Sheringham Shoal and Dudgeon Offshore Wind Farm Extension Projects

Appendix 9.7.3 - Cable Protection Decommissioning Feasibility

August 2022
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Glossary of Acronyms

CSCB	Cromer Shoal Chalk Beds
DCO	Development Consent Order
DEP	Dudgeon Offshore Wind Farm Extension Project
GRP	Glass Reinforced Plastic
HDD	Horizontal Directional Drilling
MCZ	Marine Conservation Zone
ROV	Remotely Operated Vehicle
SEP	Sheringham Shoal Offshore Wind Farm Extension Project

Glossary of Terms

Dudgeon Offshore Wind Farm Extension Project (DEP)	The Dudgeon Offshore Wind Farm Extension onshore and offshore sites including all onshore and offshore infrastructure.
Infield cables	Cables which link the wind turbine generators to the offshore substation platform(s).
Interlink cable corridor	This is the area which will contain the interlink cables between offshore substation platform/s and the adjacent Offshore Temporary Works Area.
Offshore cable corridors	This is the area which will contain the offshore export cables or interlink cables, including the adjacent Offshore Temporary Works Area.
Offshore export cable corridor	This is the area which will contain the offshore export cables between offshore substation platform/s and landfall, including the adjacent Offshore Temporary Works Area.
Offshore export cables	The cables which would bring electricity from the offshore substation platform(s) to the landfall. 220 – 230kV.
Sheringham Shoal Offshore Wind Farm Extension Project (SEP)	The Sheringham Shoal Offshore Wind Farm Extension onshore and offshore sites including all onshore and offshore infrastructure.
The Applicant	Equinor New Energy Limited. As the owners of SEP and DEP, Scira Extension Limited and Dudgeon Extension Limited are the named undertakers that have the benefit of the DCO. References in this document to obligations on, or commitments by, ‘the Applicant’ are given on behalf of SEL and DEL as the undertakers of SEP and DEP.

Summary

Within the Marine Conservation Zone (MCZ) cable will be buried where the substrate allows. Should this not be achieved it may be necessary for remedial cable protection to be installed. External cable protection will only be considered if the planned cable protection methodology through burial fails to achieve an acceptable depth.

Following a review of the supply chain, the Applicant has made a commitment to decommission external export cable protection in the MCZ at the end of the project life. At present there are existing methodologies in the market, which with refinements in the future should allow the recovery of external cable protection

Available solutions for remedial cable protection today other than rock installation are typically concrete mattresses, protection covers and filter units.

Recovery of the remedial protection is considered to be feasible. Protection methods like filter units (rock bags) and protection covers are shown to be suitable both with regards to recovery method and limited material degradation. Other commonly used remedial protection methods like e.g., concrete mattresses might need some further assessment of suitability for recovery.

The project will do further assessments on main cable trenching methodologies and to find the most convenient remedial protection solutions prior to the project construction phase.

CABLE PROTECTION DECOMMISSIONING FEASIBILITY

1 Introduction

1. This document describes decommissioning strategies for the export cables in the Sheringham Shoal Offshore Wind Farm Extension Project (SEP) and Dudgeon Offshore Wind Farm Extension Project (DEP). In particular the potential use of remedial cable protection structures within the MCZ.
2. Based on the geophysical survey data available for the export cable corridor and lessons learned from installation and protection of the neighbouring Dudgeon cables, the risk of not being able to protect the cables are considered low. In case target burial depth of 1.0 m is not met, remedial cable protection may be performed by methods using concrete mattresses, concrete or Glass Reinforced Plastic (GRP) protection covers or by use of filter units (rock bags). Remedial cable protection in the MCZ will be given high focus, hence the ability for recovery after the lifetime of the project is a requirement. The export cables will cross the Cromer Shoal Chalk beds (CSCB) MCZ over a length of approximately 10km from the shore.

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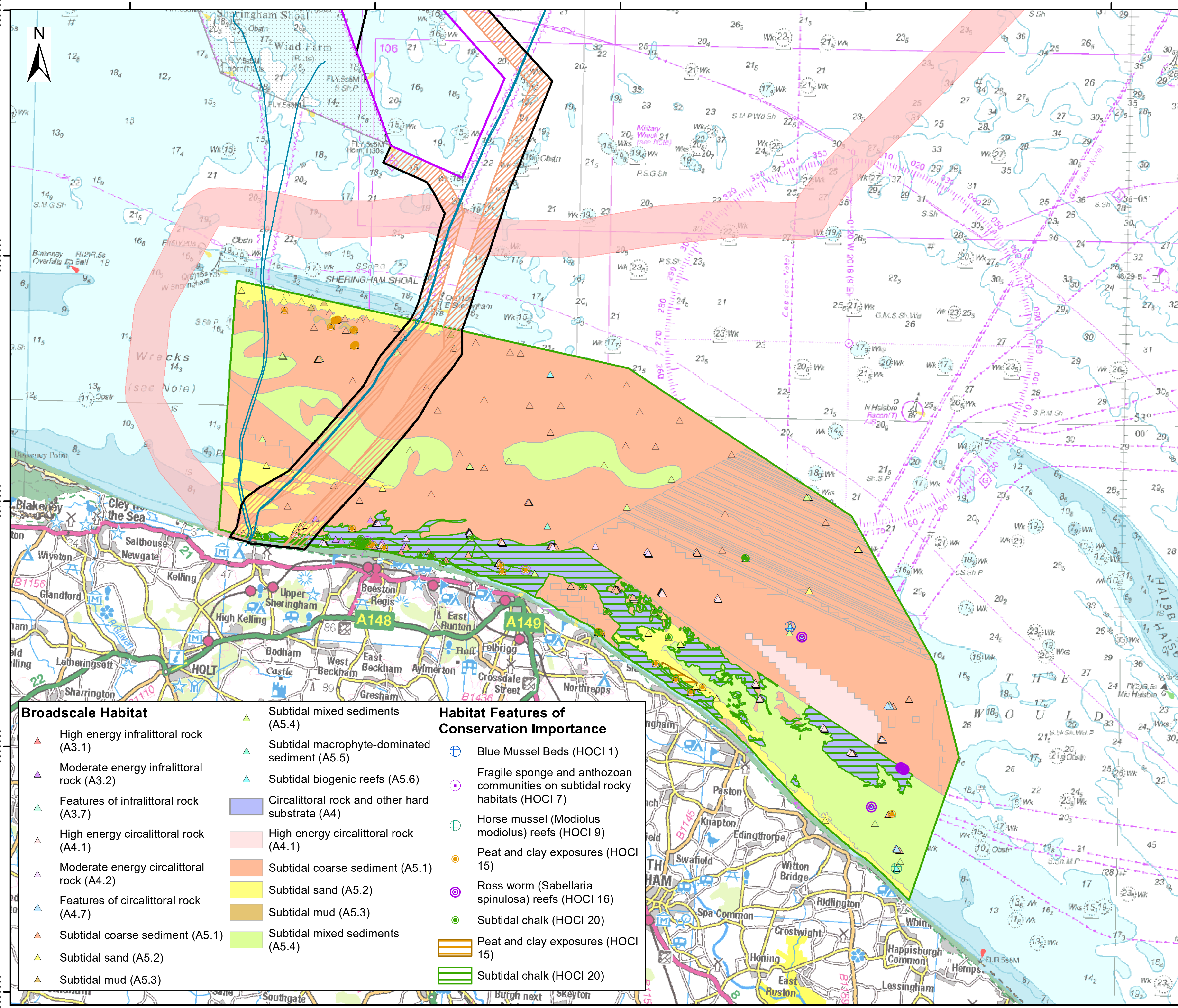

Sheringham Shoal and Dudgeon Extension Projects

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Figure 1-1 Cromer Shoal Chalk Beds MCZ

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Appendix 9.7.3: Cable Protection Decommissioning Feasibility

Application Doc. no.: 5.6

Legend:

- Sheringham Shoal Offshore Wind Farm Extension Project Wind Farm Site
- Offshore Cable Corridors
- Existing Offshore Wind Farm Export Cable
- Offshore Temporary Work Area
- Existing Offshore Wind Farm
- Cromer Shoal Chalk Beds Marine Conservation Zone (MCZ)
- Hornsea P3 Corridor

Coordinate Reference System: WGS 1984 UTM Zone 31N
Transformation WGS84: OSGB_1936_To_WGS_1984_7

0 4.5 9 km
0 2.5 5 Miles

Scale: 1:150,000 Scale at size: A3

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2 Impacts from external rock protection

3. The cables are to be protected where seabed geology and external risks to the cables are taken into account. External risks are typically tidal current, wave induced movement, fishing activities and emergency or accidental anchor drops from crossing vessels. Various protection methodologies exist and have been assessed in the Interim Cable Burial Study.

4. The use of external cable protection creates a footprint on the sea bed for the lifetime of the Projects. Dependent on the subsequent need and/or ability to remove the cable protection on decommissioning (see below) this impact would become permanent rather than long term (40 years).

5. As above, the amount of external cable protection will be minimised as far as is possible across the offshore sites.

6. Given the sensitivity of the MCZ, the allowance for external protection within the MCZ boundaries has been further restricted by

   - For unburied cables, no more than 100m of external cable protection per export cable, up to 6m in width (i.e. up to 200m (equalling 1,200m2) within the total allowance of 500m for the export cables);
   - At the Horizontal Direction Drilling (HDD) exit pit transition zone, no more than 100m of external cable protection per export cable, up to 3m in width (i.e. up to 200m (equalling 600m2) in total for two cables); and
   - No use of loose rock type systems.

7. Based on the restrictions in the MCZ, the project has considered protection by simultaneous laying and ploughing as the most favourable methodology, where a non-displacement plough is the preferred trenching tool. Experience from the Dudgeon project show that this methodology will give acceptable protection of the export cables with minimum risk of remedial cable protection.

8. External cable protection will only be considered if the planned cable protection methodology through burial fails to achieve an acceptable depth.

9. The preferred methods for remedial cable protection inside the MCZ are:

   - Filter units;
   - Concrete protection covers;
   - Concrete Mattresses; and
   - GRP protection covers.

10. Remedial cable protection by a second pass from the plough is not possible, and remedial rock installation is considered undesirable due to difficulties with removal during decommissioning.

3 Decommissioning

11. In general, all the cables will be left in-situ from where they have been laid and protected during the construction phase or from post repair and remedial protection. However, methods for recovery and safe handling of cables are expected to be developed through the lifespan.

3.1 Export cables

12. Cable protection by burial techniques is the preferred methodology along the planned route, especially in the MCZ. The existing Dudgeon cables were protected by simultaneous laying and burial operation and no remedial protection was required. By adopting the same methodology for SEP and DEP it is expected that remedial protection is an unlikely scenario but may be required if the burial depth does not reach an acceptable risk level. Rock placement may be adopted outside the MCZ.

13. Optional protection alternatives considered viable as remedial protection in case of unsuccessful ploughing operation are described further in **Section 4**. Mattresses, protection structures or filter units are recommended alternatives to rock placement.

14. Based on a burial risk assessment burial depth less than the target burial depth of 1.0 m may still be acceptable without remedial protection. Due to the early stage of the project, and the upcoming geotechnical surveys still outstanding, the presence of chalk/depth to chalk is unknown and must be investigated in order to define the target burial depth.

3.2 Landfall

15. The export cables are connected to the offshore substation at the offshore end and goes through two HDD ducts at the shore end and is jointed to the onshore cables in a transition joint bay. At the HDD exit locations, an area on the seabed will be excavated for cable entry into the HDD ducts. Excavated soil to be put back on top of the cable after installation.

16. The HDD ducts (filled with typically bentonite) with a cable inside will remain in-situ after project decommissioning. In case of recovery of the export cables, the cables will be cut at the HDD exit location and at the Offshore Substation. On the basis that the export cables are trenched, the backfilled/protection material must be removed. The backfill clearance can be achieved by use of a Mass Flow Excavator, or Trailing Suction Hopper Dredger. Mattresses, protection covers and filter units to be recovered are described in **Section 4**.

4 Recovery of remedial protection alternatives

17. The following examples are typical alternative cable protection methods suitable for remedial protection of cables and have facilities for recovery after lifetime of the project. Diverless methodologies for installation and recovery shall be selected for safety reasons and lifting can be Remotely Operated Vehicle (ROV) assisted.

4.1 Filter Units

18. Filter units are rock bags filled with aggregate in 2, 4 and 8 tonnes sizes and feature a one-point lifting ring for installation. It has several applications and is commonly used for subsea remedial works in the offshore oil and gas industry.

19. The rock bags from “Ridgeway” have a lifetime of minimum 50 years in saline waters. An acceleration test of soaking the filter unit nets in saltwater has been performed to evaluate the long-term effect on the strength and degradation of the net. The test concluded that the remaining tensile strength was 80-90% (depending

on thickness of the ropes in the net). This infers that recovery of the filter unit bags will be possible to perform.

20. Removal of the filter units can be performed by lifting the bags from the one-point lifting point. This operation can be performed from a vessel and supported by an ROV. See **Plate 4-1** for typical design and installation.

Plate 4-1: Typical Filter Unit Design and Installation

21. Initial market research has suggested that external cable protection systems (filter units) may be available on the market that are manufactured from non-plastic material and would be recoverable where necessary after the lifetime of the wind farm. Selection of the appropriate system for use at SEP and DEP will be completed at the pre-construction stage once the requirements are better understood. The selection process will include all potential external cable protection systems that meet the project requirements, after consideration of the factors detailed above. This may include for example systems that use 100% recycled polyester nets that have been tested and shown not to degrade over the lifetime of the project.

4.2 Concrete Protection Covers

22. One alternative cable protection system is concrete protection covers. A typical product is SeaCult subsea cable protection system, see **Plate 4-2**. The concrete cover provides the cable with protection from external impacts like dropped object and trawling/fishing activity. Test have been performed to confirm that the design is over-trawlable. The weight of the concrete makes the cover stable on the seabed

also in shallow water and ensures stability of the cable. The covers are installed above the cable on seabed (with no direct contact between cover and cable) and can be hooked together to form a continuous cover over the required length. The cover can be designed for 50 years design life if the steel components are manufactured with stainless steel material. The cover has a dedicated lifting point suitable for single or combined installation, see **Plate 4-3**. The same lifting point can be used for recovery of the cover during decommissioning.

Plate 4-2: Example of Concrete Protection Cover

Plate 4-3: Typical Concrete Cover Installation

4.3 Concrete Mattresses

23. Use of concrete mattresses is well known from the oil and gas industry and the physical properties and track record of concrete mattresses to protect subsea cables are well proven. Different suppliers and designs exist in the marked with the same principals for installation.

Plate 4-4: Example of Concrete Mattress Lifting

24. Mattresses can be designed for diverless recovery by use of ROV operated lifting hooks and specially designed mattress recovery tool as shown. Vessel with crane and deck space, as for mattress installation, can be used for recovery operation.

Plate 4-5: Example of Mattress Recovery Tool

25. There has been less focus on methodology for recovery of concrete mattresses at end of field life, and therefore some further refinements of the design might be needed to confirm durability properties and suitable recovery method. This is expected to be achievable.

4.4 GRP Protection Covers

26. Different suppliers provide GRP covers for protection of subsea structures, flowlines, umbilicals and cables. A typical product is SCUB protection structures which can be used to protect cables prom external impacts from dropped object, trawl, and anchor loads. The benefit of this type is the required size and hence weight and can easily be installed and recovered from a small installation vessel. A typical cover can be as shown in **Plate 4-1** where shorter GRP cover sections are installed above the cable on seabed (with no direct contact between cover and cable) and connected to a continuous cover length as required. Position stabilisation is by use of ballast or skirt solution, see **Plate 4-8** for typical cover cross section.

27. GRP covers are often designed for 25 years design life with functionality requirements also at end of the design life, and material degradation is therefore expected to be low. This can be confirmed as part of the project assessment prior to the project construction phase.

1. As seen in **Plate 4-6** and **Plate 4-7**, the covers can be stacked for installation. Recovery may be single lifts with assistance by ROV for connection of lifting beams.

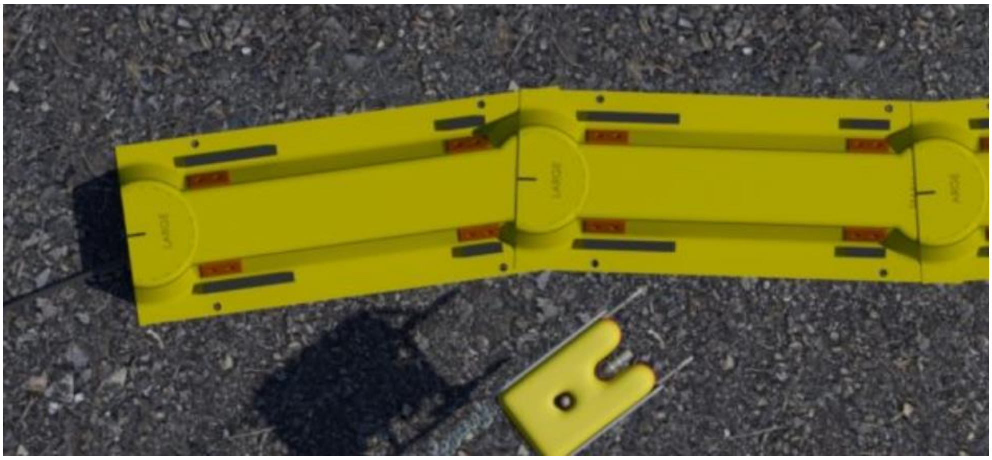

Plate 4-6: Example of GRP Cover on Seabed

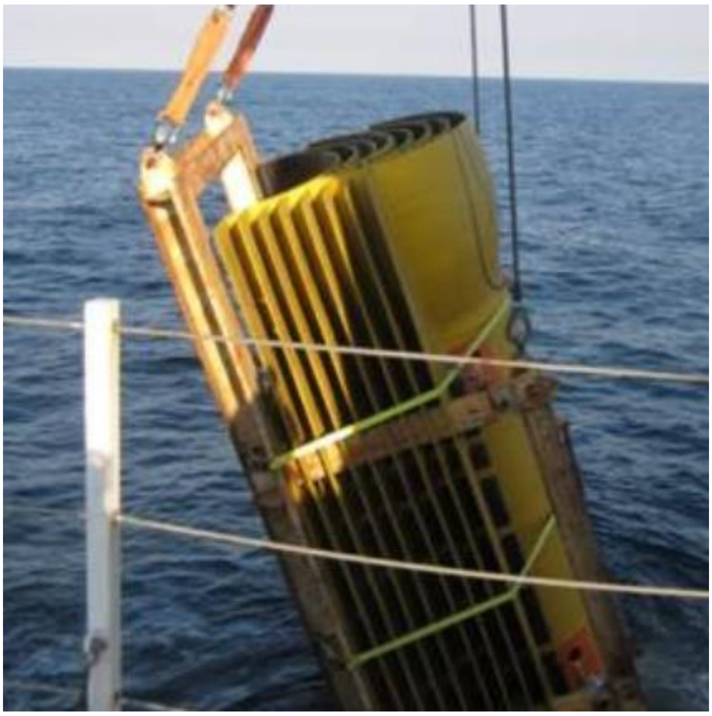

Plate 4-7: Example of GRP Cover Installation

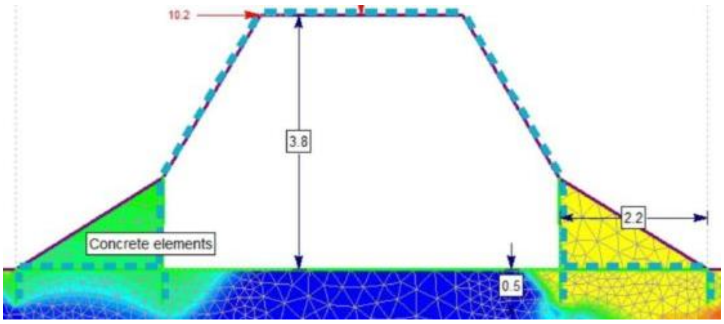

Plate 4-8: Example of GRP Cover Cross Section

5 References

Peritus International Ltd. 2022. Scour and Cable Protection Decommissioning Study. NECR403. Natural England.