ABWP Phase I Decommissioning

Comparative Assessment Report

Volume 3, Appendix 2.1



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Project name ABWP Phase I Decommissioning

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Glossary

Term	Meaning
Arklow Bank Wind Park (ABWP) Phase I	Arklow Bank Wind Park (ABWP) Phase I comprises: • Offshore infrastructure seaward of High Water Mark (HWM), including: – Seven Wind Turbine Generators (WTG) with a combined capacity of 25.2 MW; – One meteorological (met) mast; – Inter-array cables connecting the WTGs and met mast; and – One offshore export cable connecting WTG T4 with landfall at HWM; • Onshore infrastructure landward of HWM including: – One onshore cable connecting landfall at HWM with the onshore substation; and – One onshore substation compound, where the onshore substation and ancillary infrastructure are located.
ABWP Phase II	ABWP Phase II comprises: • Offshore Infrastructure, including: – 53 or 47 WTGs and two Offshore Substation Platforms (OSPs) located within the "Array Area"; – Inter-array cables connecting WTGs with the OSPs; and – Two offshore export cables; • Onshore grid connection infrastructure, including a 220 kV substation at Shelton Abbey with an associated connection to the existing National Electricity Transmission Network; • Operations and Maintenance Facility (OMF) at South Dock, Arklow Harbour; and • EirGrid Upgrade Works.

Term	Meaning
Alternatives	A description of other options that have been considered during the conception of the Proposed Works (Environmental Protection Agency (EPA), 2022). Article 5(1) and Annex IV of the Environmental Impact Assessment (EIA) Directive) require "a description of the reasonable alternatives studied by the developer, which are relevant to the project and its specific characteristics, and an indication of the main reasons for the option chosen, including a comparison of the environmental effects" (EIA Directive 2011/92/EU (as amended)).
Arklow Energy	Arklow Energy Limited, the entity seeking planning permission for the Proposed Works, i.e. the applicant.
Comparative Assessment	Systematic process that evaluates different decommissioning options in a structured way providing the information needed to make a robust decommissioning recommendation (International Association for Oil & Gas Producers (IOGP), 2024).
Competent authority	Are those authorities that are entitled to give authorisation or consent to a plan or project. In the planning system, this means planning authorities and An Coimisiún Pleanála. There are, however, a wide range of other competent authorities in respect of other consent regimes e.g. Environmental Protection Agency (environmental licensing), Minister for Agriculture, Food and the Marine (forestry, aquaculture and foreshore management), and various state bodies that have authority to undertake development under Part 9 of the Planning and Development Regulations (e.g. An Garda Síochána, defence forces, the courts service). The competent authority for this planning application is An Coimisiún Pleanála (ACP).
Decommissioning	The final closing down and putting into a state of safety of a development, project or process when it has come to the end of its useful life (EPA, 2022).
'Do-nothing' scenario	The situation or environment which would exist if the Proposed Works were not carried out. This scenario needs to take account of the continuation or change of current management regimes, as well as the continuation or change of trends currently evident in the environment (EPA, 2022). In this EIAR, the do-nothing scenario is described under "Future Baseline Conditions" in **Volume 2, Chapters 4 – 8**.
Draught	Vertical distance between the waterline and the lowest point of a vessel's hull (usually the keel). It essentially measures how deep a vessel sits in the water.
Dredged material	Seabed material arising from localised dredging potentially required to facilitate safe vessel access during Proposed Works Offshore, and / or extraction of seabed material located inside monopile (MP) foundations, as part of MP decommissioning.
Effect	The consequence of an impact on a receptor. For example, in the offshore environment, vessel activity (activity) results in increased levels of underwater noise (impact), with the potential to disturb marine mammals (effect).
EIA Scoping	The scoping stage provides an opportunity for both developers and the Competent Authority to determine those key environmental impacts and issues of concern that are likely to be of the utmost importance to the Project proposal's decision-making and eliminates those that are less of a concern (European Commission (EC,) 2017).
EIA Scoping Presentation	Presentation scoping the likely environmental impacts of the Proposed Works to be further considered in the Environmental Impact Assessment Report (EIAR). The EIA Scoping Presentation is included in **Volume 3, Appendix 1.1** of the EIAR.
Environmental Impact Assessment (EIA)	Process of assessment of the effects of a project or development proposal on the environment. In the planning area, it is undertaken by a planning authority or An Coimisiún Pleanála during the consideration of applications for planning permission, taking account of an Environmental Impact Assessment Report (EIAR). The projects which require EIA are listed in Annex I and Annex II of the EIA Directive, as amended (Office of the Planning Regulator, n.d.).

Term	Meaning
Environmental Impact Assessment Report (EIAR)	A report or statement of the effects, if any, that Proposed Works, if carried out, would have on the environment. It is prepared by the developer to inform the EIA process (Office of the Planning Regulator, n.d.).
Exclusive Economic Zone (EEZ)	Area beyond and adjacent to the territorial sea, subject to the specific legal regime established in this Part (UNCLOS, 1982). The EEZ in Ireland extends up to 200 nautical miles (nm) from the outer edge of the territorial sea.
Grapnel Run	A cable recovery technique involving dragging a grapnel along the seabed, causing shallow and temporary seabed disturbance.
High Water Mark (HWM)	Level reached by the sea at high tide, measured as the mean of high tides.
Impact	A change brought about by the Proposed Works.
Inter-array cables	Subsea power lines that link individual wind turbine generators (WTGs) together in an offshore wind farm, forming an electrical network. In ABWP Phase I, inter-array cables connect WTGs and the met mast to each other and have an overall length of 7.4 km.
Landfall	The point where the offshore export cable transitions from the offshore marine environment to the onshore terrestrial environment.
Meteorological (Met) mast	A mast with a number of meteorological sensors located at different heights to record meteorological and sea condition data
Monitoring	The periodic or continuous observation of biodiversity indicators and of other parameters that may affect biodiversity for any changes that may occur over time, so as to confirm predictions made with respect to likely effects and identify adverse changes that may require remedial action (Office of the Planning Regulator, n.d.).
Monopile (MPs)	Hollow steel cylinder driven into the seabed typically used to anchor an offshore wind turbine generator (WTG). In ABWP Phase I, MPs support the seven WTGs as well as the meteorological (met) mast.
Nautical mile (nm)	Measurement used for distances at sea. 1 nm equates to 1.852 km.
Noise	The terms noise and sound are often used interchangeably. Noise usually refers to unwanted or disturbing sounds that interfere with normal hearing and can be unpleasant or harmful. It is often characterised by irregularities in the sound waves and is considered a form of sound pollution.
Offshore export cable	Subsea power cable that transports the total generated power from an offshore wind farm to the onshore power grid. In ABWP Phase I, the offshore export cable connects the wind turbine generator (WTG) T4 to landfall with an approximate overall length of 15.6 km. At landfall, the offshore export cable transitions to the onshore cable connecting to the onshore substation.
Offshore Site	Part of the Site where Proposed Works Offshore are proposed to take place. In this application for planning permission, the Offshore Site comprises the Sub Lease Area, where the ABWP Phase I wind turbine generators (WTGs), met mast and inter-array cables are located, and the offshore export cable 10 m corridor connecting WTG T4 to the landfall at high water mark (HWM) near Arklow Harbour.
Pathway	The route by which an effect is conveyed between a source and a receptor (EPA, 2022).
Planning permission	Formal, legal approval required from a local planning authority or An Coimisiún Pleanála (ACP) to carry out development. The Proposed Works require planning permission submitted from ACP under Section 291 of the Planning and Development Act 2000, as amended.
Proposed Works	The Proposed Works include decommissioning of ABWP Phase I offshore infrastructure (Proposed Works Offshore) and decommissioning of ABWP Phase I onshore infrastructure (Proposed Works Onshore).
Receptor	Any element in the environment which is subject to impacts (EPA, 2022).
Scour protection	Engineered barrier typically placed on the seabed around WTG foundations and subsea cables to prevents sediment erosion caused by accelerated water currents and waves, safeguarding the WTG's stability and protecting subsea cables. In ABWP Phase I, scour protection was originally introduced in the form of rock armour, however, this proved ineffective, and was removed in 2005. Since then, scour protection has been introduced through sandbags.

Term	Meaning
Special Areas of Conservation (SACs)	Sites designated under the Habitats Directive (92/43/EEC). This requires the conservation of important, rare or threatened habitats and species (not birds, which are protected by Special Protection Areas (SPAs)) across Europe (Office of the Planning Regulator, n.d.).
Special Protection Areas (SPAs)	Sites designated under the Birds Directive (79/409/EEC), to conserve the habitats of certain migratory or rare birds (Office of the Planning Regulator, n.d.).
Sub Lease Area	Area where the ABWP Phase I WTGs, met mast and inter-array cables are located, as defined in the Sub Lease granted by Sure Partners Limited (SPL) to Arklow Energy Limited (Arklow Energy) to construct and operate ABWP Phase I.
Territorial Sea	Belt of sea adjacent to a coastal State's land territory and internal waters, over which the State has sovereignty. A coastal State may claim up to 12 nautical miles from its baseline (usually the low-water line along the coast) (UNCLOS, 1982).
Transition Piece	The steel connection structure between the tower and the monopile (MP) foundation.
Vessel Monitoring System (VMS)	A satellite-based monitoring system used to track the activity of larger fishing vessels and assess spatial fishing effort.
Waste	Any substance or object belonging to a category of waste specified in the First Schedule or for the time being included in the European Waste Catalogue which the holder discards or intends or is required to discard, and anything which is discarded or otherwise dealt with as if it were waste shall be presumed to be waste until the contrary is proved (Waste Management Act 1996 (as amended)).
Wind Turbine Generator (WTG)	Structure that converts the kinetic energy of ocean winds into electrical energy. ABWP Phase I includes seven GE Energy 3.6s WTGs with a rated capacity of 3.6 megawatts (MW) per WTG.

Acronyms

Acronym	Meaning
ABWP	Arklow Bank Wind Park
ACP	An Coimisiún Pleanála
ATONs	Aids to Navigation
AWC	Abrasive Waterjet Cutting
BHD	Back-hoe Dredger
CD	Chart Datum
CSD	Cutter Suction Dredger
CTV	Crew Transfer Vessel
CUT	Cutting Underwater Technologies
DAF	Dynamic Amplification Factor
DCEE	Department of Climate, Energy and the Environment
DOP	Direct Operated Pump
DRP	Decommissioning and Reinstatement Plan
DWC	Diamond Wire Cutting
EEZ	Exclusive Economic Zone
EIA	Environmental Impact Assessment
EPA	Environmental Protection Agency
EU	European Union

Acronym	Meaning
GHG	Greenhouse Gas
HAT	High Astronomical Tide
IEMA	Institute of Environmental Management and Assessment
IMO	International Maritime Organisation
JUB	Jack Up Barge
JUV	Jack Up Vessel
LAN	Local Area Network
LAT	Low Astronomical Tide
MAC	Maritime Area Consents
MAP	Maritime Area Planning
MARA	Maritime Area Regulatory Authority
MCG	Motion Compensated Gangway
MFE	Mass Flow Excavation
MP	Monopile
MPV	Multi-Purpose Vessel
MSL	Mean Sea Level
NMPF	National Marine Planning Framework
O&M	Operations and Maintenance
OMF	Operations and Maintenance Facility
OOS	Out-of-Service
ORE	Offshore Renewable Energy
OSP	Offshore Substation Platform
ROV	Remotely Operated Vehicle
SAC	Special Area of Conservation
SCV	Subsea Construction Vessel
SPA	Special Protection Area
SPL	Sure Partners Limited
SPM	Suspended Particulate Matter
SPRT	Soil Plug Removal Tool
TP	Transition Piece
TRL	Technology Readiness Level
UKC	Under Keel Clearance
UNCLOS	United Nations Convention on the Law of the Sea
WCF	Weight Contingency Factor
WTG	Wind Turbine Generators
W2W	Walk to Work

Units

Unit	Meaning
kg	kilograms
km	kilometers

Unit	Meaning
MW	megawatts
m	meters
m^3	cubic meter
mm	millimeters
mt	metric tonnes
nm	nautical miles
t / mt	tonnes / metric tonnes
µm	micrometer

1 Introduction

1.1.1.1 Arklow Energy Limited (Arklow Energy) is seeking planning permission to decommission Arklow Bank Wind Park (ABWP) Phase I (referred to hereafter as 'the Proposed Works'). The Proposed Works include decommissioning of ABWP Phase I offshore infrastructure (Proposed Works Offshore) and decommissioning of ABWP Phase I onshore infrastructure (Proposed Works Onshore).

1.1.1.2 This Comparative Assessment Report (CAR) aims to present the emerging recommendations from the Comparative Assessment (CA) process undertaken to identify the optimum method of decommissioning of ABWP Phase I foundations and electrical cables (both inter-array and offshore export cables), which are part of the Proposed Works Offshore, and inform **Volume 2, Chapter 2: Description of Alternatives** of the Environmental Impact Assessment Report (EIAR).

1.1.1.3 A CA is a systematic process that evaluates different decommissioning options in a structured way providing the information needed to make a robust decommissioning recommendation. CAs have been extensively used to inform offshore oil and gas decommissioning options (International Association of Oil & Gas Producers (IOGP), 2024) and has been adapted in this CAR to inform the decommissioning options for foundations and electrical cables, as well as the 'do-noting' option, which assumes that the structures are left *in situ*.

1.1.1.4 This CAR is informed by:

- **Volume 3, Appendix 1.1: EIA Scoping Presentation**
- **Volume 3, Appendix 4.1: Seabed Mobility Assessment;**
- **Volume 3, Appendix 4.3: Scour Assessment;**
- **Volume 3, Appendix 5.1: Benthic/Live Habitat Cable Survey and Observations Log;**
- **Volume 3, Appendix 7.1: Navigational Risk Assessment**.

1.1.1.5 This CAR describes:

- The Offshore Site where Proposed Works Offshore will take place, and infrastructure to be decommissioned;
- The decommissioning options considered for foundations and electrical cables;
- The CA methodology followed; and
- The emerging recommendations from the CA.

1.1.1.6 This CAR is supported by the following appendices:

- **Appendix A: TP/MP and Cable Decommissioning Methods and Supporting Technologies;** and
- **Appendix B: Scoring Matrix Summary and Sensitivity Analysis.**

2 Offshore Site Background

2.1 Overview of the Offshore Site

2.1.1.1 ABWP Phase I was constructed between 2003 and 2004 and has reached the end of its design life.

2.1.1.2 Offshore infrastructure (within the 'Offshore Site', see **Figure 2.1**) is located seaward of the High Water Mark (HWM) of the coast of Arklow, County Wicklow, in southeast Ireland, and comprises:

- Seven WTGs sitting on transition pieces (TPs) and monopile (MP) foundations, with a combined capacity of 25.2 MW, surrounded by scour protection in the form of sandbags (see description in **Table 2.2**);
- One meteorological (met) mast sitting on a TP and MP located south of the southernmost WTG turbine (T1);
- Inter-array cables that connect WTGs and the met mast, all located within the Sub Lease Area, at the crest of Arklow Bank sandbank, within 10 kilometers (km) of the coast; and
- One offshore export cable connecting WTG turbine 4 (T4) to the landfall point at HWM.

2.1.1.3 As further described in **Section 2.2** and **Volume 3, Appendix 4.1: Seabed Mobility Assessment**, the Sub Lease Area within the Offshore Site experiences strong seabed level variations that respond to the natural dynamics of the Arklow sandbank. In order to inform the comparison of decommissioning options, it is assumed that seabed levels at the time of decommissioning will be comparable to those recorded during the most recent bathymetric survey conducted within the Sub Lease Area in 2025, which also recorded the highest seabed levels across the Sub Lease Area (on average) in bathymetric surveys undertaken within the Offshore Site and analysed to define Proposed Works Offshore (see **Volume 2, Chapter 3: Proposed Works Description**). The 2025 seabed levels are therefore adopted as the reference case for calculations presented in this CAR.

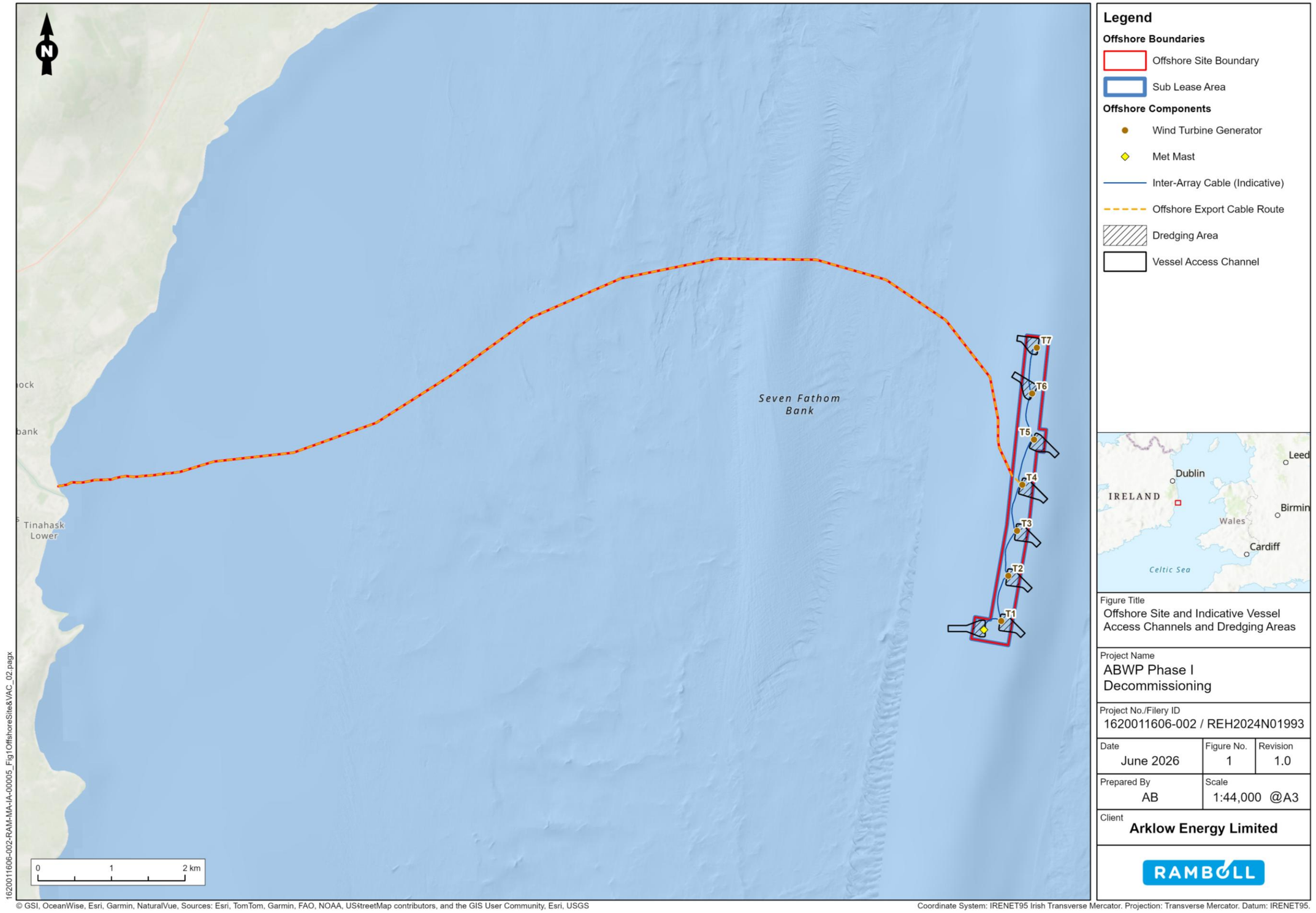


Figure 2.1: Offshore Site location. Vessel access channels and dredging areas are indicative only.

2.2 Offshore Site Environmental Conditions

2.2.1.1 **Table 2.1** provides a high-level overview of the environmental conditions at the Offshore Site, based on the baseline information presented in the ABWP Phase I decommissioning EIA Scoping Presentation, see **Volume 3, Appendix 1.1: EIA Scoping Presentation**. **Volume 2, Chapters 4 – 8** present updated baseline conditions for environmental factors scoped into the EIAR.

Table 2.1: Overview of environmental conditions within the Offshore Site

Environmental Factor	Description
Coastal processes, water and sediment quality	The Arklow Bank sandbank is a long, north–south-oriented dynamic offshore sandbank located approximately 10 km off the Wicklow coast. INFOMAR classifies the substrate within the Sub Lease Area as sand, and the offshore export cable route is shown to go through sand, coarse sediment and mud to muddy sand (Infomar, 2026). Mobile sandbanks are generally considered minor, or in some cases, ineffective carbon sinks in comparison to other coastal habitats like muddy seabeds (Robbins *et al.*, 2022). Tidal current is the primary driver of the sandbank morphodynamics, and wind- and wave-induced flows have shown to temporarily alter sediment distribution patterns. The currents in the Offshore Site vary between 0.75 m/s and 2.5 m/s, with governing current directions reported to be NNW-SSE. Southerly waves are reported to be the governing direction for wave propagation. A review of historical bathymetry data recorded within the Offshore Site shows strong variations in seabed levels across the Offshore Site caused by the natural migration of sand waves and global scour (caused by natural processes), with the largest seabed lowering occurring at depths of up to 17 m, and suggests that local scour (observed within the vicinity of MPs) is considered to have limited influence 250 m beyond MP locations. Survey data from ABWP phase I pre- and post-construction monitoring surveys and ABWP Phase II EIAR survey data indicate that sediments are heterogenous, composed of mobile sands, slightly gravelly sands and gravelly sands.
Marine Biodiversity **Benthic subtidal and intertidal**	The Offshore Site is characterised by sediments with little or no fixed hard substrata recorded. Species diversity has been reported to be highest with areas of sandy shell, gravel and cobbles in the northwest, southwest and southeast of the sandbank (outside the Offshore Site) and inshore along the offshore export cable route. In comparison, communities associated with sandy sediments have been reported to have lower biodiversity. The number of taxa recorded pre- and post-construction ABWP Phase I has remained fairly constant according to surveys conducted as part of ABWP Phase I (i.e. pre-construction (2000, 2001) and post-construction (2004 - 2011 and 2021) and as part of ABWP Phase II EIAR surveys. It should also be noted that the Operations and Maintenance (O&M) Manual of ABWP I has required the removal of marine growth on TPs / MPs (based on growth thickness criteria), last time undertaken in 2019. Both *Sabellaria spp*. have been recorded subtidally to the northwest and the east of the sandbank, although with variable distribution and not within the Offshore Site itself. There are no sites of nature conservation importance for benthic subtidal/ intertidal ecology within the Offshore Site, with the closest being Slaney River Valley Special Area of Conservation (SAC), located within 13.9 km north of the Offshore Site and designated for Annex I habitats 'Estuaries' and 'Mudflats and sandflats not covered by seawater at low tide', Wicklow Reef SAC, within 15.5 km north of the Offshore Site, designated for Annex I habitats 'Reefs', and Blackwater Bank SAC located within 29.2 km, designated for Annex I habitats 'Estuaries' and 'Mudflats and sandflats not covered by seawater at low tide' among others. The nearshore and intertidal environment adjacent to the offshore export cable landfall is strongly influenced by the presence of the Arklow Harbour breakwater, which supports typical rocky-shore biota such as algal growth and lichen communities on exposed rock surfaces, as well as adjacent pockets of cobble, pebble and gravel beach material within the estuarine margin (Uisce Éireann, 2018).
Marine Biodiversity **Fish, shellfish and sea turtle**	Benthic fish populations have been recorded to be consistently low across within the Offshore Site and wider area in benthic surveys conducted as part of ABWP Phase I (i.e. pre-construction (2000, 2001) and post-construction (2004 - 2011 and 2021) and as part of ABWP Phase II EIAR surveys. The Arklow Bank forms part of the wider Western Irish Sea fish ecology system, supporting a representative mix of pelagic, demersal, elasmobranch, shellfish and diadromous species typical of the region. The Arklow Bank and its flanks host characteristic Irish Sea flatfish and demersal assemblages. There are no spawning grounds for herring or sandeel species (demersal spawners) near the Offshore Site (other species will be further considered in the EIAR). The wider area also supports pelagic and benthopelagic species, many of which use the region for spawning or nursery functions, and there is potential for connectivity with nearby SACs designated for diadromous fish (including Atlantic salmon (*Salmo salar*), sea trout (*Salmo trutta*), sea

Environmental Factor	Description
	lamprey (*Petromyzon marinus*), river lamprey (*L. fluviatilis*) and twaite shad (*Allosa fallax*), which may occur transiently in the Arklow Bank area during marine migration phases (SPL, 2024). No designated fish SAC overlaps the Offshore Site, with the closest being Slaney River Valley SAC, located within 13.9 km north of the Offshore Site and designated for sea / river lampreys, Twaite shad and salmon. Basking shark (*Cetorhinus maximus*) may be occasionally present. Shellfish communities reflect typical Irish Sea assemblages, with commercially important species present in the wider area; inshore grounds west of the Bank are recognised as important blue mussel seed areas, while the mobile sandy sediments of Arklow Bank itself limit persistent shellfish habitat locally. Leatherback turtle (*Dermochelys coriacea*), loggerhead turtle (*Caretta caretta*) and Kemp's Ridley turtle (*Lepidochelys kempii*) are likely to occur in Irish waters but only one leatherback turtle has been recorded within the vicinity of the Offshore Site to date (SPL, 2024).
Marine Biodiversity **Marine mammals**	ABWP Phase I post-construction marine mammal surveys (2004 – 2009) and ABWP Phase II surveys covering marine mammals (2018 – 2020, 2023) suggest that the Arklow Bank area supports a typical assemblage of Irish Sea marine mammals, including harbour porpoise (*Phocoena phocoena*), bottlenose dolphin (*Tursiops truncatus*), Risso's dolphin (Grampus griseus), short-beaked common dolphin (*Delphinus delphis*), minke whale (*Balaenoptera acutorostrata*), grey seal (*Halichoerus grypus*) and harbour seal (*Phoca vitulina*) (SPL, 2024). Harbour porpoise was the most frequently recorded species during ABWP Phase II surveys, with density estimates of 0.38 animals/km². Other cetaceans, such as bottlenose or Risso's dolphins, were recorded at lower frequency. Two species of pinniped, harbour seal and grey seal, occur in the Irish Sea, with the harbour seal being more abundant on the west coast of Ireland. Both species have established terrestrial colonies (or haul-outs) along all coastlines of Ireland to rest ashore, breed, moult, and engage in social activity (Cronin *et al*., 2004; Ó Cadhla *et al*., 2007). Site-specific aerial survey data (0.38 animals/km²) for ABWP Phase II identified both species of seal over the 24-month campaign (SPL, 2024). However, the Arklow area does not appear to be particularly important for either grey or harbour seals, based on Carter *et al*. (2022) at-sea densities. The main haul-out sites appear to be concentrated much further north in Dublin Bay and beyond, and 14 km south in the Slaney River Valley SAC. No designated marine mammal SAC overlaps the Offshore Site, with the closest being Slaney River Valley SAC, located within 13.9 km north of the Offshore Site and designated for harbour seal, Blackwater Bank SAC located within 29.2 km, designated for harbour porpoise, and Rockabill to Dalkey Island SAC within 47.4 km designated for harbour porpoise
Marine Biodiversity **Ornithology and Bats**	The Arklow Bank sandbank and wider area supports a typical Irish Sea seabird assemblage, including red-throated divers (*Gavia stellata*), cormorants (*Phalacrocorax carbo*), gannets (*Morus bassanus*), guillemots (*Uria aalge*), razorbills (*Alca torda*), puffins (*Fratercula arctica*), kittiwakes (*Rissa tridactyla*), little tern (*Sterna albifrons*), and several gull species. ABWP Phase I post-construction bird surveys (2004 – 2009) and ABWP Phase II surveys suggest that seabird presence have a strong seasonal variation, with markedly higher abundance during autumn, winter and spring migration periods, particularly for auks, kittiwakes and divers, while the Offshore Site and the wider area is generally of lower ornithological importance during the breeding season (SPL, 2024). No designated Special Protection Areas (SPAs) overlap the Offshore Site, with the closest being Wicklow Head SPA, located within 15 km north of the Offshore Site and designated for Kittiwake, The Murrough SPA located within 18 km north, designated for many species, such as Red-throated Diver and Little Tern. ABWP Phase II offshore bat surveys (2021 – 2023) suggest that offshore bat activity at Arklow Bank is extremely low and is limited to occasional detections of two migratory specie, Nathusius' pipistrelle (*Pipistrellus nathusii*) and Leisler's bat (*Nyctalus leisleri*), during spring and autumn migration periods, functioning as a broad migratory transit corridor across the Irish Sea. Offshore bat presence within the Offshore Site is expected to be very infrequent, highly seasonal, and restricted to individual bats in transit (SPL, 2024).
Commercial fisheries and aquaculture	Baseline desktop data sources include (among others) Sea Fisheries Protection Agency (SFPA) landings/value datasets, Atlas if Commercial Fisheries around Ireland, Ireland's Marine Atlas, ICES Vessel Monitoring System (VMS) Surface Swept Area Ration fishing intensity and European Maritime Safety Agency Automatic Information System route density for fishing vessels, Marine Institute and Bord Iascaigh Mhara (BIM) shellfish landings/value.

Environmental Factor	Description
	Inshore activity can be characterised using the Marine Institute inshore fishing activity dataset (vessels <15 m) which includes multiple methods (e.g., dredging, nets, trawls, potting). The commercial fisheries baseline in the vicinity of the Offshore Site is characterised by Irish potting vessels targeting whelk (*Buccinum undatum)*, using plastic drums/pots. Vessels operate from the shore out to the Sub Lease Area, with effort highest closer to shore. Potting vessels also use creels/pots to target lobster (*Homarus Gammarus)* and crab species, including brown crab (*Cancer Pagurus)* and velvet crab (*Necora puber)*. There is also sporadic blue mussel (*Mytilus edulis)* seed collection from ephemeral beds in the inshore areas. In addition, a highly seasonal herring (*Clupea harengus)* and sprat (*Sprattus sprattus)* fishery occurs along the Arklow shoreline. No classified shellfish production areas for bivalve molluscs are identified in or adjacent to the Offshore Site. A mussel aquaculture site, focused on spat collection, is located on the coast, approximately 5 km from the offshore export cable.
Shipping and navigation	Marine traffic data analysed as part of ABWP Phase II EIAR (SPL, 2024) shows that there is a limited amount of vessel traffic movements across the Arklow Bank due to its shallow water depths representing a navigational hazard. The Arklow Bank is marked by a north cardinal buoy equipped with AIS at its northern extent and a south cardinal buoy equipped with AIS and a radar beacon (racon) at its southern extent. These aids to navigation provide clear warning of shallow water and the presence of ABWP Phase I offshore infrastructure. Each turbine is also charted and lit in accordance with navigational requirements. The most common vessels found inshore of Arklow Bank were smaller vessels (e.g. fishing and recreation), with the majority of commercial vessels passing offshore of the Arklow Bank. Cargo vessels were the most common vessel type during summer periods, accounting for 40% of vessel traffic in 2023 and 43% during 2022. Fishing vessels were also commonly recorded (31% in 2023 and 22% in 2022), followed by recreational vessels and tankers. Passenger vessels were less frequent. There are no International Maritime Organization (IMO) designated Traffic Separation Schemes within the vicinity of the Offshore Site. The closest port to the Offshore Site is Arklow, with Wicklow to the northwest and Dublin located further north. From these ports, a significant proportion of vessel traffic is recorded transiting through the region (SPL, 2024). There are local emergency response resources in Arklow and Wicklow.
Seascape, landscape and visual amenity	At a regional scale, according to the Regional Seascape Character Assessment for Ireland (Marine Institute, 2020), the Offshore site lie within Seascape Character Area (SCA) 13 - South East Irish Sea. This SCA is characterised by an open, low-lying coastline and a strong maritime identity. The wider seascape is defined by gently curving shorelines, low headlands that frame but do not dominate views, and an established pattern of recreational and commercial fishing activity. Nearby settlements, particularly Arklow, display a distinct maritime character with active harbour functions, including docks, marina facilities, storage areas, fishing vessels, and associated maritime services. ABWP phase I currently forms part of the recognised seascape and represents a familiar element within views from the surrounding coastline (Marine Institute, 2020; SPL, 2024).
Marine Archaeology and Cultural Heritage	The seabed within Arklow Bank sandbank is dominated by sand and gravel deposited by the abating ice front during the last Glaciation (pre-12,000 Before Present (BP)). The surface sediment is mobile, formed due to reworking following relative sea level rise post-10,000 BP (SPL, 2024). The southeast coast of Ireland is not associated with the potential for prehistoric underwater landscapes but there is potential for earlier horizons to be discovered (SPL, 2024). The ABWP phase II EIAR (SPL, 2024) reported 165 recorded historic shipwreck events associated with the Arklow Bank sandbank and its immediate vicinity, with a high concentration of these in the northern half of the Arklow Bank sandbank. A 5.5 m section of the offshore export cable was laid over timber wreck remains. As Arklow Bank is a dynamic sandbank with significant historic shipwreck occurrence, there is potential for new shipwreck exposure and known shipwreck burial. Interaction with the site of a wreck that was exposed during installation of ABWP phase I will need to be managed in line with the expectations of the National Monuments Service. There is also potential for cultural heritage sites located on land to be located within theoretical visibility of Proposed Works Offshore.

Environmental Factor	Description
Airborne noise	The existing airborne noise environment within and around the Offshore Site and the nearest coastline is dominated by routine marine activity. The main offshore noise source is vessel traffic, including commercial, fishing, service and recreational craft using established inshore and offshore routes. The relevant Noise Sensitive Receivers (NSRs) within the vicinity of the Offshore Site include the Arklow Harbour land users and the town of Arklow residential and commercial population. Operational wind turbines may emit two type of noise. Firstly, aerodynamic noise, produced by the movement of the rotating blades. Secondly, mechanical noise from components within the nacelle of a WTG may be generated (AONA, 2024). Although blades were removed from WTGs during summer 2025, when operational, these were noted to be inaudible from the shore during ABWP Phase II surveys (AONA, 2024).
Marine Infrastructure and Other Users	There is a wide range of existing marine users present between the Sub Lease Area and the coastline, with activity concentrated around fishing, sailing, recreational boating and diving, commercial vessel transit, and established marine services. Recreational boating is highly seasonal, with vessel activity increasing during spring and summer months (ICC, 2018). Arklow Sailing Club is an active user of the waters surrounding Arklow Bank sandbank, operating regular sailing and racing events. Several race marks are located in proximity to ABWP Phase I, including the "Turbines Race," a 34-nautical-mile circumnavigation of the ABWP Phase 1 WTGs held annually in May (SPL, 2024). The coastal zone also contains operational marine infrastructure. Arklow Harbour supports commercial activity and recreational vessel access, known for its fishing fleet and marina. Periodic maintenance dredging is required within the harbour and approach channel to ensure adequate navigational draught, and disposal activities are undertaken at licensed offshore dumping grounds (licensed by the EPA) located near the offshore export cable corridor (STL, 2024). The WWTP adjacent to the Onshore Site includes a discharge pipeline that extends offshore and is located within approximately 200 m from the offshore export cable route. A Supervisory Control and Data Acquisition (SCADA) communication system is in place between the ABWP Phase I WTGs and the shore, which is transmitted through the fibre optic cables that lie within the existing offshore export cable corridor to landfall.
Air quality and climate	Air quality within the Offshore Sites is influenced by natural atmospheric inputs, such as sea-salt aerosols, and marine traffic, although no significant anthropogenic pollution sources have been identified. Levels of pollutants based on the data from EPA Zone D averages relevant to the Offshore Site are currently below ambient air quality limit values (SPL, 2024). The climate baseline is informed by national greenhouse-gas reporting from the EPA and long-term meteorological summaries from Met Éireann, which together describe prevailing mild maritime conditions and national emission trends influenced primarily by the energy-generation sector and changes in fuel mix. Renewable electricity generation in Ireland capacity is dominated by wind, and it is expected that renewable energy generation increases to approximately 68% of electricity consumption by 2030 (EPA, 2025). Met Éireann climate-change projections identify expected conditions relevant to the east coast and the Irish Sea, including sea-level rise, increase of temperature, greater storm intensity, increased rainfall, and heightened coastal-flooding risk. These projections form part of the contextual climate baseline for assessing long-term climatic influences in the region (Met Éireann, 2021; SPL, 2024).
Population and human health	The local area is mostly rural, with several urban areas, including Wicklow, Arklow and Courtown. Both Country Wicklow and County Wexford have above average employment in manufacturing and construction, and account for just under a quarter of all visits across Ireland, but around 16% of total annual spending of tourists, which are attracted to the presence of marine activities.
Waste	At national level, waste management in Ireland is guided by a circular-economy framework that places strong emphasis on waste prevention, high-value resource recovery, and adherence to the EU waste hierarchy. Recent national data show increasing quantities of several key waste streams relevant to the Proposed Works. Waste Electrical and Electronic Equipment (WEEE) generation has risen in recent years, with consistently high recovery and recycling rates (generally >85%) (Regional Waste Management Offices (RWMO), 2024). the waste management hierarchy is set out in the EU Waste Framework Directive (Directive 2008/98/EC).

Environmental Factor	Description
	Where waste cannot be prevented or reused, it must be managed in accordance with the Waste Management Acts (1996-2024 as amended) and transferred only by authorised collectors to licensed or permitted facilities. At regional and local level, waste management also operates within established statutory requirements that prioritise prevention, reuse and recycling wherever feasible. The Proposed Works located in the Eastern-Midlands Region, but Arklow lies adjacent to the Southern Region (Uisce Éireann, 2018).
Civil and Military Aviation	The Offshore Site lies entirely within Class C controlled airspace, where all aircraft must be in receipt of an Air Traffic Service (ATS) from the appropriate air traffic control (ATC) unit. This classification governs how aircraft operate in the vicinity of the Offshore Site and ensures that any interaction between the development and aviation users is fully managed through established ATC procedures (SPL, 2024). Military aviation activity in the region is associated with the Casement Aerodrome, located approximately 30 nautical miles northwest of the Offshore Site. Casement supports fixed-wing and rotary operations of the Air Corps, including routine training flights and occasional maritime support missions. Civil aviation considerations include the safeguarding requirements of Dublin Airport, which operates a Primary Surveillance Radar (PSR) approximately 33 nautical miles to the northwest Aerodrome activity also includes movements from Newcastle Aerodrome, located roughly 10 nautical miles northwest of the Offshore Site. This aerodrome primarily facilitates general aviation and recreational flying, with aircraft generally operating at relatively low altitudes and within established local routing patterns. Search and Rescue (SAR) activity in the region is undertaken by the Irish Coast Guard, with SAR helicopter bases located at Dublin, Waterford, Shannon, and Sligo. SAR aircraft may transit over the Irish Sea in response to emergency situations, although their operations in this area are infrequent and typically routed to maximise efficiency and safety. Meteorological radar coverage of the east coast is provided by Met Éireann radars at Dublin and Shannon airports. The nearest installation, at Dublin Airport, is situated approximately 30 nautical miles from the Offshore Site. ABWP Phase I currently complies with required marking and aviation relevant to aeronautical safeguards.
Major accidents and natural disasters	Biological Hazards – Epidemics / Animal and Insect Infestation: Introduction of INNS is a potential risk during the Proposed Works Offshore Mass movements: The Offshore Site is located within the Arklow Bank sandbank, known for its strong dynamism with frequent sand movements. ABWP Phase I has effectively managed scour risks associated with the sandbank movements. Fire risks: Offshore Site contain equipment and materials (e.g., electrical components, oils, fuels, temporary storage during decommissioning) that could, under abnormal conditions, pose a fire risk. Terrorist incidents / Criminal action: There is a potential, though low, risk of targeted attacks (including terrorism, acts of war, sabotage or cyber-attacks) on Proposed Works Offshore.

2.3 Proposed Works Offshore and Consideration in the Comparative Assessment

2.3.1.1 **Table 2.2** provides an overview of the offshore infrastructure to be decommissioned, noting which components are included in the CA. It should be noted that the focus of the CA is on options that are considered technically feasible, environmentally responsible, and economically viable.

Table 2.2: Offshore infrastructure to be decommissioned and consideration in the CA

Component / Sub-component	Description	Consideration in the CA
WTG	A total of seven GE Energy 3.6sl (3.6 MW) WTGs will be decommissioned. Each WTG broadly comprises the subcomponents detailed below.	No. WTGs will be subject to full removal as they have reached the end of their design life and alternatives, such as repowering or retrofitting, are not considered technically feasible or economically viable, see **Volume 2, Chapter 2: Description of Alternatives**.
Nacelle	The nacelle sits on top of the tower, housing the yaw system, gearbox, generator, transformer and auxiliary control systems. The hub is made of ductile cast iron and houses the blade pitching mechanisms.	
Blade	Three blades made of epoxy resin/ glass fibre with a length of 50.5 m and approx. weight of 13 tonnes (t) each per turbine, forming a rotor (104 m diameter).	
Tower	There are two tubular steel tower sections connected by a bolted flange, 57 m high. Diameter is 5.4 m at the bottom and 3.4 m at the top.	
TPs	Located between each of the WTGs / met mast and their associated foundations. The interface between TPs and MPs is a grout connection. The TPs of the WTGs are made of steel, with a diameter of 5.4 m, length of 15.3 m and weight of 87.1 t (132 t including accessories). The met mast's TP, also made of steel, measures 2 m in diameter, 16.5 m in length and weighs 35 t.	**Yes**. There are different options that are considered feasible for TPs, although these are considered in combination with foundation decommissioning, given that decommissioning or otherwise of both components would be undertaken at the same stage.
Foundations (MPs)	All seven WTGs sit on MP foundations of 5.1 m diameter and lengths between 42 and 45 m, weighting between 252 t and 281 t. The MP at the met mast has a diameter of 1.8 m and weight of 47.5 t.	**Yes**. There are different options that are considered feasible for TPs, although these are considered in combination with TP decommissioning, given that decommissioning or otherwise of both components would be undertaken at the same stage. It should be noted that although there are significant differences in the dimensions of MPs at WTGs and the met mast, for practical purposes and to facilitate comparison of options, all MPs have been treated in the same way.
Scour Protection	Rock armour remains, as only rock armour exposed / accessible was removed in 2005 after proving ineffective. In subsequent years, sandbags were filled with sand from the Offshore Site and were placed around the bases of the MPs.	No. Scour protection sandbags will be removed when it is identified and located during the pre-decommissioning surveys. The sandbags will be lifted using a grab dredger or similar method. Alternatives, such as leaving visible sandbags *in situ*, is not considered environmentally responsible.
Inter-array cables	The total length of inter-array cables is approx. 7.4 km, originally buried. A cable position and burial depth survey completed in 2007 noted that inter-array cables were buried in sandwaves of approx. 0.5 m to 1 m depths, and although seabed levels can vary across the Sub Lease	**Yes**. There are different options that are considered feasible for inter-array cables.

Component / Sub-component	Description	Consideration in the CA
	Area, accordingly, it is considered reasonable to assume that inter-array cables will be located within 3 m below the seabed level at the time of decommissioning.	
Offshore export cable	The offshore export cable has an approximate length of 15.6 km, and was originally buried throughout its length. Cable position and burial depth surveys undertaken in 2010, found the export cable buried between 0 m and 0.5 m. The latest survey conducted in 2025, which combined Side Scan Sonar (SSS) with Remotely Operating Vehicle (ROV) deployment, suggests that the offshore export cable is largely covered except for three short sections, including the section of the offshore export cable that overlays the aforementioned wreck remains. Accordingly, it is considered reasonable to assume that the offshore export cable will be located within 3 m below the seabed level at the time of decommissioning.	**Yes**. There are different options that are considered feasible for the offshore export cable.
Met Mast	The met mast comprises a number of meteorological sensors located at different heights, a lattice tower with an overall length of 60 m and weight of approximately 10 t, and a triangular platform. The met mast was intended to record wind data pre-construction and stopped working in 2005. The met mast also includes three marine lanterns as Aids to Navigation (ATONs) and a functioning web local area network (LAN) camera mounted on the met mast which is currently operational and used for onshore sea condition monitoring.	No. The met mast will be subject to full removal as it is currently not working, and without an operational offshore wind farm within the Offshore Site, it will no longer be needed, see **Volume 2, Chapter 2: Description of Alternatives**.

3 Comparative Assessment Process

3.1 Overview

3.1.1.1 The framework for conducting the CA uses qualitative and quantitative data to evaluate the alternative decommissioning options identified. A scoring system is used to assess each of the decommissioning options considered.

3.2 Comparative Assessment Workshops

3.2.1.1 Two workshops were held with Arklow Energy on 24 March 2025 and 25 February 2026 to discuss:

- The scenarios and options to be considered in the CA;
- Review and confirm proposed evaluation criteria, sub-criteria and scorings;
- Review and confirm weighting to be applied; and
- Review and confirm approach to sensitivity analysis.

3.2.1.2 Participants included:

- Arklow Energy
  - Chris Delahunt, Operations Manager
  - Anne-Marie Coyle, Director
- Ramboll
  - Fernando Gallego, Chief Consultant (Offshore Wind Advisory)
  - Marie-Antoinette Schwarzkopf, Senior Consultant (Offshore Wind Advisory)
  - Matt Royall, Principal (Environmental Consultant)
  - Kim Bridge, Senior Managing Consultant (Marine Environment)
  - Sara Méndez Roldán, Senior Environmental Consultant

3.2.1.3 The criteria and methodology to assess each option / scenario were reviewed during the workshops, modified where necessary and agreed upon, before progressing with the CA. Using the agreed criteria and methodology, the team then considered each decommissioning option in turn, within their area of expertise, assigning impact values and weighting values to generate an overall assessment of the decommissioning options under each scenario.

3.3 Definition of Decommissioning Options and Assumptions

3.3.1.1 Decommissioning options were identified in consultation with Arklow Energy (see **Section 3.2**) and based on current industry practice**.**

3.3.1.2 An initial identification and review of partial and full decommissioning methods and supporting technologies was undertaken considering the characteristics of offshore infrastructure and those of the Offshore Site, presented in **Appendix A: TP/MP and Cable Decommissioning Methods and Supporting Technologies.**

3.3.1.3 Assumptions were developed using the initial identification and review of methods and supporting technologies presented **Appendix A**, and engagement with the supply chain undertaken by Arklow Energy.

3.4 Assessment Criteria and Scoring

3.4.1.1 The assessment criteria were derived from the issues set out in Annex 2 of OSPAR Decision 98/3 (OSPAR, 2024), which were modified to suit the context of the Proposed Works Offshore (see **Volume 2, Chapter 1: Introduction**).

3.4.1.2 Five main assessment criteria were adopted:

- Safety, considering risks to decommissioning workers, other sea users and offshore infrastructure;
- Environment, considering potential environmental impacts during and after decommissioning activities. However, it should be noted that this CA does not integrate a

detailed environmental impact assessment, which shall be performed once preferred options are selected by Arklow Energy;
- Technical feasibility, considering practical and engineering considerations;
- Societal, considering how stakeholders and third party uses may be affected by decommissioning options; and
- Cost, considering economic considerations associated with decommissioning activities and long-term liability costs.

3.4.1.3 These were further broken down to provide a set of sub-criteria that address both the decommissioning phase effects and post-decommissioning effects.

3.4.1.4 **Table 3.1** presents the broad set of sub-criteria, organised under the above five main criteria, initially identified in consultation with Arklow Energy (**Section 3.2**), screened for relevance and merged where sub-criteria were found to overlap with the aim of obtaining a manageable number of criteria to meaningfully compare and assess decommissioning options.

Table 3.1: Broad set of sub-criteria initially identified and justification of their further consideration in the Comparative Assessment

Long list of Sub-criteria	Further considered in the Comparative Assessment?	
Safety		
Risks to personnel offshore	**Y**	Considers the potential risk of harm or fatality to personnel working offshore based on the nature of the job (e.g. heavy lifting, cutting works, handling of tensioned cables, MP structural failure risks, etc), working conditions (e.g. personnel exposure hours), environmental hazards (e.g. changing seabed conditions, weather-related operational risks, etc) and emergency preparedness that may impact the safety of offshore personnel.
Risks to third parties and assets	**Y**	Considers safety risk posed to third parties and their assets. It involves evaluating the likelihood of vessel collision, accidental damage, spills, or other incidents that may adversely affect third-party properties or personnel considering the use of the Offshore Site.
Environmental		
Alteration of environmental sensitive receptors	**Y**	Considers potential disturbance, damage or injury to environmental sensitive receptors, including marine biodiversity and heritage assets, based on the nature of the job (e.g. increased vessel activity, introduction of light and airborne / underwater noise, interactions with the seabed, etc), or opportunities for recovery, growth and preservation of environmental sensitive receptors.
Extent of seabed disturbance	**Y**	Considers the anticipated extent of seabed disturbance during seabed interaction activities (e.g. dredging and disposal activities that may be required to facilitate safe vessel access, anchoring, footprint of jack-up legs, cable removal works, etc) and associated effects, including sediment plume generation that may affect water quality, changes to seabed morphology and potential destabilisation of sandbank features.
Alteration of scour dynamics	**Y**	Considers potential alteration of scour dynamics introduced by decommissioning options, both in the short and long-term, mainly relevant to MP decommissioning options.
Alteration of benthic habitats	N	Considers loss of artificial reef habitat, disturbance of benthic communities during Proposed Works Offshore, or opportunities for habitat creation and benthic habitat recovery. These are considered to be already covered under "alteration of environmental sensitive receptors".
Disturbance to marine fauna	N	Considers potential airborne / underwater noise impacts, vessel collision risk / strike with marine megafauna, disturbance to potential fish spawning and nursery areas, or attraction/aggregation effects. These are considered to be already covered under "alteration of environmental sensitive receptors".
Alteration of water quality	N	Considers release of contaminants from disturbed sediments and accidental oil/chemical/debris spills based on the nature of the job. However, it is standard practice in offshore operations to develop and adhere to appropriate accidental spill response protocols to prevent and mitigate accidental spills, and therefore the same level of risk would apply across all decommissioning options considered. In addition, contamination from sediment disturbance is already considered to be covered under "extent of seabed disturbance".

Long list of Sub-criteria	Further considered in the Comparative Assessment?	
Increase of greenhouse gas (GHG) emissions	**Y**	Considers GHG emissions resulting from Proposed Works Offshore, particularly vessel activity, which depends on the number and type of vessels required, as well as fuel type and duration of activities.
Carbon footprint	N	Considers the overall carbon footprint of Proposed Works Offshore, including GHG emissions, use of energy and raw material consumption, carbon release through sediment disturbance and carbon footprint associated with waste management options. This assessment would need a separate life cycle assessment, which has been excluded on the basis of having GHG emissions and material recovery as separate sub-criteria considered in the CA. It should also be noted that mobile sandbanks are generally considered minor / ineffective carbon sinks, so the exclusion of this factor is considered justified.
Material recovery	**Y**	Considers the amount of material that can be recovered as part of the works for reuse / recycling.
Technical Feasibility		
Technical complexity	**Y**	Considers how complex the different offshore operations are, i.e. complex operations in which greater experience / higher skilled / less available, more specialised contractors are required and in which there is more risk associated with the operation, are negatively scored.
Method maturity and precedented application	**Y**	Considers the current technology readiness (TRL) of methods and tools associated with each decommissioning option, as well existing experience applying these to relevant contexts.
Vessel availability	**Y**	Considers the capabilities of vessel required (e.g. deck space, crane capacity, dredging capacity, etc.), which is directly linked to the vessel availability on the market, i.e. requirement for large, less available vessels are negatively scored.
Weather sensitivity	**Y**	Considers how vulnerable each decommissioning option is with regards to weather downtime. This depends on the vessel requirements, programme duration, vessel and associated operations resistance to adverse weather and sea states.
Duration of Proposed Works Offshore	**Y**	Considers the time required to execute each decommissioning option and represents a score of the full duration of each campaigns required to successfully execute the operations. Given that 2025 bathymetry is used as a basis, in the evaluation of MP partial / full removal options, this sub-criterion is strongly influenced by the duration of required dredging works rather than the duration of the actual removal operation of each TP/MP.
Societal		
Disturbance to commercial / recreational marine users	N	Considers alterations to access by commercial and recreational users during the execution of decommissioning options, which are considered to be already covered under "risks to third parties and assets".
Compatibility with future use of the Offshore Site	**Y**	Considers potential residual impacts on third-party activities such as fishing, navigation, and anchoring in the long-term, including consideration of how seabed dynamics could influence post-decommissioning exposure risks to infrastructure left in situ or partially removed, and implications to third parties.
Cost		
Total cost	**Y**	Considers the direct and indirect costs of decommissioning options, including vessel charter costs, costs associated with waste handling and recycling, project management and engineering, monitoring post-decommissioning, and risk and contingency, particularly high where there is uncertainty and/or high risks of weather downtime to affect decommissioning options.
Residual liability	**Y**	Considers the likelihood of liability risks and associated costs to Arklow Energy post-decommissioning, including monitoring and remediation, should this be necessary

3.4.1.5 Each sub-criterion was given an ordinal score based on a four-point scale ranging from least preferred (1) to most preferred (4). The scoring is based on measurable and option-relevant proxies where possible. This means that, for instance, the assessment for the third-party risks is based on the complexities of marine spread, vessel activities, and vessel interactions with other users; the assessment for greenhouse gas emissions is based on indicative vessel use and

duration of activities; and finally, the assessment for resource recovery is based on recoverable resources and the availability of reuse, recycle, and disposal options.

3.4.1.6 The weighting factors for the sub-criteria are based on expert judgment developed through the comparative assessment workshops (**Section 3.2**) and allow applying the "weighted sum method" (WSM) commonly used in CAs, where the overall score for each option is the sum of weighted scores across all criteria:

$$Total\ Score = \sum(weight \times score)$$

3.4.1.7 The WMS method allows combining qualitative and quantitative factors, but it does have limitations, like assuming that criteria are independent and additive, potential oversimplification of environmental or social trade-offs and heavy reliance on chosen scores and weights.

3.4.1.8 Criteria, sub-criteria, weighting and scoring applied in this CA are presented in **Table 3.2**.

3.4.1.9 The quantitative and qualitative assessment used in the CA is based on a range of sources including regional and Offshore Site-specific data and wider expert knowledge of experience in the strategic and project level assessment of offshore wind construction, operation and decommissioning activities. Inherent uncertainties associated with each decommissioning option have been considered in the CA, described in detail to justify how uncertainties and conservative assumptions have informed scoring.

Table 3.2: Criteria, sub-criteria, scoring used in the comparative assessment of decommissioning options

Criteria	Sub-criteria	Weighting and Justification	Scoring			
			1	2	3	4
Safety	Risk to personnel offshore	17%. Given the relatively limited use of the Offshore Site by third parties, particularly within the Sub Lease Area, the safety of personnel is considered of higher importance than the risk to third parties or assets, and therefore given a higher weighting.	High risk: The likelihood of incidents is high, and potential impacts could be severe or catastrophic. Safety measures are considered critical and rigorous.	Significant risk: The likelihood of incidents is high, with moderate to severe potential impacts. Requires thorough safety measures and constant monitoring.	Moderate risk: The likelihood of incidents is modest, and potential impacts are manageable with effective safety protocols.	Low risk: The likelihood of incidents is very low, and potential impacts are negligible with comprehensive safety measures in place.
	Risk to third parties and assets	8%. As above.	High Risk: high number of vessel trips to and from the Site and duration of / outcomes from activities significantly increases risks of collision and/or accidental damage that could affect third parties.	Moderate risk: moderate number of vessel trips to and from the Site and duration of / outcomes from activities moderately increases risks of collision and/or accidental damage that could affect third parties.	Low risk: low number of vessel trips to and from the Site and duration of / outcomes from activities barely increases risks of collision and/or accidental damage that could affect third parties.	Very low risk: very low number of vessel trips to and from the Site and very short duration of / outcomes from activities poses a negligible increase in risks of collision and/or accidental damage that could affect third parties.
Environment	Alteration of environmental sensitive receptors	9%. Overall alteration of environmental sensitive receptors is considered of higher importance than the rest of environmental criteria, as it encompasses potential risks associated with a range of decommissioning activities potentially affecting a range of environmental sensitive receptors during and post-decommissioning.	Significant alteration anticipated, with medium/high risk of damage or injury to environmental sensitive receptors over a medium/long period of time.	Moderate alteration anticipated, with medium risk of damage or injury to environmental sensitive receptors over a short/medium period of time.	Some disturbance anticipated, with low risk of damage or injury to environmental sensitive receptors over a short period of time.	No / minimal disturbance anticipated, with no /very low risk of damage or injury to environmental sensitive receptors and/or opportunities for recovery / preservation.
	Extent of seabed disturbance	5%. The extent of seabed disturbance is considered of moderate importance as seabed interaction activities, particularly those associated with potential dredging, have the potential to generate sediment plumes that could have wide range of effects,	Extent of seabed disturbance anticipated to be significant and over a medium/long period of time.	Extent of seabed disturbance anticipated to be moderate and over a short/ medium period of time.	Extent of seabed disturbance anticipated to be localised and temporary.	Extent of seabed disturbance anticipated to be none or negligible.

Criteria	Sub-criteria	Weighting and Justification	Scoring			
			1	2	3	4
		depending on the magnitude of seabed interaction.				
	Alteration of scour dynamics	3%. The seabed within the Offshore Site and the wider sandbank is highly dynamic, and therefore any post-decommissioning scour would be anticipated to be temporary in nature and likely infill in response to seabed dynamics. Accordingly, this sub-criterion is considered to be of low importance.	High risk of MP sections protruding above seabed level / high risk of scour to take place post-decommissioning with any potential impacts of large scale and significant effect on regional sediment dynamics.	Moderate risk of MP sections protruding above seabed level / moderate risk of scour to take place post-decommissioning with any potential impacts of medium scale and moderate effect on regional sediment dynamics.	Low risk of MP sections protruding above seabed level / low risk of scour to take place post-decommissioning with any potential impacts highly localised and low effect on regional sediment dynamics.	Negligible risk of MP sections protruding above seabed level / negligible or no risk of scour to take place post-decommissioning, with negligible effect on regional sediment dynamics.
	Increase of GHG emissions	3%. The contribution of vessel activity to GHG emissions is anticipated to be relatively small within the context of greenhouse gas emissions by the wider maritime industry in Ireland, and therefore this sub-criterion is considered to be of low importance.	High number of vessel trips to and from the Offshore Site and/or long duration of vessel activity.	Moderate number of vessels trips to and from the Offshore Site and/or long/medium duration of vessel activity.	Low number of vessels trips to and from the Offshore Site and/or short duration of vessel activity.	Very low number of vessels trips to and from the Offshore Site and/or long/medium duration of vessel activity and very low duration of activities.
	Material recovery	5%. There are differences in the amount of material that could be recovered and that can be used for other purposes or recycled, and therefore this sub-criterion is considered of moderate importance.	No material / a low proportion of material could be recovered	A moderate proportion of material could be recovered	A large proportion of material could be recovered	All material could be recovered
Technical Feasibility	Technical complexity	5%. The criteria regarding the applicability of the tool or methods in question, and associated risks of failure, are considered of moderate importance.	Very complex operation, including the involvement of complex offshore lifts and use of high risk equipment.	Complex offshore operation.	Standard offshore operation.	Very simple offshore operation involving low complexity / low risk equipment.
	Method maturity and precedented application	7%. Method maturity and precedented application is weighted highest among the technical feasibility criteria, as it considers technology readiness and previous experience that would reduce uncertainty on	Concept and Research (TRL 1-3): Concept formulated and / or proof of concept with no / very limited practical experience.	Development (TRL 4-5): Method validated in lab and / or validated in relevant environment.	Demonstration (TRL 6-7): Technology demonstrated in a relevant and/ or operational environment.	Deployment (TRL 8-9): System complete and qualified and / or actual system proven in operational environment.

Criteria	Sub-criteria	Weighting and Justification	Scoring			
			1	2	3	4
		successful implementation. TRL is used as a proxy.				
	Vessel availability	4%. Vessel availability is considered of moderate importance, as part of the risk associated with this sub-criteria can be managed to some extent with early planning / investments.	High number of vessels required for long periods of time, including large floating crane or large JUV (+1,000mt crane)	Moderate number of vessels required for medium/long periods of time, including large floating crane or large JUV (+600mt crane)	Moderate number of vessels required for short/medium periods of time, including medium-sized JUB (+300mt crane)	Low number of vessel required for short periods of time, mainly including small construction vessels.
	Weather sensitivity	2%. Weather sensitivity is considered of significant importance, as it determines the actual feasibility of executing the Proposed Works Offshore. However, given that programme estimates consider potential weather downtime / equipment failure, its weighting has been reduced to minimise double-counting.	Critical Sensitivity: Project execution is severely impacted with continuous weather downtime, necessitating major delays and substantial extensions to the project timeline.	High Sensitivity: Frequent disruptions from weather downtime, requiring careful scheduling adjustments and mitigation strategies.	Moderate Sensitivity: Occasional weather downtime, manageable within the project schedule.	Low Sensitivity: Project execution minimally affected by weather conditions.
	Duration of Proposed Works Offshore	7%. Considers whether the offshore work duration has an impact on serval other factors such as safety, cost and timeline of the Proposed Works Offshore and is therefore ranked second highest among the technical criteria.	Long (> 4 months) / multiple campaigns	Long (> 4 months) / one single campaign	Short (< 4 months) / multiple campaigns	Short (< 4 months) / one single campaign
Societal	Compatibility with future use of the Offshore Site	10%.	Closed access to the Offshore Site	Some / moderate restricted access to the Offshore Site	Limited restricted access to the Offshore Site	Access to Offshore Site unrestricted
Cost and Residual Liability	Total cost	5%. Considers the overall cost of executing Proposed Works Offshore based on complexity and programme, assessed qualitatively. This sub-criteria is considered less important than residual liability, given the long-term nature of the latter.	High cost	Medium/high cost	Medium/low cost	Low cost

Criteria	Sub-criteria	Weighting and Justification	Scoring			
			1	2	3	4
	Residual liability	10%. As above.	High risk of residual liability with associated high costs.	Moderate risk of residual liability with associated moderate costs.	Low risk of residual liability with associated low costs.	Negligible risk of residual liability with minimal costs.

3.5 Sensitivity Analysis

3.5.1.1 A sensitivity analysis was conducted to understand how the different variables affect the scoring system using the "Eliminating One Criterion at a Time" sensitivity check, which has the purpose of assessing the robustness of the scoring system without a particular criterion by removing one criterion completely and evaluating the changes in the overall scores. This test shows how dependent the scoring system is on individual criteria. If the removal of certain criteria has a significant impact on the scores, then these criteria are crucial, and the overall evaluation may be sensitive to changes in them.

3.5.1.2 By performing this sensitivity check, it's possible to gain insights into:

- Which criteria are most influential.
- How the scoring system handles variability.

3.5.1.3 This kind of analysis ensures that the scoring system is robust, fair, and comprehensive, making it suitable for informed decision-making.

4 Decommissioning Options Included in the Comparative Assessment

4.1 Overview

4.1.1.1 **Table 4.1** outlines the options that were considered and taken forward in the CA, indicating references used across this CA.

Table 4.1: Overview of decommissioning options considered in the CA

Offshore infrastructure	Decommissioning option	Description	Option ID
TP/MP	Do-nothing	This option would leave the TP/MP *in situ* and entirely intact. This option may provide an artificial reef effect, supporting marine life in the long-term until the collapse of infrastructure. Without regular maintenance, there would likely be structural degradation that could lead to collapse or fragmentation. Without the integration of navigational aids, navigational risks would be introduced, increasing liability costs. This option is therefore not considered environmentally responsible or economically viable.	N/A
	Retain *in-situ*	Following decommissioning of WTGs, TPs/MPs would be retained *in situ* with installation of navigational aids to minimise navigational risks, and minimal maintenance in perpetuity to extend the structural integrity of both components in the long-term. After removal of the WTG the internal area of the TP will be exposed to the environment. It is expected that the weight of accumulating water will pose a structural risk over time. However, there is uncertainty on how long it would take for these components to eventually corrode, which could lead to collapse or fragmentation. This option may provide an artificial reef effect, supporting marine life in the long-term until the collapse of infrastructure takes place.	MP-A
	Partial removal (2 m)	Following decommissioning of WTGs and TPs, MPs would be cut 2 m below seabed level encountered at the time of decommissioning, in line with standard industry practice and as envisaged in the Decommissioning & Reinstatement Plan. This option would require dredging of the soil plug inside the MP before the cut can be performed, see **Section 4.2**, and would not necessarily minimise the risks of MP post-decommissioning exposure given the high mobility of the sandbank within the Offshore Site.	MP-B
	Partial removal (LSBL P2)	Following decommissioning of WTGs and TPs, MPs would be cut below the seabed to a level defined to minimise to possibility of re-exposure. Assuming the lowest seabed level (LSBL) predicted considering a time horizon up to 2070 and a probability percentile of 2% (P2)*, the length of MP to be removed in order to minimise the possibility of exposure is set out below. Whilst seabed mobility may result in cuts being performed at different depths below the seabed level, subject to the Offshore Site conditions encountered at the time of decommissioning, the target cutting depths would be fixed for each MP, as follows: • T1: -8.34 m Low Astronomical Tide (LAT) • T2: -6.59 m LAT • T3: -8.55 m LAT • T4: -8.09 m LAT	MP-C

Offshore infrastructure	Decommissioning option	Description	Option ID
		• T5: -6.67 m LAT • T6: -8.89 m LAT • T7: -9.75 m LAT • Met mast: -10.55 m LAT	
	Full removal	Following decommissioning of WTGs and TPs, MPs would be fully extracted using a vibration tool.	MP-D
Inter-array cables	Do-nothing	This option would leave inter-array cables *in situ,* with no remediation, maintenance or monitoring.	IAC-A
	Retain *in situ*	This option would retain inter-array cables in situ, with any exposed sections re-buried and maintenance, remediation and monitoring continued in perpetuity. However, the effort of reburial and long-term maintenance makes this option not economically viable.	N/A
	Partial removal	This option would cut sections of the inter-array cables exposed and leaving the rest of the cables buried and *in situ.* However, risks of cables becoming exposed post-decommissioning could not be ruled out, and the effort required to complete cutting operations in comparison to full removal does not make this option advantageous in comparison	N/A
	Full removal	Inter-array cables would be fully removed.	IAC-B
Offshore export cable	Do-nothing	This option would leave the offshore export cable *in situ,* with no remediation, maintenance or monitoring.	EXC-A
	Retain *in situ*	This option would retain the offshore export cable *in situ*, with any exposed sections re-buried and maintenance, remediation and monitoring continued in perpetuity. However, the effort of reburial and long-term maintenance makes this option not economically viable.	N/A
	Partial removal	This option would cut sections of the offshore export cable exposed and leaving the rest of the cable buried and *in situ.* However, risks of cable becoming exposed post-decommissioning could not be ruled out, and the effort required to complete cutting operations in comparison to full removal does not make this option advantageous in comparison.	N/A
	Full removal	The offshore export cable would be fully removed.	EXC-B

*The MP target cutting depth under this option has been defined using the numerical model developed to inform **Volume 3, Appendix 4.1: Seabed Mobility Assessment**, which predicts the LSBL that will be reached at each MP location within the model timescales (up to 2070). The second probability percentile (P2) LSBL is considered to represent a very low and rare seabed level value that will minimise post-decommissioning MP exposure risks.

4.2 Screening of Methods and Supporting Technologies

4.2.1.1 Methods and supporting technologies considered further in the CA are summarised in **Table 4.2**.

Table 4.2: Overview of partial and full removal methods and supporting technologies selected for further consideration in the CA.

Methods / Supporting Technologies		Further considered in this CA? Yes / No (justification)
Soil Plug Dredging Technologies (inside the MP)	Air Lift Dredgers	No. Air lift dredgers are not considered suitable for soil plug dredging because of their potential limitations in small sized MPs, such as those supporting the met mast.
	Direct-Operated Pump (DOP) dredger	**Yes.** DOP dredgers are considered a suitable method for internal MP dredging.
	Soil Plug removal Tool (SPRT)	**Yes**. Soil Plug Removal tools refers to a specialised heavy-duty tool for the removal of soil plug and the internal cleaning of subsea piles.

Methods / Supporting Technologies		Further considered in this CA? Yes / No (justification)
MP Cutting Technologies	Internal abrasive waterjet cutting (AWC)	**Yes.** Internal AWC is considered the most suitable option for MP cutting, as it avoids the need for external dredging around MPs, the deployment of divers / ROV, removal of marine growth or higher noise emissions that would be required to facilitate an external cut (see below).
	External AWC	No. In contrast with internal AWC, among other disadvantages, external cutting technologies would require additional external dredging for MP cuts below seabed level.
	Diamond wire cutting (DWC) (external)	
	Oxy fuel cutting (external)	
MP Full Removal Technologies	Vibro-lifting	**Yes.** Vibro-lifting is considered the most suitable method for MP full removal, and has already been used in full removal projects for smaller MPs.
	Overpressure	No. In contrast with vibro-lifting, among other disadvantages, overpressure methods are not readily available in the market for MP removal at present.
TP/MP lifting / Upending Technologies	Internal lifting tool	No. Internal AWC and vibro-lifting tools normally incorporate internal lifting tools, however, the use of internal or external lifting tools has no relevant implications in relation to safety, environmental, technical feasibility, societal or cost and residual liability considerations, and are not further considered in this CA.
	External lifting tool	
Friction reduction / sand liquefaction		**Yes.** Friction reduction or sand liquefaction will be required to facilitate MP extraction under some decommissioning options. Different methods can be applied for this purpose, however, given that these have no significantly different implications in relation to safety, environmental, technical feasibility, societal or cost and residual liability considerations, these are not distinguished in this CA.
Cable Removal Technologies	Running methods (grapnel run / detrenching grapnel)	**Yes.** Cable removal using a running method is considered the most suitable method for cable removal in cable burial depths within 3 m from the seabed level.
	Remotely Operated Vehicle (ROV) jetting	No. Cable removal using ROV jetting is not considered suitable for the Offshore Site given the high sensitivity of the method to adverse weather conditions and programme implications.
	Mechanical trenching	No. Cable removal using mechanical trenching is considered the most suitable method for cable removal in cable burial depths deeper than 3 m from the seabed level. However, it is considered reasonable to assume that the offshore export and inter-array cables are located within 3 m from the seabed level, and therefore mechanical trenching is not considered further.
	Mechanical flow excavation (MFE)	No. Cable removal using MFE, although efficient in cable burial depths deeper than 3 m from the seabed level, has significantly higher environmental impacts than mechanical trenching. However, it is considered reasonable to assume that the offshore export and inter-array cables are located within 3 m from the seabed level, and therefore MFE is not considered further.
	Cable reburial	No. Reburial of exposed sections of cables would not remove risks of cables becoming exposed again post decommissioning and the effort of reburying cables would equate to cable removal options. Accordingly, this option is not further considered in this CA.
Pre-decommissioning surveys, including ROV inspection		No. Pre-decommissioning surveys, including ROV inspection will be required across all MP / cable full / partial removal options with no significantly different implications in relation to safety, environmental, technical feasibility, societal or cost and residual liability considerations, and accordingly, this is not further considered in this CA.
Gangways and / or Motion compensated platforms		No. The use of gangways and / or motion compensated platforms will be required across all MP / cable full / partial removal options with no significantly different implications in relation to safety, environmental, technical feasibility, societal or cost and residual liability considerations, and accordingly, this is not further considered in this CA.
Vessels	Jack Up Barge (JUB)	**Yes.** JUBs are considered the most suitable vessel for partial MP removal options, as these allow to fix the positioning of the vessel during works, ensuring these can withstand strong currents and / or adverse sea states.
	Jack Up Vessel (JUV)	**Yes.** JUVs are considered the most suitable vessel for the full MP removal option, as these allow to fix the positioning of the vessel during works and ensure sufficient crane capacity is available for lifting works, JUVs can also withstand strong currents and / or adverse sea states.

Methods / Supporting Technologies		Further considered in this CA? Yes / No (justification)
	Sheerlegs	No. Sheerlegs are not considered suitable for Proposed Works Offshore, as these are highly vulnerable to strong currents and / or adverse sea states.
	Transport Barge	**Yes.** Although JUBs/JUVs may have sufficient deck capacity to temporarily store decommissioned components, this depends on the selected vessel and deck layout / capacity. Accordingly, it is assumed that all partial / full MP removal options may require supporting transport barges.
	Multi-Purpose Vessel (MPV)	**Yes.** MPVs are considered the most suitable vessel for cable removal works given their reduced draught.
	Subsea Construction Vessel (SCV)	No. Due to their large size, SCVs are not considered suitable to support cable removal works.
	Deck Carrier	No. Due to their large size, Deck Carriers are not considered suitable to support Proposed Works Offshore.
	Dredging Vessel	**Yes.** Dredging vessels may be needed to facilitate safe site access. Different dredging methods could be used, however, there would be no significantly different implications in relation to safety, environmental, technical feasibility, societal or cost and residual liability considerations, and accordingly, different dredging methods are not further considered in this CA.

4.3 Decommissioning Options and Assumptions Considered in the Comparative Assessment

4.3.1.1 **Table 4.3** presents the decommissioning methods and supporting technologies assigned to each decommissioning option considered in the CA, as well as key assumptions developed to inform the CA.

Table 4.3: High level summary of decommissioning methods and assumptions

Decommissioning Methods and Assumptions	Decommissioning Options for TPs/MPs				Decommissioning Options for Inter-array and Offshore Export Cables	
	MP-A (Retain *in situ*)	MP-B (2 m cut)	MP-C (LSBL P2 cut)	MP-D (Full removal)	IAC-A / EXC-A (Do-Nothing)	IAC-B / EXC-B (Full removal)
Removal Operations	• Remove any loose components • Installation of navigational aids • Periodic corrosion maintenance (e.g. painting / anode replacement)	• Following the removal of the TP, internal dredging of MP using DOP dredger or SPRT, up to 3 m below target cutting depth • Internal cutting of MP • Lifting and transfer of MP section to the JUB and/or transport barge		• Installation of vibration tool • MP extraction, lifting and transfer of MP to the JUV and/or transport barge • Removal of vibration tool	• Cable cutting at landfall (EXC-B)	• Deployment of running method • Cable cutting at landfall (EXC-B) • Cable cutting *in situ* / on deck
Supporting Technologies	N/A	N/A	• Friction reduction / sand liquefaction	• Friction reduction / sand liquefaction	N/A	N/A
Post-decommissioning requirements	Assumed maintenance is undertaken with increased frequency in perpetuity	Assumed some monitoring required within a few years following decommissioning to monitor potential exposure risks and implications on the sandbank		None assumed beyond post-decommissioning surveys	None assumed as current risks would just persist	None assumed beyond post-decommissioning surveys
Amount of material recovered	• Negligible	1,023.47 t	1,170.63 t	2,461,99 t	8.45 t (conductor only)	125,52 t (conductor only)
Vessel Requirements	• Crew Transfer Vessel (CTV)	• JUB + 300 metric tonnes (mt) crane • Transport barge • 2 small tugboats • Dredging vessel supported by a small tugboat and a barge or small survey vessel		• JUV + 600 mt crane • Transport barge • 2 small tugboats • Dredging vessel supported by a small tugboat and barge or small survey vessel	• MPV	• MPV
Maximum number of vessel trips generated*	• 6 vessel trips on any given day (for	• 7 vessel trips on any given day (for all seven vessel types)		• 7 vessel trips on any given day (for all seven vessel types)	• 2 vessel trips per day / campaign	IAC-B • 2 vessel trips per day

Decommissioning Methods and Assumptions	Decommissioning Options for TPs/MPs				Decommissioning Options for Inter-array and Offshore Export Cables	
	MP-A (Retain *in situ*)	MP-B (2 m cut)	MP-C (LSBL P2 cut)	MP-D (Full removal)	IAC-A / EXC-A (Do-Nothing)	IAC-B / EXC-B (Full removal)
	all three vessel types) • 6 vessel trips per campaign (for all three vessel types)	• 40 vessel trips within a given campaign (assuming dredging required in 5 vessel access channels)		• 52 vessel trips within a given campaign (assuming dredging required in 7 vessel access channels)		• 16 vessel trips per campaign EXC-B • 2 vessel trips per day • 19 vessel trips per campaign
Seabed level depth required to facilitate vessel access	N/A	-6 m LAT	-6 m LAT	-8 m LAT	N/A	N/A
Max Dredging Volumes (see Appendix A)	N/A	191,827.475 cubic meters (m^3) (potential maintenance dredging of up to 95,913.7375 m^3)**		392,435 m^3 (potential maintenance dredging of up to 225,650.125 m^3)**	N/A	N/A
Programme***	Very short campaign (<1 week) but repeated in perpetuity for maintenance purposes	• Anticipated duration of TP/MP partial removal is 9.5 days per TP/MP (76 days in total) • Additional time for potential dredging required to facilitate safe vessel access, estimated at 30 days based on 2025 bathymetry.		• Anticipated duration of TP/MP full removal is 8 days per TP/MP (64 days in total) • Additional time for potential dredging required to facilitate safe vessel access, estimated at 70 days based on 2025 bathymetry.	Very short campaign (<1 week) for EXC-A	• IAC-B is anticipated to take up to 20 days • EXC-B is anticipated to take up to 35 days
Cost****	High Cost	Medium Cost		High Cost	Low Cost	Medium Cost

*One vessel trip equals one way between the designated port and the Offshore Site or vice versa
**Total maintenance maximum dredging volumes have been estimated as 50% of the total maximum dredging volume across all vessel access channels, which may be needed to maintain the target water depth throughout the duration of the Proposed Works Offshore.
***It is assumed that Proposed Works Offshore that can be undertaken within four months can be undertaken within a single campaign / season
****Qualitative assessment only, based on option complexity, duration and frequency. E.g. although individual maintenance campaigns required as part of MP-A may have a very low/low cost, these are assumed to be required in perpetuity until feasible, with potential for them to become more costly as structures start to deteriorate, with an overall high cost.

5 Comparative Assessment Evaluation

5.1.1.1 The following section provides a narrative summary of the CA outcomes for the different decommissioning options, discussed relative to its performance across the sub-criteria.

5.2 Safety

5.2.1 Risk to Personnel Offshore

5.2.1.1 Although the safety risk to offshore personnel is considered manageable when appropriate safety protocols are followed, this assessment evaluates the potential for harm or fatality based on job nature, offshore working conditions, environmental hazards, and the level of emergency preparedness.

5.2.1.2 Regarding MP decommissioning, the level of risk is considered higher for MP-A given the uncertainty associated with structural failure risks associated with TP/MP abandonment, as even though maintenance is assumed to be applied in perpetuity, the risk of corrosion and fragmentation potentially leading to collapse cannot be ruled out, and if occurring during maintenance works, could introduce significant risks to personnel.

5.2.1.3 The level of risk for MP partial removal options (MP-B, MP-C) are considered similar, as they both involve the use of heavy machinery and lifts, and high-risk activities, such as cutting and internal dredging. However, these are considered manageable through the implementation of effective safety protocols. In contrast, the level of risk for full MP removal (MP-D) is considered relatively higher due to the increased technical complexity, risk of failure, and extended use of friction removal technologies and potential requirement for alternate solutions if the initial machinery fails to deliver extraction. In addition, if considering 2025 bathymetric conditions, associated dredging works, assumed to be required to facilitate safe vessel access during MP-D, introduce additional challenges and the potential need for increased maintenance dredging.

5.2.1.4 Regarding cable decommissioning, heavy machinery is used for cutting both inter-array and offshore export cables in IAC-B and EXC-B, and these operations are widely applied and well-known. In principle, any risks are considered negligible with appropriate safety measures in place.

5.2.1.5 The 2025 Side Scan Sonar (SSS) and ROV survey along the offshore export cable route (see **Volume 3, Appendix 5.2: Benthic/Live Habitat Cable Survey and Observations Log**) identified some sections of the cable exposed, and given previous burial depths recorded (between 0 and 0.5 m deep) and that seabed mobility along the route is considered relatively limited, the offshore export cable is considered likely to be located within 3 m from seabed level, and a low complexity running method could be deployed for cable recovery. Similarly, although the 2025 SSS and ROV survey across the Sub lease Area did not identify any exposed sections of the inter-array cables, previous surveys recorded cables in sandwaves of approximately 0.5 m to 1 m depths, and it is considered reasonable to assume that inter-array cables will be located within 3 m from the seabed level at the time of decommissioning.

5.2.2 Risks to Third Parties and Assets

5.2.2.1 The second safety criterion concerns the risk to third parties or assets, evaluating the likelihood of accidental damage, vessel collisions, spills, or other incidents that could negatively impact third-party properties / personnel, which is measured in relation to the anticipated number of vessel trips, duration of works and any residual risks.

5.2.2.2 In this regard, the number of vessel trips and overall duration of works remains consistent across both partial MP removal options (MP-B, MP-C), and given the relatively low use of the Sub Lease Area by third parties, the overall risk is considered to be low. The risk increases in both MP-A and MP-D options. In MP-A due to uncertainty around catastrophic failure of TP/MP integrity, although considered of low probability given the reduced use of the Sub Lease Area by third parties; and in MP-D due to the extended duration of the works, particularly influenced by assumed dredging operations that would be required to ensure safe vessel access.

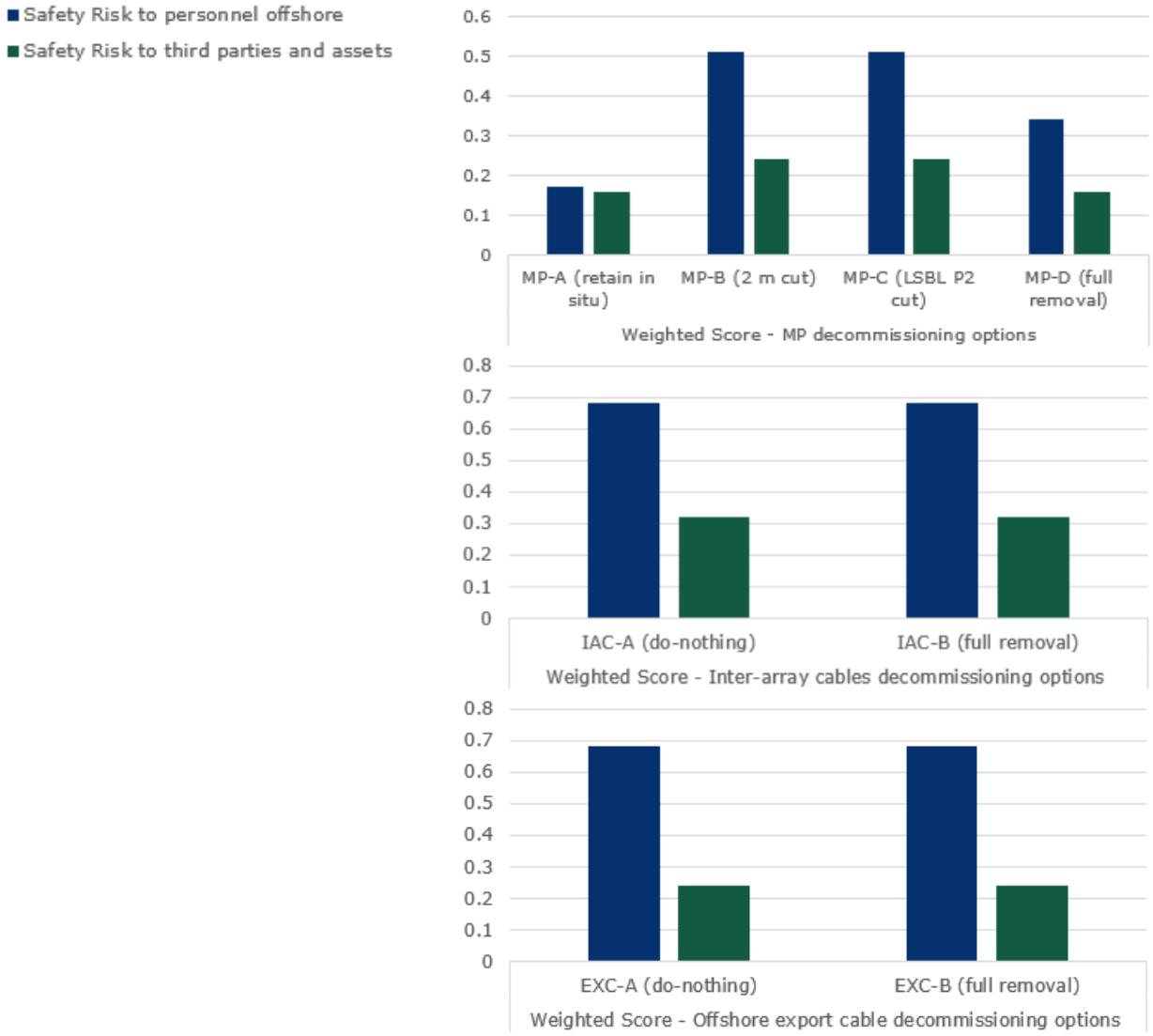
5.2.2.3 For the complete removal of the cables (IAC-B, EXC-B), only a low number of vessel trips would be needed during relatively short time. However, the fact that wreck remains lie below the

offshore export cable route and there is higher vessel activity within the vicinity of the offshore export cable route leads to a low risk scoring overall.

5.2.2.4 On the other hand, the scoring of do-nothing options (IAC-A and EXC-A) are considered to differ due to the current / future use of the areas where cable lie, relatively lower in the Sub Lease Area, and therefore scored as very low risk, than along the offshore export cable route, scored as low risk overall.

5.2.3 Safety Weighted Score

5.2.3.1 The charts below illustrate the weighted score for each decommissioning option considered in relation to safety criteria.



5.3 Environment

5.3.1 Alteration of Environmental Sensitive Receptors

5.3.1.1 Among the MP decommissioning options, MP-D represents the option introducing the largest alterations to the marine environment, mainly due to the increased level of dredging required to support decommissioning works and associated programme extension. Overall risks of disturbance or injury to marine biodiversity receptors are considered greater than in the case of partial removal options MP-B and MP-C. For instance, underwater noise generated during MP extraction would be generated for a longer period of time, given that the increased length of the MP to be lifted would introduce higher friction forces that would take longer to be overcome.

5.3.1.2 In the case of MP-A, although initial TP/MP preparations and maintenance campaigns in isolation would only involve limited vessel activity and negligible seabed interaction, and retaining TPs/MPs intact could introduce opportunities for marine biodiversity growth, the fact that maintenance would be required with increased frequency in perpetuity, and uncertainty around the point at which TPs/MPs would fail and collapse (affecting any marine growth achieved in the long-term), means that some level of alteration still needs to be assumed.

5.3.1.3 Regarding cable decommissioning, removal options (IAC-B, EXC-B) would both have relatively localised interaction with the seabed, and given the short duration of works and low number of vessels involved, overall disturbance on marine ecological receptors would be considered limited and short-term. The risk of alteration in heritage assets is relatively higher in EXC-B due to the presence of wreck remains laying below the offshore export cable, which could be affected by cable recovery works. In contrast, do-nothing options (IAC-A, EXC-A) would not introduce pathways for disturbance to sensitive receptors.

5.3.2 Extent of Seabed Disturbance

5.3.2.1 During MP removal, seabed disturbance would be caused by partial and full MP removal options, considered localised in the case of partial MP removal options (MP-B, MP-C) and moderate in the case of full MP removal (MP-D), mainly due to potentially increased intensity of friction removal works during lifting operations and increased level of dredging assumed to be required to facilitate safe vessel access.

5.3.2.2 The retention of TPs/MPs *in situ* (MP-A) would introduce no / negligible pathways for seabed disturbance.

5.3.2.3 Regarding cable decommissioning, only full removal (IAC-B, EXC-B) would generate seabed disturbance, however, this would be of relatively limited scale and of short-term nature.

5.3.3 Alteration of Scour Dynamics

5.3.3.1 Post-decommissioning scour risks would only be relevant to MP decommissioning options, higher in the case of retaining the full length of the MP in situ (MP-A), see **Volume 3, Appendix 4.3: Scour Assessment,** relatively lower in the case of partial removal with a cut of 2 m below seabed level at the time of decommissioning (MP-B), and considered negligible in the case of cutting the MP at LSBL P2, defined to minimise the probability of post-decommissioning exposure risks, and full removal (MP-D), in which case risks would be fully eliminated.

5.3.4 Increase of Greenhouse Gas (GHG) Emissions

5.3.4.1 Increase of GHG emissions associated with each decommissioning option reflects the number of vessels involved and duration of vessel activity in the field, and associated fuel consumption.

5.3.4.2 The retention of the TP/MP (MP-A) and partial MP removal options (MP-B, MP-C) have been scored equally, as although maintenance of the retained TP/MP would introduce minimal vessel activity during each maintenance campaign, these would repeat with increased frequency in the long-term.

5.3.4.3 Although the number of vessels / vessel trips that would be engaged during partial MP (MP-B, MP-C) and full MP removal options (MP-D) would be similar, the fact that MP-D would require more extensive dredging, potentially requiring more than one campaign, scores MP-D more negatively.

5.3.4.4 Regarding cable decommissioning, although full removal (IAC-B, EXC-B) would introduce some level of vessel activity, this is considered of short-term nature and overall scored as very low, and equivalent to the do-nothing options (IAC-A, IAC-B).

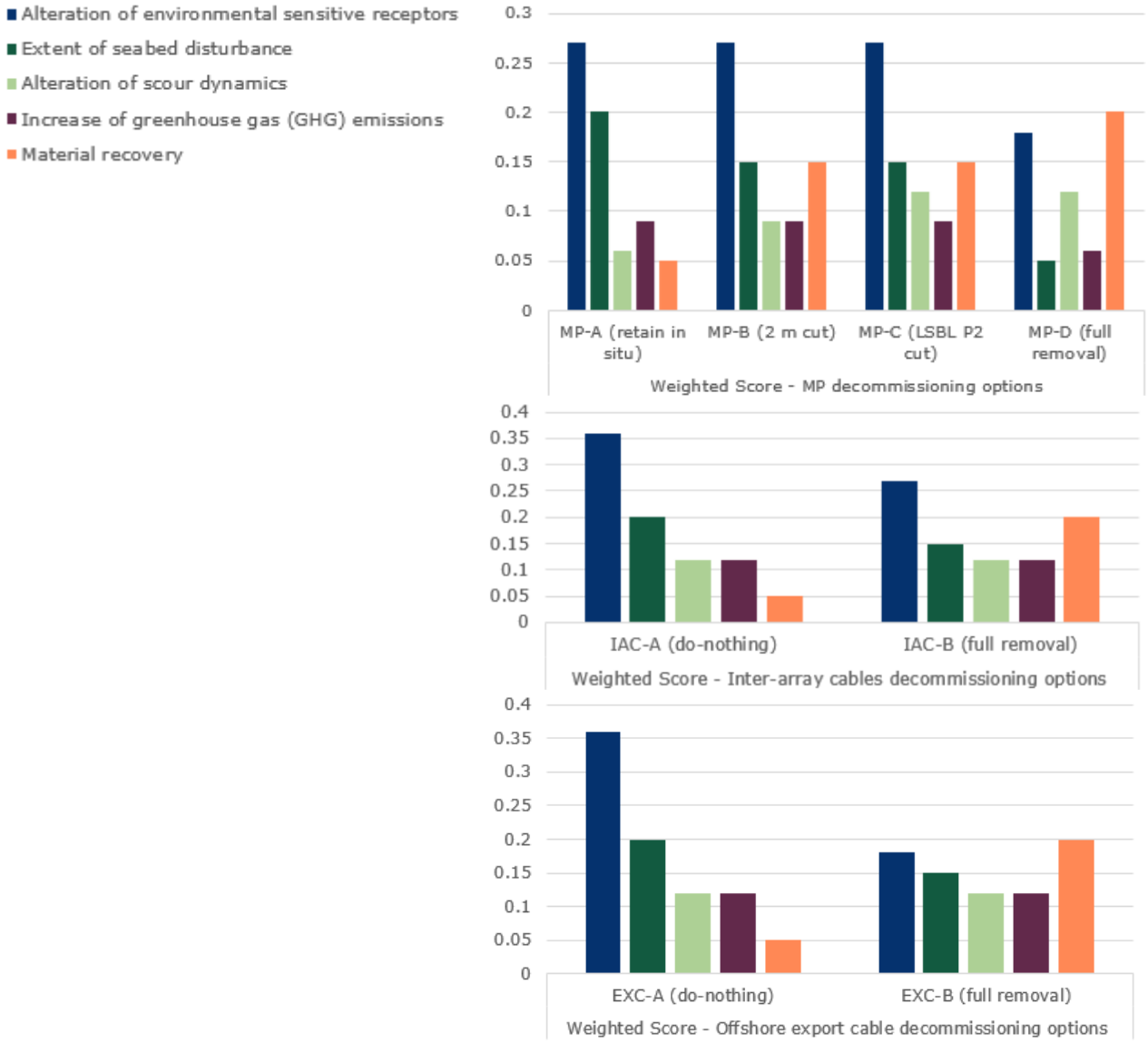
5.3.5 Material Recovery

5.3.5.1 The recovery of material for each of the MP decommissioning options reflects the length of MP extracted under each option, where partial MP removal options (MP-B, MP-C) represent a relatively lower amount of steel recovered from MP decommissioning in comparison to the full MP removal option (MP-D), which would maximise opportunities for steel reuse / recycling. No material recovery would be undertaken under MP-A.

5.3.5.2 Regarding cable decommissioning, full removal of inter-array and offshore export cables (IAC-B, EXC-B) would allow recovering metal conductors from cables for reuse or recycling, something that would not be possible under options IAC-A and IAC-B.

5.3.6 Environment Weighted Score

5.3.6.1 The charts below illustrate the weighted score for each decommissioning option considered in relation to environmental criteria.



5.4 Technical Feasibility

5.4.1 Technical Complexity

5.4.1.1 The partial MP removal options (MP-B, MP-C) involve deployment of existing technologies albeit on a larger scale due to the weights and dimensions of the foundations. After cutting, the MP section may need to be down ended onto the vessel's deck, which requires additional specialised handling equipment. Furthermore, to overcome shaft friction from the remaining embedded section, friction reduction techniques may be required, adding to the method's complexity. Should a vibration tool, a technology already widely applied outside decommissioning (e.g. in offshore wind installation projects), be used for this purpose, given that these are equipped with a down ending tool, an easy lifting and down ending process of the MP stump would be possible.

5.4.1.2 In the full MP removal option (MP-D), the use of a vibration tool would also facilitate extraction and lifting operations. As shown in **Table 7.3** in **Appendix A** there are currently only three extractions which have been attempted and not under the varying seabed conditions experienced within the Offshore Site. Additionally, the success of this method is highly dependent on the interaction between the MP and the surrounding soil, which introduces a higher level of variability and uncertainty in execution, and therefore associated technical complexity / risk.

5.4.1.3 Partial and full MP removal options differ considerably regarding the assumed level of shaft friction (which increases with higher seabed levels), potential dredging required, which not only influences the complexity of dredging operations (e.g. increased dredging may lead to increased risks of vessel access channel infill and maintenance dredging requirements) but also lifting weights associated with potential marine growth on the MP, as this depends on water depths. Bathymetry conditions are therefore considered to have a strong influence on technical complexity of MP removal methods.

5.4.1.4 In the case of retaining the MP *in situ* (MP-A), although in principle, maintenance campaigns in offshore wind farms can be considered standard offshore operations, given the uncertainty associated with the structural failure risks associated with TP/MP retention, maintenance operations may become increasingly complex as these structural failure risks increase over time.

5.4.1.5 In the case of cable decommissioning the marine operations associated with cable removal (IAC-B, EXC-B) and related lifting and cutting works are considered widely known and applied with a proven track record.

5.4.2 Method Maturity and Precedented Application

5.4.2.1 This criterion assesses the maturity and proven application of the tools proposed for the decommissioning options. In the case of partial MP removal (MP-B, MP-C), the technologies involved — namely internal cutting and dredging tools — are well-established and have a strong track record in offshore decommissioning operations albeit with much smaller diameter piles and sections. These methods are considered technically mature, with minimal uncertainty regarding performance and implementation, corresponding to a TRL of 8–9.

5.4.2.2 For the full MP removal option (MP-D), the proposed use of a vibration tool is based on the method that has been successfully applied in MP installation projects and, in a limited number of cases, for MP removal (see **Table 7.3**). One documented case involved a comparable embedment duration (24+ years), although the pile diameter in the referenced examples were smaller than those of the MPs supporting the WTGs at ABWP Phase I. The overall method proposed for full removal options has seen only limited application in full decommissioning contexts. Further research and demonstration is still required to validate performance across a broader range of soil types, MP diameters, and consolidated soil conditions after decades of embedment. As such, MP-D is assessed at a lower TRL of 6–7, reflecting their partial demonstration and the remaining need for real-world validation under varied site conditions. Additionally, the size of vessel required to accommodate the necessary craneage would require greater water depth than that likely to be present within the Offshore Site at the time of decommissioning.

5.4.2.3 In the case of cable decommissioning the marine operations associated with cable removal (IAC-B, EXC-B) and related lifting and cutting works are considered technically mature, with minimal uncertainty regarding performance and implementation, corresponding to a TRL of 8–9.

5.4.3 Vessel Availability

5.4.3.1 This sub-criterion evaluates the technical requirements of the vessels involved — such as deck space, crane capacity, and draughtt — and how these influence their availability on the market.

5.4.3.2 In the case of partial MP removal (MP-B, MP-C), the MP lifting weights and crane capacity anticipated to be needed is lower than for the full MP removal option (MP-D). This enables the use of JUBs with smaller lifting capacities, which are generally more readily available on the market. Additionally, their smaller draughtt improves accessibility to the Offshore Site reducing the need for dredging activities and use of dredging vessels.

5.4.3.3 In contrast, the full removal option (MP-D) would involve the highest MP weights, requiring increased crane capacities and anticipated use of a JUV to manage these heavy lifts safely. However, JUVs can be considered to be less available than JUBs on the market and the range of

reduced draughts is considered more limited, increasing the possibility of requiring more extensive dredging works, both in terms of temporal and magnitude of scale, to guarantee safe vessel accessibility.

5.4.3.4 In the case of cable full removal options (IAC-B, EXC-B), a MPV, such as a multicat vessel, is anticipated to be sufficient to manage works, overall considered to have a high availability on the market and of which the lead time shall not pose a challenge to the Proposed Works Offshore programme. In the event that the cables are not removed but left in place (IAC-A, EXC-A), no vessel would be required, with the exception of that used during pre-/post-decommissioning surveys.

5.4.4 Weather Sensitivity

5.4.4.1 This sub-criterion assesses the susceptibility of the decommissioning option to weather-related delays, particularly in relation to wind speeds, wave conditions, and marine currents.

5.4.4.2 In relation to MP decommissioning options, the degree of weather sensitivity is largely influenced by the type of vessel(s) used, their stability in offshore conditions, and the operational limits for lifting activities.

5.4.4.3 All MP decommissioning options are affected by the strong site currents and prevailing wind conditions. For JUBs assumed in partial MP removal (MP-B, MP-C), current conditions influence positioning during preloading and jacking, but once jacked-up, the platform remains stable and the potential impact of waves or current is considered to be manageable. However, wind speed becomes the primary limiting factor, especially due to the high number of lifts required throughout the operation.

5.4.4.4 Similarly, although the JUV assumed to be required for full MP removal (MP-D) is considered to be less sensitive to adverse weather / sea state conditions, especially once jacked-up due to its larger size, programming of works will also favour favourable weather windows to minimise downtime risks during positioning operations.

5.4.4.5 The retention of the MP in situ (MP-A) is assumed to solely require a small CTV to perform maintenance activities. Given the small dimensions of CTVs and high vulnerability to adverse weather / sea state conditions, maintenance works will be limited to short weather windows.

5.4.4.6 For the decommissioning of the cables (IAC-B, EXC-B), weather sensitivity is expected to be relatively limited in relation to wind speeds, but operations may be vulnerable to high scale waves and strong currents. These options are therefore scored as of moderate sensitivity.

5.4.5 Duration of Proposed Works Offshore

5.4.5.1 This sub-criterion evaluates the time required to execute decommissioning options, considering whether works could be completed within a single campaign, defined as within four months during favourable weather conditions, or otherwise.

5.4.5.2 In partial MP removal options (MP-B, MP-C), the use of AWC is considered to increase the actual time required to prepare MPs for lifting in comparison to the full MP removal option (MP-D). The internal dredging of the MPs, however, would prolong this operation, relatively higher for MP-D.

5.4.5.3 The duration of lifting operations would be directly influenced by the level of shaft friction, potentially increasing with increased lengths of MPs, particularly for MP-D, which would also be subject to relatively higher levels of uncertainty around higher shaft friction risks, particularly after long-term embedment depth, which could lead to unanticipated delays and extended offshore durations despite the inherently faster extraction mechanism.

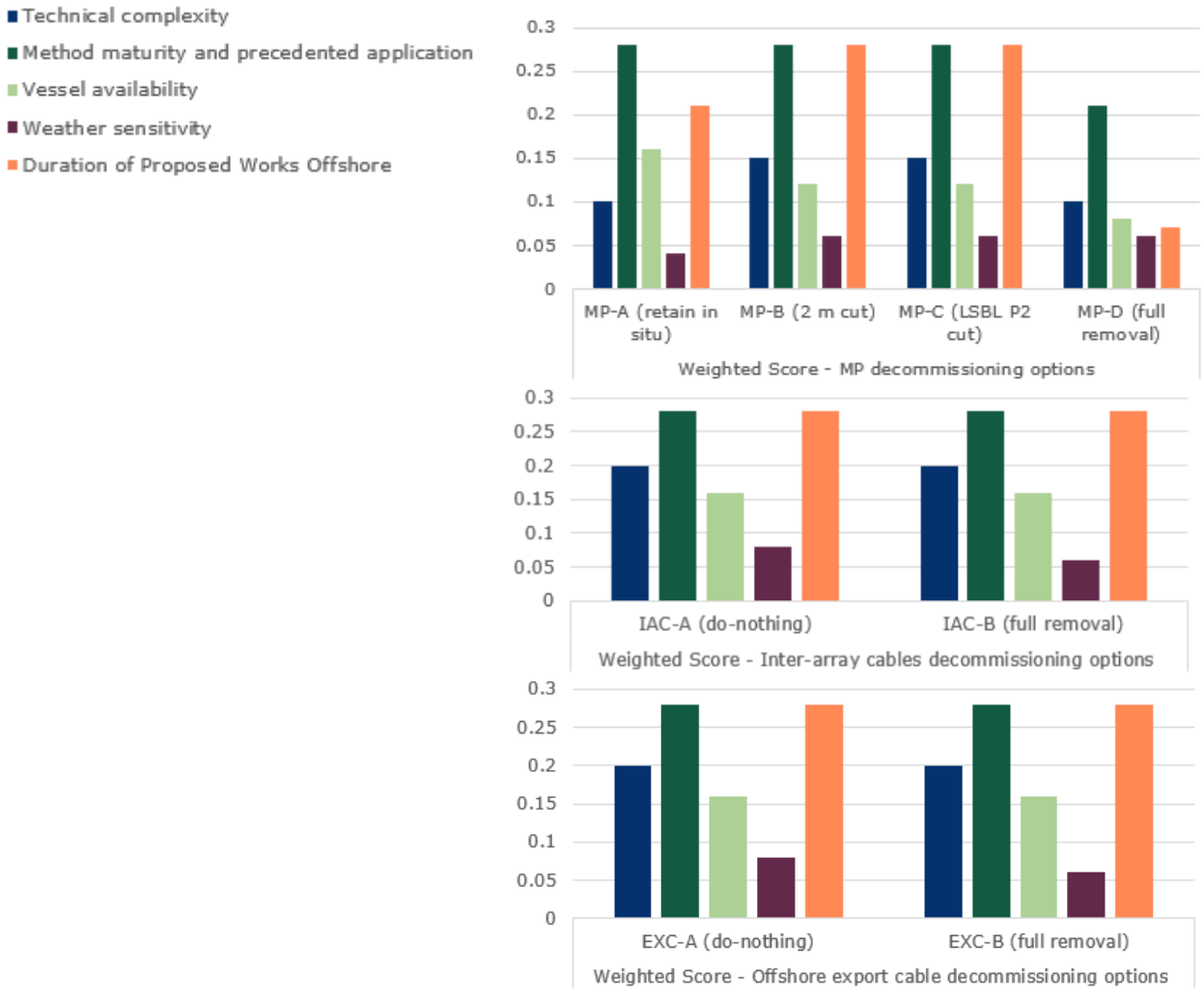
5.4.5.4 The duration of assumed dredging works would also need to be factored into the overall duration of works' execution, as depending on bathymetric conditions, these could increase the time required to secure safe vessel access. Considering the 2025 bathymetry, it is assumed that whilst the execution of partial MP removal options (MP-B, MP-C) would be achieved within four months and within a single campaign, there are higher risks for full MP removal (MP-D) to extend is programme beyond this 4-month threshold, potentially requiring more than one campaign.

5.4.5.5 In the case of retaining the MP *in situ* (MP-A), although maintenance campaigns are anticipated to be of very short duration, multiple campaigns are assumed to be required in perpetuity until structural integrity of the TP/MP fails.

5.4.5.6 For cable decommissioning, the full removal of the offshore export cable (EXC-B) will require a relatively longer programme than the full removal of inter-array cables (IAC-B) due to differences in cable length and diameter, which would increase the number of vessel trips to and from the Offshore Site and overall duration of works. However, in both decommissioning options, works would be anticipated to be executed within 4 months in a single campaign.

5.4.6 Technical Feasibility Weighted Score

5.4.6.1 The charts below illustrate the weighted score for each decommissioning option considered in relation to technical feasibility criteria.



5.5 Societal

5.5.1 Compatibility with Future Use of the Offshore Site

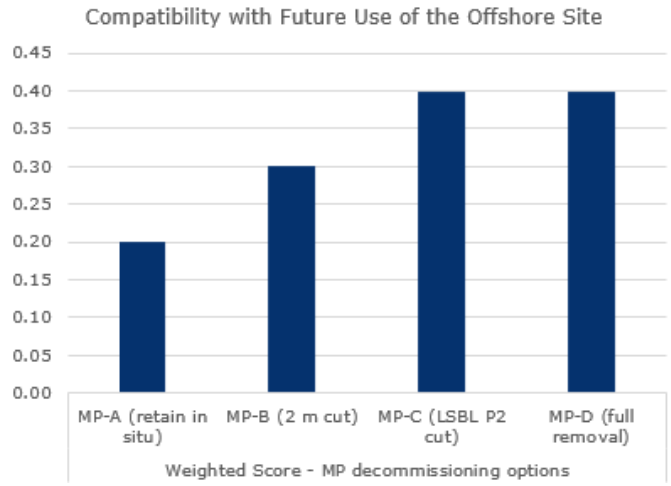
5.5.1.1 This criterion considers potential residual impacts on third-party activities, including consideration of how sediment movement and the presence of exposed or buried residual MPs may influence the safe and unrestricted use of the Offshore Site, within the context of its current use.

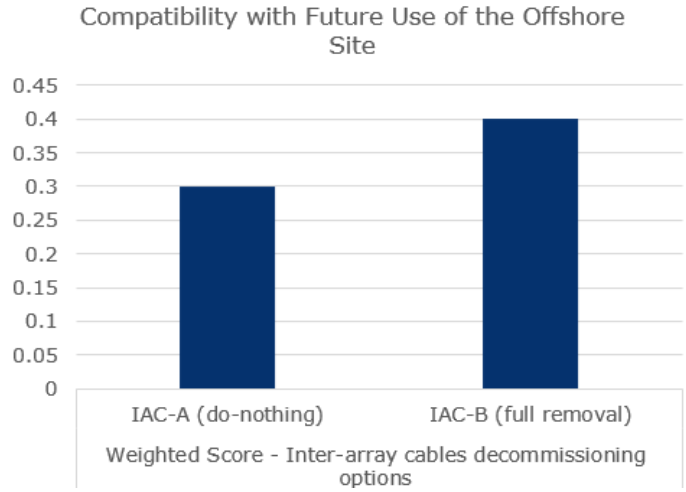
5.5.1.2 The presence of ABWP Phase I WTGs within the Sub Lease Area does not currently pose access restrictions, except at the WTG locations. It could be argued that there is currently limited access or restricted undertaking of certain activities along the offshore export cable route due to its presence and risks it may pose to anchoring and/or fishing activities. Although this current situation would persist with the retention of MP *in situ* (MP-A) and with do-nothing options selected for cables (IAC-A, EXC-A), the retention of infrastructure could represent a constraint for other activities over time, and risk is therefore scored as moderate for MP-A and EXC-A and

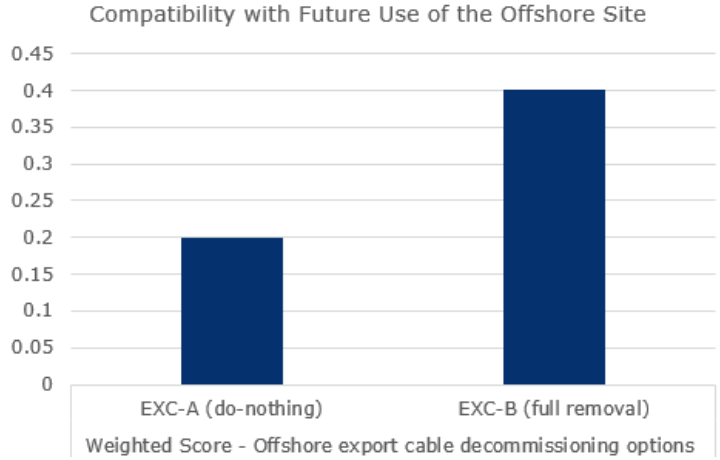
limited for IAC-A given the current low usage of the Sub Lease Area by activities that would require interaction with the seabed.

5.5.1.3 In contrast, full MP / cable removal (MP-D, IAC-B, EXC-B) and MP partial removal option MP-C, are considered to pose unrestricted access to the Offshore Site, given the absence of infrastructure and the very low probability of post-decommissioning exposure risks intended with the implementation of MP-C, which has been informed by predicted seabed level dynamics.

5.5.1.4 The charts below illustrate the weighted score for each decommissioning option considered in relation to this criterion.







5.6 Cost and Residual Liability

5.6.1 Total Cost

5.6.1.1 The total cost associated with the execution of decommissioning options has been evaluated qualitatively.

5.6.1.2 In the case of retaining MP *in situ* (MP-A), although each individual maintenance campaign is considered likely to be of relatively lower cost than any other MP decommissioning option, the fact that maintenance works will need to be programmed in perpetuity, with potential for increased frequency as the TP/MP structures approach structural failure, maintenance costs could become increasingly costly. Given the uncertainty of the temporal scale associated with this decommissioning option, it has been scored negatively.

5.6.1.3 Both MP partial removal options (MP-B, MP-C) are considered of relatively similar cost given commonalities in the methods, technologies and programme involved, and overall considered of lower cost in comparison to the full MP removal option, mainly influenced by the more extensive dredging works assumed to be required when considering the 2025 bathymetry data, which impacts on programme and duration throughout which dredging vessel will need to be engaged, increasing overall costs; and the anticipated need for a larger JUV vessel, considered to be more costly than a JUB.

5.6.1.4 In the case of the cable decommissioning options, full removal options (IAC-B, EXC-B) introduce higher costs in comparison to the do-nothing option (IAC-A, IAC-B), which would be limited to survey activity.

5.6.2 Residual Liability

5.6.2.1 This sub-criterion considers potential post-decommissioning liability risks and associated costs, including any post-decommissioning monitoring or maintenance that may be required.

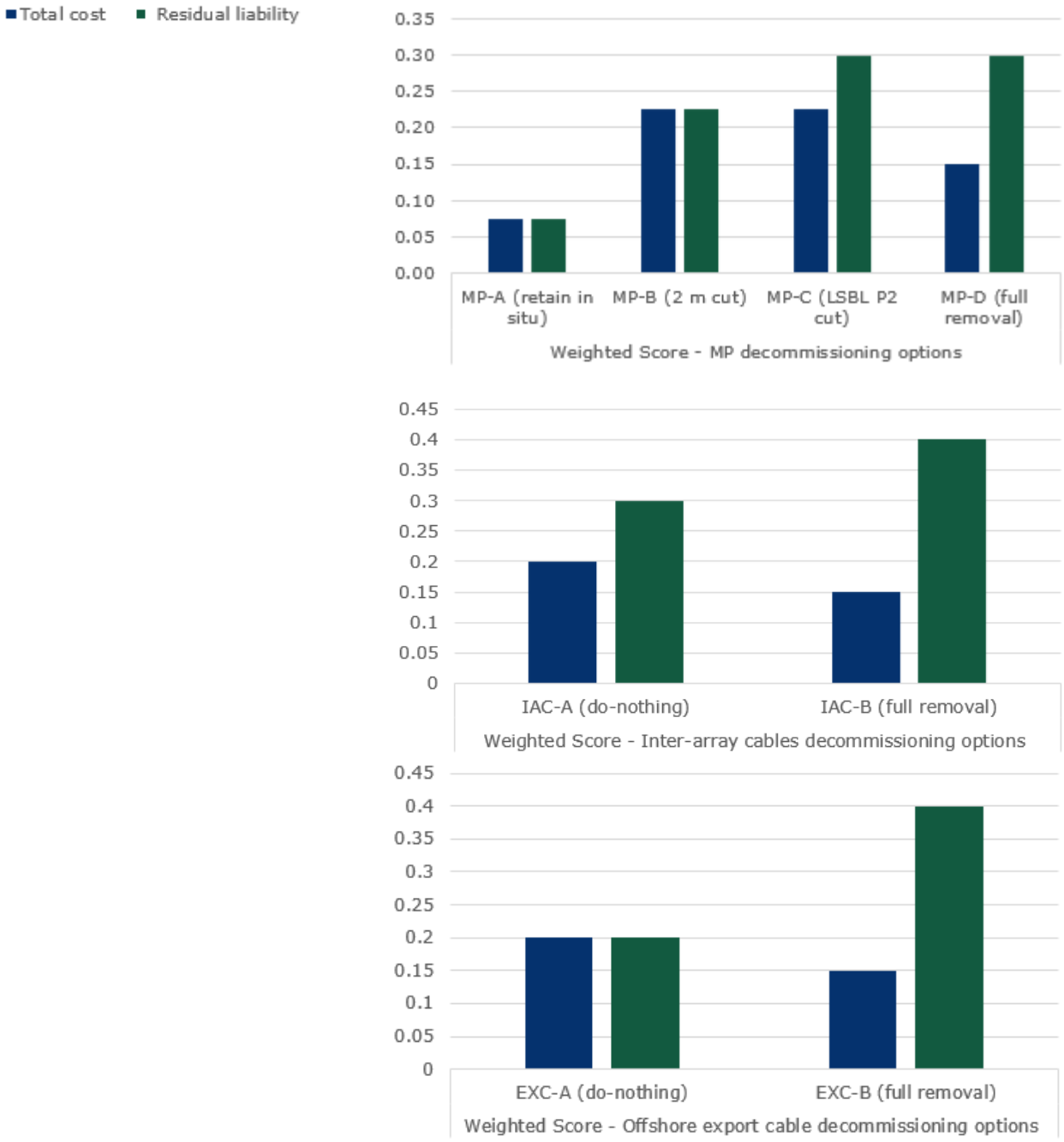
5.6.2.2 The retention of MPs in situ (MP-A) introduces the highest residual liability risks and in cases of accidental failure involving workers and/or third parties, these could result in high liability costs to Arklow Energy. The scoring has been defined as moderate given the relatively low usage of the Sub Lease Area by third parties.

5.6.2.3 In partial MP removal options (MP-B, MP-C), there is a possibility of residual MPs becoming exposed post-decommissioning as a result of the seabed mobility conditions experienced within the Offshore Site. However, MP-C has been defined to minimise these risks, considered therefore to be very low probability, and therefore equivalent to a full MP removal option (MP-D). The costs of post-decommissioning monitoring anticipated for MP-B and MP-C are considered to have a low bearing given their limited timespan.

5.6.2.4 In the case of cable decommissioning, do-nothing options (IAC-A, EXC-A) are consider to result in moderate risks of residual liability and associated costs, relatively lower for IAC-A due to the low usage of the Sub lease Area by third parties, mainly given that cables will be de-energised and would be the main asset affected in case of interaction with an anchor or dredging works. In contrast, full removal options (IAC-B, EXC-B) would eliminate any residual liability risks completely.

5.6.3 Cost Weighted Score

5.6.3.1 The charts below illustrate the weighted score for each decommissioning option considered in relation to cost criteria.


Total cost
Residual liability
0.35
0.30
0.25
0.20
0.15
0.10
0.05
0.00
MP-A (retain in situ)
MP-B (2 m cut)
MP-C (LSBL P2 cut)
MP-D (full removal)
Weighted Score - MP decommissioning options
0.45
0.4
0.35
0.3
0.25
0.2
0.15
0.1
0.05
0
IAC-A (do-nothing)
IAC-B (full removal)
Weighted Score - Inter-array cables decommissioning options
0.45
0.4
0.35
0.3
0.25
0.2
0.15
0.1
0.05
0
EXC-A (do-nothing)
EXC-B (full removal)
Weighted Score - Offshore export cable decommissioning options

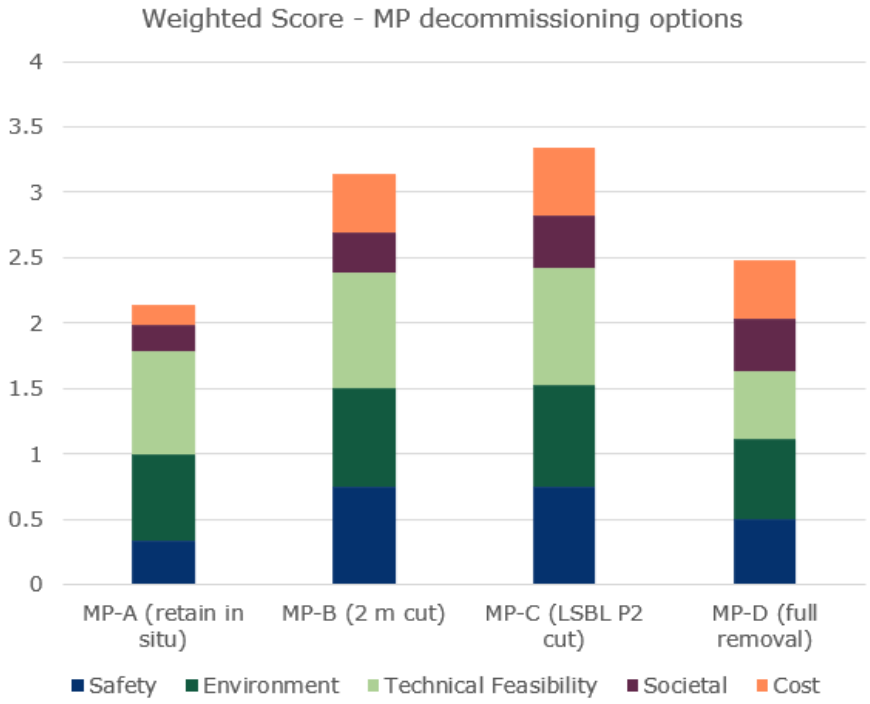
6 Summary and Final Recommendations

6.1.1.1 The charts below summarise the overall weighted score for each decommissioning option considered in relation to each of the five criteria assessed. **Appendix B: Scoring Matrix Summary and Sensitivity Analysis** presents additional detail of the assessment, including tabulated weighted scores for each decommissioning option / sub-criterion.

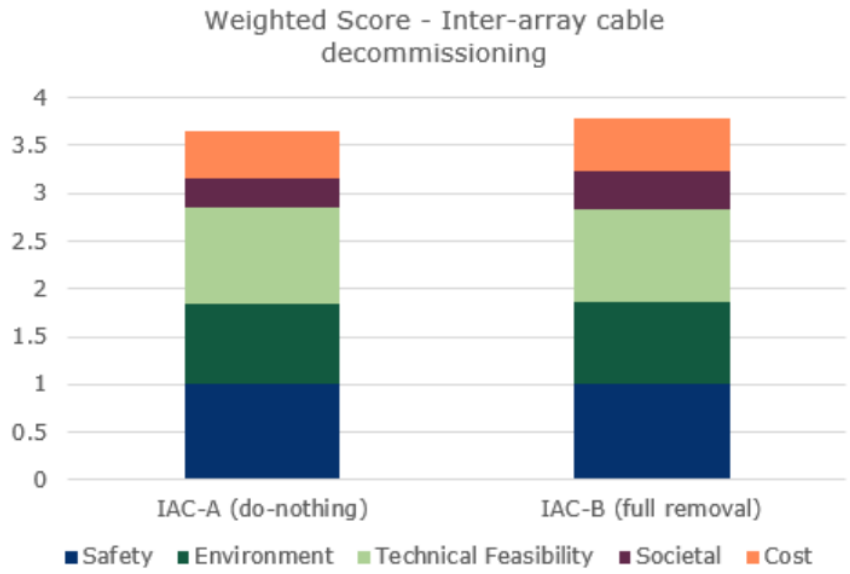
6.1.1.2 In relation to MP decommissioning options, partial MP removal (MP-B and MP-C) are considered the most favourable, with a slightly better score achieved by MP-C associated with the lower residual liability risks associated with MP cut at LSBL P2.

6.1.1.3 Retention of TPs/MPs *in situ* receives the lowest score, mainly influenced by the level of uncertainty around structural failure of components and temporal scale of this option.

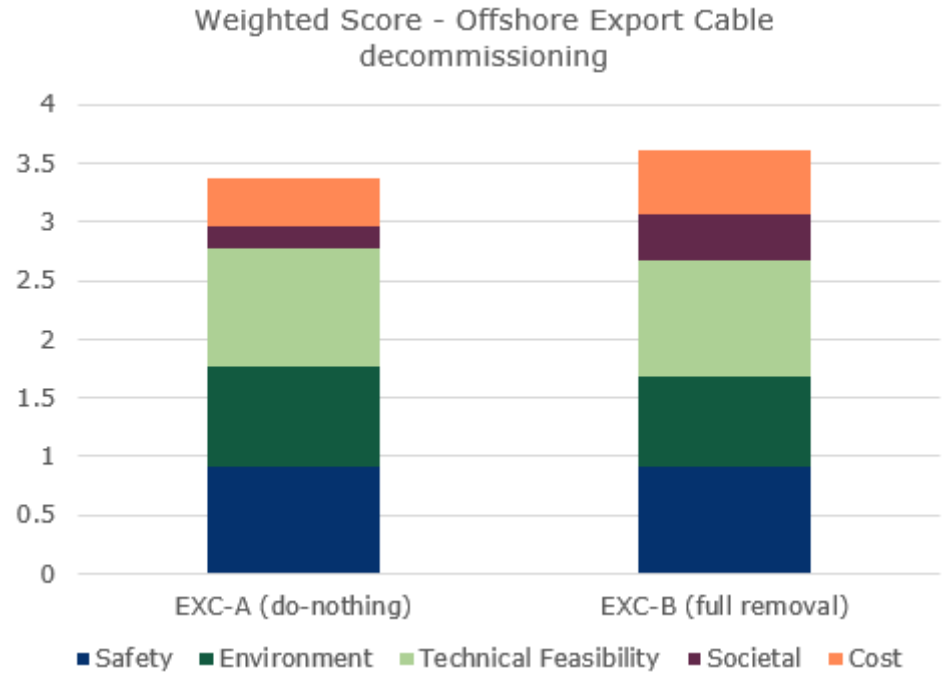
6.1.1.4 Similarly, full MP removal (MP-D) scores lower than partial MP removal options given the relatively lower technical feasibility (associated with method maturity and precedented application) and associated safety implications.



6.1.1.5 Regarding inter-array cable decommissioning options, the full removal option (IAC-B) achieves a higher score, primarily due to the societal and cost benefits, particularly post-decommissioning, whilst the do-nothing option (IAC-A) scores higher considering technical feasibility criteria. In any case, the difference between both options is considered marginal (0.14 weighted score).



6.1.1.6 Regarding the offshore export cable decommissioning options, full removal (EXC-B) achieves a higher score, mainly due to balancing safety risks and societal and cost benefits, whilst the do-nothing option (EXC-A) achieves a better score in relation to environmental and technical feasibility criteria. In any case, the difference between both options is relatively low (0.25 weighted score).



6.1.1.7 Based on the findings of this CA, the following decommissioning options are recommended:

- Partial MP removal applying a cutting depth at LSBL P2;
- Full removal of the inter-array cables; and
- Full removal of the offshore export cable.

6.1.1.8 It should be noted that the findings of this CA are not transferrable to other offshore wind decommissioning projects, as the CA assessment has been specifically developed to suit the characteristics of the Offshore Site and Proposed Works Offshore.

6.1.1.9 The strong influence of bathymetry assumptions should be highlighted, with different results potentially obtained under different bathymetry circumstances. It is therefore recommended that final decommissioning methodologies are informed by pre-decommissioning surveys that provide an updated picture of existing bathymetry within the Offshore Site and cable burial depths. Given the high mobility of the sandbank within the Sub Lease Area, it is recommended

that these pre-decommissioning surveys are undertaken within three months of decommissioning works being programmed for execution to avoid data becoming obsolete.

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APPENDIX A TP, MP and cable decommissioning methods and supporting technologies

A.1 Introduction

This Appendix explores which methods and supporting technologies are currently available in the market to carry out the Proposed Works Offshore, with a focus on the transition piece (TP) / monopile (MP) foundations and the inter-array and offshore export cables. The information presented in this appendix is intended to inform the main **Appendix 2.1: Comparative Assessment Report** that forms part of Volume 3 of the Environmental Impact Assessment Report (EIAR) prepared for the proposed decommissioning of Arklow Bank Wind Park (ABWP) Phase I (the 'Proposed Works').

ABWP Phase I Overview

Offshore infrastructure (within the 'Offshore Site', see **Figure 2.1** in **Section 2.1** of the main **Appendix 2.1: Comparative Assessment Report**) is located seaward of the High Water Mark (HWM) of the coast of Arklow, County Wicklow, in southeast Ireland, and comprises:

- Seven WTGs sitting on TPs and MP foundations, with a combined capacity of 25.2 megawatt (MW), surrounded by scour protection in the form of sandbags;
- One meteorological (met) mast sitting on a TP and MP located south of the southernmost wind turbine generator (WTG) turbine (T1);
- Inter-array cables that connect WTGs and the met mast, all located within the Sub Lease Area, at the crest of Arklow Bank sandbank, within 10 kilometers (km) of the coast; and
- One offshore export cable connecting WTG turbine 4 (T4) to the landfall point at HWM.

Decommissioning Options Considered

As outlined in **Section 3** of the main **Appendix 2.1: Comparative Assessment Report,** the following decommissioning options are considered in the comparative assessment (CA):

- TP/MP:
  - MP-A: Retain *in-situ*;
  - MP-B: Partial removal (MP cut 2m below seabed level at the time of decommissioning);
  - MP-C: Partial removal (MP cut at lowest seabed level (LSBL) predicted (considering a probability percentile of 2% (P2) and time horizon of 2070); and
  - MP-D: Full removal.
- Inter-array cables:
  - IAC-A: Do-nothing; and
  - IAC-B: Full removal.
- Offshore export cable:
  - EXC-A: Do-nothing; and
  - EXC-B: Full removal.

Accordingly, this appendix focuses on decommissioning methods and supporting technologies for MP-B, MP-C, MP-D, IAC-B and EXC-B.

Site Conditions

The dynamism of Arklow Bank sandbank and variability of bathymetry observed on the Sub Lease Area over the years (see **Volume 3, Appendix 4.1: Seabed Mobility Assessment**), shows that it can have a significant effect on the restrictions and requirements of vessels required to support the Proposed Works Offshore. For instance, bathymetric data collected in 2016 and 2024 show that shallow waters can particularly restrict vessel access to T5.

Within the Sub Lease Area, the highest astronomical tide (HAT) in relation to mean sea level (MSL) is 1.5 m, whilst the lowest astronomical tide (LAT) in relation to MSL is -1.3 m.

Using Arklow Port as reference, the Sub Lease Area experiences two high tides and two low tides each day.

Vessel access during Proposed Works Offshore could be managed to consider tidal movements that facilitate access of required vessels, as water depths would be around 2.5 m higher in HAT conditions, compared to LAT conditions. However, given that water depths at different turbine locations vary significantly over time and between each other, pre-decommissioning surveys will be required to confirm and refine the final methodology and vessel access requirements for Proposed Works Offshore.

A.2 Decommissioning Methodologies

Monopile Partial Removal

The partial removal of the MP involves cutting the structure below the existing seabed level, extracting the upper section while leaving the lower portion embedded.

This process typically requires internal or external dredging to up to 3 m below the target cutting depth to create sufficient space for deploying the selected cutting tool.

When cutting from the inside of the MP, the sediments inside the MP will also need to be removed before cutting can commence using an internal dredging tool, which is typically inserted into the MP opening created by removing the TP.

Plate 1 illustrates dredging requirements when cutting externally and internally for reference.

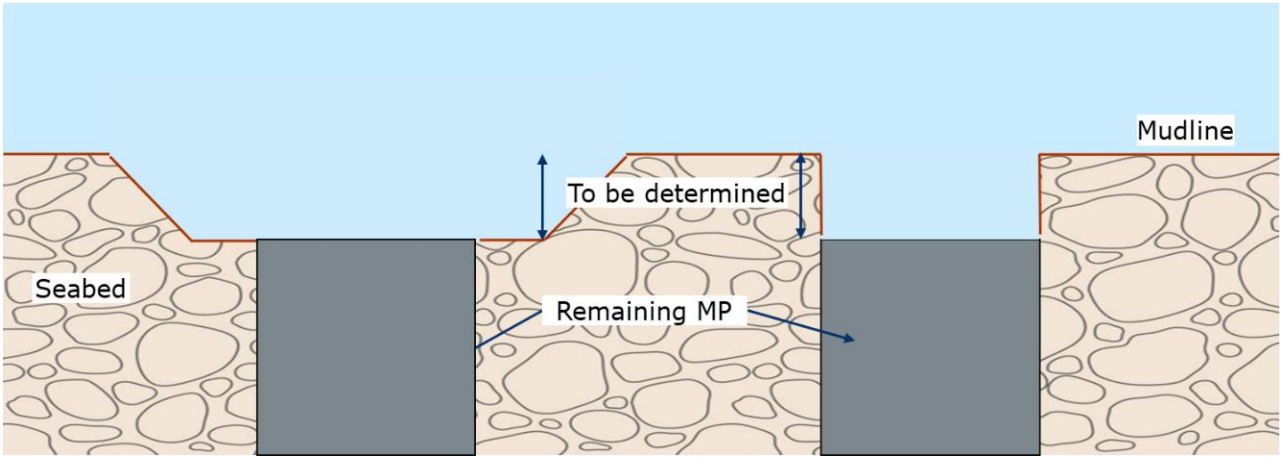


Plate 1: MP partial removal sketch. Dredging pit for external cut (left) and internal cut (right).

Table 7.1 summarises the execution of a partial MP removal step-by-step. irrespective of the cutting depth / type proposed.

Table 7.1: Monopile partial removal – step by step

Step	Description
Dredging works	Removal of the inner soil plug in the MP through internal dredging, reaching a depth of up to 3 m below the target cutting depth. The dredging level is then surveyed and verified.
Cutting equipment preparation	Cutting equipment is installed at the cutting elevation inside / outside the MP.
MP rigging connection	MP is secured to crane for lifting.
Cutting	Second cut is done at determined depth below the existing seabed level.
Removal of MP	Cutting equipment is lifted back to deck together with the MP, whilst activating any shaft friction removal needed. MP cut-off section is lifted onto deck of the transportation barge and down-ended.
MP seafastening	MP section is seafastened on deck of vessel. Cutting equipment is retrieved and transferred back to the decommissioning vessel.

Table 7.2 displays the remaining MP lengths in the seabed after partial removal for the turbine locations and their approximate masses.

Table 7.2: Length and masses of the remaining piles in the seabed

Decommissioning Option		T1	T2	T3	T4	T5	T6	T7	Met mast
MP-B (2 m cut)	length [m]	29.5	29.4	29.4	31.7	29.5	30.8	28.0	20.6
	mass [t]	184	183	184	198	177	192	174	31
MP-C (LSBL cut)	length [m]	28.4	31.1	29.2	29.6	28.0	28.8	27.0	18.6
	mass [t]	177	194	182	185	168	180	168	28

Monopile Full Removal

The full removal of the MP involves the extraction of the embedded MP from the seabed, ensuring that no part of the structure is left in situ.

As of March 2026, only three full removals of MP foundations have been executed. In all cases, a vibratory lifting tool was employed for the extraction of the MPs:

Table 7.3: List of reference projects for full monopile removal using vibro technology.

Project	Country	Decommissioning Status	Pile dimensions	Vibration Tool	Public Source
Lely Offshore Wind Farm	Netherlands	Fully decommissioned (2016)	MP length: 27 m MP diameter: 3.7 m Pile embedment length: 20 m	Four monopiles were fully extracted using a PVE 500M vibratory hammer after 24 years of operation.	Dieseko Group project page: Decommissioning Lely OWF
Amalia Offshore Wind Farm – DOT FOX Project	Netherlands	Fully decommissioned (2021)	MP length: 56.6 m MP diameter: 4.0 m Pile embedment length: unknown	Full monopile removal for re-installation, executed using CAPE VLT-320 Tandem vibratory lifting tool after 3 years of operation.	Cape Holland project page: Monopile decommissioning on amalia offshore wind farm Cape Holland Project page: Monopile decommissioning on Amalia OWF
Maasvlakte 2 Demonstration Project	Netherlands	Fully decommissioned (2016)	MP length: 27 m MP diameter: 4.0 m Pile embedment length: unknown	One monopile fully extracted in sandy soil, seven months after installation, using CAPE VLT-320 vibratory lifting tool.	Cape Holland Project page: Monopile decommissioning demonstration

Full removal process is described in the following **Table 7.4** based on the use of a vibro-lifting tool, as recommended in **Section A3**.

Table 7.4: Monopile Full Removal – step-by-step

Step	Description
1. Vessel positioning	Decommissioning vessel is positioned next to the foundation location. Transport barge is moored next to it.
2. Installation of vibration tool	Vibration tool is installed on MP top and secured to crane for lifting.
3. MP extraction	Controlled vibratory forces are employed to break the shaft friction, loosen and lift the MP from the seabed. If necessary, jet lancing is activated to remove any remaining friction.
4. MP lifting	Once the MP is extracted from the seabed it is lifted onto the vessel's deck.

Step	Description
5. MP down-ending and sea-fastening	MP is down-ended onto the transportation barge deck into a horizontal position with the help of the vibro-lifting tool and secured on deck.
6. Removal of vibration tool	The vibration tool is disconnected from the MP.
7. Move to next location	The vessel moves to the next wind foundation location. Transport barge is unmoored and transits to the next location.

Cable Recovery

There are two main methods for cable recovery:

- Cutting (underwater or on vessel deck) and transported to shore; and
- Spooling of cables directly onto cable drums for later cutting.

The latter method is quicker but would require a larger vessel that may not be suitable to access the shallow water depths that can occur within the Offshore Site. Accordingly, cutting of cables after being removed by one of the removal methods defined in **Section A.3**, is considered more suitable and overall recommended.

The decommissioning process of cables (analogous for inter-array and offshore export cables) is described in **Table 7.5** and involves cutting the cable into manageable sections. The cable sections are then stored in containers onboard the vessel or a barge and transported to a designated disposal or recycling.

The disconnection of the offshore export cable at landfall is to be analysed separately, depending on the local conditions and disconnection point. The characteristics (material, weight, etc.), location and burial depth of the duct will determine the exact operational requirements for disconnection:

- If the duct is deeply buried, excavation may be required. In this case, an excavation pontoon or similar will be required to reach the duct and perform the disconnection operation; and
- If the duct is not buried, and weight remains within the capabilities of the vessel deployed for cable removal, this can be grabbed and the offshore export cable disconnected.

Table 7.5: Cable removal – step-by-step*

Step	Description
1. Survey & Inspection (preparatory work)	Conduct a seabed survey to assess burial depth, sediment conditions, and existing protection structures (e.g., rock berms, mattresses). This is done using a MBES and a sub-bottom profiler (SBP) in combination with an ROV for visual confirmation.
2. Position Vessel	Vessel is positioned at the designated location near the WTG where the cable needs to be recovered.
3. Uncovering the Buried Cable	Unburial of cable.
4. Lifting and Recovery	Cables are pulled out of the sea floor using clamps and a cable puller.
5. Cable extraction	One of the cable ends is attached to a cable pulling sock. TP cable end is loosened from winch.
6. Cable cutting	Cables are cut with shears into manageable sections and deposited in containers onto barges.
7. Move to next location	Cable extraction vessels and barges redeploy to the next cable. Barges transit to designated port, once loading capacity has been reached, to unload the containers with the cable sections for onward disposal.
8. Transport and Dispose/Reuse	Transport the recovered cable to the designated location for proper disposal, recycling, or potential reuse.

(*) This step-by-step approach assumes that the power supply has already been disconnected.

A.3 Supporting Technologies

Monopile Internal Dredging Technologies

Table 7.6 presents an overview of MP internal dredging technologies, further illustrated in Plate 2, which is required to reduce the overall weight of MPs and perform any internal MP cuts required.

Table 7.6: Monopile internal dredging technologies

MP internal dredging technologies	Description	Advantages	Disadvantages
Air Lift Dredgers	Employs a suction force created by a combination of air compression and high-volume water jetting. The obstructions are lifted through a hose onto the dredging vessel. The air lift dredge system is designed for effective excavation of seabed sand, gravel, clay, and rocks. The system features internal water and air delivery to minimise the risk of snagging or hose damage. High-flow water is directed to the suction head to reduce the density of the material being dredged. Adjustable jetting nozzles provide flexibility. Compressed air is forced into pipe work, creating a suction force caused by the pressure differential. This ensures that loosened debris is safely expelled through the hose to the vessel.	• Wireless remote operation. • Capable of carrying out both operations (lifting and upending). • Simple design with fewer moving parts. • Applicable use for deep water dredging operations.	• Mainly used for sandy sediments, does not perform well with other seabed types, such as gravel, clays and compact sands. • MP size limitations, may be challenging for smaller MPs, like those supporting the met mast • Difficult application for coarse-grained sediments.
Direct Operated Pump (DOP) Dredgers	Employs a high-efficiency submersible dredge pump combined with various suction heads to handle a wide range of seabed sediment types, from fine silt to coarse gravel. The DOP dredger is designed for efficient excavation and transport of dredged material through a discharge pipeline to a barge, the vessel's deck or marine environment. High-flow water jets or cutter heads can be integrated into the suction head to break up compacted material before extraction if required. The powerful suction mechanism enables continuous material removal, making it ideal for MP internal dredging, and large-scale dredging projects, land reclamation, and port maintenance. The adaptability of DOP dredgers allows for effective operation in water depths from a few meters up to over 50 m, depending on the model and configuration.	• Suitable for a wide variety of sediments including sand and gravel. • Suitable for MP internal dredging. • Interchangeable suction heads for task specifics.	• High power levels required to operate.
Soil Plug Removal Tool (SPRT)	The SPRT is a purpose-designed subsea system for efficient soil plug removal and internal cleaning of piles. It combines jetting, suction, and optional mechanical cutting to operate across a wide range of seabed conditions, including very stiff clays, sand, grout, limestone, concrete, and rock-like materials. The system simultaneously dredges and cleans the pile interior using a rotating 360° jetting head and an electrically driven dredging pump to remove fluidized sediments. For highly cohesive or hard soils, a mechanical cutting module can be integrated, while combined jetting-mechanical configurations enable high production rates in demanding conditions. SPRT is electrically controlled via a topside umbilical, requiring no subsea rigging or ROV intervention, and is designed to minimize deck	• Wide soil applicability incl. very stiff clays, sand, grout, limestone, and rock-like materials. • Suitable for MP internal dredging. • Minimal subsea complexity, as electrically controlled from topside with no requirement for subsea rigging or ROV intervention. • Adaptable to pile dimensions (adjustable guide bars	• Requires electrical umbilical control and topside power supply. • Increased system complexity for hard or highly heterogeneous soils as they may require configuration adjustments.

MP internal dredging technologies	Description	Advantages	Disadvantages
	footprint and offshore personnel requirements. Adjustable guide bars and project-specific jetting rings allow adaptation to a wide range of pile diameters.	and project-specific jetting rings) • Additional cleaning capability with high-pressure jetting pumps for removal of marine growth, corrosion, and hard sediments.	





Plate 2: Left: Ashtead air lift dredger; Right: DAMEN DOP dredger (DAMEN, n.d.)

Monopile Cutting Technologies

Table 7.7 presents an overview of MP cutting technologies, including reference to their practicability in relation to the MP decommissioning options considered, as well as their technical and commercial readiness and proven track record. These are further illustrated in **Plate 3**.

Table 7.7: Monopile cutting technologies

Cutting technology	Description	Advantages	Disadvantages
Abrasive waterjet cutting (AWC)	Uses a high-pressure water jet which is shot on the material such that the impact perforates the structure. To cut through strong material like steel the water stream is combined with an abrasive substance creating a "slurry". The abrasive component possesses a high degree of hardness (e.g., iron silicate, garnet, copper slag, or sand) and helps to grind through the material. The tool therefore consists of a control unit for the position of the nozzle, a high-pressure water pump and a hydraulic power unit as well as a mixing tube where the abrasive substance is added The cutting speed ranges between 25 mm/min and 180 mm/min and depends on the steel thickness. The water is pressurised to approximately 3000 bars. Internal and external AWC are distinguished below. However, overall, internal AWC is considered to be more advantageous and suitable than external AWC, which is not recommended for the Proposed Works Offshore.		

Cutting technology	Description	Advantages	Disadvantages
Internal AWC	Inserted into the MP from the open top or an opening in the MP wall. It is equipped with a centralising system to ensure a correct alignment with the surrounding MP wall. The nozzle is in direct contact with the MP wall and rotates with a controlled speed around the internal circumference while perforating the steel. The cutter is connected with a service umbilical to relay "real-time" data to the monitoring system on the surface. A launch frame deployment method can be used in combination with the internal AWC, allowing the vessel crane to disconnect from the internal waterjet device. The launch frame, positioned over the MP, is equipped with two winches: one for lowering and retrieving the cutter and another for the umbilical. After the operation, the internal AWC and the launch frame can lift the MP, however, the tools are not capable of upending the MP onto a vessel's deck.	• Accurate and clean profile of the cut • Variable cutting angles. • Remote operated vehicle (ROV) or diver support not required. • Can be used in combination with a launch frame which allows using the crane independently. • Robust and proven track record in offshore environment. • Only internal dredging is required, when cutting below seabed level.	• Each tool is only applicable on limited range of diameters. However, Internal AWC is considered suitable for cutting that may be required at the TP (5.4 m) and MP (5.1 m) • Moderate noise emission (although this would be internal within turbine structure).
External AWC	For external cutting, the nozzle is mounted on a guide rack which is clamped around the pile. The nozzle then rotates on a trolley around the external circumference of the pile. The guide rack is attached to the pile using structural or magnetic supports. The trolley with the external cutting manipulator can either be inserted by a diver or using a ROV. In the first case, the divers return after the cutting operation to connect the external manipulator to the rigging before releasing the clamping system.	• Accurate and clean profile of the cut • Cutting angle may be altered. • No limits for pile diameters (only guide frame needs to be adjusted). • Robust and proven track record in offshore environment. • No external shaft friction due to external dredging.	• ROV or diver support required. • Higher noise emission (including to the marine environment). • Requires removal of marine growth before positioning. • External dredging required for cuts below seabed
Diamond wire cutting (DWC)	Uses wires, impregnated with diamond dust to cut through various materials like anchor chains, steel piles, piles with grout, and concrete structures using abrasion. The wires allow circular cutting on all sides and can cut pile diameters of up to 7.3 m (Cutting Underwater Technologies (CUT), n.d.), with a cutting speed around 25 mm/min, depending on the material. DWC tools are surface powered for depths up to 300 m. DWC tools take hold of the pile via a hydraulic clamp controlled remotely. DWC tools can be error-prone, especially in case the wire is bent, jammed, or entangled. However, newer systems offer self-adjusting auto-feed technology that controls wire bend and automatically matches the feed rate to the cutting rate. This allows for a more effective cutting and an extension of the wire lifetime.	• Fast cutting speed. • A proven track record in offshore environment for pipe cutting. • Limited noise emission. • Less waste material is produced compared to conventional solid blades. • Economical compared to waterjet cutting. • Diver support not required.	• Not deployed redundantly. Wire failure may lead to additional repair work and time delays. • Only applicable externally. • Limited application in case of presence of internal structures within the pile (pipes, ladders, etc.). • Requires removal of marine growth before positioning. • Additional external dredging required for cuts below seabed.
Oxy-fuel cutting	Thermal cutting method which uses oxygen and fuel gas to cut though materials such as steel. It is a widely applied industrial cutting process that can be used to cut thicknesses from 0.5 mm up to 250 mm. The tool cuts by preheating the materials with a mixture of fuel gas, and oxygen to its ignition	• Lower costs of the tool compared to some other cutting methods. • Multiple fuel options can be utilised as fuel gases.	• The selected fuel gas used can impact cut speed and efficiency. • Achieving ignition temperature without reaching

Cutting technology	Description	Advantages	Disadvantages
	temperature (between 700ºC and 900ºC for steel) without reaching its melting point. After reaching set temperature, a jet of oxygen with a purity superior to 99.5% is directed to the heated area to oxidize the metal and create a cut. A decrease in purity can potentially reduce the cutting speed and increase the gas consumption. Cutting speed is also conditioned by the type of fuel gas used. Acetylene, propane, MAPP (methylacetylene-propadiene), propylene, and natural gas are the most commonly used. When using the method to cut a steel monopile underwater, a diver or an ROV can position and operate the oxy-fuel cutting equipment accurately to ensure a precise cut.	• Proven track record in offshore for industrial use.	their melting point is a limitation for certain materials. • ROV or diver support required. • Additional external dredging required for cuts below seabed.

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Plate 3: Top left: Internal AWC device (Oil States, n.d.); Top right: External AWC tool; Bottom left: DWC (MIRAGE, n.d.); Bottom right: Oxy fuel cutting

Monopile Full Removal Technologies

Full extraction of the MP foundations is the option with least track record in the offshore environment. Most of the current extraction methods have not yet reached commercial maturity.

Table 7.8 presents two main technologies: vibro-lifting and overpressure. These are further illustrated in **Plate 4**. Overall, vibro-lifting is considered more advantageous and suitable than overpressure full removal methods, and is therefore recommended to be further considered in the CA.

Table 7.8: Monopile full removal technologies

MP full removal technology	Description	Advantages	Disadvantages
Vibro-lifting	Used as an installation technique for steel MPs, vibro-driving can be used in reversed function for the decommissioning and extraction of MPs. The MP is moved vertically up and down with high frequency, which causes a temporary reduction in marine soil resistance in the immediate vicinity of the pile. Through the reduced shear forces, the pile can be lifted and pulled out of the ground. This works particularly well in granular soils like sand and silt. The larger the grain size of the soil, the more efficient the process. In order to vibrate the pile vertically out of the soil, the tool is fixed to the MP with hydraulic clamps and is connected to a lifting crane. This fixed connection has the additional advantage to prevent pile run. Once the vibration is turned off, the soil regains its strength immediately.	• Fast extraction. • Works well in granular soils like sand. • Methodology well known from its application for pile installation. • Complete removal of MP is achieved, potentially without the need to cut the MP. • Low noise emission. • No risk of pile run. • Lifting of the MP can be executed with the same tool.	• Limit for MP diameters. However, adaptation to required diameters may be possible (5.1 m). • Limit for MP weight, however, considered suitable for MPs considered (< 300 t). • Limited proven track record in offshore environment for decommissioning. • Increases crane requirements due to tool weight. • MP shall have sufficient allowance for fatigue loads for vibro loads. • Uncertainty about soil conditions due to set-up effect over time (i.e. increase in soil resistance and strength after installation). • Shaft friction of full MP needs to be removed for extraction.
Overpressure	Uses hydraulic pressure to extract a pile from the seabed, by filling the void with water, and pressurising it to force the pile upward. While being readily available for suction buckets, the method requires further development for its application to MPs. It is a promising solution for full removal which is currently looked at by research and joint industry projects. The HyPE-ST project by the GROW consortium tested this method in various soil types using scale models of an 8m diameter pile, with promising results. The Accelerator BLUE PILOT project used this method to extract a test pile, demonstrating its potential. The method requires extensive preparation work as when applying this technology to MPs, sealing the MP top and any holes, such as water replenishment or cable entry holes, is crucial. The soil conditions play an important role in the applicability of the method. When the hydraulic pressure is applied, the soil plug within the MP will partially fluidise causing a reduction of the internal shaft friction. This phenomenon can be observed in full (homogenous) sand or clay conditions. However, in heterogenous soils, a hard clay layer in sandy conditions can have a detrimental effect as this layer acts like a plug and seepage cannot be realised,	• Proven technology for suction buckets. • Linear increase in uplift force with pressure. • Pile cap can be reused. • Limited noise profile. • Medium sized crane vessel required to retrieve pile to deck.	• Lack of market-ready solutions for MPs. • Extensive preparation works and large hydraulic pile cap required. • Long extraction time. • Larger burial depths will require larger overpressure. • High internal pressure required may pose a safety risk. • Surplus water management.

MP full removal technology	Description	Advantages	Disadvantages
	especially when it lies close to the seabed surface. To mitigate this challenge, a combination of overpressure and jet lancing can be employed as a supporting technique to enhance effectiveness.		



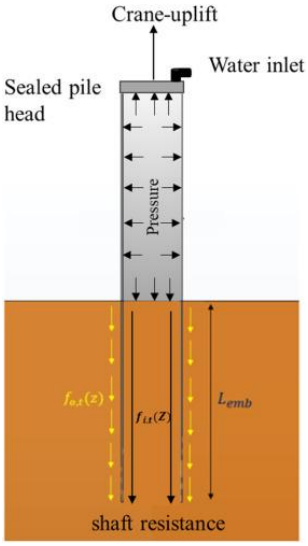


Plate 4: Left: vibro-lifting; right: overpressure (Shabouee *et al.* 2025).

Monopile Lifting and Upending Technologies

Table 7.9 presents an overview of lifting / upending technologies, further illustrated in **Plate 5**, which pose the highest safety risk because of lower stability and the displacement of non-fixed components throughout the worksite.

Cranes, grippers and pile upending tools can be used to move and place elements that are disassembled or dismantled as well as displaced from the seabed onto suitable vessels. Heavy lifting must be carried out in a controlled manner which safeguards the integrity of the sensitive components and ensures the safety of the personnel at the worksite. Lifting tools can be applied to MPs internally or externally.

Depending on the Proposed Works Offshore, such as the type of cutting done, a certain tool will be used. Internal AWC tools and vibro-lifting tools normally incorporate internal lifting tools, however, there are no strong advantages / disadvantages in comparison to external lifting tools, should these be required.

Table 7.9: Lifting and upending technologies

MP Lifting / Upending technology	Description	Advantages	Disadvantages
Internal lifting tools	MP internal lifters boast a demonstrated history of no project downtime. Their wireless remote-control feature enables self-engagement, mitigating the need for personnel to enter hazardous areas. Additionally, they offer an optimal solution for situations where longer piles extend beyond the vessel's edge. Some cutting tools (such as internal AWC) directly incorporate this function, although for low weights. The coupling of the tool, particularly in the case of internal lifters, is generally done on the upper top section of the MP structure.	• Wireless remote operation. • Capable of carrying out both operations (lifting and upending). • Proven track record in offshore environment for installation.	• Limited availability for MPs with wider diameters, although in principle considered suitable for ABWP Phase I MPs (5.1 m). • Upper end of the pile may require reinforcement before coupling – compatibility with lifting tool for lifting load case shall be demonstrated.

MP Lifting / Upending technology	Description	Advantages	Disadvantages
External lifting tools	Ensure efficient MP handling with proven reliability. Hydraulic or mechanical clamps secure the outer circumference, while upending frames enable controlled rotation from vertical to horizontal on the vessel's deck. Grippers provide additional stability during lifting, mitigating potential movement risks. External lifting collars distribute weight evenly, preventing surface damage. Advanced hydraulic systems offer automated precision for heavy-lift vessels. Designed for safety and efficiency, these tools optimise offshore installation and decommissioning while minimising operational hazards.	• Quicker to couple and decouple compared to internal lifting tools. • Fail safe principle equipped which creates locking connection.	• Limited availability for MPs with wider diameters, although in principle considered suitable for ABWP Phase I MPs (5.1 m). • Tools may protrude and interfere with other operations or equipment nearby. • Requires removal of marine growth prior to deployment.

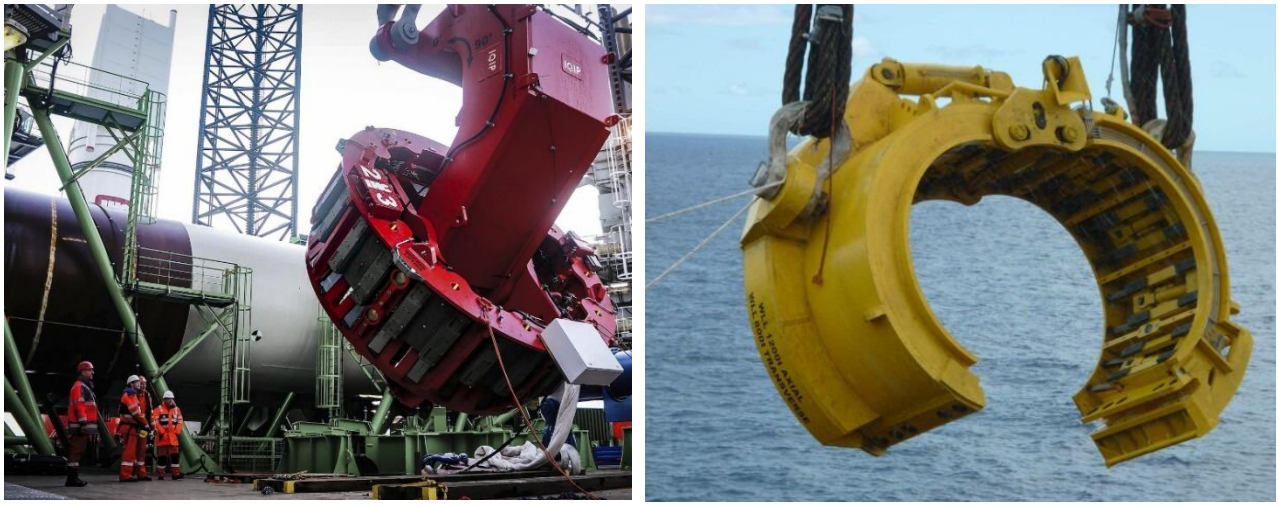


Plate 5: Left: Internal lifting tool (IQIP, n.d.a); Right: External lifting tool (IQIP, n.d.b).

Friction Reduction / Sand Liquefaction

Friction reduction / sand liquefaction may be needed to support MP lifting operations, particularly for long sections of MPs and certain sediment types. There are a number of technologies that can be used, although the most common are:

- Vibratory tool (i.e. vibratory hammer/extractor) attached to the top of the MP that uses counter-rotating eccentric weights driven by hydraulic or electric motors creating a vertical oscillating force that is transmitted into the MP, temporarily fluidising the soil around the MP; and
- Jet lancing, a hydraulic method that injects high-pressure water via steel pipes (i.e. jet lances) placed along the MP or integrated into the lifting frame, eroding and weakening the seabed to facilitate lifting operations.

Given that these two main methods have no significantly different implications in relation to safety, environmental, technical feasibility, societal or cost and residual liability considerations, it is not recommended to distinguish them in the CA.

Other Monopile Removal Supporting Technologies

- Remote Operated Vehicles (ROV), underwater vehicles that feature visualisation and lighting equipment, remote piloting and control systems, and robotic arms for various operations. ROVs can move in all directions and are capable of operating at depths of up to 6,000 m. They are divided into two classes:
  - Work class ROVs, utilised for work tasks and interactions with the environment. They are involved in cable laying, positioning equipment, and support tasks for cutting and

lifting operations. Work class ROVs have powerful robotic arms for these tasks and can be further categorised as work class or heavy work class ROVs, which are suitable for cable removal, underwater cutting, and wet storage placement during decommissioning.
  - Inspection class ROVs are primarily used for inspecting underwater structures and the offshore wind farm environment. They can be deployed intermittently during specific decommissioning phases or stationed subsea for continuous monitoring.

- Gangways and motion compensated platforms, platforms installed on floating assets, providing a stable deck area and acting as an active wave compensation tool, reducing the influence of waves on offshore operations by counterbalancing the effects of vessel motions. This allows lifting and placement of heavy components to be performed in more difficult weather conditions, significantly reducing the operational downtime, and resulting in a faster decommissioning of the offshore wind farm. Equipment such as cranes, excavators and drilling configurations can also be placed on them, making it possible to operate the machinery with almost the same precision as onshore. Access points are required during preparations for the decommissioning activities for technicians to climb onto the assets. Personnel can reach the external platform of a TP over a motion compensated gangway (MCG) installed on a decommissioning operations vessel. These gangways are also known as "walk to work" (W2W) gangways. In case the decommissioning vessel is a fixed asset (such as a jack-up), then standard gangways, installed with the crane, can be used to access the TP.

Cable Decommissioning Technologies

Table 7.10 presents different methods used for subsea cable removal operations. Overall, for cables buried within 3 m from the seabed level, a running method using a grapnel run or detrenching grapnel is recommended. Given that no cables are expected to be located in depths greater than 3 m from the seabed level, no other decommissioning options are recommended to be further considered.

Table 7.10: Cable decommissioning technologies

Cable decommissioning technologies	Description	Advantages	Disadvantages
Running methods (grapnel run / detrenching grapnel)	Towed tool from a vessel dragged along the seabed to penetrate the seabed, detrench the cable and eventually hook it for recovery.	• Simple, vessel-based (no ROV spread required) • Fast to deploy and low mobilisation cost • Can cover long distances quickly • Works reasonably well in loose to medium sands where there is shallow burial (<3 m) (ETA Subsea Cable Specialists, n.d.) • Localised footprint (< 10 m, increasing with additional runs), with narrow furrows or plough marks and low to moderate sediment plumes with rapid deposition	• Low precision without cable burial depth surveys undertaken beforehand • Performance heavily depends on seabed density, burial variability (does not perform well in sandwave environments) • Can require multiple passes • Limited control over detrenching, snagging or cable damage
ROV jetting	ROV uses high-pressure water jets to fluidise the sediment and expose the cable in a controlled trench.	• Highly controlled and precise • Real-time visual feedback • Effective in sands, variable burial conditions (< 2 m) • Introduces minimal mechanical stress on cable • Localised footprint (< 6 m), with narrow trenches and low to moderate sediment plumes with rapid deposition	• Slow compared to towed methods • Requires ROV support vessel and skilled operators • Performance drops in very dense sands, gravel / mixed soils • Weather sensitive
Mechanical trenching	Tracked seabed vehicle (e.g., chain cutter, rock wheel) that mechanically cuts a trench and	• High precision and can handle dense sands, stiff soils and mixed sediments	• High cost and mobilisation effort • Skilled operators required

Cable decommissioning technologies	Description	Advantages	Disadvantages
	excavates sediment around the cable.	• Capable of deep burial recovery (>2–3 m) • Localised footprint (< 10 m, increasing with additional runs), with narrow trenches	• Slow compared to grapnel runs • Requires heavy support vessel and complex logistics • Less efficient in very loose/mobile sand (as it tends to lead to over-excavation) • Can generate moderate sediment plumes, increasing turbidity, and can lead to permanent seabed modification
MFE	Stem that uses large volumes of water (low pressure, high flow) to mobilise sediment over a wide area, creating large-scale seabed lowering that facilitates cable recovery.	• Very effective in loose sands and large sandwave fields • Can expose long cable sections quickly • Works well for wide-area lowering, not just trenching	• Skilled operators required • Requires significant vessel power and pumping capacity • Not effective in dense sands or cohesive soils • Large footprint (> 20 m) and can generate large sediment plumes

A.4 Vessel Spread and Logistics

Review of Vessel Types

Table 7.11 presents an overview of the type of vessels generally used for offshore wind and cable decommissioning works.

Table 7.11: Vessel type review

Vessel type	Description	Illustration
Jack-up Barge (JUB)	Unit that can elevate itself out of the water on three, four or six legs using a jacking system to provide a stable working platform. JUBs require the assistance of tugs to move to the location and be positioned next to the turbine foundation. Typically, two or three tugs are required, and these are selected based on the required bollard pull to transport the JUB and the site conditions. Depending on the unit, the JUB can have a crane with lifting capacity of up to 500 mt. Alternatively, an onshore crane can be mobilised and mounted on deck. JUBs are typically old designs which are not currently used for the construction of modern offshore wind farms. However, their reduced dimensions make them potentially suitable for the characteristics of Proposed Works Offshore.	 JB-115 at Kriegersflak. Source: https://www.jackupbarge.com

Vessel type	Description	Illustration
Jack-up Vessel (JUV)	Vessel that can elevate itself out of the water to provide a stable working platform. Compared to JUBs, JUVs are self-propelled, and can navigate and manoeuvre without the aid of tugs. The draught of a JUV can vary significantly depending on the specific design and the operational requirements. When afloat and not jacked up, the draught of a JUV typically ranges from 6 m to 15 m. However, some JUVs have a minimum draught of 4.5 m. When elevated, the draught is not relevant as the hull of the JUV is lifted above the water surface. JUVs have a large deck space to carry foundations and turbine components and a large capacity crane. A typical modern wind farm installation JUV has a crane with a lifting capacity ranging from 600 t to over 3,000 t and a lifting height of over 160 m above deck. Tubular leg JUVs with lower operability limits could also be used.	 Sea Challenger. Source: https://www.jackupbarge.com
Sheerlegs	Floating vessels with an integrated crane. These vessels are typically used for civil works, port activities (such as loading and unloading cargo, or assistance at shipyards), salvaging and decommissioning. The crane may vary in capacity between 300 mt and up to 10,000 mt. However, it shall be noted that cranes are not capable of rotating and swinging in the same manner as the cranes integrated in JUVs or JUBs. Sheerlegs generally have a propulsion system integrated for position keeping and short movements, however, depending on the unit, the use of tugs may be required for long sailing distances. Sheerlegs are vulnerable to strong current and adverse weather / sea state and are therefore not considered suitable for the Proposed Works Offshore.	 Scaldis Rambiz sheerleg
Transport barge	designed to carry heavy and bulky items, like turbine components and foundations, from coastal assembly points to offshore installation sites. There are different types of logistical barges, including flat-top barges, semi-submersible barges, and heavy lift barges, each serving specific transportation needs. The typical draught of barges can vary based on their type, size, and load capacity but typically have a draught ranging from 3 m to 5 m when unloaded. Key features of transport barges include large deck space for carrying multiple components, high load capacity to handle heavy loads, and design elements that ensure stability and safety in various sea conditions. Their primary functions include transportation of wind turbine components, temporary storage of these components before installation, and providing logistical support for other vessels involved in offshore operations. Considering the dimensions of the ABWP Phase I foundations and the access restrictions due to water depth, only cargo barges are considered for this study	 Flat top cargo barge

Vessel type	Description	Illustration
Multi-purpose Vessel (MPV)	MPVs have a large bollard pull capacity and may deploy various pieces of equipment such as winches, winch wires, anchor lockers, shark jaws, etc. to facilitate handling activities. An MPV often has an active heave compensated crane, and large deck space. A MPV can be used in decommissioning for several purposes: to disconnect the cables from the platform using the crane hook; recover the inter-array cables onto the deck; and de bury export cables. For the recovery of the cables, cable lay equipment needs to be mobilised to deck such as cable winches, tensioners, dedicated crane hook fittings, mobile reel and a reel drive system. Water depth conditions of the Offshore Site shall be considered when selecting MPVs. Multicat vessels are appropriate for shallow water sites and can be used to support both MP removal and cable removal operations.	 Jifmar Artemis
Subsea Construction Vessel (SCV)	Flexible vessel with specific equipment for subsea construction, a large back deck space and large offshore crane. SCVs are typically equipped with a vertical or tiltable lay tower with large capacity tensioners and winches for the installation of flexible (umbilicals, flexible flow lines, and cables). They are also typically equipped with an underdeck carousel and/or large deck space, where a large on deck carousel can be installed. SCVs can be used for the retrieval, storage, transportation and offloading of export cables. These vessels are equipped for the installation of deep-water flexibles and so have suitable installation and storage equipment and expertise to perform these types of operations. SCV draught depends on the selected unit. However, typical draughts range between 6 m and 8 m, and are therefore not considered to be suitable to support Proposed Works Offshore.	 Viking Naptune
Deck carrier	Vessel with a large deck space and a large deck strength, typically between 10-20 t/m^2 bearing capacity. These vessels are typically used in offshore operations for long distance transportation of cargo, large topsides or foundations or wind turbine components. These vessels are self-propelled and are sometimes equipped with dynamic positioning (DP) capabilities. Deck carrier draught depends on the unit and the loaded cargo, however, typically this is >5 m which is not considered suitable to support Proposed Works Offshore.	 BigRoll Bering

Foundation Lifting Weight Review

Table 7.12 presents the resulting lifting weights for the cut-off TP (first lift) and the MP (second lift). These lifting weights take into account:

- The water depth at each respective MP location, based on the bathymetric data from 2025, which recorded the highest seabed levels across the Sub Lease Area (on average), and has been used as a basis in the CAR;
- The weights for the first lift, which include:
  - The TP itself, assuming the cut would take place under water. It should be noted that that different cuts could have an impact on weighting calculations, but not considered to significantly impact the scoring of decommissioning options;
  - The grout;

  - The connected MP stump;
  - The marine growth on the submerged part of the TP; and
  - A 10% weight contingency.

- The weights for the second lift, which include:
  - The removed MP, the extent of which varies depending on the decommissioning options;
  - The marine growth on the submerged part lifted; and
  - A 10% weight contingency.

Marine growth of the submerged part of TP and MP is estimated considering a uniform thickness of 150 mm and density of 1,325 kilograms (kg) / cubic meter (m^3) as per DIN 18088-1 (standard on structures for wind turbines and platforms - which contains supplementary provisions on the design and execution of on- and offshore wind turbines and platforms to complement the existing provisions of the Eurocodes).

Table 7.12: Lifting weights and lengths for the TP and MP lift.

	T1	T2	T3	T4	T5	T6	T7	Met mast	MAX lifted weight (t)	MAX lifted length (m)
MP-B (2 m cut)										
First lift	164.3	164.5	164.5	164.5	162.4	164.5	164.3	51.8	164.5	16.3
Second lift	38.1	48.9	48.3	26.8	18,6	35.3	52.4	13.4	64.7	7.5
MP-C (LSBL cut)										
First lift	164.5	164.3	164.5	164.5	162,4	164.5	164.3	51.8	164.5	16.3
Second lift	45.2	38.1	50.1	39.8	27.3	47.8	58.9	16.6	71.3	8.6
MP-D (full removal)										
First lift	164.3	164.5	164.5	164.5	162.4	164.5	164.3	51.8	164.5	16.3
Second lift	229.9	240.4	240.2	232.8	203.3	235.8	234.8	44.8	244.7	36.5

Crane Dimensioning for Monopile Removal

Preliminary crane dimensioning has been performed for all MP decommissioning options considering:

- A Dynamic Amplification Factor (DAF), selected as per DNV-ST-N001 - Marine operations and marine warranty, which addresses the marine operations that can occur during the development or decommissioning of an offshore asset or when objects are moved by water from one place to another; and
- A Weight Contingency Factor (WCF) of 1.10 has been considered.

It is recommended that the detailed design of Proposed Works Offshore consider a DAF, WCF and any other safety factors agreed between Arklow Energy, Decommissioning Contractor and Marine Warranty Surveyor.

This preliminary crane dimensioning excludes the additional crane pulling load required to overcome the shaft resistance of the MP section removed, and the expected set-up effects over time, assuming that it can be partly addressed by the use of friction reduction / sand liquefaction technologies.

This preliminary crane dimensioning provides the required crane capacity at the specific radius where the foundation will be located. Lifting radius will depend on several factors such as vessel dimensions, crane position on deck and seabed conditions.

Table 7.13: Crane capacity assessment

	MAX lifted weight [t]	Rigging weight assumption [t]	Vibro tool [t]	15% hook-load increase	Min. Crane Capacity [t]	Selected Crane Capacity [t]
MP-B (2 m cut)						
First lift	164.5	20.0	n/a	n/a	223.2	230.0

	MAX lifted weight [t]	Rigging weight assumption [t]	Vibro tool [t]	15% hook-load increase	Min. Crane Capacity [t]	Selected Crane Capacity [t]
Second lift	64.7	20.0	76.9	1.15	225.0	
MP-C (LSBL cut)						
First lift	164.5	20.0	n/a	n/a	223.2	240.0
Second lift	71.3	20.0	76.9	1.15	234.1	
MP-D (full removal)						
First lift	164.5	20.0	n/a	n/a	223.2	480.0
Second lift	244.7	20.0	76.9	1.15	475.4	

Given the residual uncertainty around any additional crane pulling load and lifting radius required, it is recommended that a crane capacity of 300 t is allowed for in MP decommissioning options MP-B and MP-C, and a crane capacity of 600 t is allowed for in MP decommissioning option MP-D.

Vessel Selection Assessment

Based on the initial review of vessel types, and crane capacity assessment, a preliminary review of JUBs and JUVs available on the market as of March 2026 has been undertaken, to define potential vessel access requirements associated with TP/MP decommissioning options, and is presented in **Table 7.14**.

Table 7.14: Vessel selection assessment for MP decommissioning

Vessel name	Owner	Length (m)	Width (m)	Draught (m)*	Crane capacity
Crane capacity > 300 t					
JB 114	Jack Up Barge	55.5	32.2	3.6 5.0 (incl. spudcan)	300 mt @22 m
JB 115	Jack Up Barge	55.5	32.2	3.6 6.0 (incl. Spudcan)	300 mt @22 m
JB 119	Jack Up Barge	46.1	30	3.25	300 mt @15 m
SIRIUS	Eunsung O&C	55	30	3	400
Wind Server	Ziton	79.6	32.2	4.5	400 mt @20 m
Wind Lift I	Harren & Partner	93	44	3.9	500 mt @31 m
Crane capacity > 600 t					
MPI Resolution	MPI Offshore	130	38	4.3	600 mt @25 m
MPI Adventure	MPI Offshore	138.55	40.8	5.5	1.000 mt @25m
Wind Discovery	Ziton	138.6	40.8	4.09	800 mt @25m
Neptune	DEME Group	60	38	7.2	600 mt
JB 117	Jack Up Barge	75.9	40	3.9	1.000 mt @22m

*Value extracted from Owner specification sheets. Project specific draught value to be engineered by vessel owner.

Although it may be possible for vessels to access the Offshore Site considering tidal movements that maximise windows of favourable water depths, under keel clearance (UKC) and flexibility to avoid limiting vessel selection need to factored in, and based on this preliminary review, it is recommended to consider:

- For MP-B and MP-C, the use of a JUB with crane capacity of 300 t, requiring water depths of -6 m LAT; and
- For MP-D, the use of a JUV with crane capacity of 600t, requiring water depths of -8 m LAT.

It should be noted that the water depth requirements are generic for the type of decommissioning vessel, and would require further assessment when the preferred vessels are known and project specific engineering considering the operational constraints (deck layout, deck load, lifting operations, etc.) has been undertaken.

Outlines the estimated number of vessel trips between the selected port and the Offshore Site during MP removal works.

Decommissioning Option	Max. number of vessel trips on any given day	Max. number of vessel trips in total*	Notes
MP-B (2 m cut)	7	40	*Maximum number of trips on any given day = 7 given that up to 7 vessel types would be engaged, i.e. transport barge, JUB + 2 tugboats, dredging vessel + 2 supporting vessels *Maximum number of trips for transport barge during a single campaign = 4 (components taken to port twice during a given campaign) *Maximum number of trips for JUBs and the two tugboats = 6 (2 x 3 vessel types) *Maximum number of trips for dredging vessels and supporting vessels = 6 (2 x 3 vessel types) per vessel access channel *The dredging vessel and supporting vessels could only be able to stay within the Sub Lease Area if the weather conditions are safe, otherwise they will head for a safe haven or sheltered area as these vessels are not built for rough conditions. *Maximum number of trips considers going to port after dredging within any given channel (5 vessel access channels would require dredging as part of MP-B / MP-C; and 7 vessel access channels would require dredging as part of MP-D) *It is assumed that disposal will be done within the Offshore Site at the same time that dredging works take place, i.e.it is assumed that no transfer of dredged material to port is required.
MP-C (LSBL P2 cut)	7	40	
MP-D (full removal)	7	52	
IAC-B (full removal)	2	16	The maximum number of vessel trips is based on the assumption that in addition to the return trips required to mobilise / demobilise the multicat vessel, 14 vessel trips will be needed to / from the port to off-load the inter-array cable sections recovered.
EXC-B (full removal)	2	19	The maximum number of vessel trips is based on the assumption that in addition to the return trips required to mobilise / demobilise the multicat vessel, 17 vessel trips will be needed to / from the port to off-load the offshore export cable sections recovered.

*Assuming works executed within a single campaign.

For cable decommissioning, the use of a multicat vessel has already been identified in **Table 7.11** as the most suitable option for the Offshore Site. Multicat vessels are widely available in the market and include vessels or shallow draughts that would not be constrained by the shallow depths experienced within the Sub Lease Area, see examples presented in **Table 7.16**.

Table 7.15: Multicat vessel examples

Vessel name	Owner	Length (m)	Width (m)	Draught (m)*	Crane capacity
Artemis	Jifmar	42	12	2.30 – 2.75	20.5 mt @14 m
Coastal Enterprise	Jifmar	39	11.5	1.12 - 1.40	60 mt @4 m 16 mt @11.8 m
Green Isle	Green Marine UK	27.7	12.5	2.85	11.3 mt @16.5 m
Julia M Multicat 10	GSS Marine Services	10	5	1.8	7 mt @3.3 m
AMS Retriever	Seacontractors	23.3	9.5	2	25.1 mt @5.8 m 8.1 mt @14.1 m

*Value extracted from Owner specification sheets. Project specific draught value to be engineered by vessel owner.

Dredging Requirements

Table 7.16 presents the maximum dredging volumes and potential duration of dredging activities for target seabed levels of -6 m LAT and -8 m LAT (required to facilitate vessel access during MP-B and MP-C, and MP-D respectively), estimated using the 2025 bathymetry dataset and the indicative vessel access channels described in **Volume 2, Chapter 3: Proposed Works Description**, which shows that not all vessel access channels would necessarily need to be dredged, subject to the seabed levels encountered within the Sub Lease Area at the time of decommissioning.

Table 7.16: Dredging volume calculations using the 2025 bathymetry dataset

Vessel access channel location	Target seabed level of -6 m LAT			Target seabed level of -6 m LAT		
	Dredging volume (m^3)	Dredging volume including 15% allowance* (m^3)	Duration (days)	Dredging volume (m^3)	Dredging volume including 15% allowance* (m^3)	Duration (days)
Met Mast	4,133	4,752.95	1	19,445	22,361.75	4
T1	0	0	0	7,687	8,840.05	2
T2	754	867.1	1	9,138	10,508.7	2
T3	0.5	0.575	1	18,911	21,747.65	4
T4	54,254	62,392.1	9	134,030	15,4134.5	23
T5	107,665	123,814.75	18	201,700	231,955	34
T6	0	0	0	1,524	1,752.6	1
T7	0	0	0	0	0	0
Total	166,806.5	191,827.475	30	392,435	451,300.25	70

*Additional 15% allowance included to address overdredge tolerance and potential re-sedimentation

**Assuming the use of a back-hoe dredger (BHD) which has a lower dredging production rate (7000 m^3/day) in comparison to the use of a cutter suction dredger (CSD) (10,000 m^3/day)

APPENDIX B Scoring matrix summary and sensitivity analysis

B.1 Scoring Overview

Table 7.17 and **Table 7.18** provide a summary of how the decommissioning options for the MPs and the inter-array and offshore export cables have been scored against the respective criteria.
The presented scores are weighted according to the weighting introduced in **Section 3.4**. The conclusion on the final outcome of the rating is presented in **Section 6**.

Table 7.17: Weighted score of the sub-criteria for the decommissioning options for MP Removal.

Criteria	Sub-criteria	Weighted Score - Monopile Decommissioning Options			
		MP-A (retain *in situ*)	MP-B (2 m cut)	MP-C (LSBL P2 cut)	MP-D (full removal)
Safety	Risk to personnel offshore	0.17	0.51	0.51	0.34
Safety	Risk to third parties and assets	0.16	0.24	0.24	0.16
Environment	Alteration of environmental sensitive receptors	0.27	0.27	0.27	0.18
Environment	Extent of seabed disturbance	0.20	0.15	0.15	0.05
Environment	Alteration of scour dynamics	0.06	0.09	0.12	0.12
Environment	Increase of greenhouse gas (GHG) emissions	0.09	0.09	0.09	0.06
Environment	Material recovery	0.05	0.15	0.15	0.20
Technical Feasibility	Technical complexity	0.10	0.15	0.15	0.10
Technical Feasibility	Method maturity and precedented application	0.28	0.28	0.28	0.21
Technical Feasibility	Vessel availability	0.16	0.12	0.12	0.08
Technical Feasibility	Weather sensitivity	0.04	0.06	0.06	0.06
Technical Feasibility	Duration of Proposed Works Offshore	0.21	0.28	0.28	0.07
Societal	Compatibility with Future Use of the Offshore Site	0.20	0.30	0.40	0.40
Cost	Total cost	0.05	0.15	0.15	0.10
Cost	Residual liability	0.10	0.30	0.40	0.40
Overall Weighted Score		**2.14**	**3.14**	**3.37**	**2.53**

Table 7.18: Weighted score of the sub-criteria for decommissioning options for inter-array and offshore export cables.

Criteria	Sub-criteria	Weighted Score - IAC Decommissioning Options		Weighted Score - EXC Decommissioning Options	
		IAC-A (do nothing)	IAC-B (full removal)	EXC-A (do nothing)	EXC-B (full removal)
Safety	Risk to personnel offshore	0.68	0.68	0.68	0.68
Safety	Risk to third parties and assets	0.32	0.32	0.24	0.24
Environment	Alteration of environmental sensitive receptors	0.36	0.27	0.36	0.18
Environment	Extent of seabed disturbance	0.2	0.15	0.2	0.15
Environment	Alteration of scour dynamics	0.12	0.12	0.12	0.12
Environment	Increase of greenhouse gas (GHG) emissions	0.12	0.12	0.12	0.12
Environment	Material recovery	0.05	0.2	0.05	0.2
Technical Feasibility	Technical complexity	0.2	0.2	0.2	0.2
Technical Feasibility	Method maturity and precedented application	0.28	0.28	0.28	0.28
Technical Feasibility	Vessel availability	0.16	0.16	0.16	0.16
Technical Feasibility	Weather sensitivity	0.08	0.06	0.08	0.06
Technical Feasibility	Duration of Proposed Works Offshore	0.28	0.28	0.28	0.28
Societal	Compatibility with Future Use of the Offshore Site	0.3	0.4	0.2	0.4
Cost	Total cost	0.2	0.15	0.2	0.15
Cost	Residual liability	0.3	0.4	0.2	0.4
Overall Weighted Score		**3.65**	**3.79**	**3.37**	**3.62**

B.2 Sensitivity Analysis

Figure 7.1 and **Figure 7.2** show the sensitivity check of eliminating one criterion at a time. The applied analysis provides insight into the relative influence of individual criteria on the overall scoring results. It can be observed that for all decommissioning options, the largest absolute reductions in weighted scores occur when safety, environmental, and technical feasibility criteria are eliminated, reflecting their higher weighting and central role within the assessment framework.

For the foundation (monopile) decommissioning options, elimination of individual criteria leads to noticeable reductions in absolute weighted scores, with safety, environmental, and technical feasibility criteria having the strongest influence, while removal of the societal criterion results in comparatively minor score changes, consistent with its lower weighting. The largest absolute score reductions tend to occur for options that originally performed strongly under the eliminated criterion; however, this effect is observed in terms of score magnitude only. Across all sensitivity scenarios, the relative ranking of the foundation decommissioning options remains unchanged. In particular, the LSBL P2 cut option (MP-C) consistently achieves the highest weighted score, demonstrating that the preferred foundation decommissioning outcome is not driven by any single criterion but results from balanced performance across the full set of assessment criteria.

A similarly robust behaviour is observed for the inter-array and offshore export cable decommissioning options. Removal of individual criteria results in predictable reductions in absolute weighted scores, with the most pronounced effects again associated with safety, environmental, and technical feasibility criteria, reflecting their weighting and importance. However, in all scenarios tested, the relative ranking of options remains unchanged. Full removal of the IAC consistently achieves the highest weighted score across all cases, while the relative ordering of the remaining options is preserved. This indicates that the comparative outcome for cable decommissioning is likewise not dependent on any single criterion and that the applied weighting structure provides a stable basis for comparison.

Overall, the sensitivity analysis confirms the robustness of the scoring methodology. By systematically eliminating individual criteria, the analysis demonstrates that while certain criteria have a strong influence on absolute score values, the overall decision outcome remains stable. Safety, environmental, and technical feasibility criteria are confirmed as the most influential drivers of score magnitude, whereas societal criteria have the least impact, consistent with their assigned weightings. The absence of any rank reversals across all scenarios provides confidence that the comparative assessment is well-balanced, internally consistent, and suitable to support robust and informed decision-making.

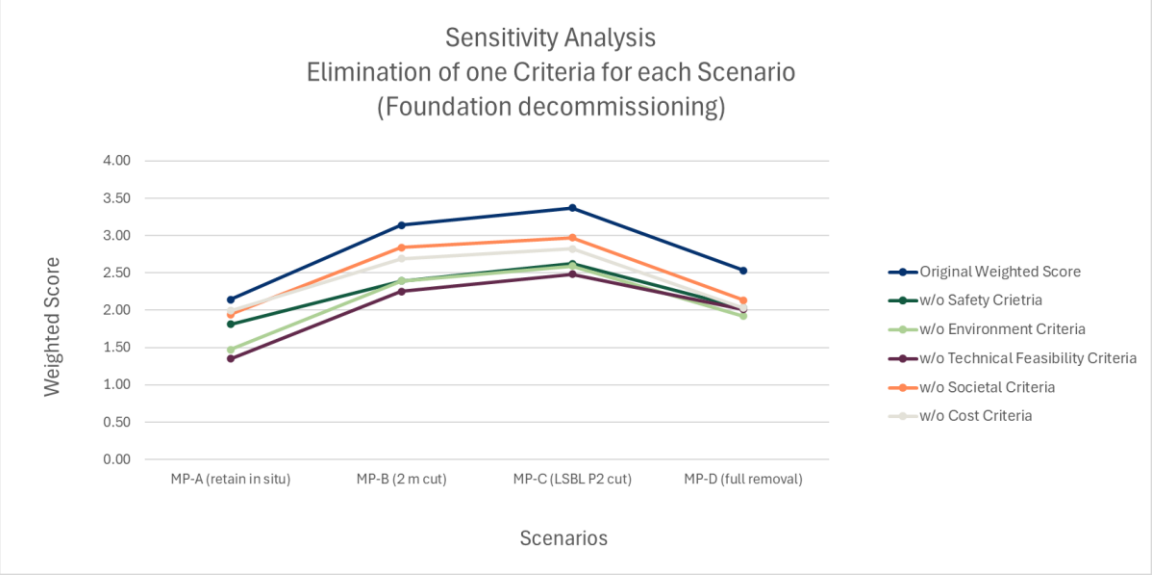


Figure 7.1: Elimination of each criterion separately for each foundation decommissioning option and comparing the scoring results to the original weighted scores.

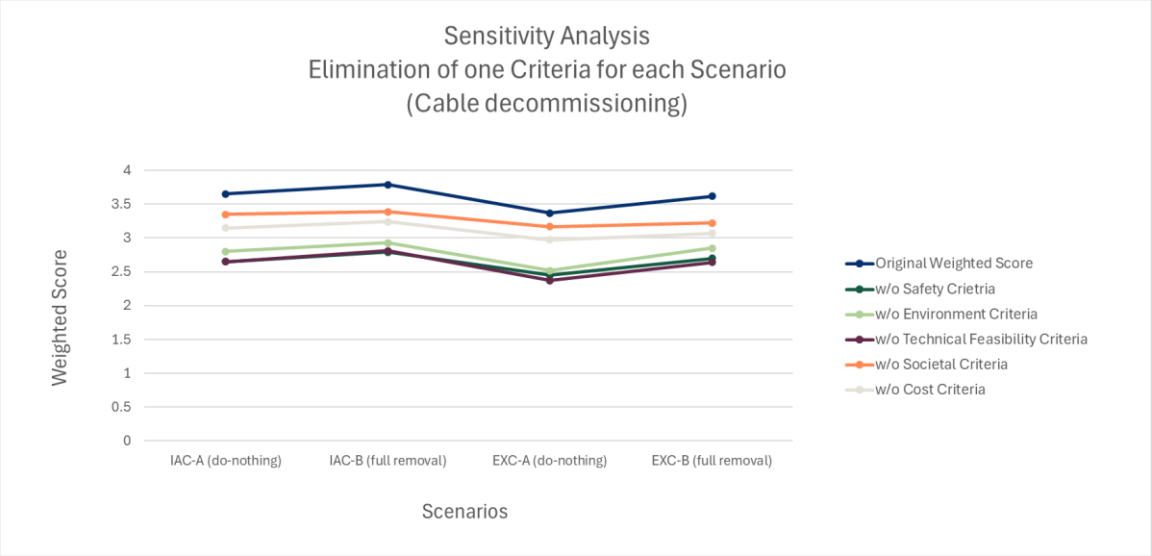


Figure 7.2: Elimination of each criterion separately for each cable decommissioning option and comparing the scoring results to the original weighted scores.