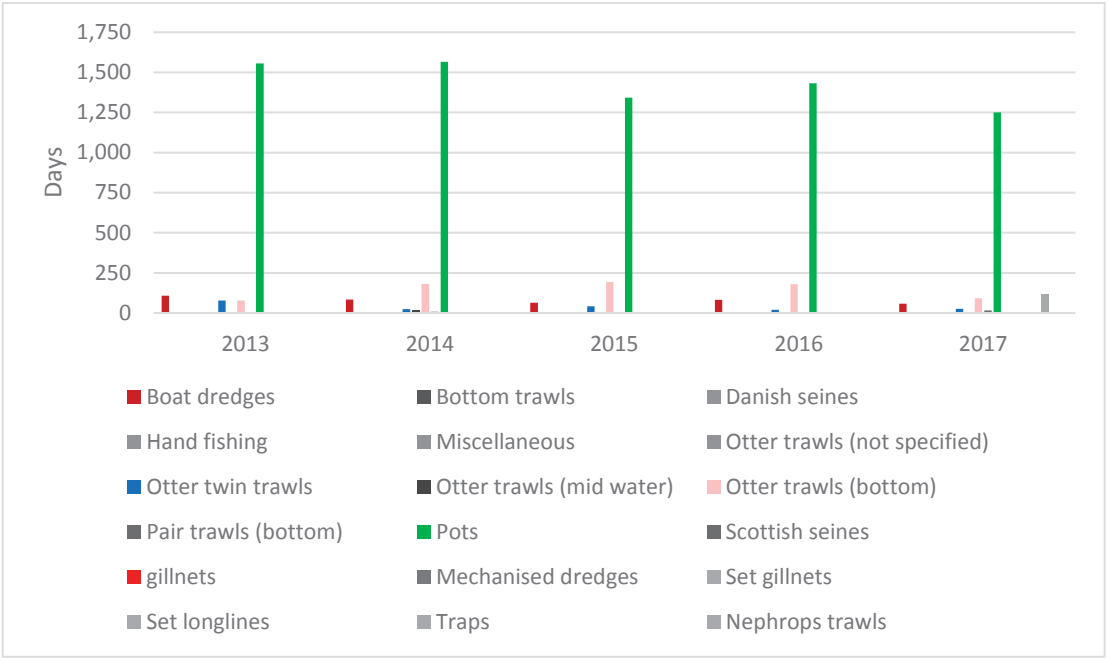
Gear Type	Number of vessels required for fishing	Number of nets required for fishing	Towing speed (knots)	Tow duration (hours)	Additional information	Target species and fishery type
Single bottom trawl	One	One	2-4	Up to 6	Nets used are chosen to be compatible with seabed conditions in the area being fished.	Mixed whitefish, Norway lobster (Nephrops) and squid.
Twin-rig trawl	One	Two	2-3	4-7	Sometimes associated with heavy rock hopper ground gear.	Mixed whitefish, Norway lobster (Nephrops) and squid.
Demersal pair trawl	Two	One	3-3.5	4-5	Vessels 370 m apart; will close during hauling and pairing up.	Mixed whitefish.
Seine net	One	One	1-2	2	At greatest distance net is over 1 nm from vessel.	Demersal species.
Dredge	One	n/a	3-5	4-5	Dredges are towed up to 1 nm from the vessels.	King scallop, queen scallop.
Traps	One	n/a	n/a	n/a	Baited creels are left in place for a period of time before being hauled (up to two weeks).	Common lobster, brown crab, velvet crab, green crab.
Hooks and lines	One	n/a	n/a	n/a	Hand lines or jigging machines.	Mackerel.

Figure 14.11 Effort by gear type in the under 10 m fleet (2013-2017) (Scottish Government, 2018)



	2013	2014	2015	2016	2017
Hand fishing	636.00	dd	568.00	588.50	177.43
Hand and pole lines	102.50	166.33	dd	160.00	20.73
0tter trawls (bottom)	dd	dd	0.00	dd	0.00
Pots	3,666.00	3,466.33	3,998.75	4,327.50	3,453.11
Boat dredges	0.00	dd	0.00	dd	0.00
Mechanised handlines	0.00	0.00	0.00	0.00	0.00
Gillnets	0.00	0.00	0.00	dd	dd
Hooks and lines	0.00	0.00	0.00	dd	98.65

Figure 14.12 Effort by gear type in the over 10 m fleet (2013-2017) (Scottish Government, 2018)



	2013	2014	2015	2016	2017
Boat dredges	107.24	84.24	64.85	81.72	57.96
Bottom trawls	dd	dd	dd	dd	dd
Danish seines	dd	0.00	0.00	0.00	0.00
Hand fishing	dd	dd	dd	dd	dd
Miscellaneous	dd	dd	0.00	dd	dd
Otter trawls (not specified)	dd	0.00	0.00	0.00	0.00
Otter twin trawls	77.50	23.16	41.17	20.94	25.80
Otter trawls (mid water)	dd	15.70	0.00	0.00	dd
Otter trawls (bottom)	77.50	180.87	194.21	180.52	91.98
Pair trawls (bottom)	dd	7.28	0.00	6.08	15.60
Pots	1,556.64	1,566.33	1,342.03	1,431.88	1,250.15
Scottish seines	dd	dd	dd	dd	dd
gillnets	0.00	dd	0.00	0.00	0.00
Mechanised dredges	0.00	dd	0.00	0.00	0.00
Set gillnets	0.00	dd	0.00	0.00	dd
Set longlines	0.00	dd	0.00	0.00	118.54
Traps	0.00	0.00	dd	dd	dd
Nephrops trawls		0.00	0.00	0.00	dd

14.6.1.5 Nephrops fishery

14.6.1.5.1 Operating patterns and practices

Nephrops gear is configured in the same way as that used to target whitefish but with modified nets. Nephrops inhabit burrows in the seabed and favour muddy and soft substrates. Nephrops distribution is therefore limited by the extent of suitable muddy sediment available for animals to construct burrows (Marine Scotland, 2017). In fishing for Nephrops, vessels tow one or more trawl nets (single or twin rig) along the seabed. Nephrops are assessed across Europe as individual stocks in 34 functional units (FUs). The proposed cable corridor does

not overlap with any FU, the closet is FU10 (Noup) located approximately 3 km north of the cable landfall on Orkney (NMPi, 2018).

14.6.1.5.2 Monetary value

Nephrops landings did not feature in the top five valued species from 2013 to 2017 for vessels over 10 m (Figure 14.8). The monetary value and effort levels for Nephrops trawls is considered to be low for the entirety of the proposed cable route (Figure 14.13 and Figure 14.14).

Figure 14.13 Value of *Nephrops* trawls (ScotMap, 2014)

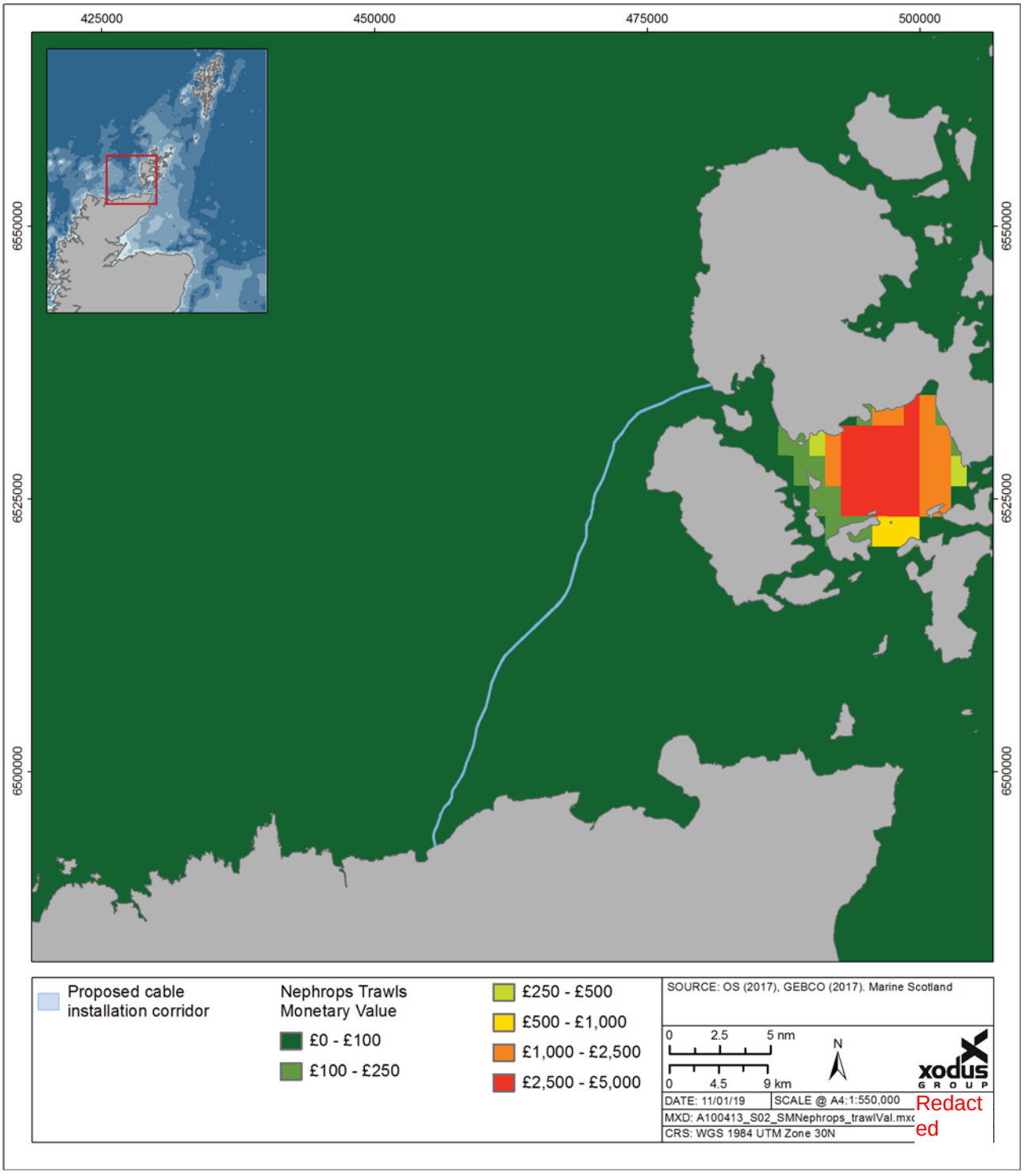
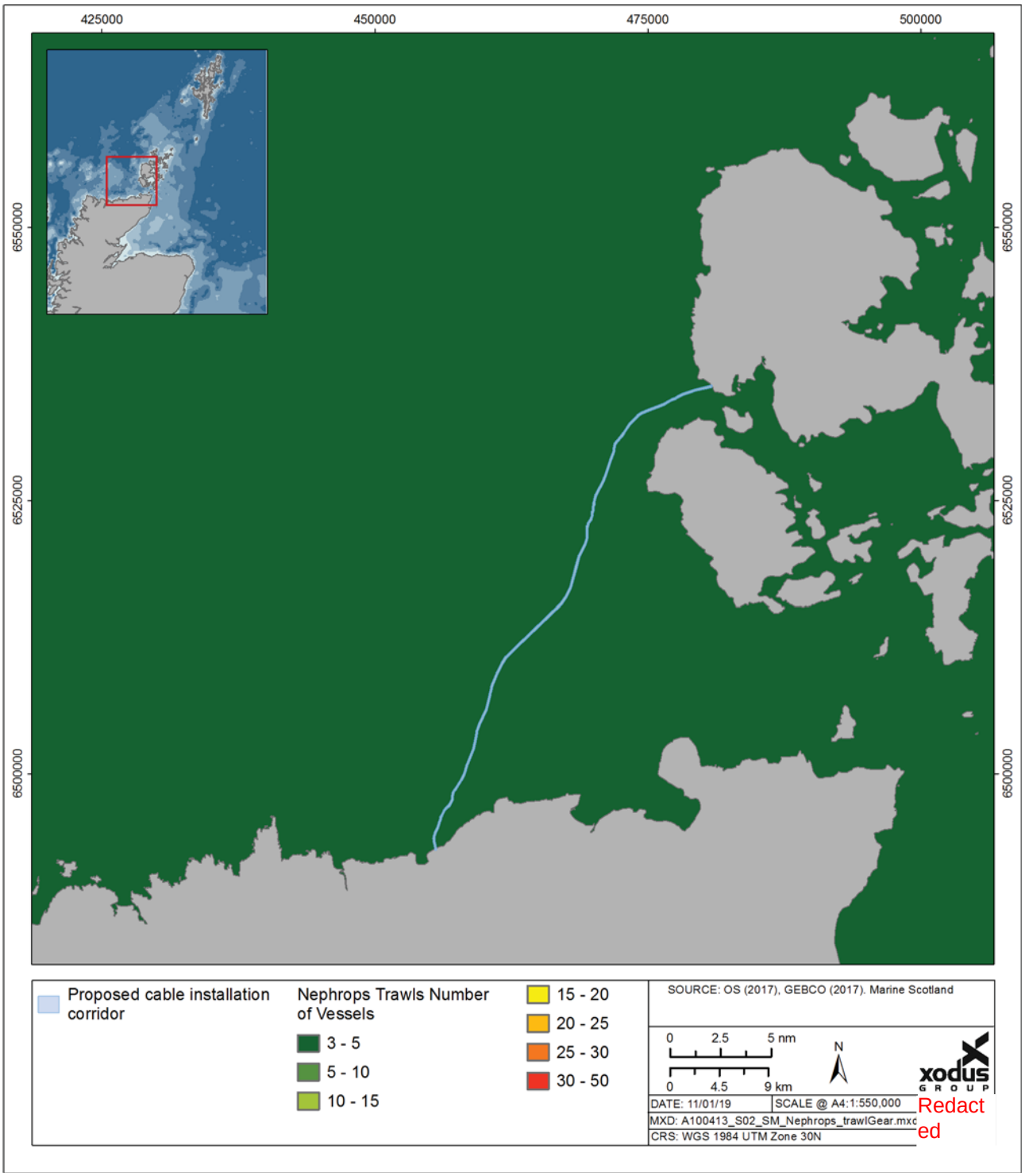


Figure 14.14 Number of vessels utilising *Nephrops* trawl gear (ScotMap, 2014)



14.6.1.6 Crab and lobster fishery

14.6.1.6.1 Operating patterns and practices

Brown crab is targeted on a variety of substrates, while lobsters are targeted on rocky, uneven ground and around wreck sites. Brown crab and lobster are not currently quota restricted, although all vessels landing over a particular weight (200 kg of lobster, 750 kg of crab) must be licensed. There are however size restrictions for the landings of these species (Section 14.5.2.1 and below). The fishery for green crab is minimal around the UK, traditionally fishermen have resorted to fishing for green crabs when other usually more profitable fisheries such and brown crab or velvet swimming crab are not either not available or low in price (Tallack, 2002).

Crab and lobster are principally targeted by full time static gear vessels setting creels (pots). Inspection of ScotMap data indicates that static gear is utilised along the length of the proposed cable route at varying intensities with a heavier concentration around the Orkney landfall area (Figure 14.15 and Figure 14.16). There are no seasonal restrictions on static gear such as the pots and creels utilised for crabs and lobsters along the proposed cable route.

The majority of brown crab in Scotland is landed from June to December and velvet crabs between July and November. As a result of the limited size of vessels in the area, weather conditions are a significant factor in determining levels of activity in the winter months. In addition to full time vessels, there are also a number of part time vessels that will set a small number of creels in inshore areas during the summer months.

In February 2018 new landing controls (under the Specified Crustaceans (Prohibition on Landing, Sale and Carriage) (Scotland) Order 2017) for Scottish crab and lobster fisheries came into effect in recognition that fishing for these species is occurring at levels close to or above the FMSY proxy (FMSY is the fishing mortality consistent with the largest average yield that can continuously be taken from a stock under existing environmental conditions) (Marine Scotland, 2018). These restrictions apply a minimum landing size to brown crab, velvet crab and lobster and also prohibit selling velvet crab of a carapace length less than 70 mm and landing velvet crabs with eggs.

As of 2017 OSF has employed a part time fishery development manager, who is managing the Marine Stewardship Council (MSC) assessment of the OSF Orkney brown crab creel fishery as well as under taking out reach work throughout Orkney. The brown crab Fishery Improvement Project (FIP) is the first in the UK to enter the full MSC assessment process (OSF, 2018).

14.6.1.6.2 Monetary value

Brown crab is the most landed species in terms of value and liveweight for vessels over 10 m in ICES rectangle 46E6 for all years from 2013 to 2017, apart from 2015 when lobster was the most valuable (Figure 14.7 and Table 14-4). On average brown crab accounted for 25.82% of the annual landings value from 2013 to 2017 with an average annual landings value of £996,934. Brown crab also dominated the landings weight for the same time period, accounting for on average almost 30% of the annual landings weight for ICES rectangle 46E6. Other species of crab namely velvet and green also make significant contributions to the landings from ICES rectangle 46E6. Lobsters are also an important commercial species in ICES rectangle 46E6 accounting for on average 13.66% of the annual landings value from 2013 to 2017, for vessels greater than 10 m and with an annual average value of £527,380 (Figure 14.7 and Table 14-4).

Figure 14.15 Value of crab and lobster pots (ScotMap, 2014)

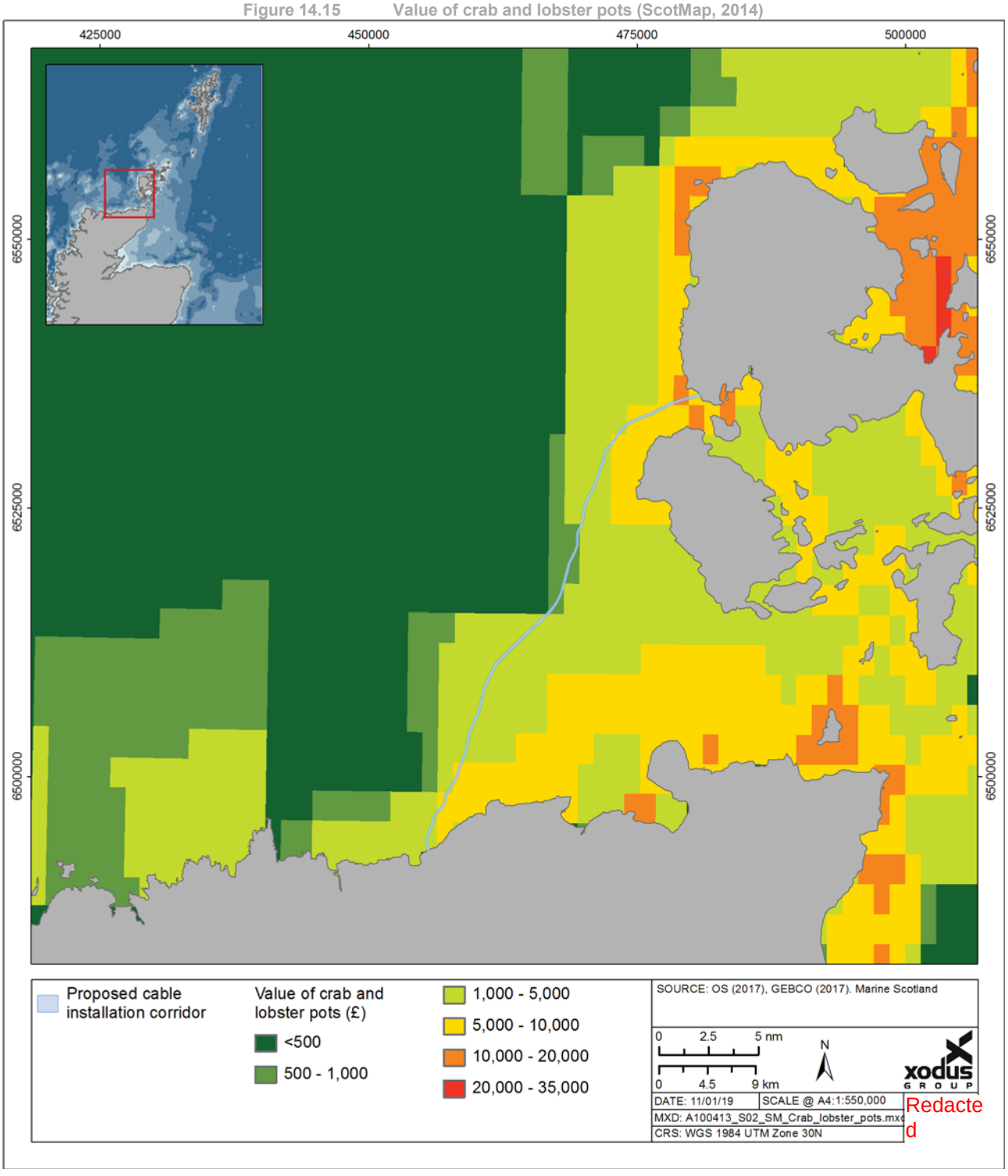
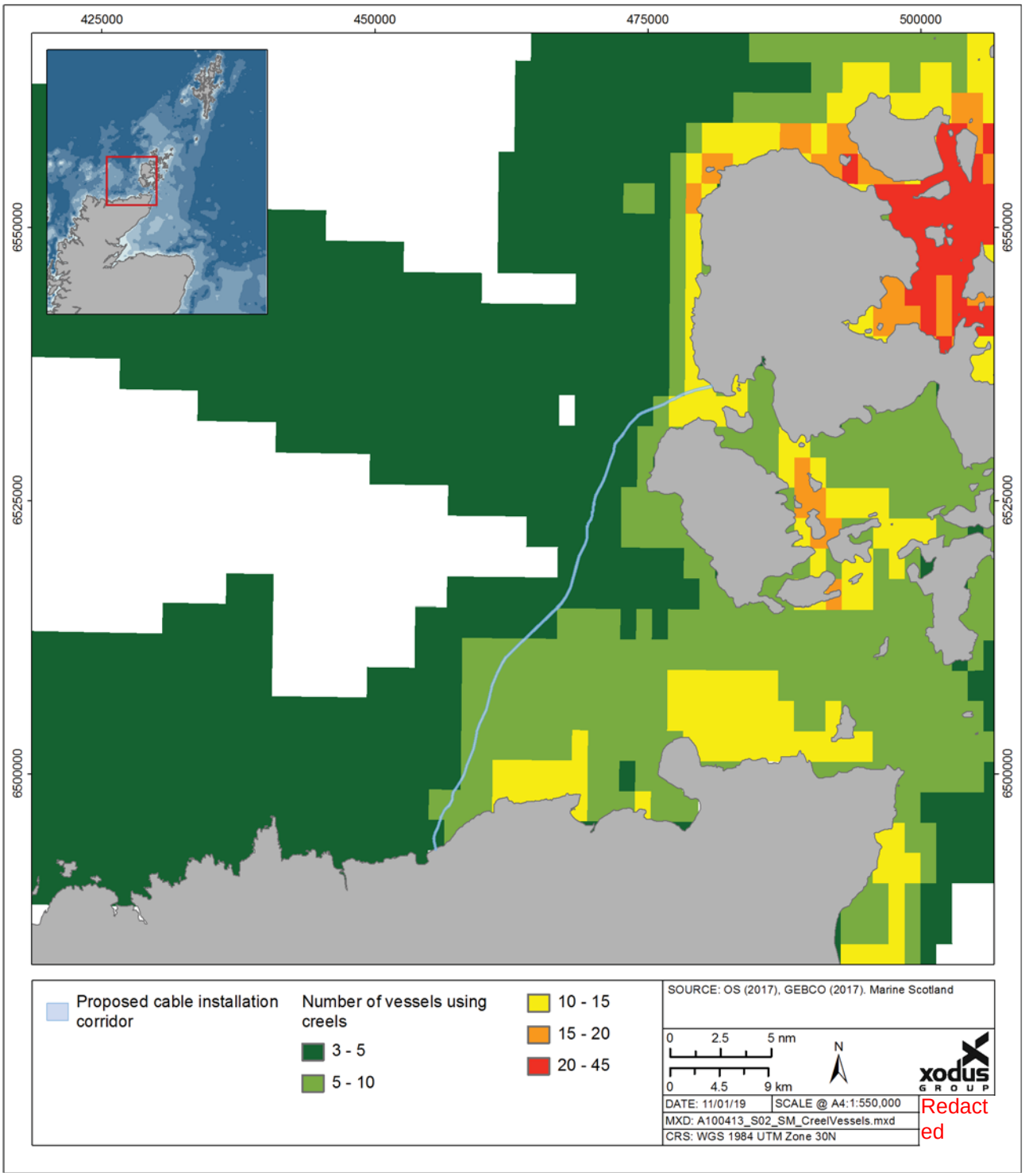


Figure 14.16 Number of vessels utilising static potting gear (ScotMap, 2014)



14.6.1.7 Scallop fishery

14.6.1.7.1 Operating patterns and practices

Scallops occur on the seabed primarily on sediments comprising sand, gravel and mud and possibly interspersed with stones, rocks or boulders. Scallops lie disguised in the sediments and are generally considered sedentary; however they are able to swim short distances propelled by jets of water (Carter, 2008).

Scallop vessels tow one (astern) or two (either side) beams onto which a number of dredges are attached. The number of dredges used depends on vessel size, engine power and winch capacity. In Scottish waters vessels are restricted to eight dredges per side inside 6 nm from shore and up to ten dredges per side between 6 and 12 nm from shore. Scallops are “raked” from the seabed by a row of sprung steel teeth up to 11 cm in length. Mesh bags are situated behind the teeth to retain the catch. The maximum penetration depth of this gear is up to 20 cm, although this will vary depending on substrate composition

14.6.1.7.2 Monetary value

Figure 14.17 and Figure 14.18 illustrate the distribution of scallop fishing value and effort respectively along the cable route by vessels greater than 15 m in length based on VMS data. The figures indicate that the cable route does not intersect with areas of high importance for scallop dredging for the majority of the route, with both a relatively low value and effort, with the exception of a small area approximately 2 km from mainland Scotland cable landfall. However, scallops do contribute relatively significantly to the value of landings from ICES rectangle 46E6 (Table 14-4). From 2013 to 2017, scallops accounted for an average of 7.54% of the annual landings value. The areas with higher landings value and effort appear to be concentrated in the coastal area to the west of the cable landfall on mainland Scotland (Figure 14.18) The monetary value of hand dived scallops along the proposed cable route is less than £100 as indicated in Figure 14.19[17].

[17] Monetary value is based on interviews that took place from 2007-2011 and represent the average £/cell over the five year period (2007-2011)

Figure 14.17 Relative distribution of scallop landings (£) of vessels using dredge gear (MMO, 2018)

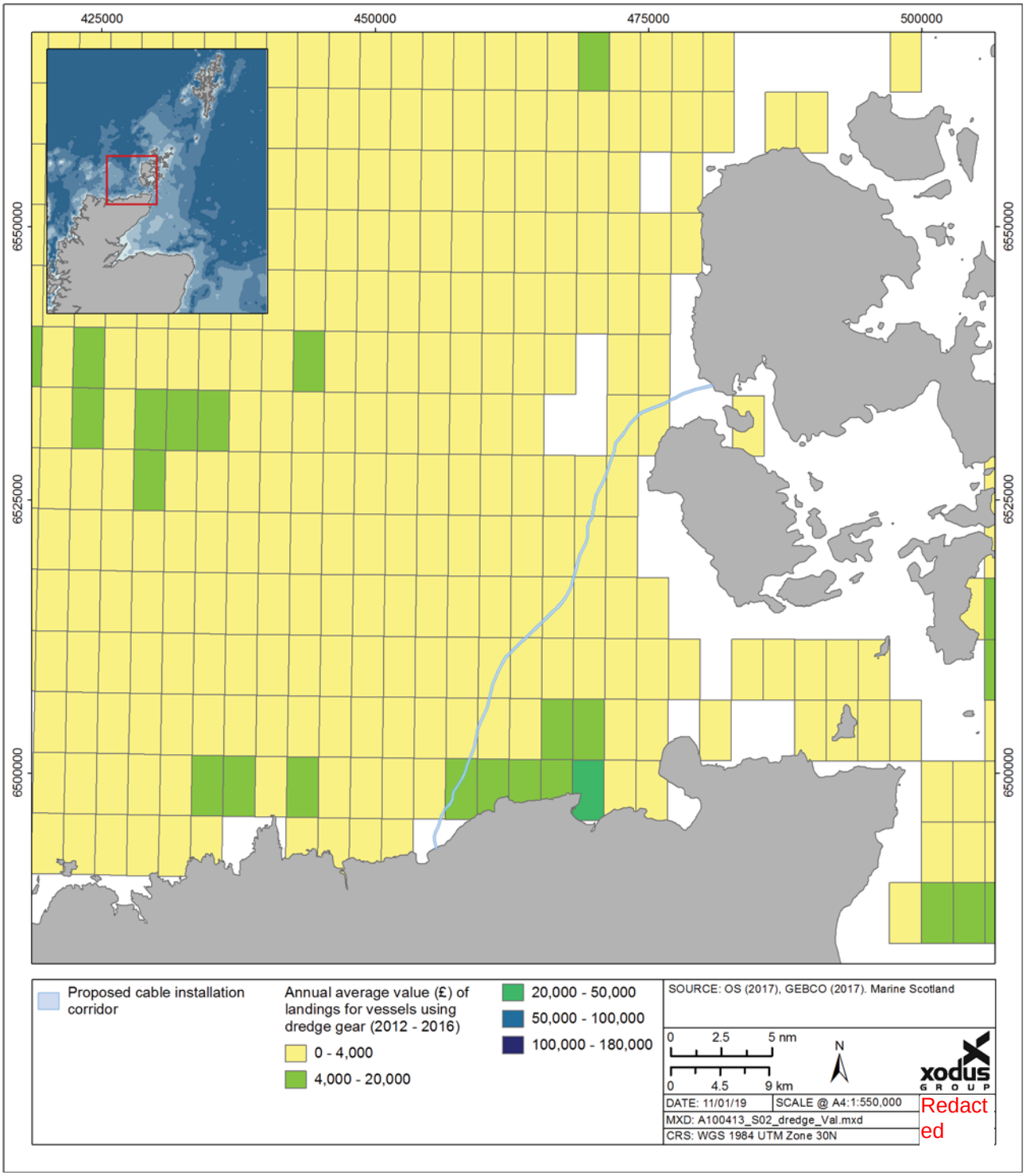


Figure 14.18 Relative distribution of scallop fishing effort of vessels using dredge gear (MMO, 2018)

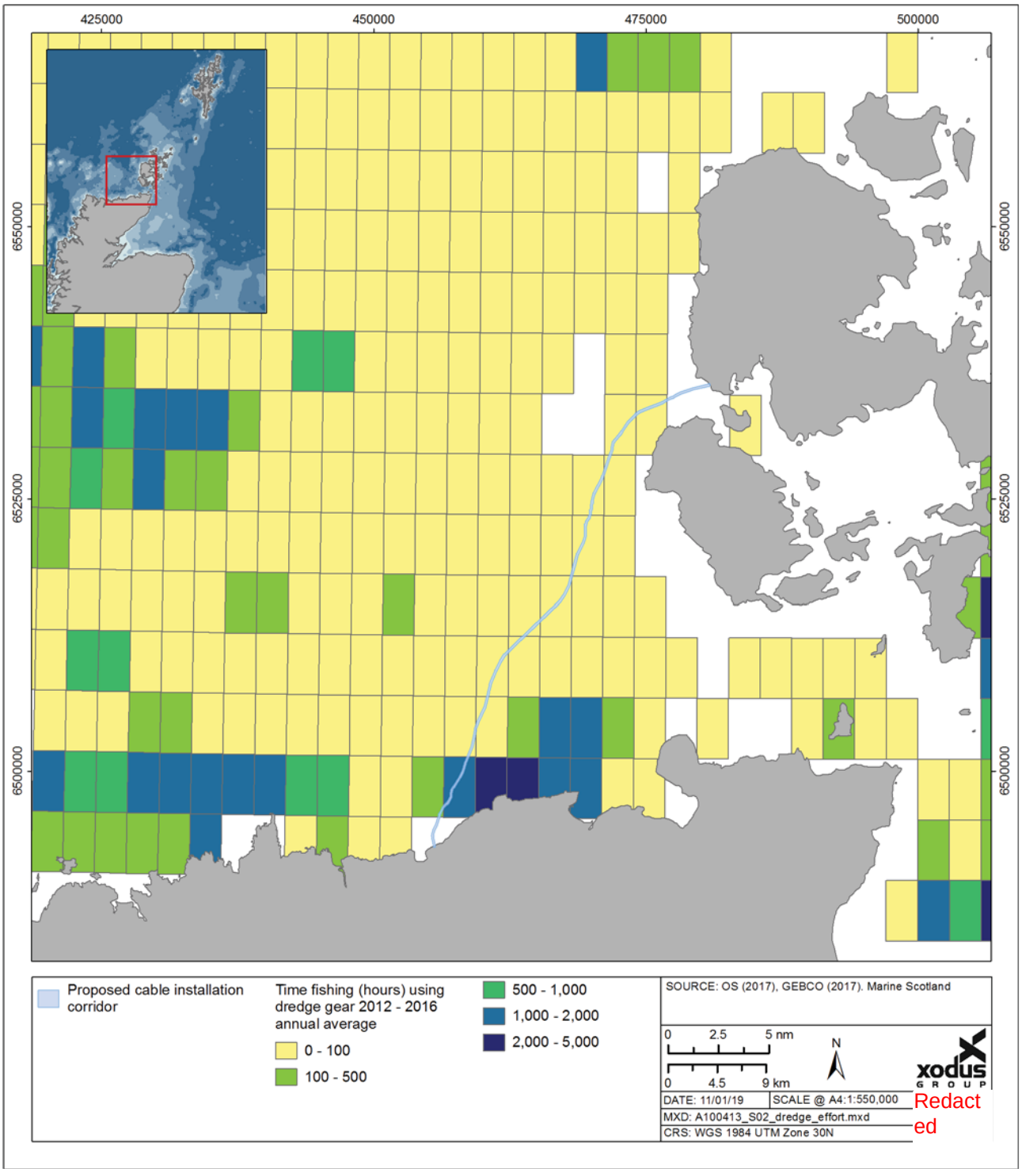
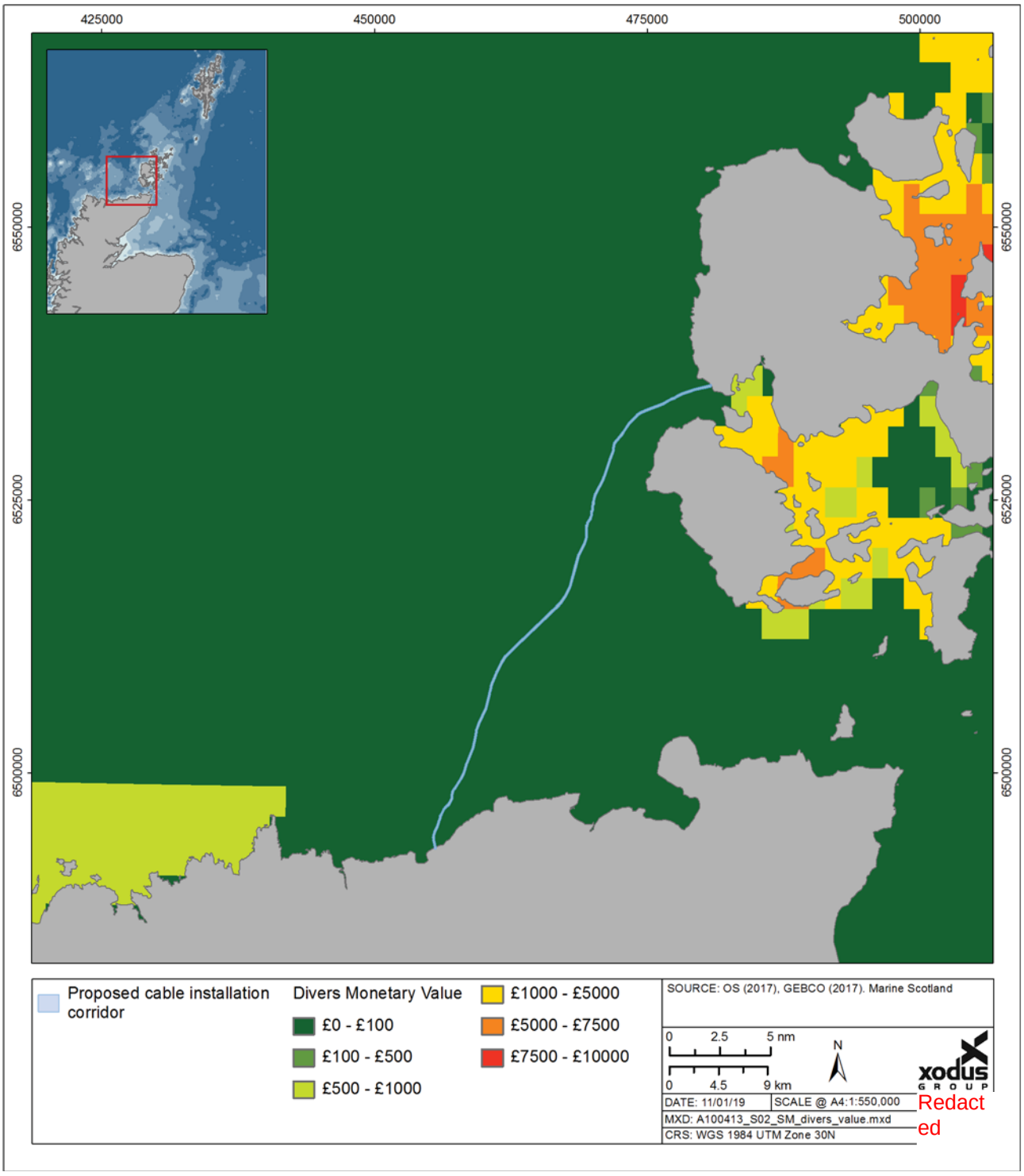


Figure 14.19 Value of scallop diving fisheries (ScotMap, 2014)



14.6.1.8 Demersal fishery

14.6.1.8.1 Operating patterns and practices

The whitefish trawl fishery is for the most part a mixed fishery wherein multiple demersal species are simultaneously caught. Species targeted include haddock, monkfish, hake and saithe; flatfish species including witch, plaice, lemon sole and halibut, and skates and rays (including spotted rays and dogfish).

14.6.1.8.2 Monetary value

Haddock and monkfish and anglerfish are the most valuable species landed along the proposed cable corridor. Haddock accounted for on average 16.87% of the annual landings value for ICES rectangle 46E6 from 2013 to 2017 with an annual average value of £651,485. Monkfish and anglerfish contributed 7.73% of the annual average value for rectangle 46E6 with an average annual value of £298,537.

MMO data presented in Figure 14.20 and Figure 14.21 indicate that there are areas along the proposed cable route which are demersal fishing grounds. Figure 14.20 indicates there is an area approximately 14 km from the mainland Scotland cable landfall which is considered to be of higher value for demersal fishing. Figure 14.21 shows that approximately half way along the proposed cable route is an area of greater effort for demersal fishing techniques, no value data was available to support this in the same location in Figure 14.20.

Figure 14.20 Relative distribution of landings (£) of vessels using demersal gear (MMO, 2018)

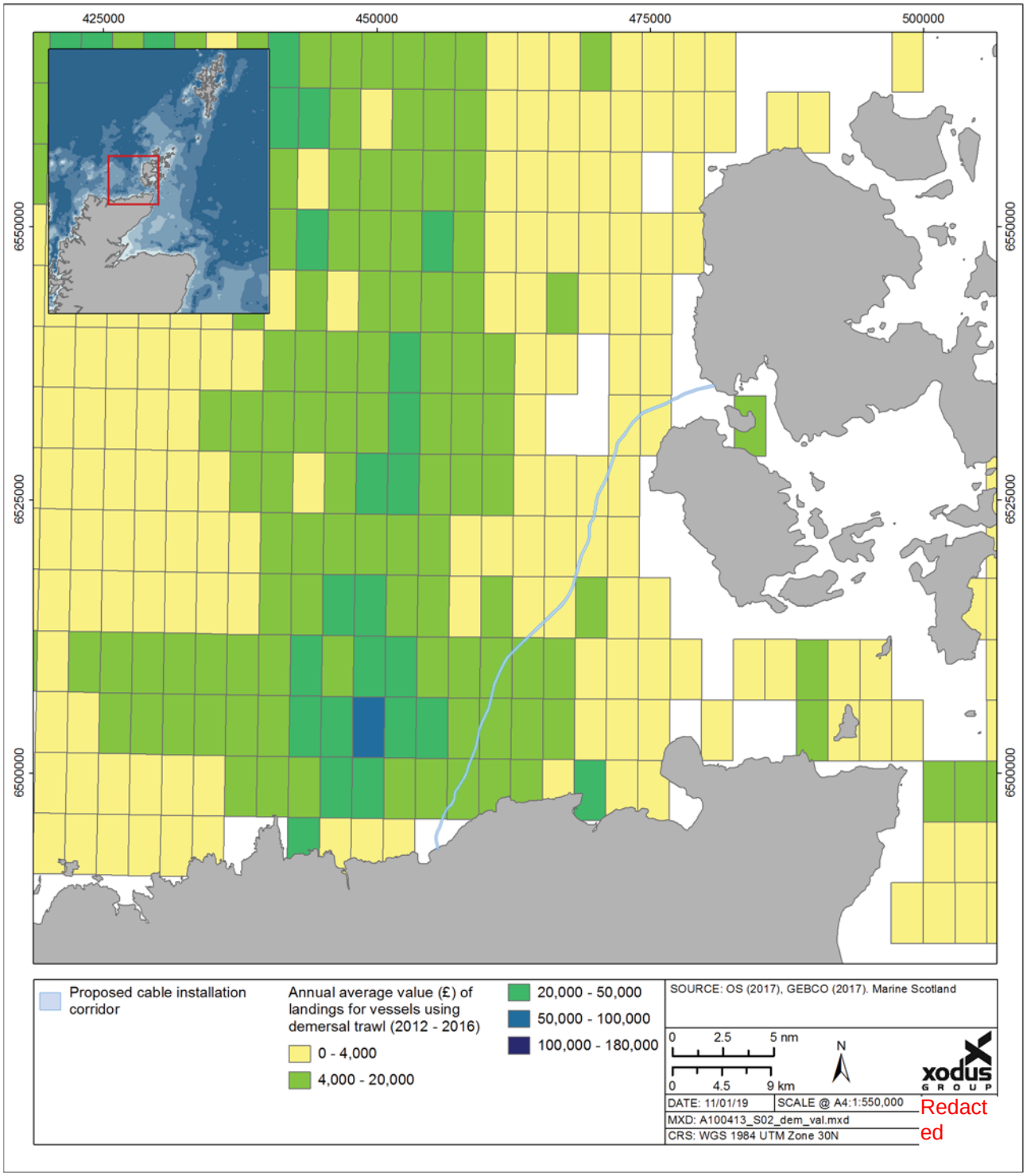
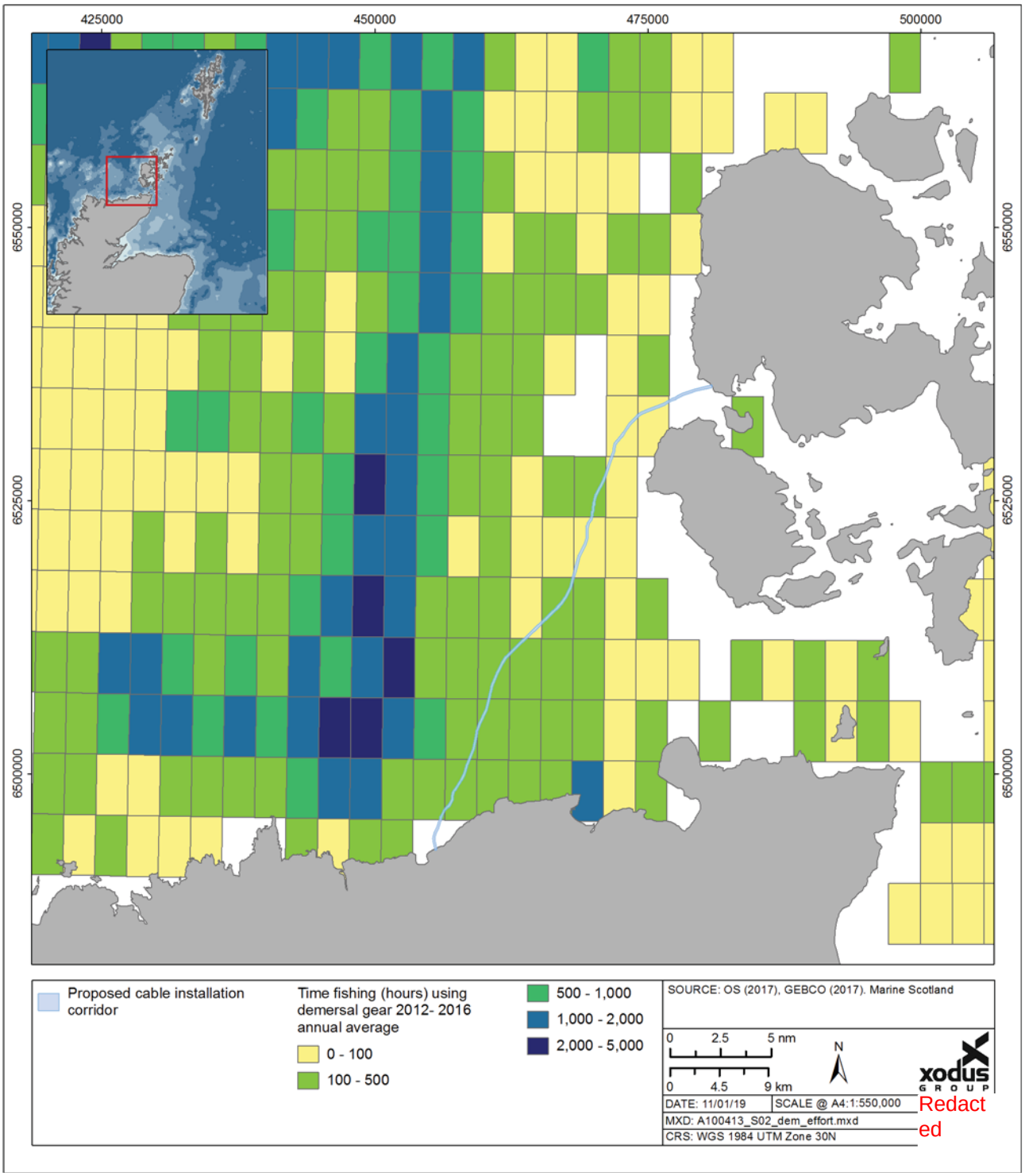


Figure 14.21 Relative distribution of fishing effort of vessels using demersal gear (MMO, 2018)



14.6.1.9 Pelagic fishery

14.6.1.9.1 Operating patterns and practices

Pelagic or mid-water trawl vessels are amongst the most powerful in European waters. They are also mainly multi-purpose vessels capable of pursing and pelagic pair-trawling as well as pelagic trawling. Pelagic species are habitually mid-water shoaling fish, but during full daylight conditions they will congregate in dense shoals near the sea-bed. Normally they are caught while they are nearer the surface but it is possible to trawl for them near the bottom. In normal circumstances these nets would not come into hard contact with the seabed as they have no protective ground-line.

14.6.1.9.2 Monetary value

Pelagic species contribute only a small value to the landings value for ICES rectangle 46E6 for the years 2013 to 2016 (Figure 14.22) and

Figure 14.5). However certain pelagic species do contribute to the landings value to a notable degree, in 2017 mackerel was one of the top five landed species for vessels under 10 m (Figure 14.6 and Table 14-4). For vessels over 10 m, cod was one of the top five landed species in both 2014 and 2017 and made an annual average contribution to the landings value of 8.38% in the years from 2013 to 2018. Herring was also one of the top five landed species in 2013, however this year appears to be a rarity rather than the norm and herring only contribute 2.39% of the average annual landings value from 2013 to 2017. Figure 14.22 and Figure 14.23 support the low value and effort attributed to pelagic fisheries in the vicinity of the proposed cable route. Where data is available for the area of the proposed cable route it indicates a consistently low value and low effort.

Figure 14.22 Relative distribution of landings (£) of vessels targeting pelagic species (MMO, 2018)

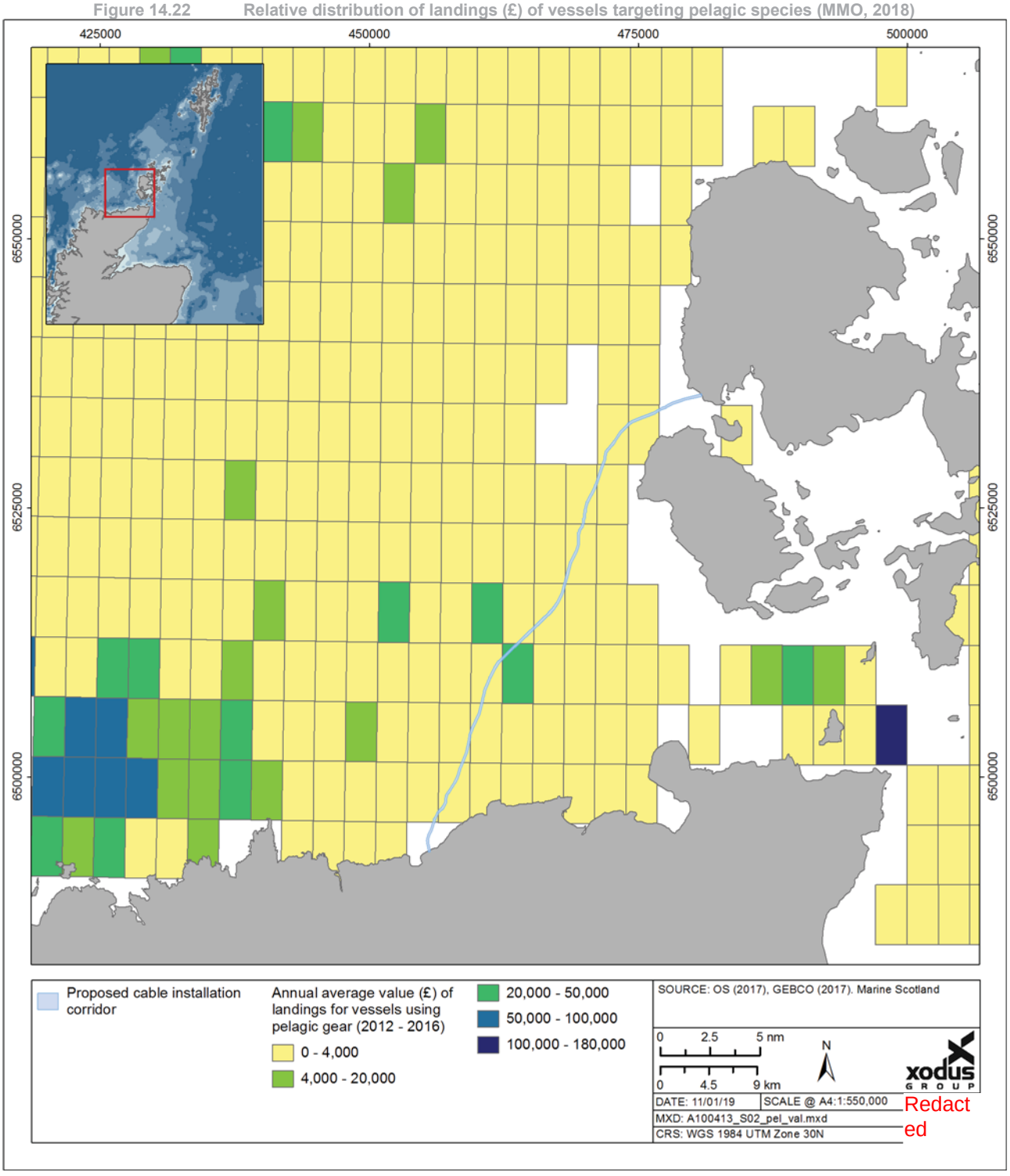
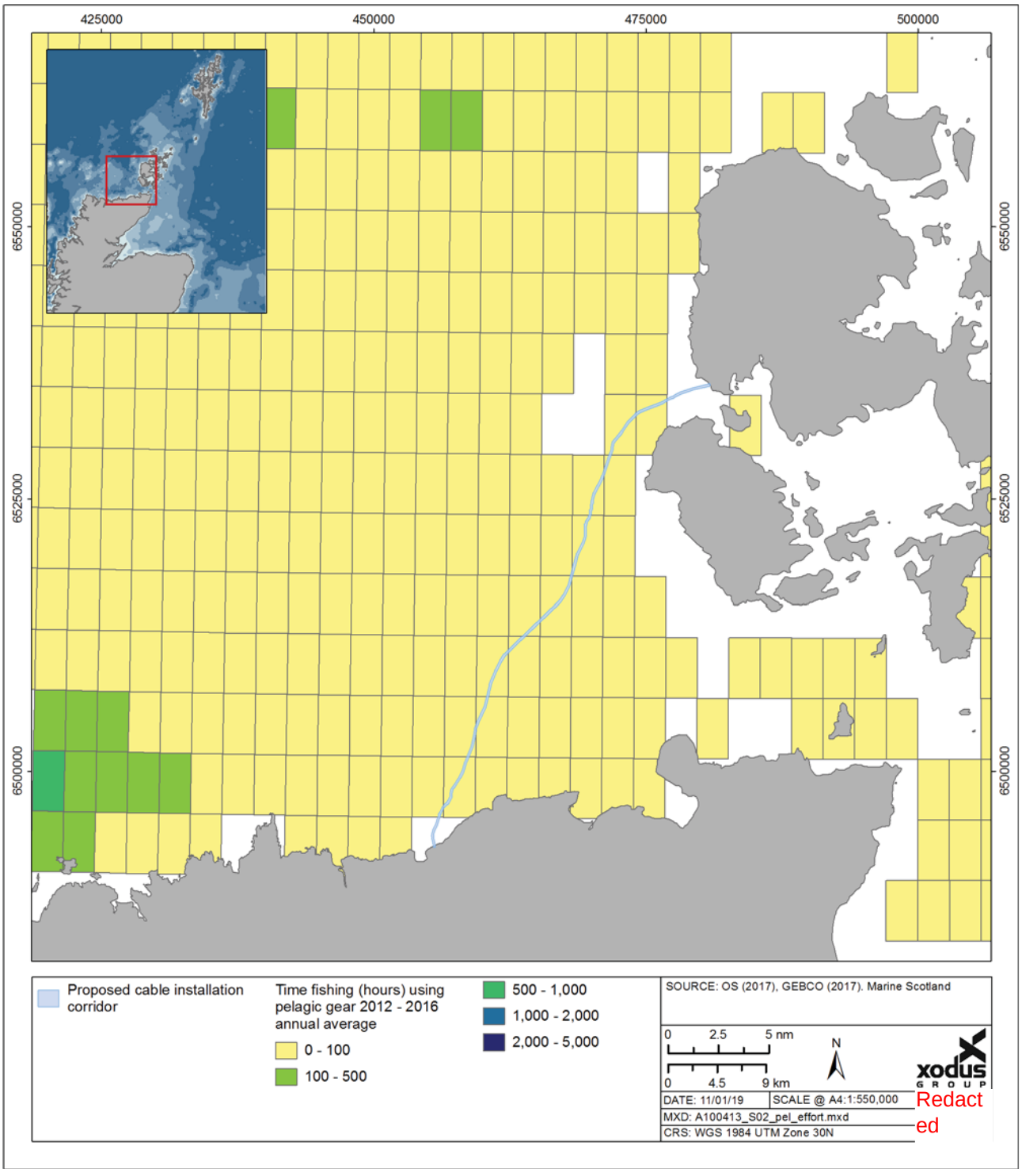


Figure 14.23 **Relative distribution of fishing effort of vessels** targeting pelagic species **(MMO, 2018)**



14.6.2 Salmon fisheries

Atlantic salmon and sea trout are diadromous or migratory species of fish, with a life cycle that includes time in freshwater river environments and at sea. After a period spent in a riverine environment, the individuals undertake a marine migration to offshore feeding grounds, returning after a varying number of years to their

natal river to spawn. A number of salmon rivers occur along the north coast of mainland Scotland, the two most important rivers in the vicinity of the mainland Scotland landfall are the River Halladale and the River Thurso (Figure 14.27). The Halladale is approximately 32 km in length and flows northward from Forsinard to enter the sea at Melvich approximately 14 km from the mainland Scotland cable landfall. The key times for salmon fishing on the river are from June until September, the lower reaches of the river have seen an improvement in catch numbers in recent years with the five-year average for the season being in the region of 600 fish (Salmon Fishing Scotland, 2018,). The River Thurso is located approximately 12 km from the cable landfall on the Scottish mainland. The River is designated as an SAC for Atlantic salmon and the upper reaches of the river provides extensive and valuable spawning grounds for the species. Fishing is mainly focussed on the lower section of the river, from Loch More to the outflow at Thurso (Salmon Fishing Scotland, 2018). It is probable that Atlantic salmon associated with the rivers on the north coast of Scotland will transit the proposed cable corridor, therefore migration and catch levels could potentially be disrupted.

Each fishery in Scotland is required to provide the number and total weight of salmon and grilse and sea trout caught and retained each month of the fishing season. The principal salmon and sea trout fisheries are rod and line (including catch and release), fixed engine (bag netting) and net and coble.

The fishery is managed through fishery districts, each of which has a District Salmon Fishery Board (DSFB). Of relevance to the mainland Scotland landfall is the Caithness DSFB, Orkney does not have a DSFB. For the purposes of fishery statistics, data is split geographically into 109 Districts, the mainland Scotland cable landfall enters into the Forss District, which is covered by the Caithness DSFB. The Orkney cable landfall occurs within the Orkney District. Salmon and sea trout catches are recorded under the following categories:

- Sea trout (sea trout that have spent multiple winters at sea);
- Finnock (sea trout that have only spent one winter at sea);
- Salmon (salmon that have spent multiple winters at sea); and
- Grilse (salmon that have only spent one winter at sea).

Salmon and sea trout catch methods are shown in Table 14-6. Rod and line gears dominate with the greatest proportion of caught fish subsequently being released. There were no fixed engine salmon or sea trout landings in 2017, the last recorded fixed engine catches were in 1985 in Orkney and 1997 for Forss indicating the method is not commonly employed. No net and coble landings were recorded in either Forss or Orkney, the last recorded entry for this technique in Forss was 1983 and the landing method does not have any records in Orkney. Rod and line is the dominant technique for salmon fishing in Forss with a total of 163 individuals being caught and released and 83 being retained in 2017 (Marine Scotland, 2018b). Currently in Orkney there is no requirement to report rod and line records, hence in Table 14-6, there are no records detailed for the Orkney district.

The Conservation of Salmon (Scotland) Regulations 2016 outlined for the first time a system whereby the killing of Atlantic salmon in inland waters is managed on an annual basis by categorising the conservation status of their stocks. The Scottish Government is now consulting on proposals for the 2019 fishing season.

Table 14.6 Salmon catch in Forss and Orkney districts in 2017 (Marine Scotland, 2018)

Method	Salmon	Grisle	Sea Trout	Finnock	Farmed fish	Total
Forss district						
Rod and line (released)	38	127	2	0	0	167
Rod and line (retained)	28	55	0	0	0	83
Net and Coble	0	0	0	0	0	0
Fixed Engine	0	0	0	0	0	0
Orkney district						

Method	Salmon	Grisle	Sea Trout	Finnock	Farmed fish	Total
Rod and line (released)	-	-	-	-	-	-
Rod and line (retained)	-	-	-	-	-	-
Net and Coble	0	0	0	0	0	0
Fixed Engine	0	0	0	0	0	0

14.7 Navigational risk assessment

To support the Project, a Navigational Risk Assessment has been undertaken by Xodus Group (Appendix B: NRA). The assessment was based upon a Vessel Traffic Survey which identifies and analyses navigational features and shipping activity in the vicinity of the proposed cable route, followed by a Formal Safety Assessment. The IMO requires that all ships of ≥ 300 gross tonnage and all passenger ships are fitted with an AIS. These systems broadcast a variety of information at up to two second intervals and can therefore be used to retrospectively reconstruct individual vessel tracks/paths.

AIS data was purchased from marinetraffic.com for the period March 2016 to February 2018 for the Project area. This data can provide a useful insight into the fishing vessels utilising the area of the proposed cable route. The AIS data for the time period recorded the highest level of vessel tracks for cargo vessels over 300 GRT (39.1%), followed by passenger and pleasure vessels tracks (27%), fishing vessels tracks accounted for the third highest value with 3,679 tracks recorded accounting for 19.5% of the total. Fishing vessel AIS tracks are shown in Figure 14.24. The most frequented routes appear to be:

- To/from Stromness to/from the north, about 0.3 nm from the coastline;
- To/from Stromness to/from the north, about 1 nm from the coastline;
- To/from Stromness to/from the west south west;
- To/from the Pentland Firth to/from the west;
- To/from the Pentland Firth to/from the north-west; and
- To/from Scrabster to/from the north or north-west.

As noted previously, the tracks of larger vessels tend to be in the area to the west of the Pentland Firth. Figure 14.25, shows the time spent fishing by demersal gear in the area of the proposed cable route, it correlates with the ScotMap data presented in Figure 14.21 and Figure 14.22 in that for the majority of the proposed cable route demersal gear is not greatly significant. An area closer to the mainland Scotland cable landfall does show some effort, with the proposed cable route touching on an area classed as greater effort.

Figure 14.26 shows the time spent fishing in the area of the proposed cable route by vessels using dredge gear, again this correlates with the ScotMap data presented in Figure 14.17 and Figure 14.18 with no effort recorded in the vicinity of the Orkney mainland and the greatest effort recorded in the vicinity of the cable landfall on mainland Scotland.

Figure 14.24 Fishing vessel AIS tracks by Dead weight tonnage (DWT), Xodus 2018: Appendix B

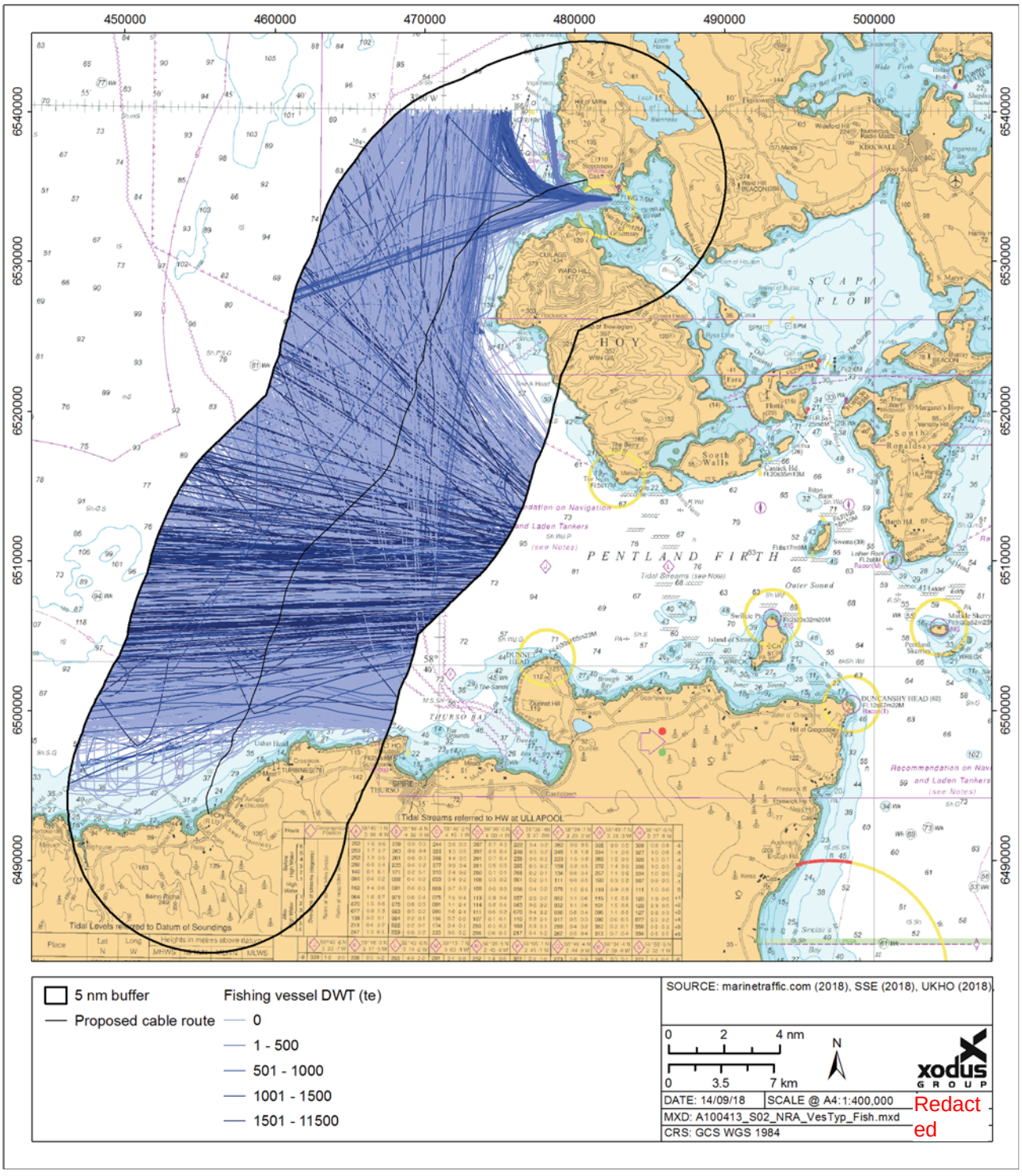


Figure 14.25 Time spent fishing using demersal gear, Xodus, 2018: Appendix B

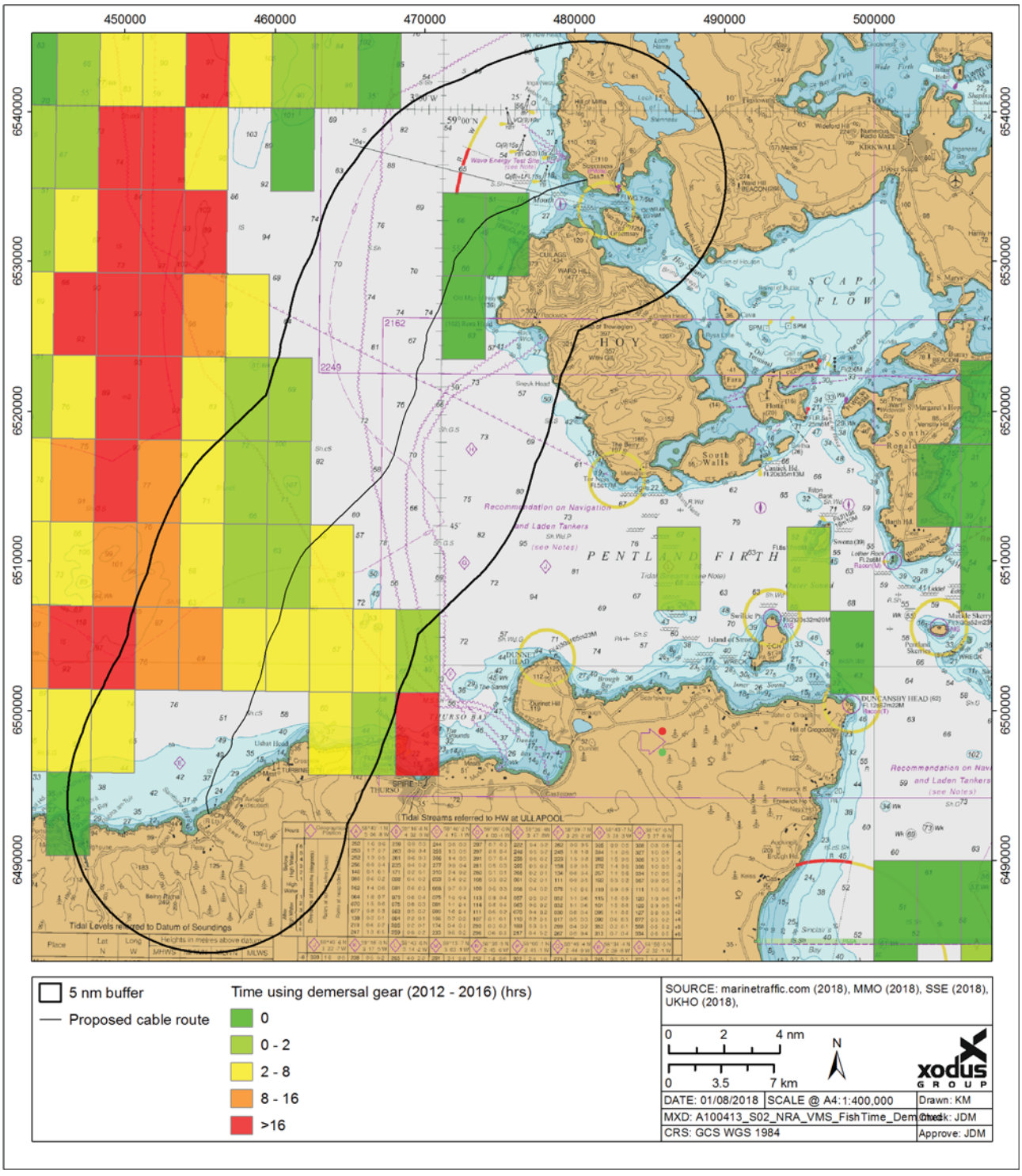
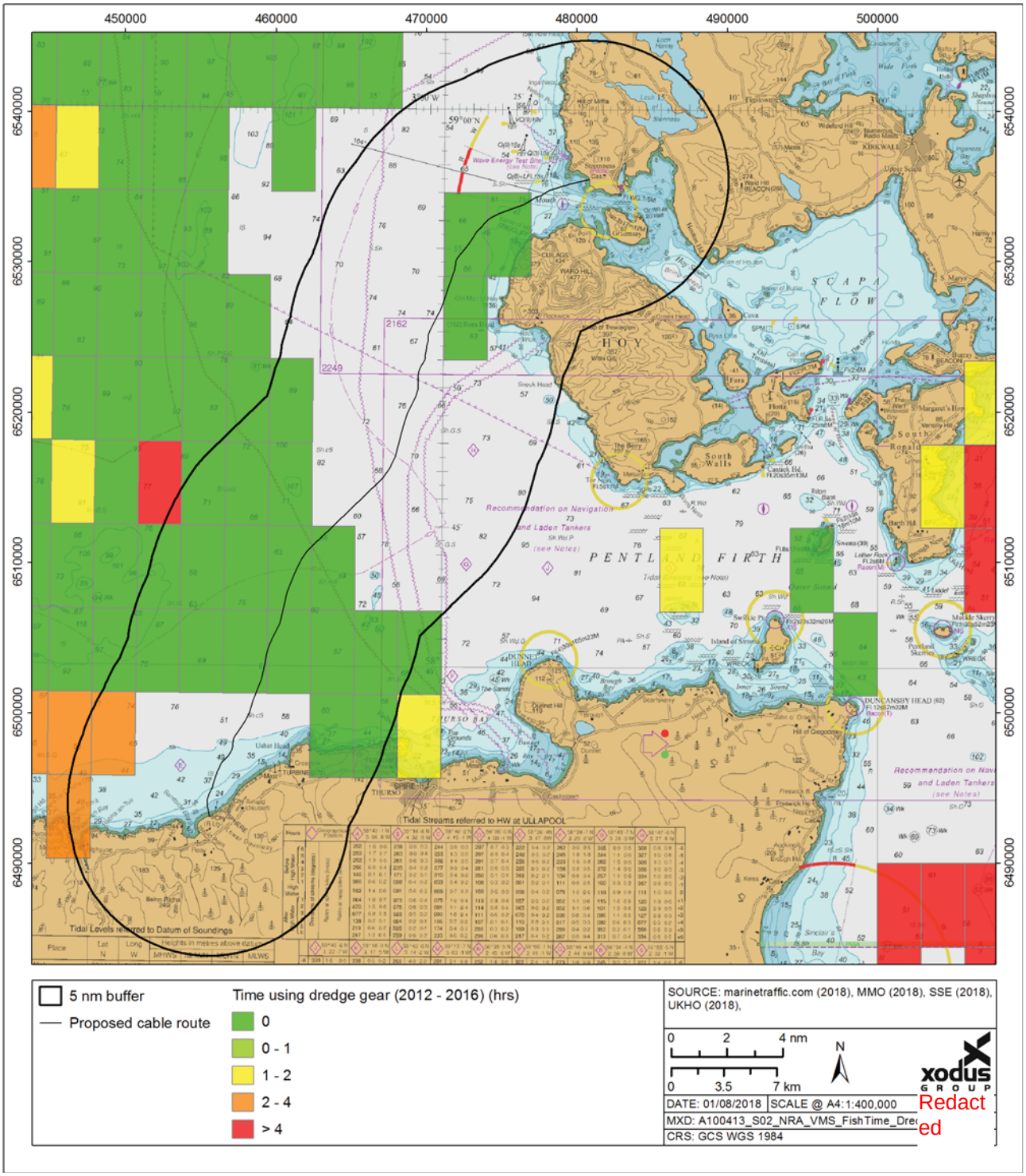


Figure 14.26 Time spent fishing using dredge gear, Xodus, 2018: Appendix B



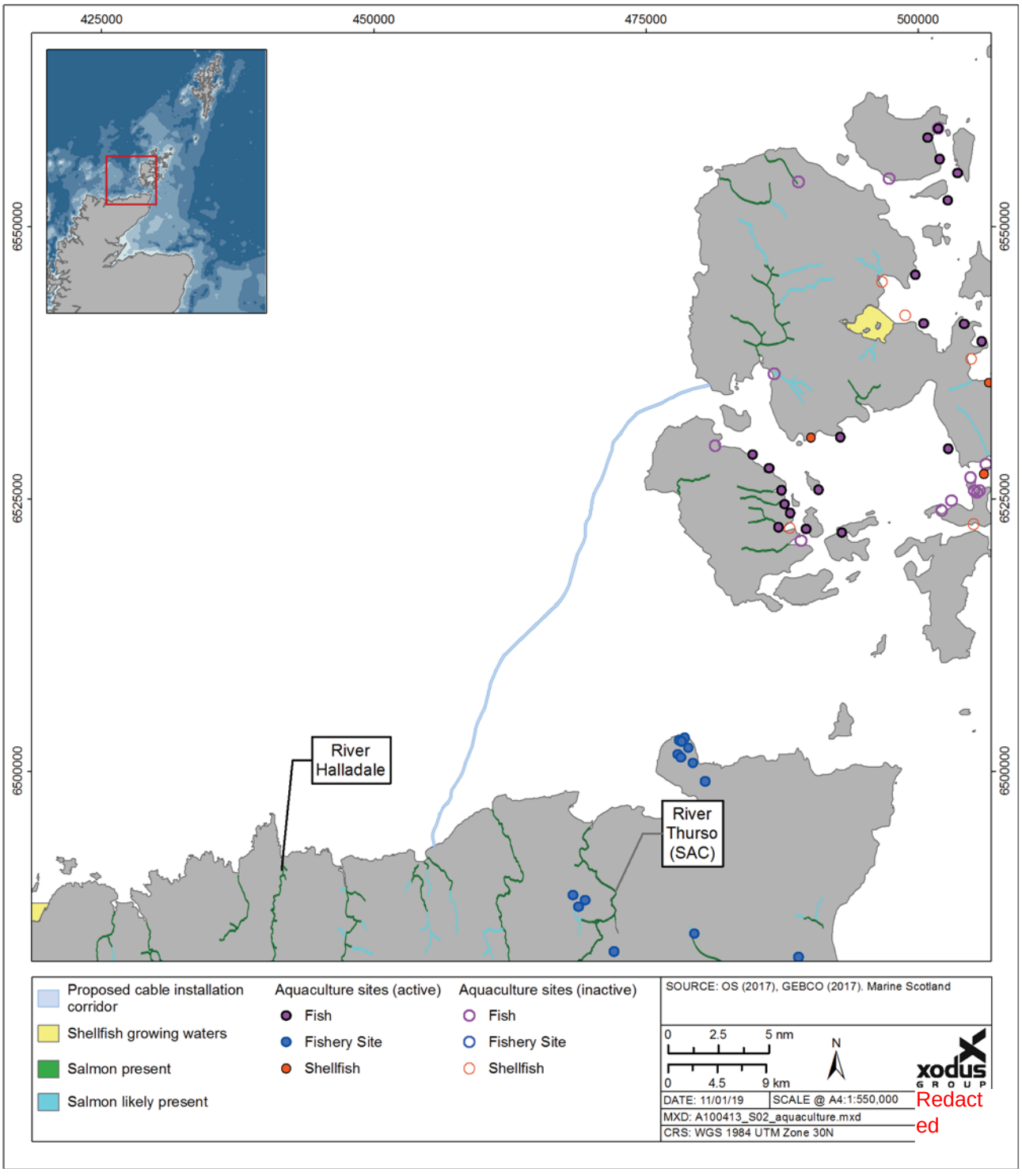
14.8 Aquaculture

There are a number of aquaculture sites in Orkney waters and around the north coast of mainland Scotland (Figure 14.27). Aquaculture in these areas can be divided into:

- Finfish in cages, or land-based tanks with pumped seawater; and/or
- Shellfish either on trestles on the seabed, attached to vertical ‘dropper’ ropes suspended from horizontal longlines or rafts, or grown directly on the seabed without equipment.

There is an inactive fish farm site located approximately 5 km from the proposed cable route. The closest active site is a finfish farm located at Bring Head approximately 8 km south-east of the proposed cable route. No aquaculture sites are anticipated to be affected by this development and are therefore not considered further.

Figure 14.27 Aquaculture sites in the vicinity of the cable route (Marine Scotland, 2017)



14.9 Assessment criteria

The general assessment methodology is outlined in Section 7- Impact assessment methodology. Specific criteria relating to commercial fisheries have been developed for the sensitivity/value of a receptor and the magnitude of impacts.

The sensitivity of a receptor has been considered in terms of the tolerance to change, recoverability, adaptability and value. Expert judgement has been employed to consider the final sensitivity of a particular receptor. The sensitivity criteria relevant to commercial fisheries are presented in Table 14-7.

Table 14.7 Criteria for sensitivity value of commercial fisheries

Sensitivity/value	Definition
Very high	No spatial adaptability due to operational range and ability to deploy only one gear type. No recoverability due to inability to mitigate loss of fishing area by operating in alternative areas.
High	Low spatial adaptability due to limited operational range and ability to deploy only one gear type. Dependence mostly on one area but with some fishing activity occurring in other areas. Low recoverability due to inability to mitigate loss of fishing area by operating in alternative areas.
Medium	Some spatial adaptability due to extent of operational range and/or ability to deploy an alternative gear type. Dependence on a limited number of fishing grounds. Limited recoverability with some ability to mitigate loss of fishing area by operating in alternative areas.
Low	High spatial adaptability due to extensive operational range and/or ability to deploy a number of gear types. Ability to fish a moderate number of fishing grounds. High recoverability due to ability to mitigate loss of fishing area by operating in range of alternative areas.
Negligible	Fisheries are not sensitive to change.

The magnitude of the impact has been considered in terms of the size and spatial extent, duration and timing/seasonality and frequency of the impact in question. Expert judgment has been employed to consider and evaluate the likely impact. The magnitude criteria relevant to commercial fisheries are presented in Table 14-8.

Table 14.8 Criteria for magnitude of effect

Magnitude of effect	Definition
Major	Effect is over a large scale or spatial extent, or occurs long term, or at a medium-high frequency, resulting in extensive temporary change or some permanent change to baseline fishing areas and their condition.
Moderate	Effect is localised, or occurs for a short duration, or at a medium frequency, resulting in temporary changes or limited permanent changes to baseline fishing areas and their condition.
Minor	Detectable disturbance or change to baseline fishing areas and their condition and no long term noticeable effects above the level of natural variation experienced for commercial fisheries.
Negligible	No change or an imperceptible change to the baseline fishing areas and their condition.
Note: Magnitude of effect is presented as a variety of parameters including duration, timing, size and scale, and frequency. Definitions in this table may not be appropriate for all effects, for example there may be an effect which is over a very small area (minor or moderate) but is repeated a large number of times during a particular phase of the project (major). In such cases expert judgement is used to determine the most appropriate magnitude ranking and this is explained through the narrative of the assessment.	

14.9.1 Mitigation

Where potentially significant impacts (i.e. those ranked as being of moderate impact level or higher) are identified mitigation measures have been considered. The intention is that such measures should remove, reduce or manage the impacts to a point where the resulting residual significance is at an acceptable or insignificant level.

14.10 Identification of potential impacts

Following establishment of the baseline conditions of the Project and surrounding area and an understanding of the Project activities, it is possible to assess the potential impacts from the Project. The range of impacts that has been considered is based on impacts identified during scoping and any further potential impacts that have been identified as the impact assessment has progressed. The following impacts have been identified for the various stages of the Project:

Table 14.9 Potential impacts and associated project activities

Project activity	Potential impact	Footprint	Phase			Indicative duration
			I	O	D	
DP cable lay vessel	Temporary loss of access to fishing grounds	500 m safety exclusion zone around the cable installation vessel extending to 1000 m astern of the vessel	✓	X	✓	1 month
Rock placement vessel	Temporary loss of access to fishing grounds	Operating within 500 m safety exclusion zone	✓	X	✓	2 weeks
Other support vessels	Temporary loss of access to fishing grounds	Operating within 500 m safety exclusion zone	✓	X	✓	1 month
Seabed preparation: Pre-sweeping of sandwaves	Change in distribution of target species	20 – 30m wide along areas of sandwaves	✓	X	✓	1 week
Seabed preparation: Pre-lay grapnel	Change in distribution of target species	Towed along centreline 1m width corridor	✓	X	✓	2 weeks
Seabed preparation: Boulder clearance plough	Change in distribution of target species	10 – 15.8 m width depending on type	✓	X	✓	1 week
Cable installation: Jet trencher	Change in distribution of target species	10 m wide along length of corridor	✓	X	✓	6 weeks
Cable installation: pre-trench / back fill plough	Change in distribution of target species	Displacement ploughs, trench up to 5 m width, plough footprint up to 15 m Non-displacement plough trenches between 0.3 - 1.0 m trench width and plough footprint of 5 –10 m	✓	X	✓	3 weeks
Cable installation: jet trencher & mechanical trenching	Change in distribution of target species	Trench 0.5-1m width, footprint of trencher 5-10m	✓	X	✓	6 weeks
Cable protection material: Rock placement	Snagging resulting from obstructions on the seabed or exposed cable	7 m wide rock berm along areas of rock protection by 1 m high	X	✓	X	2 weeks
	Change in distribution of target species		X	✓	X	

Cable protection: Concrete mattresses	Snagging resulting from obstructions on the seabed or exposed cable	6 m wide x 3 m wide (Crossings only)	X	✓	X	1 week
	Change in distribution of target species		X	✓	X	
Cable protection: Cast iron shells	Snagging resulting from obstructions on the seabed or exposed cable	Width of cable + thickness of shell < 0.25 m wide	X	✓	X	1 week
	Change in distribution of target species		X	✓	X	
Cable protection: Composite sleeving	Snagging resulting from obstructions on the seabed or exposed cable	Width of cable + thickness of sleeving < 0.25 m wide	X	✓	X	1 week
	Change in distribution of target species		X	✓	X	

Compass deviation was also identified as a potential impact. This has been assessed in the Navigational Risk Assessment provided in Appendix D and is considered to represent a broadly acceptable risk. It is not discussed further here.

When operational, the HVAC cable will emit a magnetic field. The magnetic fields generated by the cable are expected to attenuate to background levels within around 1 m. Burial and remedial protection measures are anticipated to prevent magnetic fields being detectable at the seabed. It is therefore considered there will be no indirect impact on commercial fisheries in the area as a result of EMF and this impact is not considered further.

For each potential impact, the implications for fisheries during the construction / installation and operation / maintenance/ decommissioning phase of the cable route are assessed separately where appropriate.

14.11 Embedded mitigation and management measures

As part of the Project design process a number of embedded mitigation and management measures and best practice measures have been included to reduce the potential impact on commercial fisheries. There is a commitment to deliver these measures and therefore they are considered part of the project design.

The assessment of magnitude, sensitivity and significance in section 14.12 includes the incorporation of these measures.

Table 14.10 Best practice (BP) and embedded mitigation and management measures (EM)

ID	Measure	Justification
BP1	A CEMP and an Emergency Spill Response Plan will be developed and implemented for the installation phase. A non-native species management plan / biosecurity plan for vessels will be developed as part of the CEMP.	To minimise the potential for release of pollutants from construction, operation and decommissioning.
BP2	Control measures and shipboard oil pollution emergency plans (SOPEP) will be in place and adhered to under MARPOL Annex I requirements for all vessels. In the event of an accidental fuel release occurring appropriate standard practice management procedures will be implemented accordingly.	To minimise the potential for release of pollutants from construction, operation and decommissioning.
BP3	Ballast water discharges from vessels will be managed under International Convention for the Control and Management of Ships' Ballast Water and Sediments and in accordance with the Ballast Water Management Policy for Scapa Flow (Orkney Islands Council, 2017).	To minimise the potential for release of pollutants from construction, operation and decommissioning.
BP4	Vessels will be equipped with waste disposal facilities (sewage treatment or waste storage) to IMO MARPOL Annex IV Prevention of Pollution from Ships standards.	To minimise the potential for release of pollutants from construction, operation and decommissioning.
BP7	Implementation of a 500 m radius safety zone around the cable installation vessel.	Ensure navigational safety.
BP8	CLV to be fitted with AIS so that it can be easily detected by other vessels transiting through the area.	Ensure navigational safety.
BP9	FLO will be employed to manage interactions between cable installation vessels, personnel, equipment and fishing activity.	Ensure appropriate and proactive communication.

ID	Measure	Justification
BP10	Notice to Mariners (including local), Kingfisher bulletins, Radio Navigational Warnings, NAVTEX, and/or broadcast warnings will be promulgated in advance of any proposed works. The notices will include the time and location of any work being carried out, and emergency event procedures.	Ensure navigational safety and minimise the risk and equipment snagging.
BP11	Compliance with International Regulations for the Prevention of Collision at Sea (IMO, 1972) and the International Regulations for the Safety of Life at Sea (SOLAS).	Ensure navigational safety.
BP12	A CBP will be produced outlining the proposed method statement and cable protection requirements for approval by the Regulator and discussion with fisheries stakeholders.	To ensure that relevant stakeholders are aware of the installation.
EM6	Rock protection and/or mattresses will only be deployed where adequate burial cannot be achieved to protect the cable. Rock berms and mattresses will be designed to have an over trawlable profile.	Minimising the disturbance to the seabed and potential fish stocks, as well as reducing the hazard from fishing equipment snagging the cable.

14.12 Impact assessment

14.12.1 Potential Impacts during installation, maintenance and decommissioning

14.12.1.1 Temporary loss of access to fishing grounds

Some fishermen will experience a temporary loss of traditional fishing grounds in the immediate vicinity of the cable route due to the presence of cable installation vessels which will have safety zones in place during operations. The area of the exclusion zone is dependent on the vessel type to be employed. If a DP vessel is used for cable lay a safety zone of 500 m will be employed, a 500 m exclusion zone will also apply for other support vessels. If an anchored vessel is utilised for cable lay an exclusion zone of up to 2 km will be put in place.

Installation activities are most likely to occur between April and October; however, an absence of operations outside of this window cannot be guaranteed at this stage. It is anticipated that the installation vessels will adopt a rolling safety zone so that disruption will not affect the entire route initially, although safety zones will remain in place until it is ensured that the cable is buried or sufficiently protected.

The cable will be installed using one of the techniques described in Section 4 – Project description. The cable trenches will either be infilled during cable burial or left to infill naturally, as the sediment will naturally fill back over the trench. Where trenching does not provide sufficient protection, remedial protection will be required, a variety of techniques are currently under consideration for this purpose (Section 4 – Project description), however for the purposes of this assessment the worst-case scenario of rock placement has been assumed. Additional protection will also be required to protect the cables at subsea asset crossings (two have been identified) where trenching is not possible.

Cable laying will begin with the operation of cable pull, with the burial vessel starting no more than days or at most weeks following the commencement of laying activities. Throughout installation there will be a 500 m safety zone in place around installation spread and areas of exposed cable on the seabed between the laying and burial phases will be guarded by guard vessels. A survey campaign will follow the burial vessel to ensure the cable is properly protected, this will confirm adequate burial before the exclusion area is removed to allow fishing in the area to continue. Guard vessels will remain over asset crossings or areas identified as requiring remedial rock placement until rock placement works are completed. SHE Transmission is committed to ensuring all protection works (including rock placement) are completed as quickly as possible after completion of cable laying, in order to open up the areas to legitimate users of the sea.

There will be periods of repair and maintenance during the operational life of the cable. These will cause disruption similar to that experienced during the installation phase however on a smaller scale and for a shorter duration.

Surveys of the cable will be conducted ahead of installation and during the lifetime of the cable. The frequency of surveys will be risk dependent; based on ongoing gathering of data but are expected to be annual for the first three years to build understanding of system behaviour and risks. The first survey is expected to commence within 12 months of the 'as-built survey' of the installed subsea cable and a safety exclusion zone will be required around the survey spread which may disrupt fishing activities. Survey frequency will be outlined in more detail as part of Operations and Maintenance (O&M) Requirements. Exclusion zones for survey operations will be short in duration, and transient, so will not have a significant effect on fishing activities.

It is likely that any impacts during decommissioning of the cable will be similar to those experienced during installation. However, it is often considered good practice to leave cables *in situ* after they are no longer in service as this causes the least disruption.

Mobile gear

During installation there will be a 500 m safety zone around the cable laying spread. However, this increases to 2 km with the use of an anchor handling vessel. All fishing vessels will be prohibited from operating within the exclusion zone in order to prevent collisions and interference between fishing vessels and cable installation vessels.

The nature of towed gear such as trawls and dredges require that vessels operating such demersal gear will be excluded from the unprotected or unburied sections of the cable. It is estimated that such areas will be restricted to small areas of the cable route. This temporary safety zone will occur behind the CLV in areas of exposed cable prior to burial and/or protection. Exclusion zones could last for periods of up to several months along some sections of the route until the cable has reached an adequate level of protection. It is expected that fishermen will be able to exploit alternative fishing grounds during the cable installation works but it is acknowledged that some disruption is inevitable. Fishing industry representatives will be kept informed of installation activities. Additionally, Notices to Mariners, and notices in the Kingfisher Bulletin, will be issued in good time to advise fishermen of where and when the installation activities will be operating. Further details are provided in the FLMAP, which will be produced prior to work commencing.

Assessment of impact significance

The sensitivity of fisheries is considered medium on the basis that although some fishing activity is located within the proposed cable corridor there are alternative fishing areas in the vicinity of the Project. The magnitude of effect is considered minor as areas of exclusion and restricted access during construction will be temporary and confined to a small area of fishing grounds. Therefore, the overall level of impact is minor and not significant. This impact is certain to occur.

Sensitivity	Magnitude of effect	Level of impact
Medium	Minor	Minor
Impact significance - NOT SIGNIFICANT		

Static gear

Fishing vessels using static gear will need to avoid the temporary exclusion zone during installation. Any static gear lying within the proposed cable corridor, or the worst case 2 km safety zone, would need to be removed by the fishing vessel operators immediately prior to and during the installation period. On completion of cable laying and burial, static gear can be redeployed in the area. The disruption period is therefore temporary. It is however recognised that the area proposed for cable installation is important for static gear operators, especially over the summer months and at any time a significant amount of static gear can be deployed in the area. Additionally, it is acknowledged that removal of static gear takes time and effort away from fishing and

temporarily reduces grounds for fishing. This will predominantly impact vessels < 10 m fishing in coastal areas of the proposed cable route. Notices to Mariners, and notices in the Kingfisher Bulletin will be issued in good time to advise fishermen of where and when the installation activities will be operating. Further detail is provided in the FLMAP. Additionally, a FLO will be used to communicate activities with local fishermen.

Assessment of impact significance

The sensitivity of static gear fisheries is considered medium on the basis that some of the proposed cable route (areas closer to shore) are known to be important for static gear and that movement to alternative grounds may be difficult. However, the receptor is considered to have the ability to recover from the impact as, following completion of installation static gear can be redeployed in the area. Taking into account the proposed mitigation and considering areas of exclusion and restricted access during installation will be short term and confined to a relatively small area of fishing grounds the magnitude of the effect is considered minor. The overall level of impact is therefore minor to moderate. This impact is certain to occur.

Sensitivity	Magnitude of effect	Level of impact
Medium	Minor	Minor

Impact significance – NOT SIGNIFICANT

14.12.1.2 Change in distribution of target species

During installation, maintenance and repair, and decommissioning there is the potential for indirect impacts on commercial fisheries due to impacts on the distribution of fish and shellfish species as a result of these activities.

As discussed in Section 14.6.1.2, along the proposed cable route does not intersect with the spawning area of any commercially important species, therefore there will not be an impact to spawning as a result of benthic habitat disturbance or removal, these factors may however have an indirect impact on nursery areas.

In relation to crustacean species in the proposed cable route such as crabs and lobster which contribute significantly to the landings value in the area, it is considered there is limited possibility of impact as a result of installation, maintenance and decommissioning activities as the habitat loss resulting from trenching is minimal and species have the ability to move away from the impact. Once the trench has refilled, crustacean species are likely to move back into the area.

Assessment of impact significance

The sensitivity of fisheries is considered low on the basis that although some commercially targeted species occur within the cable installation corridor, this comprises a small fraction of their habitat within Scotland and recoverability is assessed as high. The magnitude of the effect is considered minor as the majority of effects are considered to be short term. Variation will be within the range of experience for the fishery. The overall level of impact is therefore minor and not significant. This impact is certain to occur.

Sensitivity	Magnitude of effect	Level of impact
Low	Minor	Minor

Impact significance – NOT SIGNIFICANT

14.12.2 Potential impacts during operation

14.12.2.1 Permanent loss of access to fishing grounds

The cable will be buried for the majority of its length. The designed protection levels and associated trench depths have taken demersal fishing gear into consideration and trenching will occur to a depth which will not

be penetrated by fishing gear. The CBRA carried out for the Project identified the following threatline depths based on the substrate and fishing methods employed in the area:

> Fishing gear penetration in surficial sand ~0.2m; and

> Fishing gear penetration in soft clay ~0.3m.

This means by ensuring the cable is buried to a greater depth, the risk of penetration by fishing gear and potential interaction with the buried cable is kept to a minimum. At existing subsea asset crossings (Figure 15.1), and in areas where adequate cable protection is not provided by trenching, the cable will be protected by remedial protection such as mattresses and rock placement. All protection will be designed to have a smooth overtrawlable profile, with the rock grade utilised suitable for the nature of fishing activity typically undertaken in the area. As such mobile fishing vessels will not be excluded from the cable installation corridor during the operational phase. Static gear such as pots are also not anticipated to be affected during the operational phase, since the cable protection design accounts for the placement of static gear over the cable. It should be noted that The Submarine Telegraph Act 1885 applies to cables in UK waters and was most recently updated by the Merchant Shipping Act 1995. This Act aims to protect cables by, amongst other things, making it an offence to damage a cable.

Assessment of impact significance

The sensitivity of fisheries is considered low on the basis that although some fishing activity is located within the cable corridor, most effort is outside the area. The magnitude of the effect is considered negligible as it is anticipated that the cable corridor will be overtrawlable and suitable for the deployment of static gear for the entirety of the route, unless post installation surveys indicate otherwise, in which case localised areas may be restricted. Fishermen will also have the ability to utilise the wider environment for fishing. While this impact is certain to occur, the overall level of impact is considered minor and not significant.

Sensitivity	Magnitude of effect	Level of impact
Low	Negligible	Negligible
Impact significance - NOT SIGNIFICANT		

14.12.2.2 Change in distribution of target species

Cable repairs and maintenance will occur as and when required. These events will be short in duration and impact a very limited area. It is not anticipated there will be any impact to fish or shellfish as a result of these repair activities and therefore no indirect impacts on commercial fishing in the vicinity of the cable corridor.

In relation to crustacean species in the proposed cable installation corridor such as crabs and lobster which contribute significantly to the landings value in the area, it is considered there is limited possibility of impact as a result of habitat loss resulting from rock placement. Placement of rock and or mattresses will lead to a change in habitat which can be considered long term, this change may lead to some species seeking alternate habitat. However, this is estimated to apply to affect an area of 0.041 km^2, which represents an insignificant proportion of habitat available, both within the Project area and the wider Pentland Firth and Orkney and Caithness waters.

Assessment of impact significance

The sensitivity of fisheries is considered low on the basis that although some commercially targeted species occur within the cable route, this comprises a small fraction of their habitat within Scotland and recoverability is assessed as high. The magnitude of the effect is considered minor as although the impact is considered long term (lifetime of the Project) it represents a very small area in relation to available habitat in the wider environment. Variation will be within the natural for the fishery. The overall level of impact is therefore negligible and not significant. This impact is certain to occur.

Sensitivity	Magnitude of effect	Level of impact
Low	Low	Negligible

Impact significance – NOT SIGNIFICANT

14.12.2.3 Snagging risk

If any section of cable was to become exposed during the operational phase, this could present a snagging risk to fishing vessels. This could cause a significant hazard to fishing vessels and in turn a loss of earnings to fishermen, as a result of lost or damaged gear. The likelihood of this occurring is considered very low. However, the sensitivity of fishermen to this and other snagging hazards is recognised. The safety aspect of this impact is considered in the NRA provided in Appendix B.

A further potential impact would be that external cable protection measures (rock placement and mattresses) become eroded or degraded rendering them not overtrawlable by fishing gear. If a rock berm degrades to the point where it is no long overtrawlable, it could present a snagging risk to demersal trawlers and inshore creel vessels. This could result in loss of earnings, expenses due to the loss of or damage to gear, and displacement from the area. The NRA assessed the risk of snagging associated with fishing gear and concluded a tolerable risk ranking, with cable burial anticipated to largely remove the risk of snagging. It should be noted that the Submarine Telegraph Act 1885 applies to cables in UK waters and was most recently updated by the Merchant Shipping Act 1995. This Act aims to protect cables by, amongst other things, making it an offence to damage a cable.

Prior to installation a CMS and CBP will be produced, including method statements for and requirements of cable protection for approval by MS-LOT and in consultation with fisheries stakeholders. Following the installation of the cables, as built survey information will be provided to the UKHO for inclusion in admiralty charts, and the Kingfisher Cable awareness charts will be updated to advise fishermen on their location. Post installation inspection surveys and any necessary maintenance will be conducted along the length of the cable on a regular basis, this will ensure cables remain buried and protected, and areas where rock protection has been placed remain overtrawlable.

Assessment of impact significance

The sensitivity of commercial fisheries to a snagging incident is considered to be low, as the proposed cable route is not considered of significant importance to dredge and demersal gear. The likelihood of the impact is considered low due to the relevant mitigation measures and regular surveys which will ensure the seabed is in an overtrawlable condition. The magnitude of the effect is considered negligible as if a snagging incident did occur it would not cause long term effects to commercial fisheries in the area of the cable, although the financial implications from time lost due to replacement of fishing gear is recognised. The overall level of impact is therefore minor and not significant.

Sensitivity	Magnitude of effect	Level of impact
Low	Negligible	Negligible

Impact significance - NOT SIGNIFICANT

14.13 Conclusion

The area surrounding the proposed cable installation corridor is important for the under 10 m and over 10 m fishing fleets. From the years 2013 to 2017, 30 species were recorded in the landings data for ICES rectangle 46E6 where the cable route occurs. Crab is the dominant species in terms of landings value for vessels under and over 10 m in the years 2013 to 2017, shellfish dominate landings with other key species include lobster and velvet crab. Finfish species which contribute to the landings include haddock, monkish and angler fish.

Fishing effort occurs throughout the year with a slight increase in effort seen over the summer months and with lowest effort recorded in January. The dominant gear types for vessels of all sizes are pots, the level of effort with this gear type has remained relatively constant over the years from 2013 to 2017. A number of restricted and management areas occur within the vicinity of the proposed cable route. Both the cable landfall at Warebeth, Orkney and at Dounreay, mainland Scotland, coincide with fisheries restrictions. At the Dounreay landfall fishing is completely restricted, while the Warebeth landfall fishing is restricted between May and September. Approximately 36 km to the west of the proposed cable route lies the West of Scotland restricted area for trawling for cod, haddock and whiting. The entire length of the cable route and indeed all inshore Scottish waters are subject to a restriction for cockle harvesting.

Fishing activity will be displaced during the installation activities, which will most likely take place between April and October; however, an absence of operations outside of this window cannot be guaranteed at this stage. Due to the localised nature and short duration of activities, no significant impact is anticipated. Fishing will be able to resume in the cable corridor when the cable becomes operational. Changes in the distribution of commercially important species is not expected to occur. Therefore, commercial fisheries are not anticipated to be indirectly affected by any effects on fish species. Thus, no significant adverse impacts on commercial fisheries are anticipated as a result of the installation and operation of this cable. Mitigation measures will be adopted to ensure that fishermen are aware of the location of the cable and the timing and duration of all installation and maintenance operations.

Table 14.11 Impact assessment summary for commercial fisheries receptors

Potential impact			Assessment				Additional requirements	
Project activity	**Potential impact**	**Receptor**	**Sen/Val**	**Mag**	**Level of impact**	**Significance**	**Proposed mitigation measures**	**Residual impact**
Installation/ maintenance & repair/ decommissioning								
DP cable lay vessel and support vessels	Temporary reduced access to fishing grounds	Mobile vessel	Medium	Minor	Minor	Not significant	N/A	N/A
		Static gear	Medium	Minor	Minor	Not significant	N/A	N/A
Anchored cable lay vessel or barge and support vessels	Temporary reduced access to fishing grounds	Mobile vessel	Medium	Minor	Minor	Not significant	N/A	N/A
		Static gear	Medium	Minor	Minor	Not significant	N/A	N/A
Rock placement vessel and support vessels	Temporary reduced access to fishing grounds	Mobile vessel	Medium	Minor	Minor	Not significant	N/A	N/A
		Static gear	Medium	Minor	Minor	Not significant	N/A	N/A
Anchors for cable lay vessel or cable lay barge	Change in distribution to target species	Commercial fisheries	Low	Minor	Minor	Not significant	N/A	N/A
Seabed preparation: Pre-sweeping of sandwaves	Change in distribution to target species	Commercial fisheries	Low	Minor	Minor	Not significant	N/A	N/A
Seabed preparation: Pre-lay grapnel	Change in distribution to target species	Commercial fisheries	Low	Minor	Minor	Not significant	N/A	N/A

Potential impact			Assessment				Additional requirements	
Project activity	**Potential impact**	**Receptor**	**Sen/Val**	**Mag**	**Level of impact**	**Significance**	**Proposed mitigation measures**	**Residual impact**
Cable installation: Ploughing	Change in distribution to target species	Commercial fisheries	Low	Minor	Minor	Not significant	N/A	N/A
Cable installation: Jet trenching	Change in distribution to target species	Commercial fisheries	Low	Minor	Minor	Not significant	N/A	N/A
Cable installation: Mechanical trenching	Change in distribution to target species	Commercial fisheries	Low	Minor	Minor	Not significant	N/A	N/A
Operation								
Cable protection: Rock protection	Permanent loss of access to fishing grounds	Commercial fisheries	Low	Negligible	Negligible	Not significant	N/A	N/A
	Snagging resulting from obstructions on the seabed or exposed cable	Commercial fisheries	Low	Negligible	Negligible	Not significant	N/A	N/A
	Change in distribution of target species	Commercial fisheries	Low	Minor	Minor	Not significant	N/A	N/A
Cable protection: Concrete mattresses	Permanent loss of access to fishing grounds	Commercial fisheries	Low	Negligible	Negligible	Not significant	N/A	N/A
	Snagging resulting from obstructions on the seabed or exposed cable	Commercial fisheries	Low	Negligible	Negligible	Not significant	N/A	N/A
	Change in distribution of target species	Commercial target species	Low	Minor	Minor	Not significant	N/A	N/A

Potential impact			Assessment				Additional requirements	
Project activity	**Potential impact**	**Receptor**	**Sen/Val**	**Mag**	**Level of impact**	**Significance**	**Proposed mitigation measures**	**Residual impact**
Cable protection: Cast iron shells	Permanent loss of access to fishing grounds	Commercial fisheries	Low	Negligible	Negligible	Not significant	N/A	N/A
	Snagging resulting from obstructions on the seabed or exposed cable	Commercial fisheries	Low	Negligible	Negligible	Not significant	N/A	N/A
	Change in distribution of target species	Commercial fisheries	Low	Minor	Minor	Not significant	N/A	N/A
Cable protection: Composite sleeving	Permanent loss of access to fishing grounds	Commercial fisheries	Low	Negligible	Negligible	Not significant	N/A	N/A
	Snagging resulting from obstructions on the seabed or exposed cable	Commercial fisheries	Low	Negligible	Negligible	Not significant	N/A	N/A
	Change in distribution of target species	Commercial fisheries	Low	Minor	Minor	Not significant	N/A	N/A

15 OFFSHORE INFRASTRUCTURE & OTHER SEA USERS

15.1 Introduction

This section presents the assessment of impacts on offshore infrastructure and other sea users. It describes the baseline environment, identifies potential impacts the Project is likely to have on identified receptors, presents the findings of the impact assessment, and where applicable proposes best practice and Project specific embedded mitigation measures.

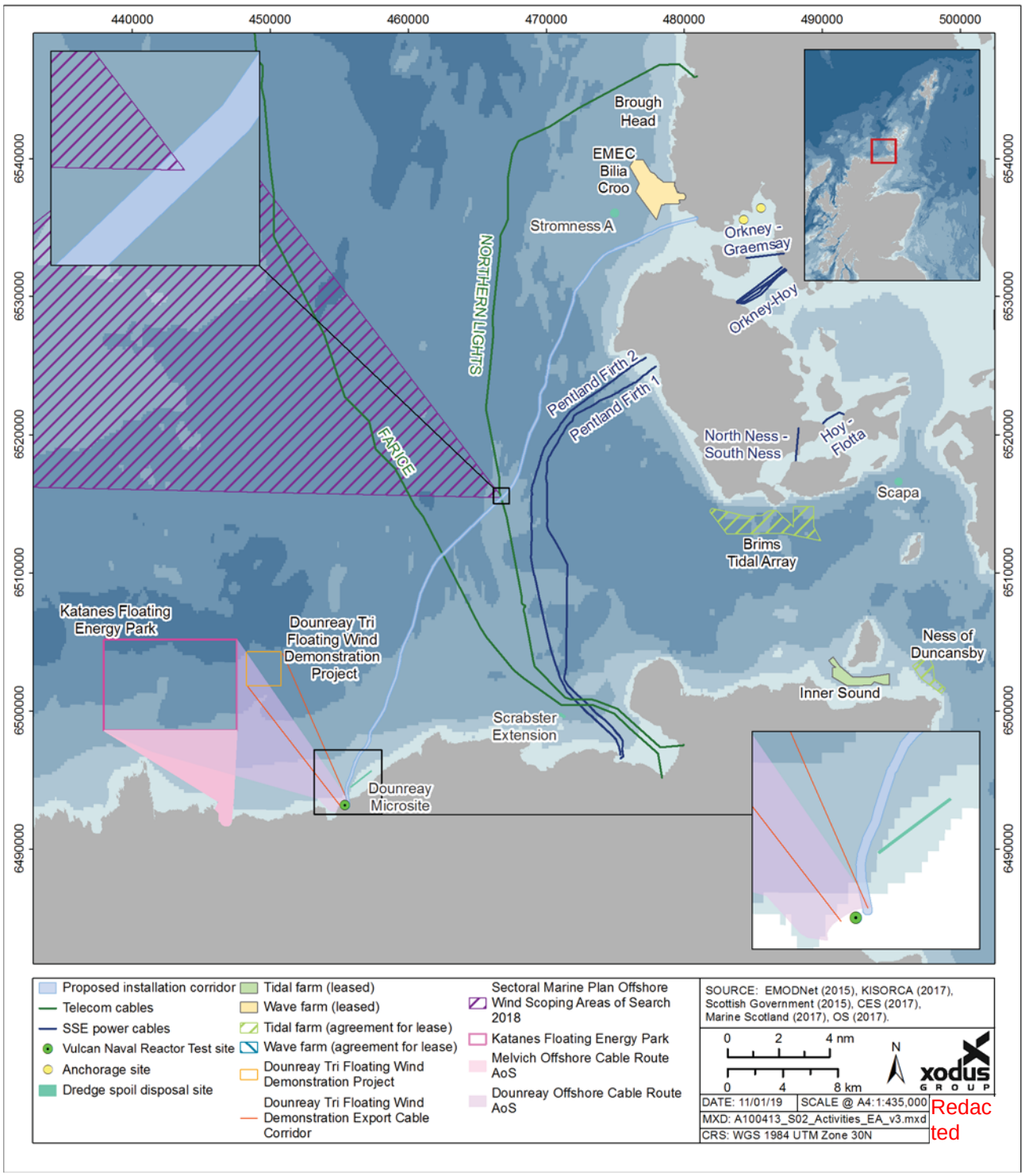
Where relevant, any limitations related to the baseline conditions, data sources or scientific understanding / interpretation within the process of assessing the impacts have been highlighted.

The following receptors have been considered in this section:

- Renewable energy projects (operational / consented / planned);
- Cables and pipelines including SSE assets and telecommunications;
- Offshore infrastructure – oil and gas;
- Potential UXO and munitions;
- Aggregate extraction and disposal sites.; and
- Recreational activities.

The spatial distribution of the identified receptors is demonstrated in Figure 15.1.

Figure 15.1 Offshore infrastructure and other sea users within the vicinity of the proposed cable route



Impacts relating to commercial fisheries and shipping and navigation are covered in Section 14 – Commercial fisheries and Appendix B – Navigational Risk Assessment, respectively.

15.2 Legislation, policy and guidance

Legislation and policy relevant to offshore infrastructure and other sea users has been identified in Section 2 - Planning policy and legislative framework.

15.3 Consultation

Scoping and consultation have been ongoing throughout the Project and played an important part in ensuring the scope of the baseline characterisation work and impact assessment have been appropriate to the Project and the requirements of the regulators and their advisors.

Relevant comments from Marine Scotland's Scoping Opinion are summarised in Table 15-1, together with responses to the comments and reference to the relevant EA sections where specific comments have been addressed.

Table 15.1 Scoping comments relevant to offshore infrastructure and other sea users

Name of organisation	Key concerns	Response	Section within which the specific issue is addressed
Highland Council	Nuclear sites have been identified as also having a potential interest and recommend that they are included in the list of other sea users who should be considered by the applicant in their EA.	Noted. Receptors who have the potential to be impacted by the proposed cable route are detailed within Section 15.4 – Existing baseline description.	Section 15.4.1
Marine Scotland	In support of the need for further assessment and the potential consultation with other sea users that have been identified by the applicant and consultees to try and minimise any impact of the proposed works.	The potential impact of the installation of the proposed cable route on the identified receptors is assessed in Section 15.6 – Impact assessment.	Section 15.6

15.4 Existing baseline description

15.4.1 Renewable energy projects (operational / consented / planned)

In October 2010, The Crown Estate (TCE) awarded Agreements for Lease (AfL) for a number of commercial scale wave and tidal development sites in the Pentland Firth and Orkney Waters (PFOW). Over the last six years the location and number of AfL areas have changed as technologies have developed or changed as resources have been examined in more detail. Development plans for a number of the leased areas for wave and tidal projects have not progressed as quickly as was originally expected (Table 15-2).

In November 2017, CES announced their intention to run a further leasing round for commercial scale offshore wind energy projects in Scottish Waters. To inform the spatial development of this leasing round, Marine Scotland, as Planning Authority for Scotland's Seas, is required to undertake a planning exercise, in accordance with relevant EC, UK and Scottish legislation. The plan development process involves identifying spatial 'Areas of Search' and a 'Sustainability Appraisal' which considers the impacts on communities, other users of the sea, the economy and the environment (encompassing a Strategic Environmental Assessment and a HRA to identify the potential for effects on European nature conservation sites). In June 2018 Marine Scotland consulted on the spatial Areas of Search, where potential development options for lease for future offshore wind projects could be located, this includes one area off the coast of Caithness, to the west of Orkney. The proposed installation corridor overlaps eastern edge of this proposed area (Figure 15.1). The consultation ended in July 2018, and the final proposed areas to be included in the leasing round are expected to be announced in early 2019.

There are seven active offshore renewable projects within the region of the proposed cable route including those constructed, under construction and planned. Table 15-2Table 15-2 provides an overview of all offshore renewable projects within the vicinity of the Project.

Table 15.2 Offshore renewable projects within the vicinity of the proposed cable route

Name	Developer/Operator	Status	Distance (km) to proposed cable route corridor (from array site)
Brough Head Wave Farm	Brough Head Wave Farm Ltd	Planned	4.8
Dounreay Tri Floating Wind Demonstration project	Dounreay Tri Ltd	Consented – on hold	7.2
EMEC Wave Test Facility	The European Marine Energy Centre Ltd	Operational	0.7
Brims Tidal Array	Brims Tidal Array Limited	Planned	14.0
Inner Sound	MeyGen Limited	Operational	26.0
Ness of Duncansby	Duncansby Tidal Power Limited	Planned	31.67
Katanes Floating Energy Park	Katanes Floating Energy Limited	Planned	9
Marwick Head Wave Farm	ScottishPower Renewables (UK) Ltd	Cancelled	N/A

Brough Head Wave Farm

The Brough Head wave farm (agreement for lease area) is located 4.8 km north of the proposed cable route, on the west coast of Orkney. This project proposes to install Oyster wave energy devices west of Orkney, between Nebin Point and the southern border of the Marwick Head SPA. The proposed installed capacity could be up to 200MW. This project is a joint venture between Aquamarine Power Limited and SSE Renewables. The future of this project has been uncertain since Aquamarine Power Limited ceased to trade in 2015. As there is no work currently being carried out at this site, and the intervening distance of 4.8 km between this receptor and the proposed cable route, it is considered unlikely that any direct or indirect impacts will occur during the installation, maintenance and repair, and decommissioning phases of the Project. As such, this receptor is not considered further within this assessment.

Dounreay Tri Floating Demonstration Project

The Dounreay Tri Floating Wind Demonstration project, developed by Dounreay Tri Ltd is a commercial demonstration project which is to be installed off the North coast of Scotland approximately 9 km off Dounreay. Currently, a semi-submersible foundation for offshore wind power has been installed at the site. The export cable associated with the Dounreay Tri Floating Wind Demonstration project is proposed to be buried in the seabed between the site and the landfall. The proposed cable route corridor will overlap with the proposed Project cable installation corridor (Figure 15.1). The project was consented in March 2017 but is currently on hold; however, it is envisaged that the project will re-start and commissioning is planned for Q1 2020. This floating wind project has a potential capacity of 5 MW. As there is no work currently being carried out at the demonstration site, and the intervening distance of 7.2 km, it is considered unlikely that any direct or indirect impacts will occur during the installation, maintenance and repair, and decommissioning phases of the Project. In the event that the export cable route of the Dounreay demonstration project crosses the Projects cable route, Crossing Agreements will be put in place prior to installation to protect third party assets.

EMEC Wave Test Facility

The EMEC wave test facility at Billia Croo is connected to the grid via electronic infrastructure located onshore at Billia Croo. The site consists of five cabled test berths in up to 70 m water depth, located approximately 2 km offshore and 0.5 km apart. Two waverider buoys are located on site measuring the wave height, period and direction, and a purpose-built weather station provides real-time met data for the site. It is proposed that a Penguin WEC-2 will be constructed at the EMEC wave test facility towards the end of 2018. This site is located approximately 800 m to the north of the proposed cable route at the nearest point. Although the proposed installation works will be highly localised and temporary, the EMEC wave test facility is located within the vicinity of the proposed route (0.7 km). As such, there is potential for other users to be impacted by the proposed cable works during installation, maintenance and decommissioning, as the presence of additional vessels may limit the access to the waters along the proposed cable route. This may represent a collision risk with other sea users.

Brims Tidal Array Site

The Brims tidal array site is located to the south of the island of Hoy and within The Crown Estates Pentland Firth and Orkney Waters Strategic Area. The site is located approximately 14 km east of the proposed cable route. The project is currently in the development stage, with Marine Licence application and Section 36 applications for the offshore elements of this development having been submitted to Marine Scotland in June 2016. This project is a joint venture between Open Hydro and SSE. Following the recent announcement on the liquidation of OpenHydro, the future of this project (which is still in the determination by Marine Scotland and does not yet have consent) is uncertain. As there is no work currently being carried out at this site, and the intervening distance of 14 km between this receptor and the proposed cable route, it is considered unlikely that any direct or indirect impacts will occur during the installation, maintenance and repair, and decommissioning phases of the Project. As such, this receptor is not considered further within this assessment.

Meygen Inner Sound Tidal Stream Project

The Meygen Limited Inner Sound tidal stream project is located between Scotland's northernmost coast and the island of Stroma, approximately 26 km east of the proposed cable route. It is currently the largest tidal stream project globally, and it is the only commercial multi-turbine array to have be in operation (Simec Atlantic Energy, 2018). Due to the intervening distance of 26 km between this receptor and the proposed cable route, there will be no direct or indirect impacts will occur during the installation, maintenance and repair, and decommissioning phases. As such, this receptor is not considered further within this assessment.

Ness of Duncansby Tidal Stream Project

Ness of Duncansby neighbours the Inner Sound tidal stream project to the east and is located approximately 31.67 km east of the proposed cable route. This project has the potential to support the installation of up to 100 MW of tidal energy capacity. The consenting process for this site is expected to be initiated in parallel with specific construction phases of Inner Sound tidal stream project (Simec Atlantic Energy, 2018). As there is no works being carried out on site at present, and the intervening distance of 31.67 km between this receptor and the proposed cable route, it is considered unlikely that any direct or indirect impacts will occur during the installation, maintenance and repair, and decommissioning phases. As such, this receptor is not considered further within this assessment.

Katanas Floating Energy Park

The proposed Katanas Floating Energy Park is located offshore Dounreay, Caithness and is currently at the planning stage; a Screening Opinion was provided on the 1st November 2017 concluding that an EIA would be required for the proposed installation of the project. The project is a joint venture between DP Energy Limited and Floating Power Plant Limited. The proposed project is to deploy up to five combined floating wind and wave energy devices. The proposed project lies 2.3 km from the shore, and immediately west of the consented Dounreay Tri Floating Wind Demonstration project. There are two proposed export cables associated with the Katanas Floating Energy Park; Dounreay and Melvich as shown on Figure 15.1. The Melvich proposed export cable route corridor does not overlap with the Project installation corridor and therefore is not considered further, however the Dounreay proposed export cable route corridor overlaps with the Project installation corridor. The Katanes Floating Energy Park has an indicative installation dates of between 2019 – 2023. The project is currently going through the consenting process, and as such there is no

work currently being carried out at this site. Given the intervening distance of 9 km from the offshore site, it is considered unlikely that any direct or indirect impacts will occur during the installation, maintenance and repair, and decommissioning phases of the Project. As such, this aspect of the receptor is not considered further within this assessment.

N6 Offshore Wind Scoping Area of Search

The eastern edge of the N6 Offshore Wind Scoping Area of Search 2018 overlaps with the Project cable installation corridor by 100 m as shown in Figure 15.1. As the area of overlap is across the far eastern corner of the Area of Search, it is considered unlikely that future development within the area of overlap will occur. As such, the potential impact of the Project on the N6 Offshore Wind Scoping Area of Search 2018 is considered negligible.

15.4.2 Cables and pipelines including SSE assets and telecommunications

As stated in Section 4.3.3, the submarine cable corridor crosses two cable routes, and is within the vicinity of two further cable routes. These include both electric and telecommunication cables. A summary of key cables is provided in Table 15-3 below. These cables are illustrated in Figure 15.1.

Table 15.3 Subsea cables in the vicinity of the proposed cable route

Location	Cable	Type	Description	Distance to proposed cable corridor (km)
West Orkney	FARICE	Telecommunications	Telecoms cable between Iceland, Faroe Islands and Scotland (Dunnet Bay, Caithness).	0
West Orkney	Northern Lights	Telecommunications	Telecoms cable between mainland Scotland and Orney (Dunnet Bay, Caithness and Bay of Skaill, West Coast Orkney).	0
West Orkney	Pentland Firth 1 East	Electricity (33 kV)	Subsea cable between mainland Scotland (Murkle Bay, near Thurso) and Rack Wick Bay, Hoy).	1.7
West Orkney	Pentland Firth 2 West	Electricity (33 kV)	Subsea cable between mainland Scotland (Murkle Bay, near Thurso) and Rack Wick Bay, Hoy)	1

The telecommunications cables pose a constraint to installation of the proposed cable rather than a source of potential environmental impact.

As detailed within Section 15.4, where avoidance is not possible (e.g. with respect to cables), Crossing Agreements will be put in place to ensure protection of the third-party assets. As such, they are not considered further within this assessment.

15.4.3 Other infrastructure – oil and gas

There are currently no oil and gas installations within 20 km of the proposed cable route. The nearest oil and gas installation is the Well 11/25, located 46.13 km SE in 11/25 Quad/Block. Given the intervening distance between the installation, as well as embedded mitigation measures detailed within Section 15.7, the risk for

any impact from the Project upon this receptor is considered to be negligible. As such, this receptor is not considered further within this assessment.

15.4.4 Military Practice Areas

As detailed within the NRA contained within Appendix B, there are no known military firing practise sites within the vicinity of the cable installation path. Should the military wish to use the area whilst installation or maintenance activities are taking place, it is expected that promulgated information will provide suitable vehicle for appropriate recourse. The frequency of this impact is assessed as being extremely unlikely with a severity outcome of minor. This therefore leads to a broadly acceptable risk. No further risk reduction measures are required to be identified.

15.4.5 Disposal sites

As an established maritime nation, the UK relies on dredging and disposal of dredged material to keep its ports, harbours and marinas open for business. Each year between 25 – 50 million tonnes (wet weight) are deposited, in allocated disposal sites in UK waters. Only marine sediment (mainly sand, silt and clays) dredged from dock sites and navigation channels and small amounts of fish waste are disposed of at sea. Industrial waste and sewage sludge has been banned from disposal at sea since 1992 and 1998 respectively (Cefas, 2016).

There are four dredge spoil disposal sites within the area (and wider area) of the proposed cable route as detailed in Table 15-4.

Table 15.4 Dredge spoil disposal sites within the area of the proposed cable route

Site name	Area Num	Site type	Status	Distance to cable route corridor (km)
Scrabster Extension	F1008	Dredge Soil Disposal	Open	12.1
Dounreay Microsite	F1002	Dredge Soil Disposal	Open	0.3
Scapa	F1055	Dredge Soil Disposal	Open	26.2
Stromness A	F1040	Dredge Soil Disposal	Open	2.4

The active status of all four disposal sites indicate they are in use. The presence of vessels during the installation of the proposed cable route could cause disruption to disposal site routeing / timetables of the disposal sites in particular those in closest proximity to the cable route. The maximum footprint of impact of the Project is a 2 km rolling safety zone around the CLV's. As such, it is considered that the potential disruption to disposal site vessels outwith 2 km of the cable route area is unlikely given the amount of room for vessels to re-route a safe distance from the construction work. As such, the potential impact upon Scrabster Extension, Scapa and Stromness A is not considered further within this assessment.

15.4.6 Recreational activities

Given the offshore nature of the proposed cable route, the main recreational activities that could be impacted during the construction phase are sailing, yachting, canoeing and sea angling. In the vicinity of the Dounreay landfall are the following recreational clubs; Pentland Firth Yacht Club, Pentland Canoe Club, and Dounreay Fly Fishing club. Within the vicinity of the Warebeth landfall there is the Stromness Sailing Club and the Orkney Islands Sea Angling Association.

Sailing opportunities within the Orkney island is limited due to the strong tidal influence. The proposed cable installation corridor crosses areas of moderate recreational boating intensity (NMPI, 2018) as well as crossing several RYA cruising routes including: four 2RYA Cruising routes and three 3RYA Cruising routes (NMPI, 2018). As such, during installation, maintenance, repair and decommissioning phases of the Project, recreational activities may be disturbed.

15.4.1 Nuclear receptor

The Vulcan Naval Reactor Test Establishment (NRTE) is a MoD establishment that contains the prototype nuclear propulsion plants of the type operated by the Royal Navy in its submarine fleet. The last of the reactors within this facility was shut down in July 2015. This site is currently in the post operational work phase including defueling the reactor, clearance of fuel from the site and preparations for future decommissioning and disposal of both the reactors on the site. This work will continue up to 2022. The site is located approximately 0.5 km east of the proposed cable route corridor as shown on Figure 15.1.

Due to the close proximity of the proposed cable route corridor to the Vulcan NRTE, as well as the sensitive nature of materials on this site, further consideration regarding the potential impact of the proposed works will be carried out.

15.5 Identification of potential impacts and their zones of influence

The identified potential activities i.e. activities associated with the Project which could lead to impacts on offshore infrastructure and other sea users during installation, operation, maintenance and decommissioning activities are presented in Table 15-5. For each impact, the assessment considered the identified Project activities which could cause the impact (and their respective zones of influence) and from these the largest in Zone of Influence was selected, resulting a worst-case assessment.

Potential impacts that could occur during the installation, repair, maintenance and decommissioning works of the Project have been assessed together. This is due to maintenance and repair activities having the same impacts to those that could occur during the installation and decommissioning phase, but to a lesser extent.

Table 15.5 Potential impacts on offshore infrastructure and other sea users during installation, operation, maintenance and decommissioning, and their zones of influence

Project activity	Potential impact	Footprint	Phase			Duration
			I	O	D	
DP cable lay vessel and support vessels	Temporary disruption to planned routes and access to working areas	500 m radius safety zone around the cable installation vessel extending to 1000 m astern of the vessel	✓	✓	✓	1 – 6 weeks
	Collision risk between vessels and other sea users		✓	✓	✓	
Rock placement and support vessels	Temporary disruption to planned routes and access to working areas	Operating within 500 m safety zone	✓	✓	✓	2 weeks
	Collision risk between vessels and other sea users		✓	✓	✓	
Cable protection material: Rock protection	Permanent alteration to planned routes and access to working areas	Immediate vicinity of cable	X	✓	X	2 weeks
Cable protection: Concrete mattresses	Permanent alteration to planned routes and access to working areas	Immediate vicinity of cable	X	✓	X	1 week
Cable protection: Cast iron shells	Permanent alteration to planned routes and access to working areas	Immediate vicinity of cable	X	✓	X	1 week
Cable protection: Composite sleeving	Permanent alteration to planned routes and access to working areas	Immediate vicinity of cable	X	✓	X	1 week

15.6 Impact Assessment

15.6.1 Overview

Following establishment of baseline conditions of the proposed cable route and surrounding areas, and an understanding of the Project activities, it is possible to assess the potential impacts from the installation, maintenance and repair and decommissioning phases of the Project.

The potential impacts are summarised below. It should be noted that not all impacts are relevant to all phases of the Project.

> Temporary disruption to planned routes and access to working areas; and

> Permanent alteration to planned routes and access to working areas.

Where impacts are relevant during multiple phases of the Project, they have been ranked under the phase where they are considered to be most significant. For example, work vessel activity will be most intense during the installation phase and therefore the discussion is presented under this phase.

15.6.2 Assessment criteria

The assessment methodology is outlined in Section 7 – Impact Assessment Methodology.

Specific criteria relating to other infrastructure and sea users have been developed for the sensitivity/value of the receptor, and magnitude of impact.

The sensitivity of a receptor has been considered in terms of the tolerance to change, recoverability, adaptability /value. Expert judgement has been employed to consider the final sensitivity of a particular receptor. Definitions of sensitivity are provided in Table 15-6.

Table 15.6 Criteria for sensitivity/value of receptor for offshore infrastructure and other sea users

Sensitivity / Value	Definition
Very high	Activity / receptor of international importance in the Project area and/or with no flexibility and capability to utilise areas for activities
High	Activity / receptor is of strategic national importance (e.g. infrastructure or assets / developments) and/or very limited capacity to accommodate the predicted change or interaction.
Medium	Activity / receptor is of regional importance (e.g. infrastructure or assets / developments) and/or have limited capacity to accommodate the predicted change or interaction.
Low	Activity / receptor is of local importance to marine users and/or has capacity to tolerate/ accommodate the predicted change or interaction.
Negligible	Activity/ receptor is not considered to be of any importance and is capable of accommodating the predicted change or interaction/ will not be affected by the Project.

The magnitude of the impact has been considered in terms of the size and spatial extent, duration and timing/seasonality and frequency of the impact in question. Expert judgment has been employed to consider and evaluate the likely impact on the infrastructure or sea users. Definitions of magnitude are provided in Table 15-7.

Table 15.7 Definition of magnitude

Magnitude	Definition
Major	A permanent / long lasting change or alteration to the key characteristics or functions of the activity / receptor affecting the majority of the activity / receptor
Moderate	Short term / temporary change or alteration to the key characteristics or functions of the activity / receptor (infrastructure or asset) affecting a small proportion of the activity / receptor

Magnitude	Definition
Minor	Imperceptible change or alteration to the key characteristics or functions of the activity / receptor (infrastructure or asset) affecting a very limited part / area of the activity / receptor
Negligible	No loss of extent or alteration to infrastructure or asset.

Following the identification of receptor sensitivity/value and magnitude of the effect, the significance of the impact is determined using the assessment matrix and expert judgement. The matrix used to identify the significance of an impact is presented within Section 7.3.3. Impacts categorised as moderate or major are considered to be significant, minor or negligible impacts are not considered to be significant.

15.6.3 Design envelope

This assessment considers the Project parameters which are predicted to result in the greatest environmental impact. This approach ensures that impacts of a greater adverse significance would not arise should any other development scenario be taken forward in the final scheme design. With regards to the assessment of offshore infrastructure and other sea users, the potential impacts and their ZoI is summarised within Table 15-5.

15.6.4 Data gaps and uncertainties

With regards to the operational and decommissioning stage of the Project, further consultation is still required with the Maritime and Coastguard Agency (MCA) and the Department of Energy and Climate Change (DECC) regarding safety zones, or other methods of protecting against unnecessary impacts. It is also noted that continued awareness of adjacent renewable energy projects must be maintained throughout the lifespan of the Project.

15.7 Embedded mitigation and management Measures

As part of the Project design process a number of embedded mitigation and management measures and best practice measures have been included to reduce the potential impact on offshore infrastructure and other sea users. There is a commitment to deliver these measures and therefore they are considered part of the Project design.

The assessment of magnitude, sensitivity and significance in Section 15.8 includes the incorporation of these measures.

Table 15.8 Best practice (BP) and embedded mitigation and management measures (EM)

ID	Measure	Justification
BP10	Notice to Mariners (including local), Kingfisher bulletins, Radio Navigational Warnings, NAVTEX, and/or broadcast warnings will be promulgated in advance of any proposed works. The notices will include the time and location of any work being carried out, and emergency event procedures. The Project will be depicted on Admiralty Charts produced by the UKHO.	For navigational safety and to ensure other marine users are aware of the proposed works.
BP7	Implementation of a 500 m radius safety zone around the cable installation vessel extending to 1000 m astern of the vessel	Safety zones are established in the interests of safety to infrastructure and other user's receptors.
BP13	SHE Transmission will have in place a Safety Management System (SMS) throughout the Project	Ensure Project safety is appropriately managed.
BP14	Equipment and Training for Site Personnel: site personnel will be suitably equipped and trained for work offshore including in firefighting, first aid and offshore survival.	Ensure Project safety.is appropriately managed.

ID	Measure	Justification
BP15	There will be adverse weather working policies and procedures for periods of construction and maintenance	Ensure preparations are in place for adverse weather conditions.
BP16	A Crossing Agreement will be established with relevant cable operators of other assets. This agreement will include the ability of a cable operator to access their cable during construction if required. If such works are required to occur simultaneously, consultation with the cable operator will be undertaken.	To reduce potential conflict at cable crossing locations.
BP17	Communications Strategy	To outline commination protocols between the Project and other marine stakeholders

15.8 Impacts during installation period (including maintenance activities)

15.8.1 Disruption to renewable energy projects planned routes and access to working areas

The installation vessels associated with the Project have the potential to disrupt any planned routes and associated access areas associated with the receptors identified within Section 15.4.1; EMEC wave test facility, proposed cable routes for the Dounreay Tri Floating Wind Demonstration Project and the Dounreay proposed cable route for the Katanes Floating Energy Park.

During the installation phase of the Project, a number of different vessels will be present for a period of several months. A 500 m radius safety zone around the cable installation vessel extending to 1000 m astern of the vessel will be designated around any working vessels. Due to the short intervening distance between the cable route corridor and the EMEC site, the presence of vessels installing the cable have the potential to disrupt any vessel activities in the southern area of the EMEC wave test facility. Similarly, due to short intervening distance between the proposed cable routes associated with the Dounreay Floating Wind Demonstration Project and the Katanes Floating Energy Park, disruption to due vessel presence could also impact any survey activities carried out (Figure 15.1).

Vessels associated with the installation of the Project have the potential to collide with other transiting vessels during the construction and installation phase. Receptors identified to be most at risk of this impact include the EMEC wave test facility and any vessels associated with activities at / overlapping adjacent renewable energy projects on the approach to the mainland Scotland landfall.

Although the proposed installation works will be highly localised and temporary, the EMEC Wave Test site is located approximately 800 m to the north of the proposed cable installation corridor at the nearest points. The proposed export cable corridors associated with the Dounreay Tri Floating Wind and Katanes Floating Energy Park (Dounreay cable corridor) overlap with the Project. Given the close proximity to the cable corridor, the presence of additional vessels may limit the access to the waters along the proposed cable route. To reduce the potential risk of collision between other sea users during the Project, a simultaneous operations (SIMOPS) procedure will be agreed and followed prior to activities being carried out.

It is noted that guard vessels will be used to mitigate risks and increase awareness of the Project when vessels are working at the Project site. Additionally, construction safety zones are industry-standard to protect installation vessels and their personnel.

Assessment of significance The receptors are considered to have low sensitivity; although renewable energy projects are of national importance, the embedded mitigation measures noted in Section 15.7 will ensure that multiple activities in the same / adjacent areas can be co-ordinated and managed as required to avoid conflict. The magnitude of the potential impact is considered to be moderate; short-term and will have a temporary duration. The impact is likely to occur.		
Sensitivity/value	**Magnitude of effect**	**Level of impact**
Low	Moderate	Minor
Impact significance – NOT SIGNIFICANT		

15.8.2 Disruption to disposal sites

The installation vessels associated with the Project have the potential to disrupt planned routes and associated access areas associated with the receptor identified in Section 15.4.5; Dounreay Microsite. Given the active status of the site, there is the potential for this receptor to utilise the area within the vicinity of the cable route for vessel traffic.

During the installation phase of the Project, a number of vessels will be present for several weeks. A 500 m radius safety zone around the cable installation vessel extending to 1000 m astern of the vessel will be designated around any working vessels. Due to the short intervening distance between the cable route corridor and the Dounreay Microsite, the presence of vessels installing the cable have the potential to disrupt any vessel activities associated within the dredge soil disposal site.

Assessment of significance The Dounreay Microsite is considered to have low sensitivity; this site is of local importance to marine users, however the embedded mitigation measures noted in Section 15.7 will ensure that the site has the capacity to accommodate the predicted interaction between the construction and installation vessels of the Project. The magnitude of the potential impact is considered to be moderate; short-term, temporary duration of the works that could impact upon the dredge soil disposal site. This impact is likely to occur.		
Sensitivity/value	**Magnitude of effect**	**Level of impact**
Low	Moderate	Minor
Impact significance – NOT SIGNIFICANT		

15.8.1 Disruption to recreational activities

Vessel presence associated with the installation of the proposed cable have the potential to disrupt a number of recreational activities during the installation phase. Receptors identified to be most at risk of this impact are yachts and boats utilising the several RYA recreational routes which the proposed cable route crosses.

The proposed installation works will be highly localised, transient and temporary. Given the cable installation corridor crosses several of the recreational routes, the presence of additional vessels will limit the access to the several of the routes along the proposed cable route. This may disrupt recreational activities at each crossing point of the RYA routes, however it should be noted that disruption to the routes will occur concurrently rather than at the same time.

It is noted that guard vessels will be used to mitigate risks and increase awareness of the Project when vessels are working at the Project site. Additionally, construction safety zones are industry-standard to protect installation vessels and their personnel.

Assessment of significance
Receptors are considered to have low sensitivity; the routes are of local importance however, given the embedded mitigation measures noted in Section15.7, the areas of potential disruption have the capacity to accommodate the predicted interaction between the installation vessels of the Project and other sea users of the identified receptors. The magnitude of the potential impact is considered to be moderate; short-term alteration of the functions of the receptor, affecting a small proportion of the activity. The likelihood of this impact occurring is low.

Sensitivity/value	Magnitude of effect	Level of impact
Low	Moderate	Minor

Impact significance – NOT SIGNIFICANT

15.8.2 Disruption to nuclear receptor

Vessel presence associated with the installation of the proposed cable has the potential to disrupt any nearshore activities associated with the Vulcan NTRE.

The proposed installation works will be highly localised, transient and temporary. The Vulcan NTRE (receptor) is situated onshore and therefore it is considered unlikely that the proposed works will have much interaction with the MoD site.

Assessment of significance
The receptor is considered to have high sensitivity; the materials contained at the site are of a sensitive nature however, given the embedded mitigation measures noted in Section 15.7, the areas of potential disruption have the capacity to accommodate the predicted interaction between the installation vessels of the Project and other sea users of the identified receptor. The magnitude of the potential impact is considered to be minor; short-term alteration of the functions of the receptor, affecting a small proportion of the potential activity. The likelihood of this impact occurring is very low.

Sensitivity/value	Magnitude of effect	Level of impact
High	Minor	Minor

Impact significance – NOT SIGNIFICANT

15.9 Impacts during operation

15.9.1 Permanent alteration to planned routes and access to working areas

Once installed, a working zone is required either side of the proposed cable route to enable access for cable maintenance and repair operations. In accordance with subsea guidance for separation distance, a working zone is 500 m either side of the subsea cable (however this may vary depending on the site). This guidance is considered appropriate for water depths up to 75 m (Renewables Sub-Group of Subsea Cables UK 2012).

The cable corridor working zone passes through the Dounreay Microsite dredge soil disposal site and as such, the Project has the potential to restrict any future expansion of the disposal site.

Assessment of significance The Dounreay Microsite is considered to have low sensitivity; this site is of local importance to marine users. The potential magnitude of the impact is considered to be moderate; although this proposed cable route would see a permanent alteration to working areas, it will only restrict a small proportion of the disposal site.		
Sensitivity/value	**Magnitude of effect**	**Level of impact**
Low	Moderate	Minor
Impact significance – NOT SIGNIFICANT		

15.10 Cumulative and in-combination impacts

Cumulative impacts are those resulting from the combined effects of the Project with other subsea cable projects through space and time, in the context of natural variability. It also includes the combined effects with other sea users generating similar effects.

The consideration of which projects located within the vicinity of the proposed cable route could result in potential cumulative or in-combination impacts is based on the results of the Project specific impact assessment together with the expert judgement of the specialist consultant. The key projects for which there is potential for cumulative and in-combination impacts are EMEC wave test facility, the Dounreay Microsite disposal facility, the proposed cable routes associated with the Dounreay Tri Floating Wind Demonstration Project and the Katanes Floating Energy Park and any concurrent activities associated with potential future renewable energy projects.

Both the EMEC Wave Test facility and the Dounreay Microsite spoil disposal site are located within the vicinity of the proposed cable route and are currently operational. The level of shipping activity associated with the marine cable installation and operation will increase the existing vessel activity within the area. During the installation phase of the proposed cable route, the presence of increased vessel activity within the area could result in minor interference to vessels going to and from the disposal site, or working vessels at the EMEC site. However, the mitigation measures proposed in Section 16 will ensure that the potential impact to vessels are not significant.

As noted, there are two overlapping projects within the vicinity of the Project are the cable routes associated with the Dounreay Tri Floating Wind Demonstration Project and the Katanes Floating Energy Park. If the Project was to commence during a period in which the work on the overlapping cable routes was being carried out, such as surveys and installation phases, the overlapping areas will have the capacity to accommodate the predicted interaction between the installation vessels of the Project and other sea users of the identified receptors due to the embedded mitigation measures noted in Section 15.7.

15.11 Conclusion

Table 15-9 provides a summary of the potential impacts on other infrastructure and other sea users. The Project has the potential to disrupt other project activities and access. No significant impacts have been identified.

Table 15.9 Impact assessment summary

Potential impact			Assessment				Additional requirements	
Project activity	**Potential impact**	**Receptor**	**Sen/Val**	**Mag**	**Level of impact**	**Significance**	**Proposed mitigation measures**	**Residual impact**
Installation/ maintenance & repair/ decommissioning								
DP cable lay vessel and support vessels	Disruption to renewable energy projects planned routes and access to working areas	EMEC wave test facility	Low	Moderate	Minor	Not significant	N/A	N/A
		Dounreay Tri Floating Wind Demonstration project	Low	Moderate	Minor	Not significant	N/A	N/A
		Katanes Floating Energy Park	Low	Moderate	Minor	Not significant	N/A	N/A
	Disruption to aggregate extraction and disposal sites	Dounreay Microsite	Low	Moderate	Minor	Not significant	N/A	N/A
	Disruption to recreational activities	RYA Routes	Low	Moderate	Minor	Not significant	N/A	N/A
Anchored cable lay vessel or barge and support vessels	Disruption to renewable energy projects planned routes and access to working areas	EMEC wave test facility	Low	Moderate	Minor	Not significant	N/A	N/A
		Dounreay Tri Floating Wind Demonstration project	Low	Moderate	Minor	Not significant	N/A	N/A
		Katanes Floating Energy Park	Low	Moderate	Minor	Not significant	N/A	N/A

Potential impact			Assessment				Additional requirements	
Project activity	**Potential impact**	**Receptor**	**Sen/Val**	**Mag**	**Level of impact**	**Significance**	**Proposed mitigation measures**	**Residual impact**
	Disruption to aggregate extraction and disposal sites	Dounreay Microsite	Low	Moderate	Minor	Not significant	N/A	N/A
	Disruption to recreational activities	RYA Routes	Low	Moderate	Minor	Not significant	N/A	N/A
Rock protection vessel and support vessels	Disruption to renewable energy projects planned routes and access to working areas	EMEC wave test facility	Low	Moderate	Minor	Not significant	N/A	N/A
		Dounreay Microsite	Low	Moderate	Minor	Not significant	N/A	N/A
	Disruption to aggregate extraction and disposal sites	Dounreay Microsite	Low	Moderate	Minor	Not significant	N/A	N/A
	Disruption to recreational activities	RYA Routes	Low	Moderate	Minor	Not significant	N/A	N/A
Operation								
Cable protection: Rock protection	Permanent alteration to planned routes and access to working areas	Dounreay Microsite	Low	Moderate	Minor	Not significant	N/A	N/A
Cable protection: Concrete mattresses	Permanent alteration to planned routes and access to working areas	Dounreay Microsite	Low	Moderate	Minor	Not significant	N/A	N/A
Cable protection: Cast iron shells	Permanent alteration to planned routes and access to working areas	Dounreay Microsite	Low	Moderate	Minor	Not significant	N/A	N/A
Cable protection: Composite sleeving	Permanent alteration to planned routes and access to working areas	Dounreay Microsite	Low	Moderate	Minor	Not significant	N/A	N/A

16 SCHEDULE OF MITIGATION

16.1 Introduction

This section outlines the Best Practice and proposed embedded mitigation and management measures that will be implemented as part of the Project. These have been extracted from Sections 8 to 15 and additional measures also listed, as required, to provide a comprehensive Schedule of Mitigation (SoM).

The purpose of the SoM is to clearly set out the mitigation which is required and ensure it can be effectively implemented during the design, installation (including maintenance and repair), operation and decommissioning of the Orkney – Mainland Subsea Link.

16.2 Construction Environmental Management Plan

The SoM will form the basis of a CEMP to be implemented in all Project phases. A draft CEMP will be prepared and submitted separately, after submission of the Marine Licence application. This will be finalised following appointment of the installation Contractor and will be updated to include conditions outlined in the Marine Licence and submitted to MS-LOT for approval prior to commencement of installation activities. The finalised CEMP will be supported by a number of additional documents including a Waste Management Plan, Biosecurity Plan and Oil Spill Contingency Plan.

16.3 Schedule of mitigation

The best practice (BP) and embedded mitigation (EM) measures to be implemented as part of the design, installation (including maintenance and repair), operation and decommissioning of the marine cables are outlined in Table 16-1.

Table 16.1 Schedule of Mitigation

Code	Best Practice (BP) and Mitigation (M) Measures	Relevant EA Section
BP1	A final CEMP and an Emergency Spill Response Plan will be developed and implemented for the installation phase. A non-native species management plan / biosecurity plan for vessels will be developed as part of the CEMP.	All topics
BP2	Control measures and shipboard oil pollution emergency plans (SOPEP) will be in place and adhered to under MARPOL Annex I requirements for all vessels. In the event of an accidental fuel release occurring appropriate standard practice management procedures will be implemented accordingly.	All topics
BP3	Ballast water discharges from vessels will be managed under International Convention for the Control and Management of Ships' Ballast Water and Sediments and in accordance with the Ballast Water Management Policy for Scapa Flow (Orkney Islands Council, 2017).	14
BP4	Vessels will be equipped with waste disposal facilities (sewage treatment or waste storage) to IMO MARPOL Annex IV Prevention of Pollution from Ships standards.	All topics
BP5	Vessel crew will be made aware of all marine mammals they might encounter and will employ best practice measures for boat control near wildlife as informed by the Scottish Marine Wildlife Watching Code and Guide to Best Practice for Watching Marine Wildlife.	11
BP6	JNCC guidelines for minimising the risk of disturbance and injury to marine mammals from seismic surveys (JNCC, 2017) will be implemented throughout the survey period.	11
BP7	Implementation of a 500 m radius safety zone around the cable installation vessel extending to 1000 m astern of the vessel	14,15
BP8	CLV to be fitted with AIS so that it can be easily detected by other vessels	14,15

Code	Best Practice (BP) and Mitigation (M) Measures	Relevant EA Section
	transiting through the area.	
BP9	FLO will be employed to manage interactions between cable installation vessels, personnel, equipment and fishing activity.	14
BP10	Notice to Mariners (including local), Kingfisher bulletins, Radio Navigational Warnings, NAVTEX, and/or broadcast warnings will be promulgated in advance of any proposed works. The notices will include the time and location of any work being carried out, and emergency event procedures.	14,15
BP11	Compliance with International Regulations for the Prevention of Collision at Sea (IMO, 1972) and the International Regulations for the Safety of Life at Sea (SOLAS).	14,15
BP12	A CBP will be produced outlining the proposed method statement and cable protection requirements for approval by the Regulator and discussion with stakeholders.	10, 14, 15
BP13	SHE Transmission will have in place a Safety Management System (SMS) throughout the Project	14, 15
BP14	Equipment and Training for Site Personnel: site personnel will be suitably equipped and trained for work offshore including in firefighting, first aid and offshore survival.	15
BP15	There will be adverse weather working policies and procedures for periods of construction and maintenance	15
BP16	A Crossing Agreement will be established with relevant cable operators of other assets. This agreement will include the ability of a cable operator to access their cable during construction if required. If such works are required to occur simultaneously, consultation with the cable operator will be undertaken.	15
BP17	Communications Strategy	15
BP18	Implementation of a project-specific Written Scheme of Investigation (WSI) and Protocol for Archaeological Discoveries (PAD) that clearly set out procedures to deal with unexpected archaeological discoveries prior to any intrusive operations which may impact upon the seabed.	13
EM1	The duration of cable installation activities from the vessel will minimised as much as possible.	All topics
EM2	Deployment of anchors/anchor chains on the seabed will be kept to a minimum.	10
EM3	Marine Mammal Observers (MMO) and Passive Acoustic Monitoring (PAM) will be deployed on all vessels emitting noise which could cause a disturbance to marine mammals.	11
EM4	The presence of vessels adjacent to the shore areas will be minimised during sensitive periods for breeding birds and where possible will limited to works in the location of the HDD pop-outs	12
EM5	The slow speed of installation vessels (maximum of a few knots per hour) will reduce impacts of disturbance and lighting on-board the cable installation vessel will be kept to the minimum level required to ensure safe operations.	11, 12
EM6	Rock protection and/or mattresses will only be deployed where adequate burial cannot be achieved to protect the cable. Rock berms and mattresses will be designed to have a smooth overtrawlable profile.	10, 14, 15

17 CONCLUSIONS

17.1 Introduction

This section summarises the results of the assessment of the potential impacts of the installation (including maintenance and repair), operation and decommissioning of the Orkney – Mainland Subsea Link which is proposed between Warebeth, Orkney and Dounreay on the Scottish mainland.

The preferred route selection for the marine cable has been developed following desk-based routing studies, site visits and marine surveys undertaken to support the EA. Route selection has taken into account a range of factors including the directness of the route, seabed conditions, environmental sensitivities and potential interactions with other sea users. This has led to a preferred option which is considered to represent the most technically feasible and least environmentally disturbing option.

Consultation was undertaken with MS-LOT on the content and level of detail to be provided in the EA in support of the Marine Licence application. This resulted in detailed information being provided in the EA, in relation to the Project alone and cumulatively, for the following topics:

- Protected sites;
- Benthic and intertidal ecology;
- Marine Mammals;
- Ornithology;
- Marine Archaeology;
- Commercial fisheries;
- Other infrastructure and other sea users; and
- Cumulative impacts.

17.2 Assessment summary

Following the EA of the potential impacts on each of the topics outlined above in Section 18.1 the following can be concluded:

17.2.1 Protected sites and species

There a number of protected sites with marine components located along, and in the immediate vicinity of the subsea cable route and landfall locations. Protected sites and features (Natura 2000 sites and NCMPAs) are assessed within the Appendix D: Nature Conservation Appraisal (NCA) in accordance with the Habitats Directive and the Marine (Scotland) Act 2010. Additional protected sites have assessed within the topic specific sections as required. The Project is not considered to be Capable of Affect (CoA) on any NCMPAs due to the distance of the Project and designated sites. The following Natura 2000 sites were taken forward for assessment of LSE Hoy SPA, North Caithness Cliffs SPA, Scapa Flow pSPA, Caithness and Sutherland Pentlands SPA, Orkney Mainland Moors SPA, River Thurso SAC, River Borgie SAC, River Naver SAC and Sanday SAC. Upon assessment no potential LSE has been identified on any Natura 2000 site.

17.2.2 Benthic and intertidal ecology

MMT was commissioned by SHE Transmission to undertake geophysical, geotechnical and environmental surveys between February and May 2018 along a 1,000 m wide survey corridor between Dounreay on the Scottish mainland and Warebeth in Orkney. The geophysical and the benthic survey reports (MMT, 2018a, 2018b) were the main sources of information used to prepare the benthic environmental baseline and impact assessment.

Habitats of potential conservation importance were identified along the cable route; however, these stony and bedrock reefs were classified as low to medium grade and none of these habitats presented a high reefiness as listed on the Annex I of the Habitats Directive (MMT, 2018b). The 'Atlantic and Mediterranean moderate energy infralittoral rock' habitat identified offshore of the Caithness landfall presented a potential habitat for the PMF kelp beds. However, no kelp beds were observed in this habitat (MMT, 2018b). The great majority of the installation corridor is occupied by biotopes of no specific conservation concern which are present on a wider scale throughout this area of the North Sea. A pre-lay survey will inform cable routing and will allow avoiding any sensitive features.

The potential impacts identified as a result of the Project are:

- Temporary direct loss or disturbance to benthic habitats and communities;
- Temporary increase in suspended sediments and associated deposition;
- Permanent habitat loss;
- Introduction of new substrate; and
- Increased risk of introducing or spreading INNS.

Physical disturbance by trenching and cable laying activities and smothering of benthic habitat and species via sediment re-suspension and settlement are likely to occur within the footprint of the proposed works.

The installation options, which include a number of techniques including ploughing, jet trenching and mechanical trenching, will generate seabed disturbance within a corridor of maximum 15 m width increasing to 20 m in areas where pre-sweeping of sandwaves is required. The HDD method will only impact the substrate and biota at the exit point of the HDD duct on the seabed.

These impacts will be highly localised and restricted to the immediate footprint of the installation method. Due to the current through the Pentland Firth the quick dispersal and re-settlement of sediments is expected. Since cable burial is not possible in areas of harder seabed, the footprint will be limited to the width of the protection method (cast iron shells, sleeving or rock placement). Considering the small footprint of the cable infrastructure (1.03 km^2), the area of habitat that will be lost, although permanent, will remain localised and will not cause long-term impacts to the associated benthic communities. A non-native species management plan / biosecurity plan for vessels has been developed as part of the Marine Licence application and is detailed in the Construction Environment Management Plan (CEMP). The adoption of the management plan will ensure any risks linked to the introduction of INNS is reduced as much as possible.

17.2.3 Marine mammals

The following cetacean species are considered to regularly occur within the vicinity of the Project; harbour porpoise, bottlenose dolphin, white-beaked dolphin, Risso's dolphin, killer whale and minke whale. Two species of seal inhabit the waters of the Pentland Firth and West of Orkney: the grey seal and the harbour seal. The undisturbed coastlines in Orkney make excellent habitat for seal haul-outs, which is why over a quarter of the harbour seals in the UK can be found in this region. However, there are no designated seal haul-outs which fall within the Project footprint. Scotland remains a stronghold for otters within Europe, with the greatest densities occurring in Shetland and the northern and western parts of the country.

The potential impacts identified as a result of the Project are:

- Increase suspended sediment;
- Potential disturbance at landfall sites; and
- Injury or disturbance from noise emissions.

Given the anticipated limited duration, localised extent and high reversibility of sediment suspension no significant impact has been identified. The cable will be installed using HDD at the landfall, there will be no direct disturbance to the coastline. The presence of vessels adjacent to the shore areas will be minimised and

where possible will limited to works in the location of the HDD pop-outs while the cable is pulled through the HDD duct.

Underwater noise is considered to be the main impact mechanism by which marine mammals in the vicinity of the cable route may be affected. Noise sources which are likely to occur during the installation of the Orkney–Mainland Subsea Cable Link subsea cable and which have the potential to cause injury or disturbance to marine mammals are limited to the following: vessels; cable burial activities; and geophysical survey activities. Installation activities are expected to take place over a relatively short period and vessels will not be in one location for the whole period but will rather traverse the cable route, meaning noise emissions will only occur within a singular location for a brief period. Marine mammal moving away from the temporary noise source will reduce any impacts. Embedded mitigation measures and best practice measures will reduce the risk of injury and disturbance from underwater noise further.

17.2.4 **Ornithology**

There are five protected sites for which the project has the potential to affect; Hoy SPA, North Caithness Cliffs SPA, Scapa Flow pSPA, Caithness and Sutherland Peatlands SPA and Orkney Mainland Moors SPA.

The potential impacts identified as a result of the Project are:

- Physical disturbance and/or displacement due to vessel presence;
- Disturbance and/or displacement of seabirds due to increased turbidity in the water column;
- Indirect effects on seabirds due to changes in distribution of prey items; and
- Indirect effects on prey species due to EMF during cable operation

Physical disturbance would be restricted to the export cable corridor footprint and at any one time to the immediate vicinity of the Project vessels when they are operating. Disturbance associated with vessel presence / activity is of limited duration and also represents a transient impact as vessels move through an area. Impacts are spatially and temporally restricted and are considered unlikely to affect the breeding productivity or survival rates of an individual or population. The presence of vessels adjacent to the shore areas will be minimised during sensitive periods for breeding birds and where possible will limited to works in the location of the HDD pop-outs limiting the disturbance to species along the shoreline.

The increase in suspended sediment has the potential to effect visual seabird foragers, yet because the increase will be temporary in nature and the suspended sediment will settle on the seabed (small spatial extent) it is not considered likely there will be a large effect on seabird foraging.

The change in habitat or abundance and distribution of prey, is not considered to be significant compare to the overall foraging range of each seabird species. The effect of EMF only constitutes a minor shift away from baseline conditions given the localised nature of the effect. Any changes to the distribution of seabird prey species and habitat during the operation of the Project as a result of EMFs is not significant considering the size of the Project in relation to each species' total foraging range.

17.2.5 **Marine archaeology**

A review was undertaken of existing literature, data sources and databases to identify known sites in the area, and the potential for unidentified marine cultural heritage sites and areas. Marine survey data (geophysical data) for the Project area was also reviewed to identify the potential presence of marine historic assets in the survey area.

No marine cultural heritage statutory designations have been identified in the cable survey corridor. There are no shipwrecks or aircraft with known locations in proximity to the cable route. However, some geophysical contacts and anomalies have been identified that are probably anthropogenic and may be of archaeological importance.

The potential impacts identified as a result of the Project are:

- Direct damage to or destruction of known marine historic environment assets including geophysical anomalies and UXO; and
- Potential indirect damage to or destruction of known and unknown marine historic environment assets including UXO.

The cable will avoid known sites and there is a low likelihood of the cable being accidentally laid over unknown sites. Procedures will be in place for reporting accidental discoveries.

17.2.6 Commercial fisheries

A range of species are targeted in ICES rectangle 46E6 by vessels of various sizes, 30 species were recorded in the landings data from 2013 to 2017 for vessels under 10 m and 56 species were recorded for vessels over 10 m in length. The area of the proposed cable route is considered a nursery area for herring but does not support herring or sand eel spawning.

The potential impacts identified as a result of the Project are:

- Temporary loss of access to fishing grounds;
- Change in distribution of target species;
- Permanent loss of access to fishing grounds;
- Change in distribution of target species; and
- Snagging risk.

Some fishermen will experience a temporary loss of traditional fishing grounds in the immediate vicinity of the cable route due to the presence of installation vessels which will have safety zones in place during operations. Project vessels will adopt a rolling Safety Zone so that disruption will not affect the entire route initially. The proposed cable rote does not intersect with the spawning area of any commercially important species, therefore there will not be an impact to spawning as a result of benthic habitat disturbance or removal. The habitat loss resulting from trenching is minimal and species have the ability to move away from the impact.

All protection will be designed to have a smooth overtrawlable profile, with the rock grade utilised suitable for the nature of fishing activity typically undertaken in the area. Static gear such as pots are also not anticipated to be affected during the operational phase, since the cable protection design accounts for the placement of static gear over the cable. Prior to installation a CMS and CBP will be produced, including method statements for and requirements of cable protection for approval by the Regulators and in discussion with fisheries stakeholders. Following the installation of the cables, as built survey information will be provided to the UKHO for inclusion in admiralty charts, and the Kingfisher Cable awareness charts will be updated to advise fishermen on their location. Post installation inspection surveys and any necessary maintenance will be conducted along the length of the cable on a regular basis, this will ensure cables remain buried and protected, and rock berms remain overtrawlable.

17.2.7 Offshore infrastructure and other sea users

The following receptors have been considered within the baseline characterisation; renewable energy projects, cables and pipelines, oil and gas infrastructure, potential UXO, aggregate extraction and disposal sites and recreational activities. No oil and gas infrastructure or UXOs have been identified in the proximity of the project. Two cables cross the installation corridor however as crossing agreements will be in place no further assessment has been required.

The potential impacts identified as a result of the Project are:

- Disruption to renewable energy projects planned routes and access to working areas;
- Disruption to aggregate extraction and disposal sites;

- Disruption to recreational activities;
- Permanent alteration to planned routes and access to working areas.

Project vessels have the potential to disrupt any planned routes and associated access areas associated with the receptors. The proposed works will be highly localised and temporary. Notice to Mariners (including local), Kingfisher bulletins, Radio Navigational Warnings, NAVTEX, and/or broadcast warnings will be promulgated in advance of any proposed works and a maximum 2 km safety zone will be in place around vessels. A working zone is required either side of the proposed cable route to enable access for cable maintenance and repair operations.

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APPENDIX A: CONSULTATION

marinescotland

Scottish Government
Riaghaltas na h-Alba
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Marine Scotland - Licensing Operations Team Advice on the Proposed Content of the Environmental Assessment to Support a Marine Licence Application

Scottish Hydro Electric Transmission (per Xodus Group), Subsea Cable Installation – Orkney to Caithness

ADVICE ON THE PROPOSED CONTENT OF THE ENVIRONMENTAL ASSESSMENT TO SUPPORT A MARINE LICENCE APPLICATION TO INSTALL A SUBSEA CABLE WITHIN THE SCOTTISH MARINE AREA.

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1. Executive Summary

This is the advice provided by the Scottish Ministers, as to the content and level of detail of information to be provided in an environmental assessment submitted in support of a marine licence application for the proposed installation of the subsea cable between Orkney and Caithness ("the proposed works"). The advice has been requested by Scottish Hydro Electric Transmission ("the applicant").

This advice is based on the information provided in the applicant's request, dated 19 July 2018, for the Scottish Ministers to provide advice. The request included the submission of a report identifying the additional studies required to support a marine licence application in the opinion of the applicant. The Scottish Ministers have consulted on the report provided and the responses received have been taken into account in providing this advice. The matters addressed by the applicant in the report have been carefully considered and use has been made of professional judgement (based on expert advice from stakeholders) and experience in order to provide this advice.

Detailed information is provided in the specialist topic sections. Matters are not recommended for exclusion unless specifically addressed and justified by the applicant and confirmed as being excluded by the Scottish Ministers. Table 1 summarises the Scottish Ministers' advice on whether topics are to be included or excluded.

Table 1: The Scottish Ministers' advice as to whether topics are to be included or excluded.

Topic	Reason for Inclusion/Exclusion
Protected Sites	INCLUDED. Multiple consultees raised potential impacts on designated sites which require further assessed.
Physical Environment and Seabed Conditions	EXCLUDED. All concerns regarding this receptor will be addressed through the benthic and intertidal chapter.
Benthic and Intertidal Ecology	INCLUDED. European protected bedrock reefs have been identified in the cable corridor and there is the potential for priority marine features which require further assessment.
Fish Ecology	INCLUDED. Potential impacts on Atlantic salmon from underwater noise, suspended sediment and electromagnetic field emissions require assessment. There is also the potential for disturbance to basking sharks.

Ornithology	INCLUDED. Cable corridor crosses three designated sites for birds and there are further potential impacts at landfall locations which require assessment.
Marine Mammals	INCLUDED. The cable is in an area of high usage by pinnipeds and potential for otters along the coastline. Also potential for underwater noise to disturb cetaceans.
Commercial Fisheries	INCLUDED. Cable route is area which is important for commercial fisheries. The potential impacts on this sector require further assessment.
Shipping and Navigation	INCLUDED. Navigational risk assessment and detailed cable burial plan required.
Marine Archaeology	INCLUDED. Potential wrecks and other deposits close to the route so further surveys are required.
Other Sea Users	INCLUDED. Further consultation to identify and mitigate any potential impacts on other sea users required.

For the avoidance of doubt, the provision of this advice by the Scottish Ministers does not preclude the Scottish Ministers from requiring the applicant to submit additional information in connection with any assessment submitted with their application for a marine licence relative to the proposed works.

In the event that an application is not submitted by the applicant for the proposed works within 12 months of the date of this advice, the Scottish Ministers recommend that the applicant seeks further guidance from them regarding the potential to update this advice.

2. Introduction

2.1 Background

2.1.1 We refer to your email of 19 July 2018 requesting advice from the Scottish Ministers on the proposed content of the environmental assessment to be submitted in support of a marine licence application. Your request included a report which contained a description of the location of the works, including a plan sufficient to identify the area in which the works are proposed to be sited, and a description of the nature and purpose of the proposed works and their likely impact on the environment. The Scottish Ministers consider that they have been provided with sufficient information to provide the requested advice.

2.2 The requirement for Environmental Assessment

2.2.1 Whilst standalone submarine cable projects are not listed as Environmental Impact Assessment ("EIA") projects under Schedule 1 or 2 of The Marine Works (Environmental Impact Assessment) (Scotland) Regulations 2017 (as amended), the Scottish Ministers require an application for a marine licence to be accompanied by a report of the potential environmental effects of the works including details of the studies carried out, in this case termed an "Environmental Assessment" ("EA"). The Scottish Ministers offer to provide advice on the content of such a report in a similar manner to the scoping opinion provided for EIA projects. This aims to ensure that the required information can be considered at the pre-application stage.

2.3 The content of this advice

2.3.1 In regards to your request for a scoping opinion on the proposed content of the required environmental assessment, the Scottish Ministers have considered the documentation provided to date and consulted with the appropriate consultation bodies (see Appendix I) in reaching their opinion.

2.3.2 The process is vital in generating an understanding of the biological, chemical and physical processes operating in and around the proposed works' location and those that may be impacted by the proposed activities. We would however state that references made within this document with regard to the significance of impacts should not prejudice the outcome of the marine licence application. It is therefore expected that these processes will be fully assessed in the EA unless advised otherwise.

3. Description of works

3.1 Background to the works

3.1.1 The proposal by the applicant is to lay a new HVAC marine cable linking mainland Orkney to mainland Scotland. The proposed landfall locations are at Dounreay in Caithness on the mainland and Warebeth (Billia Croo) on Orkney. The applicant intends to bury the cable along the majority of the route however where burial is not possible, it may be necessary to use other protection measures such as rock placement, concrete mattressing, Uraducting or cast iron half shells. The exact installation method has not been confirmed at the time of providing this advice.

4. Aim of this opinion

4.1 The process

4.1.1 This pre-application process provides the first identification, and likely significance, of the environmental impacts of the proposal and the information needed to enable their assessment. The process is designed to identify which impacts will or will not need to be addressed in the EA. This includes the range of impacts to be addressed and the method of assessment to be used. The pre-application process also allows consultees to have early input into the application process, to specify their concerns and to supply information that could be pertinent to the works. In association with any comments herein, full regard has been given to the information contained within the documentation submitted with the advice request.

4.1.2 The Scottish Ministers have also used this opportunity to provide advice in relation to the licensing requirements, (see Appendix II).

5. Consultation

5.1 The consultation process

5.1.1 On receipt of the request documentation, the Scottish Ministers initiated a 30 day consultation process, which commenced on 31 July 2018. The following bodies were consulted:

- Caithness West Community Council
- Crown Estate Scotland
- Dounreay
- European Marine Energy Centre
- Fisheries Management Scotland
- *Highland Council*
- Highland Council Harbours Authority
- Highland and Islands Enterprise
- *Historic Environment Scotland ("HES")*
- Joint Nature Conservation Committee ("JNCC")
- Kirkwall Fishery Office
- Marine Safety Forum
- Marine Planning and Policy
- *Maritime and Coastguard Agency ("MCA")*
- *Ministry of Defence ("MOD")*
- *Northern Lighthouse Board ("NLB")*
- Orkney Fisheries Association
- Orkney Islands Council
- *Royal Society for the Protection of Birds Scotland ("RSPB")*
- *Royal Yachting Association Scotland ("RYA")*
- *Scottish Environment Protection Agency ("SEPA")*
- *Scottish Fishermen's Federation*
- *Scottish Natural Heritage ("SNH")*
- Scottish Wildlife Trust
- Scrabster Fishery Office
- Stromness Community Council
- *UK Chamber of Shipping*
- Whale and Dolphin Conservation Society

5.2 Responses received

5.2.1 From the list above a total of 11 responses were received from those listed in italics. The purpose of the consultation was to obtain advice and guidance from each

consultee or advisor as to which potential effects should be included or excluded from the EA.

5.2.2 The sections below highlight issues which are of particular importance with regards to the EA and any marine licence application. Full consultation responses are attached in Appendix I and each should be read in full for detailed requirements from individual consultees. The Scottish Ministers expect all consultee concerns to be addressed in the EA unless otherwise stated.

6. Contents of the environmental assessment

6.1 Requirements of the Environmental Assessment

6.1.1 The EA must be based on this advice and must include the information that may be reasonably required for reaching a reasoned conclusion, which is up to date, on the significant effects of the works on the environment, taking into account current knowledge and methods of assessment.

6.1.2 A gap analysis template is attached at Appendix III to record the environmental concerns identified during this pre-application process. This template should be completed and used to inform the preparation of the EA.

6.2 Mitigation

6.2.1 Within the EA it is important that all mitigating measures are:

- clearly stated;
- accurate;
- assessed for their environmental effects;
- assessed for their effectiveness;
- fully described with regards to their implementation and monitoring, and;
- described in relation to any consents or conditions.

6.2.2 The EA should contain a mitigation table providing details of all proposed mitigation discussed in the various chapters. Refer to Appendix I for consultee comments on specific baseline assessment and mitigation.

6.2.3 Where potential environmental impacts have been fully investigated but found to be of little or no significance, it is sufficient to validate that part of the assessment by detailing in the EA:

- the work that has been undertaken;
- what this has shown i.e. what impact, if any, has been identified; and
- why it is not significant.

6.3 Design Envelope

6.3.1 The exact nature of the work that is needed to inform the EA may vary depending on the design choices. Where flexibility in the design envelope is required, this must be defined within the EA and the reasons for requiring such flexibility clearly stated. To address any uncertainty the EA must consider the potential impacts associated with each of the different scenarios. The criteria for selecting the worst case, and the most likely scenario, along with the potential impacts arising from these,

must also be described. The Scottish Ministers will determine the application based on the worst case scenario. The EA will reduce the degree of design flexibility required and the detail will be further refined in a Construction Method Statement ("CMS") to be submitted to the Scottish Ministers, for their approval, before works commence. The CMS will freeze the design of the project and will be reviewed by the Scottish Ministers to ensure that the worst case scenario described in the EA is not exceeded.

7. Interests to be considered within the environmental assessment

7.1 Introduction

7.1.1 The report provided by the applicant considered the likely impacts on the environment under the headings and topics addressed below. This section also contains a summary of the main points raised by consultees and the Scottish Ministers' advice on whether each topic should be included or excluded from the environmental assessment. The consultation responses are contained in Appendix I and the applicant is advised to carefully consider these responses and use the advice and guidance contained within them to inform the EA.

7.2 Protected Sites

7.2.1 The applicant provides an assessment of all of the designated sites that are likely to be impacted by the works and identifies those for which further assessment is required. The applicant also proposes that the impact on certain qualifying features will be included within the specific chapters of the EA such as benthic ecology, ornithology and marine mammals. However, even with the assessment of the impacts in the specialist chapters, the applicant concludes that a chapter on protected sites should be included in the EA.

7.2.2 In their consultation response, the Highland Council support the view that the North Caithness Cliffs SPA and Hoy SPA should be assessed. The RSPB also support the need for further assessment of the impact on protected sites and in particular suggest clarification on the works location relative to the Scapa Flow pSPA. SNH are also of the view that protected sites should be included in the EA and recommends a list of potential impacts which require to be assessed. SNH also recommend that an assessment of cumulative impacts with other projects be carried out as part of the Habitats Regulations Appraisal.

7.2.3 The Scottish Ministers agree with the conclusion that protected sites should be included within the EA and this should include an assessment of the potential impacts identified by SNH in their consultation response.

7.3 Physical Environment and Seabed Conditions

7.3.1 The applicant has commissioned geophysical and geotechnical surveys to inform the assessment in their report. No seabed features of conservation importance were identified by the surveys and the impacts on benthic and intertidal ecology will be addressed through other chapters. On this basis, the applicant

proposes that the physical environment and seabed conditions should be excluded from the EA.

7.3.2 The physical environment and seabed conditions were not discussed by any of the consultees in their consultation responses.

7.3.3 The Scottish Ministers are satisfied by the assessments carried out by the applicant and have concluded that any impacts on this receptor will be covered in the benthic and intertidal ecology chapter and thus physical environment and seabed conditions should be excluded from the EA.

7.4 Benthic and Intertidal Ecology

7.4.1 The applicant has identified the presence of European protected bedrock reefs and suggested that there may also be priority marine features in the vicinity of the proposed works. Their report identifies a number of potential impacts of the works on these features. Based on this information, the applicant has concluded that benthic and intertidal ecology should be included within the EA.

7.4.2 In their consultation responses, the RSPB and SEPA support the view of the applicant and request that further assessment of benthic and intertidal ecology is carried out. SNH have requested clarity on whether or not priority marine features have been identified along the cable route and emphasised the importance of addressing the impact on these features, should any be identified.

7.4.3 The Scottish Ministers concur with the applicant and the views of the consultees that an assessment of the impact on the bedrock reefs is required and in addition, further surveys should be carried out to determine the presence or absence of priority marine features and to assess any impacts should they be identified. On this basis, benthic and intertidal ecology should be included within the EA.

7.5 Fish Ecology

7.5.1 In their report, the applicant has addressed the potential impact on fish from direct impact to spawning and nursery habitats, underwater noise, electromagnetic field (“EMF”) emissions, potential collision risk for basking sharks and sediment disturbance and concluded that no further assessment is required mainly due to the highly mobile nature of fish. The report also cites the low number of vessels and short duration of the works as reasoning for their conclusion. With relation to the ongoing effects of EMF emissions, the applicant concludes that the cable burial and protection plan, effects from this are unlikely.

7.5.2 SNH raised concerns regarding the potential effects of the works on Atlantic salmon from underwater noise, suspended sediment release and electromagnetic

field emissions. Salmon from a number of SACs are likely to pass through the works area and SNH have recommended that further assessment of the impacts on this species is required especially in relation to the cable burial plan. In addition, there is a potential for disturbance to basking sharks to be caused during the installation works which requires further assessment.

7.5.3 The Scottish Ministers agree with the view of SNH that when considering the potential impacts on species specifically protected by legislation or as a feature of a designated site, further assessment is required. Thus fish ecology should be included in the EA to assess the potential impacts on Atlantic salmon and basking sharks.

7.6 Ornithology

7.6.1 The applicant proposes that ornithology is included within the EA. This is because the proposed cable route crosses three sites designated for the protection of bird species; the Hoy SPA, the North Caithness Cliffs SPA and the Scapa Flow pSPA. They also identify the potential for localised disturbance at each of the landfalls.

7.6.2 In their consultation response, the RSPB recommended that ornithology should be assessed in the EA. In addition to the points in the applicant's report, they also request that the potential impact from marine traffic and accidental fuel spillage are assessed. Both SNH and the RSPB request further assessment of the impact on birds at the landfall points. SNH also support the applicant's proposal to assess the impact on designated sites.

7.6.3 The Scottish Ministers agree with the applicant and the consultees that ornithology should be included in the EA to assess the impact on designated sites and at the landfall locations.

7.7 Marine Mammals

7.7.1 The applicant has identified that there are several species of cetacean which occur within the vicinity of the proposed cable route although the encounter rate is low or very low so they have proposed that there is unlikely to be a significant impact on these species. The applicant's report finds that habitat usage by pinnipeds is very high around the landfall in Orkney and medium in Caithness. On this basis and considering the population decline around Orkney, they propose that additional assessment is required of the impact on pinnipeds. The applicant has also proposed that further assessment of the potential impact on otters is required due to their potential presence along the coastline in the vicinity of the proposed landfalls.

7.7.2 In their consultation response, the RSPB support the need for further

assessment of marine mammals. SNH also support the need for assessment of the impact of underwater noise on cetaceans and pinnipeds from vessels and also geophysical surveys and USBL beacons. Further, SNH agree with the applicants report regarding the need for assessment of the impact of the proposals on otters.

7.7.3 The Scottish Ministers agree with the views in the applicant's report regarding the need for further assessment of otters and pinnipeds. In addition, the protected nature of cetaceans means that the impacts of underwater noise on these species requires assessment in line with the SNH advice. On this basis, the Scottish Ministers have concluded that marine mammals should be included in the EA.

7.8 Commercial Fisheries

7.8.1 The applicant identifies that the proposed cable route is located in waters that are important to the commercial fishing industry and that the impact of the cable laying activity on the sector requires further assessment. The main impact pathways are identified as temporarily restricting access to the fishing grounds and on the abundance and distribution of target species.

7.8.2 In their consultation response, the Scottish Fishermen's Federation emphasise the need for further assessment of the impacts on commercial fisheries including on the use of traps, scallop fishing and the potential loss of access post lay.

7.8.3 The Scottish Ministers concur with the applicant and consultees that the potential impact on commercial fisheries requires further assessment and thus should be included within the EA.

7.9 Shipping and Navigation

7.9.1 In their report, the applicant identifies that vessel density is low along the majority of the cable route and at the landfall points however there is a short section where shipping density is high due to the fishing and cargo routes which run east to west through the Pentland Firth. As the slow moving cable lay vessel will be transiting perpendicular to the main flow of traffic, there is a risk of collision and the applicant proposes the need to carry out a navigational risk assessment to be included within the EA.

7.9.2 In their consultation responses, the RYA, MCA and NLB support the need for a navigational risk assessment and the MCA also request further details of the burial and cable protection plan and how this will be achieved. The RYA highlight the need for further assessment in particular of the activities around the entrance to Hoy Sound and the impact this may have on recreational boaters and also for consideration to be given to the methods of communicating the proposed works to the recreational boating community. In their consultation response, the UK Chamber

of Shipping echo the views of the other consultees with regards to potential impacts on navigation and anchoring activity and the need to see further detail on the cable burial plan.

7.9.3 The Scottish Ministers agree with the applicant and the consultees that a navigational risk assessment should be carried out to address the potential impacts on navigation and anchoring. In addition, a detailed cable burial and protection plan should be submitted to support the navigational risk assessment. On this basis, the Scottish Ministers have concluded that shipping and navigation should be included in the EA.

7.10 Marine Archaeology

7.10.1 The applicant has reported that there are no charted wrecks along the proposed route however there are a number of potential wrecks and other deposits close to the route. They therefore propose to carry out a desk based assessment and to collect further survey data to try to identify any potential unknown sites prior to confirming the final routing of the cable. These additional studies should be included within the EA.

7.10.2 In their consultation response, HES support the conclusions of the applicant's report and agree with the further assessment methods proposed.

7.10.3 The Scottish Ministers support the views of the applicant and the consultees that the proposed assessments and survey should be carried out and the results included in the EA.

7.11 Other Sea Users

7.11.1 The applicant identifies a number of other sea users who have interests in the vicinity of the cable route. Following an assessment of each in turn, the applicant concludes that the potential impacts from loss of access and collision require further assessment and should be included within the EA.

7.11.2 The Highland Council, in their consultation response, identify the nuclear sites as also having a potential interest and recommend that they are included in the list of other sea users who should be considered by the applicant in their EA.

7.11.3 The Scottish Ministers support the need for further assessment and potential consultation with the other sea users that have been identified by the applicant and consultees to try and minimise any impact of the proposed works. On this basis, other sea users should be included in the EA.

8. Marine Planning

8.1 Background

8.1.1 The development of projects requiring an environmental assessment should be in accordance with the UK Marine Policy Statement and the National Marine Plan ("NMP").

8.2 The UK Marine Policy Statement 2011

8.2.1 The UK Administrations share a common vision of having clean, healthy, safe, productive and biologically diverse oceans and seas. Joint adoption of a UK-wide Marine Policy Statement provides a consistent high-level policy context for the development of marine plans across the UK to achieve this vision. It also sets out the interrelationship between marine and terrestrial planning regimes. It requires that when the Scottish Ministers make decisions that affect, or might affect, the marine area they must do so in accordance with the Statement.

8.3 Scotland's NMP 2015

8.3.1 Developed in accordance with the Marine (Scotland) Act 2010 and the Marine and Coastal Access Act 2009 (as amended), the NMP provides a comprehensive statutory planning framework for all activities out to 200 nautical miles. This includes policies for the sustainable management of a wide range of marine industries. The Scottish Ministers must make authorisation and enforcement decisions, or any other decision that affects the marine environment, in accordance with the NMP. The NMP sets out a presumption in favour of sustainable development and use of the marine environment when consistent with the policies and objectives of the Plan.

8.4 Applicant and Environmental Assessment

8.4.1 It should be noted that any changes produced after the environmental assessment is submitted may require further environmental assessment and public consultation.

9. Judicial review

All decisions may be subject to judicial review. A judicial review statement should be made available to the public.

10. Gaelic Language

If the proposed works are located in an area where Gaelic is spoken, the applicant is

encouraged to adopt best practice by publicising details of the proposed works in both English and Gaelic.

Redacted

Appendix I: Consultee Responses

Highland Council

The Highland Council
Comhairle na Gàidhealtachd

Marine Scotland
Scottish Government
Marine Laboratory
375 Victoria Road
Aberdeen
AB11 9DB

Please ask for / Foighnich airson: [Redacted]
Direct Dial / Àireamh fòn: [Redacted]
Email / Post-d: [Redacted]

Our Ref / Ur n-àireamh-iùil: 18/03597/PREAPP/SHTU/KAHU
Your Ref / Ar n-àireamh-iùil:
Date / Ceann-là: 17 August 2018

Dear Sir/Madam

MS-LOT CONSULTATION: SHE TRANSMISSION - ORKNEY TO CAITHNESS SUBSEA LINK AT ORKNEY TO CAITHNESS

Thank you for consulting The Highland Council on the above application, which was received on 26/07/18. We hope the following comments may be useful.

Section 1.7.2 It would be helpful to know which sections of cable will be surface laid and which will be buried and the corresponding seabed conditions to ensure any impacts on Priory Marine Features are minimized.

Section1.7.4. Once the chosen landfall site method of installation is determined, an assessment of impacts on the North Caithness Cliffs Special Protection Area will be required. Given the close proximity of the nuclear sites, advice from both establishments may be helpful regarding any potential impacts.

Section 2.1 Notes the nearest conservation site is Hoy SPA; the Caithness Cliffs SPA is also within the proposal area.

If you have any further questions regarding the application please contact the case officer.

Yours faithfully

[Redacted]
Case Officer

Historic Environment Scotland

HISTORIC ENVIRONMENT SCOTLAND | ÀRAINNEACHD EACHDRAIDHEIL ALBA

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T: 0131 668 8716

By email to [Redacted]

[Redacted]
Marine Licensing Casework Manager
Marine Scotland
Marine Laboratory
375 Victoria Road
Aberdeen
AB11 9DB

Our ref: AMN/16/R
Our case ID: 300030469

28 August 2018

Dear [Redacted]

Marine (Scotland) Act 2010
Orkney to Mainland Subsea Link - Orkney to Caithness
Pre-application/scoping consultation

Thank you for your correspondence dated 31 July seeking comments on the above. We have reviewed the details provided and our comments here concentrate on our historic environment interests for scheduled monuments and their settings, category A listed buildings and their settings, World Heritage Sites, gardens and designed landscapes (GDL) appearing in the Inventory, Inventory battlefields and Historic Marine Protected Areas (Marine (Scotland) Act 2010). In this case, our advice also includes matters relating to marine archaeology outwith the scope of the terrestrial planning system.

If you have not already done so, I recommend that you consult the relevant local authority's archaeological and conservation services who will also be able to comment on potential impacts to the historic environment. This may include heritage assets outwith our remit, such as category B and C listed buildings and unscheduled archaeology.

Proposed development
We understand that the proposed development comprises the installation of a 220kV alternating current (AC) cable system between Orkney and Caithness. The selected route option for the cable runs between Dounreay on the Scottish mainland and Billia Croo, Warebeth on Orkney. It is intended to bury the subsea cable along the majority of the route with a variety of installation and burial techniques likely to be required along the proposed cable corridor.

Scope of assessment
Marine assets - potential impacts
In relation to the submitted search area of a 1km wide corridor along the proposed cable route, we can confirm that there are no statutory designation within our remit located within this area.

We welcome that the pre-application report identifies that there are a number of wrecks potentially located within the area covered by the proposed cable route and that there is the potential for impacts on both known and unknown marine historic environment assets along the route. We note that geophysical and geotechnical data will be assessed and

used to identify potential unknown assets of archaeological importance within the marine survey corridor. We acknowledge that the intention is to re-route the proposed subsea cable to avoid impacts to any historic environment assets. We welcome the proposal to include a mitigation strategy to eliminate or reduce any adverse impacts to an insignificant level, including a reporting protocol.

The report indicates that additional information is required for Marine Archaeology to support the Marine Licence application for the proposed subsea cable. We agree that further information is required at this stage. We note that a Marine Historic Environment Appraisal will be carried out by ORCA to assess potential effects on marine historic environment assets. We are content that the information summarised in section 3.3.4 should be sufficient to provide an adequate assessment of effects.

We would be happy to provide further comment on the historic environment appraisal as further information becomes available if that would be helpful.

Further information
Guidance about national policy can be found in our 'Managing Change in the Historic Environment' series available online at www.historicenvironment.scot/advice-and-support/planning-and-guidance/legislation-and-guidance/managing-change-in-the-historic-environment-guidance-notes. Technical advice is available on our Technical Conservation website at http://conservation.historic-scotland.gov.uk/.

We hope this is helpful. Please contact us if you have any questions about this response. The officer managing this case is [Redacted] and they can be contacted by phone on [Redacted] or by email on [Redacted] .

Yours sincerely

Historic Environment Scotland

Cc. ms.majorprojects@gov.scot

Maritime and Coastguard Agency

[Redacted]

From: navigation safety <navigationsafety@mcga.gov.uk>
Sent: 19 October 2018 11:47
To: MS Marine Licensing
Subject: RE: SHE Transmission – Orkney to Caithness - pre-application consulation - deadline for response 30 August 2018

Dear Marine Scotland,

Thank you for the opportunity to comment on this pre-application consultation by the developer for a sub-sea cable running from Caithness to Orkney. Please accept our apologies for the long delay in reply.

We note that the developer intends to protect as much of the cable route as possible through burial and additional cable protection. At the formal marine licencing stage we would ideally like to see further details on how this will be achieved, including the results of any applicable penetration studies. We would like to remind the developer of the MCA's policy that any consented cable/pipeline protection works must ensure existing and future safe navigation is not compromised. The MCA would accept a maximum of 5% reduction in surrounding depth referenced to Chart Datum but under no circumstances should depth reductions compromise safe navigation.

We welcome the developer's intent to submit a navigation risk assessment, and look forward to being able to review this at the formal marine licencing stage. At this point the MCA is likely to propose a number of our standard conditions and advisories for consideration by Marine Scotland.

Should you have any questions please feel free to get in touch.

Best Regards,

[Redacted]
Marine Licencing Lead
Maritime & Coastguard Agency
Spring Place, 105 Commercial Road, Southampton, SO15 1EG
[Redacted]

Maritime & Coastguard Agency | HM Coastguard

Safer Lives, Safer Ships, Cleaner Seas

Ministry of Defence

[Redacted]

From: DIO-Safeguarding-Offshore (MULTIUSER) <DIO-Safeguarding-Offshore@mod.gov.uk>
Sent: 01 August 2018 09:08
To: [Redacted] ; MS Major Projects
Subject: RE: 20180801-SHE Transmission – Orkney to Caithness - pre-application consultation -DIO 10043929-O

Good Morning [Redacted]

Further to your e-mail below and after our investigation, I can confirm that the MOD has No Objection regarding this activity in the locations specified. I hope this information is sufficient for your purposes.

Regards

[Redacted]

Safeguarding Assistant
Estates – Safeguarding

Defence Infrastructure Organisation

Building 49, DIO Sutton Coldfield, Kingston Road, B75 7RL

[Redacted]

Website: www.gov.uk/dio/ | **Twitter**: @mod_dio

Read DIO's blog: https://insidedio.blog.gov.uk/



Northern Lighthouse Board

Northern Lighthouse Board

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Email: enquiries@nlb.org.uk

Your Ref: Orkney – Caithness Subsea Link
Our Ref: AL/OPS/ML/S8_15_242

[Redacted]
Redacted
Marine Scotland – Marine Planning & Policy
Scottish Government
Marine Laboratory
375 Victoria Road
ABERDEEN
AB11 9DB

01 August 2018

Dear [Redacte

SCOTTISH HYDRO ELECTRIC TRANSMISSION PLC – ORKNEY TO MAINLAND SUBSEA LINK – ORKNEY TO CAITHNESS – PRE–APPLICATION CONSULTATION

Thank you for your e-mail correspondence dated 31st August 2018 regarding the pre-application consultation submitted by Scottish Hydro Electric Transmission plc (SHET), regarding the proposal for a new subsea cable between Orkney and Caithness. It is noted that SHET plan to carry out a full Navigational Risk Assessment for the project, prior to any Marine Licence application.

Northern Lighthouse Board has no objections to this proposal, and recommends the following:

- **SCOTTISH HYDRO ELECTRIC TRANSMISSION PLC should** liaise with all local marine stakeholders, and the UK Hydrographic Office (UKHO) regarding the promulgation of Notices to Mariners and local Radio Navigation Warnings, stating the nature, location, timescale, and any other appropriate details of any project works.

- Cable Marker Boards shall be installed at all landfall sites – these boards shall be diamond shaped, with dimensions 2.5 metres long and 1.5 metres wide, background painted yellow with the inscription 'Cables' painted horizontally in black. The structures shall be mounted at least 4 metres above ground level.

- The Statutory Sanction of the Commissioners of Northern Lights is required for the establishment of these Aids to Navigation. The form to request the Statutory Sanction is available through the Northern Lighthouse Board website.

- Upon completion, all cable routes and landfall positions are to be communicated to the UKHO in order that the relevant charts are updated.

If any further information is required, please do not hesitate to contact the Navigation Department at navigation@nlb.org.uk.

Yours sincerely
[Redacted]

Redacted

Royal Society for the Protection of Birds

giving nature a home
Scotland

Email: ms.majorprojects@gov.scot
Date: 29th August 2018

Dear [Redacted]

SHE Transmission –Orkney to Mainland Subsea Link – Orkney to Caithness

Thank you for consulting RSPB Scotland on the above.

The preferred route option for the subsea cable link will likely pass through the Hoy Special Protection Area (SPA) marine extension, the North Caithness Cliffs SPA marine extension (both designated for internationally important numbers of breeding seabirds as well as peregrine; and red-throated diver in Hoy) and the Scapa Flow pSPA (designated for internationally important wintering populations of sea ducks and divers and breeding re-throated diver). Please note the description in table 2.1 on page 20 of the scoping report is incorrect with regards to Scapa Flow pSPA.

According to the map in figure 2.1 (but not table 2.1), the landfall area also seems to cross the Stromness Heaths and Coast Special Area of Conservation (SAC) and Site of Special Scientific Interest (SSSI), designated for the special geology and internationally important habitats. There is also potential for the landfall area to cross the Warebeth, Stromness Local Nature Conservation Site (LNCS) which protects small areas of Aeolianite and plants associated with it. This site was not recognised in the scoping document.

Where there is potential for a project have an adverse effect on a Natura site SAC or SPA including proposed sites i.e. pSPAs, an appropriate assessment is required in accordance with the Birds and Habitats Directive to ascertain whether a project will adversely affect the integrity of a site in view of the conservation objectives of the site. Therefore we would like to see robust data collection and analysis work that is fit to produce a Habitats Regulations Assessment (HRA) for Marine Scotland to enable an appropriate assessment of the project to be undertaken.

Due to the large-scale scope of this work and the fact it passes though some designated sites, we agree with the report identifying further assessment work required to support a marine licence application with regards to the following receptors: protected sites, benthic and intertidal ecology, ornithology and marine mammals.

However, we would like to see the assessment address the following additional points to inform a robust HRA.

1. The map in figure 2.1 does not show how the preferred route passes through Scapa Flow pSPA, but the table 2.1 indicates that it is 0km away. We would like to see clearly how the route overlaps with the site. If there is indeed an overlap with the pSPA we would like to see an assessment on the benthic impacts of the cable burial on food resources and availability since the area important for wintering birds as a

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Stromness
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BirdLife INTERNATIONAL
The RSPB is part of BirdLife International, a partnership of conservation organisations working to give nature a home around the world.

Patron: Her Majesty the Queen Chairman of Council: Kevin Cox President: Miranda Krestovnikoff
Chairman, Committee for Scotland: Professor Colin Ga braith Director, RSPB Scotland: Anne McCall Regional Director: Martin Auld
The Royal Society for the Protection of Birds (RSPB) is a registered charity in England and Wales 207076, in Scotland SCO37654

foraging area, in addition to disturbance and displacement during construction and maintenance. This is missing from table 2.3.

2. Other potential impacts on birds that should be assessed with regards to cable installation, maintenance and decommissioning include disturbance and displacement from marine traffic on the sea surface. This is missing from table 2.2.
3. Any bird survey data collected at sea should be sufficient to characterise day to day variability in bird activity as well as seasonal variability. This is because food supply and weather vary substantially between years and that will impact bird behaviour. We would be happy to review and comment on a more detailed proposal for the ornithological assessment prior to it being undertaken.
4. We would also like to see a rigorous assessment of the impacts of an accidental fuel spillage on marine ecology and birds.
5. We would like to see further information on the landfall area. We understand this will be addressed in a separate application, however, improved maps of planned infrastructure above and below the mean high water spring could show us where the subsea cable ends and the landfall begins, as currently this is unclear.

Yours sincerely,

[Redacted]

Conservation Officer

[Redacted]

Royal Yachting Association Scotland

RYA Scotland

Royal Yachting Association Scotland

RYA Scotland

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13 August 2018

[Redacted]

Marine Scotland - Marine Planning & Policy
Scottish Government, Marine Laboratory,
375 Victoria Road, Aberdeen,
AB11 9DB
[Redacted]

ms.majorprojects@gov.scot

Dear [Redact

SHE Transmission –Orkney to Mainland Subsea Link – Orkney to Caithness

On behalf of RYA Scotland, I agree with the statement at the end of section 2.9 that further assessment work is required [on the impacts on shipping and navigation]. The distribution of recreational vessel movements in this area is shown on the RYA AIS intensity map that can be seen on NMPi. The actual number of movements can be approximated by multiplying figures by five, as about 20% of recreational vessels in the vicinity of the Pentland Firth transmit an AIS signal. The AIS coverage shows that the key recreational routes are from Cape Wrath and the Kyle of Tongue to Stromness. Cable laying in the Pentland Firth should not pose a significant problem for recreational sailors and the landfall sites are unlikely to pose problems either.

However, consideration will need to be given to the impacts of cable laying in the approaches to Hoy Sound, particularly in the light of the usual 500 m exclusion zone. Fig. 1.2 shows the 104° line of the course into Hoy Sound as described in the Clyde Cruising Club *Sailing Directions and Anchorages* volume *Orkney and Shetland Islands*. Accurate timing of approach is essential for safety reasons. Moreover, informing recreational sailors about cable laying there will pose some difficulties as their last port of call might be Stornoway or a harbour further away, and Notices to Mariners are an ineffective way of informing recreational boaters.

A Navigational Risk Assessment, as proposed, will be a good way to consider these issues and identify robust mitigation. RYA Scotland, in the person of myself or one of our local coastwatchers, would wish to contribute to the NRA.

Yours sincerely,

[Redacted]

Planning and Environment Officer, RYA Scotland

sport scotland
LOTTERY FUNDED

The Royal Yachting Association Scotland
A company limited by guarantee and registered in Scotland
Number SC219439

Scottish Environment Protection Agency

Scottish Environment Protection Agency
Buidheann Dìon Àrainneachd na h-Alba

[

Our ref: PCS/160537
Your ref:

If telephoning ask f[R [Redacted]

29 August 2018

[Redacted]
Marine Scotland
Marine Laboratory
375 Victoria Road
Aberdeen
AB11 9DB

By email only to [Redacted]

Dear [Redacte

Marine (Scotland) Act 2010
Report identifying additional studies required to support Orkney - Mainland marine licence application
Orkney to Mainland Subsea Link - Orkney to Caithness

Thank you for your consultation email which SEPA received on 31 July 2018.

You have asked that we provide comments on a 'Report identifying additional studies' required to support Orkney – Mainland subsea cable marine licence application. You further state that the report details what environmental impacts the applicant will consider in more detail to support the marine licence application. We have reviewed the report and have the following comments to make.

We understand that the cable route options are limited due to challenge of site. The route that is proposed/suggested is a pragmatic one where a number of installation options have to be kept for consideration. We advise that any impact is minimised impact where possible.

Section 2.4.2. of the Scoping report by Xodus Group – 'Orkney – Mainland Subsea Cable Link' indicates that developer will have to undertake further work (to support an application for a Marine licence) to consider impacts on the benthic and intertidal ecology so has recognised that more information is needed. Report states that a full assessment of impacts to benthic and intertidal ecology will be undertaken.

We will be happy to review these assessments when they are undertaken.

Regulatory advice for the applicant – with regards to the land fall elements

1. Regulatory requirements

1.1 Authorisation is required under The Water Environment (Controlled Activities) (Scotland)

Regulations 2011 (CAR) to carry out engineering works in or in the vicinity of inland surface waters (other than groundwater) or wetlands. Inland water means all standing or flowing water on the surface of the land (e.g. rivers, lochs, canals, reservoirs).

1.2 Management of surplus soils may require an exemption under The Waste Management Licensing (Scotland) Regulations 2011. Proposed crushing or screening will require a permit under The Pollution Prevention and Control (Scotland) Regulations 2012. Consider if other environmental licences may be required for any installations or processes.

1.3 A Controlled Activities Regulations (CAR) construction site licence will be required for management of surface water run-off from a construction site, including access tracks, which:

- is more than 4 hectares,
- is in excess of 5km, or
- includes an area of more than 1 hectare or length of more than 500m on ground with a slope in excess of 25˚

See SEPA's Sector Specific Guidance: Construction Sites (WAT-SG-75) for details. Site design may be affected by pollution prevention requirements and hence we strongly encourage the applicant to engage in pre-CAR application discussions with a member of the regulatory services team in your local SEPA office.

1.4 Below these thresholds you will need to comply with CAR General Binding Rule 10 which requires, amongst other things, that all reasonable steps must be taken to ensure that the discharge does not result in pollution of the water environment. The detail of how this is achieved may be required through a planning condition.

1.5 Details of regulatory requirements and good practice advice for the applicant can be found on the Regulations section of our website. If you are unable to find the advice you need for a specific regulatory matter, please contact a member of the regulatory services team in your local SEPA office at: Norlantic House, Scotts Road, Hatston, Kirkwall, Orkney, KW15 1GR, Tel: 01856 871080

If you have any queries relating to this letter, please contact me by telephone on 01224 266604 or e-mail at planning.aberdeen@sepa.org.uk

Yours sincerely

[Redacted]
Senior Planning Officer
Planning Service

E copy to: ms.majorprojects@gov.scot

Disclaimer
This advice is given without prejudice to any decision made on elements of the proposal regulated by us, as such a decision may take into account factors not considered at this time. We prefer all the technical information required for any SEPA consents to be submitted at the same time as the planning or similar application. However, we consider it to be at the applicant's commercial risk if any significant changes required during the regulatory stage necessitate a further planning application or similar application and/or neighbour notification or advertising. We have relied on the accuracy and completeness of the information supplied to us in providing the above advice and can take no responsibility for incorrect data or interpretation, or omissions, in such information. If we have not referred to a particular issue in our response, it should not be assumed that there is no impact associated with that issue. For planning applications, if you did not specifically request advice on flood risk, then advice will not have been provided on this issue. Further information on our consultation arrangements generally can be found on our website planning pages.

Scottish Fishermen’s Federation

[Redacted]

From: [Redacted]
Sent: 30 August 2018 10:21
To: [Redacted]
Cc: MS Major Projects
Subject: RE: SHE Transmission – Orkney to Caithness - pre-application consulation - deadline for response 30 August 2018

Categories: Orange Category

Dear Sir/ Madam,

The Scottish Fishermen's Federation (SFF) is pleased to respond to this application on behalf of the 400 plus fishing vessels in membership of its constituent associations, The Anglo Scottish Fishermen's Association, Fife Fishermen's Association. Fishing Vessel Agents and Owners Association, Mallaig & North West Fishermen's Association, Orkney Fisheries Association, Scottish Pelagic Fishermen's Association, the Scottish White Fish Producer's Association and Shetland Fishermen's Association.

Whilst the report clearly acknowledges that traps are the most common gear in the relevant ICES square, 69% of total effort, neither the chapter on Fish Ecology or the one on Commercial Fisheries seems to address these fisheries adequately.
Furthermore, as Scallops also seem to be high value for this square, the SFF would also expect to see them addressed in terms of sediment redistribution and any interference with spat.
The loss of access post lay should also be considered in case species do not return to the corridor.

Best regards, [Redacted]

Scottish Natural Heritage

Scottish Natural Heritage
Dualchas Nàdair na h-Alba
nature.scot

BY EMAIL

[Redacted]
Redacted
Marine Scotland - Marine Planning & Policy
Scottish Government
Marine Laboratory
375 Victoria Road
Aberdeen
AB11 9DB

29 August 2018

Dear [Redacte

SHE Transmission – Report identifying additional studies required to support Orkney – Mainland subsea cable marine licence application

Thank you for consulting us on the report identifying additional studies required to support the Orkney – Mainland subsea cable marine licence application. We welcome this opportunity to provide advice on the environmental assessment of this strategic project. The following comments are set out using section headings from the report identifying additional studies (referred to subsequently as "the report").

Project Description

The report indicates a number of uncertainties regarding installation techniques, including at landfalls, which are unlikely to be clarified until the contract for installation is awarded. These uncertainties will limit the ability of the proposed studies to accurately assess environmental impacts. We therefore suggest that the assessment is based on realistic worst case scenarios and is informed by experience of installation of similar subsea cables.

2.2 Protected Sites

Table 2.1 provides a list of protected sites with marine components located within the vicinity of the proposed cable route. Annex 1 to this letter provides SNH's advice on the protected sites which, in our view, should be considered in the environmental assessment.

Potential impacts on SPAs

Table 2.2 of the report sets out potential impacts on features designated within protected sites and is focused on SPA and pSPA features. We recommend that the following potential impacts on these features are assessed:

Installation:

- Disturbance and/or displacement of qualifying interests due to vessel presence, noise or light pollution
- Disturbance and/or displacement of qualifying interests due to increased turbidity in the water column
- Indirect effects on qualifying interests due to changes in distribution of prey items

Operation (Depending on anticipated frequency of repair and maintenance activities):

- Disturbance and/or displacement of qualifying interests due to vessel presence, noise or light pollution during maintenance activities

Further advice on potential impacts is provided in Annex 2

Potential impacts on SACs

As indicated in section 2.5 of the report, there is evidence to suggest that Atlantic salmon use the Pentland Firth as a key migration route between freshwater rivers on the north and east coast of Scotland and deeper offshore waters. These will include Atlantic salmon from a number of SACs designated for this species. We recommend that the impact of the proposal on these sites (listed in Annex 1) is assessed. We recommend that the following potential impacts on these features (migrating adult salmon and post smolts) are assessed:

Installation

- Disturbance to migrating Atlantic salmon from underwater noise generated during installation
- Displacement of migrating Atlantic salmon due to suspended sediment released during installation

Operation

- Effect of EMF on migrating Atlantic salmon passing over the cable route

The report indicates that the cable will be buried or protected for the majority of its route, although it does not appear to specify the burial depth. We note that the previous Environmental Appraisal indicated a target minimum burial depth of 1 m. We would encourage continuation of this minimum target burial depth to minimise exposure of Atlantic salmon and other electro-sensitive species to EMF. The wording used in the report implies that some sections of the cable will not be buried or protected – we suggest that the extent of unburied or unprotected cable should be quantified and effect of the resulting increased exposure to EMF assessed.

2.4 Benthic and intertidal ecology

We agree that further assessment of impacts on benthic and intertidal ecology will be required. It is not clear from the report whether Priority Marine Features (PMFs) have been recorded during survey of the cable route. If PMFs have been recorded, impacts on these features should be assessed.

2.5 Fish Ecology

See comments above regarding SACs designated for Atlantic salmon. There is potential for disturbance to basking sharks during installation and so a basking shark licence application is likely to be required.

2.6 Ornithology

Section 2.6.1 summarises the legal protection given to wild birds in the UK, with particular emphasis given to birds listed on Schedule 1 and 1A of the Wildlife and Countryside Act. Birds not listed on these schedules are also protected – further details of this protection can be found in SHE Transmission's Species Protection Plan for birds and the SNH website https://www.nature.scot/professional-advice/safeguarding-protected-areas-and-species/protected-species/protected-species-z-guide/protected-species-birds

Our advice on potential impacts on SPA qualifying species is provided below in our comments on the proposed Nature Conservation Appraisal.

As noted in the report, there is potential for localised disturbance to birds at each of the landfalls and it is suggested that impacts above MHWS will be addressed as part of a separate planning application and study. We would welcome further clarification on whether this planning application and study will cover installation activities, such as Horizontal Directional Drilling (HDD). In other projects installation activities have not required a planning application as they have been classed as permitted development. Unless these installation activities will be covered by a planning application and study we recommend that they are assessed as part of the marine licence application study.

Installation at the Dounreay landfall could cause disturbance to the seabird qualifying species of the North Caithness Cliffs SPA and this potential impact should be assessed. Depending on the location of the HDD drilling points, installation at this landfall could also cause disturbance to wintering Greenland white-fronted and greylag geese which are qualifying interests of the Caithness Lochs SPA. The Dounreay decommissioning Phase 3 EIA noted these species foraging around NC97556640. A breeding colony of Arctic terns (not an SPA feature) may also be present in the vicinity of the Dounreay landfall and could

be disturbed during installation. Pre-construction breeding bird surveys and mitigation measures may be required.

2.7 Marine mammals

Advice on additional data sources regarding marine mammals is provided in Annex 3.

Section 2.7.2 indicates that the main potential impact on cetaceans and pinniped is disturbance due to underwater noise from vessels involved in the installation of the subsea cable and cable trenching activities. Noise from geophysical surveys and USBL beacons should also be assessed.

For the assessment of the impact of underwater noise on cetaceans we recommend thresholds for injury published in 2016 by the US National Oceanic and Atmospheric Administration (NOAA) https://www.fisheries.noaa.gov/national/marine-mammal-protection/marine-mammal-acoustic-technical-guidance. We consider that these thresholds reflect the most comprehensive and up to date scientific knowledge relating to the risk of auditory injury to marine mammals.

We agree that further assessment work is required to assess the potential impacts of the proposal on otters. The Dounreay decommissioning Phase 3 EIA recorded considerable otter activity to the east of the cable route and the Orkney landfall is in an area which provides suitable habitat for foraging and breeding, resting or sheltering places. The SHE Transmission Species Protection Plan on otters provides guidance on licensing requirements and further guidance can also be found on the SNH website: https://www.nature.scot/professional-advice/safeguarding-protected-areas-and-species/licensing/species-licensing-z-guide/otters-and-licensing

3.3.1 Nature Conservation Appraisal

The report indicates that the purpose of the Nature Conservation Appraisal (NCA) will be to provide Marine Scotland with the information required in order to undertake an HRA and NCMPA appraisal if required. To assist with this process we have provided advice in Annex 1 on the Natura sites which, in our view, should be considered in an HRA, we have also provided preliminary advice on whether there is potential for likely significant effects on these sites.

In summary, we consider that the proposal is likely to have a significant effect on all SPAs/pSPAs crossed by the cable route or within 5km of the cable route, although not all of the qualifying species of each SPA/pSPA are likely to be affected.

Information required to inform the HRA for the SPAs/pSPAs which should be included in the NCA includes:

- Cable installation techniques;
- Number and type of vessels;
- Speed of vessels;
- Time-scales of cable installation, including likely duration of activity within SPAs/pSPAs;
- Season the cable surveys and installation are expected to take place;
- How often maintenance checks and/or repair are anticipated;
- Numbers and status of qualifying species within the SPAs/pSPAs
- Distribution of qualifying species within the cable corridor area;
- Sensitives of the qualifying species to disturbance;
- Quantification of the amount of overlap between the SPA and the cable corridor;
- Likely effects on prey species as a result of the cable installation and operation;
- Cumulative and in-combination effects within and between projects being carried out at the same time; and
- Mitigation measures: any mitigation measures specifically related to the ornithological qualifying species and associated SPAs/pSPAs should be laid out clearly within the EIAR documentation.

A number of SACs designated for Atlantic salmon or Atlantic salmon and freshwater pearl mussel should be considered in the NCA, these are listed in Annex 1, it is our preliminary view that the proposal is not likely to have a significant effect on these sites.

In our view, an NCMPA appraisal will not be required as the proposal is not likely to affect the features of the North West Orkney NCMPAs.

The Orkney landfall will cross the Stromness Heaths and Coast Site of Special Scientific Interest (SSSI) and, depending on the exact location and installation method, could affect the geological, maritime grassland and maritime heath interest of the site. Impacts on these features should be included in the assessment. Unless regulated by marine licence or other permission, operations affecting the features of the SSSI may require a consent from SNH.

Several of the Natura sites listed in Annex 1 are also designated as SSSIs, however assessment of impact on the Natura features listed will be sufficient to ensure that impacts on SSSI features are also taken into account.

Information on data sources to help inform the NCA is provided in Annex 3. Information on protected areas can be found on Sitelink http://gateway.snh.gov.uk/sitelink/index.jsp

Cumulative impacts

We recommend that the assessment of cumulative impacts takes into account the approved Dounreay Tri floating offshore wind demonstration project and its grid connection. We are aware that SHE Transmission are proposing a number of inter-island connections as part of

the larger Orkney Connection Project. It would be preferable for the impacts of these connections to be included in a cumulative impact assessment.

3. Concluding remarks

Please contact me should you have any queries regarding this letter.

Yours sincerely

[Redacted]
Senior Casework Manager
[Redacted]

Annex 1 - Summary table of designated sites to consider in the environmental assessment .

Table 1.1 SPAs, pSPAs and NCMPAs designated for bird features

Protected site	**Approx. distance from cable corridor (km)**	**Relevant qualifying species of interest**	**Within foraging range?**	**LSE?***
Hoy SPA (includes marine extension)	0	Breeding: Arctic skua Fulmar Great black-backed gull Great skua Guillemot Kittiwake Peregrine Puffin Red-throated diver	YES for all	YES
North Caithness Cliffs SPA (includes marine extension)	0	Breeding: Fulmar Guillemot Kittiwake Peregrine Puffin Razorbill	Yes for all	YES
Scapa Flow pSPA	0	Breeding: Red-throated diver Non-breeding: Black-throated diver Goldeneye Common eider Great northern diver Long-tailed duck Red-breasted merganser Slavonian grebe European shag	Yes for all	YES
Caithness and Sutherland Peatlands SPA	5km	Breeding: Red-throated diver *This diver species relies on the marine environment, foraging in coastal waters during the breeding period, and therefore should be included.*	Yes	YES
Orkney Mainland Moors SPA	5km	Breeding: Red-throated diver	Yes	YES

Protected site	Approx. distance from cable corridor (km)	Relevant qualifying species of interest	Within foraging range?	LSE?*
		As with Caithness and Sutherland Peatlands SPA, this species forages in coastal waters during the breeding period and should therefore be included.		
Marwick Head SPA (includes marine extension)	15km	Breeding: Guillemot Kittiwake	Yes	NO
Pentland Firth pSPA	15km	Breeding: Arctic skua Arctic tern Common guillemot Though the species are within foraging range, the pSPA is designated to preserve foraging habitat. As the development doesn't directly impact supporting habitats or distributions of birds within this site, it does not need to be assessed.	Yes	NO
Pentland Firth Islands SPA	25km	Breeding: Arctic tern	Yes	NO
Rousay SPA (includes marine extension)	25km	Breeding: Common guillemot Black-legged kittiwake Northern fulmar Arctic tern Arctic skua	Yes	NO
Copinsay SPA (includes marine extension)	35km	Breeding: Fulmars Great black-backed gull Guillemot Kittiwake	Yes	NO
West Westray SPA (includes marine extension)	35km	Breeding: Arctic skua Arctic tern Fulmar Guillemot Kittiwake Razorbill	Yes, except arctic tern.	NO
East Caithness Cliffs SPA (includes marine	40km	Breeding: Cormorant Fulmar Great black-backed gull	Yes, except cormorant and	NO

Protected site	Approx. distance from cable corridor (km)	Relevant qualifying species of interest	Within foraging range?	LSE?*
extension)		Guillemot Herring gull Kittiwake Peregrine Razorbill Shag	peregrine	
Calf of Eday SPA (includes marine extension)	45km	Breeding: Common guillemot Black-legged kittiwake Northern fulmar Great black-backed gull Great cormorant	Yes, except cormorant	NO
Papa Westray NCMPA	55km	All year: Black guillemot	No	NO
Papa Westray (North Holm and Hill) SPA	55km	Breeding: Arctic tern Arctic skua	No Yes	NO
Caithness Lochs SPA	7km	Wintering Greenland white-fronted goose Greylag goose	Yes	

LSE* assumes an overlap in breeding or non-breeding period as a worst-case scenario. Note: only relevant qualifying species of interest are shown. Other terrestrial-based species may be present as qualifying features, but are more relevant to assess within the planning applications for the terrestrial aspects of the project proposal. The preliminary assessment of LSE is on a precautionary basis due to limited information on the project currently available.

Table 1.2 SACs designated for Atlantic salmon and freshwater pearl mussel features

Protected site (all SACs)	Approx. distance from cable corridor (km)	Relevant qualifying species of interest	LSE?
River Thurso	13	Atlantic salmon	No
River Naver	34	Atlantic salmon, freshwater pearl mussel*	No
River Borgie	36	Atlantic salmon, freshwater pearl mussel*	No

*Impacts on freshwater pearl mussel would be indirect via impacts on Atlantic salmon as its larval host.

Annex 2 – Advice on potential impacts on seabird features of SPAs/pSPAs and NCMPAs

Table 2.2 in the report sets out potential impacts on the bird features of SPAs/pSPAs. Potential impacts which, in our view, should be included as part of the assessment on these features are as follows:

SCOPE IN

Installation:

- **Disturbance and/or displacement of qualifying interests due to vessel presence, noise or light pollution.**

The presence of ships and increased activity on the water in the vicinity of foraging areas for birds could be enough to displace and/or disturb birds. This disturbance could overlap with sensitive periods in the life cycle of some species (e.g. breeding, moulting) during which time birds may be unwilling/unable to move out of the area of disturbance. Those birds in moult will have a reduced ability to avoid vessel movements when flightless. It should also be noted that responding to a disturbance or displacement event can be an energetically costly activity for the birds which can have implications for their breeding success or over-winter survival. Particular species known to be sensitive to disturbance can be found in Furness et al (2012) and Wade et al (2016).

- **Disturbance and/or displacement of qualifying interests due to increased turbidity in the water column.**

Disturbance to the seabed could affect/reduce seabird foraging habitat. There may be localised effects on turbidity, which may differ depending on which installation technique is utilised and the type of seabed substrate. It will be important to assess those species which are visual foragers in particular, and those known to be sensitive to changes in water quality.

- **Indirect effects on qualifying interests due to changes in distribution of prey items.**

The disruption to the benthic environment during cable installation, and subsequent disturbance of fish species during potential spawning lifecycle stages can have implications for the seabirds relying on the fish species as a prey items. Species with particular sensitivities to this are included in Cook and Burton's (2010) assessment of seabird sensitivity to effects on dredging, which includes effects of turbidity changes.

We would expect that **all the above potential installation effects would be temporary and localised.** Therefore the **disturbance or displacement itself would be short-lived**. The timings of the cable installation and the season of cable installation will determine whether or not these temporary activities may still result in LSE for the qualifying species.

For many of the SPAs/pSPAs only a small proportion of potential foraging habitat will likely be affected.

Operation:
The level of disturbance and/or displacement caused during maintenance and repair operations will depend on how frequently the maintenance regime is expected**. An estimated value of how often maintenance is expected to take place should be provided within the assessment.**

- **Disturbance and/or displacement of qualifying interests due to vessel presence, noise or light pollution during maintenance activities.**

It is assumed that maintenance activities will be extremely temporary in nature and any disturbance or displacement would be short-lived. This is not expected to be a large effect during operation of the subsea cable.

- **Indirect effects on prey species due to EMF during cable operation or disturbance of prey items from maintenance or repair vessels.**

Provided the burial technique is sufficient to alleviate effects of EMF, it is not anticipated that there will be significant effects on prey items as a result of operation of the cable. Any disturbance to prey items as a result of maintenance or repair vessels is likely to be temporary in nature.

Further to the above, we would advise that the effects of accidental oil or fuel spills as a result of installation or maintenance vessels could be **SCOPED OUT** from further assessment, in terms of the ornithological interests, providing standard pollution prevention measures are laid out in their Schedule of Mitigation/Construction Environmental Management Plan, or equivalent documentation.

It is noted within the scoping report (Page 30) that disturbance at breeding sites near landfall locations (above MHWS) will be covered in a separate planning application, although see our comments above regarding planning and installation activity. Any effects on seabirds breeding in locations near the cable landfalls should however still be taken into consideration in terms of their use of the surrounding waters. Work close to shore for the landfall could disturb species using nearshore water for breeding, resting, or foraging activities. Therefore the landfall locations and techniques still require **SCOPING IN** for their assessment. The breeding seabirds and breeding peregrine falcon at North Caithness Cliffs SPA near the mainland Scotland landfall site, and at the Hoy SPA will need to be considered as part of a planning or other application for any works above MHWS. (Note that for that application there could be indirect effects for the breeding peregrine falcon at each landfall site if effects are found on seabirds, which are prey species for the peregrine falcon.)

Annex 3 – Information on data sources

The EA for the previous marine licence application for a Caithness to Orkney subsea transmission cable used a number of sources of information which are also likely to be relevant to the current proposal.

A number of potentially useful sources of information are listed below:

Ornithology, including consideration of SPA and pSPA species

- Information on bird breeding and non-breeding periods, for seabirds and for other bird species:

https://www.nature.scot/sites/default/files/2017-07/A303080%20-%20Bird%20Breeding%20Season%20Dates%20in%20Scotland.pdf

https://www.nature.scot/sites/default/files/2017-07/A2332152%20-%20Suggested%20seasonal%20definitions%20for%20birds%20in%20the%20Scottish%20Marine%20Environment%20-%203rd%20February%202017.pdf

- Any relevant data for qualifying species as collected as part of the wider Orkney Connection project.

- JNCC databases which include:

    - Seabird Monitoring Programme: can search under 'Sites' and then 'Browse for sites', can provide information on counts of seabirds at designated sites.

http://jncc.defra.gov.uk/smp/

    - ESAS database, see http://jncc.defra.gov.uk/page-4469 for link to JNCC contact.

    - JNCC Natura Data Forms for each relevant SPA.

- Site selection document for Scapa Flow proposed SPA and Pentland Firth pSPA. For distributions of qualifying species within the Scapa Flow proposed SPA.

https://www.nature.scot/scapa-flow-proposed-marine-spa-supporting-documents
https://www.nature.scot/pentland-firth-proposed-marine-spa-supporting-documents

- Pentland Firth and Orkney Water Marine Spatial Plan documentation and associated data.

- For foraging ranges of key seabird species see Thaxter et al. (2012) as a starting point, and Furness et al. (2012) Supplementary files for summaries of diving depths, foraging ranges, and disturbance distances for some key marine species.

Useful references:

Cook, A.S.C.P. & Burton, N.H.K. (2010). *A review of the potential impacts of marine aggregate extraction on seabirds*. Marine Environment Protection Fund (MEPF) Project 09/P130.

Furness, R.W., H.M., Robbins, A.M.C., Masden, E.A., (2012) Assessing the sensitivity of seabird populations to adverse effects from tidal stream turbines and wave energy devices. *ICES Journal of Marine Science*, 69, 1466–1479, https://doi.org/10.1093/icesjms/fss131.

Thaxter, C.B., Lascelles, B., Sugar, K., Cook, A.S.C.P., Roos, S., Bolton, M., Langston, R.H.W., Burton, N.H.K (2012) Seabird foraging ranges as a preliminary tool for identifying candidate Marine Protected Areas. *Biological Conservation*, 156.

Wade, H.M., Masden, E.A., Jackson, A.C., Furness, R.W. (2016) Incorporating data uncertainty when estimating potential vulnerability of Scottish seabirds to marine renewable energy developments Marine Policy, 70, 108-113.

Marine mammals

In addition to SCANs III data for cetacean density we recommend that additional data on coastal species is sought from sources such as:

- Whale and Dolphin Conservation (WDC)
- Sea Mammal Research Unit (SMRU)
- Aberdeen University
- Cetacean Research and Rescue Unit (CRRU)
- Seawatch Foundation
- Local Biological Record Centres.

Other potentially useful data sources include:

SNH Commissioned Report: Abundance and Behaviour of Cetaceans & Basking Sharks in the Pentland Firth and Orkney Waters
http://seawatchfoundation.org.uk/wp-content/uploads/2012/08/Orkney-and-Pentland-review-final.pdf

The outputs from the Joint Cetacean Protocol (JCP) which provide useful context
http://jncc.defra.gov.uk/page-5657

The modelling work SNH carried out in support of identifying MPA proposals might also be useful (relevant for minke whale, Risso's dolphin, white-beaked dolphin and basking shark). The report is at https://www.nature.scot/snh-commissioned-report-594-statistical-approaches-aid-identification-marine-protected-areas-minke and data layers are available to view on nmpi.

Up-to-date figures for seal populations are available from the Special Committee on Seals annual reports - http://www.smru.st-andrews.ac.uk/research-policy/scos/.

Seal usage maps will be relevant http://marine.gov.scot/information/seal-usage-maps

The SNH report: Utilisation of space by grey and harbour seals in the Pentland Firth and Orkney waters https://tethys.pnnl.gov/sites/default/files/publications/SMRU_Ltd_2011.pdf contains relevant seal tagging data.

Marine Scotland EPS licensing guidance is available-
https://www.gov.scot/Resource/0044/00446679.pdf

Marine Scotland have also produced guidance on harassment at seal haul outs -
https://www.gov.scot/Resource/0045/00452869.pdf

UK Chamber of Shipping

[Redacted]

From: [Redacted]
Sent: 31 July 2018 15:55
To: [Redacted]
Cc: MS Major Projects
Subject: FW: SHE Transmission – Orkney to Caithness - pre-application consulation - deadline for response 30 August 2018
Attachments: SHET - Orkney to Caithness - EA document in pdf for consultation - 27 July 2018 #2.pdf

Categories: Orange Category

Dear [Redact ,

Thank you for sending this to the Chamber of Shipping. We welcome the opportunity to respond.

The Chamber has obvious navigational concerns with the subsea cable route passing across a major shipping route and see that there is not currently much detail in the EA document over impact on navigation and anchoring activity and therefore agree with your conclusion that further investigation and research is needed for the marine licence application.

The Chamber also does not think that the cable burial plan contains a lot of detail and should be developed further.

Look forward to further dialogue and research being undertaken.

Kind regards,

[Reda
cted]
Policy Manager

UK Chamber of Shipping
30 Park Street, London, SE1 9EQ

[Redacted]

www.ukchamberofshipping.com

Please consider the environment before printing this email.

The information contained in this communication, and any attachments, may be confidential and / or privileged. It is intended only for the use of the named recipient. If you are not the intended recipient, please contact us on 020 7417 2800. In such an event, you should not access any attachments, nor should you disclose the contents of this communication or any attachments to any other person, nor copy, print, store or use the same in any manner whatsoever. Thank you for your cooperation.

Appendix II: Licensing Process

Application

The application letter must detail how many licences are being sought, what marine licensable activities are proposed and what legislation the application is being made under.

Applicants are required to make a copy of the non-technical summary available for viewing by members of the public in communities at each of the landfall locations. There must also be instructions regarding where the full EA may be accessed. An electronic copy of the EA in a user-friendly PDF format must be submitted to the Scottish Ministers which will be placed on the Scottish Government website alongside the application documents. If requested to do so by the Scottish Ministers, the applicant must send to the Scottish Ministers further hard copies of the EA as requested.

Requirement for Public Pre-Application Consultation ("PAC")

From 6th April 2014, applications received for certain activities are subject to a public pre-application consultation requirement. Activities affected will be large projects with the potential for significant impacts on the environment, local communities and other legitimate uses of the sea. This requirement allows local communities, environmental groups and other interested parties to comment on proposed works in their early stages and before an application for a marine licence is submitted.

The Marine Licensing (Pre-application Consultation) (Scotland) Regulations 2013 can be accessed via:

http://www.legislation.gov.uk/ssi/2013/286/made

Guidance on marine licensable activities subject to Pre-application Consultation can be obtained at:

http://www.gov.scot/Topics/marine/Licensing/marine/guidance/preappconsult

The licensing authority reserves the right not to accept an application in the absence of an acceptable PAC report.

Ordinance Survey ("OS") Mapping Records

Applicants are requested at application stage to submit a detailed OS plan showing the site boundary and location of all deposits and onshore supporting infrastructure in a format compatible with The Scottish Government's Spatial Data Management Environment ("SDME"), along with appropriate metadata. The SDME is based around Oracle RDBMS and ESRI ArcSDE and all incoming data should be supplied in ESRI shape file format. The SDME also contains a metadata recording system based on the ISO template within ESRI ArcCatalog (agreed standard used by The Scottish Government); all metadata should be provided in this format.

Advertisement

The applicant must publish their details of their proposals. Licensing information and guidance, including the specific details of the adverts to be placed in the press, can be obtained from the Scottish Ministers. If additional information is submitted further public notices will be required

EPS licence

European Protected Species ("EPS") are animals and plants (species listed in Annex IV of the Habitats Directive) that are afforded protection under The Conservation (Natural Habitats, &c.) Regulations 1994 (as amended) and The Offshore Marine Conservation (Natural Habitats, &c.) Regulations 2007 (as amended). All cetacean species (whales, dolphins and porpoise) are European Protected Species. If any activity is likely to cause disturbance or injury to a European Protected Species a licence is required to undertake the activity legally.

A licence may be granted to undertake such activities if certain strict criteria are met:

- there is a licensable purpose;
- there are no satisfactory alternatives, and;
- the actions authorised will not be detrimental to the maintenance of the population of the species concerned at favourable conservation status in their natural range.

Applicants must give consideration to the three fundamental tests and should refer to the guidance on the protection of marine European Protected Species for more detailed information in relation to Scottish Inshore Waters. Applicants may choose to apply for an EPS licence following the determination of the EIA application and once construction methods have been finalised, however it is useful to include a shadow EPS assessment within the EIA report.

Please note that basking sharks are also afforded protection under the Wildlife & Countryside Act 1981 (as Amended by the Nature Conservation (Scotland) Act 2004) and as such the applicant should consult with MS-LOT on the requirement for a licence to disturb basking sharks.

Appendix III: Gap Analysis

Applicant to complete:

Consultee	No.	Point for inclusion	EA Section	Justification
	1			
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Appendix IV: Cable Guidance

Cable Guidance – Required Submissions

The installation, protection and decommissioning of transmission cables are controlled by:

- Marine (Scotland) Act 2010;
- Marine and Coastal Access Act 2009; and
- Scotland's National Marine Plan (“SNMP”).

The requirements set out in this guidance will ensure applications are in compliance with the above regulations and policy. Deviations from these requirements are liable to result in delays in processing your application as well as the potential requirement for further consultation and assessment.

Further documentation, supplied at the time of a marine licence application, should be all of the following:

- Construction Method Statement;
- Cable Burial Plan;
- Fisheries Liaison and Mitigation Action Plan;
- Communication Strategy;
- Post Installation Survey Plan; and
- Decommissioning Plan.

More detail on what these should include are provided below.

Construction Method Statement

The EA will reduce the degree of design flexibility required and that the detail will be further refined in a Construction Method Statement (“CMS”) to be submitted to the Scottish Ministers, for their approval, before works commence.

Cable Burial Risk Assessment / Plan

To avoid interference with legitimate users of the sea and to protect the asset, in accordance with the SNMP there is a presumption in favour of cable burial. As such, marine licence applications should also be accompanied by a Cable Burial Plan which should include the following information:

- evidence of advice from fishing representatives and other marine users;
- depth profiles of any burial (provision of shapefiles);
- data and analysis of survey data to justify not burying; and
- detail of how the cable will be protected.

Fisheries Liaison and Mitigation Action Plan (“FLMAP”)

The EA will detail a Fisheries Liaison and Mitigation Action Plan (FLMAP) which should include the following information:

- Fisheries Liaison Officer credentials;
- must be applicable to all legitimate users of the sea – not just commercial fishing; and
- must not be date-specific to allow for timeline shifts and should refer to times in relation to installation works.

Communication Strategy

The EA will detail a Communication Strategy which should include the following information:

- Notice to Mariners;
- notice to fishermen to allow for gear clearance;
- Kingfisher bulletin;
- MCA / radio notices;
- timing of each of the above relative to project timings; and
- method of handling information relating to updates and problems.

Post Installation Survey Plan

The EA will detail a Post Installation Survey Plan which should include the following information:

- immediate post-lay survey and longer term survey and inspection programme;
- proposed timescales;
- survey type / details;
- mitigation if spans or movement found; and
- provision of proposed inspection timetable for all assets (if available).

GAP ANALYSIS

Consultee	No.	Point for inclusion	EA Section	Justification
Scottish Natural Heritage	**1**	The report indicates a number of uncertainties regarding installation techniques, including at landfalls, which are unlikely to be clarified until the contract for installation is awarded. These uncertainties will limit the ability of the proposed studies to accurately assess environmental impacts. We therefore suggest that the assessment is based on realistic worst case scenarios and is informed by experience of installation of similar subsea cables.	Section 4 - Project Description of the EA.	A full project description is presented in Section 4 - Project Description of the EA providing further detail on the installation techniques. The environmental assessment has been based upon the worst case scenario and informed by the previous experience of the Project team.
Scottish Natural Heritage	**2**	The following protected sites with marine components are located within the vicinity of the proposed cable route: Hoy SPA, North Caithness Cliffs SPA, Scapa Flow pSPA, Caithness and Sutherland Peatlands SPA, Orkney Mainland Moors SPA, Marwick Head SPA, Pentland Firth pSPA, Pentland Firth Islands SPA, Rousay SPA, Copinsay SPA, West Westray SPA, East Caithness Cliffs SPA, Calf of Eday SPA, Papa Westray NCMPA, Papa Westray (North Holm and Hill) SPA, Caithness Lochs SPA, River Thurso SAC, River Naver SAC, River Borgie SAC	Section 9 - Protected Sites of the EA and Appendix D: Nature Conservation Appraisal.	The protected sites with marine components relevant to the Project are described within Section 9 - Protected Sites of the EA. Impacts to the sites and protected features are considered within Appendix D: Nature Conservation Appraisal of the EA.
Scottish Natural Heritage	**3**	With regards to potential impacts on SPAs, the following potential impacts should be assessed: Installation - Noise disturbance and/or displacement of qualifying interests due to vessel presence, noise or light pollution - Disturbance and/or displacement of qualifying interests due to increased turbidity in the water column - Indirect effects on qualifying interests due to changes in distribution of prey items Operation - Disturbance and/or displacement of qualifying interests due to vessel presence, noise or light pollution during maintenance activities.	Section 12 - Ornithology of the EA and Appendix D: Nature Conservation Appraisal.	Impacts to ornithology have been assessed within Section 12 - Ornithology of the EA and effects on SPAs have been assessed within Appendix D: Nature Conservation Appraisal. All impacts listed have been considered within these sections.
Scottish Natural Heritage	**4**	With regards to potential impacts on protected sites for which Atlantic salmon are a designated feature, it is recommended that the impact of the Project on the designated sites should be assessed. The following potential impacts on these features (migrating adult salmon and post smolts) are assessed: Installation - Disturbance to migrating Atlantic salmon from underwater noise generated during installation - Displacement of migrating Atlantic salmon due to suspended sediment released during installation Operation - Effect of EMF on migrating Atlantic salmon passing over the cable route.	Appendix D: Nature Conservation Appraisal of the EA	Impacts to Atlantic salmon and the SACs designated for this species are assessed within Appendix D: Nature Conservation Appraisal. All the impacts listed have been considered. Given the mobile nature of fish, potential impacts associated with cable installation and operation are expected to be minimal on the basis that fish can readily move out of or avoid the main area of potential impact. Installation activities are expected to take place over a relatively short period and vessels will not be in one location for the whole period but will rather traverse the cable route, meaning noise emissions will only occur within a singular location for a brief period. Given the large expanse of comparable marine habitat surrounding the vessel and cable installation operations, it is highly unlikely that project activities would compromise regional movements. Coarser fractions up to and including fine sand, ejected from the trench will be raised a few metres from the seafloor, and will be re-deposited within 10 m or less of the cable trench. Finer silt fractions will remain in suspension for longer with levels expected to fall to ambient levels within 70 m with fine deposition occurring out to a maximum of 2 km from the trench. Far field deposition is predicted to be below 1 mm. EMF for an HVAC cable are expected to attenuate to background levels within 1 m and will not affect migrating Atlantic salmon passing over the cable route.
Scottish Natural Heritage	**5**	**Cable Burial** It is encouraged that the minimum target burial depth of 1 m be continued. It is also suggested that the extent of unburied or unprotected cable should be quantified and effect of the resulting increased exposure to EMF assessed.	Section 4 - Project Description of the EA. Cable Burial Plan to be produced prior to marine installation activities commencing.	A Cable Burial Risk Assessment has been produced for the Project which specifies the burial required to protect the cable. This follows Carbon Trust guidance for burial and in some areas of the route ground conditions and risk to the cable is such that burial to less than 1 m may be acceptable. The CBRA also quantifies the sections of the cable route which may required additional cable protection due to difficulties in burial. No section of the cable will be surface laid without additional cable protection. This has been reflected within the assessments of EMF on various ecological receptors.
Scottish Natural Heritage	**6**	Benthic and intertidal ecology It is agreed that further assessment of impacts on benthic ecology will be required. It is not clear from the Scoping Report whether Priority Marine Features (PMFs) have been recorded during the survey of the cable routes - if PMFs have been recorded, impacts on these features should be assessed.	Section 11 - Benthic and Intertidal Ecology of the EA.	Impacts on benthic ecology are assessed within Section 11 - Benthic and Intertidal Ecology of the EA. The geophysical and environmental survey undertaken along the proposed cable route in 2018 (MMT, 2018a, 2018b) did not identify the presence of PMFs in the cable survey corridor, although bedrock habitat that could potentially support PMF kelp beds was identified. There are no other known PMF at the Dounreay and Orkney landfalls (NMPi, 2018).
Scottish Natural Heritage	**7**	**Fish ecology** There is potential for disturbance to basking sharks during installation and as such a basking shark licence is likely to be required.	Separate Basking Shark Licence application to be made prior to any installation activity commencing including any pre-installation surveys.	A separate basking shark licence will be applied for as part of the Project application prior to installation activity commencing
Scottish Natural Heritage	**8**	Ornithology Due to the potential for localised disturbance to birds at each of the landfalls, further clarification regarding activities located above MHWS would be welcomed i.e. Horizontal Directional Drilling. If activities which fall above MHWS are not classed as permitted development, or are not covered in a separate planning application, it is recommended that they are assessed as part of the marine licence application study.	Section 4 - Project Description of the EA.	The Marine Licence application covers the marine area from MHWS at each of the landfalls. A full project description is presented in Section 4 - Project Description of the EA which includes some further detail on the marine aspects of the landfall installation techniques. The cable will make landfall through HDD which will exit on the seabed at a distance of between 900 m to 1050 m offshore , therefore there will be no direct disturbance from HDD activities related to marine cable installation at the landfall. This application focuses on the marine aspects of the Project from MHWS to MHWS. Onshore aspects related to the HDD methodology are not considered in the EA to support the Marine Licence application.
Scottish Natural Heritage	**9**	Installation at the Dounreay landfall could cause disturbance to seabird qualifying species of the North Caithness Cliffs SPA, species associated with the Caithness Lochs SPA as well as a breeding colony of Arctic terns (not an SPA feature). A pre-construction breeding bird survey and mitigation measures may be required.	Appendix D: Nature Conservation Appraisal of the EA	Appendix D: Nature Conservation Appraisal has considered potential impacts to SACs and SPAs. The potential effect on the North Caithness Cliffs SPA has been considered. The ornithological baseline has been characterised using existing data and information. Ornithological surveys have been conducted at the landfall sites at Dounreay and Warebeth.
Scottish Natural Heritage	**10**	Marine Mammals The following underwater noise sources should be assessed with regards to the potential impact to marine mammals; noise from vessels involved in the installation of the subsea cable and cable trenching activities, noise from geophysical surveys and USBL beacons.	Section 11 - Marine Mammals of the EA	Section 11.9 of the EA assesses the potential impact of underwater noise on marine mammals. Noise from vessels, cable installation, cable trenching, USBL beacons and geophysical surveys are all considered.
Scottish Natural Heritage	**11**	It is recommended that for the assessment of impact of underwater noise on cetaceans, thresholds for injury published in 2016 by the US National Oceanic and Atmospheric Administration (NOAA) are used.	Section 11 - Marine Mammals of the EA	The NOAA injury and disturbance criteria, as provided by the most recently updated guidance (2018) has been included and used in the assessment of noise impacts on marine mammals herein.
Scottish Natural Heritage	**12**	With regards to otters, it is agreed that further assessment is required.	Section 11 - Marine Mammals of the EA	Disturbance to otters at the landfall has been assessed within Section 11.9.2 of the EA.
Scottish Natural Heritage	**13**	**Conservation** The Project is likely to have a significant effect on all SPAs/ pSPAs crossed by the cable route, or within 5 km of the cable route (although not all of the qualifying species of each site are likely to be affected).	Appendix D: Nature Conservation Appraisal of the EA.	Appendix D: Nature Conservation Appraisal has considered potential impacts to SACs and SPAs. All sites within 5 km of the cable route have been assessed for a potential Likely Significant Effect (LSE).

Scottish Natural Heritage	**14**	Nature Conservation Appraisal (NCA) The following information is required to inform the HRA for the SPA's/pSPAs which should be included in the NCA: - Cable installation techniques - Number and type of vessels - Speed of vessels - Time-scales of installation (including likely duration of activity within SPAs/pSPAs - Season the cable surveys and installation are expected to take place - How often maintenance checks and/or repair are anticipated - Numbers and status of qualifying species within the SPAs/pSPAs - Distribution of qualifying species within the cable corridor area - Sensitivities of the qualifying species to disturbance - Quantification of the amount of overlap between the SPA and the cable corridor - Likely effects on prey species as a result of the cable installation and operation - Cumulative and in-combination effects within and between projects being carried out at the same time - Mitigation measures	Appendix D: Nature Conservation Appraisal of the EA.	Requested information is provided within Appendix D: Nature Conservation Appraisal.
Scottish Natural Heritage	**15**	A number of SACs designated for Atlantic salmon and freshwater pearl mussel should be considered in the NCA	Appendix D: Nature Conservation Appraisal of the EA.	Appendix D: Nature Conservation Appraisal has considered potential impacts to SACs. The potential for LSE has been considered for River Borgie SAC, River Thurso SAC and the River Naver SAC.
Scottish Natural Heritage	**16**	An NCMPA appraisal will not be required as the proposal is not likely to affect the features of the North West Orkney NCMPAs.	Appendix D: Nature Conservation Appraisal of the EA.	Appendix D: Nature Conservation Appraisal has considered the potential effects to NCMPAs. No realistic pathway for effect has been identified there further assessment has not been undertaken.
Scottish Natural Heritage	**17**	Potential impacts upon the Stromness Heaths and Coast Site of Special Scientific Interest (SSSI) (depending on the exact location and installation method) should be included in the assessment. Activities which have the potential to affect SSSI's may require a consent from SNH.	Appendix D: Nature Conservation Appraisal of the EA.	SSSIs have been considered within Section 9 - Protected Sites of the EA. As the Project is being installed using HDD techniques at the landfalls, for which the exit on the seabed is located 900 m to 1050 m offshore, no impact is anticipated on the Stromness Heaths and Coast SSSI from marine installation activities.
Scottish Natural Heritage	**18**	Several of the Natura sites listed in Annex 1 are also designated as SSSIs, however assessment of impact on the Natura features listed will be sufficient to ensure that impacts on SSSI features are also taken into account.	Appendix D: Nature Conservation Appraisal of the EA.	The applicant has adopted this approach, where a SSSI overlaps with a Natura 2000 site an assessment is only provided on the Natura 2000 site.
Scottish Natural Heritage	**19**	Cumulative Impacts The assessment of cumulative impacts should take into account the approved Dounreay Tri Floating offshore wind demonstration project and its grid connection. SHE Transmission are proposing a number of inter-island connections as part of the larger Orkney Connection Project, and it is preferable for the impacts of these connections to be included in a cumulative impact assessment.	Individual topic chapters of the EA where cumulative impacts are assessed.	The projects noted have been included within the cumulative assessments undertaken in each of the EA topic chapters, where relevant. A list of other projects considered is outlined in Table 7.3 of the EA.
The Highland Council Comhairle na Gaidhealtached	**20**	It would be helpful to know which sections of the cable will be surface laid, and which will be buried and the corresponding seabed conditions to ensure any impacts on PMF's are minimised.	A separate Cable Burial Plan and Construction Method Statement will be provided to MSLOT prior to marine cable installation activities commencing. Section 4 - Project Description of the EA provides initial information on cable burial and protection requirements and impacts to PMFs are assessed in Section 10 - Benthic and Intertidal Ecology of the supporting EA.	The aim of cable installation will be to bury the cable across its entire length. However this is not always possible due to ground conditions or existing infrastructure. The cable burial risk assessment outlines the sections of cable that potentially may require cable protection due to difficulties in burial. No section of the cable will be surface laid without additional cable protection. A separate Cable Burial Plan and Construction Method Statement will be provided to MSLOT prior to marine cable installation activities commencing. Section 4 - Project Description of the EA provides initial information on cable burial and protection requirements and impacts to PMFs are assessed in Section 10 - Benthic and Intertidal Ecology of the supporting EA.
The Highland Council Comhairle na Gaidhealtached	**21**	Once the chosen landfall site method of installation is determined, an assessment of the impacts on the North Caithness Cliffs SPA will be required. Advice from the nuclear sites in close proximity may be helpful regarding any potential impacts.	Appendix D: Nature Conservation Appraisal of the EA.	The cable landfall will be installed using HDD techniques at the landfalls for which the exit point is located approximately 900 m to 1050 m offshore. Potential effects on the North Caithness Cliffs SPA is considered within Appendix D: Nature Conservation Appraisal.
Historic Environment Scotland	**22**	Recommended that consultation is carried out with the relevant local authority's archaeological and conservation services who will also be able to comment on potential impacts to the historic environment. This may include heritage assets outwit our remit, such as category B and C listed buildings and unscheduled archaeology.	Section 5 Stakeholder Engagement and Section 13 Marine Archaeology	Orkney Islands Council was consulted as part of the MS-LOT 30 day consultation process on the 'Report Identifying Additional Studies Required to Support Orkney – Mainland Subsea Cable Marine Licence Application, Xodus Reference: A100413-S02'. No response was received and further consultation will be undertaken as part of the installation of the marine cables.
Historic Environment Scotland	**23**	Can confirm that there are no statutory designated sites within the HES remit located within the 1 km wide search area.	N/A	Noted.
Historic Environment Scotland	**24**	It is agreed that further information is required to support the Marine Licence application. It is noted that a Marine Historic Environment Appraisal will be carried out by ORCA.	Section 13 - Marine Archaeology of the EA.	Potential impacts to marine archaeology have been assessed in Section 13 - Marine Archaeology of the EA
Historic Environment Scotland	**25**	We are content that the information summarised in section 3.3.4 should be sufficient to provide an adequate assessment of effects.	Section 13 - Marine Archaeology of the EA.	Potential impacts to marine archaeology have been assessed in Section 13 - Marine Archaeology of the EA
Historic Environment Scotland	**26**	Guidance about national policy can be found in our 'Managing Change in the Historic Environment' series available online at www.historicenvironment.scot/advice-and-support/planning-and-guidance/legislation-and-guidance/managing-change-in-the-historic-environment-guidance-notes. Technical advice is available on our Technical Conservation website at http://conservation.historic-scotland.gov.uk/.	Section 13 - Marine Archaeology of the EA.	Noted. Section 13.2.2 of the EA outlines relevant guidance used to inform the assessment.
UK Chamber of Shipping	**27**	The cable route passes across a major shipping route. More detail is required over the impact on navigation and anchoring activity. It is agreed that further investigation and research is needed for the marine licence application.	Appendix D: Navigational Risk Assessment of the EA.	A full navigational risk assessment is presented in Appendix D: Navigational Risk Assessment of the EA which addresses the potential impacts on navigation and anchoring activity.
UK Chamber of Shipping	**28**	It is also noted that the cable burial plans require more detail and should be developed further.	A Cable Burial Risk Assessment has been produced for the Project. A separate Cable Burial Plan and Construction Method Statement will be provided to MSLOT prior to marine cable installation activities commencing.	A Cable Burial Risk Assessment has been produced for the Project. A separate Cable Burial Plan and Construction Method Statement will be provided to MSLOT prior to marine cable installation activities commencing.
Royal Yachting Association Scotland	**29**	It is agreed that further assessment is required on the impacts to shipping and navigation.	Appendix B: Navigational Risk Assessment of the EA.	Further assessment is presented within Appendix B: Navigational Risk Assessment.
Royal Yachting Association Scotland	**30**	The AIS coverage shows that the key recreational routes are from Cape Wrath and the Kyle of Tongue to Stromness. Cable laying in the Pentland Firth should not pose a significant problem for recreational sailors and the landfall sites are unlikely to pose problems either.	Section 15 - Offshore Infrastructure and Other Sea Users of the EA.	No response required.
Royal Yachting Association Scotland	**31**	Consideration should be given to the impacts of cable laying in the approaches to Hoy Sound, particularly in the light of the usual 500 m exclusion zone. Accurate timing of approach is essential for safety reasons. Moreover, informing recreational sailors about cable laying there will pose some difficulties as their last port of call might be Stornoway or a harbour further away, and Notices to Mariners are an ineffective way of informing recreational boaters.	Section 15 - Offshore Infrastructure and Other Sea Users of the EA.	The approach to the Hoy Sounds has been identified in the Appendix B: Navigational Risk Assessment as an area of higher density traffic.
Scottish Environment Protection Agency	**32**	Authorisation is required under The Water Environment (Controlled Activities) (Scotland) Regulations 2011 (CAR) to carry out engineering works in or in the vicinity of inland surface waters (other than groundwater) or wetlands. Inland water means all standing or flowing water on the surface of the land (e.g. rivers, lochs, canals, reservoirs).	N/A	This will be covered in the onshore Construction Environmental Management Plan (CEMP) that is produced in support of the onshore aspects of the Project.
Scottish Environment Protection Agency	**33**	Management of surplus soils may require an exemption under The Waste Management Licencing (Scotland) Regulations 2011. Proposed crushing or screening will require a permit under The Pollution Prevention and Control (Scotland) Regulations 2012. Consideration should be given if other environmental licenses may be required for any installations or processes.	N/A	This will be covered in the onshore Construction Environmental Management Plan (CEMP) that is produced in support of the onshore aspects of the Project.

Scottish Environment Protection Agency	**34**	A Controlled Activities Regulations (CAR) construction site licence will be required for management of surface water run-off from a construction site, including access tracks, which: - is more than 4 hectares - is in excess of 5 km, or - includes an area of more than 1 hectare or length of more than 500 m on ground with a slope in excess of 25o See SEPA's Sector Specific Guidance: Construction Sites (WAT-SG-75) for details. Site design may be affected by pollution prevention requirements and hence we strongly encourage the applicant to engage in pre-CAR application discussions with a member of the regulatory services team in your local SEPA office.	N/A	This will be covered in the onshore Construction Environmental Management Plan (CEMP) that is produced in support of the onshore aspects of the Project.
Scottish Environment Protection Agency	**35**	Below the thresholds noted above, the applicant will need to comply with CAR General Binding Rule 10 which requires, amongst other things, that all reasonable steps are taken to ensure that the discharge does not result in pollution of the water environment. The detail of how this is achieved may be required through a planning condition.	N/A	This will be covered in the onshore Construction Environmental Management Plan (CEMP) that is produced in support of the onshore aspects of the Project.
Ministry of Defence	**36**	The MoD have no objection regarding the project activities in the locations specified.	N/A	The Project welcomes the response of no objection.
Scottish Fishermen's Federation	**37**	Traps are the most common gear however the fish and shellfish section nor the commercial fisheries section has addressed these fisheries adequately.	Section 15 - Commercial Fisheries of the EA.	A full assessment on commercial fisheries is provided in Section 15 - Commercial Fisheries of the EA, including a full description of the baseline and an assessment of potential impacts.
Scottish Fishermen's Federation	**38**	Scallop fisheries should also be addressed in terms of sediment redistribution and any interference with spat.	Section 15 - Commercial Fisheries of the EA.	A full assessment on commercial fisheries is provided in Section 15 - Commercial Fisheries of the EA, including a full description of the baseline and an assessment of potential impacts. Scallop fisheries are to be included in the fisheries assessment, targeted from the trawls will
Scottish Fishermen's Federation	**39**	The loss of access post lay should be considered in case species do not return to the corridor.	Section 15 - Commercial Fisheries of the EA.	The change in distribution of target species is assessed within Section 14.12.1.2 of the EA and the permanent loss of access to fishing is assessed in Section 14.12.2.1 of the EA. As the project impacts are limited spatially and temporary it is considered that disturbance to species is minimal and recolonization of the disturbed area will occur.
Northern Lighthouse Board	**40**	It is recommended that SHET liaise with all local marine stakeholders, and the UK Hydrographic Office (UKHO) regarding the promulgation of Notices to Mariners and local Radio Navigation Warnings, stating the nature, location, timescale and any other appropriate details of any project works.	Appendix B: Navigational Risk Assessment of the EA.	Notice to Mariners (including local), Kingfisher bulletins, Radio Navigational Warnings, NAVTEX, and/or broadcast warnings will be promulgated in advance of any proposed works. The notices will include the time and location of any work being carried out, and emergency event procedures. A full navigational risk assessment is presented in Appendix B - Navigational Risk Assessment of the EA.
Northern Lighthouse Board	**41**	Cable Marker Boards shall be installed at landfall sites - these boards should be diamond shaped, with dimensions 2.5 m long and 1.5 m wide, background painted yellow with the inscription 'Cables' painted horizontally in black. The structures should be mounted at least 4 m above ground level.	Further consultation is required with the NLB on the requirement for Cable Marker Boards at the landfall sites.	Further consultation is required with the NLB on the requirement for Cable Marker Boards at the landfall sites.
Northern Lighthouse Board	**42**	The Statutory Sanction of the Commissioners of Northern Lights is required for the establishment of these Aids to Navigation. The form to request the Statutory Sanction is available through the Northern Lighthouse Board website.	N/A	Noted.
Northern Lighthouse Board	**43**	Upon completion, all cable routes and landfall positions are to be communicated to the UKHO in order that the relevant charts are updated.	N/A	Upon installation the final cable route and landfall positions will be communicated to the UKHO as requested.
RSPB	**44**	Where there is potential for the project to have adverse effect on a Natura site SAC or SPA, including proposed sites, an appropriate assessment is required in accordance with the Birds and Habitats Directive to ascertain whether a project would adversely affect the integrity of a site in view of the conservation objectives of the site. As such, a HRA should be carried out.	Appendix D: Nature Conservation Appraisal of the EA.	Appendix D: Nature Conservation Appraisal of the EA has considered potential impacts to SACs and SPAs. The potential for a Likely Significant Effect has been considered.
RSPB	**45**	It is agreed that further assessment work is required to support a marine licence application with regards to the following receptors; protected sites, benthic and intertidal ecology, ornithology and marine mammals.	Section 9 - Ecological Protected Sites and Species, Section 10 - Benthic and Intertidal Ecology, Section 11 - Marine Mammals, Section 12 - Ornithology and Appendix D: Nature Conservation Appraisal of the EA	Further assessment has been undertaken. Please see Section 9 - Ecological Protected Sites and Species, Section 10 - Benthic and Intertidal Ecology, Section 11 - Marine Mammals, Section 12 - Ornithology and Appendix D: Nature Conservation Appraisal of the EA.
RSPB	**46**	A figure clearly showing how the preferred route passes through Scapa Flow pSPA (it is indicated that the site is 0 km away from the route) should be included. If there is an overlap, an assessment on the benthic impacts of the cable burial on food resources and availability should be carried out as the area is important for wintering birds as a foraging area. This assessment is in addition to disturbance and displacement during construction and maintenance. (This is missing from table 2.3)	Section 12 - Ornithology of the EA.	The proposal installation corridor does not pass through the Scapa Flow pSPA. At its closest point the installation corridor is 0.2 km from the pSPA, at the landfall. A full ornithological assessment is provided in Section 12 - Ornithology of the EA.
RSPB	**47**	Other potential impacts on birds that should be assessed with regards to cable installation, maintenance and decommissioning include disturbance and displacement from marine traffic on the sea surface. (This is missing from table 2.2)	Section 12 - Ornithology of the EA.	A full ornithological assessment is available in Section 12 - Ornithology of the EA.
RSPB	**48**	Any bird survey data collected at sea should be sufficient to characterise day to day variability in bird activity as well as seasonal variability.	Section 12 - Ornithology of the EA.	The ornithological assessment has focused on the protected species surrounding the Project. Existing data has been used to characterise the distribution of these species. Survey data has been collected at the landfall.
RSPB	**49**	Rigorous assessment of the impacts of an accidental fuel spillage on marine ecology and birds should be carried out	N/A	The ecological impact of accidental release of pollution has been scoped out of further assessment - see MS-LOT Opinion and SNH response and Table 7.1 of the EA. Potential for accidental fuel release is very low. In the event of an accidental fuel release occurring appropriate standard practice management procedures will be implemented accordingly. Standard pollution prevention measures are laid out in Section 17 - Schedule of Mitigation of the EA and for all vessels over 400 GT (gross tonnage) a Ship Oil Pollution Emergency Plan (SOPEP) will be in place.
RSPB	**50**	Further information on the landfall area should be detailed. Although this will be addressed in a separate application, improved maps of planned infrastructure above and below the MHWS could be beneficial in indicating where the subsea cable ends and the landfall begins.	Construction Method Statement will be provided to MS-LOT prior to the commencement of marine cable installation.	A description of the Project is provided in Section 4 - Project Description of the EA. The installation of the cable at the landfall will utilise HDD techniques with the exit point on the seabed located between 900 m to 1050 m offshore.
Maritime & Coastguard Agency	**51**	We note that the developer intends to protect as much of the cable route as possible through burial and additional cable protection. At the formal marine licencing stage we would ideally like to see further details on how this will be achieved, including the results of any applicable penetration studies.	A separate Cable Burial Plan and Construction Method Statement will be provided to MSLOT prior to marine cable installation activities commencing.	A Cable Burial Risk Assessment has been produced for the Project. A separate Cable Burial Plan and Construction Method Statement will be provided to MSLOT prior to marine cable installation activities commencing.
Maritime & Coastguard Agency	**52**	We would like to remind the developer of the MCA's policy that any consented cable/pipeline protection works must ensure existing and future safe navigation is not compromised.	Appendix B - Navigational Risk Assessment of the EA.	A full navigational risk assessment is presented in Appendix B - Navigational Risk Assessment of the EA, which addresses the potential impacts on navigation and anchoring safety.
Maritime & Coastguard Agency	**53**	The MCA would accept a maximum of 5% reduction in surrounding depth referenced to Chart Datum but under no circumstances should depth reductions compromise safe navigation.	Appendix B - Navigational Risk Assessment of the EA.	Appendix B: Navigational Risk Assessment of the EA addresses the issue of reduction in water depth. The vast majority of the cable is laid in the open sea in waters with a depth of 47 m or more at low tide. Therefore, vessel draught presents no concern for the majority of the length of the cable.
Maritime & Coastguard Agency	**54**	We welcome the developer's intent to submit a navigation risk assessment, and look forward to being able to review this at the formal marine licencing stage. At this point the MCA is likely to propose a number of our standard conditions and advisories for consideration by Marine Scotland.	Appendix B - Navigational Risk Assessment of the EA.	The navigational risk assessment is presented in Appendix B - Navigational Risk Assessment of the EA.

APPENDIX B: NAVIGATIONAL RISK ASSESSMENT



LT17 Orkney - Mainland HVAC 220kV Subsea Link Environmental Appraisal

Navigational Risk Assessment

Scottish and Southern Energy plc

Assignment Number: A100413-S02
Document Number: A-100413-S02-REPT-003

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Navigational Risk Assessment

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EXECUTIVE SUMMARY

This document presents the results of a Navigational Risk Assessment undertaken on behalf of Scottish Hydro Electric Transmission plc for a proposed a 220 kV Alternating Current (AC) subsea power cable system between Mainland Orkney and Caithness, on the Scottish Mainland. The project is required in order to provide increased capacity to accommodate increased generation from renewable energy projects (onshore and offshore/marine) in the Orkney area. This standalone document will ultimately form part of a wider Marine Licence Application, in line with Part 4 of the Marine (Scotland) Act 2010.

The assessment comprises a Vessel Traffic Survey which identifies and analyses navigational features and shipping activity in the vicinity of the proposed cable route, followed by a Formal Safety Assessment. No intolerable risks were identified; however, the following recommendations have been made:

- Cable installation and maintenance schedules should be rationalised with the timetables of regular users of the Hoy Mouth and Stromness harbour such that the impact to their existing schedules is reduced to limit disruption;
- Collision prevention measures embedded into the project should be reviewed to determine whether temporarily scaling them up when works are being undertaken in the busiest areas of the cable route will reasonably provide further risk reduction; and
- Regular runners using the Pentland Firth as part of their shipping route should be identified and notifications to owner/operators should be issued.

Taking into account the above recommendations, in conjunction with the existing risk reducing measures embedded into the project, including those specified in the project cable burial risk assessment, will ensure that risks to marine navigation remain As Low As Reasonably Practicable.

ACRONYMS AND ABBREVIATONS

AToN	Aids to Navigation
CBRA	Cable Burial Risk Assessment
DWT	Dead Weight Tonnage
EMEC	European Marine Energy Centre
EMF	Electro-magnetic Field
EU	European Union
FLO	Fisheries Liason Officer
FSA	Formal Safety Assessment
IALA	International Association of Lighthouse Authorities
ICES	International Council for the Exploration of the Sea
Kn	Knots
KP	Kilometre Post
IMO	International Maritime Organisation
MCA	Maritime Coastguard Agency
NAVTEX	Navigational Telex
MMSI	Maritime Mobile Service Identity
NLB	Northern Lighthouse Board
Nm	Nautical Miles
NRA	Navigational Risk Assessment
VMS	Vessel Monitoring System
VTS	Vessel Traffic Survey
SOLAS	Safetu of Life at Sea
Te	Metric Tonnes
UKHO	UK Hydrographic Office

1 INTRODUCTION

1.1 Introduction

In line with Part 4 of the Marine (Scotland) Act 2010, Scottish Hydro Electric Transmission plc (SHE Transmission) is planning to submit an application for a Marine Licence for the planned installation of a 220 kV Alternating Current (AC) cable system between Orkney and Caithness on the Scottish mainland, referred to as the Orkney to Mainland Subsea Link.

The purpose of this report is to provide an assessment of the potential effects of the proposed works on marine navigation in the area, referred to as a Navigational Risk Assessment (NRA). The assessment comprises a Vessel Traffic Survey (VTS), which establishes baseline navigational features and shipping activity in the project area, and a Formal Safety Assessment (FSA), which identifies hazards specific to marine navigation, qualitatively assesses the associated risks and identifies potential risk reduction measures.

1.2 Project overview

The Orkney – Mainland HVAC 220kV Subsea Link project is required to upgrade the electrical network connection between the Orkney islands and Scottish Mainland and thereby provide increased capacity to accommodate increased generation from renewable energy projects (onshore and offshore/marine) in the Orkney area. The proposed cable route, shown in Figure 1.1, runs south from Warebeth, west of Stromness and makes landfall at Dounreay, west of Thurso. It is approximately 53 km in length. The proposed submarine cable technology will employ a three-core design, which minimises electric and magnetic field emissions during operation.

1.2.1 Installation

SHE Transmission intend to bury the subsea cable along the majority of the route. It is envisaged that a variety of installation and burial techniques will be required due to the variable nature of the seabed along the proposed cable corridor. In areas with insufficient sediment cover, cable crossings, or where burial cannot be achieved, additional cable protection in the form of rock placement may be required.

1.2.2 Operation

Once buried, submarine cables do not require routine maintenance. However, it is likely that intermittent inspection surveys will be undertaken using standard geophysical survey equipment and/or Remotely Operated Vehicles (ROVs) to monitor the cables.

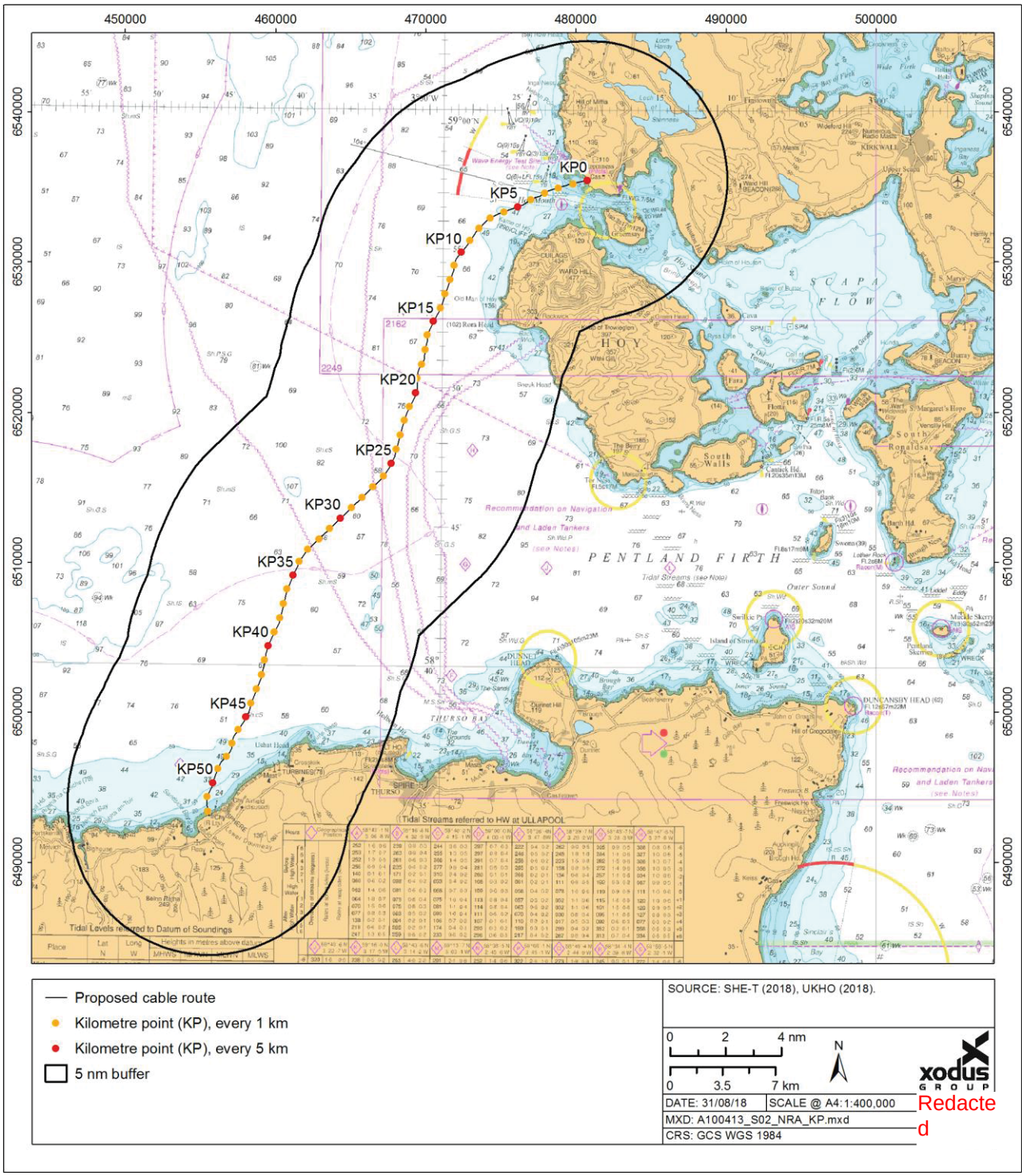


Figure 1.1 Proposed cable route and study area (5 nm buffer around route)

2 METHODOLOGY

2.1 Introduction

The NRA comprises three principal components:

- Vessel Traffic Survey (VTS);
- Formal Safety Assessment (FSA); and
- Consultation on the contents of the NRA as part of submission with the marine licence application.

These are explained in further detail in the following sections.

2.2 Vessel traffic survey

The purpose of the VTS is to identify navigational features and patterns of vessel activity within the vicinity of the proposed cable, and thereby establish baseline conditions to inform the subsequent FSA. Several data sources have been used to achieve this:

- Automatic Identification System (AIS) data;
- Vessel Monitoring System (VMS) data; and
- Information on anchorages and navigational features gleaned from admiralty charts and the Clyde Cruising Club Sailing Directions and Anchorages handbook for the Orkney and Shetland Islands (CCC, 2016).

The study area was defined as 5 nm buffer around the proposed cable route (Figure 2.1).

2.2.1 Automatic Identification System (AIS) data

The International Maritime Organisation (IMO) requires that all ships of ≥ 300 gross tonnage and all passenger ships are fitted with an Automatic Identification System (AIS). These systems broadcast a variety of information at up to two second intervals, and can therefore be used to retrospectively reconstruct individual vessel tracks/paths.

AIS data was purchased from marinetraffic.com for the period March 2016 to February 2018 for the area shown in Figure 2.1 to fulfil the requirements of the NRA, as well as the Cable Burial Risk Assessment (CBRA; Cathies, 2018). The 5 nm NRA study area around the proposed cable route location marginally exceeds the data coverage at its northernmost extent, but was deemed adequate for the purposes of this NRA as all vessels must pass through an area with data coverage to cross the proposed cable route (see Figure 2.1 AIS data area).

The AIS records were supplied with all standard parameters (longitude, latitude, vessel Maritime Mobile Service Identity (MMSI), status, speed, course, heading and timestamp) and the following additional parameters:

- Deadweight tonnage (DWT);
- Vessel length;
- Vessel width;
- Vessel type; and
- Vessel draught (maximum).

The AIS data provided by marinetraffic.com is in a raw, point-based format. These points were converted into vessel tracks in ArcMap using the unique MMSI and the timestamp associated with each individual AIS record. The tracks were subsequently ‘reattached’ to the ship-specific attribute database to enable further analysis, and clipped to the 5 nm buffer shown in Figure 2.1.

Vessel density grids for the wider area were produced by overlaying a grid comprising 250 m cells and determining the density of tracks within each cell.

Vessel tracks were assumed to be wholly in the season or month in which the track started in the data request area. Similarly, vessel speeds were calculated from the length of the track in the data request area and the start and end times of that track.

2.2.2 Vessel Monitoring System (VMS) data

As mentioned above, AIS is only a requirement of larger vessels, or those carrying passengers, whereas fishing vessels are exempt (although many carry AIS voluntarily for safety). As such, AIS data can underrepresent fishing activity. However, the EU requires that all EU, Faroese and Norwegian fishing vessels of 12 m and above are fitted with a vessel monitoring system (VMS). Vessel positions are transmitted every two hours rather than every few minutes as for AIS data, so tracks cannot be readily reconstructed. Nevertheless, the data provides a comprehensive and informative overview of the distribution and density of fishing vessels over 12 m.

Two sets of VMS data were obtained:

- Fishing activity by International Council for the Exploration of the Sea (ICES) statistical rectangle (this includes data about fishing effort and gear type; 2012 - 2016); and
- Anonymised VMS data for the area of interest for February 2015 – December 2017 (no information on gear type or status, but vessel speeds can be used as a proxy for fishing status, albeit with an inherent level of uncertainty).

2.2.3 Other data sources

A number of additional data sources have been used to identify navigational features in the vicinity of the project, such as anchorages, Aids to Navigation (AToN), ports and harbours, routing measures and military exercise areas.

These data sources include:

- Admiralty charts:
  - Chart 2162: Pentland Firth and approaches;
  - Chart 35: Scapa Flow and approaches; and
  - Chart 2249: Orkney Isles western sheet.
- Ports Handbook for Orkney (6th addition);
- Scrabster port information webpage: http://www.scrabster.co.uk/port-information/local-services/; and
- The Clyde Crusing Club Sailing Directions and Anchorages handbook for the Orkney and Shetland Islands (CCC, 2016).

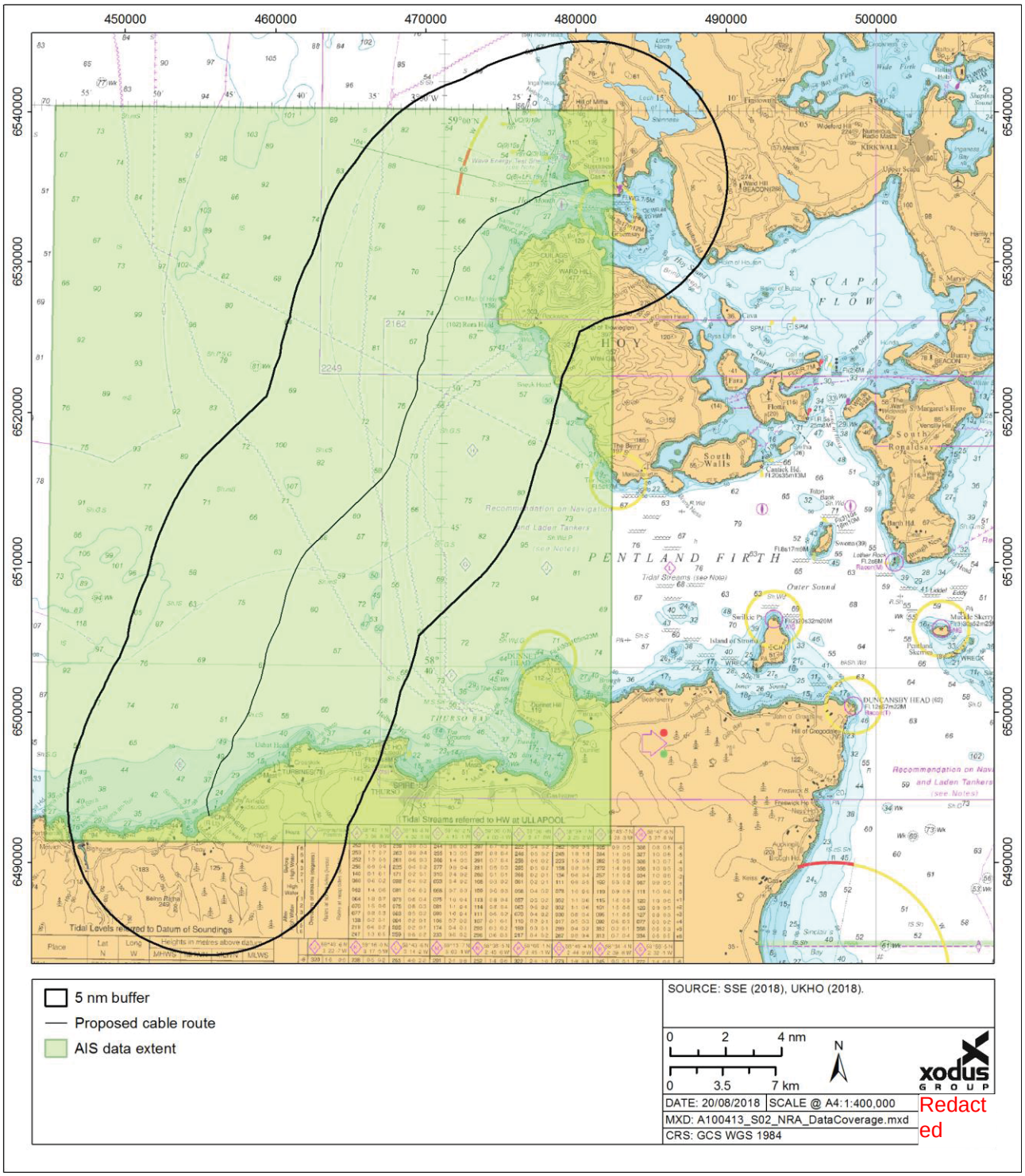


Figure 2.1 AIS data area

2.3 Formal Safety Assessment (FSA)

The NRA is based upon an FSA process, which provides a structured and systematic method for evaluating and controlling risk within a proactive, transparent framework. The process is broadly qualitative and comprises the following principal elements:

- Hazard / impact identification;
- Identification of existing risk control measures;
- Risk assessment;
- Identification of additional risk control measures; and
- Cost benefit considerations.

The outcome of these five steps is the formulation of recommendations to inform decision-making for all relevant parties. Further detail on each step is provided below.

2.3.1 Hazard / impact identification

Taking into account the project components and activities, baseline information provided in the VTS, consultation responses and expert judgement/industry experience, a list of all relevant hazards, as well as their potential causes and outcomes is compiled. It is usually instructive to break these down by project phase. These are taken forward to the risk assessment phase.

2.3.2 Identification of existing risk control measures

All existing risk control measures are identified such that they can be incorporated into the risk assessment process. These include industry standard and SHE Transmission-specific measures that are implemented as standard practice during their operations.

2.3.3 Risk assessment

The risk assessment process is implemented using the risk matrix approach defined in the International Maritime Organisation (IMO) FSA Methodology (IMO, 2002). Each impact is individually evaluated against specific criteria and assigned categories for “severity of consequence” and “frequency of occurrence”. The definitions used in the FSA to evaluate the consequence and frequency of impacts are shown below in Tables 2.1 and 2.2.

Table 2.1 IMO FSA Consequence Severity Definitions

Severity	Definition
Negligible	• No injury to persons • No significant damage to infrastructure or vessel • No environmental damage • No significant operational impacts
Minor	• Slight injury(s) to person • Minor damage to infrastructure or vessel • Minor environmental damage • Minor business, operation, or reputation impact
Moderate	• Serious injury to person • Notable damage to infrastructure or vessel • Significant environmental damage • Considerable business, operation, or reputation impact

Severity	Definition
Serious	• Loss of a crew member, or multiple serious injuries • Major environmental damage • Major damage to infrastructure or vessel • Major national business, operation or reputation impacts
Catastrophic	• Total loss of a vessel or crew • Extensive environmental damage

Table 2.2 IMO FSA Frequency Definitions

Frequency	Definition
Negligible	Only likely to happen in exceptional circumstances
Extremely Unlikely	Unlikely to happen but not exceptional
Remote	Likely to happen during the project span
Reasonably Probable	Extremely likely to happen during the project span
Frequent	Will occur on a regular basis during the project

The frequency and consequence categories and then combined using the IMO FSA risk matrix shown below in Figure 2.2, which is used to derive a risk tolerability level of either Unacceptable, Tolerable or Broadly acceptable. Definitions of each risk tolerability level are provided in Table 2.3.

Frequency						
	Frequent	Tolerable	Tolerable	Unacceptable	Unacceptable	Unacceptable
	Reasonably Probable	Broadly Acceptable	Tolerable	Tolerable	Unacceptable	Unacceptable
	Remote	Broadly Acceptable	Broadly Acceptable	Tolerable	Tolerable	Unacceptable
	Extremely Unlikely	Broadly Acceptable	Broadly Acceptable	Broadly Acceptable	Tolerable	Tolerable
	Negligible	Broadly Acceptable	Broadly Acceptable	Broadly Acceptable	Broadly Acceptable	Tolerable
		Negligible	Minor	Moderate	Serious	Catastrophic
	Consequence					

Figure 2.2 IMO FSA Risk Matrix

Table 2.3 IMO FSA Risk Tolerability

Tolerability	Definition
Broadly Acceptable (Low Risk)	Generally regarded as acceptable and adequately controlled. At these risk levels the opportunity for further reduction is limited.
Tolerable (Moderate Risk)	Typical of the risks from activities which people are prepared to tolerate to secure benefits. There is however an expectation that such risks are properly assessed, appropriate control measures are in place, residual risks are as low as reasonably practicable (ALARP) and that risks are periodically reviewed to monitor if further controls are appropriate.
Unacceptable (High Risk)	Generally regarded as unacceptable whatever the level of benefit associated with the activity. Significant risk mitigation or design modification required to reduce to tolerable (ALARP).

2.3.4 Identification of additional risk control measures

Where risks are assessed as being unacceptable or tolerable after factoring in the existing risk control measures already identified, further additional risk control measures are identified and considered.

2.3.5 Cost-benefit analysis

In order to formulate recommendations for decision-making, any additional risk control measures identified are subjected to a qualitative cost-benefit comparison in order to establish a basic ALARP position.

2.4 Guidance and legislation

As described in Section 2.2, the IMO Guidelines for Formal Safety Assessment (FSA)– MSC/Circ. 1023 (IMO, 2002) are the overarching guidance used in this NRA. In addition, the following have been taken into account during the assessment:

- International Regulations for Preventing Collisions at Sea (COLREGS 1972/78), as implemented in the UK through Marine Shipping Notices (IMO, 1972/78); and
- International Association of Lighthouse Authorities, Guidance on Aids to Navigation and Buoyage (IALA, 2001).

3 VESSEL TRAFFIC SURVEY

3.1 Overview

The proposed cable route crosses the Pentland Firth, which is recognised as an international shipping lane, and is also a passage route for oil and gas passenger transfer vessels between Aberdeen and Kirkwall (Orkney) and Scrabster (Scottish Mainland). There are also long-established ferry routes from Mainland Scotland to Orkney passenger ferry routes running across the Pentland Firth between Scrabster and Stromness (western route) (Hamnavoe) and between Gills Bay and St Margaret's Hope (South Ronaldsay) (Pentalina) (eastern route. The Orkney Isles are popular for sailing. Recreational routes are distributed among most of the islands, with yachts visiting main harbours and marinas of Scrabster, Kirkwall, Stronmess and Westray.

3.2 Navigational features

3.2.1 Ports and harbours

There are two main harbours in the vicinity of the cable route, Stromness and Scrabster (Figure 3.1). Stromness is a very busy port, representing the base for the daily Serco Northlink Ferry to Scrabster, the MV Graemsay ferry to Hoy and Graemsay, the base for the local lifeboat, as well as for numerous fishing vessels and dive vessels, and vessels associated with the various European Marine Energy Centre (EMEC) testing facilities. It is located to the north-west of Scapa Flow, one of the world's largest natural harbours offering sheltered, swell and tidal free deep water anchorages, encompassing an area of around 125 square miles. This is northern Europe's preferred location for Ship to Ship transfer operations of crude oil, gas and other products, long term storage and lay up of tankers and accommodation rigs.

Scrabster harbour is Britain's most northern mainland port providing services for man commercial vessels, including a fishing fleet and ferries. It is also a port of call for cruise ships and provides support for offshore oil and gas and marine renewables. The harbour provides a safe, deep water anchorage to seafarers and is known as the "gateway to the northern lands of Orkney, Shetland, Scandinavia and the Faroes".

3.2.2 Anchorages

There are no designated anchorage areas along the proposed cable route, however there are some areas in the vicinity of the route where vessels have been recorded at anchor (see Section 3.7 for further details).

Anchoring anywhere in the Pentland Firth is highly dangerous for any vessels and not possible for yachts and leisure craft.

3.2.3 Military practise areas

There are no military practise areas in the vicinity of the project.

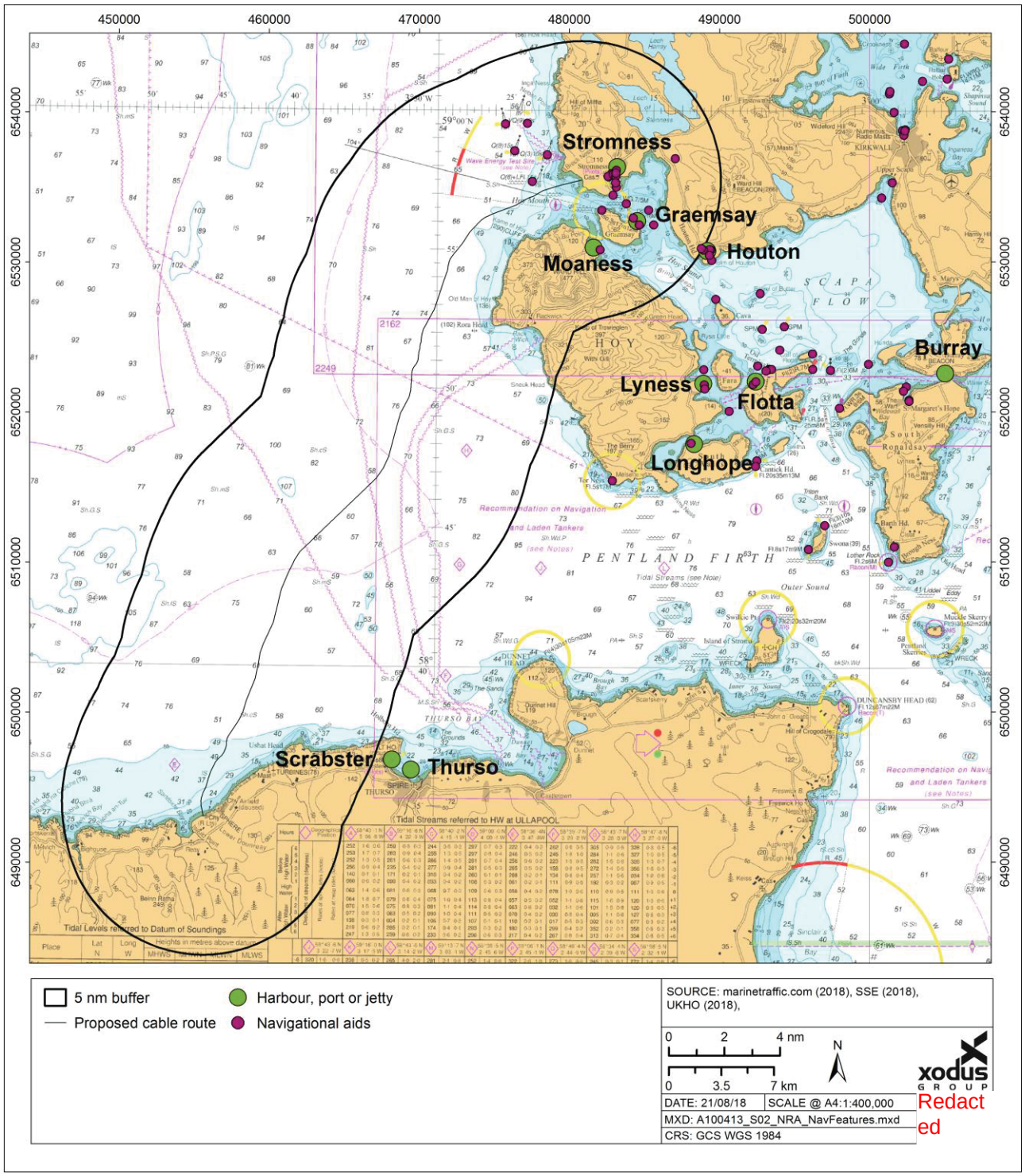


Figure 3.1 Harbours, ports, jetties and navigational aids

3.3 Automatic Identification System (AIS) data

3.3.1 Data overview and seasonality

Just under 19,000 AIS vessel tracks were recorded in the two year study period between March 2016 and February 2018 (Figure 3.2) The areas of densest tracks are the north-south route between Stromness and Scrabster, and east-west entering/exiting the Pentland Firth (Figure 3.3). The area with the highest track density (3542 tracks per 0.25 m²) is near Hoy Mouth, resulting from the vessels entering and exiting Stromness.

Two ferry routes are operated within the area of interest: Stromness – Scrabster and Stromness – Moaness (Hoy). Further detail is given in Section 3.4.2.

The number of vessel tracks and track density was highest in the summer (June, July and August; July was the highest month at 1,848 tracks) and lowest in the winter (December, January and February; December was the lowest month at 1,241 tracks; Table 3.1; Figure 3.4; Figure 3.6). This is mostly due to the seasonality of the number of passenger/pleasure vessels which peaked in July: clearly the summer is a more popular time for tourists. The number of fishing vessels peaked in March, making March the month with the second highest number of vessel tracks at 1, 801 tracks.

The day on which the most vessels began a journey or crossed into the 5 nm zone was 14th December 2017 (Figure 3.5), when 51 tracks were recorded. Conversely, the day on which the least vessels began a journey or crossed into the 5 nm zone was 26th December 2016, when only one vessel track was recorded to have started.

Table 3.1 Vessel tracks by season

	Spring	Summer	Autumn	Winter	All seasons
Mean density (tracks per 0.25 m²)	69	76	63	62	276
Number of tracks started	5045	5343	4458	4011	18857

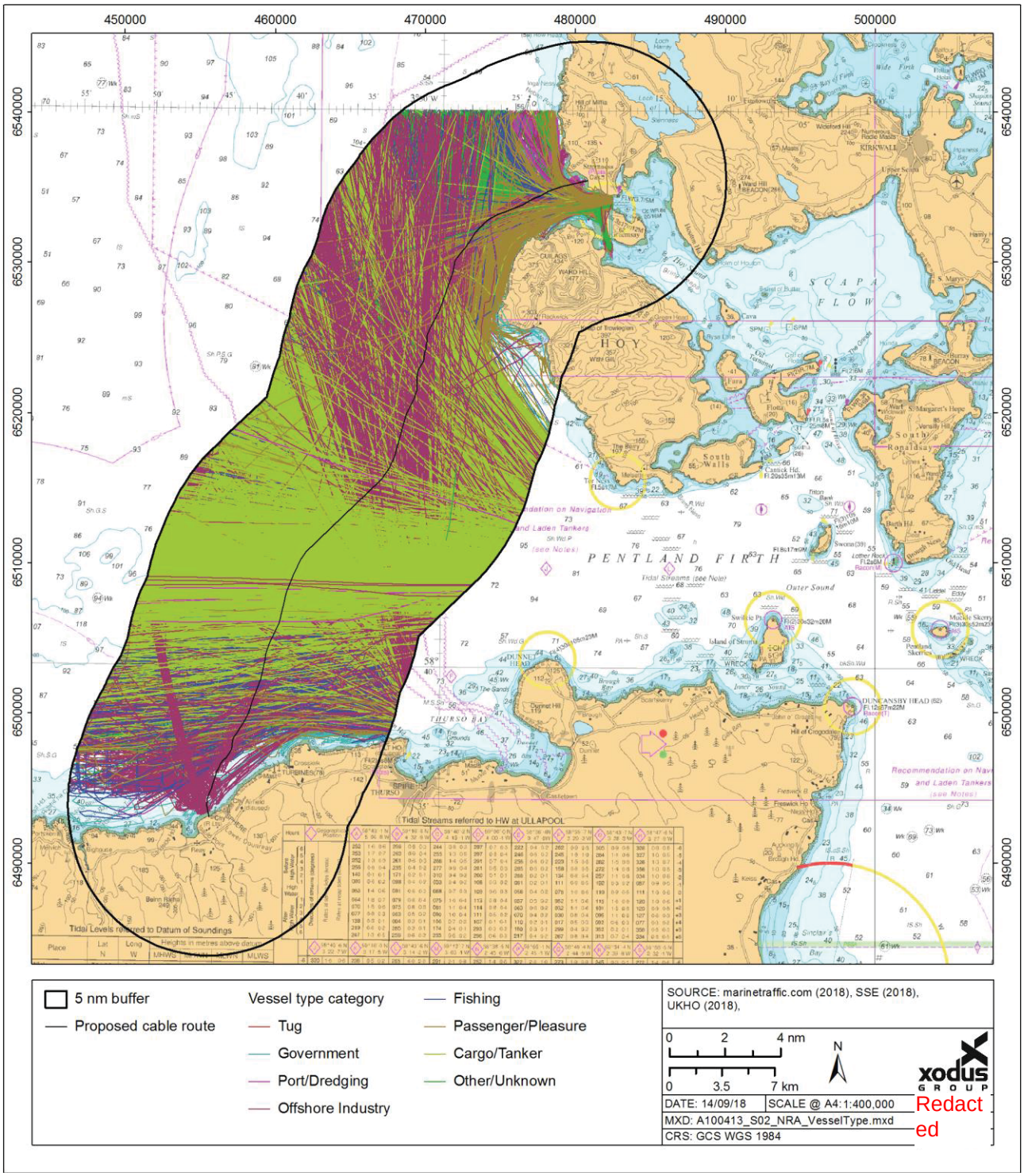


Figure 3.2 Vessel tracks by vessel category

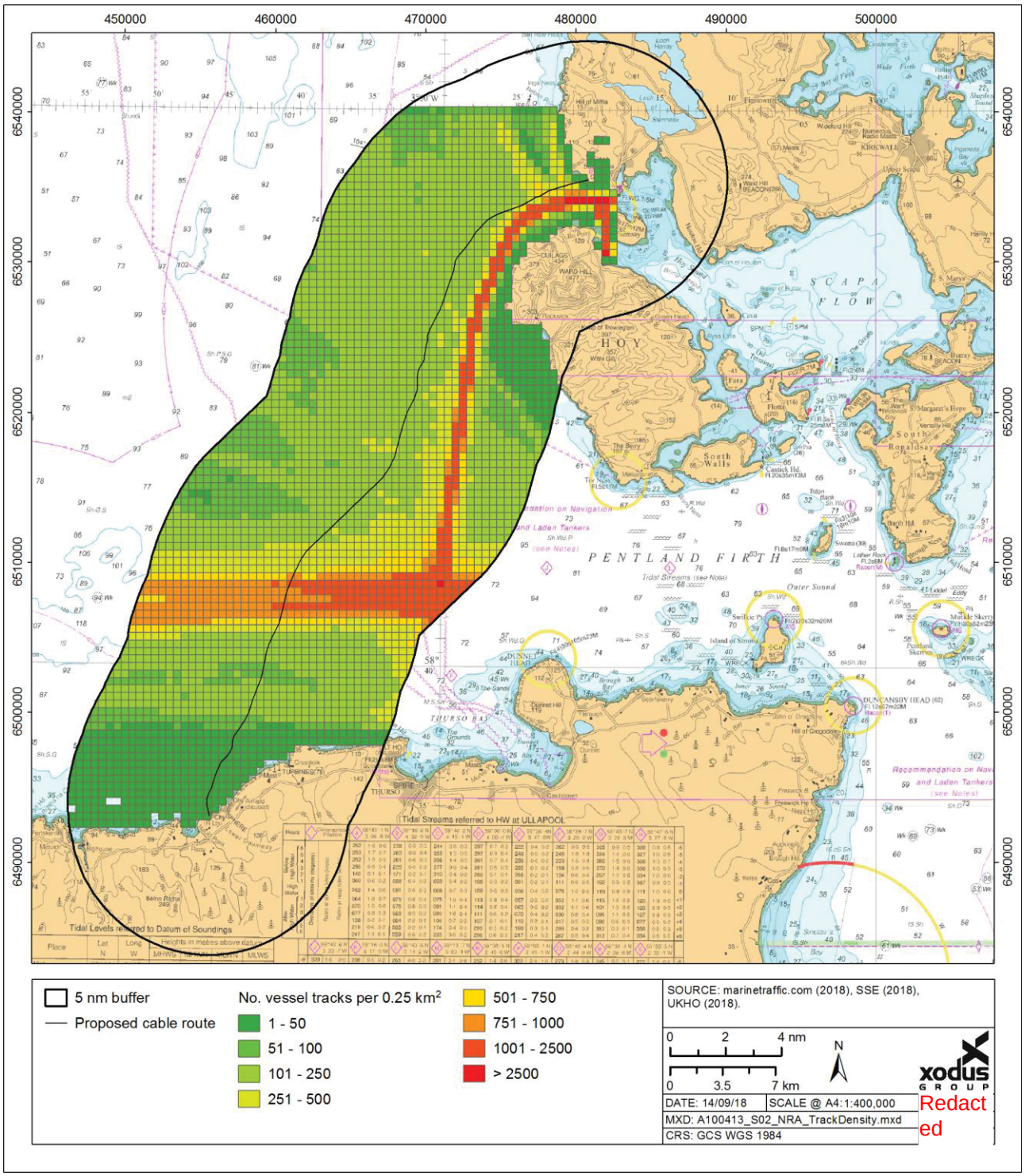


Figure 3.3 Vessel track density between March 2016 and February 2018

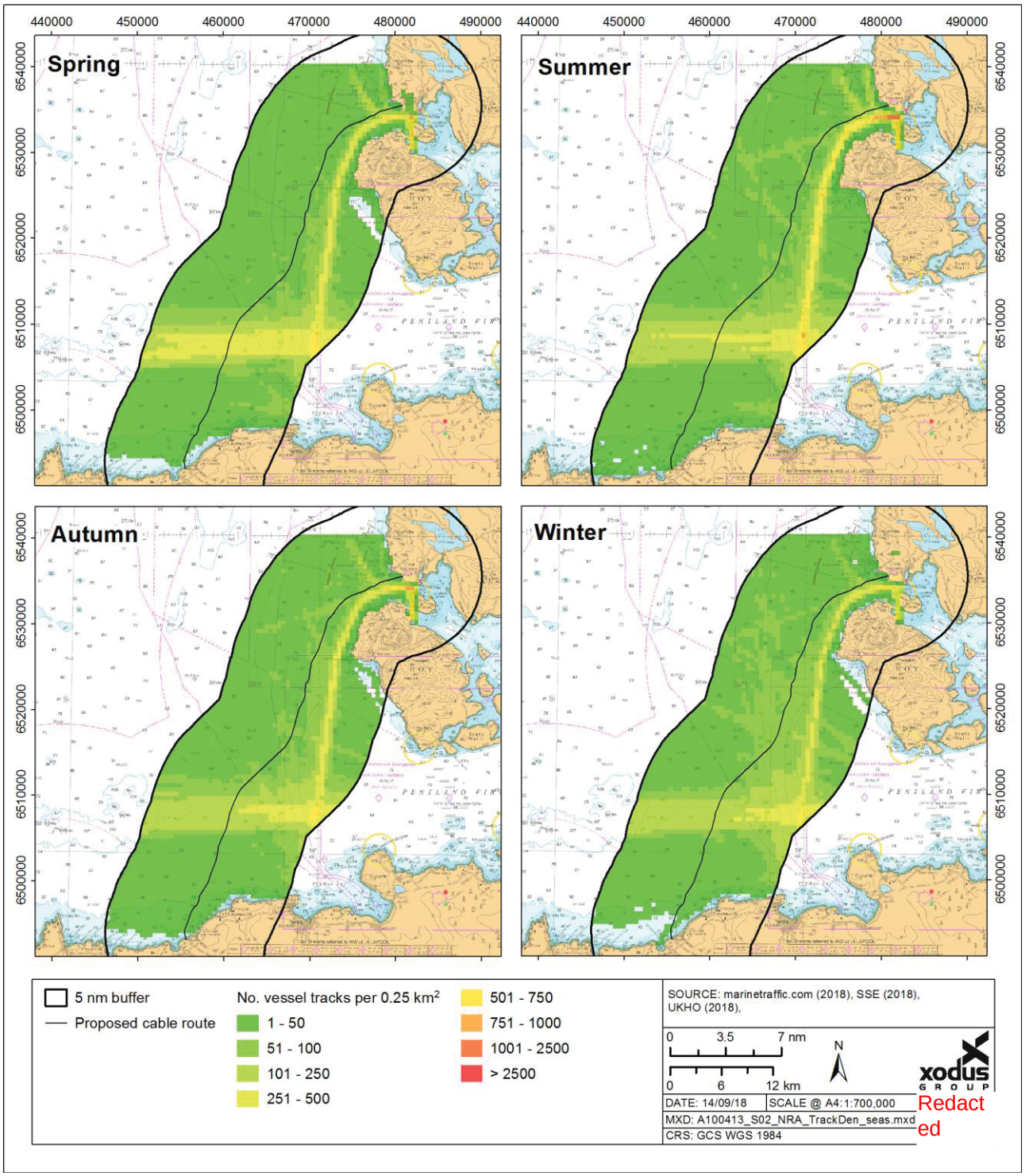


Figure 3.4 Vessel track density by season

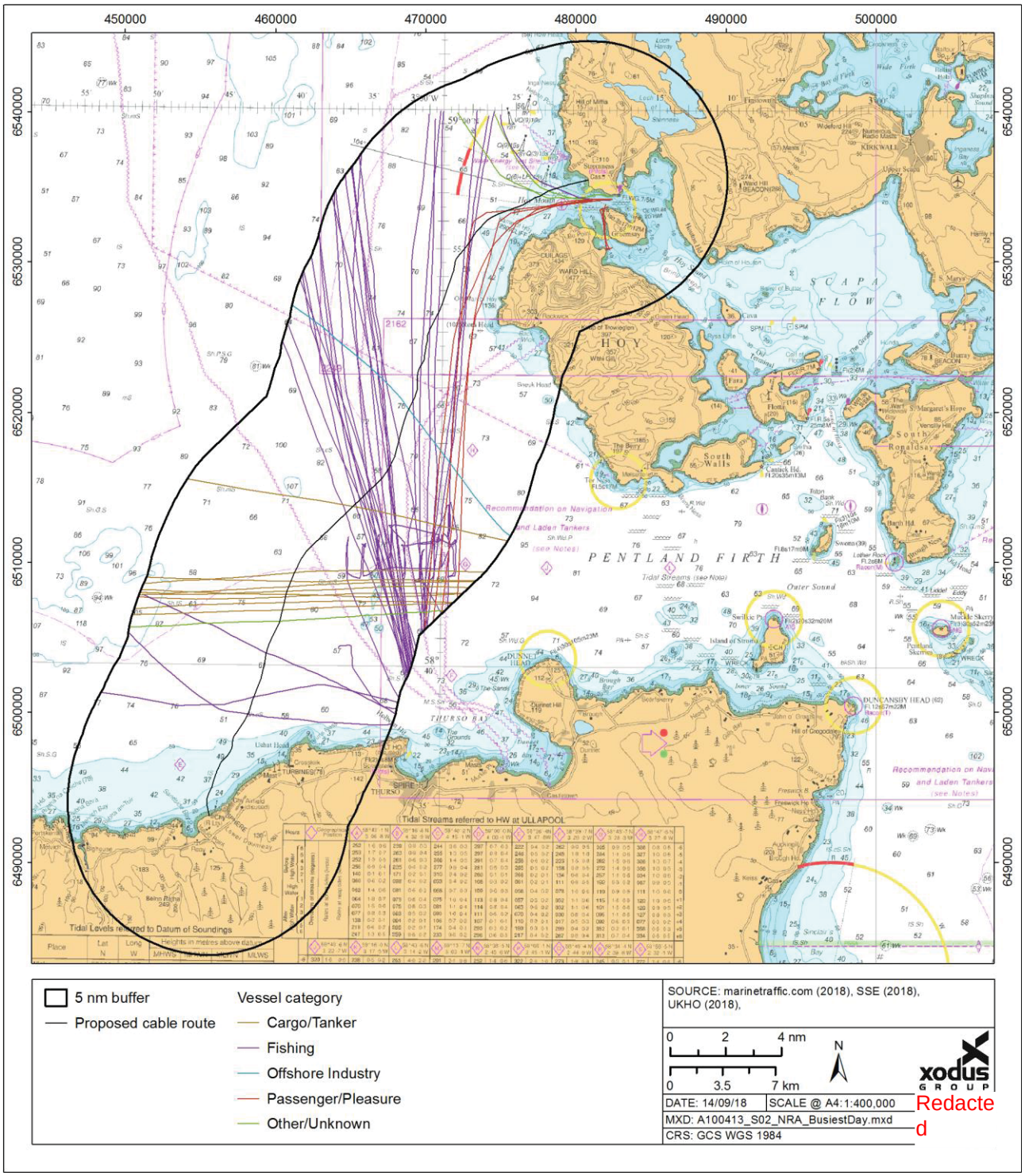


Figure 3.5 Busiest day (14th December 2017)

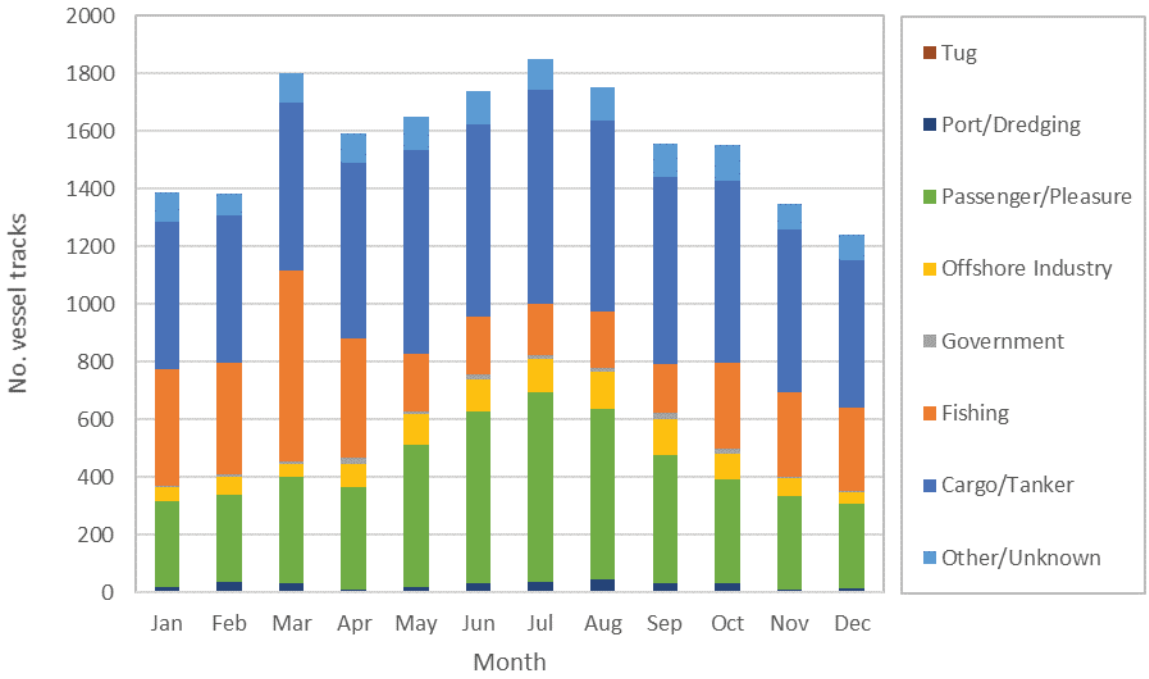


Figure 3.6 Vessel tracks by month

3.4 Vessel type

The most frequently recorded vessels in the study area were cargo vessels or tankers, followed by passenger or pleasure vessels, fishing vessels and offshore industry (Figure 3.2, Figure 3.7 and Table 3.2). Port or dredging vessels, government vessels and tugs account for just 2.5% of the total vessel tracks. Further detail on the top five vessel categories is given in the following sections.

Table 3.2 Vessel tracks by vessel category

Vessel category	Vessel tracks	% of total
Cargo/Tanker	7367	39.1
Passenger/Pleasure	5092	27.0
Fishing	3679	19.5
Offshore Industry	1006	5.3
Port/Dredging	296	1.6
Government	160	0.8
Tug	7	0.0
Other/Unknown	1250	6.6
Total	*18857*	*100*

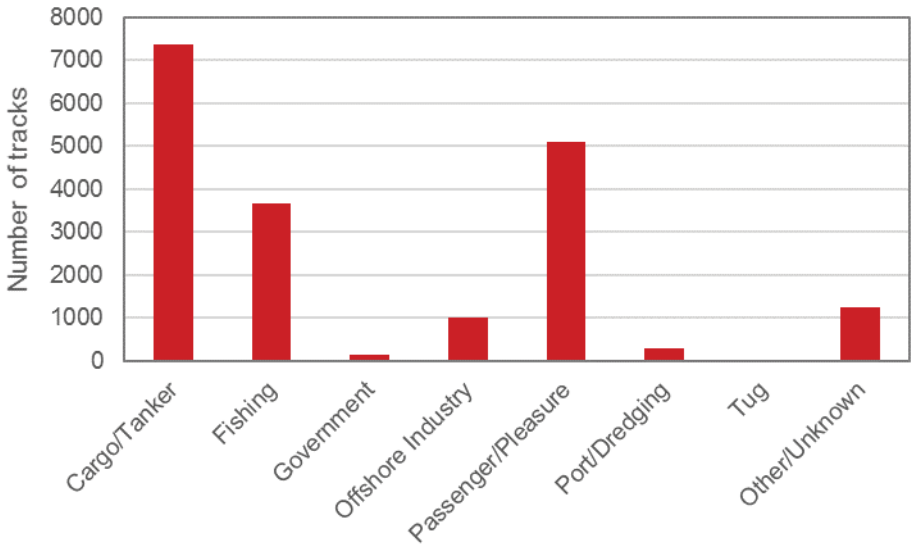


Figure 3.7 AIS tracks by vessel category

3.4.1 Cargo vessels/tankers

Cargo vessels and tanker AIS tracks are shown in Figure 3.8. The busiest area for vessels in this category was the area immediately west of the Pentland Firth, where the heavier vessels in particular (>50,000 te) tend to be travelling east-west/west-east towards/away from the Pentland Firth. There also appears to be a particular route going to/from the Pentland Firth to the north west and vice versa, and through the Hoy Mouth towards/away from Stromness.

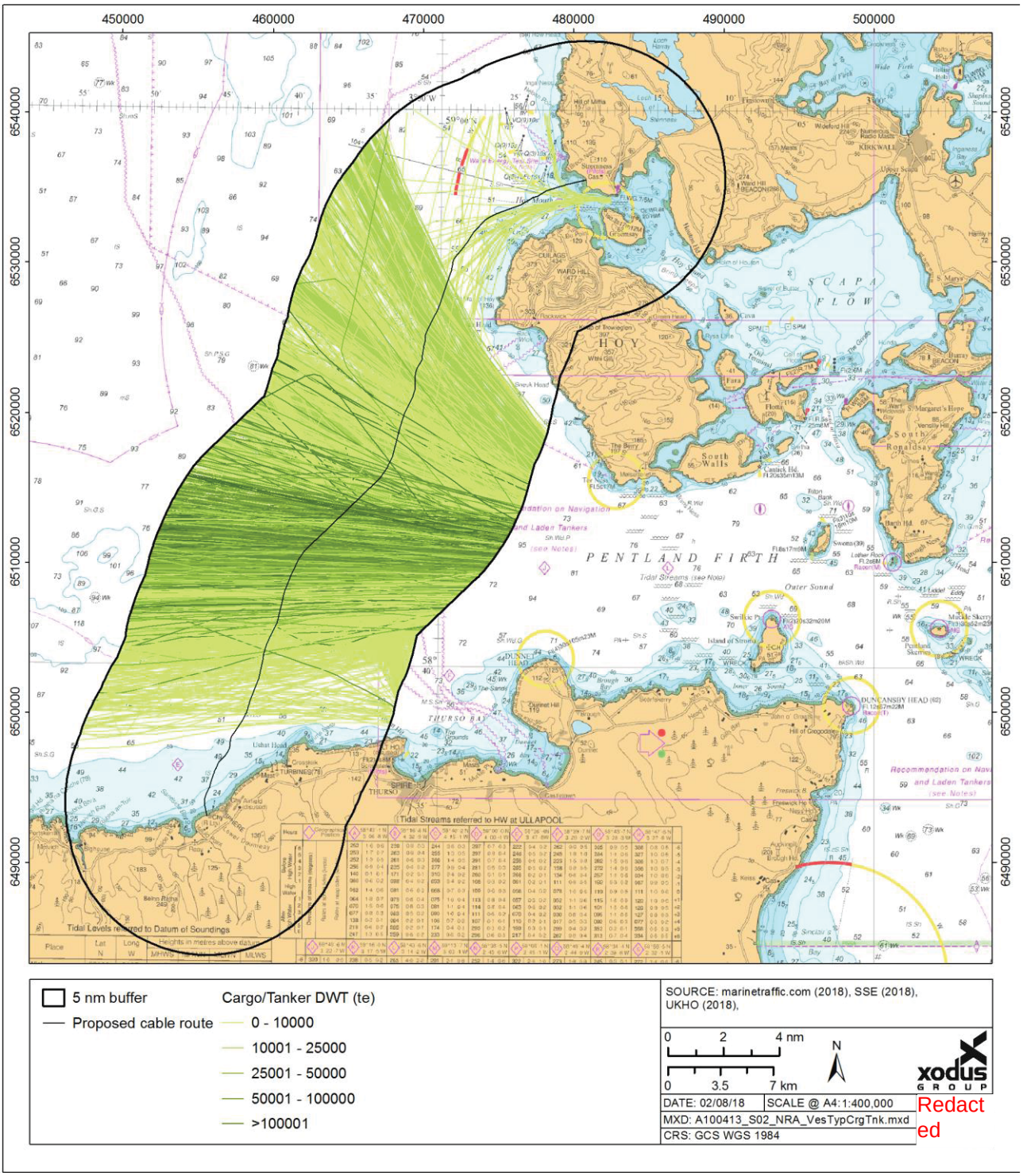


Figure 3.8 Cargo vessel and tanker AIS tracklines by DWT

3.4.2 Passenger/pleasure vessels

Passenger or pleasure vessel AIS tracks are shown in Figure 3.9, with the Scrabster – Stromness ferry indicated in red (MV Hamnavoe) or orange (MV Isle of Lewis whilst MV Hamnavoe was being refitted in early 2016), and the Stromness - Moaness ferry shown in blue or purple (MV Graemsay or MV Golden Mariana

respectively; Table 3.3). The Stromness – Moaness ferries tended to keep quite close to their charted route, whilst the MV Hamnavoe on the Scrabster – Stromness route frequently deviated from the most direct route. This occurred during all seasons.

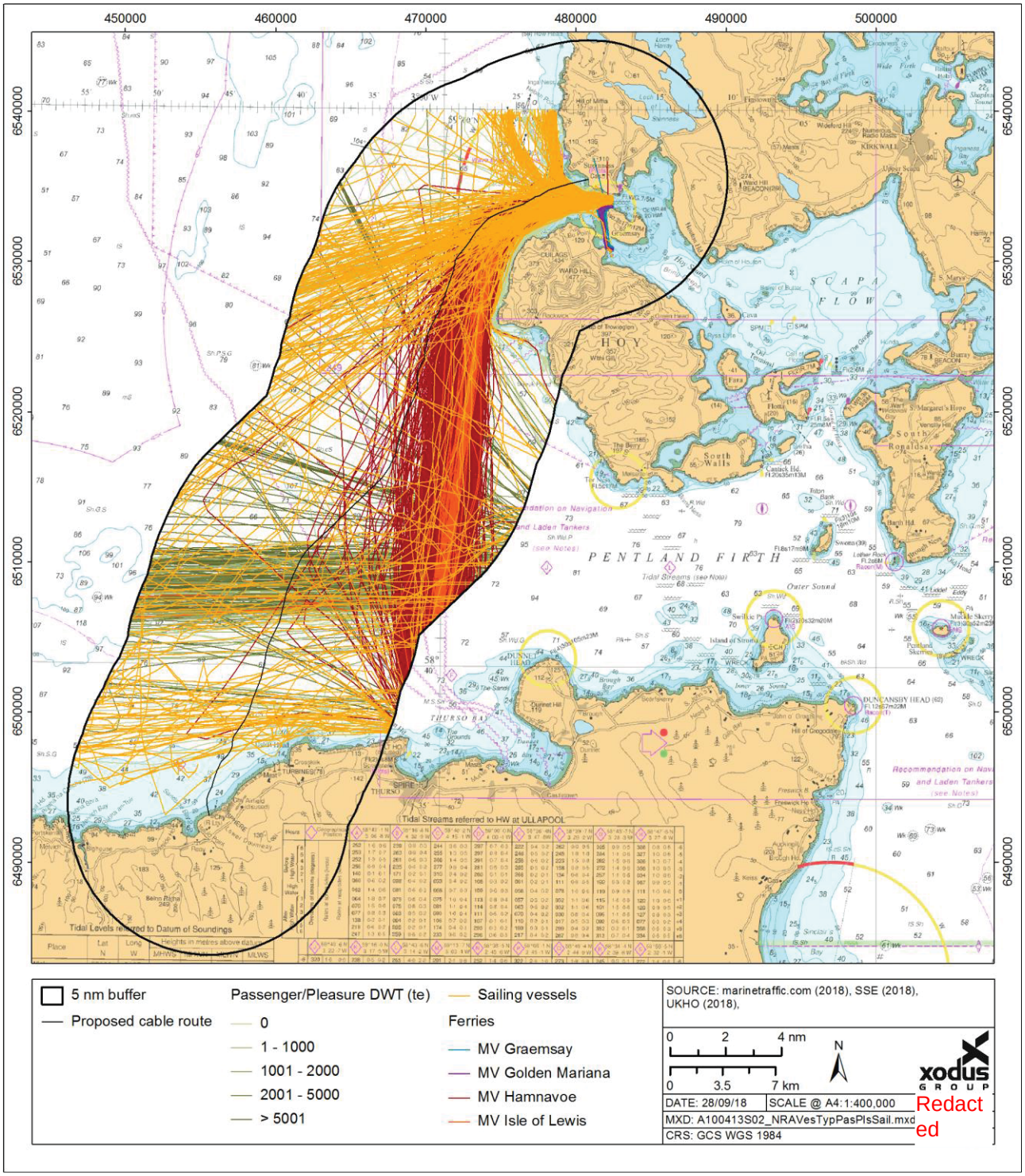


Figure 3.9 Passenger/pleasure vessel AIS tracks by DWT

Table 3.3 Ferry details

Vessel name	Route	Length (m)	DWT (te)	Maximum draught (m)
MV Hamnavoe	Scrabster – Stromness	112	1200	4.4
MV Isle of Lewis	Scrabster – Stromness	101	867	25.5
MV Graemsay	Stromness - Moaness	21	Not recorded	Not recorded
MV Golden Mariana	Stromness - Moaness	15	Not recorded	Not recorded

As noted previously, the tracks of larger vessels tend to be located immediately west of the Pentland Firth. Sailing vessels and yachts have tracks that are much more random in nature than others (Figure 3.9), and frequently broadcast a DWT of 0 te.

3.4.3 Offshore industry vessels

Offshore industry vessel AIS tracks are shown in Figure 3.10. Three vessels were recorded undertaking survey work, listed in Table 3.4 . The MV Stril Explorer undertook a survey of the proposed cable route corridor in February 2018, the MV Kommander two surveys of a proposed offshore wind farm in September/October 2016 and April/May 2017 and the MV Fugro Discovery survey work in July/Aug 2017.

Table 3.4 Survey vessels

MMSI	Name	Type
235011900	MV Kommandor Stuart	Survey vessel
372698000	MV Fugro Discovery	Survey vessel
259006000	MV Stril Explorer	Offshore support

The majority of smaller offshore survey vessels travel towards the north-west, and are most likely associated with works at the Brough Head and Billia Croo wave energy sites, located approximately 5 km and 0.7 km to the north of the route, respectively (Figure 3.10).

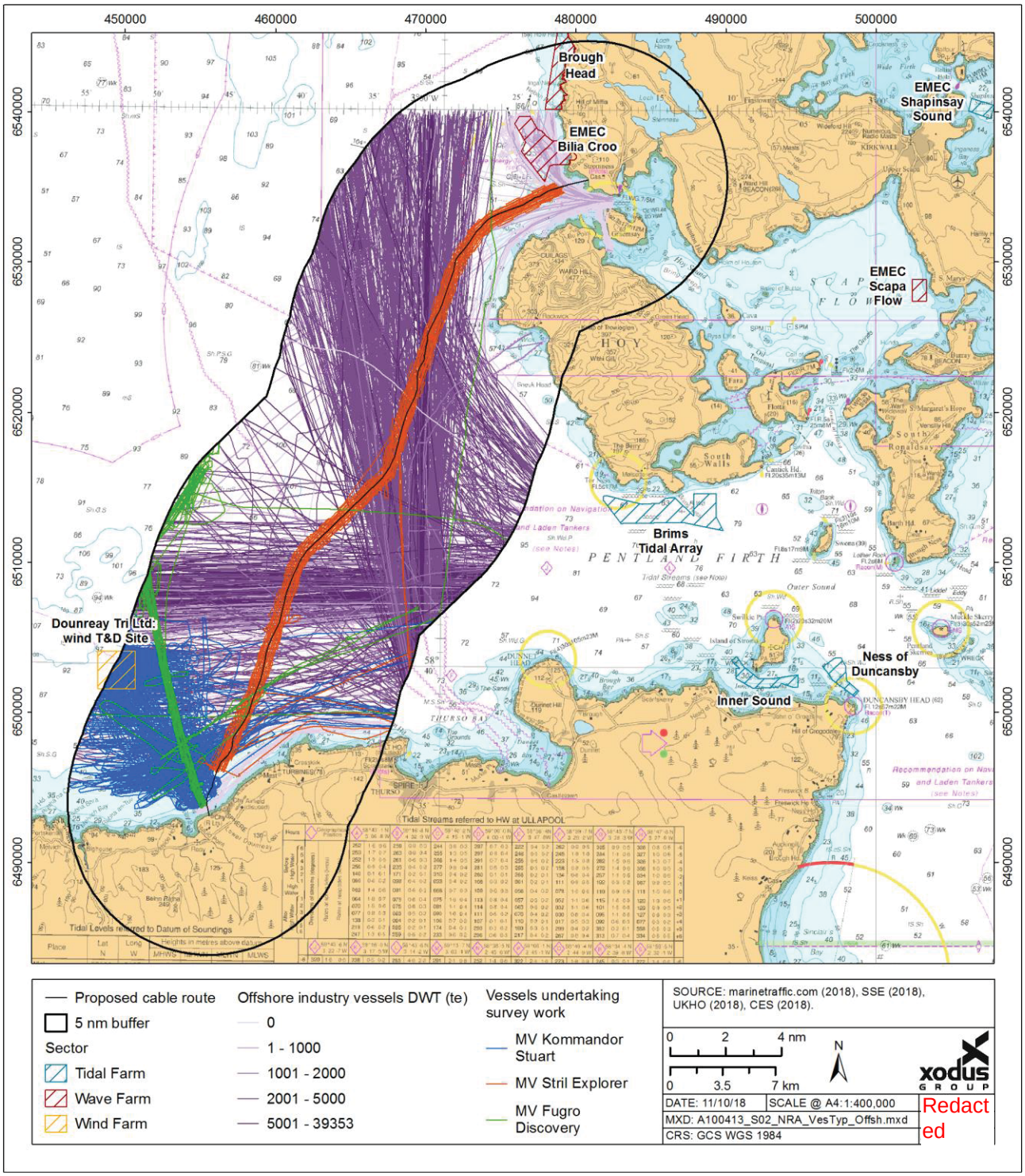


Figure 3.10 Offshore industry vessel tracks by DWT

3.4.4 Other/unknown vessels

Vessels in the other/unknown category include vessels where no vessel type is broadcast or the vessel does not fit into one of the prescribed vessel types. The tracks of these vessels are shown in Figure 3.11.

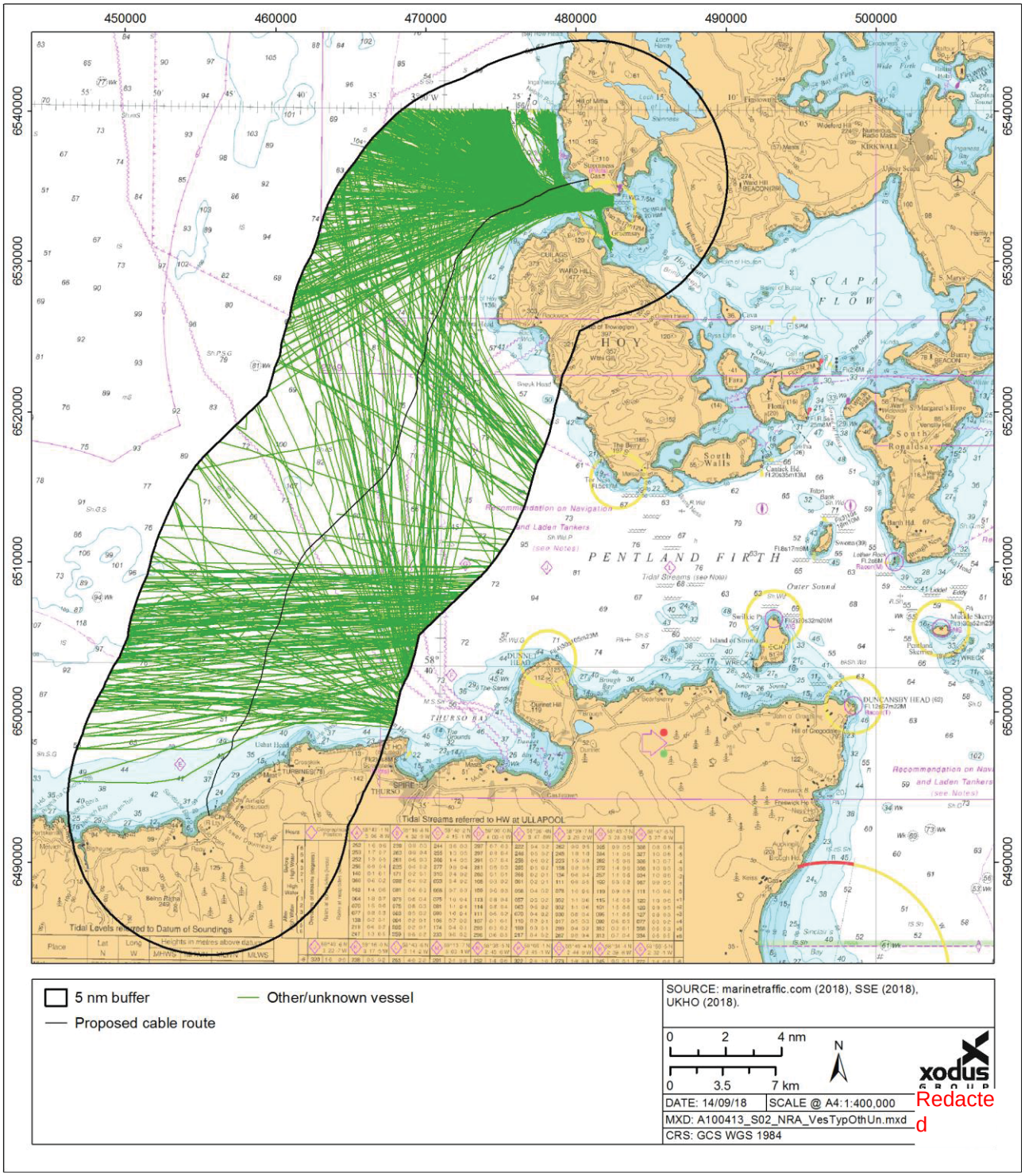


Figure 3.11 Other/unknown AIS vessel tracks

3.5 Vessel size

3.5.1 Vessel length

Recorded vessel lengths ranged between 2 and 627 m, with a mean of 81 m long. The distribution of vessel lengths are given in Table 3.5 and Figure 3.12. Longer vessels tend to be found in the area immediately west of the Pentland Firth, whilst smaller vessels tend to be in the vicinity of Stromness and the Orkney coast.

Table 3.5 Vessel lengths

Length (m)	No. vessel tracks	% of total
1 - 50	6370	33.8
50 - 100	4453	23.6
100 - 150	5603	29.7
200 - 700	1076	5.7
Length of 0 recorded	1355	7.2

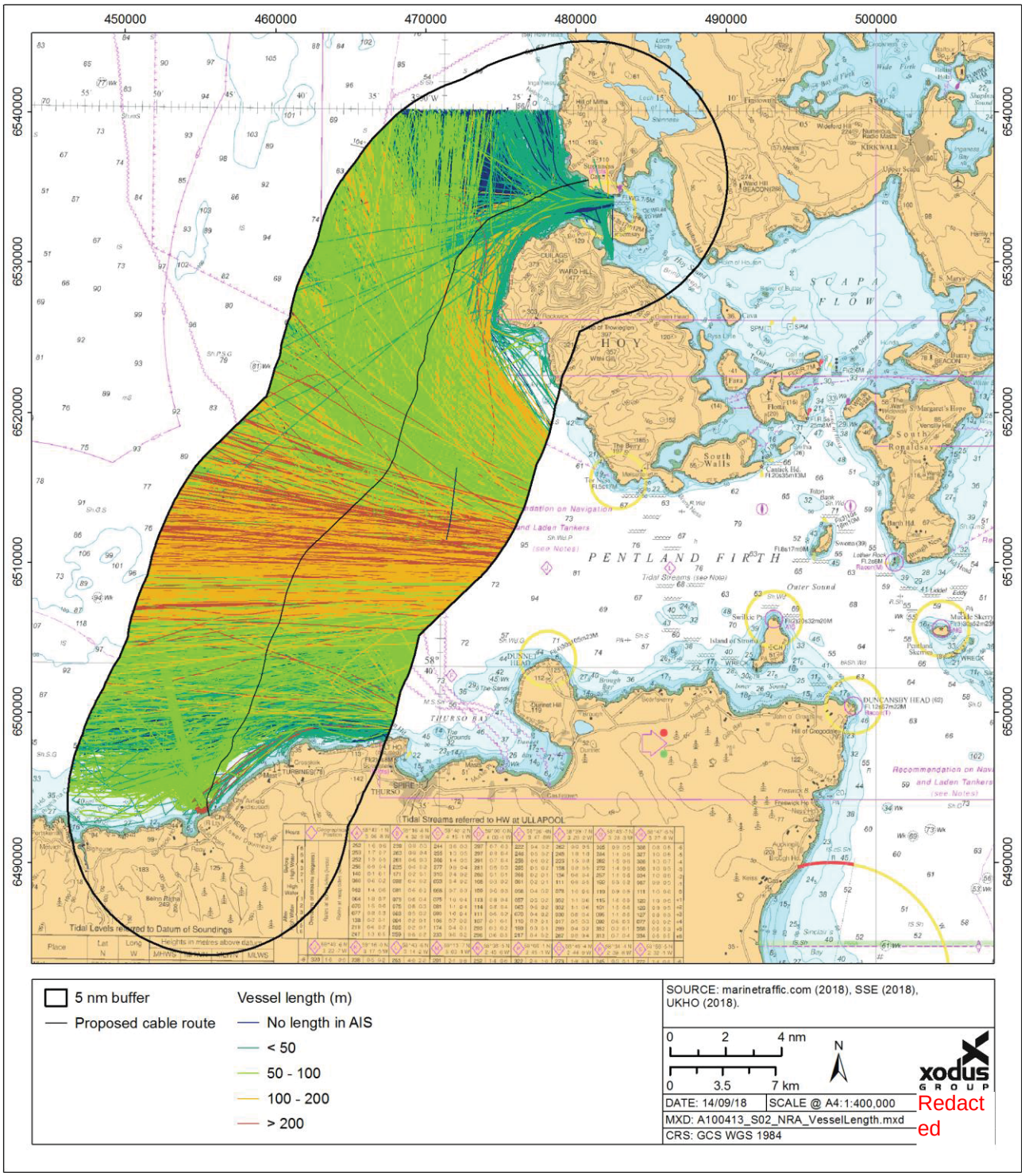


Figure 3.12 AIS tracks by vessel length

3.5.2 Vessel Dead Weight Tonnage

Recorded vessel Dead Weight Tonnage (DWT) ranged between 12 and 320,000 te, with a mean of 8,690 te. The distribution of vessel DWT are given in Table 3.6, Figure 3.13 and Figure 3.14. As noted previously, vessels with higher DWT tended to be located in the area immediately to the west of Pentland Firth. Vessels with lower DWT or no DWT recorded tend to be located closer to the coast.

More than 40% of vessels did not record any data for DWT. These were mostly passenger/pleasure or fishing vessels. Vessels of more than 5,000 te were almost exclusively cargo/tanker vessels (94%), whilst vessels of less than 5,000 te were more evenly split between cargo/tanker (41%), passenger/pleasure (28%) and fishing (20%).

Table 3.6 Vessel DWT

DWT (te)	Vessel tracks	% of total
1 - 1000	1021	5.4
1000 - 5000	5174	27.4
5000 - 10000	2036	10.8
10000 - 50000	2061	10.9
50000 - 100000	717	3.8
100000 - 500000	263	1.4
No DWT in AIS data	7585	40.2

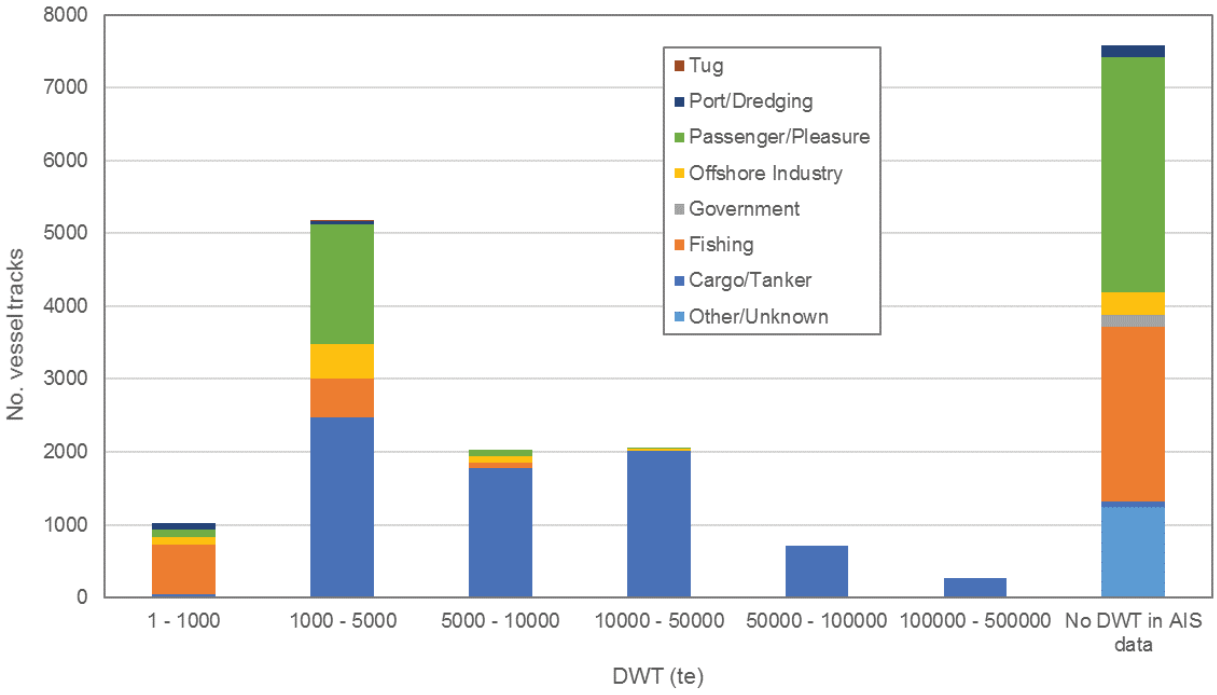


Figure 3.13 Vessel DWT by vessel category

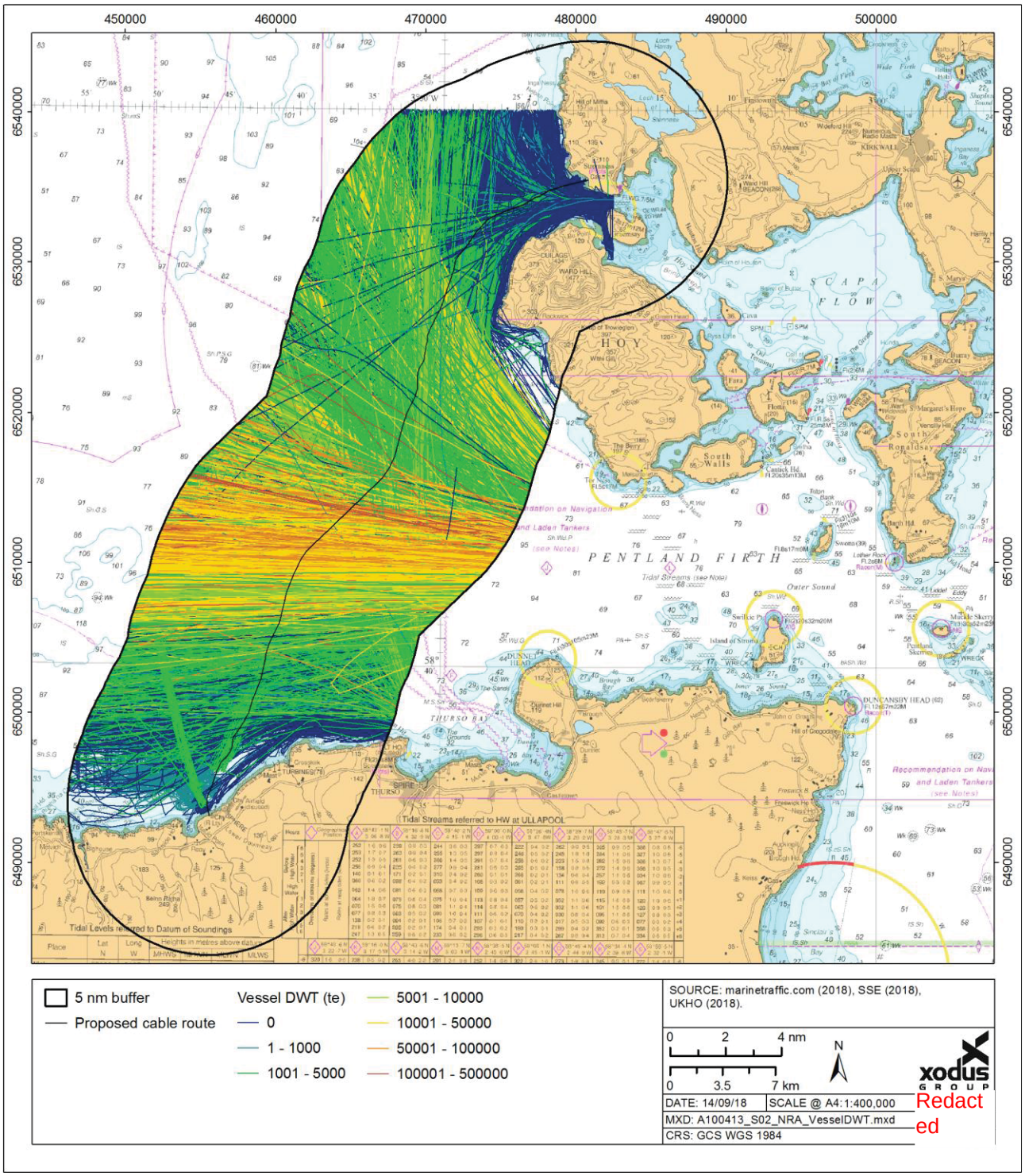


Figure 3.14 AIS tracks by DWT

3.5.3 Vessel draught

The distribution of vessel draughts are given in Table 3.7, Figure 3.15 and Figure 3.16. As noted previously, vessels with higher draughts tended to be located in the area immediately to the west of Pentland Firth. The maximum draught recorded was 29.7 m, whilst the minimum was 0.1 m.

Nearly a quarter of all vessel tracks did not record any data for draught (Table 3.7). These were mostly passenger/pleasure vessels. Vessels with a draught of more than 8 m were almost exclusively cargo/tanker vessels (83%), whilst those with a draught of less than 8 m were more evenly split between cargo/tanker (39%), fishing (27%), and passenger/pleasure (18%).

Table 3.7 Vessel draught

Draught (m)	No. vessel tracks	% of total
0 - 2	255	1.4
2 - 4	1502	8.0
4 - 6	4312	22.9
6 - 8	4092	21.7
8 - 10	1948	10.3
10 - 15	1524	8.1
15 - 30	617	3.3
No draught in AIS data	4607	24.4

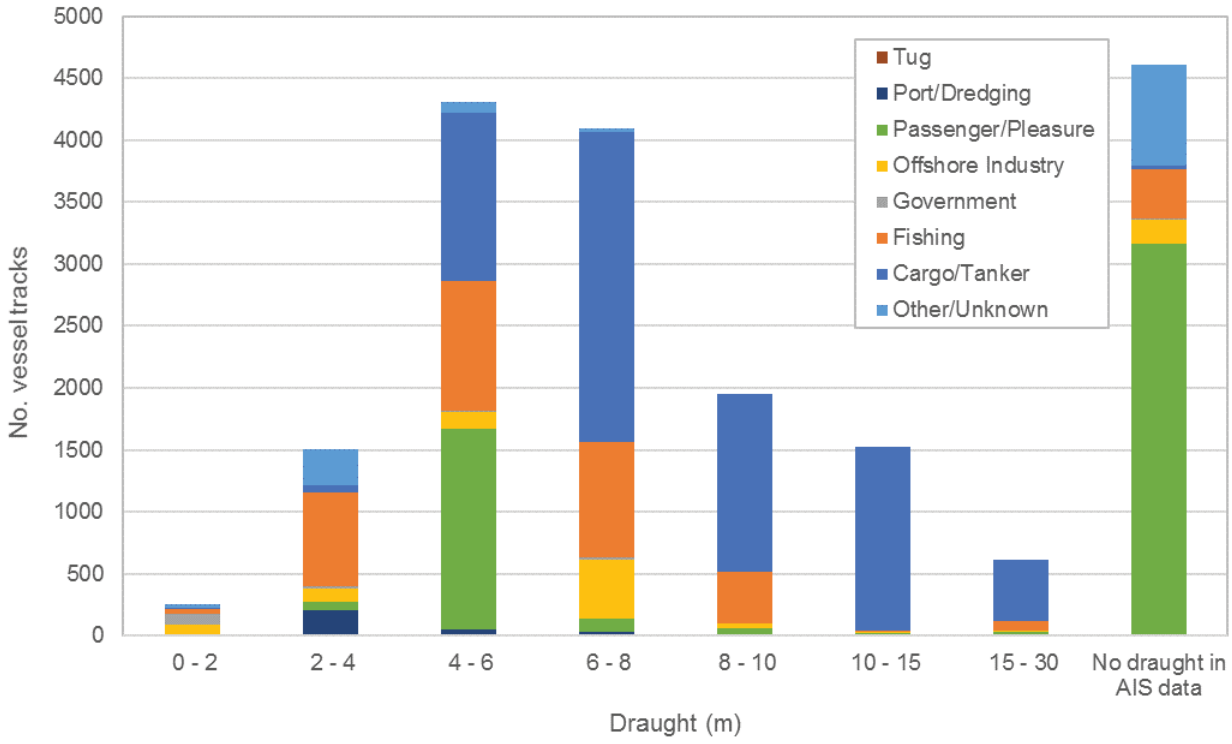


Figure 3.15 Draught by vessel category

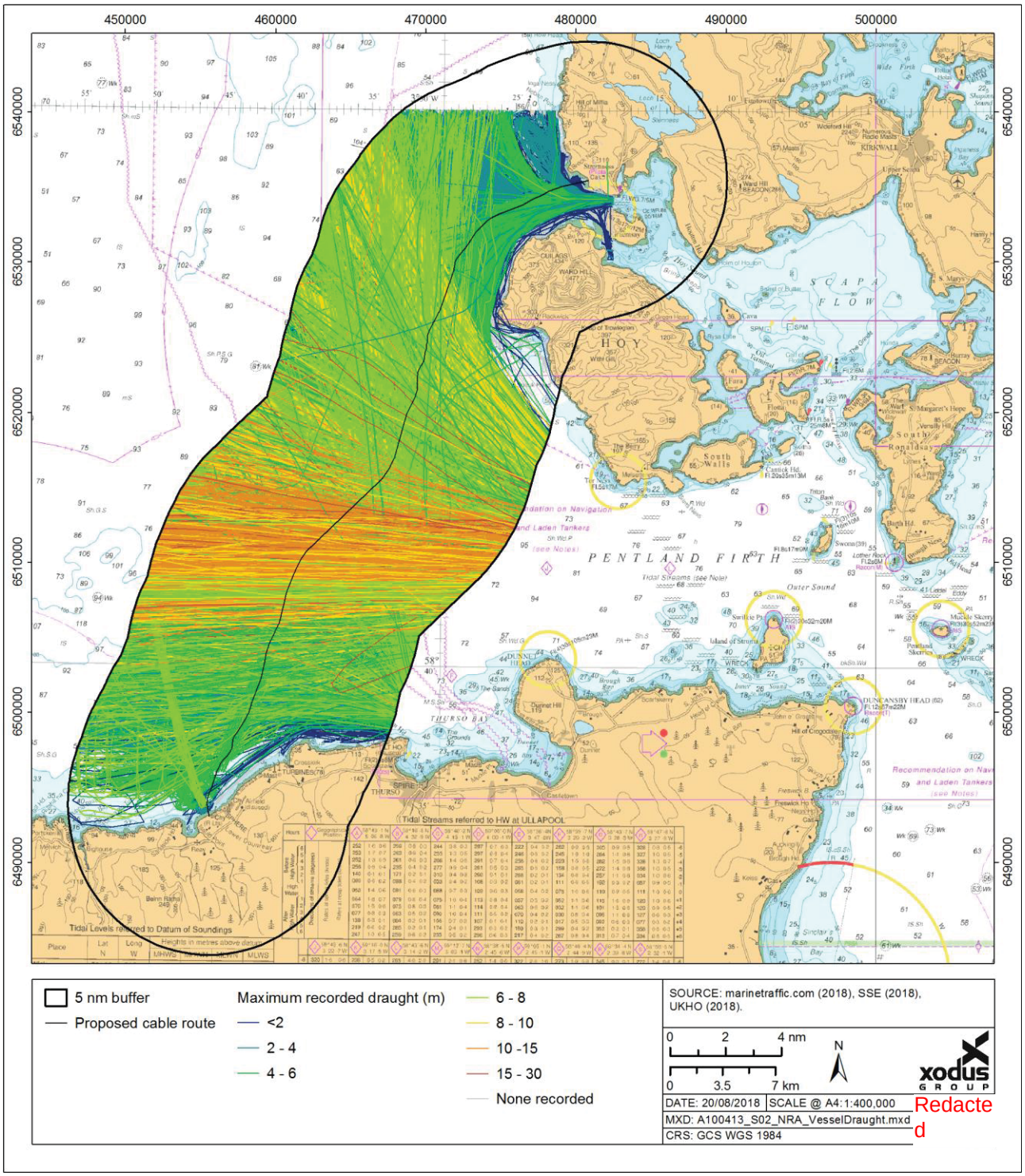


Figure 3.16 Vessel draughts

3.6 Fishing analysis

This section presents a specific analysis of fishing vessels in the vicinity of the project, making use of both AIS and VMS data. The AIS data provides detailed information on the specific trajectories of the vessels, but is likely to underrepresent fishing activity, since fishing vessels are not obliged to carry an AIS transponder (though many do for the sake of safety).

VMS data provides a more comprehensive picture of fishing activity since vessels greater than 12 m are obliged to carry VMS equipment; however, the data are not publicly available in a format that allows reconstruction of trajectories, and vessels under 12 m will not be represented. As detailed in Section 2.2.2, two sources of VMS data have been used to supplement the AIS data:

- Anonymised VMS data for the area of interest for February 2015 – December 2017 – these provide no information on gear type or fishing status, so vessel speeds have been used as a proxy for fishing status, albeit with an inherent level of uncertainty; and
- Fishing activity by International Council for the Exploration of the Sea (ICES) statistical rectangle distributed by the Marine Management Organisaiton (MMO). This data includes details about fishing effort and gear type over the period 2012 – 2016, but is aggregated within each ICES statistical rectangle, so local patterns of activity cannot readily be discerned.

3.6.1 Fishing vessels in AIS data

Fishing vessel AIS tracks are shown in Figure 3.17. Particular routes appear to be:

- To/from Stromness to/from the north, about 0.3 nm from the coastline;
- To/from Stromness to/from the north, about 1 nm from the coastline;
- To/from Stromness to/from the west south west;
- To/from the Pentland Firth to/from the west;
- To/from the Pentland Firth to/from the north west; and
- To/from Scrabster to/from the north or north west.

As noted previously, the tracks of larger vessels tend to be in the area to the west of the Pentland Firth.

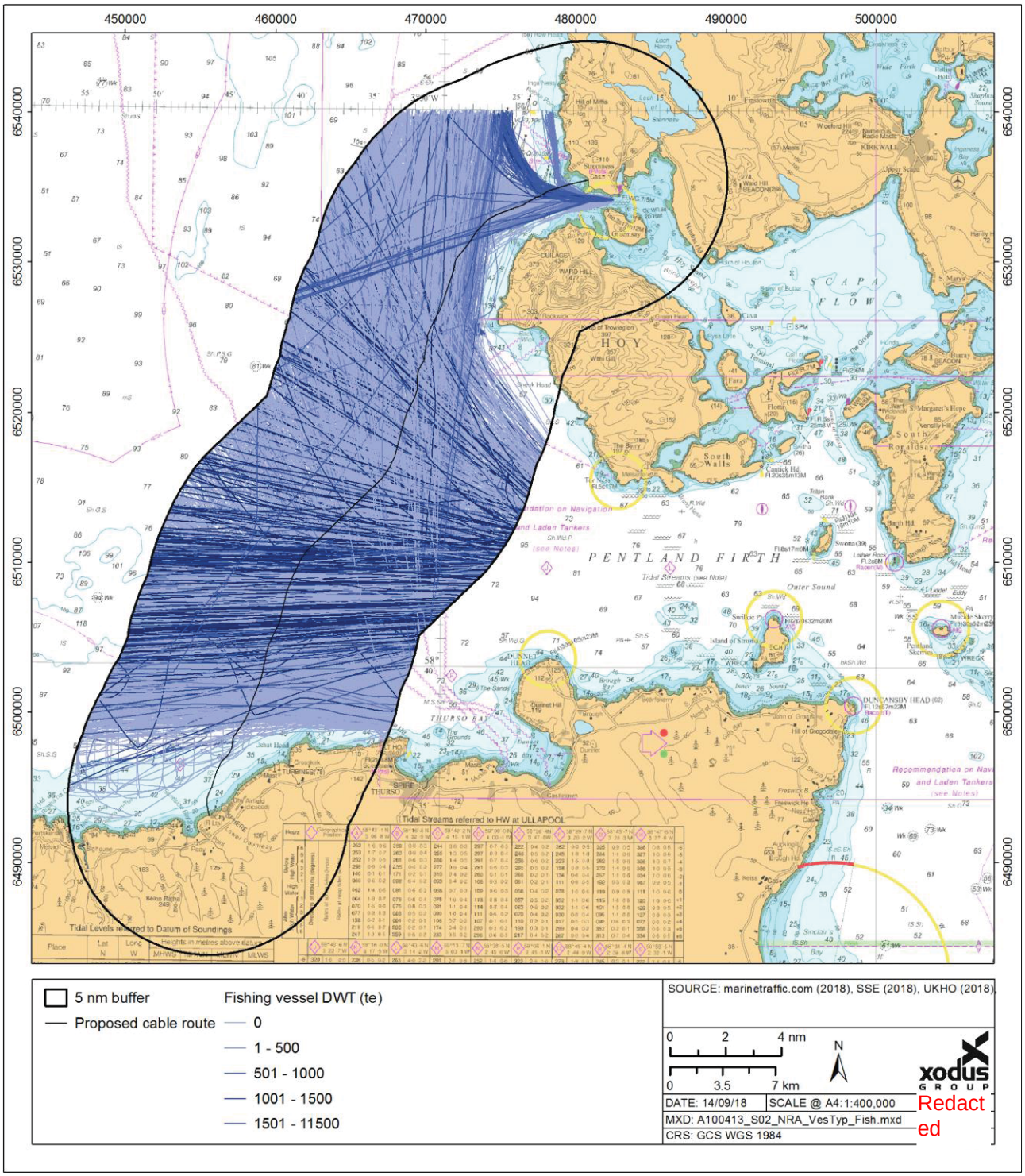


Figure 3.17 Fishing vessel AIS tracks by DWT

3.6.2 Anonymised VMS point data supplement

This section makes use of point VMS data from the period February 2015 to December 2017. Vessel density plots are given in Figure 3.18 and Figure 3.19, split by vessel speed. It can be assumed that those vessels travelling at more than 6 kn are not fishing and are likely to be in transit, whilst those travelling at less than 6

kn may be fishing or engaged in other activities. Although the highest density of vessels travelling at less than 6 kn is near Stromness, it is likely that these vessels are simply leaving or returning to harbour in an area of high vessel density. The areas where fishing is likely to be occurring are north west of Thurso Bay (Figure 3.19).

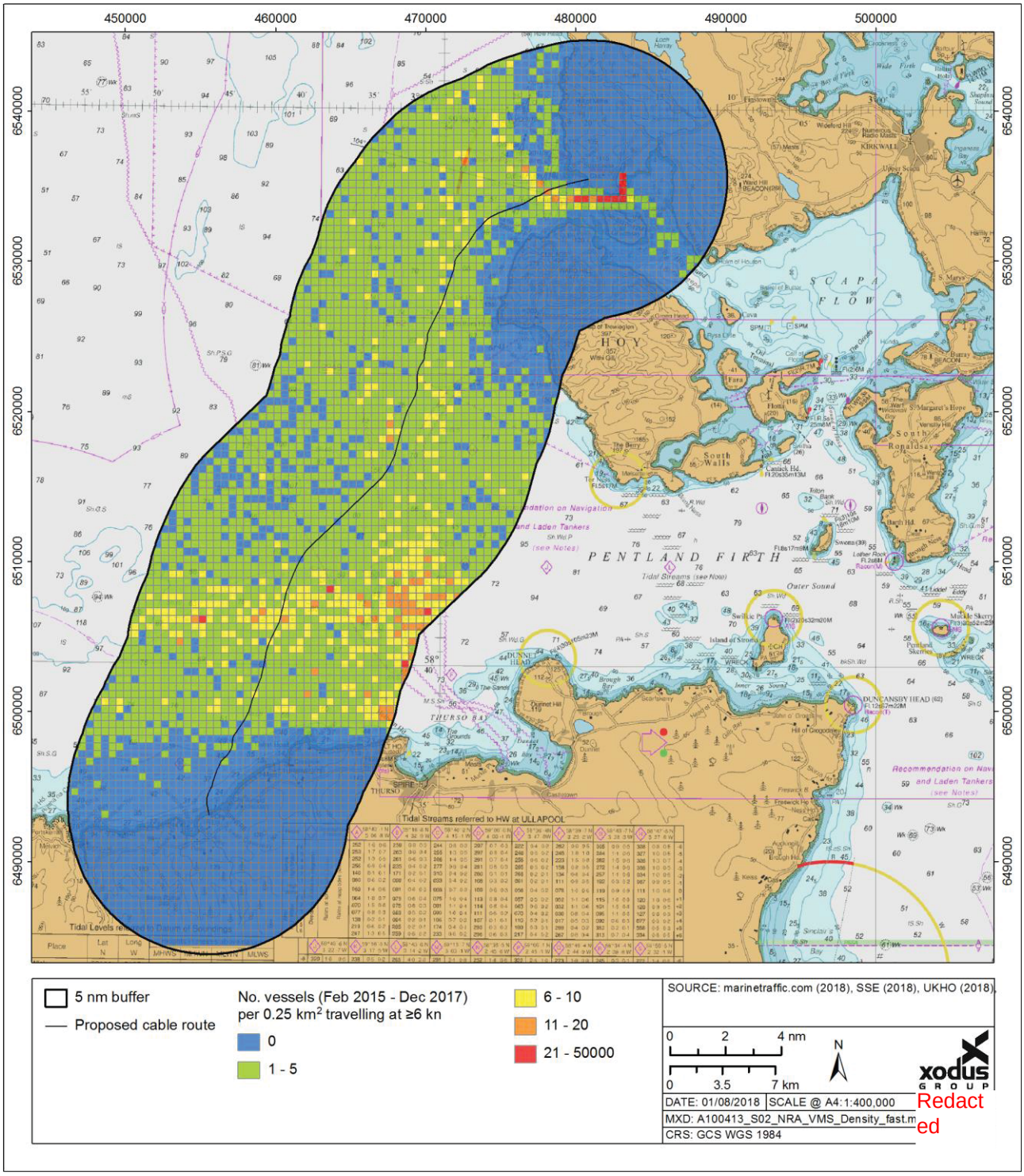


Figure 3.18 Density of fishing vessels (> 12 m) travelling at ≥ 6 kn

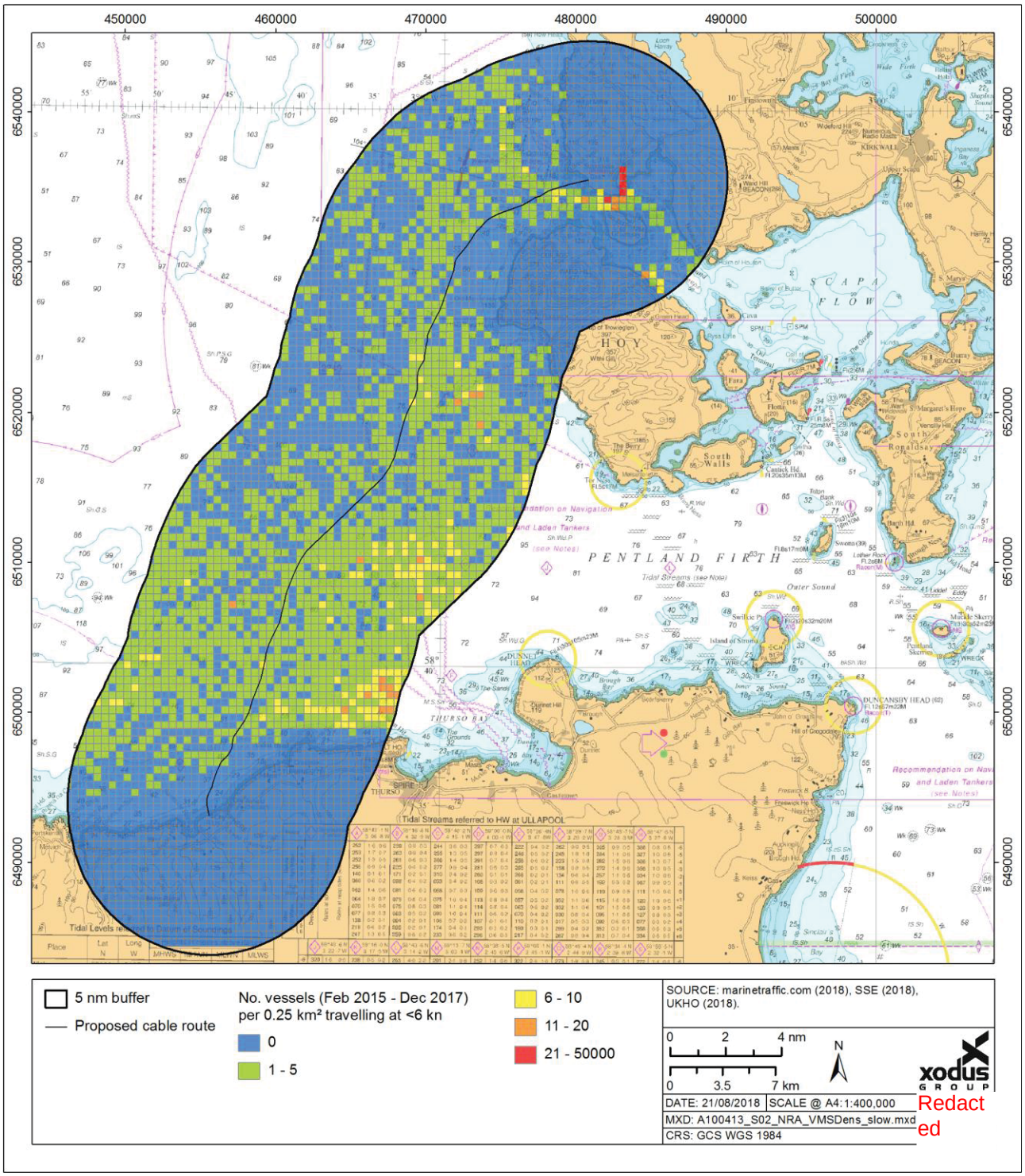


Figure 3.19 Density of fishing vessels (> 12 m) travelling at <6 kn

3.6.3 VMS data by ICES statistical rectangle supplement

This section makes use of fishing activity data available by statistical rectangle for the period 2012 - 2016. Figure 3.20 and Figure 3.21 show that there is a small amount of fishing activity using trawl and demersal gear that takes place in the area of interest. This dataset, and the anonymised data presented in Section 3.6.2,

show that the majority of fishing activity occurs to west of the proposed cable route, well outside the 5 nm study area buffer.

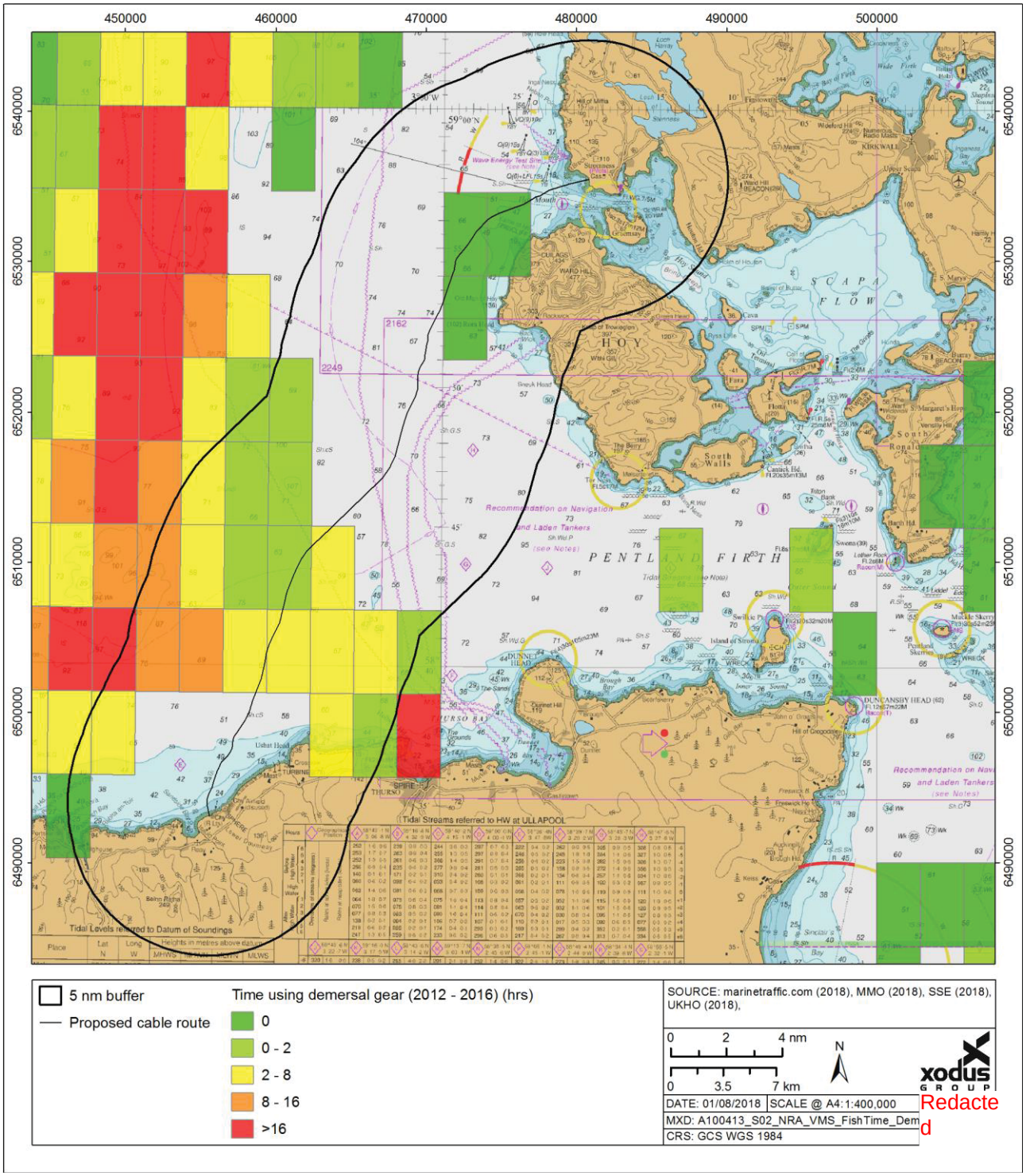


Figure 3.20 Mean time spent fishing using demersal gear between 2012 and 2016 (hours per year))

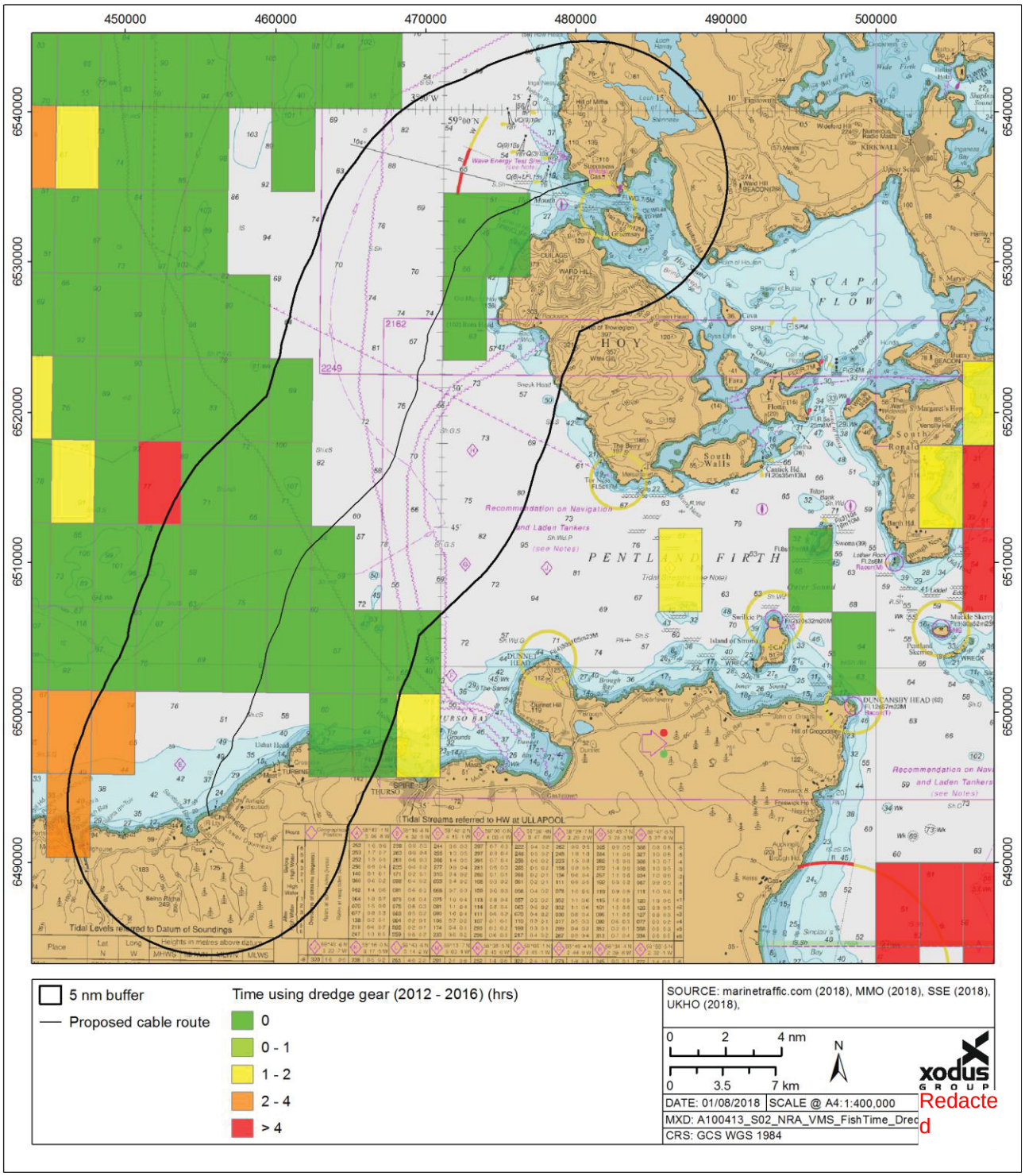


Figure 3.21 Time spent fishing using dredge gear

3.7 Anchoring vessels

Figure 3.22 shows the locations at which a vessel broadcasts a status of “at anchor” or that were travelling at speeds of less than 0.5 kn. It is clear that on occasion, an AIS operator may forget to change their status from “at anchor”, for example the red/orange points to the west of the Pentland Firth. The only “at anchor” points that appear to be correct are located just south of Moaness at the north of Hoy.

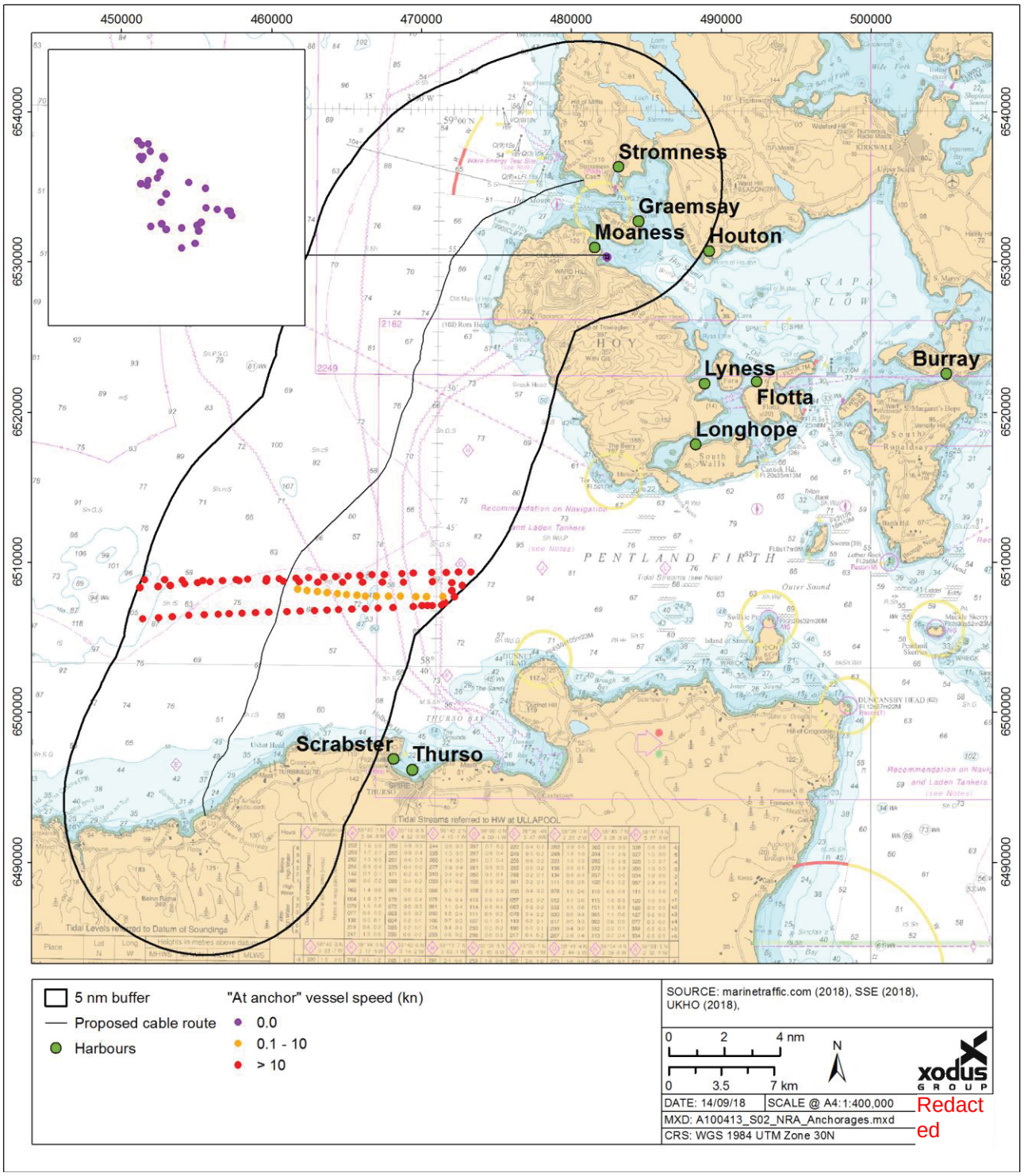


Figure 3.22 Vessels at anchor

4 FORMAL SAFETY ASSESSMENT

4.1 Hazard / impact identification

The following hazards / impacts on marine navigation have been identified based on Xodus' industry experience.

4.1.1 Installation and maintenance impacts

- Collision of a third-party vessel with cable installation / maintenance vessels and equipment;
- Disruption to vessel routing schedules or timetables as a result of installation / maintenance activities;
- Disruption to fishing activities as a result of installation / maintenance activities; and
- Disruption to military activities as a result of installation / maintenance activities.

4.1.2 Operational impacts

- Vessel anchor snagging or dragging cable leads to foundering;
- Fishing gear snagging or dragging cable leads to foundering; and
- Electro-magnetic field (EMF) interference with passing vessel navigational equipment.

4.2 Identification of existing risk control measures

The following risk control measures, which are either industry standard practice, or standard practice within SHE Transmission, have been identified and incorporated into the subsequent risk assessment.

4.2.1 Installation phase

The following risk control measures are assumed to be in place prior to the commencement of the installation phase:

- Compliance with International Regulations for the Prevention of Collision at Sea (International Marine Organisation (IMO), 1972) and the International Regulations for the Safety of Life at Sea (SOLAS)
- Notice to Mariners Radio Navigational Warnings, NAVTEX, and/or broadcast warnings will be made in advance of works, including the time and location of work being carried out, and emergency event procedures.
- Appropriate marks and lights on installation vessels
- Installation Vessels shall broadcast their status on AIS at all times, to indicate the nature of the work in progress, and restricted manoeuvrability
- Temporary aids to navigation will be deployed (if required) to guide vessels around location of installation activities
- Guard vessel(s) will be employed to work alongside the installation vessel(s) during installation and maintenance work.
- Temporary (advisory) safety zones will be established around the installation works, monitored by the guard vessels
- Consultation with the Maritime and Coastguard Agency (MCA), Northern Lighthouse Board (NLB) and and local Harbour Masters at Stromness and Scrabster as part of submission of the marine licence application.
- A Fisheries Liaison Officer (FLO) will be in place.

4.2.2 Operation and maintenance phase

The following measures are considered to be in place to cover the operation and maintenance phase:

- Cable will be clearly marked on nautical charts in line with UK Hydrographic Office (UKHO) standards
- Details of the cable positions will be provided to Kingfisher to ensure their positions are shown in fishermen's awareness charts
- Cable will be suitably protected, e.g. buried/protected where required to help protect against snagging from fishing gear and risk from vessel anchors (Cathies, 2018)
- The potential effects of any electromagnetic fields (EMF) on navigation etc. will be minimised through cable design and choice of cable protection

4.3 Risk Assessment

The following section describes the risk assessment which covers the relevant impacts, for all stages, captured in the hazard identification section.

4.3.1 Collision of a third-party vessel with cable installation vessels and equipment

As the installation phase will require large slow-moving vessels with restricted manoeuvrability, their continued presence across the location of the cable path will present an obstacle to all passing traffic (commercial, fishing, recreational) with limited capability for avoidant action.

The collision risk is likely to be greater in higher density sections of the installation path and in particular around Hoy Mouth where the traffic from Stromness, including the ferry routes, currently passes within a kilometre of the cable location and with reduced sea room. Two wave power generation sites are also located just north of the cable path – Billia Croo (ca, 700 m north) and Brough Head (ca. 5 km north).

Commercial shipping routes (predominantly), passing through the Pentland Firth also present a high-density area close to the cable path, some 20 to 25 kilometres north west of Thurso.

It is expected that the majority of vessels passing via Hoy Mouth, in particular regular local vessels such as the ferry and vessels associated with the tidal power generation sites (Billia Croo and Brough Head), will be aware of the construction or maintenance work through the assumed mitigation measures, principally, promulgation of information to the port and navigation authorities, guard vessel presence and procedures and temporarily deployed navigational aids and indicators.

It is not however expected that commercial vessels approaching and exiting the Pentland Firth will necessarily be aware of the presence of the installation or maintenance works. However unrestricted sea room provides space for vessels to easily take avoidant actions. Additionally, given that the highest density of commercial traffic approaching or exiting the Pentland Firth covers a length of the cable path of around 4 kilometres and a conservative progression rate for the installation fleet is expected to be around 150m per hour, this gives periods of exposure to the highest collision risk of only 27 hours.

The severity of a collision with a commercial vessel is likely to result in a **Catastrophic** outcome (total loss of vessel and crew), however, the frequency is not considered to be 'likely in the lifespan of the project' and is therefore judged to be **Extremely unlikely**. These assessments combine to provide a **Tolerable** risk ranking.

It is therefore necessary to identify potential risk reduction measures to further reduce the risk to ALARP. It is thus recommended that additional or increased measures are employed specifically for phases of the installation or maintenance activities which are located along the cable route from Kilometre Posts KP1 to KP8 and from KP32 to KP 39 (those areas being the high density area identified on exit of the Hoy Mouth and some 10-15 km north west of Thurso on Figure 3-2). Note that Kilometre Posts locations can be seen in Cathies, 2018.

Any of the standard control measures which address reduced visibility and provide earlier warning to commercial vessels using the Pentland Firth should be increased/intensified where appropriate. Existing and additional measures in place to address this risk should be periodically reviewed to confirm their suitability.

4.3.2 Disruption to vessel routing schedules or timetables as a result of installation activities

Installation of the cable may cause disruption to vessel routeing/timetables. This will most likely affect vessels transiting on regular routes such as passenger ferries and commercial vessels. Any delays on timetables may cause a cascading effect on other vessels entering or leaving the harbour. The risk of a collision between two third party vessels may also therefore be increased as a result of route deviation.

However, there is expected to be room for vessels to re-route a safe distance from the construction work, assuming a rolling safety zone around the cable installation activity. The vast majority of vessels should be aware of the cable work in advance, allowing alternate routes to be planned with minimal impact on schedules. Liaison with local harbours, in particular Stromness, will minimise schedule impact and establish common adjustment to the routes and approaches affected by the cable installation or maintenance locations.

The frequency of this impact is considered to be **Reasonably Probable** given the limited sea room at Hoy Mouth. The severity is assessed as **Minor**. This results in a ranking of **Tolerable**. Further measures to reduce the impact should therefore be considered. It is recommended that the cable installation and maintenance schedule is rationalised with the timetables of regular users of the Hoy Mouth and Stromness harbour such that the impact to their existing schedules is reduced to limit disruption.

4.3.3 Disruption to fishing activities as a result of installation activities

Fishing activity was recorded in both summer and winter periods along the entirety of the cable route. Therefore, the presence of vessels associated with the installation of the cable, may cause a disruption to local fishermen.

It is expected that existing control measures such as promulgation of information (including Kingfisher) as well as the presence of guard vessels and appointment of FLO will ensure local fishermen are aware of the activities.

The frequency of this impact is considered to be **Reasonably Probable**, and the severity **Minor** resulting in a ranking of **Tolerable**. No measures further to promulgation of information and the presence of the guard vessel and navigational aids are identified and the risks is therefore considered to be ALARP.

4.3.4 Disruption to military activities as a result of installation activities

There are no known military firing practice sites within the vicinity of the cable installation path. Should the military wish to use the area whilst installation of maintenance activities is taking place it is expected that promulgated information will provide a suitable vehicle for appropriate recourse. The frequency of this impact is assessed as **Extremely Unlikely** with a severity of outcome of **Minor** leading to a **Broadly Acceptable** risk. As such, no further risk reduction measures are required.

4.3.5 Vessel anchor snagging or dragging cable leads to foundering

After the installation of the subsea cable, there is a risk that an anchored vessel will lose its holding ground, and subsequently drag anchor over the cable.

From the baseline shipping analysis the majority of anchoring was seen to be near to the Moaness harbour (Figure 4.25). Overall very little evidence of anchoring in general is seen in the data set. Vessels do not however necessarily report anchored status reliably. Nonetheless, the cable is expected to be suitably protected from this type of event where appropriate (Cathies, 2018).

The frequency of anchor snagging is therefore assessed as **Extremely Unlikely**. It is possible that smaller snagged vessels suffer a risk of foundering should they not be able to free themselves. A severity of outcome of **Catastrophic** is therefore selected and these combine to give a **Tolerable** risk ranking.

Taking into account the cable protection measures detailed in Cathies, 2018 (principally, appropriate cable burial depths and where required mattressing etc) as well as the visibility of the pipeline in navigational maps, no recommendations for additional risk control measures have been identified and the risks associated with anchoring are considered to be ALARP.

4.3.6 Fishing gear snagging or dragging cable leads to foundering

Fishing vessels whose gear becomes snagged on cables can be unable to free themselves and can suffer foundering as a result. The baseline data shows a significant proportion of the vessel activity in the vicinity of the cable path is associated with fishing. However, the data also shows (Figures 4.23 and 4.24) that very little demersal or dredging gear is used in the vicinity of the cable path.

Again, cable burial will greatly reduce the potential for snagging and subsequent foundering. A frequency category of **Extremely Unlikely** is therefore combined with a **Catastrophic** outcome severity to provide a **Tolerable** risk ranking.

Given the cable protection measures identified in Cathies, 2018, and visibility of the pipeline in navigational maps, no recommendations for additional risk control measures have been identified and the risks associated with anchoring are considered to be ALARP.

4.3.7 EMF interference with passing vessel navigational equipment

Electrical cables can interact with the earth's magnetic field. This can result in interference with magnetic navigational equipment when in close proximity to the affected area.

The vast majority of vessel traffic uses GPS as the primary means of navigation, which is unaffected by EMF. Therefore, it is considered unlikely that any created interference will have a significant impact on vessel navigation.

Magnetic compasses may be used as a back-up navigation method, and some smaller vessels (fishing or recreational) may rely on it as their sole means of navigation. However, the potential effects of any EMF on navigation would only be expected in shallower inshore waters where sustained reliance upon compass navigation is unlikely given the proximity/visibility of the shore, other vessels and markers, and general navigation awareness and experience of skippers in the area.

The frequency of this impact is considered to be **Remote**, and the severity **Minor** resulting in a ranking of **Broadly Acceptable**.

4.3.8 Subsea collision with deep draught vessels

The vast majority of the cable is laid in the open sea in waters with a depth of 47 m or more at low tide. Therefore, vessel draught presents no concern for the majority of the length of the cable.

The cable is however laid in shallower waters as it approaches land at either end of its route. Where the cable makes landfall on the Caithness mainland the lowest expected depth at the shore is 20m. The data shows that the maximum recorded draught at this lowest depth is 8m and vessels with larger draughts (10m and above) are only seen in much greater depths further out along the cable route. Therefore, vessel draught presents no concern at the shallower depths at the Caithness mainland.

The lowest expected depth where the cable makes landfall near Stromness is considerably lower at some 5m graduating quickly to 10m and then reaching 20m at around 1nm from the shore along the cable route.

Only vessels with a draught of less than 2m were recorded in the lowest depth (5m) section. Only vessels with a draught of up to 8m are recorded crossing the cable route at sections where the lowest expected depth is 20m and again vessels with draughts greater than this are only recorded at much greater minimum expected depths further out to sea. Therefore, again, vessel draught presents no particular concern at the Orkney landfall end of the cable route.

It should be noted that a large number of vessels in the set do not provide draught data. However, given that none of the known vessel draughts appear to present any particular concern in terms of collision with the cable and that vessel draught is not identified as posing any primary or secondary risks to the pipeline in Cathies, 2018 it is concluded that vessel draught poses no risk to marine navigation.

4.4 Additional Identified Risk Control Measures (and cost-benefit analysis)

The above risk assessment has identified three additional risk control measures for cost-benefit consideration:

- The cable installation and maintenance schedules to be rationalised with the timetables of regular users of the Hoy Mouth and Stromness harbour such that the impact to their existing schedules is reduced to limit disruption;
    - Cost-benefit: rationalisation of the work schedules with the timetables of regular runners is not expected to present significant cost and therefore it is recommended that this measure is implemented; and
- Additional, increased or upscaled collision prevention measures to be employed specifically for phases of the installation or maintenance activities which are located along the cable route from KP1 to KP8 and from KP32 to KP 39 (those sections being the high-density area on exit of the Hoy Mouth and some 10-15 km north west of Thurso, on Figure 4.2);
    - Cost-benefit: the specific details of the collision prevention measures such as safety zone extents, beacon locations, guard vessel procedures etc are not yet defined. When these details are defined, cost-benefit analysis should be applied to determine whether upscaling any particular aspects will reasonably provide further collision prevention in the busiest sections of the cable route;
    - Since the review itself will not present significant cost this measure is recommended for implementation. Where recommendations are made following the review, justification of their omission may be based only upon cost benefit analysis which demonstrates that the risk are ALARP;
- Identify regular runners using the Pentland Firth as part of their shipping route and issue notifications to owner/operators detailing locations/duration of works/planned mitigation measures:
    - Regular runners can be identified at low cost from the AIS data. Since thus measure will increase the success of promulgation of information to non-local traffic without significant cost, it is recommended that it should be implemented.

4.5 Cumulative Effects

The potential for cumulative effects with other Projects will be assessed following further consultation with the MCA on the contents and findings of the NRA.

5 CONCLUSIONS

Following a review of the baseline environment in the vicinity of the proposed AC cable route between Caithness and Orkney, a Navigational Risk Assessment (NRA) has been undertaken to assess the effect of the cable on shipping and navigation. The assessment captures potential navigation issues resulting from the installation and maintenance activities associated with the cable. The findings of the NRA are summarised below.

Two years' AIS data has been analysed to establish the baseline shipping behaviours prior to the cable installation, including the identification of any specific spatial and temporal/seasonal trends.

During the period, a total of 18,857 vessel tracks were recorded. The majority (39%) of these were cargo/tanker vessels leaving passenger/pleasure vessels comprising 27%, fishing 19.5%, unknown 6.6%, offshore industry 5.3%, port/dredging 1.6% and government 0.8%

The busiest areas in terms of shipping reflect the ferry routes between Stromness and Thurso and some 10 km north of Thurso at the west side of the Pentland Firth where commercial shipping routes pass into and out from the Pentland Firth. These busiest areas either cross or come near to the cable route at kilometre posts KP1 to KP8 and KP32 to KP39 respectively.

The data shows fishing vessel activity does exist in the general area however very little was recorded in the immediate vicinity of the cable path (Figure 4.23). Similarly, very little evidence of anchoring was seen in the data set however it is noted that many vessels may frequently fail to broadcast anchored status.

Based on the baseline assessment and general industry experience, the impacts / hazards associated with the different phases of the planned cable were assessed. No hazards were identified to be Unacceptable, with all being either Tolerable or Broadly Acceptable, based on the assumed mitigation measures.

Two recommendations are made to reduce the risks of disruption to shipping to ALARP. These focus on the busiest shipping areas in the vicinity of the cable path and the Ferry activity between Hoy Mouth and Scrabster. The recommendations aim to reduce collision risk in the busiest locations by reviewing collision prevention measures with a view to identifying any potential risk reduction gained from upscaled collision prevention measures (increased safety distances, numbers of markers etc) when the installation fleet is in these particular locations. Additionally, rationalisation of cable installation and maintenance schedules with the regular routes such as the Stromness to Scrabster ferry is recommended to minimise disruption.

Risks to shipping from anchor and gear snagging is suitably managed via cable burial and protection measures identified in another study (Cathies, 2018).

6 RECOMMENDATIONS

The following recommendations are made:

- Cable installation and maintenance schedules should be rationalised with the timetables of regular users of the Hoy Mouth and Stromness harbour such that the impact to their existing schedules is reduced to limit disruption; and
- A review of collision prevention measures should be undertaken to determine whether additional, increased or intensified measures will reasonably provide further collision prevention in the busiest sections of the cable route.
- Further consultation on the NRA should be undertaken as part of submission of the marine licence application.

Implementation of these measures along with the provision of the assumed existing risk reduction measures will ensure that risks to Shipping and Navigation are reduced to ALARP.

7 REFERENCES

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Clyde Crusing Club (CCC) (2016). Sailing Directions and Anchorages handbook for the Orkney and Shetland Islands. Clyde Cruising Club Publications Ltd 2016.

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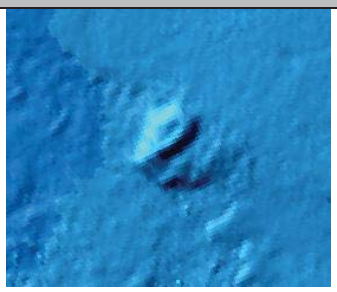
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APPENDIX C: MBES HIGH POTENTIAL CONTACTS

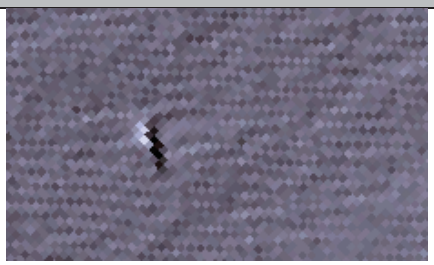
Appendix C: MBES high potential contacts

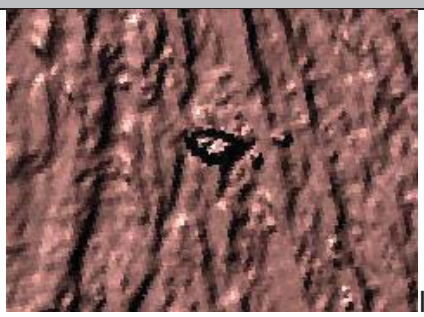
Where the distance of a contact from the cable is given, this is from the position of the potential cable route within the 1 km wide cable survey corridor in the client's shapefiles. Only MBES contacts are listed, since all SSS contacts were seen on MBES data also, and SSS images were of slightly lower quality than MBES images. Only contacts of High geophysical potential are listed (there were no anomalies of medium potential).

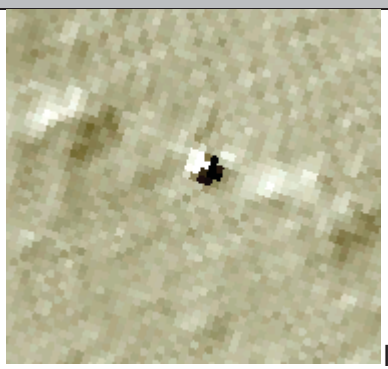
ORCA number: ORCA_C 089	
 A large boat shaped contact. Isolated, high potential to be small wreck. Good return on both MBES and SSS. Probable wreck.	
MMT Code: None	WGS UTM Zone 30N
Easting 476671	**Northing** 6534336
Size: 18.7m by 8.4m	**Proximity to cable:** 357 m west
Level of geophysical potential: High	

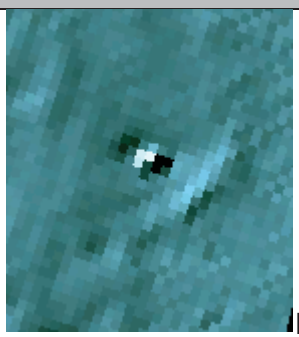
ORCA number: ORCA_C 317	
 Irregular contact, 78m west of MMT contact S_LT17_SE_0037. Good return on both MBES and SSS. Probably anthropogenic.	
MMT Code: None	WGS UTM Zone 30N
Easting 459582	**Northing** 6503838
Size: 10.3m by 5.1m	**Proximity to cable:** 217 m east
Level of geophysical potential: High	

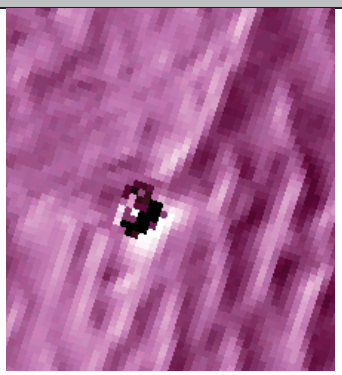
ORCA number: ORCA_C 318	
 Irregular contact, 81m south south-west of MMT contact S_LT17_SE_0037. Good return on both MBES and SSS. Probably anthropogenic.	
MMT Code: None	WGS UTM Zone 30N
Easting 459630	**Northing** 6503761
Size: 5.9m by 3.7m	**Proximity to cable:** 279 m east
Level of geophysical potential: High	

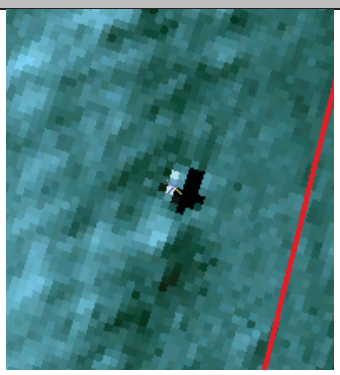
ORCA number: ORCA_C 319	
 Linear feature. Good return on both MBES and SSS. Probably anthropogenic.	
MMT Code: None	WGS UTM Zone 30N
Easting 463730	**Northing** 6512116
Size: 7.1m by 1.4m	**Proximity to cable:** 156 m east
Level of geophysical potential: High	

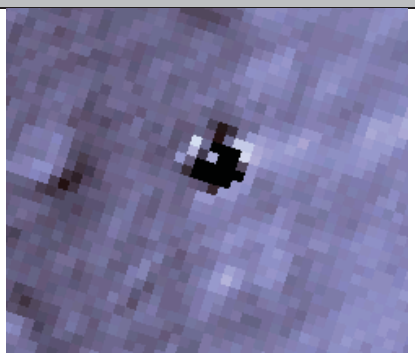
ORCA number: MMT_C 003	
 Irregular feature on bedrock, very good return on both MBES and SSS. Probable debris.	
MMT Code: S_LT17_SB_A1_3075	WGS UTM Zone 30N
Easting 480089	**Northing** 6535661
Size: 7.3m by 3.1m	**Proximity to cable:** 370 m west
Level of geophysical potential: High	

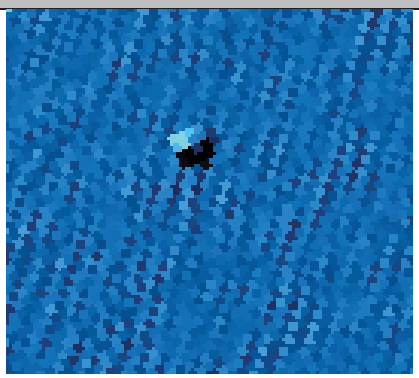
ORCA number: MMT_C 050	
 Irregular feature on sand ripples, very good return on both MBES and SSS. Probable wreckage.	
MMT Code: S_LT17_SE_0037	WGS UTM Zone 30N
Easting 459659	**Northing** 6503846
Size: 3.0m by 0.6m	**Proximity to cable:** 296 m east
Level of geophysical potential: High	

ORCA number: MMT_C 122	
 Irregular feature on sand, very good return on MBES, SSS and MAG (MMT_M 486). Probable wreckage.	
MMT Code: S_LT17_SE_0191	WGS UTM Zone 30N
Easting 460389	**Northing** 6506615
Size: 1.7 m by 1.1m	**Proximity to cable:** 20 m west
Level of geophysical potential: High	

ORCA number: MMT_C 127	
 Irregular feature among sand waves, very good return on both MBES and SSS. Probable wreckage.	
MMT Code: S_LT17_SE_0197	WGS UTM Zone 30N
Easting 461048	**Northing** 6508956
Size: 4.4m by 2.8m	**Proximity to cable:** 60 m west
Level of geophysical potential: High	

ORCA number: MMT_C 139	
 Irregular feature on sand, very good return on both MBES and SSS. Probable wreckage.	
MMT Code: S_LT17_SE_0214	WGS UTM Zone 30N
Easting 460481	**Northing** 6506557
Size: 3.4m by 2.8m	**Proximity to cable:** 85 m east
Level of geophysical potential: High	

ORCA number: MMT_C 212	
 Irregular feature on sand, very good return on both MBES and SSS.	
MMT Code: S_LT17_SE_0305	WGS UTM Zone 30N
Easting 461121	**Northing** 6508079
Size: 4.0m by 2.2m	**Proximity to cable:** 338 m east
Level of geophysical potential: High	

ORCA number: MMT_C 734	
 Isolated irregular feature on sand, very good return on both MBES and SSS. Probably anthropogenic.	
MMT Code: S_LT17_SE_1177	WGS UTM Zone 30N
Easting 474391	**Northing** 6533055
Size: 3.2m by 2.2m	**Proximity to cable:** 77 m west
Level of geophysical potential: High	

ORCA number: MMT_C 035	
 Dounreay effluent outfall. UKHO wreck card number 1122	
MMT Code: S_LT17_SB_G_3010	WGS UTM Zone 30N
Easting 456148	**Northing** 6493994
Size: 15.1m by 11.9m	**Proximity to cable:** 741 m east
Level of geophysical potential: High	

APPENDIX D: NATURE CONSERVATION APPRAISAL



Orkney - Mainland HVAC 220kV Subsea Link Environmental Appraisal

Nature Conservation Appraisal

Scottish and Southern Energy plc

Assignment Number: A100413-S02
Document Number: A-100413-S02-REPT-004

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Nature Conservation Appraisal

A100413-S02

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Document Type: Report
Document Number: A-100413-S02-REPT-004

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Rev	**Date**	**Description**	**Issued By**	**Checked By**	**Approved By**	**Client Approval**

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1 INTRODUCTION

1.1 Background

SHE Transmission, part of the SSE plc group of companies, is the licensed electricity Transmission Owner (TO) in the north of Scotland. It owns the 5,000 km network of high voltage underground cables and overhead lines that provides electricity to people across northern Scotland and connects northern Scotland to central and southern Scotland and the rest of Great Britain. SHE Transmission is also responsible for maintaining and investing in this transmission network, which covers around 70% of Scotland.

SHE Transmission is currently looking at taking forward a number of strategic projects which are aimed at expanding the transmission network across northern Scotland. These projects, which involve both network reinforcements and upgrades, have been identified as being required to facilitate the substantial increase in renewable energy generation in the north of Scotland and the subsequent increasing demand for renewable energy connections and hence to support the growth of the low carbon economy. The Orkney - Mainland HVAC 220kV Subsea Link is one of these projects.

The aim of the Orkney Connection Project is to develop the transmission network in Orkney in order to provide increased capacity to accommodate increased generation from renewable energy in the Orkney area. This involves:

- Development and reinforcement of the onshore grid including substations; and
- Development of a subsea connection between Orkney and Mainland Scotland (The Orkney – Mainland HVAC 220kV Subsea Link) to enable the export of increased generation connecting on Orkney.

The need for a transmission link from Orkney is centred around the development and connection of a significant volume of new renewable generation on the archipelago. The area benefits from abundant wind, marine and tidal energy resources which have long been the subject of development as far back as the 1980s. The Orkney Local Development Plan adopted in 2017 sets out the Local Authority's vision and spatial strategy for the development of land in Orkney over the next ten years, including its aspirations with regards to renewable energy generation.

In addition to the Orkney – Mainland HVAC 220kV Subsea Link (the subject of this specific report), as part of the Orkney Connection Project SHE Transmission will also develop a number of inter-island connections (cables and overhead lines) to enable the various generation projects to connect to the 220kV link. The extent of this infrastructure will depend on which generation projects progress to construction and the design is currently being finalised. The inter-island connections will be the subject of separate Marine Licence applications.

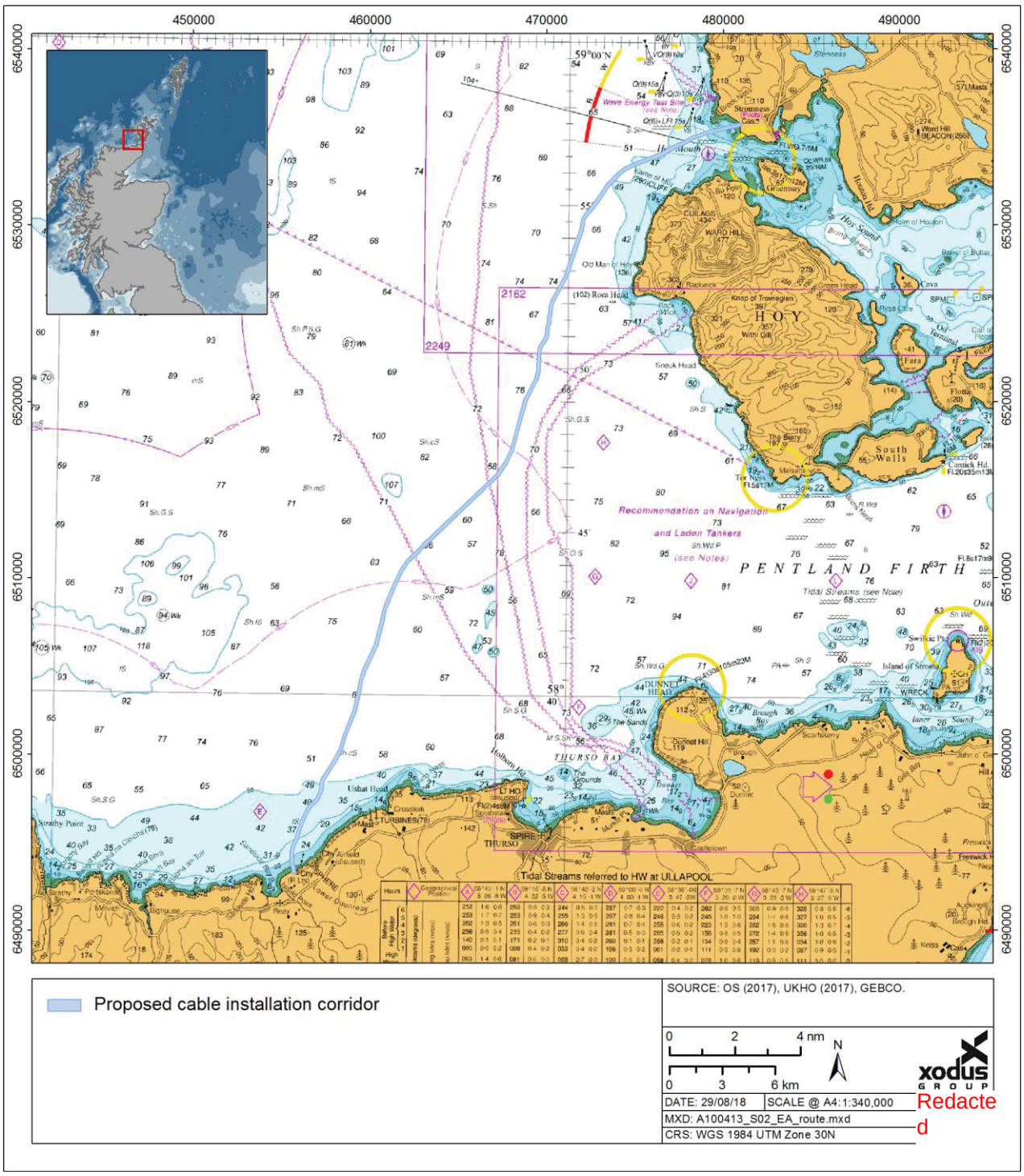
1.1.1 Orkney – Mainland Subsea Link

The Orkney – Mainland Subsea Link Project will be a single subsea circuit comprising a 220 kV AC cable system with Horizontally Directionally Drilled (HDD) landfalls at Warebeth, Orkney and Dounreay, Caithness (Figure 1.1). The total length of the subsea cable route is approximately 53 km.

1.2 Purpose of this document

This Nature Conservation Appraisal (NCA) considers the potential impact to ecological protected sites and provides detail on the ecologically protected sites and their qualifying features in the vicinity of the Orkney – Mainland HVAC 220 kV Subsea Link ("the Project"). Only sites with marine elements or those with assumed connectivity have been considered. The potential impacts on the sites that could be impacted from the proposed activities have been assessed. Where no Likely Significant Effect (LSE) is predicted on Natura 2000 sites or the Project is not considered Capable of Affect (CoA) in the case of Nature Conservation Marine Protected Areas (NCMPAs), the sites have been screened out of further assessment in this report. Where LSE or CoA cannot be ruled out, a more detailed impact assessment has been carried out and presented Sections 8 - 10 of this report.

Figure 1-1 Proposed cable installation corridor for Orkney – Mainland HVAC 220kV Subsea Link



1.3 Structure of this document

The NCA Report is structured as outlined in Table 1-1.

Table 1-1 NCA report structure overview

Section	Heading	Overview
2	NCA Assessment Process	Overview of the different assessment approaches utilised within this report in relation to the different protected sites and relevant legislation
3	Project Description	Overview of the proposed HVAC 220 kV subsea link
4	Approach to Screening	Step by step break down of the assessment process
5	Initial Identification of Sites and Features	Sites and features initially identified based on the assessment criteria and description of sites taken forward for further assessment
6	Potential Impacts	Potential impact to protected sites as a result of the Project
7	Offshore Ornithology Assessment of LSE	Consideration of LSE on ornithology sites and features
8	Fish and Shellfish Assessment of LSE	Consideration of LSE on fish and shellfish sites and features
9	Marine Mammals Assessment of LSE	Consideration of LSE on marine mammal sites and features
10	Conclusions	Conclusion of assessment
11	References	References

2 NCA ASSESSMENT PROCESS

2.1 Legislation overview

Table 2-1 outlines the key legislation in relation to the potential impacts on ecologically protected sites from the Orkney – Mainland HVAC 220kV Subsea Link cable installation.

Table 2-1 Legislation and Policy relevant to ecologically protected sites

Protected site	Legislation
SPA/SAC (Natura 2000)	> The EU Habitats Directive implemented through the Conservation (Natural Habitats, &c.) Regulations 1994 (as amended in Scotland) > Conservation of Offshore Marine Habitats and Species Regulations 2017 (the Offshore Habitats Regulations)
NCMPA	> Marine (Scotland) Act 2010 > Marine and Coastal Access Act 2009
SSSI	> Nature Conservation (Scotland) Act 2004 > Wildlife and Natural Environment (Scotland) Act 2010
Seal haul-out	> Marine (Scotland) Act 2010 > The Protection of Seals (Designation of Haul-out Sites) (Scotland) Order 2014

2.2 Habitats Regulation Appraisal process

The European Commission guidance 'Assessment of plans and projects significantly affecting Natura 2000 sites' outlines a staged assessment process, which are cumulatively referred to as a Habitats Regulation Appraisal (HRA). In the UK the four stages are commonly referred to as:

- Stage One: Screening;
- Stage Two: Report to Inform Appropriate Assessment (AA);
- Stage Three: Assessment of Alternative Solutions; and
- Stage Four: Assessment of 'Imperative Reasons of Overriding Public Interest' (IROPI).

HRA in Scotland is undertaken in line with the Scottish Natural Heritage (SNH) guidance document 'Habitats Regulations Appraisal: Guidance for Plan-making Bodies in Scotland' (Tyldesley *et al.,* 2015).

The purpose of HRA Screening is to identify aspects of the project/plan for which it is not possible to rule out the risk of significant effects on a European site (referred to as likely significant effect (LSE)), either alone or in-combination with other projects. A likely effect is one that cannot be ruled out on the basis of objective information. The Court of Justice of the EU has recently ruled (case C-3232/17) that it is not appropriate, at the screening stage, to take account of measures intended to avoid or reduce the harmful effect of a plan or project. Previously, it was considered suitable to consider limited forms of mitigation at the screening stage.

European sites and features which will be subject to an AA are those for which LSEs could not be ruled out during the screening exercise. A European site is progressed to the AA Stage (Stage 2 of the HRA) where it is not possible to exclude a LSE to one or more qualifying features of that site in view of the Conservation Objectives. A Project is required to provide a report to inform the AA which considers the impacts of a project, alone and in-combination with other plans and projects, on the integrity of a European site, with regard to the

site's structure and function and its conservation objectives. The Competent Authority (CA) is then required to carry out an AA on the implications for a site in view of that site's conservation objectives, before deciding to undertake or give any consent, permission or other authorisation for, a plan or project.

The need for AA extends to plans or projects out with the boundary of the site in order to determine the implications for the interests protected within the site. CAs (in this case Marine Scotland) need to identify the qualifying interests and the conservation objectives for each European site involved in an AA.

2.3 NCMPA process

It is an offence to intentionally or recklessly kill, remove, damage, or destroy any protected feature of a Nature Conservation Marine Protected Area (NCMPA). Marine Scotland must be sure that consenting/licensing decisions do not cause a significant risk to the conservation objectives of any NCMPA. To ensure that Marine Scotland has sufficient information available to make such a decision, this document presents information on the potential interaction with NCMPAs.

Under section 126 of the Marine and Coastal Access Act 2009, Marine Scotland is required to consider whether a licensable activity is capable of affecting (other than insignificantly) a protected feature of an NCMPA or any protected ecological or geomorphological process on which the conservation of any protected feature of an NCMPA is dependant. If MS-LOT (on behalf of the Scottish Ministers) believe there is or may be a significant risk of a project hindering the achievement of the conservation objectives then they must notify the relevant conservation bodies, SNH in the case of this Project (where NCMPAs are within 12 nm of the coast).

The NCMPA assessment process follows the following broad steps:

- **Initial screening**: The assessment stage focuses on what can reasonably be predicted as a consequence of the proposal and whether it is 'capable of affecting (other than insignificantly)' a protected feature of a NCMPA. A capability that is both remote (in terms of likelihood of occurrence) and hypothetical should not be the basis of a conclusion that further assessment is required. If a project is 'capable of affecting' a site then consideration is also given to whether the proposed development or activity will affect the protected features of a NCMPA, other than insignificantly. Consideration of the degree of pressure that could be exerted by the activity on a spatial basis should help to establish what level of effect might occur.
- **Main assessment**: Focuses on determining whether the exercise of a function would or might significantly hinder, or there is or may be a significant risk of the act hindering (referred to as a significant risk of hindering), the achievement of the conservation objectives. Aspects such as scale, timing and duration of the proposed activities or developments should all be considered. However, whilst the initial screening focuses on the protected features, this main assessment focuses on the potential impact on the achievement of the conservation objectives of the protected features.

2.4 Sites of Special Scientific Interest

Scottish planning policy states that developments affecting Sites of Special Scientific Interest (SSSIs, should only be permitted where the objectives of designation and the overall integrity of the area will not be compromised; or any significant adverse effects on the qualities for which the area has been designated are clearly outweighed by social, environmental or economic benefits of national importance. Where a SSSI overlaps with a Natura 2000 site, the Natura 2000 site will be assessed in line with the HRA process. The assessment will not be replicated for the SSSI.

2.5 Seal-haul out sites

Under Section 117 of the Marine (Scotland) Act 2010, Scottish Ministers are permitted to designate specific seal haul-out sites to provide additional protection for seals from intentional or reckless harassment. Seal haul-outs are locations on land where seals come ashore to rest, moult or breed.

3 PROJECT DESCRIPTION

3.1 Overview

SHE Transmission proposes to install a 220 kV Alternating Current (AC) cable system between Orkney Mainland and Caithness on the Scottish mainland (Orkney – Mainland HVAC 220 kV Subsea Link). This section provides a description of the Project detailing the physical construction of the cable and the method of installation, operation, maintenance and decommissioning of the cable.

The cable will be brought ashore through pre-installed Horizontal Directional Drilling (HDD) ducts, bridging the shallow coastal and intertidal areas by drilling through the bedrock. Once the cables emerge from the HDD duct they will be laid on the seabed and buried in seabed sediment where possible. If the subsea cable cannot be buried, for example due to hard seabed conditions, the presence of sensitive environmental habitats/species or at the crossings of other assets, it will be protected by alternative methods, for example High Density Polyethylene (HDPE) ducting, Cast Iron Shells (CIS), rock placement or concrete mattressing.

In limited areas where there is hard seabed or outcropping bedrock mechanical trenching may be used to create a slot trench in which the cable and its protection system will be laid.

In addition to the subsea cable, there are terrestrial elements of the Orkney to Mainland Scotland Transmission connection. These include:

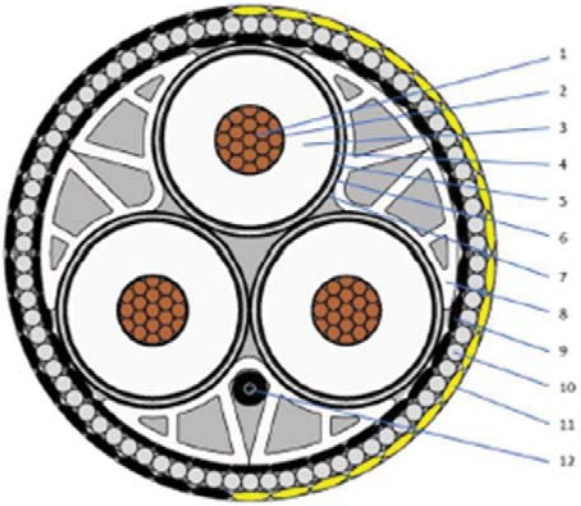
- A new substation at Finstown;
- An underground cable linking the Finstown substation to a cable landing site at Warebeth, west of Stromness;
- An underground cable linking the Dounreay West Substation to a cable landing site at Dounreay; and
- The construction of Dounreay West Substation, linking to the existing 275kV network.

This document considers the marine components of the route up to Mean High Water Springs (MHWS) at both HDD landfalls. The onshore aspects of the Project above MHWS are not considered in this document and will be subject to separate assessment as appropriate.

3.2 Cable type

Electricity will be transmitted using HVAC submarine cable technology. The proposed submarine cable consists of a three-core design with copper stranded conductors, cross-linked polyethylene (XLPE) insulation, water blocking / screening tape, polyethylene sheath and galvanized steel wire armour with an outer serving. An armoured optical fibre is included within the three-core cable. The three-core design minimises the electric and magnetic fields produced by the cable during operation. For similar HVAC systems, the cable is approximately 250-300 mm in diameter and weighs approximately 100 -150 kg/m. The exact cable design is not known at this stage and will depend on which Installation Contractor is appointed. A typical HVAC cable structure is shown below in Figure 3-1.

Figure 3-1 Typical HVAC subsea cable construction



No.	Description
1	Conductor
2	Conductor screen
3	Insulation
4	Insulation screen
5	Water Blocking
6	Metal sheath
7	Inner sheath
8	Fillers
9	Armour bedding
10	Armouring
11	Serving
12	OF cable

3.3 Proposed route and cable crossings

The subsea cable route is approximately 53 km long. It follows a broadly southwest alignment from Warebeth, Orkney across the western approaches to the Pentland Firth to Dounreay, Caithness.

The routing studies have considered the crossings of existing infrastructure, with the following principal criteria:

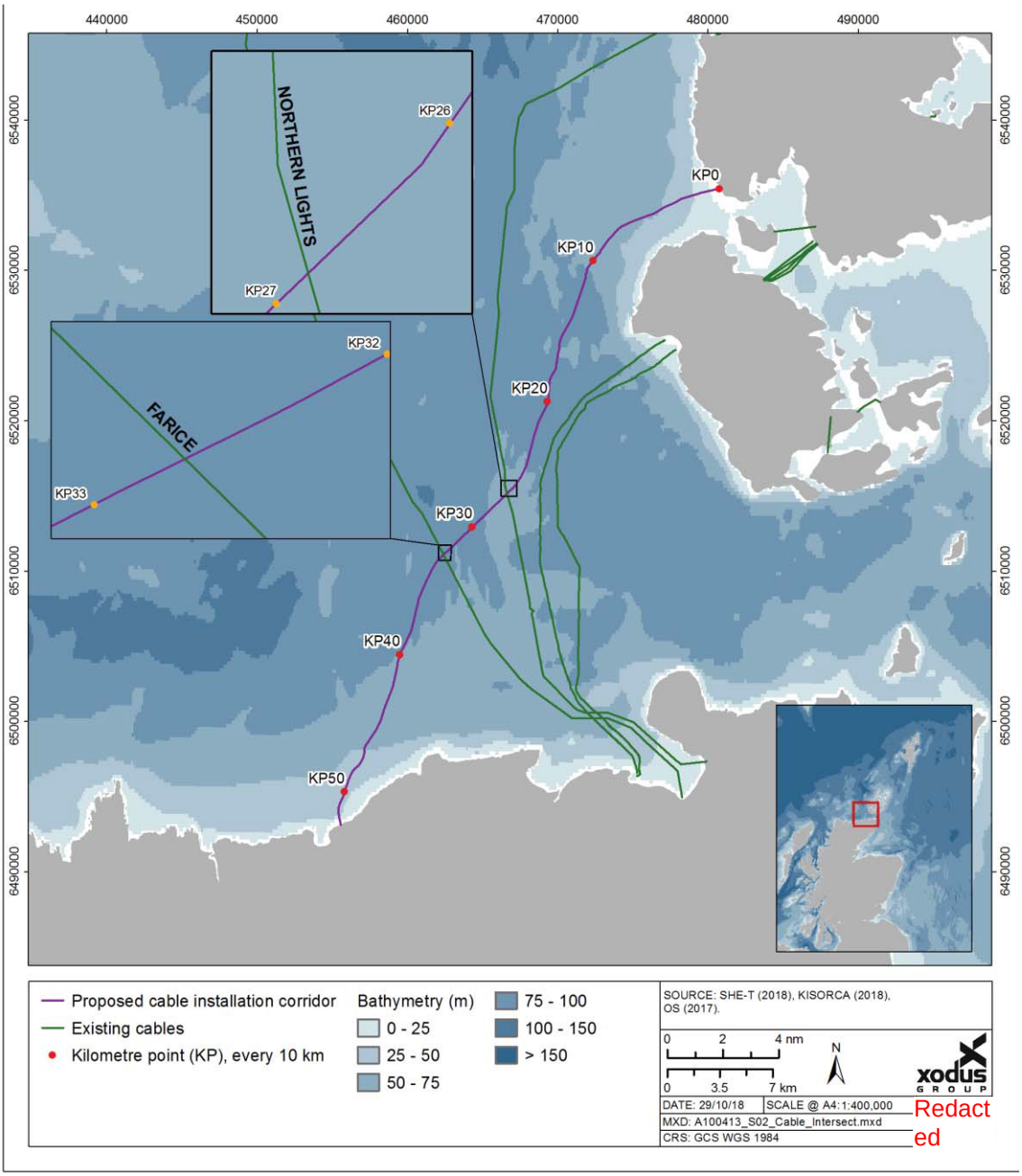
- Avoid or minimise the number of cable crossings;
- Ensure the angle of crossing is perpendicular (i.e. as close to 90° as practicable);
- Assess crossing design to pass over the existing assets;
- Post-installation, the crossing shall be suitably protected (with rock placement or similar); and
- Crossing proposals to be acceptable to the operators of existing assets (it is normal practice to have cable Crossing Agreements in place).

The cable route crosses existing telecoms infrastructure in two locations:

- Farice-1 telecoms cable at KP32.7.
- British Telecom (BT) Northern Lights telecoms cable at KP26.8.

The locations of the cable crossings are shown in Figure 3-2.

Figure 3-2 Overview of cable crossing locations



The crossing of third party infrastructure is made with agreement of the owners following a negotiated formal Crossing Agreement. The Crossing Agreement describes the rights and responsibilities of the parties and the detailed physical design of the crossing. The design addresses the need to protect both the cables and the third-party infrastructure and other aspects such as crossing angle and vertical separation.

Prior to marine cable installation, the selected contractor for the burial and protection scopes of work will propose a suitable crossing design in sufficient time such that SHE Transmission can enter into early discussion with third party asset owners on their requirements for crossing architecture and separation distances, with a view to finalising the design as the Project progresses through detailed design, in order to allow time to review and respond and make changes to the design where required.

3.4 Preliminary estimate for remedial work

The geology below the shallow marine sediments (where present) comprises glacial till and / or bedrock, which both exhibit undulating surfaces. Due to this, and the sediment mobility and erosion resultant from high currents, the glacial till and bedrock regularly outcrop along the installation corridor.

The thin nature or absence of marine sediments can create difficult conditions for burial. In these conditions, remedial works are required following cable lay. Two of the likely remediation options include:

- Rock placement: This technique is one of the most established and proven methods of cable protection suitable for cable crossings, subject to detailed design. Rock placement can also be utilised along lengths of the cable where burial is not achievable, or addition protection is required.
- Mattressing: This involves prefabricated concrete block sections connected by polypropylene rope to form a semi-rigid structure which can be used for crossings over existing subsea cables.

Table 3-1 details the sections which have been identified in the Cable Burial Risk Assessment (CBRA) as areas where burial will be difficult or where cable crossings are present which may require alternative means of cable protection and/or remedial works, but it should be noted that, due to variability in the soil conditions, further remedial works may be required in other areas. A total cable length of 5,300 m has been identified as potentially requiring external protective measures. Additional remedial works may also be required in areas of difficult burial.

Table 3-1 Sections of cable route where remedial works may be required

KP range requiring remedial works	Reason why remedial works are required
0.00 to 2.10	Outcropping bedrock
2.30 to 2.50	Outcropping bedrock
3.30 to 3.40	Outcropping bedrock
15.60 to 18.10*	Shallow/potentially outcropping till and bedrock
26.75 to 26.85	Cable crossing protection required
32.65 to 32.75	Cable crossing protection required
51.8 to 52.10	Outcropping bedrock

*Attempt may be made to bury in this zone however there remains residual risk of requirement for external protection.

3.5 Offshore works – planning stage

A range of geological and environmental surveys were conducted along the proposed cable corridor. The cable corridor survey area is approximately 1000 m wide routed between Warebeth, Orkney and Dounreay, Caithness between February and May 2018.

The geophysical surveys were performed to map the seabed bathymetry, topography, key features and shallow seabed types along the route. This allowed a preliminary route to be identified. The geophysical survey methods used a range of non-intrusive techniques including the following:

- MBES (Multi-Beam Echo Sounder) to determine seabed depth and topography;
- SSS (Side Scan Sonar) to identify seabed features and heights;
- SBP (Sub-bottom Profiler) to determine shallow seabed composition and layers; and
- Magnetometer runs to identify magnetic strength (mainly metallic objects).

The geotechnical investigation performed a more detailed survey along the route to confirm the soils and identify more closely any anomalies or objects along the proposed route. The geotechnical investigation methods included:

- Vibrocoring to recover soil samples for analysis onshore.
- CPT (Cone Penetration Testing) to determine soil strength.
- Benthic surveys, using a combination of grab samples and still/video photography.
- Visual inspections using an ROV (Remote Operated Vehicle) to identify the condition of existing cables and to inspect targets i.e. potential UXO.

The collection of the survey data was used to inform the selection of appropriate burial and protection requirements as outlined in the supporting CBRA (Cathie Associates, 2018). The final cable installation route will be optimised, by the installation contractor, taking account of any seabed features and sensitive habitats. This may also be informed by a further pre-installation route survey which will be completed by the cable installation contractor prior to commencement of cable installation

3.6 Offshore works – pre-lay preparation

The objective of an Unexploded Ordnance (UXO) survey is to identify any ferrous objects which may be UXO and thus a hazard to the installation operations. This is normally performed once the cable route is well defined as the survey work required to clear a corridor is onerous. Any targets observed will be investigated further by ROV to identify them, potentially removing small quantities of seabed, if required, to aid identification. Where realistic UXO threats are identified the cable will be micro routed to avoid them. Where this is not possible the UXO may require to be cleared. Where UXO clearance is required specialist Explosives and Ordnance Disposal (EOD) contractors will be engaged. Should UXO clearance be required, specific engagement and consent will be sought from the appropriate regulator.

The route will be cleared using pre-lay grapnel, boulder clearance and pre-sweeping (sand waves). A pre-lay grapnel run (PLGR) ensures that the cable route is free from obstructions such as discarded or lost fishing gear and wires/cables that could affect the cable installation. The grapnel hooks will normally penetrate up to 1m into the seabed, subject to soils, and are towed along the centreline of the cable route. A boulder clearance plough will be used if there are large stones or boulders along the route, which could interfere with cable laying. The plough is typically 10-15m wide and would be towed along the relevant parts of the route. The plough will push boulders and other surface debris to the side of the route. Where there are sand waves along the route which could present a barrier to the safe lay and burial of the cable a plough or mass flow excavator system will be used to pre-sweep or ‘flatten’ the seabed sufficient to allow safe burial of cable. This operation is used in very localised and specific areas and is normally an alternative to rock-dumping or other means or other means of stabilising and protecting the cable.

Any cable or pipeline crossing areas will be prepared to allow the cable to smoothly transition over the existing infrastructure. This crossing arrangement is normally in the form of rock bags, grout bags, rock berm or concrete ‘link-lok’ mattresses to lift the cable over the infrastructure.

The landfall locations at Warebeth (Orkney) and Dounreay have been selected, balancing a range of cost, technical and environmental factors. A review of potential options at each landfall was carried out by JACOBS on behalf of SHE Transmission, considering both open cut and HDD techniques. An HDD landfall is the preferred option at each landfall as it:

- Minimises impact on the intertidal and nearshore areas;
- Protects the cable in high energy environments;
- Reduces the requirement for cable protection in shallow water; and
- Allows the landfall to be created prior to cable installation.

3.7 Offshore works – cable installation

A pre-lay survey is normally performed by the Installation Contractor shortly prior to the cable laying operation, to ensure that there is no debris present along the route, that has appeared since the previous surveys.

A potential installation option is pre-lay trenching, which involves pre-cutting a 'V' shaped trench along the cable route to facilitate achievement of the target burial depth as well as reducing the risk of cable damage during installation. Pre-lay trenching is often undertaken in areas of potential high-strength cohesive or difficult soils where the capability of jetting trenchers may be restricted.

The cable will be pulled into the HDD duct from the vessel using the following outline procedure:

- HDD exit surveyed, and cap removed;
- Pull-in wire pulled onto the vessel whilst paid out from the onshore winch;
- Cable first end connected to the pull-in wire using a pulling head;
- Deploy cable whilst pulling in on the shore winch;
- Guide the cable end into the HDD duct and commence pulling onshore; floats and / or a lowering rig may be used to support and guide the cable into the HDD duct
- When cable end appears in the TJP, clamp cable to anchor the onshore end; and
- Vessel commences laying the rest of the cable.

The cable will be installed by one of a number of CLVs on the market. The vessel will be DP and will not use anchors. The typical laying speed can vary between 200 m/hr to 800 m/hr, subject to the vessel equipment, weather and accuracy of lay required. Where necessary a guard vessel(s) may be used

Subject to the vessel selected and the final cable design and as-manufactured length's, there may be a requirement for a cable joint. In addition, if there is an unplanned marine emergency the cable may have to be cut and subsequently re-joined.

A second end pull in will be performed using the following outline method:

- The CLV will deploy a loop of cable sufficient to reach the TJP plus a surplus;
- The cable loop will be kept afloat using floats and small work boats;
- The cable will be attached to the pulling head and winch wire;
- The work boats will guide the cable end to the HDD bellmouth where the floats will be removed in sequence; and
- As the cable is pulled ashore through the HDD duct a lowering rig and additional ROV's may be used to help stabilise the cable.

Cable protection systems such as CIS may be installed at both shore ends as the cable is laid away from the CLV. This will further protect and stabilise the cable in the shallower nearshore areas.

3.8 Offshore works – cable protection

It is proposed to bury the cable along the majority of the submarine cable route for protection purposes and to reduce the risks associated with potential fishing gear interaction and anchoring. This is in line with National Marine Plan (NMP) Policy for submarine cables. Where burial is not feasible, either at crossings with existing cables, or where seabed sediments are too firm to achieve burial to the target burial depth (as currently predicted in the CBRA), it will be necessary to protect the cable by other means such as rock, CIS, split duct or concrete mattress placement. The exact details of the installation technique will be confirmed when the contract for installation is awarded. It is envisaged that a variety of installation and burial techniques may be required due to the variable nature of the seabed along the cable route corridor

The ability to bury the cable is heavily dependent upon the soils on which the cable is resting. Two principal methods are available to bury the cable, namely trencher and plough. Very soft or loose soils can be jetted using a trencher, fluidising the seabed locally and letting the cable sink into the seabed. Harder soils may require mechanical cutting to form a trench into which the cable will drop into. In very hard soils and some types of rock a mechanical trencher may be used to cut a slot shaped trench into the seabed into which the

cable will be installed. The protection of the cable is afforded by a combination of the depth of lowering into the seabed and the depth of cover achieved by the resettlement of fluidised sediment and natural sediment movement will also backfill the trench over time. Alternatively, a plough can be used to create a pre-cut trench or for post lay trenching. The typical burial depth of the cable is between 0.6 m and 1.8 m to the top of cable subject to the protection requirements.

Where the cable cannot be buried, or the required depth of burial cannot be achieved, rock is usually placed to protect the cable from damage and from the effects of waves and currents. For the purposes of the EA, a worst-case 7 m rock berm width has been used to allow for flexibility in the final design. In addition to rock placement there are a number of alternatives that are used in more localised areas, including protection mattresses, sand / grout / rock bags and physical protection (articulated half shells).

3.9 Offshore works – as built survey

Following the completion of the installation activities, the Installation Contractor will compile an 'As-Built' report, part of which is the as-built drawings, imagery and video evidence that the asset has been safely installed.

Core to this report is the final route survey to confirm depth of burial and the position of the cable. This will be used as the baseline for subsequent surveys and to identify any movement of the cable, whether it be settling or exposure through scour.

3.10 In-service operations

The operational surveys of the cable will generally consist of the measurement of the cable depth of burial, position and seabed local profile. The objective is to determine whether the seabed has changed significantly, whether the cable is exposed or has moved and the status of any protection on or around the cable. Subsequent surveys will use the as-built survey as a baseline to understand the behaviour of the cable and seabed, enabling any changes to be understood and quantified.

The AC cable produces no external electric field due to the presence of a metallic outer sheath and the cancelling effect of the cores. An AC power cable generates a magnetic field that is directly proportional to the conductor current and reciprocally proportional to the distance of the cable. The cable is expected to produce a magnetic field of between 7.5 to 15 µT at 1 m distance from the cable surface at the maximum operating current. The background geomagnetic field along the north coast of Scotland is approximately 48 to 49 µT. The magnetic fields generated by the Orkney – Mainland Subsea Link cable are therefore expected to attenuate to background levels within around 1 m. It is also proposed to bury the cable or for rock to be placed over the cables where burial cannot be achieved at crossings or in areas of harder seabed and therefore minimal or no magnetic fields are expected to be detectable outside of 1 m at the seabed.

The cable is expected to a have a maximum operating conductor temperature of up to 90 ºC. The rate of heat dissipation into the environment from the cable will depend upon the amount of power passing through the cables, the cable design, current flowing and depth of burial. Negligible heating effects are expected to surrounding seawater due to the very high heat capacity of water and insulation of the soil. However, when the cables are in operation and where the cables are buried, there will be some heating of the surrounding sediment. Protection of the cables by burial or with rock placement is expected to result in a negligible heating effect of the surrounding environment.

Once installed, submarine cables generally do not require any routine maintenance other than confirming that there are no areas of exposure or significant movements indicative of external influence. The subsea cable will be monitored from onshore for electrical integrity to provide early indications of fault conditions. During the first few years of asset life surveys will be performed to confirm the depth of burial of the cable, the stability of any rock berms and protection arrangements. The surveys will utilise standard geophysical survey equipment / ROVs. All subsequent surveys will be based on an assessment of risk, based on previous surveys, metocean conditions and threat. When a subsea cable is damaged, whether as a result of cable failure or where it has been injured by fishing gear, anchors or dropped objects, a repair will be required. The repair vessel would be expected to be on location for between 2 and 3 weeks.

3.11 Decommissioning

Cables in the UK territorial waters are installed on Crown Estate land and therefore a lease or licence is generally entered into for a set term, in this case, 40 years. An Initial Decommissioning Plan (IDP) will be developed and appended to the Crown Estate's licence agreement entered into by SHE Transmission for this Project. The principal options for the cable are to either:

- Leave in-situ buried;
- Leave in-situ and provide additional protection where exposed;
- Remove sections of the cable which present a risk; and
- Remove entire cable.

There may be an option for the cable to be left in place if the environment is best served by doing so, effectively recognising that recovering cables may lead to more damage to the environment or other seabed interests than leaving them in place. This acknowledges that the recovery and disposal of redundant cables is both difficult and expensive. SHE Transmission will retain liability for any residual cable sections in perpetuity. An Out of Service Deed will be entered into by SHE Transmission and the Crown Estate to reflect this, should the cable be left in-situ.

The case for cable recovery will need to be the subject of an environmental and economic assessment in the years leading up to decommissioning.

3.12 Maximum installation footprint / zone of influence

The footprint of marine cable installation activities and/or the zone of influence (ZOI) (i.e. spatial extent over which the Project is predicted to have an impact on the receiving environment based on worst-case assumptions) is presented in Table 3-2. It should be noted that although the cable installation corridor (within which consent for installation of the submarine cable will be applied for) is 200 m wide, cable installation will only require a small part of this width.

Table 3-2 Marine installation footprint / zone of influence

Construction Activity	Footprint / Zone of Influence
Cable installation corridor	53 km long by 200 m wide
HDD Landfall	5 m by 5 m at duct 'pop-out' on seabed
DP cable lay vessel	500 m safety exclusion zone. If followed by burial, vessel safety zone can result in 500 m x 1,000 m zone
Other support vessels	500 m safety exclusion zone
Pre-lay geophysical survey	Up to 2 km at any time
Seabed preparation: Pre-sweeping of sandwaves	20 m wide along areas of sandwaves
Seabed preparation: Pre-lay grapnel	1 m width and 0.5 – 1 m penetration towed along centreline
Seabed preparation: Boulder clearance by 'Orange peel' grab	Localised to boulders within 5 – 10 m of corridor, subject to burial machine type
Seabed preparation: Boulder clearance plough	10 – 15 m width depending on type of plough
Construction Activity	**Footprint / Zone of Influence**
Seabed preparation: Pre-cut trenching system	Trench 1 – 3 m wide, soils spoils each side total width 8 – 10 m

Cable installation: Ploughing	Displacement ploughs, trench up to 5m width, plough footprint up to 15 m Non-displacement plough trenches between 0.3 - 1.0 m trench width and plough footprint of 5 –10 m
Cable installation: Jet trenching	Trench 0.5-1 m width, footprint of trencher 5 – 10 m
Cable installation: Mechanical trenching	Trench 0.5-1 m width, footprint of trencher 5 – 10 m
Cable protection material: Rock placement	5 - 8 m wide rock berm along areas of rock protection by 0.5 - 1 m high
Cable protection: Concrete mattresses	6 m wide x 3 m wide
Cable protection: Cast iron shells	Width of cable and thickness of shell
Cable protection: Composite Lining Sleeve	Width of cable and thickness of lining Sleeve
Disturbance of sediment	Coarser fractions up to and including fine sand, ejected from the trench will be raised a few metres from the seafloor, and are expected to be re-deposited within 10 m or less of the cable trench. Finer silt fractions will remain in suspension for longer with levels expected to fall to ambient levels within 70 m with fine deposition occurring out to a maximum of 2 km from the trench. Far field deposition is predicted to be below 1 mm
Operation of cables	Heating of sediments in very immediate vicinity of cables EMF detectable in immediate vicinity of cables to 1 m

3.13 Permanent Deposits

The permanent deposits which will be installed in the seabed as part of the Project are outlined in Table 3-3.

Table 3-3 Permanent Deposits

Deposit	Detail		
Cable	Diameter: 255 mm	Length: 53 km	Weight: 98 kg/m
Rock	Length: 5,900 m Tonnage: 23,000 tonnes	Volume: 11,210 m^3	Size: 2” to 5” crushed rock as per SSEN Specification Though size at this time not known
Concrete mattresses	Size: 6 x 3 x 0.3 m (assumed dimensions)	Number: 32	Location KP26.75 to KP26.85 & KP32.65 to KP32.75. PE cable protection sleeve will be installed over the cable (100 m for each crossing).
Split pipe	Size: CIS – 500 mm x 300 mm	Type: Cast Iron shells / split pipe or HDPE split duct	Length: CIS and or Tekmar 2000 m (4000 shells)
Concrete bags or grout bags	Size: 25 kg bags	Number: 2,000 bags	Location: HDD pop-out locations and areas where shells are installed and nearshore areas
HDD bore	Number: 4 Diameter: 700 mm	Location: 2 at Warebeth landfall and 2 at Dounreay landfall (1 for main	Length: Dounreay 900 m; Warebeth 1,050 m

Deposit	Detail		
		connection and 1 spare at each end)	
HDD liner	Material: HPDE Diameter: 560 mm	Length: Dounreay 900 m; Warebeth 1,050 m	Accessories: Bell mouth Masterlink seal with messenger wire installed until cable pull
HDD grout	No grouting has been specified at this time	-	-

4 APPROACH TO SCREENING

4.1 Protected site types

Throughout Caithness (north coast Mainland) and Orkney there is an extensive network of protected sites designated for their coastal and marine features nature conservation importance. These include:

- **Special Protection Areas (SPAs)** designated under the Birds Directive for the protection of rare, threatened or vulnerable bird species listed in Annex I of the Birds Directive, and also for regularly occurring migratory species. With respect to the coastal and marine environment, in 2009, marine extensions were classified for a number of SPAs located along the Caithness and Orkney coasts that are designated for seabird breeding colonies. The size of the extension depends on key qualifying features of the site and range from 1 km seaward extensions for SPAs with razorbill, guillemot and puffin, 2 km extensions for SPAs with gannet and fulmar and 4 km extensions for SPAs with Manx shearwater.
- **Proposed SPAs (pSPAs)**. More recently, the Scottish Government has identified an additional 15 proposed SPAs (pSPAs) for marine birds. These pSPAs have been identified specifically for the protection of at sea territories for 45 species of rare and vulnerable seabirds which depend on the marine environment for a large part of their lifecycle.
- **Special Areas of Conservation (SACs)** designated under the Habitats Directive for marine and coastal habitats and species of European importance.
- **Nature Conservation Marine Protected Area (NCMPAs)** designated under the Scotland (Marine) Act 2010 for the protection of nationally important habitats, species, geology and undersea landforms not covered under existing and proposed marine SPAs and SACs.
- **Sites of Special Scientific Interest (SSSIs)** designated under the Nature Conservation (Scotland) Act 2004 for nationally important habitats, species, rocks and landforms, or a combination of such natural features that are considered to best represent Scotland's natural heritage.
- **Seal haul out sites** now protected under Section 117 of the Marine (Scotland) Act 2010. Designated seal haul-outs, are coastal habitat locations that seals use to breed, pup, moult and rest. Almost 200 seal haul-out sites have been designated in Scotland.

SSSIs and seal-haul out sites have been assessed, as required, within Section 9 – Protected sites and Section 11 – Marine mammals of the main Environmental Appraisal and are not considered within this assessment.

4.2 Protected site identification

The identification of the protected sites that require assessment has been undertaken in consultation with SNH and MS-LOT. The identification process was undertaken based on filtering of qualifying interests / features and associated protected sites in a process based on:

- Identifying the range of impacts that the Project could have on qualifying interest(s) of a site (impact pathways); and
- Determining connectivity with the sites.

The following criteria, based on the above, was used to identify the sites that would require further consideration:

- SPAs and NCMPAs (including proposed and candidate sites) with breeding seabirds qualifying features with foraging ranges (as identified by Thaxter *et al* (2012)), that overlap with the proposed cable corridor;
- SACs (including proposed and candidate sites) with harbour seal interests within 50 km of the proposed cable corridor and breeding grey seal within 20 km of the proposed cable corridor;
- Designated seal haul outs that overlap with or are located within 500 m of the proposed cable corridor;

- SACs (including proposed and candidate sites) with otter interests that overlap with or are located within 500 m of the proposed cable corridor;
- SACs and NCMPAs (including proposed and candidate sites) with cetaceans as qualifying features within 50 km of the proposed cable corridor;
- SACs with Atlantic salmon and freshwater pearl mussel (which is dependent on salmonids) who's migrating smolts or adult's salmon are likely to cross the cable corridor;
- SACs (including proposed and candidate sites) and NCMPAs with seabed / benthic protected features that that overlap with or located within 2 km of the proposed cable corridor; and
- SSSIs which overlap with the marine environment (to MLWS) that overlap with or are located within 2 km of the proposed cable corridor.

This initial screening will exclude sites/features where the Project is considered to have no potential for a LSE or is not CoA. Sites not excluded at this stage are taken forward for a more detailed determination in Section 8.

4.3 Approach to assessment

The first stage of both the HRA and the NCMPA assessment is to conduct a screening exercise. Screening is a relatively coarse filter to identify those protected sites and qualifying features with connectivity to the Project for which a LSE or CoA cannot be discounted. Sites/features are identified based on connectivity to a project and pathway for effect.

Once a site/feature is identified, the screening exercise considers whether or not a significant effect can be foreseen, both directly and indirectly. A precautionary approach is followed, where it is not currently possible to exclude a LSE, then the site/feature is progressed to the next stage (Stage 2 of the HRA and the main assessment for the NCMPA). The potential conclusions drawn for each protected site are outlined in Table 4-1.

Table 4-1 Possible conclusions drawn based on the protected site and the underlying assessment process

Designated site	Screening conclusion	
	No further assessment required	Assessment required at the next stage
SPA, pSPA, SAC, cSAC, Ramsar	No Likely Significant Effect (LSE) - There are no LSEs on the European site(s) and their qualifying features, therefore no further assessment is required.	Potential for LSE - LSEs on the European site(s) and their qualifying features cannot be discounted and therefore an AA requires completion by the Competent Authority (CA).
NCMPA	Not Capable of Affect (CoA) - As a consequence of the Project, there are no reasonably predicted effects, and/or the project is not capable of affect any protected features.	Potential CoA – Potential that the project is capable of affecting (other than insignificantly) an NCMPA protected features and therefore a main assessment is required

The potential for a significant effect will also be considered from an in-combination perspective. The list of projects considered within this assessment is provided in Table 4-2.

Table 4-2 List of projects considered within the in-combination screening assessment.

Type	Project name	Developer/Operator	Phase	Distance from cable corridor (km)
Marine renewables	Brough Head Wave Farm	Brough Head Wave Farm Ltd	Planned	4.8
Marine renewables	Dounreay Tri project	Dounreay Tri Ltd	Consented – on hold	7.2

Type	Project name	Developer/Operator	Phase	Distance from cable corridor (km)
Marine renewables	EMEC Wave Test Facility	The European Marine Energy Centre Ltd	Operational	0.7
Marine renewables	Brims Tidal Array	Brims Tidal Array Limited	Planned	14.0
Marine renewables	Inner Sound	MeyGen Limited	Planned	26.0
Marine renewables	Ness of Duncansby	Duncansby Tidal Power Limited	Planned	31.7
Marine renewables	Katanes Floating Energy Park	Floating Power Plant	Planned	9
Telecommunications	FARICE	Farice	Operational	0
Telecommunications	Northern Lights	BT	Operational	0
Power cable (33 kV)	Pentland Firth 1	SSE	Operational	1.7
Power cable (33 kV)	Pentland Firth 2	SSE	Operational	1
Dredge Soil Disposal	Scrabster Extension		Open	12.1
Dredge Soil Disposal	Dounreay Microsite		Open	0.2
Dredge Soil Disposal	Scapa		Open	26.2
Dredge Soil Disposal	Stromness A		Open	2.4

5 INITIAL IDENTIFICATION OF SITES AND FEATURES

5.1 Initial site identification

This section provides outlines the potential sites and features for which there is potentially connectivity with the Project using the criteria outlined in Section 4.2. An overview of the designated sites within the vicinity of the Project is provided in Table 5-1.

Note: Terrestrial sites/features have not been considered or listed as this assessment is focused upon the marine aspects of the Project.

Table 5-1 Designated sites with potential connectivity to the Project

Site name	Designation	Qualifying feature	Distance from the Project. (km)
Hoy (Orkney)	SPA	**Article 4.1** Red-throated diver (56 pairs, 6.0% of the breeding GB population) Peregrine (6 pairs, 0.5% of the breeding GP population) **Article 4.2 (migratory)** Great skua (1, 900 pairs, 14% of the breeding world population) **Assemblage qualification (Article 4.2)** Great black-backed gull (570 pairs, 3% of the GB population) Guillemot (13,400 pairs, 2% of the GB population) Kittiwake (3,000 pairs, 0.6% of the GB population) Fulmar (35,000 pairs, 6% of the GB population) Puffin (3,500 pairs, 0.7% of the GB population) Arctic skua (59 pairs, 2% of the GB population)	0
North Caithness Cliffs (mainland Scotland)	SPA	**Article 4.1** Peregrine (6 pairs, 0.5% of the breeding GP population) **Article 4.2 (migratory)** Guillemot (26,994 pairs, 1.2% of the breeding East Atlantic population) **Assemblage qualification (Article 4.2)** Kittiwake (15, 630 pairs) Fulmar (13,310 pairs) Puffin (1,750 pairs) Razorbill (3,302 pairs)	0

Site name	Designation	Qualifying feature	Distance from the Project. (km)
Scapa Flow (Orkney)	pSPA	**Article 4.1** Red-throated diver (81 pairs, 7.6% of GB population) Great northern diver (506, 20.2% of GB population) Slavonian grebe (135, 12.3% of GB population) Black-throated diver (57, 9.6% of GB population) **Article 4.2 (migratory)** Goldeneye (219, 1.1% of the GB population) Common eider (1,994, 3.3% of GB population) Long-tailed duck (1,393, 12.7% of GB population) Red-breasted merganser (539, 6.4% of GB population) European shag (2929, 1.5% of the biogeographic population)	0.2
Caithness and Sutherland Peatlands (mainland Scotland)	SPA	**Article 4.1** Red-throated diver (2006, 46 pairs, 3.5% of the GB population) Black-throated Diver (1994, 26 pairs, 15% of the GB population) Golden Eagle (1992, 5 pairs, 1% of the GB population) Golden Plover (1993 and 1994, 1,064 pairs, 5% of the GB population) Hen Harrier (1993 to 1997, mean of at least 14 pairs, at least 2.8% of the GB population) Merlin (1993 and 1994, an estimated 54 pairs, 4% of the GB population) Short-eared Owl (30 pairs, 2% of the GB population) Wood Sandpiper (up to 5 pairs, up to 40% of the GB population) Dunlin (1993 and 1994, 1,860 pairs, 20% of the GB population) **Article 4.2 (migratory species)** Common Scoter (2007, at least 21 pairs, at least <0.1% of the Western Siberia / Western & Northern Europe / North-western Africa biogeographic population and at least 40.4% of the GB population) Greenshank (2009, at least 653 pairs, at least 0.9% of the Europe/Western Africa biogeographic population and at least 59.4% of the GB population) Wigeon (1993/94, at least 43 pairs, at least <0.1% of the Western Siberia / Northwestern / Northeastern Europe biogeographic population and at least 10.8% of the GB population.)	4
Orkney Mainland Moors (Orkney)	SPA	**Article 4.1** Red-throated diver (Average of 18 breeding pairs, 2% of GB) Hen harrier (Average of 28 breeding females, 5.9% of GB; average of 13 wintering individuals between 1994 and 1998, 2% of GB) Short-eared owl (Average of 19 breeding pairs between 1993 and 1995, 2% of GB)	7

Site name	Designation	Qualifying feature	Distance from the Project. (km)
Marwick Head (Orkney)	SPA	**Article 4.2 migratory** Common guillemot (37,700 individuals 1.1% of the western European biogeographic population) 37,700 individuals 1.1% of the western European biogeographic population **Article 4.2 assemblage** Kittiwake (7,700 pairs, 2% of the GB population) 7,700 pairs, 2% of the GB population Common guillemot (37,700 individuals, 4% of the GB population) 37,700 individuals, 4% of the GB population	15
Rousay (Orkney)	SPA	**Article 4.1** Arctic tern (Average of 790 pairs in the five-year period between 1991 and 1995; 2% of the GB population) **Article 4.2 assemblage** Arctic skua (130 pairs; 4% of the GB population) Northern fulmar (1,240 pairs, 0.2% of GB population) Black-legged kittiwake (4,900 pairs; 1% of the GB population) Common guillemot (10,600 individuals, 1% of the GB Population) Arctic tern (790 pairs, 2% of the GB population)	24
Pentland Firth	pSPA	**Article 4.1** Arctic skua (80 pairs, 2% of the British population) Arctic tern (100 pairs, 2% of the British population) Common guillemot (34,410 individuals, 2% of the British population) **Article 4.2 assemblage** Seabird assemblage	16
Pentland Firth Islands	SPA	**Article 4.1** Arctic tern (1,000 prs in 1995; 2% of the British breeding population)	28
Copinsay (Orkney)	SPA	**Article 4.2 assemblage** Fulmars (1,615 pairs, 0.3% of the GB population) Great black-backed gull (490 pairs, 3% of the GB population) Guillemot (29,450 individuals, 3% of the GB population) Kittiwake (9,550 pairs, 2% of the GB population)	34

Site name	Designation	Qualifying feature	Distance from the Project. (km)
West Westray (Orkney)	SPA	**Article 4.1** Arctic tern (1,140 pairs; 3% of the British breeding population) **Article 4.2 migratory** Guillemot (42,150 individuals, 1.2% of the North Atlantic biogeographic population) **Article 4.2 assemblage** Fulmar (1,400 pairs, 0.2% of the GB population) Arctic skua (78 pairs; 2% of the GB population) Kittiwake (23,900 pairs, 5% of the GB population) Razorbill (1,946 individuals, 1% of the GB population)	37
East Caithness Cliffs (mainland Scotland)	SPA	**Article 4.1** Peregrine (An estimated 6 pairs, 0.5% of the GB population and selected as one of the most suitable sites for peregrine in GB) **Article 4.2 migratory** Guillemot (106,700 individuals, 3.1% of north Atlantic biogeographic population) Razorbill (15,800 individuals, 1.8% of total A.t. islandica biogeographic population) Herring gull (9,400 pairs, 1.0% of NW European biogeographic population) Black legged kittiwake (32,500 pairs, 1.0% of north Atlantic biogeographic population) European Shag (2,300 pairs, 1.8% of the north Europe biogeographic population) **Article 4.2 assemblage** Great black-backed gull (800 pairs, 4% of the GB population) Cormorant (230 pairs, 3% of the GB population) Northern Fulmar (15,000 pairs, 3% of the GB population) Guillemot (106,700 individuals, 10% of the GB population) Razorbill (15,800 individuals, 11% of the GB population) Herring gull (9,400 pairs, 6% of the GB population) Black legged kittiwake (32,500 pairs, 7% of the GB population) European Shag (2,300 pairs, 6% of the GB population)	40
Calf of Eday (Orkney)	SPA	**Article 4.2 assemblage** Great cormorant (223 pairs, 3% of the GB population) Common guillemot (12,645 individuals, 1% of the GB population) Black-legged kittiwake (1,717 pairs, 0.4% of the GB population) Northern fulmar (1,955 pairs, 0.4% of the GB population) Great black-backed gull (938 pairs, 5% of the GB population)	44

Site name	Designation	Qualifying feature	Distance from the Project. (km)
Papa Westray (North Holm and Hill) (Orkney)	SPA	**Article 4.1** Arctic tern (1994, 1,700 pairs; 4% of the GB population) **Article 4.2** Arctic skua (1985 to 1988, 135 pairs, 0.5% of the North Atlantic biogeographic population and selected as one of the most suitable sites for Arctic skua in GB with 4.2% of the GB population)	50
Caithness Lochs	SPA	**Article 4.1** Whooper swan (1993/94-1997/98 winter peak mean of 240 representing 4% of GB and 1% of Icelandic population) Greenland white-fronted goose (1993/94-97/98 winter peak mean of 440 representing 3% of GB and 1% of Greenlandic population) **Article 4.2** Greylag goose (1993/94-1997/98 winter peak mean of 7,190 representing 7% of the GB and Icelandic populations)	7
River Thurso (mainland Scotland)	SAC	**Annex II species** Atlantic Salmon	12
River Naver (mainland Scotland)	SAC	**Annex II species** Atlantic salmon Fresh water pearl mussel	26
River Borgie (mainland Scotland)	SAC	**Annex II species** Atlantic salmon Freshwater pearl mussel Otter	29
Sanday (Orkney)	SAC	**Annex I habitat** Sandbanks which are slightly covered by sea water at all time Mudflats and sandflats not covered by seawater at low tide Annex II species Harbour seal	49
Papa Westray	NCMPA	Black guillemot (year-round) Marine geomorphology of the Scottish shelf seabed – sand wave field	55

5.2 Offshore ornithology

The Advice received from MS-LOT for the Project (Marine Scotland, 2018) clearly identifies the protected sites the CA and its statutory advisors consider should be considered at Screening and which require assessment of LSE. A review of all sites that have the potential to have connectivity with the Project (see Table 5-1) has been undertaken. Considering the limited zone of influence of the Project and the mobile nature of seabirds the sites taken forward for assessment of LSE has been limited to those within 7 km of the Project as follows:

- Hoy SPA;

- North Caithness SPA;
- Scapa Flow pSPA;
- Caithness and Sutherland Pentlands SPA; and
- Orkney Mainland Moors SPA.

The Caithness and Sutherlands SPA and the Orkney Mainland Moors SPA are terrestrial sites which have a number of qualifying features. This assessment is focused upon the marine aspects of the Orkney – Mainland Subsea Link, and therefore only SPA features (birds) which will forage or interact with the marine environment have the potential to be affected. In the case of the two protected terrestrial sites only red-throated diver is considered to have the potential to interact with the Project and therefore all other species have been screened out and are not considered further. Further assessment of red-throated diver is provided within Section 8.

5.3 Benthic ecology

Protected sites for benthic ecology have been considered for LSE/CoA if the site either overlaps or lies within 2 km of the Project. No sites with benthic ecology protected features have been identified within that range therefore no further assessment is required. No LSE has been identified and the Project is not considered CoA.

5.4 Fish and shellfish

Three SACs with Atlantic salmon and freshwater pearl mussel features have been identified in the vicinity of the Project the River Borgie SAC, River Naver SAC and the River Thurso SAC. These sites are assessed further in Section 9.

5.5 Marine mammals

The Sanday SAC, is designated for harbour seal and is located 49 km from the installation corridor, just within the 50 km distance selection criteria for sites with harbour seal interests outlined in Section 4.2). Given the distance from the installation corridor to the designated site and the predicted localised impacts of sediment dispersion with levels expected to fall to ambient levels within 70 m of trenching activity (Gooding *et al.,* 2012), disturbance from suspended sediments and disturbance at the landfall will not be considered further. Seals can be found inhabiting areas of near-persistent turbidity (e.g. the southern North Sea and The Wash, and the Thames Estuary on the south-east coast of England), so it appears unlikely that a localised increase in turbidity would place significant constraints on the foraging success of these species. The assessment of LSE will therefore be focused upon injury and disturbance from underwater noise.

The River Borgie SAC is located 29 km from the installation corridor, as such there is no pathway of effect for otter and the species is not considered further.

5.6 Sites taken forward for consideration of significant effect

Considering the information presented in Section 5.1 - 5.5, a number of sites and qualifying features have been taken forward for a further consideration of LSE. The sites are presented in Table 5-2.

Table 5-2 Designated sites and qualifying features

Designated site	Qualifying features (relevant to the Project)
Hoy SPA	Red-throated diver Peregrine Great skua Great black-backed gull Guillemot Kittiwake Fulmar Puffin Arctic skua
North Caithness Cliffs SPA	Peregrine Guillemot Kittiwake Fulmar Puffin Razorbill
Scapa Flow pSPA	Red-throated diver Great northern diver Slavonian grebe Black-throated diver Goldeneye Common eider Long-tailed duck Red-breasted merganser European shag
Caithness and Sutherland Pentlands SPA	Red-throated diver
Orkney Mainland Moors SPA	Red-throated diver
River Borgie SAC	Atlantic salmon Freshwater pearl mussel
River Thurso SAC	Atlantic salmon
River Naver SAC	Atlantic salmon Freshwater pearl mussel
Sanday SAC	Harbour seal

6 EMBEDDED MANAGEMENT MEASURES

There are a number of embedded management measures that will be adhered to in accordance with best practice approaches or which are part of the Project design. The measures, relevant to ecology are presented in Table 6-1.

Table 6-1 Best practice and embedded management measures

Best Practice (BP) and Mitigation (M) Measures	Jusitification
A final CEMP and an Emergency Spill Response Plan will be developed and implemented for the installation phase. A non-native species management plan / biosecurity plan for vessels will be developed as part of the CEMP.	Measures will be adopted to ensure that the potential for release of pollutants from construction, operation and decommissioning is minimised. A document detailing how the risk of potential introduction and spread of INNS will be minimised is to be produced. The plan will outline measures to ensure vessels comply with the International Maritime Organization (IMO) ballast water management guidelines and with the Ballast Water Management Policy for Scapa Flow (Orkney Islands Council, 2017). It will consider the origin of vessels and contain standard housekeeping measures for such vessels as well as measures to be adopted in the event that a high alert species is recorded. Compliance with the General Policy 9 of the Pilot Pentland Firth and Orkney Waters Marine Spatial Plan will also be ensured (Scottish Government, 2016).
Control measures and shipboard oil pollution emergency plans (SOPEP) will be in place and adhered to under MARPOL Annex I requirements for all vessels. In the event of an accidental fuel release occurring appropriate standard practice management procedures will be implemented accordingly.	Measures will be adopted to ensure that the potential for release of pollutants from construction, operation and decommissioning is minimised.
Ballast water discharges from vessels will be managed under International Convention for the Control and Management of Ships' Ballast Water and Sediments and in accordance with the Ballast Water Management Policy for Scapa Flow (Orkney Islands Council, 2017).	To minimise the potential for release of pollutants from construction, operation and decommissioning.
Vessels will be equipped with waste disposal facilities (sewage treatment or waste storage) to IMO MARPOL Annex IV Prevention of Pollution from Ships standards.	Measures will be adopted to ensure that the potential for release of pollutants from construction, operation and decommissioning is minimised.
Vessel crew will be made aware of all marine mammals they might encounter and will employ best practice measures for boat control near wildlife as informed by the Scottish Marine Wildlife Watching Code and Guide to Best Practice for Watching Marine Wildlife.	To minimise the potential risk of injury to marine mammals.
JNCC guidelines for minimising the risk of disturbance and injury to marine mammals from seismic surveys (JNCC, 2017) will be implemented throughout the survey period.	Compliance with the JNCC guidelines is considered best practice and will, in most cases, reduce the risk of injury to marine mammals from deliberate seismic activities to negligible levels. Although these guidelines do not deal with disturbance directly, the mitigation measures are deemed appropriate for assisting in the reduction of noise-related disturbance to marine mammals as well.
A Cable Burial Plan (CBP) will be produced outlining the proposed method statement and cable protection requirements for approval by the Regulator and discussion with stakeholders.	To ensure that relevant stakeholders are aware of the installation.
The duration of cable installation activities from the vessel will minimised as much as possible.	To ensure the disturbance of the seabed is kept to a minimum.

Best Practice (BP) and Mitigation (M) Measures	Jusitification
Deployment of anchors/anchor chains on the seabed will be kept to a minimum.	To ensure the disturbance of the seabed is kept to a minimum.
Marine Mammal Observers (MMO) and Passive Acoustic Monitoring (PAM) will be deployed on all vessels making emitting noise which could cause a disturbance to marine mammals.	To reduce the risk of physical injury and disturbance to marine mammals.
The presence of vessels adjacent to the shore areas will be minimised during sensitive periods for breeding birds and where possible will limited to works in the location of the HDD pop-outs	Ensures that seabirds nesting along the sea cliffs and coastline will not be disturbed by the presence of Project vessels.
The slow speed of installation vessels (maximum of a few knots per hour) will reduce impacts of disturbance and lighting on-board the cable installation vessel will be kept to the minimum level required to ensure safe operations.	To minimise the potential disturbance from Project vessels.
Rock protection and/or mattresses will only be deployed where adequate burial cannot be achieved to protect the cable. Rock berms and mattresses will be designed to have a smooth overtrawlable profile.	Cable burial is always the first-choice approach to protecting the cable.

7 POTENTIAL IMPACTS

The potential impact arising from installation, maintenance & repair, operation and decommissioning phases of the Project are summarised in Table 7-1. For the purposes of this report and given the limited information currently available with respect to decommissioning, potential impacts during this phase have been assumed to be similar or less than those predicted during the installation phase, for all receptors.

Table 7-1 Potential effects as a result of the Project on designated sites and features

Receptor	Effect	Justification
Installation / maintenance & repair / decommissioning		
Benthic habitats	Temporary direct loss of, or disturbance to benthic habitats and communities.	There is potential for temporary habitat loss or disturbance due to cable installation, maintenance & repair and decommissioning activities.
	Temporary increase in suspended sediment and associated deposition.	Temporary increase in suspended sediment and associated deposition arising from cable installation, maintenance & repair and decommissioning may result in adverse and indirect impacts on benthic communities.
Fish and shellfish	Disturbance to and possible alteration of migration routes due to vessel noise, noise generated during cable installation and sediment suspension during cable installation.	Underwater noise generated during cable installation, maintenance & repair and decommissioning through vessel activities and geophysical surveys may cause disturbance and behavioural effects to fish. Temporary increase in suspended sediment and associated deposition arising from cable installation, maintenance & repair and decommissioning may result in adverse and indirect impacts on fish and shellfish.
Marine Mammals	Temporary increase in suspended sediment.	Temporary increase in suspended sediment and associated deposition arising from cable installation, maintenance & repair and decommissioning may impair the foraging ability of marine mammals.
	Injury or disturbance from underwater noise.	There is the potential for underwater noise arising from cable installation, maintenance & repair and decommissioning, Project vessel activity and geophysical surveys to cause injury or disturbance to marine mammals.
Ornithology	Physical disturbance and/or displacement due to vessel presence.	There is the potential for Project activities to result in the direct disturbance/displacement of birds from important feeding or roosting areas.
	Disturbance and/or displacement due to increased turbidity in the water column.	Temporary increases in suspended sediment and associated deposition arising from cable installation, maintenance & repair and decommissioning may impair the foraging ability of seabirds.
	Indirect effects on qualifying features due to distribution of prey items.	Temporary increases in suspended sediment and associated deposition arising from cable installation, maintenance & repair and decommissioning and/or underwater noise from Project activities may cause impacts to bird prey species.
Operation		
Benthic habitats	Permanent habitat loss.	There is the potential for permanent habitat loss where cable protection is placed on the seabed.
	Introduction of new substrate.	Anthropogenic structures on the seabed are expected to be colonised by a range of marine organisms, which can alter the ecology of a site.
	Increased risk of the introduction or spread of INNS.	Project vessels can introduce INNS through ballast water or being attached to the vessel hulls.

Receptor	Effect	Justification
Fish and shellfish	Electromagnetic fields affecting migration.	EMF emitted by subsea cables during the operational phase has the potential to result in behavioural responses on fish.
Ornithology	Indirect effects on prey species due to EMF.	EMF emitted by subsea cables during the operational phase has the potential to result in behavioural responses on seabird prey species.

8 OFFSHORE ORNITHOLOGY ASSESSMENT OF LSE

8.1 Hoy SPA

8.1.1 Overview and conservation objectives

Hoy is one of the most southerly of the major islands of the Orkney archipelago in northern Scotland. The Hoy SPA covers the northern and western two-thirds of the island, which is formed of Old Red Sandstone and contains Orkney's highest hills. Most of the island is moorland, drained by numerous streams with diverse vegetation. The site supports an extremely diverse mixture of mire, heath and alpine vegetation, and also Britain's most northerly native woodland. The highly exposed nature of the vegetation results in an arctic-alpine character to the summit of Ward Hill at only 479 m. The low intensity of burning and grazing on Hoy has allowed scrub regeneration to a much greater extent than on most British moorlands. On the west coast, Old Red Sandstone cliffs reach 339 m in height and include a number of notable stacks and crags. These cliffs provide important breeding sites for a number of seabird species, especially gulls and auks, whilst moorland areas support large numbers of breeding birds, in particular Great Skua. Red-throated Diver nest on the numerous small lochans found on the moorland. The divers and seabirds feed in the rich waters around Hoy, outside the SPA.

The conservation objectives for the site are as follows:

'*To avoid deterioration of the habitats of the qualifying species (listed below) or significant disturbance to the qualifying species, thus ensuring that the integrity of the site is maintained; and*

To ensure for the qualifying species that the following are maintained in the long term:

- *Population of the species as a viable component of the site.*
- *Distribution of the species within site.*
- *Distribution and extent of habitats supporting the species.*
- *Structure, function and supporting processes of habitats supporting the species.*
- *No significant disturbance of the species'*.

Hoy SPA includes a marine extension which covers a marine area out to approximately 2 km from Hoy's western coast. These adjacent waters support a range of bird activities including feeding, loafing, preening and display.

8.1.2 Assessment of LSE

8.1.2.1 Physical disturbance and/or displacement due to vessel presence (installation / maintenance and repair / decommissioning)

Disturbance during the installation / maintenance and repair / decommissioning of a subsea cable (vessel presence and activity) may displace birds from an area of sea, effectively amounting to habitat loss during the period of disturbance (Drewitt and Langston, 2006). Project activities may directly disturb / displace birds from foraging or loafing areas, thus causing the birds to move elsewhere and potentially affecting breeding productivity or survival rates of an individual or population. A small number of disturbance events will not have an immediate effect on the survival or productivity of an individual bird. Repeated disturbance or disturbance over an extended period can affect the survival and productivity of a bird.

The sensitivity of the qualifying features of the Hoy SPA to vessel disturbance are outlined in Table 8-1.

Table 8-1 Sensitivity of seabirds to vessel disturbance (1 = low, 5 = high) (Wade *et al.*, 2016)

Species	Sensitivity to vessel disturbance
Red-throated diver	5
Peregrine	n/a
Great skua	1
Great black-backed gull	1
Guillemot	3
Kittiwake	2
Fulmar	1
Puffin	3
Arctic skua	1

During cable installation disturbance would be restricted to the cable installation corridor footprint and at any one time to the immediate vicinity of the Project vessels when they are operating. The area of habitat disturbed due to vessel movements is considered to be small in the context of the foraging range of the qualifying features (minimum of 9 km for red throated diver up to 400 ± 246 km for fulmar; Thaxter *et al.,* 2012). The cable installation corridor passes through the north west corner of the Hoy SPA for approximately 0.2 km from KP6.2 – KP6.4. Project vessels will be present within the Hoy SPA (marine extension) for limited periods of time (a few days) at different stages of the Project (pre-lay survey, seabed preparation, cable lay and protection, maintenance and repair, inspection surveys). When operating, the cable lay and trenching vessels will progress relatively slowly and therefore seabirds of the species that regularly occur in the area are likely to show a relatively mild disturbance response to them compared to faster moving vessels (Ronconi and Cassady St. Clair, 2002).

Vessel activity will be highly localised as vessels will be slow moving (maximum of a few knots per hour) or static. Disturbance associated with vessel presence / activity is of limited duration and also represents a transient impact as vessels move through an area. Impacts are spatially and temporally restricted and are considered unlikely to affect the breeding productivity or survival rates of an individual or population.

Any disturbance will take place in the context of existing sources of disturbance such as commercial shipping, recreational boating etc, considering the high level of marine vessel traffic the Pentland Firth experiences (see Appendix B: NRA of the EA). The main existing traffic route is closer to the west coast of Hoy (and therefore the Hoy SPA) than the proposed cable route and passes into Stromness port at the mouth of the Hoy Sound (see Appendix B: NRA and Figure 14-3 in the EA). The presence of Project vessels in an already busy area for marine traffic is unlikely to be detectable above existing baseline levels.

In general, it is considered that effects are likely to last only for the duration of distinct installation / maintenance and repair / decommissioning activities, and therefore will be direct, but temporary, reversible and short-term in nature for a specific event. During the work period, birds may return to areas when activities are not currently occurring. Therefore, no LSE is predicted.

8.1.2.2 Disturbance and/or displacement due to increase turbidity in the water column (Installation / maintenance and repair / decommissioning)

The cable installation technique has not yet been determined, as such there could be varying degrees of sediment disturbance depending on the technique used and the substrate type. Jetting is considered to produce the worst-case scenario for the production of increased suspended sediment. It is expected that coarser fractions up to and including fine sand, ejected from the trench will be raised a few metres from the seafloor, and will be re-deposited within 10 m or less of the cable trench (Gooding *et al.,* 2012). Finer silt fractions will remain in suspension for longer with levels expected to fall to ambient levels within 70 m with fine deposition occurring out to a maximum of 2 km from the trench. Far field deposition is predicted to be below 1 mm. Once the cable has been trenched the sediment will resettle over the cable or in the near vicinity of the cable.

This assessment focuses on visual foragers and on the potential impact to their foraging ability. Peregrine falcon will not be affected by this impact as their do not feed within the water column. Northern fulmar, skuas and gulls are opportunistic scavengers and are not considered sensitive to changes in turbidity having been seen to scavenge around marine works previously (Votier *et al.,* 2008; RPS, 2012).

The following species were identified as having moderate – high sensitivity to increases in turbidity; guillemot, razorbill, red-throated diver, kittiwake and puffin (Cook and Burton, 2010).The increase in suspended sediment has the potential to effect visual seabird foragers, yet because the increase will be temporary in nature and the suspended sediment will settle on the seabed (small spatial extent) it is not considered likely there will be a large effect on seabird foraging, especially considering the foraging range of seabirds (minimum of 9 km for red throated diver up to 400 ± 246 km for fulmar; Thaxter *et al.,* 2012) and the alternate foraging habitat available. Furthermore, due to temporary vessel disturbance during cable installation, it is unlikely that the seabirds will be foraging in the direct vicinity of the cable corridor. The impact is considered to be localised in spatial extent, short term in duration, intermittent and with high reversibility. Therefore, no LSE is predicted.

8.1.2.3 Indirect effects on qualifying features due to distribution of prey items (installation / maintenance and repair /decommissioning)

The main impacts on prey species are likely to be as a result of noise and physical disturbance from cable installation. Given the mobile nature of fish, potential impacts associated with cable installation, maintenance and repair and decommissioning activity are expected to be minimal on the basis that fish can avoid the main area of potential impact.

The habitat flexibility of Hoy SPA features is listed in Table 8-2. Furness *et al.,* (2013) and subsequently Wade *et al.,* (2016) categorised habitat flexibility from 1 (tend to forage over large marine areas with little known association with particular marine features) to 5 (tend to feed on very specific habitat features, such as shallow banks with bivalve communities, or kelp beds).

Table 8-2 Seabird habitat flexibility (1= high, 5 = low) (Wade *et al.,* 2016)

Species	Habitat flexibility
Red-throated diver	4
Peregrine	n/a
Great skua	2
Great black-backed gull	2
Guillemot	3
Kittiwake	2
Fulmar	1
Puffin	3
Arctic skua	2

Sediment disturbance will be limited to the vicinity of the cable installation operations and no impacts from the low levels of sediments disturbance by trenching activity are expected on fish or shellfish receptors. The Project will have a relatively limited footprint within the cable corridor itself so loss of, or damage to supporting habitat is likely to be insignificant. Any disturbed sediment is expected to be rapidly dispersed by tidal currents. Data from Coull *et al.,* (1998), Ellis *et al.,* (2012) and the Scottish Governments Updated Fisheries Sensitivity Maps indicates that it is unlikely that any key spawning grounds are present in the Project vicinity. Potential impacts on any spawning grounds associated with direct seabed disturbance during cable installation will be limited to the working corridor.

With respect to underwater noise, given the limited number of vessels expected to be involved in any seabed preparation and cable installation activities (estimated two vessels – cable lay vessel and guard vessel) and the short duration and temporary nature of cable installation activities, the potential for significant impacts on prey species is considered to be minimal.

Considering the localised, temporary, irregular and reversible disturbance to the habitat of seabird prey species and the overall foraging range for each qualifying features of the Hoy SPA no LSE is predicted.

8.1.2.4 Indirect effects on prey species due to EMF (Operation)

Electromagnetic fields (EMF) emissions are generated from the transmission of electricity through subsea cables. The cables produce electromagnetic fields which have both electric (E) measured in volts per metre (V m-1) and magnetic components (B) measured in micro tesla (μT). While the direct electric field is mostly blocked with the use of conductive sheathing, the magnetic field penetrates most materials and therefore are emitted into the marine environment with the resultant induced electric (iE) field. EMFs have the potential to affect seabird prey species who are sensitive to magnetic and electrical fields.

It is commonly recommended that cable burial is used to increase the distance between the cable and the EMF sensitive species (Gill *et al.,* 2005; DECC, 2011). However, where burial is not an option due to the nature of the seabed, cable protection, e.g. concrete mattresses or rock placement can also be used to increase the distance between marine species sensitive to EMF and the EMF source. Where cables are buried to a depth of 1 m, the predicted magnetic field strength at the seabed is expected to be below the earth's magnetic field (assumed to be 50 μT) (MORL, 2012) and not detectable by elasmobranch or EMF sensitive species (fish and crustaceans). Given that the cable will be buried or protected for the majority of its length (in line with SHE Transmission overarching objective for installation of a subsea cable and in accordance with National Marine Plan Policy) the potential for significant impacts due to EMF emissions are minimal and unlikely to occur.

In general, teleost fishes are not believed to be electrically sensitive except weakly electric fish, such as electric catfishes or knifefishes. There is significant evidence of teleost fishes possessing magnetic receptors and there is evidence that certain fish species orientate in relation to magnetic fields. However, it is not known whether their natural behaviour would be affected by EMF's from sub-sea cables. Bochert & Zettler (2004) found no significant effects of static magnetic fields upon flounder, *Platichthys flesus*. Swedpower (2003) found no measurable impact of subjecting salmon and trout to magnetic fields twice the magnitude of the geomagnetic field. The European eel (*Anguilla anguilla*), has been suggested to deviate temporarily from its migration course in the presence of a 5 μT magnetic field 60 m from a HVDC cable; however, the spatial resolution of the tracking was too low to draw any firm conclusions (Westerberg 2000; Ohman *et al.,* 2007). The temporary and small-scale nature of such effects would suggest it is unlikely that key functions such as breeding or feeding success would be adversely affected. Benthic species are more likely to encounter elevated magnetic fields and are possibly able to detect them even at distances at which they fall below the geomagnetic field (Westerberg 2000; Meyer *et al.,* 2004).

The only evidence of physiological effects on demersal fish relates to fish embryonic development, which has been shown to be delayed by AC magnetic fields of 1 to 100μT (Cameron et al., 1985; Cameron et al., 1993). It is considered unlikely that any key spawning grounds are present in the Project vicinity and therefore the potential for EMFs to affect eggs or embryos is considered low.

Seabirds vary from low too high in their sensitivity to changes to prey availability depending on their diet and foraging behaviour. However, any changes to the distribution of seabird prey species and habitat during the operation of the cable as a result of EMFs is likely to be minor when considering the limited footprint of the installed cable in the seabed in relation to each species' total foraging range. Therefore, no LSE is predicted.

8.2 North Caithness Cliffs SPA

8.2.1 Overview and conservation objectives

The North Caithness Cliffs SPA is located on the north coast of Caithness in northern Scotland. The site comprises most of the sea-cliff areas between Red Point and Duncansby Head on the north mainland coast, and the western cliffs on the island of Stroma. The cliffs are formed from Old Red Sandstone and are generally between 30-60 m high, rising to 120 m at Dunnet Head. Cliff ledges, stacks and geos provide ideal nesting sites for important populations of seabirds, especially gulls and auks. The seabirds nesting on the North Caithness Cliffs feed outside the SPA in the surrounding waters of the Pentland Firth, as well as further afield. The cliffs also provide important nesting habitat for Peregrine *Falco peregrinus*.

The conservation objectives for the site are as follows:

'*To avoid deterioration of the habitats of the qualifying species (listed below) or significant disturbance to the qualifying species, thus ensuring that the integrity of the site is maintained; and*

To ensure for the qualifying species that the following are maintained in the long term:

- *Population of the species as a viable component of the site.*
- *Distribution of the species within site.*
- *Distribution and extent of habitats supporting the species.*
- *Structure, function and supporting processes of habitats supporting the species.*
- *No significant disturbance of the species'.*

8.2.2 Assessment of LSE

8.2.2.1 Physical disturbance and/or displacement due to vessel presence (installation / maintenance and repair / decommissioning)

Disturbance during the installation / maintenance and repair / decommissioning of a subsea cable (vessel presence and activity) may displace birds from an area of sea, effectively amounting to habitat loss during the period of disturbance (Drewitt and Langston, 2006). Project activities may directly disturb / displace birds from foraging or loafing areas, thus causing the birds to move elsewhere and potentially affecting breeding productivity or survival rates of an individual or population. A small number of disturbance events will not have an immediate effect on the survival or productivity of an individual bird. Repeated disturbance or disturbance over an extended period can affect the survival and productivity of a bird.

The sensitivity of the qualifying features of the North Caithness Cliff SPA to vessel disturbance are outlined in Table 8-3.

Table 8-3 Sensitivity of seabirds to vessel disturbance (1= low, 5 = high) (Wade *et al.*, 2016)

Species	Sensitivity to vessel disturbance
Peregrine	n/a
Guillemot	3
Kittiwake	2
Fulmar	1
Puffin	3
Razorbill	3

The cable landfall is located within the North Caithness Cliffs SPA, however the actual overlap of the installation corridor with the SPA is small at 0.68 km.

Disturbance would be restricted to the cable installation corridor footprint and at any one time to the immediate vicinity of the Project vessels when they are operating. The area of habitat disturbed due to vessel movements is considered to be small in the context of the foraging range of the qualifying features (from 48.5 ± 35 for razorbill, up to 400 ± 246 km for fulmar; Thaxter *et al.,* 2012). For the cable pull, the Project vessels will be largely stationary, with the cable laying vessel itself being stationed around the HDD pop-out located 900 m from the cliff edge. Smaller vessels may be present around the HDD pop-out for short periods of time (approximately less than12 hours) during the cable pull-in. Species nesting on the cliffs are therefore unlikely to flush from their nests due to the presence of the mainly stationary cable lay vessel. The cable pull is only estimated to take a day (up to 3 days maximum) and therefore any impact will be short-term. Therefore, effects resulting from vessel presence for the cable pull are likely to be limited.

Vessel activity will be highly localised as vessels will be slow moving (maximum of a few knots per hour) or static. Disturbance associated with vessel presence / activity is of limited duration and also represents a transient impact as vessels move through an area. Impacts are spatially and temporally restricted and are

considered unlikely to affect the breeding productivity or survival rates of an individual or population. Any disturbance will take place in the context of existing sources of disturbance such as commercial shipping, recreational boating etc, considering the high level of marine vessel traffic the Pentland Firth experiences (see NRA). The presence of Project vessels in an already busy area for marine traffic is unlikely to be detectable above existing baseline levels.

In general, it is considered that effects are likely to last only for the duration of installation / maintenance and repair / decommissioning activity, and therefore will be direct, but temporary, reversible and short-term in nature for a specific event. During the work period, birds may return to areas when activities are not currently occurring. Therefore, no LSE is predicted.

8.2.2.2 Disturbance and/or displacement due to increase turbidity in the water column (installation / maintenance and repair / decommissioning)

The cable installation technique has not yet been determined, as such there could be varying degrees of sediment disturbance depending on the technique used and the substrate type. Jetting is considered to produce the worst-case scenario for the production of increased suspended sediment. Coarser fractions up to and including fine sand, ejected from the trench will be raised a few metres from the seafloor, and will be re-deposited within 10 m or less of the cable trench (Gooding *et al.,* 2012). Finer silt fractions will remain in suspension for longer with levels expected to fall to ambient levels within 70 m with fine deposition occurring out to a maximum of 2 km from the trench (Gooding *et al.,* 2012). Far field deposition is predicted to be below 1 mm. Once the cable has been trenched the sediment will resettle over the cable or in the near vicinity of the cable.

This assessment focuses on visual foragers and on the potential impact to their foraging ability. Peregrine falcon will not be affected by this impact as their do not feed within the water column. Northern fulmar are opportunistic scavengers and are not considered sensitive to changes in turbidity, having been seen to scavenge around marine works previously (Votier *et al.,* 2008; RPS, 2012).

The following species were identified as having moderate – high sensitivity to increases in turbidity; guillemot, razorbill, red-throated diver, kittiwake and puffin (Cook and Burton, 2010). The increase in suspended sediment has the potential to effect visual seabird foragers, yet because the increase will be temporary in nature and the suspended sediment will settle on the seabed (small spatial extent) it is not considered likely there will be a large effect on seabird foraging, especially considering the foraging range of seabirds (minimum of 9 km for red throated diver up to 400 ± 246 km for fulmar; Thaxter *et al.,* 2012) and the alternate foraging habitat available. Furthermore, due to temporary vessel disturbance during cable installation, it is unlikely that the seabirds will be foraging in the direct vicinity of the cable corridor. The impact is considered to be localised in spatial extent, short term in duration, intermittent and with high reversibility. Therefore, no LSE is predicted.

8.2.2.3 Indirect effects on qualifying features due to distribution of prey items (installation / maintenance and repair / decommissioning)

The main impacts on prey species are likely to be as a result of construction noise and physical disturbance from cable installation. Given the mobile nature of fish, potential impacts associated with cable installation, maintenance and repair and decommissioning are expected to be minimal on the basis that fish can avoid the main area of potential impact.

The habitat flexibility of North Caithness Cliffs SPA features is listed in Table 8-4. Furness *et al.,* (2013) and subsequently Wade *et al.,* (2016) categorised habitat flexibility from 1 (tend to forage over large marine areas with little known association with particular marine features) to 5 (tend to feed on very specific habitat features, such as shallow banks with bivalve communities, or kelp beds).

Table 8-4 Seabird habitat flexibility (1= high, 5 = low) (Wade *et al.,* 2016)

Species	Habitat flexibility
Peregrine	n/a
Guillemot	3
Kittiwake	2
Fulmar	1

Species	Habitat flexibility
Puffin	3
Razorbill	3

Sediment disturbance will be limited to the vicinity of the cable installation operations and no impacts from the low levels of sediments disturbance by trenching activity are expected on fish or shellfish receptors. Cable installation will have a relatively limited footprint within the installation corridor itself so loss of, or damage to supporting habitat is likely to be insignificant. Any disturbed sediment is expected to be rapidly dispersed by tidal currents. Data from Coull *et al.,* (1998), Ellis *et al.,* (2012) and the Scottish Governments updated Fisheries Sensitivity Maps indicates that it is unlikely that any key spawning grounds are present in the vicinity of the installation corridor. Potential impacts on any spawning grounds associated with direct seabed disturbance during cable installation will be limited to the vicinity of the cable trench.

With respect to underwater noise, given the limited number of vessels expected to be involved in any seabed preparation and cable installation activities (estimated two vessels – cable lay vessel and guard vessel) and the short duration and temporary nature of cable installation activities, the potential for significant impacts on prey species is considered to be minimal.

Considering the localised, temporary, irregular and reversible disturbance to the habitat of seabird prey species and the overall foraging range for each qualifying features of the North Caithness Cliffs SPA no LSE is predicted.

8.2.2.4 Indirect effects on prey species due to EMF (Operation)

Electromagnetic fields (EMF) emissions are generated from the transmission of electricity through subsea cables. The cables produce electromagnetic fields which have both electric (E) measured in volts per metre (V m-1) and magnetic components (B) measured in micro tesla (μT). While the direct electric field is mostly blocked with the use of conductive sheathing, the magnetic field penetrates most materials and therefore are emitted into the marine environment with the resultant induced electric (iE) field. EMFs have the potential to affect seabird prey species who are sensitive to magnetic and electrical fields.

It is commonly recommended that cable burial is used to increase the distance between the cable and the EMF sensitive species (Gill *et al.,* 2005; DECC, 2011). However, where burial is not an option due to the nature of the seabed, cable protection, e.g. concrete mattresses or rock placement can also be used to increase the distance between marine species sensitive to EMF and the EMF source.

Where cables are buried to a depth of 1 m, the predicted magnetic field strength at the seabed is expected to be below the earth's magnetic field (assumed to be 50 μT) (MORL, 2012) and not detectable by elasmobranch or EMF sensitive species (fish and crustaceans). Given that the cable will be buried or protected for the majority of its length (in line with SHE Transmission overarching objective for installation of subsea cable and in accordance with National Marine Plan Policy) the potential for significant impacts due to EMF emissions are minimal and unlikely to occur.

The only evidence of physiological effects on demersal fish relates to fish embryonic development, which has been shown to be delayed by AC magnetic fields of 1 to 100μT (Cameron et al., 1985; Cameron et al., 1993). It is considered unlikely that any key spawning grounds are present in the project vicinity and therefore the potential for EMFs to affect eggs or embryos is considered low.

Seabirds vary from low too high in their sensitivity to changes to prey availability depending on their diet and foraging behaviour. However, any changes to the distribution of seabird prey species and habitat during the operation of the Project as a result of EMFs is likely to be minor when considering the size of the Project in relation to each species' total foraging range. Therefore, no LSE is predicted.

8.3 Scapa Flow pSPA

8.3.1 Overview and conservation objectives

The Scapa Flow pSPA is located within the Orkney Islands. Scapa Flow is an enclosed sea area, sheltered by Orkney Mainland to the north, Hoy, South Walls and Flotta to the west and south and Burray and South

Ronaldsay to the east. The Flow is linked to the Pentland Firth on the south through the Sound of Hoxa, and to the Atlantic Ocean on the west through Hoy Sound. The site also includes nearshore waters to the east of Orkney, extending from South Ronaldsay to Deerness and including the sheltered shallow waters of Holm Sound, between Burray and East Mainland.

The conservation objectives for the Scapa Flow marine pSPA are:

'*To avoid deterioration of the habitats of the qualifying species or significant disturbance to the qualifying species, subject to natural change, thus ensuring that the integrity of the site is maintained in the long-term and it continues to make an appropriate contribution to achieving the aims of the Birds Directive for each of the qualifying species.*

This contribution will be achieved through delivering the following objectives for each of the site's qualifying features:

- Avoid significant mortality, injury and disturbance of the qualifying features, so that the distribution of the species and ability to use the site are maintained in the long-term;
- To maintain the habitats and food resources of the qualifying features in favourable condition.'

8.3.2 Assessment of LSE

8.3.2.1 Physical disturbance and/or displacement due to vessel presence (installation / maintenance and repair / decommissioning)

Disturbance during the installation / maintenance and repair / decommissioning of a subsea cable (vessel presence and activity) may displace birds from an area of sea, effectively amounting to habitat loss during the period of disturbance (Drewitt and Langston, 2006). Project activities may directly disturb / displace birds from foraging or loafing areas, thus causing the birds to move elsewhere and potentially affecting breeding productivity or survival rates of an individual or population. A small number of disturbance events will not have an immediate effect on the survival or productivity of an individual bird. Repeated disturbance or disturbance over an extended period can affect the survival and productivity of a bird.

The sensitivity of the qualifying features of the Scapa Flow pSPA to vessel disturbance are outlined in Table 8-5.

Table 8-5 Sensitivity of seabirds to vessel disturbance (1= low, 5 = high) (Wade *et al.*, 2016)

Species	Sensitivity to vessel disturbance
Red-throated diver	5
Great northern diver	4
Slavonian grebe	3
Black-throated diver	5
Goldeneye	4
Common eider	3
Long-tailed duck	3
Red-breasted merganser	n/a
European shag	4

Disturbance would be restricted to the cable installation corridor footprint and at any one time to the immediate vicinity of the project vessels when they are operating. The area of habitat disturbed due to vessel movements is considered to be small in the context of the foraging range of the qualifying features (minimum of 9 km for red throated diver and up to 80 km for common eider; Thaxter *et al.,* 2012).

When operating, the cable lay and trenching vessels will progress relatively slowly and thus seabirds of the species that regularly occur in the area are likely to show a relatively mild disturbance response to them compared to faster moving vessels (Ronconi and Cassady St. Clair, 2002).

Vessel activity will be highly localised as vessels will be slow moving (maximum of a few knots per hour) or static. Disturbance associated with vessel presence / activity is of limited duration and also represents a transient impact as vessels move through an area. Impacts are spatially and temporally restricted and are considered unlikely to affect the breeding productivity or survival rates of an individual or population.

Any disturbance will take place in the context of existing sources of disturbance such as commercial shipping, recreational boating etc, considering the high level of marine vessel traffic the Pentland Firth experiences (see Appendix B: NRA of the EA). There is an existing main traffic route from Scrabster to Stromness that passes closer to the western edge of the Scapa Flow pSPA than the cable route and enters the pSPA at Stromness port. The presence of Project vessels in an already busy area for marine traffic is unlikely to be detectable above existing baseline levels.

In general, it is considered that effects are likely to last only for the duration of installation / maintenance and repair / decommissioning activity, and therefore will be direct, but temporary, reversible and short-term in nature for a specific event. During the work period, birds may return to areas when activities are not currently occurring. Therefore, no LSE is predicted.

8.3.2.2 Disturbance and/or displacement due to increase turbidity in the water column (installation / maintenance and repair / decommissioning)

The cable installation technique has not yet been determined, as such there could be varying degrees of sediment disturbance depending on the technique used and the substrate type. Jetting is considered to produce the worst-case scenario for the production of increased suspended sediment. Coarser fractions up to and including fine sand, ejected from the trench will be raised a few metres from the seafloor, and will be re-deposited within 10 m or less of the cable trench (Gooding *et al.,* 2012). Finer silt fractions will remain in suspension for longer with levels expected to fall to ambient levels within 70 m with fine deposition occurring out to a maximum of 2 km from the trench (Gooding *et al.,* 2012). Far field deposition is predicted to be below 1 mm. Once the cable has been trenched the sediment will resettle over the cable or in the near vicinity of the cable.

This assessment focuses on visual foragers and on the potential impact to their foraging ability. The increase in suspended sediment has the potential to effect visual seabird foragers, yet because the increase will be temporary in nature and the suspended sediment will settle on the seabed (small spatial extent) it is not considered likely there will be a large effect on seabird foraging, especially considering the foraging range of seabirds (minimum of 9 km for red throated diver up to 80 km for common eider; Thaxter *et al.,* 2012) and the alternate foraging habitat available. Furthermore, due to temporary vessel disturbance during cable installation, it is unlikely that the seabirds will be foraging in the direct vicinity of the cable corridor. The impact is considered to be localised in spatial extent, short term in duration, intermittent and with high reversibility. Therefore, no LSE is predicted.

8.3.2.3 Indirect effects on qualifying features due to distribution of prey items (installation / maintenance and repair /decommissioning)

The main impacts on prey species are likely to be as a result of construction noise and physical disturbance from cable installation. Given the mobile nature of fish, potential impacts associated with cable installation and operation are expected to be minimal on the basis that fish can avoid the main area of potential impact.

The habitat flexibility of Scapa Flow pSPA features is listed in Table 8-6. Furness *et al.,* (2013) and subsequently Wade *et al.,* (2016) categorised habitat flexibility from 1 (tend to forage over large marine areas with little known association with particular marine features) to 5 (tend to feed on very specific habitat features, such as shallow banks with bivalve communities, or kelp beds).

Table 8-6 Seabird habitat flexibility (1= high, 5 = low) (Wade *et al.*, 2016)

Species	Sensitivity to vessel disturbance
Red-throated diver	4
Great northern diver	3
Slavonian grebe	4
Black-throated diver	4
Goldeneye	4
Common eider	4
Long-tailed duck	4
Red-breasted merganser	n/a
European shag	3

Sediment disturbance will be limited to the vicinity of the cable installation operations and no impacts from the low levels of sediments disturbance by trenching activity are expected on fish or shellfish receptors. The Project will have a relatively limited footprint within the cable corridor itself so loss of, or damage to supporting habitat is likely to be insignificant. Any disturbed sediment is expected to be rapidly dispersed by tidal currents. Data from Coull *et al.,* (1998), Ellis *et al.,* (2012) and the Scottish Governments Updated Fisheries Sensitivity Maps indicates that it is unlikely that any key spawning grounds are present in the project vicinity. Potential impacts on any spawning grounds associated with direct seabed disturbance during cable installation will be limited to the working corridor.

With respect to underwater noise, given the limited number of vessels expected to be involved in any seabed preparation and cable installation activities and the short duration and temporary nature of cable installation activities, the potential for significant impacts on prey species is considered to be minimal.

Considering the localised, temporary, irregular and reversible disturbance to the habitat of seabird prey species and the overall foraging range for each qualifying features of the Scapa Flow pSPA no LSE is predicted.

8.3.2.4 Indirect effects on prey species due to EMF (Operation)

Electromagnetic fields (EMF) emissions are generated from the transmission of electricity through subsea cables. The cables produce electromagnetic fields which have both electric (E) measured in volts per metre (V m-1) and magnetic components (B) measured in micro tesla (μT). While the direct electric field is mostly blocked with the use of conductive sheathing, the magnetic field penetrates most materials and therefore are emitted into the marine environment with the resultant induced electric (iE) field. EMFs have the potential to affect seabird prey species who are sensitive to magnetic and electrical fields.

It is commonly recommended that cable burial is used to increase the distance between the cable and the EMF sensitive species (Gill *et al.,* 2005; DECC, 2011). However, where burial is not an option due to the nature of the seabed, cable protection, e.g. concrete mattresses or rock placement can also be used to increase the distance between marine species sensitive to EMF and the EMF source. Where cables are buried to a depth of 1 m, the predicted magnetic field strength at the seabed is expected to be below the earth's magnetic field (assumed to be 50 μT) (MORL, 2012) and not detectable by elasmobranch or EMF sensitive species (fish and crustaceans). Given that the cable will be buried or protected for the majority of its length (in line with SHE Transmission overarching objective for installation of subsea cable and in accordance with National Marine Plan Policy) the potential for significant impacts due to EMF emissions are minimal and unlikely to occur.

In general, teleost fishes are not believed to be electrically sensitive except weakly electric fish, such as electric catfishes or knifefishes. There is significant evidence of teleost fishes possessing magnetic receptors and there is evidence that certain fish species orientate in relation to magnetic fields. However, it is not known whether their natural behaviour would be affected by EMF's from sub-sea cables. Bochert & Zettler (2004) found no significant effects of static magnetic fields upon flounder, *Platichthys flesus*. Swedpower (2003) found no measurable impact of subjecting salmon and trout to magnetic fields twice the magnitude of the geomagnetic field. The European eel (*Anguilla anguilla*), has been suggested to deviate temporarily from its migration course in the presence of a 5 μT magnetic field 60 m from a HVDC cable; however, the spatial resolution of the

tracking was too low to draw any firm conclusions (Westerberg 2000; Ohman *et al.,* 2007). The temporary and small-scale nature of such effects would suggest it is unlikely that key functions such as breeding or feeding success would be adversely affected. Benthic species are more likely to encounter elevated magnetic fields and are possibly able to detect them even at distances at which they fall below the geomagnetic field (Westerberg 2000; Meyer *et al.,* 2004).

The only evidence of physiological effects on demersal fish relates to fish embryonic development, which has been shown to be delayed by AC magnetic fields of 1 to 100μT (Cameron et al., 1985; Cameron et al., 1993). It is considered unlikely that any key spawning grounds are present in the project vicinity and therefore the potential for EMFs to affect eggs or embryos is considered low.

Seabirds vary from low too high in their sensitivity to changes to prey availability depending on their diet and foraging behaviour. However, any changes to the distribution of seabird prey species and habitat during the operation of the Project as a result of EMFs is likely to be minor when considering the size of the Project in relation to each species' total foraging range. Therefore, no LSE is predicted.

8.4 Caithness and Sutherland Pentlands SPA

8.4.1 Overview and conservation objectives

The Caithness & Sutherland Peatlands are located across the northernmost parts of mainland Scotland. The SPA contains a large proportion of these peatlands, which form one of the largest and most intact areas of blanket bog in the world. The peatlands include an exceptionally wide range of vegetation and surface pattern types (pool systems), some of which are unknown elsewhere. This range of structurally diverse peatland and freshwater habitats supports a wide variety of breeding birds including internationally important populations of raptors, wildfowl and waders.

The conservation objectives for the site are as follows:

'*To avoid deterioration of the habitats of the qualifying species (listed below) or significant disturbance to the qualifying species, thus ensuring that the integrity of the site is maintained; and*

To ensure for the qualifying species that the following are maintained in the long term:

- *Population of the species as a viable component of the site.*
- *Distribution of the species within site.*
- *Distribution and extent of habitats supporting the species.*
- *Structure, function and supporting processes of habitats supporting the species.*
- *No significant disturbance of the species'*.

8.4.2 Assessment of LSE

8.4.2.1 Physical disturbance and/or displacement due to vessel presence (installation / maintenance and repair / decommissioning)

Disturbance during the installation / maintenance and repair / decommissioning of a subsea cable (vessel presence and activity) may displace birds from an area of sea, effectively amounting to habitat loss during the period of disturbance (Drewitt and Langston, 2006). Project activities may directly disturb / displace birds from foraging or loafing areas, thus causing the birds to move elsewhere and potentially affecting breeding productivity or survival rates of an individual or population. A small number of disturbance events will not have an immediate effect on the survival or productivity of an individual bird. Repeated disturbance or disturbance over an extended period can affect the survival and productivity of a bird.

Wade *et al.,* (2016) classified red-throated diver as highly sensitive to vessel disturbance (4 out of 5). Disturbance would be restricted to the cable installation corridor footprint and at any one time to the immediate vicinity of the project vessels when they are operating. The area of habitat disturbed due to vessel movements is considered to be small in the context of the foraging range of the qualifying features (minimum of 9 km for

red throated diver; Thaxter *et al.,* 2012). Disturbance associated with vessel presence / activity is of limited duration and also represents a transient impact as vessels move through an area. Impacts are spatially and temporally restricted and are considered unlikely to affect the breeding productivity or survival rates of an individual or population.

The Caithness and Sutherland Pentlands SPA has a total area of 145,516 ha stretching across the north of Scotland. Vessel activity will be highly localised as vessels will be slow moving (maximum of a few knots per hour) or static. Any disturbance will take place in the context of existing sources of disturbance such as commercial shipping, recreational boating etc, considering the high level of marine vessel traffic the Pentland Firth experiences (see Appendix B: NRA of the EA).

In general, it is considered that effects are likely to last only for the duration of installation / maintenance and repair / decommissioning activity, and therefore will be direct, but temporary, reversible and short-term in nature for a specific event. During the work period, birds may return to areas when activities are not currently occurring. Therefore, no LSE is predicted.

8.4.2.2 Disturbance and/or displacement due to increase turbidity in the water column (installation / maintenance and repair /decommissioning)

The cable installation technique has not yet been determined, as such there could be varying degrees of sediment disturbance depending on the technique used and the substrate type. Jetting is considered to produce the worst-case scenario for the production of increased suspended sediment. Coarser fractions up to and including fine sand, ejected from the trench will be raised a few metres from the seafloor, and will be re-deposited within 10 m or less of the cable trench (Gooding *et al.,* 2012). Finer silt fractions will remain in suspension for longer with levels expected to fall to ambient levels within 70 m with fine deposition occurring out to a maximum of 2 km from the trench (Gooding *et al.,* 2012). Far field deposition is predicted to be below 1 mm. Once the cable has been trenched the sediment will resettle over the cable or in the near vicinity of the cable.

This assessment focuses on visual foragers and on the potential impact to their foraging ability. Red-throated diver were identified as having moderate sensitivity to increases in turbidity (Cook and Burton, 2010).The increase in suspended sediment has the potential to effect visual seabird foragers, yet because the increase will be temporary in nature and the suspended sediment will settle on the seabed (small spatial extent) it is not considered likely there will be a large effect on seabird foraging, especially considering the foraging range of seabirds (minimum of 9 km for red throated diver; Thaxter *et al.,* 2012) and the alternate foraging habitat available. Furthermore, due to temporary vessel disturbance during cable installation, it is unlikely that the seabirds will be foraging in the direct vicinity of the cable corridor. The impact is considered to be localised in spatial extent, short term in duration, intermittent and with high reversibility. Therefore, no LSE is predicted.

8.4.2.3 Indirect effects on qualifying features due to distribution of prey items (installation / maintenance and repair / decommissioning)

The main impacts on prey species are likely to be as a result of construction noise and physical disturbance from cable installation. Given the mobile nature of fish, potential impacts associated with cable installation and operation are expected to be minimal on the basis that fish can avoid the main area of potential impact.

Wade *et al.,* (2016) classified the habitat flexibility of red-throated diver as low (4) with 1 being tend to forage over large marine areas with little known association with particular marine features and 5 being tend to feed on very specific habitat features, such as shallow banks with bivalve communities, or kelp beds.

Sediment disturbance will be limited to the vicinity of the cable installation operations and no impacts from the low levels of sediments disturbance by trenching activity are expected on fish or shellfish receptors. The Project will have a relatively limited footprint within the cable corridor itself so loss of, or damage to supporting habitat is likely to be insignificant. Any disturbed sediment is expected to be rapidly dispersed by tidal currents. Data from Coull *et al.,* (1998), Ellis *et al.,* (2012) and the Scottish Governments Updated Fisheries Sensitivity Maps indicates that it is unlikely that any key spawning grounds are present in the project vicinity. Potential impacts on any spawning grounds associated with direct seabed disturbance during cable installation will be limited to the working corridor.

With respect to underwater noise, given the limited number of vessels expected to be involved in any seabed preparation and cable installation activities (estimated two vessels – cable lay vessel and guard vessel) and the short duration and temporary nature of cable installation activities, the potential for significant impacts on prey species is considered to be minimal.

Considering the localised, temporary, irregular and reversible disturbance to the habitat of seabird prey species and the overall foraging range for each qualifying feature of the Caithness and Sutherland Peatlands SPA no LSE is predicted.

8.4.2.4 Indirect effects on prey species due to EMF (Operation)

Electromagnetic fields (EMF) emissions are generated from the transmission of electricity through subsea cables. The cables produce electromagnetic fields which have both electric (E) measured in volts per metre (V m-1) and magnetic components (B) measured in micro tesla (μT). While the direct electric field is mostly blocked with the use of conductive sheathing, the magnetic field penetrates most materials and therefore are emitted into the marine environment with the resultant induced electric (iE) field. EMFs have the potential to affect seabird prey species who are sensitive to magnetic and electrical fields.

It is commonly recommended that cable burial is used to increase the distance between the cable and the EMF sensitive species (Gill *et al.,* 2005; DECC, 2011). However, where burial is not an option due to the nature of the seabed, cable protection, e.g. concrete mattresses or rock placement can also be used to increase the distance between marine species sensitive to EMF and the EMF source. Where cables are buried to a depth of 1 m, the predicted magnetic field strength at the seabed is expected to be below the earth's magnetic field (assumed to be 50 μT) (MORL, 2012) and not detectable by elasmobranch or EMF sensitive species (fish and crustaceans). Given that the cable will be buried or protected for the majority of its length (in line with SHE Transmission overarching objective for installation of subsea cable and in accordance with National Marine Plan Policy) the potential for significant impacts due to EMF emissions are minimal and unlikely to occur.

In general, teleost fishes are not believed to be electrically sensitive except weakly electric fish, such as electric catfishes or knifefishes. There is significant evidence of teleost fishes possessing magnetic receptors and there is evidence that certain fish species orientate in relation to magnetic fields. However, it is not known whether their natural behaviour would be affected by EMF's from sub-sea cables. Bochert & Zettler (2004) found no significant effects of static magnetic fields upon flounder, *Platichthys flesus*. Swedpower (2003) found no measurable impact of subjecting salmon and trout to magnetic fields twice the magnitude of the geomagnetic field. The European eel (*Anguilla anguilla*), has been suggested to deviate temporarily from its migration course in the presence of a 5 μT magnetic field 60 m from a HVDC cable; however, the spatial resolution of the tracking was too low to draw any firm conclusions (Westerberg 2000; Ohman *et al.,* 2007). The temporary and small-scale nature of such effects would suggest it is unlikely that key functions such as breeding or feeding success would be adversely affected. Benthic species are more likely to encounter elevated magnetic fields and are possibly able to detect them even at distances at which they fall below the geomagnetic field (Westerberg 2000; Meyer *et al.,* 2004).

The only evidence of physiological effects on demersal fish relates to fish embryonic development, which has been shown to be delayed by AC magnetic fields of 1 to 100μT (Cameron *et al.,* 1985; Cameron *et al.,* 1993). It is considered unlikely that any key spawning grounds are present in the project vicinity and therefore the potential for EMFs to affect eggs or embryos is considered low.

Red-throated diver have a high sensitivity to changes to prey availability. However, any changes to the distribution of seabird prey species and habitat during the operation of the Project as a result of EMFs is likely to be minor when considering the size of the Project in relation to each species' total foraging range. Therefore, no LSE is predicted.

8.5 Orkney Mainland Moors SPA

8.5.1 Overview and conservation objectives

Orkney Mainland Moors SPA comprises four areas of moorland on the island of Mainland in the Orkney archipelago of northern Scotland. The predominant habitats include extensive areas of blanket bog, acid grassland, wet and dry heath, raised-mire and calcareous valley mire. The presence of extensive moorland

provides nesting opportunities for an assemblage of moorland breeding birds, including Hen Harrier *Circus cyaneus* and Short-eared Owl *Asio flammeus*. Sheltered river valleys and dales support Willow Salix spp. scrub, tall-herb and flush vegetation, and there are several scattered oligotrophic lochans present on part of the SPA, which provide important breeding areas for Red-throated Diver *Gavia stellata*.

The conservation objectives for the site are as follows:

'*To avoid deterioration of the habitats of the qualifying species (listed below) or significant disturbance to the qualifying species, thus ensuring that the integrity of the site is maintained; and*

To ensure for the qualifying species that the following are maintained in the long term:

- *Population of the species as a viable component of the site.*
- *Distribution of the species within site.*
- *Distribution and extent of habitats supporting the species.*
- *Structure, function and supporting processes of habitats supporting the species.*
- *No significant disturbance of the species'*.

8.5.2 Assessment of LSE

8.5.2.1 Physical disturbance and/or displacement due to vessel presence (installation / maintenance and repair / decommissioning)

Disturbance during the installation / maintenance and repair / decommissioning of a subsea cable (vessel presence and activity) may displace birds from an area of sea, effectively amounting to habitat loss during the period of disturbance (Drewitt and Langston, 2006). Project activities may directly disturb / displace birds from foraging or loafing areas, thus causing the birds to move elsewhere and potentially affecting breeding productivity or survival rates of an individual or population. A small number of disturbance events will not have an immediate effect on the survival or productivity of an individual bird. Repeated disturbance or disturbance over an extended period can affect the survival and productivity of a bird.

Wade *et al.,* (2016) classified red-throated diver as highly sensitive to vessel disturbance (4 out of 5). Disturbance would be restricted to the cable installation corridor footprint and at any one time to the immediate vicinity of the project vessels when they are operating. The area of habitat disturbed due to vessel movements is considered to be small in the context of the foraging range of the qualifying features (minimum of 9 km for red throated diver; Thaxter *et al.,* 2012). Disturbance associated with vessel presence / activity is of limited duration and also represents a transient impact as vessels move through an area. Impacts are spatially and temporally restricted and are considered unlikely to affect the breeding productivity or survival rates of an individual or population.

Vessel activity will be highly localised as vessels will be slow moving (maximum of a few knots per hour) or static. Any disturbance will take place in the context of existing sources of disturbance such as commercial shipping, recreational boating etc, considering the high level of marine vessel traffic the Pentland Firth experiences (see Appendix B: NRA of the EA).

In general, it is considered that effects are likely to last only for the duration of installation / maintenance and repair / decommissioning activity, and therefore will be direct, but temporary, reversible and short-term in nature for a specific event. During the work period, birds may return to areas when activities are not currently occurring. Therefore, no LSE is predicted.

8.5.2.2 Disturbance and/or displacement due to increase turbidity in the water column (installation / maintenance and repair / decommissioning)

The cable installation technique has not yet been determined, as such there could be varying degrees of sediment disturbance depending on the technique used and the substrate type. Jetting is considered to produce the worst-case scenario for the production of increased suspended sediment. Coarser fractions up to and including fine sand, ejected from the trench will be raised a few metres from the seafloor, and will be re-deposited within 10 m or less of the cable trench (Gooding *et al.,* 2012). Finer silt fractions will remain in

suspension for longer with levels expected to fall to ambient levels within 70 m with fine deposition occurring out to a maximum of 2 km from the trench (Gooding *et al.,* 2012). Far field deposition is predicted to be below 1 mm. Once the cable has been trenched the sediment will resettle over the cable or in the near vicinity of the cable.

This assessment focuses on visual foragers and on the potential impact to their foraging ability. Red-throated diver were identified as having moderate sensitivity to increases in turbidity (Cook and Burton, 2010). The increase in suspended sediment has the potential to effect visual seabird foragers, yet because the increase will be temporary in nature and the suspended sediment will settle on the seabed (small spatial extent) it is not considered likely there will be a large effect on seabird foraging, especially considering the foraging range of seabirds (minimum of 9 km for red throated diver up to 400 ± 246 km for fulmar; Thaxter *et al.,* 2012) and the alternate foraging habitat available. Furthermore, due to temporary vessel disturbance during cable installation, it is unlikely that the seabirds will be foraging in the direct vicinity of the cable corridor. The impact is considered localised in spatial extent, short term in duration, intermittent and with high reversibility. Therefore, no LSE is predicted.

8.5.2.3 Indirect effects on qualifying features due to distribution of prey items (installation / maintenance and repair / decommissioning)

The main impacts on prey species are likely to be as a result of construction noise and physical disturbance from cable installation. Given the mobile nature of fish, potential impacts associated with cable installation and operation are expected to be minimal on the basis that fish can avoid the main area of potential impact.

Wade *et al.,* (2016) classified the habitat flexibility of red-throated diver as low with 1 being tend to forage over large marine areas with little known association with particular marine features and 5 being tend to feed on very specific habitat features, such as shallow banks with bivalve communities, or kelp beds.

Sediment disturbance will be limited to the vicinity of the cable installation operations and no impacts from the low levels of sediments disturbance by trenching activity are expected on fish or shellfish receptors. The Project will have a relatively limited footprint within the cable corridor itself so loss of, or damage to supporting habitat is likely to be insignificant. Any disturbed sediment is expected to be rapidly dispersed by tidal currents. Data from Coull *et al.,* (1998), Ellis *et al.,* (2012) and the Scottish Governments Updated Fisheries Sensitivity Maps indicates that it is unlikely that any key spawning grounds are present in the project vicinity. Potential impacts on any spawning grounds associated with direct seabed disturbance during cable installation will be limited to the working corridor.

With respect to underwater noise, given the limited number of vessels expected to be involved in any seabed preparation and cable installation activities (estimated two vessels – cable lay vessel and guard vessel) and the short duration and temporary nature of cable installation activities, the potential for significant impacts on prey species is considered to be minimal.

Considering the localised, temporary, irregular and reversible disturbance to the habitat of seabird prey species and the overall foraging range for each qualifying feature of Orkney Mainland Moors SPA no LSE is predicted.

8.5.2.4 Indirect effects on prey species due to EMF (Operation)

Electromagnetic fields (EMF) emissions are generated from the transmission of electricity through subsea cables. The cables produce electromagnetic fields which have both electric (E) measured in volts per metre (V m-1) and magnetic components (B) measured in micro tesla (μT). While the direct electric field is mostly blocked with the use of conductive sheathing, the magnetic field penetrates most materials and therefore are emitted into the marine environment with the resultant induced electric (iE) field. EMFs have the potential to affect seabird prey species who are sensitive to magnetic and electrical fields.

It is commonly recommended that cable burial is used to increase the distance between the cable and the EMF sensitive species (Gill *et al.,* 2005; DECC, 2011). However, where burial is not an option due to the nature of the seabed, cable protection, e.g. concrete mattresses or rock placement can also be used to increase the distance between marine species sensitive to EMF and the EMF source. Where cables are buried to a depth of 1 m, the predicted magnetic field strength at the seabed is expected to be below the earth's magnetic field (assumed to be 50 μT) (MORL, 2012) and not detectable by elasmobranch or EMF sensitive species (fish and crustaceans). Given that the cable will be buried or protected for the majority of its length (in line with SHE

Transmission overarching objective for installation of subsea cable and in accordance with National Marine Plan Policy) the potential for significant impacts due to EMF emissions are minimal and unlikely to occur.

In general, teleost fishes are not believed to be electrically sensitive except weakly electric fish, such as electric catfishes or knifefishes. There is significant evidence of teleost fishes possessing magnetic receptors and there is evidence that certain fish species orientate in relation to magnetic fields. However, it is not known whether their natural behaviour would be affected by EMF's from sub-sea cables. Bochert & Zettler (2004) found no significant effects of static magnetic fields upon flounder, *Platichthys flesus*. Swedpower (2003) found no measurable impact of subjecting salmon and trout to magnetic fields twice the magnitude of the geomagnetic field. The European eel (*Anguilla anguilla*), has been suggested to deviate temporarily from its migration course in the presence of a 5 µT magnetic field 60 m from a HVDC cable; however, the spatial resolution of the tracking was too low to draw any firm conclusions (Westerberg 2000; Ohman *et al.,* 2007). The temporary and small-scale nature of such effects would suggest it is unlikely that key functions such as breeding or feeding success would be adversely affected. Benthic species are more likely to encounter elevated magnetic fields and are possibly able to detect them even at distances at which they fall below the geomagnetic field (Westerberg 2000; Meyer *et al.,* 2004).

The only evidence of physiological effects on demersal fish relates to fish embryonic development, which has been shown to be delayed by AC magnetic fields of 1 to 100µT (Cameron et al., 1985; Cameron et al., 1993). It is considered unlikely that any key spawning grounds are present in the project vicinity and therefore the potential for EMFs to affect eggs or embryos is considered low.

Seabirds vary from low too high in their sensitivity to changes to prey availability depending on their diet and foraging behaviour. However, any changes to the distribution of seabird prey species and habitat during the operation of the Project as a result of EMFs is likely to be minor when considering the size of the Project in relation to each species' total foraging range. Therefore, no LSE is predicted.

8.6 In-combination screening assessment

Two projects have been identified that have a shared pathway of effect: the Dounreay Tri floating offshore wind demonstration project and the Katanes Floating Energy Park (see Table 8-7). Both projects are in the vicinity of the North Caithness Cliffs SPA and the Caithness and Sutherland Pentlands SPA. No projects have been identified in proximity to the Orkney landfall and therefore there is considered to be no in-combination effect to Hoy SPA, Scapa Flow SPA or the Orkney Mainland Moors SPA.

Table 8-7 Projects considered within the ornithology in-combination screening assessment

Project name	Phase	Distance from installation corridor	Common pressure
Dounreay Tri floating offshore wind demonstration project	Consented – on hold	7.2	Physical disturbance and/or displacement
Katanes Floating Energy Park	Planning	9	Physical disturbance and/or displacement

The shared pathway of effect is through the temporary disturbance or displacement due to vessel presence, which may cumulatively disturb foraging seabirds. The Project vessel activity will be highly localised as cable laying vessels are static for extended periods of time and move only short distances as cable installation is taking place. As the presence of vessels in any one location is temporary, it is assumed that birds will soon return to the area from which they were displaced therefore reducing the temporal extent of the impact. Any disturbance from Project activities will be highly localised, temporary and short-term.

The Dounreay Tri floating offshore wind demonstration project is current on hold following Dounreay Tri Ltd. entering administration in 2017, therefore the likelihood of the project moving forward in a timeframe that overlaps with the Project is low. Dounreay Tri floating offshore wind demonstration project environmental statement considered the disturbance of birds within the ES as a negligible impact. The Katanes Floating Energy Park received an EIA Screening Opinion from Marine Scotland in 2017. As such there is limited

information available publicly to inform an in-combination assessment. Due to the small scale of the Project, disturbance to seabirds is likely to be limited.

As such it is considered that there is no potential LSE for the in-combination effect of temporary physical disturbance/displacement.

8.7 Conclusions

A summary of the Project's screening assessment on protected sites with seabird features is listed features is shown in Table 8-8. The assessment indicates that no LSE has been identified on the Hoy SPA, North Caithness Cliffs SPA, Scapa Flow pSPA, Caithness and Sutherland Pentlands SPA and the Orkney Mainland Moors SPA.

Table 8-8 Summary of potential for LSE for protected sites with seabird features

Site and species	Potential effect	Conclusion
Hoy SPA - Red-throated diver, Peregrine, Great skua, Great black-backed gull, Guillemot, Kittiwake, Fulmar, Puffin, Arctic skua	Physical disturbance and/or displacement due to vessel presence (installation / maintenance and repair / decommissioning).	No LSE
	Disturbance and/or displacement due to increase turbidity in the water column (installation / maintenance and repair / decommissioning).	No LSE
	Indirect effects on qualifying features due to distribution of prey items (installation / maintenance and repair / decommissioning)	No LSE
	Indirect effects on prey species due to EMF (Operation).	No LSE
North Caithness Cliffs SPA – Peregrine falcon, guillemot, kittiwake, fulmar, puffin, razorbill	Physical disturbance and/or displacement due to vessel presence (installation / maintenance and repair / decommissioning).	No LSE
	Disturbance and/or displacement due to increase turbidity in the water column (installation / maintenance and repair /decommissioning).	No LSE
	Indirect effects on qualifying features due to distribution of prey items (installation / maintenance and repair / decommissioning).	No LSE
	Indirect effects on prey species due to EMF (Operation).	No LSE
Scapa Flow pSPA – red throated diver, great northern diver, Slavonian grebe, black-throated diver, golden eye, common eider, long-tailed duck, red-breasted merganser, European shag.	Physical disturbance and/or displacement due to vessel presence (installation / maintenance and repair / decommissioning).	No LSE
	Disturbance and/or displacement due to increase turbidity in the water column (installation / maintenance and repair / decommissioning)	No LSE
	Indirect effects on qualifying features due to distribution of prey items (installation / maintenance and repair / decommissioning).	No LSE
	Indirect effects on prey species due to EMF (Operation).	No LSE
Caithness and Sutherland Pentlands SPA – Red throated diver	Physical disturbance and/or displacement due to vessel presence (installation / maintenance and repair / decommissioning).	No LSE
	Disturbance and/or displacement due to increase turbidity in the water column (installation / maintenance and repair / decommissioning).	No LSE
	Indirect effects on qualifying features due to distribution of prey items (installation / maintenance and repair / decommissioning).	No LSE
	Indirect effects on prey species due to EMF (Operation).	No LSE
Orkney Mainland Moors SPA – Red throated diver	Physical disturbance and/or displacement due to vessel presence (installation / maintenance and repair / decommissioning).	No LSE
	Disturbance and/or displacement due to increase turbidity in the water column (installation / maintenance and repair / decommissioning).	No LSE
	Indirect effects on qualifying features due to distribution of prey items (installation / maintenance and repair / decommissioning).	No LSE
	Indirect effects on prey species due to EMF (Operation).	No LSE

9 FISH AND SHELLFISH ASSESSMENT OF LSE

9.1 Introduction

Based on the high-level screening criteria outlined in Section 4.2), there may be potential for Atlantic salmon as Annex II qualifying features of the River Thurso SAC, River Borgie SAC and the River Naver SAC to be affected by the Project. The protected sites themselves will not be affected directly by the Project as they are located 12 – 29 km from the installation corridor, but there is evidence that Atlantic salmon use the Pentland first as a migration route between freshwater rivers (Malcolm *et al.*, 2010). Freshwater pearl mussel is also a designated feature of the River Borgie SAC and the River Naver SAC, however this feature would only be impacted indirectly through impacts to Atlantic salmon as its larval host. Therefore, conclusions drawn in relation to Atlantic salmon are applied to freshwater pearl mussel.

9.2 Designated sites

9.2.1 River Thurso

The River Thurso drains a moderately large peatland catchment in Caithness and flows north through a short section of agricultural land before entering the Pentland Firth at the town of Thurso. The river supports a higher proportion of multi sea-winter salmon *Salmo salar* than is found in many rivers further south in the species' range. This is aided by the northerly location of the river and the cooler ambient water temperature, resulting in slower-growing juveniles which smolt at an older age, and tend to return as older multi sea-winter salmon. In addition to these multi sea-winter fish, grilse also return to the River Thurso, meaning that the river supports the full range of salmon life-history types.

The conservation objectives for the site are as follows:

'*To avoid deterioration of the habitats of the qualifying species (listed below) or significant disturbance to the qualifying species, thus ensuring that the integrity of the site is maintained, and the site makes an appropriate contribution to achieving favourable conservation status for each of the qualifying features; and*

To ensure for the qualifying species that the following are maintained in the long term:

- *Population of the species, including range of genetic types, as a viable component of the site.*
- *Distribution of the species within site.*
- *Distribution and extent of habitats supporting the species.*
- *Structure, function and supporting processes of habitats supporting the species.*
- *No significant disturbance of the species'.*

9.2.2 River Borgie

The River Borgie is of international nature conservation importance for its populations of freshwater pearl mussel (*Margaritifera margaritifera*), Atlantic salmon (*Salmo salar*) and Eurasian otter (*Lutra lutra*). The River Borgie lies to the east of the Kyle of Tongue, Highland, running approximately northeastwards from Loch Slaim in the south to the sea at Torrisdale Bay on the north Sutherland coast. The river is one of two major river systems flowing into this bay. The boundary follows the river channel, including shingle and gravel banks, and is subject to change as a result of channel movements.

The conservation objectives for the site are as follows:

'*To avoid deterioration of the habitats of the qualifying species (listed below) or significant disturbance to the qualifying species, thus ensuring that the integrity of the site is maintained, and the site makes an appropriate contribution to achieving favourable conservation status for each of the qualifying features; and*

To ensure for the qualifying species that the following are maintained in the long term:

- *Population of the species, including range of genetic types for salmon, as a viable component of the site.*
- *Distribution of the species within site.*
- *Distribution and extent of habitats supporting the species.*
- *Structure, function and supporting processes of habitats supporting the species.*
- *No significant disturbance of the species.*
- *Distribution and viability of freshwater pearl mussel host species.*
- *Structure, function and supporting processes of habitats supporting freshwater pearl mussel host species'*.

9.2.3 River Naver

The River Naver and its major tributary, the Mallart, flow from a large peatland catchment northward to its mouth on the north coast of Scotland. The site supports a high-quality salmon *Salmo salar* population and, along with the Rivers Borgie and Thurso, is representative of the northerly part of the species' range in the UK. The northern location of the River Naver and the cooler ambient water temperature results in the Atlantic salmon producing a higher proportion of slower-growing parr which smolt at an older age. These fish often return as multi sea-winter salmon (which have spent more than one year at sea). The full range of Atlantic salmon life-history types return to the system, with grilse, spring and summer salmon all being present. The site also scores highly for being relatively free from flow modifications, allowing unhindered migration.

The conservation objectives for the site are as follows:

'*To avoid deterioration of the habitats of the qualifying species (listed below) or significant disturbance to the qualifying species, thus ensuring that the integrity of the site is maintained, and the site makes an appropriate contribution to achieving favourable conservation status for each of the qualifying features; and*

To ensure for the qualifying species that the following are maintained in the long term:

- *Population of the species, including range of genetic types for salmon, as a viable component of the site.*
- *Distribution of the species within site.*
- *Distribution and extent of habitats supporting the species.*
- *Structure, function and supporting processes of habitats supporting the species.*
- *No significant disturbance of the species.*
- *Distribution and viability of freshwater pearl mussel host species.*
- *Structure, function and supporting processes of habitats supporting freshwater pearl mussel host species.*'

9.3 Assessment of LSE

9.3.1 Disturbance to and possible alteration of migration routes due to vessel noise, noise generated during cable installation, maintenance and repair and decommissioning and sediment suspension during cable installation, maintenance and repair and decommissioning.

Given the mobile nature of fish, potential impacts associated with cable installation, maintenance and repair and decommissioning are expected to be minimal on the basis that fish can readily move out of or avoid the main area of potential impact.

There is little systematic information on the routes used by Atlantic salmon to migrate from Scotland to their distant ocean feeding grounds (Shearer, 1992). Post-smolts originating from Scottish rivers use near-shore areas at the start of marine mitigation, however it is currently unknown how migration routes vary from river to river or the duration or extent of their dependence on near and offshore areas (Malcolm *et al.,* 2010).

Installation activities are expected to take place over a relatively short period and vessels will not be in one location for the whole period but will rather traverse the cable route, meaning noise emissions will only occur within a singular location for a brief period. Given the large expanse of comparable marine habitat surrounding the vessel and cable installation operations, it is highly unlikely that Project activities would compromise regional movements. The limited number of vessels expected to be involved in any seabed preparation and cable installation activities (maximum two vessels – cable lay vessel and guard vessel) and the short duration and temporary nature of cable installation activities, the potential for significant impacts on fish is considered to be minimal.

Seabed sediment disturbance from cable installation activities has the potential to generate localised, short term increases in turbidity. The magnitude of the potential impact depends on the variability of ambient turbidity and the environmental variable acting upon introduced sediment suspension from project activities. Any increase in turbidity or suspended sediment levels is expected to be temporary and spatially restricted, given the high-energy environment within which the sediment will be resuspended. Any elevated turbidity in the immediate vicinity of the cable burial will be very short lived.

Taking into account the points above, no LSE is predicted.

9.3.2 Electromagnetic fields affecting migration

Electromagnetic field (EMF) emissions are generated from the transmission of electricity through subsea cables. The cables produce electromagnetic fields which have both electric (E) measured in volts per metre (V m-1) and magnetic components (B) measured in micro tesla (μT). While the direct electric field is mostly blocked with the use of conductive sheathing, the magnetic field penetrates most materials and therefore are emitted into the marine environment with the resultant induced electric (iE) field.

It is commonly recommended that cable burial is used to increase the distance between the cable and the EMF sensitive species (Gill et al., 2005; DECC, 2011). However, where burial is not an option due to nature of seabed cable protection, e.g. concrete mattresses or rock placement can also be used to increase the distance between marine species sensitive to EMF and the EMF source. Where cables are buried to a depth of 1 m, the predicted magnetic field strength at the seabed is expected to be below the earth's magnetic field (assumed to be 50 μT) (MORL, 2012) and not detectable by elasmobranch or EMF sensitive species (fish and crustaceans).

There is significant evidence of teleost fishes possessing magnetic receptors (see Kirschvink 1997 for review) and there is evidence that certain fish species orientate in relation to magnetic fields. However, it is not known whether their natural behaviour would be affected by electromagnetic fields from sub-sea cables. Walker (2001) noted that Atlantic salmon migration in and out of the Baltic Sea, over a number of operating sub-sea HVDC cables, seems to continue unaffected. Swedpower (2003) found no measurable impact of subjecting salmon and trout to magnetic fields twice the magnitude of the geomagnetic field. Studies on post-smolt migration have found swimming depths are typically 1-3 m, but increase up to 6 m, and are therefore unlikely to interact with EMF emissions across the majority of the cable length (Malcolm *et al.,* 2010). Adult salmon also spend the majority of their time close to the water surface (<10 m), limiting exposure to EMF, however they also frequently dive to greater depths (up to 280 m) (Malcolm *et al.,* 2010).

Given that the cable will be buried or protected for the majority of its length (in line with SHE Transmission overarching objective for installation of subsea cable and in accordance with National Marine Plan Policy) the potential for significant impacts due to EMF emissions are minimal and unlikely to occur. Any effects upon fish orientation or migratory behaviour are likely to be small and temporary (due to species mobility). Therefore, no LSE is predicted.

9.4 In-combination screening assessment

All the projects presented in Table 10-1, have the potential to result in an in-combination effect on the River Thurso SAC, River Borgie SAC and the River Naver SAC qualifying features.

Table 9-1 Projects considered within the fish and shellfish in-combination screening assessment

Project name	Phase	Distance from cable corridor (km)	Common pressure
Brough Head Wave Farm	Planned	4.8	Disturbance to and possible alteration of migration routes due to underwater noise, and sediment suspension. Electromagnetic fields affecting migration.
Dounreay Tri project	Consented – on hold	7.2	Disturbance to and possible alteration of migration routes due to underwater noise, and sediment suspension.
European Marine Energy Ccentre (EMEC) Wave Test Facility	Operational	0.7	Disturbance to and possible alteration of migration routes due to underwater noise, and sediment suspension.
Brims Tidal Array	Planned	14.0	Disturbance to and possible alteration of migration routes due to underwater noise, and sediment suspension.
Inner Sound	Planned	26.0	Disturbance to and possible alteration of migration routes due to underwater noise, and sediment suspension.
Ness of Duncansby	Planned	31.7	Disturbance to and possible alteration of migration routes due to underwater noise, and sediment suspension.
Katanes Floating Energy Park	Planned	9.0	Disturbance to and possible alteration of migration routes due to underwater noise, and sediment suspension.
Pentland Firth 1	Operational	1.7	Electromagnetic fields affecting migration
Pentland Firth 2	Operational	1.0	Electromagnetic fields affecting migration
Scrabster Extension	Open	12.1	Disturbance to and possible alteration of migration routes due to underwater noise, and sediment suspension.
Dounreay Microsite	Open	0.2	Disturbance to and possible alteration of migration routes due to underwater noise, and sediment suspension.
Scapa	Open	26.2	Disturbance to and possible alteration of migration routes due to underwater noise, and sediment suspension.
Stromness A	Open	2.4	Disturbance to and possible alteration of migration routes due to underwater noise, and sediment suspension.

The Project installation, maintenance and repair and decommissioning activities have the potential to produce underwater noise which could result in a short term, temporary and transient disturbance to Atlantic salmon. Given the mobile nature of fish and the large expanse of comparable marine habitat surrounding the Project, potential impacts associated with cable installation, maintenance and repair and decommissioning are expected to be minimal on the basis that fish can readily move out of or avoid the main area of potential impact. There will be a rolling 500 m safety zone in existence around the Project vessels. Therefore, overlapping underwater noise disturbance zones from Project and non-project vessels is unlikely. Additionally, as the cable installation activities are scheduled to be completed within a short period of time there will be little opportunity

for overlap with other Project works. There are relatively high levels of prevailing vessel / shipping activity in the area, overall noise emissions from additional vessels is not expected to deviate from ambient noise levels. As such no in-combination LSE is predicted.

Seabed sediment disturbance from cable installation, maintenance and repair and decommissioning activities has the potential to generate localised, short term increases in turbidity. No LSE has been identified from the Project alone as a result of suspended sediment effects fish migration. Any increase in turbidity or suspended sediment levels is expected to be temporary and spatially restricted, given the high-energy environment within which the sediment will be resuspended. As a result, it is highly unlikely that there will be any significant interaction with other projects suspended sediments zone of influence, and no in-combination LSE is predicted.

The Project is in the vicinity of two subsea power cables that also lie north-south across the Pentland Firth. These power cables have the potential to result in an in-combination EMF effect on migrating Atlantic salmon (qualifying features). The project will be buried or protected along the entire length (in line with SHE Transmission overarching objective for installation of a subsea cable), therefore EMF emissions will be minimal and the potential for a significant in-combination effect is unlikely to occur. There is uncertainty around the impact of EMFs on natural behaviour and any EMF effect will be limited in spatial extent and temporary in nature of the effects due to the mobile nature of the receptors. Therefore, no in-combination LSE is predicted.

9.5 Conclusion

A summary of the Project's screening assessment on protected sites with Annex II fish and shellfish species as listed features is shown in Table 9-2. The assessment indicates that no LSE has been identified on the River Thurso SAC, the River Borgie SAC and the River Naver SAC.

Table 9-2 Summary of potential for LSE for protected sites with fish and shellfish features

Protected site	Qualifying feature	Potential effect	Conclusion
River Thurso SAC	Atlantic Salmon	Disturbance to and possible alteration of migration routes due to vessel noise, noise generated during cable installation, maintenance and repair and decommissioning and sediment suspension during cable installation, maintenance and repair and decommissioning.	No LSE
		Electromagnetic fields affecting migration	No LSE
River Borgie SAC	Atlantic Salmon	Disturbance to and possible alteration of migration routes due to vessel noise, noise generated during cable installation and sediment suspension during cable installation, maintenance and repair and decommissioning and sediment suspension during cable installation, maintenance and repair and decommissioning.	No LSE
		Electromagnetic fields affecting migration	No LSE
	Freshwater pearl mussel	Potential impacts are indirect through effects to Altantic Salmon	No LSE
River Naver SAC	Atlantic Salmon	Disturbance to and possible alteration of migration routes due to vessel noise, noise generated during cable installation, maintenance and repair and decommissioning and sediment suspension during cable installation, maintenance and repair and decommissioning.	No LSE
		Electromagnetic fields affecting migration	No LSE

Protected site	Qualifying feature	Potential effect	Conclusion
	Freshwater pearl mussel	Potential impacts are indirect through effects to Altantic Salmon	No LSE

10 MARINE MAMMALS ASSESSMENT OF LSE

10.1 Sanday SAC

Sanday SAC is situated in the north-east of the Orkney archipelago and supports the largest group of harbour seal *Phoca vitulina* at any discrete site in Scotland. The breeding groups, found on intertidal haul-out sites that are unevenly distributed around the Sanday coast, represent over 4% of the UK population. Nearshore kelp beds that surround Sanday are important foraging areas for the seals, and the colony is linked to a very large surrounding population in the Orkney archipelago.

The conservation objectives are as follows:

'*To avoid deterioration of the qualifying habitats (listed below) thus ensuring that the integrity of the site is maintained, and the site makes an appropriate contribution to achieving favourable conservation status for each of the qualifying features; and*

To ensure for the qualifying habitats that the following are maintained in the long term:

- *Extent of the habitat on site.*
- *Distribution of the habitat within site.*
- *Structure and function of the habitat.*
- *Processes supporting the habitat.*
- *Distribution of typical species of the habitat.*
- *Viability of typical species as components of the habitat.*
- *No significant disturbance of typical species of the habitat'*.

10.2 Assessment of LSE

10.2.1 Injury or disturbance from underwater noise

During the installation and decommissioning of the Project, and to a lesser extent during operation inspection surveys or maintenance and repairs, a number of vessels will be used that will have the potential to cause an acoustic disturbance. There will be a small increase in vessel traffic in the area, but it is anticipated that this increase will be temporary, short term in nature and the disturbance will be of limited extent. Studies of cable-lay operations have indicated that noise emissions from rock placement and other such activities are masked by the cable lay vessels themselves (Nedwell and Edwards, 2004). Most of the activities planned are likely to create localised disturbance which are masked by the operational vessels. Therefore, the assessment of injury or disturbance from cable installation operations are taken to be those from their relevant vessels.

Throughout installation, including pre-installation and post-installation, survey activities are expected to take place over a short period prior and following cable installation activities. Prior to the installation of the Project, geophysical surveys (multi-beam echo sounder, sub-bottom profiler and side scan sonar) may be required to re-survey the cable route. Geophysical survey equipment emits a sound source downwards into the water column towards the seabed, a monitor then receives the return signal which is reflected off the seafloor. The primary source of underwater noise which poses a potential risk of injury or disturbance to marine mammals is the sub bottom profiler, which generates sound within the hearing sensitivity range of most pinnipeds. The vertically focused equipment results in a relatively small area of ensonification and the short-term nature of the surveys means the risks are extremely localised (JNCC, 2008). The use of impulsive noise during cable installation will be limited to some MBES and imaging sonar by ROVs / ROTVs and project vessels to monitor the placement of installation equipment and the view the installation work. The sonar imaging equipment on the ROVs / ROTVs will emit very low levels of sound due to the small distances between their sound source and the equipment they are monitoring, and the survey vessel will be slowly moving along the length of the cable route, sound sources will not be static.

Noise modelling presented in Section 11 – Marine Mammals of the EA, shows that none of the permutations of the Project activities generated SEL_{cum} values which exceed the thresholds for the onset of injury for phocid seals and that strong disturbance is only likely to occur within close proximity to project activities (<500 m). However, following best practice procedures Marine Mammal Observers (MMO) and Passive Acoustic Monitoring (PAM) will be deployed on all vessels making emitting noise, (see Section 17 – Schedule of Mitigation of the EA), which will reduce the risk of physical injury and disturbance.

Installation activities (along with both pre-installation and post-installation activities) are expected to take place over a relatively short period and vessels will not be in one location for the whole period but will rather traverse the cable route, meaning noise emissions will only occur within a singular location for a brief period. Given the large expanse of comparable marine habitat surrounding the vessel and cable installation operations, it is highly unlikely that project activities would compromise regional movements, breeding, feeding or other life functions of concurrent marine mammals.

This impact would be temporary and transient in nature, which in conjunction with the highly mobile and wide-ranging nature of marine mammal species is unlikely to cause a negative effect. Therefore, no LSE is predicted.

10.3 In-combination screening assessment

All the projects presented in Table 10-1, have the potential to produce underwater noise, which could result in an in-combination effect on the Sanday SAC and its qualifying features. Project activities such as vessel movements, geophysical surveys and infrastructure installation on the seabed can all result in underwater noise.

Table 10-1 Projects considered within the marine mammal in-combination screening assessment

Project name	Phase	Distance from cable corridor (km)	Common pressure
Brough Head Wave Farm	Planned	4.8	Injury or disturbance from underwater noise
Dounreay Tri project	Consented – on hold	7.2	
European Marine Energy Ccentre (EMEC) Wave Test Facility	Operational	0.7	
Brims Tidal Array	Planned	14.0	
Inner Sound	Planned	26.0	
Ness of Duncansby	Planned	31.7	
Katanes Floating Energy Park	Planned	9.0	
FARICE	Operational	0	
Northern Lights	Operational	0	
Pentland Firth 1	Operational	1.7	
Pentland Firth 2	Operational	1.0	
Scrabster Extension	Open	12.1	
Dounreay Microsite	Open	0.2	
Scapa	Open	26.2	
Stromness A	Open	2.4	

Given the mobile nature of marine mammals there is the potential for harbour seal species associated with the SAC to be affected in areas outside of the Sanday SAC (located approximately 49 km from the Project at the nearest point). Whilst there is the potential for limited noise disturbance from the cable installation, maintenance and repair and decommissioning activities this is not expected to exclude marine mammals across the overall marine area available and hence are unlikely to result in significant in-combination impact in conjunction with other project activities that may be happening at the same time. There will be a rolling 500

m safety zone in existence around the Project vessels. Therefore, overlapping underwater noise disturbance zones from project and non-project vessels are not likely to introduce sufficient noise to result in injury as the noise sources will not overlap significantly. Additionally, as the cable installation activities are scheduled to be completed within a short period of time there will be little opportunity for them to interact with other projects. There are relatively high levels of prevailing vessel / shipping activity in the area, overall noise emissions from additional vessels is not expected to deviate from ambient noise levels. From a geophysical survey perspective, as sub-bottom profilers are highly directional, an animal outside of the direct field of the device (i.e. within 45 m) is unlikely to be exposed to any significant sound energy.

As such it is considered that there is no potential LSE for the in-combination effect of injury and/or disturbance from underwater noise.

10.4 Conclusion

A summary of the Project's screening assessment on protected sites with Annex II marine mammal species as listed features is shown in Table 10-2. The assessment indicates that no LSE has been identified on the Sanday SAC.

Table 10-2 Summary of potential for LSE for protected sites with marine mammal features

Protected site	Qualifying feature	Potential effect	Conclusion
Sanday SAC	Harbour seal	Injury or disturbance from underwater noise	No LSE

11 CONCLUSIONS

The screening assessment identified the following sites for consideration of LSE:

- Hoy SPA;
- North Caithness Cliff SPA;
- Scapa Flow pSPA;
- Orkney Mainland Moors SPA;
- Caithness and Sutherland Peatlands SPA;
- River Thurso SAC;
- River Borgie SAC;
- River Naver SAC; and
- Sanday SAC.

The assessment of potential LSE has concluded that there is no risk to the site of qualifying features of any of the identified sites.

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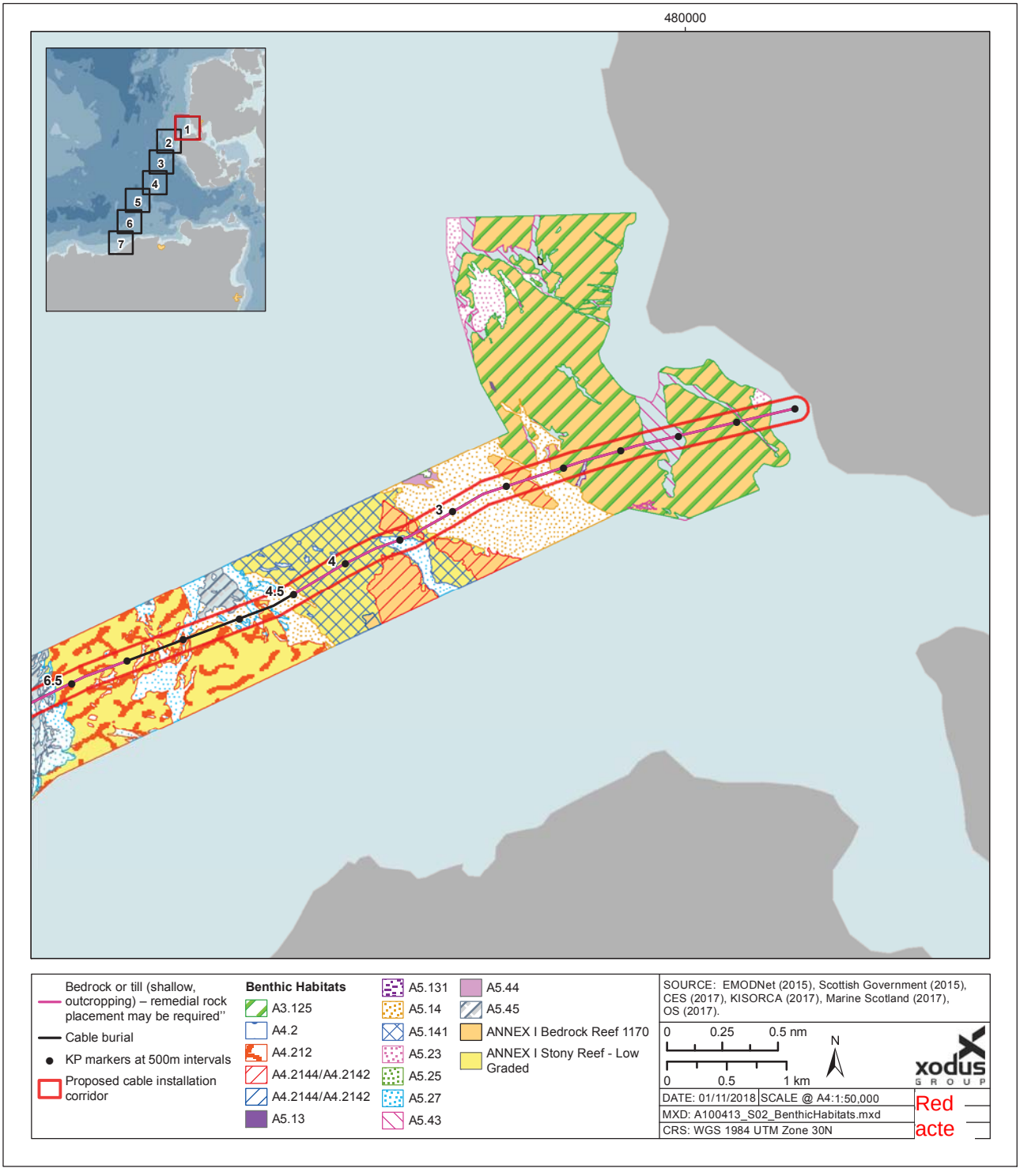
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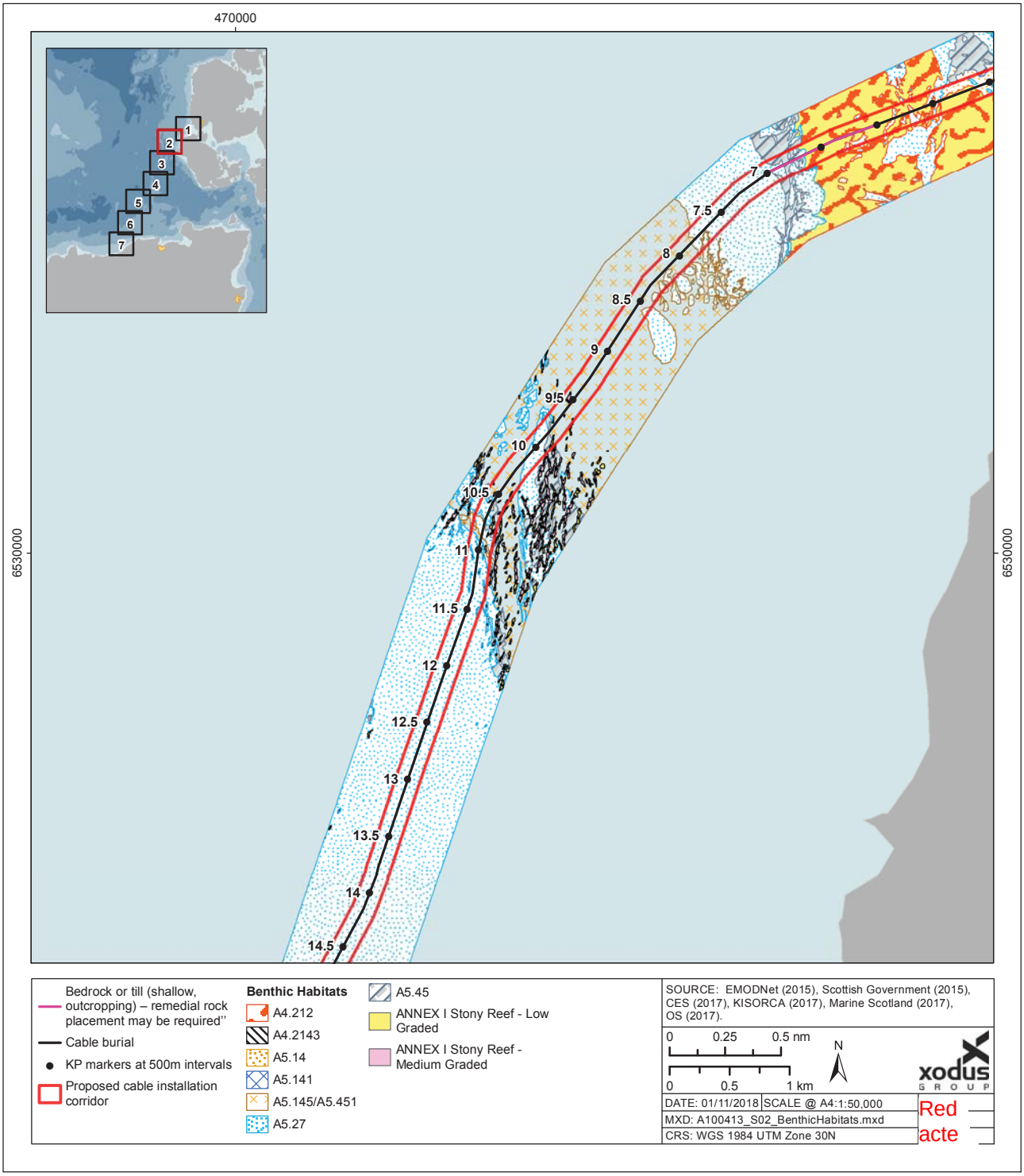
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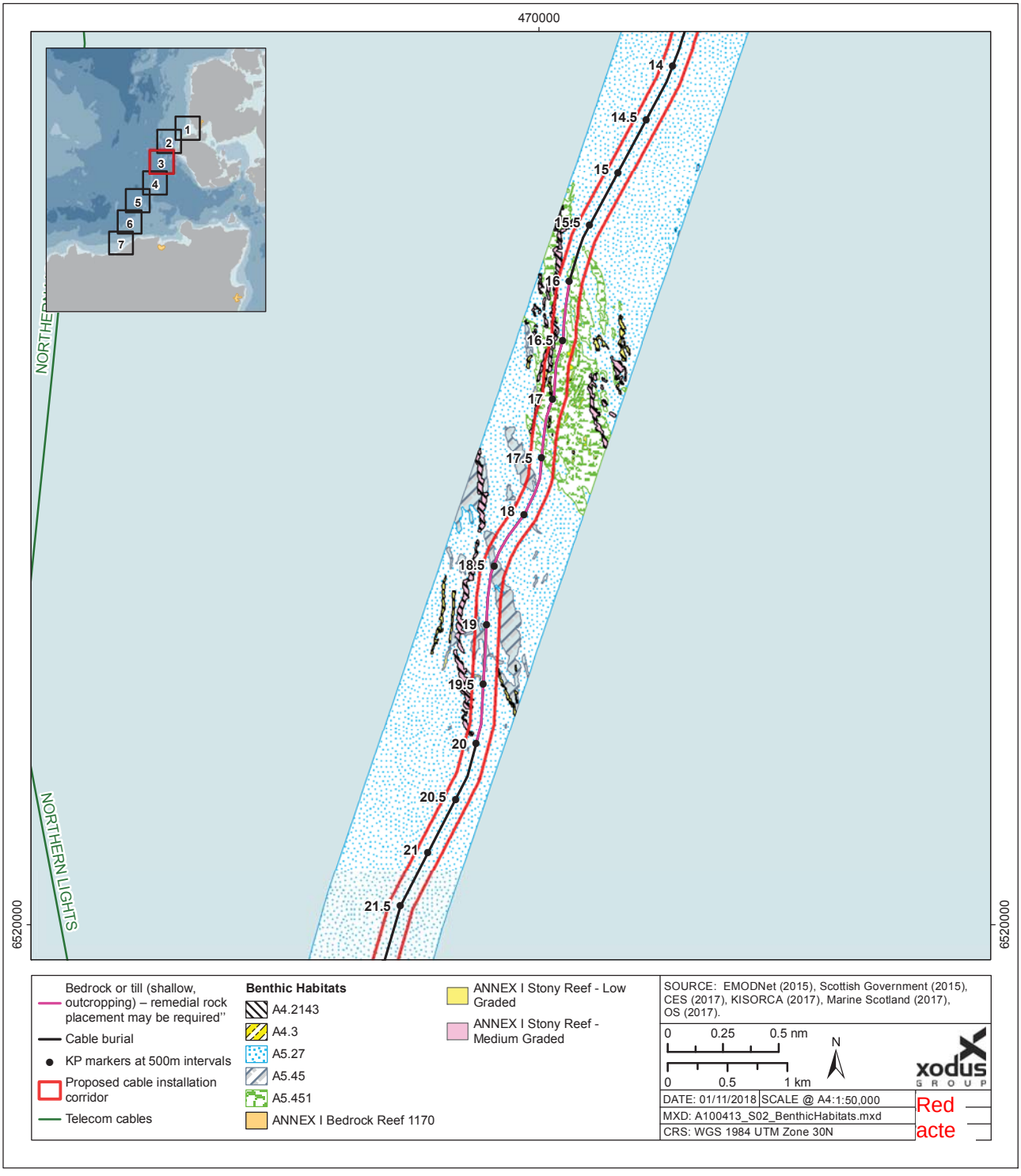
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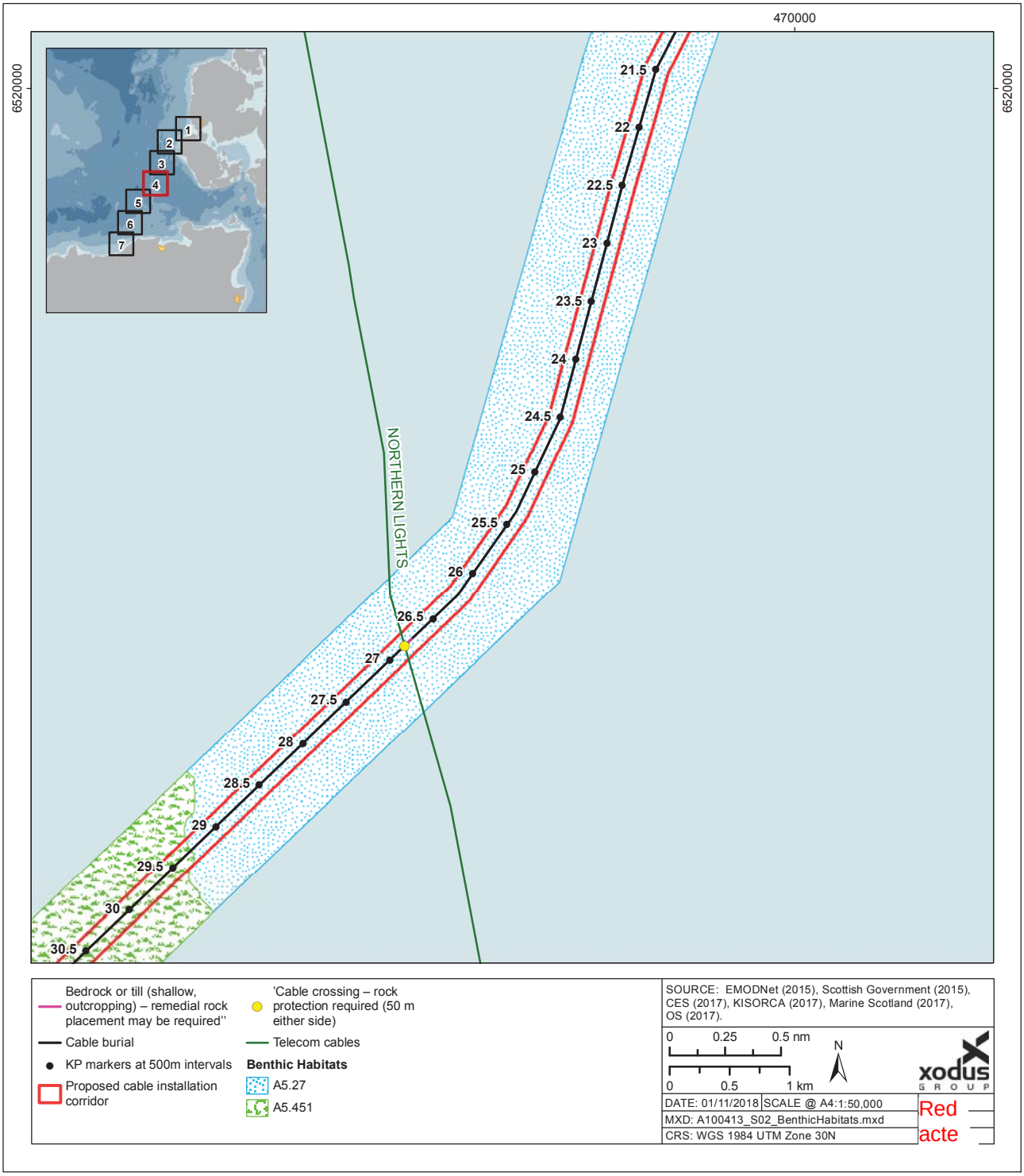
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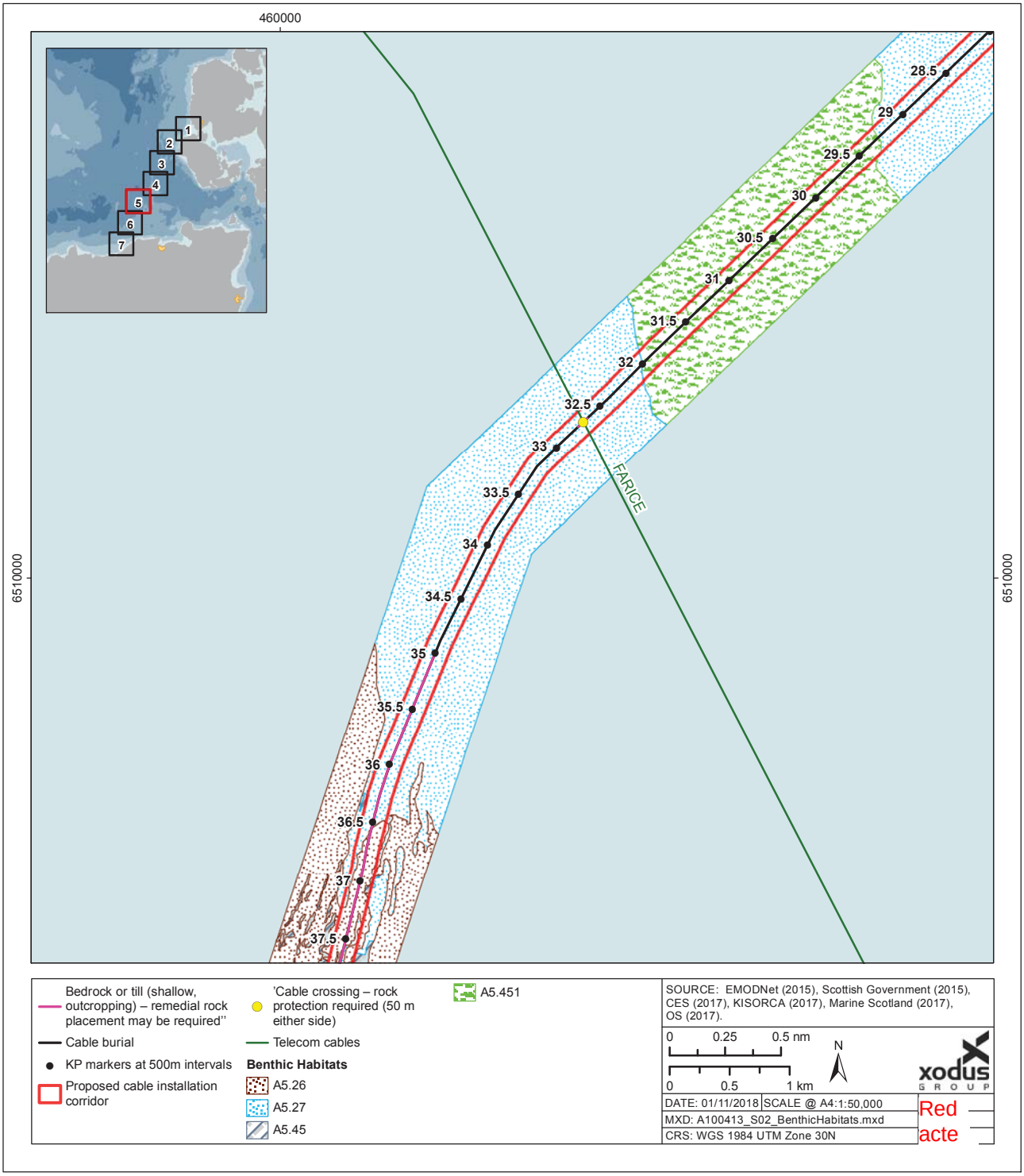
APPENDIX E: BENTHIC HABITATS (HIGH RESOLUTION)

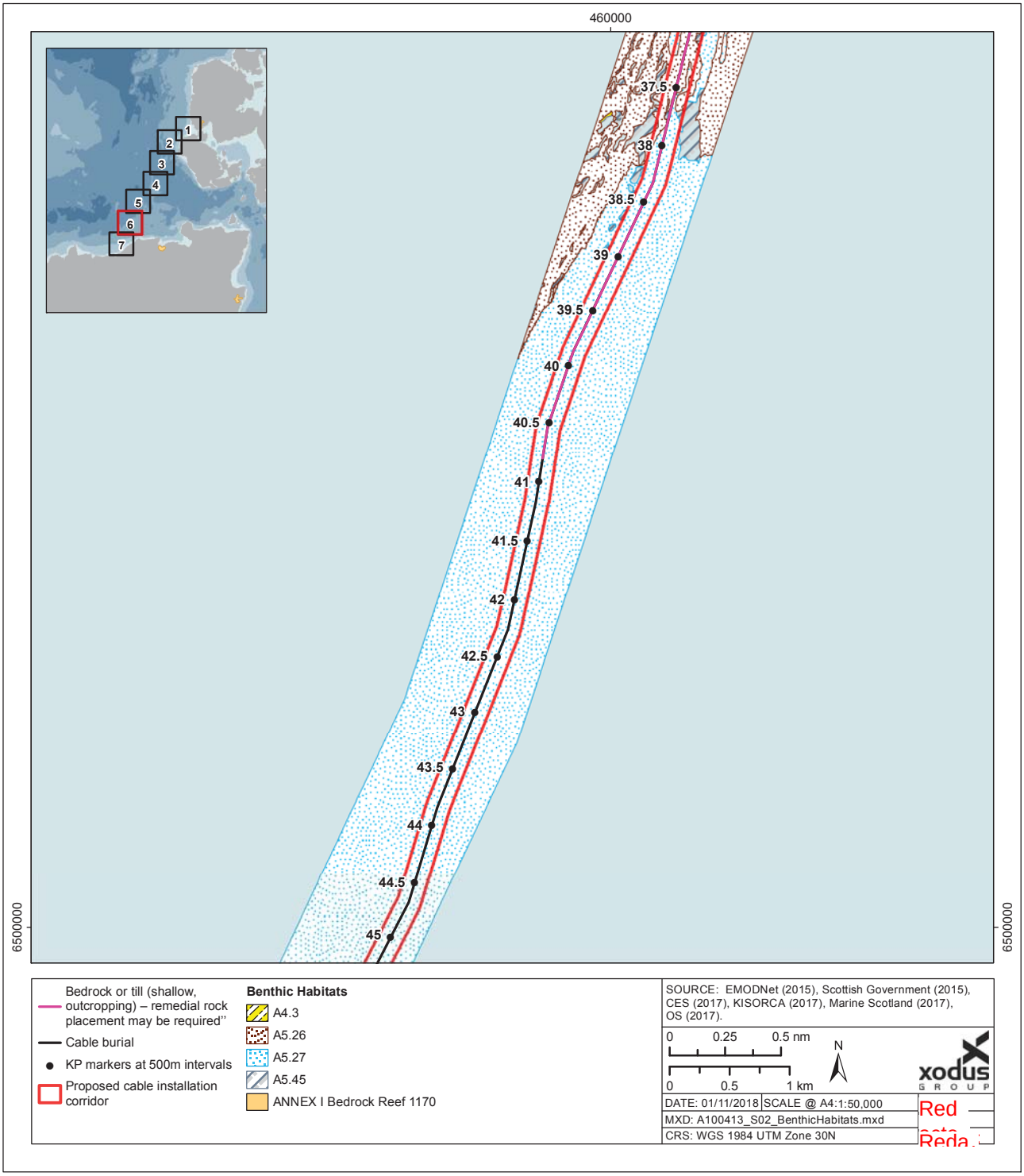

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Bedrock or till (shallow, outcropping) – remedial rock placement may be required"
Cable burial
KP markers at 500m intervals
Proposed cable installation corridor
Benthic Habitats
A3.125
A4.2
A4.212
A4.2144/A4.2142
A4.2144/A4.2142
A5.13
A5.131
A5.14
A5.141
A5.23
A5.25
A5.27
A5.43
A5.44
A5.45
ANNEX I Bedrock Reef 1170
ANNEX I Stony Reef - Low Graded
SOURCE: EMODNet (2015), Scottish Government (2015), CES (2017), KISORCA (2017), Marine Scotland (2017), OS (2017).
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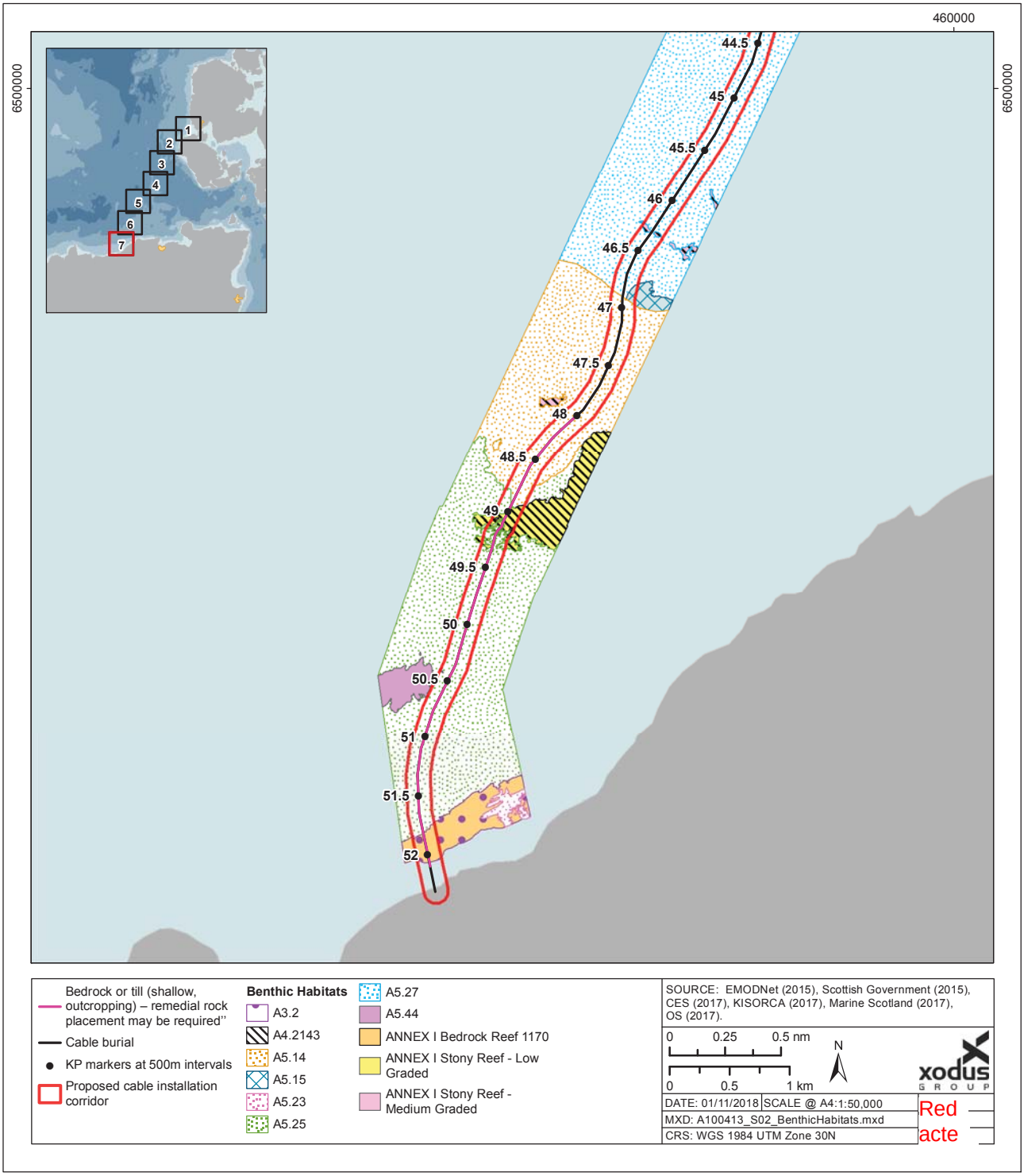

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Bedrock or till (shallow, outcropping) – remedial rock placement may be required"
Cable burial
KP markers at 500m intervals
Proposed cable installation corridor
Benthic Habitats
A4.212
A4.2143
A5.14
A5.141
A5.145/A5.451
A5.27
A5.45
ANNEX I Stony Reef - Low Graded
ANNEX I Stony Reef - Medium Graded
SOURCE: EMODNet (2015), Scottish Government (2015), CES (2017), KISORCA (2017), Marine Scotland (2017), OS (2017).
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Bedrock or till (shallow, outcropping) – remedial rock placement may be required"
Cable burial
KP markers at 500m intervals
Proposed cable installation corridor
Telecom cables
Benthic Habitats
A4.2143
A4.3
A5.27
A5.45
A5.451
ANNEX I Bedrock Reef 1170
ANNEX I Stony Reef - Low Graded
ANNEX I Stony Reef - Medium Graded
SOURCE: EMODNet (2015), Scottish Government (2015), CES (2017), KISORCA (2017), Marine Scotland (2017), OS (2017).
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NORTHERN LIGHTS
Bedrock or till (shallow, outcropping) – remedial rock placement may be required''
Cable burial
KP markers at 500m intervals
Proposed cable installation corridor
'Cable crossing – rock protection required (50 m either side)
Telecom cables
Benthic Habitats
A5.27
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SOURCE: EMODNet (2015), Scottish Government (2015), CES (2017), KISORCA (2017), Marine Scotland (2017), OS (2017).
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Bedrock or till (shallow, outcropping) – remedial rock placement may be required''
Cable burial
KP markers at 500m intervals
Proposed cable installation corridor
'Cable crossing – rock protection required (50 m either side)
Telecom cables
Benthic Habitats
A5.26
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SOURCE: EMODNet (2015), Scottish Government (2015), CES (2017), KISORCA (2017), Marine Scotland (2017), OS (2017).
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DATE: 01/11/2018
SCALE @ A4:1:50,000
MXD: A100413_S02_BenthicHabitats.mxd
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Bedrock or till (shallow, outcropping) – remedial rock placement may be required"
Cable burial
KP markers at 500m intervals
Proposed cable installation corridor
Benthic Habitats
A4.3
A5.26
A5.27
A5.45
ANNEX I Bedrock Reef 1170
SOURCE: EMODNet (2015), Scottish Government (2015), CES (2017), KISORCA (2017), Marine Scotland (2017), OS (2017).
0 0.25 0.5 nm
0 0.5 1 km
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xodus GROUP
DATE: 01/11/2018
SCALE @ A4:1:50,000
MXD: A100413_S02_BenthicHabitats.mxd
CRS: WGS 1984 UTM Zone 30N
Red


460000
6500000
6500000
44.5
45
45.5
46
46.5
47
47.5
48
48.5
49
49.5
50
50.5
51
51.5
52
1
2
3
4
5
6
7
Bedrock or till (shallow, outcropping) – remedial rock placement may be required"
Cable burial
KP markers at 500m intervals
Proposed cable installation corridor
Benthic Habitats
A3.2
A4.2143
A5.14
A5.15
A5.23
A5.25
A5.27
A5.44
ANNEX I Bedrock Reef 1170
ANNEX I Stony Reef - Low Graded
ANNEX I Stony Reef - Medium Graded
SOURCE: EMODNet (2015), Scottish Government (2015), CES (2017), KISORCA (2017), Marine Scotland (2017), OS (2017).
0 0.25 0.5 nm
0 0.5 1 km
N
xodus GROUP
DATE: 01/11/2018
SCALE @ A4:1:50,000
MXD: A100413_S02_BenthicHabitats.mxd
CRS: WGS 1984 UTM Zone 30N
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