REPORT

Andrew Drill Cuttings Pile BAT Assessment

Prepared for: **BPEOC**

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ABBREVIATIONS

£ m	Million Great British Pounds
BAT	Best Available Technique
BEIS	Department of Business, Energy and Industrial Strategy (now DESNZ)
BEP	Best Environmental Practice
BPEOC	bp Exploration Operating Company Limited
BTEX	Benzene, Toluene, Ethylbenzene, Xylene
CAR	Controlled water activities
CER	Centre for Environmental Risk
CNRI	CNR International (U.K.) Limited
CNS	Central North Sea
CO	Carbon Monoxide
CO_2	Carbon Dioxide
CO_2e	Carbon Dioxide equivalent
DNV	Det Norske Veritas
EA	Environmental Appraisal
EC	European Commission
ESAS	European Seabirds at Sea
ERT	ERT (Environmental consultancy company)
GDP	Gross Domestic Product
ICES	International Council for Exploration of the Sea
IoP	Institute of Petroleum
JNCC	Joint Nature Conservation Committee
km	Kilometres
LAT	Lowest Astronomical Tide
LTOBM	Low Toxicity Oil Based Mud
m	Metres
MBES	Multi Beam Echo Sounder
mg/kg	Milligram per kilogram

NCMPA	Nature Conservation Marine Protected Area
NOx	Oxides of Nitrogen
NPD	Naphthalenes, Phenanthrenes and Dibenzothiophenes
OSPAR	Oslo Paris Commission for the Protection of the Marine Environment of the North-East Atlantic
OBM	Oil Based Mud
OGUK	Oil and Gas UK (now OEUK)
OPF	Organic Phase Drilling Fluids
OPPC	Oil Pollution Prevention and Control
OPRED	Offshore Petroleum Regulator for Environment and Decommissioning
PAH	Polycyclic Aromatic Hydrocarbons
PCB	Polychlorinated Biphenyl
ppm	Parts Per Million
ROV	Remotely Operated Vehicle
SAC	Special Area of Conservation
SEPA	Scottish Environment Protection Agency
SO_2	Sulphur Dioxide
t	Tonnes
THC	Total Hydrocarbons
TJ	Terajoules
TLP	Tension Leg Platform
UCM	Unresolved Complex Mixture
UK	United Kingdom
UKCS	United Kingdom Continental Shelf
UKOOA	United Kingdom Offshore Operators Association
WBM	Water Based Mud

1.0 EXECUTIVE SUMMARY

bp Exploration Operating Company Limited (BPEOC) are currently preparing to decommission the Andrew Area.

Some disturbance of the drill cuttings pile located at the Andrew platform will be required to recover the jacket, drilling template and the pipeline and umbilical ends. The minimum proportion of the cuttings pile to be disturbed is estimated to be up to 40% of the whole drill cuttings pile. A number of options for management of the cuttings pile have been proposed and the present study has been commissioned to determine which of these would be the Best Available Technique (BAT).

The cuttings pile has previously been determined to be below thresholds for oil loss (<10 te/yr) and footprint persistence (<500 km^2.yr) set by Oslo Paris Commission for the Protection of the Marine Environment of the North-East Atlantic (OSPAR) Recommendation 2006/5 on the management of offshore cuttings piles. As such, were it possible to recover the infrastructure without disturbance to the cuttings pile, BAT would be to leave it *in situ* to degrade naturally. This option has not been included within the BAT assessment since it would involve decommissioning of the jacket, drilling template and umbilical ends covered with cuttings *in situ*.

In accordance with OSPAR Recommendation 2006/5, the options considered in the BAT assessment were:

1. Leave *in situ* following removal of infrastructure;
2. Recover by suction dredging, treat and discharge offshore;
3. Recover by suction dredging, transport for treatment onshore, coastal discharge of aqueous waste, reuse or disposal of treated solids; and
4. Spreading of cuttings pile by high pressure water jet.

Further options suggested in OSPAR 2006/5 include Cuttings Re-Injection, Bioremediation *in situ* and Covering *in situ*. As a result of the drill cuttings re-injection feasibility study conducted by BPEOC, it has been determined that cuttings re-injection is not feasible and therefore screened out on that basis (bp, 2025). Bioremediation *in situ* and Covering *in situ* were also screened out on the basis of assessments by United Kingdom Offshore Operators Association (UKOOA) (2002) and Oil and Gas UK (OGUK) (2011) which identified the former technique to be insufficiently demonstrated for it to be considered “Available” and the latter technique to provide little or no environmental benefit.

The assessment was undertaken on the basis that Options 2 – 4 would all remove the entire pile (100%). Option 1 was undertaken on the basis that 40% of the cuttings pile would be disturbed during the removal of Andrew infrastructure, with the remaining pile left *in situ* to naturally degrade.

The assessment undertook a high-level evaluation of several key environmental aspects for each option. In addition safety, technical feasibility, regulatory clarity and cost were considered. Evaluation of the impacts associated with disturbance of the cuttings pile were informed by the results of the Drill Cuttings Modelling Study (Genesis, 2026b).

The assessment first sought to identify any impacts of particular significance and then compared the options on a relative basis for each assessment aspect.

In the first case the significance of aspects was graded as:

- <u>Green</u>: no regulatory or technical issues, emission/discharges/wastes *etc*. considered to be insignificant, or in line with BAT;

- Amber: some regulatory requirements, potential technical issues that can be overcome with prior planning, emission/discharges/wastes *etc*. higher than what would normally be considered to represent BAT; and
- Red: option has the potential to result in regulatory non-compliance, major technical issues which it may not be feasible to overcome, emissions/discharges/wastes *etc*. significantly higher than BAT.

The assessment identified that based on the rating by significance and comparison, Option 1 (leave *in situ* following removal of infrastructure) was consequently concluded to be BAT for the management of the Andrew drill cuttings pile given that both the hydrocarbon release and footprint persistence of the pile is below the respective thresholds under OSPAR Recommendation 2006/5.

2.0 INTRODUCTION

bp Exploration Operating Company Limited (BPEOC) are currently preparing to decommission the Andrew Area.

BPEOC have commissioned Genesis to undertake an assessment of Best Available Techniques (BAT) for the management of a historic drill cuttings pile located at the Andrew platform.

The assessment draws upon information presented in the Andrew Jacket and Topsides Decommissioning Environmental Appraisal (EA) (Genesis, 2026a) and the Cuttings Pile Disturbance Modelling report (2026b).

2.1 Project Background

The Andrew Area comprises a number of fields including Andrew, Cyrus, Farragon, Kinnoull and Arundel. All of these fields produce over the Andrew platform which is located *c.* 198 km northeast of the Scottish coastline and *c.* 23 km from the United Kingdom (UK)/Norway median line. The water depth at the field is c. 117 m lowest astronomical tide (LAT) and the associated infrastructure span across United Kingdom Continental Shelf (UKCS) Blocks 16/22, 16/23, 16/27 and 16/28 (Figure 2-1).

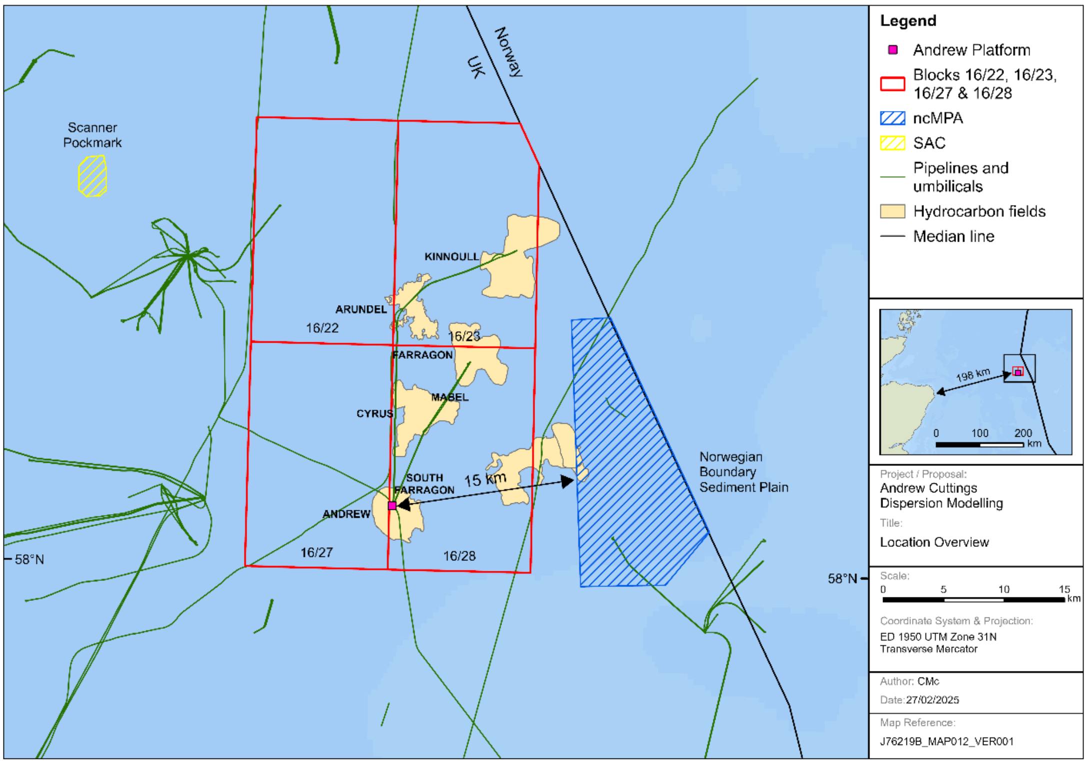


Figure 2-1 Andrew field location

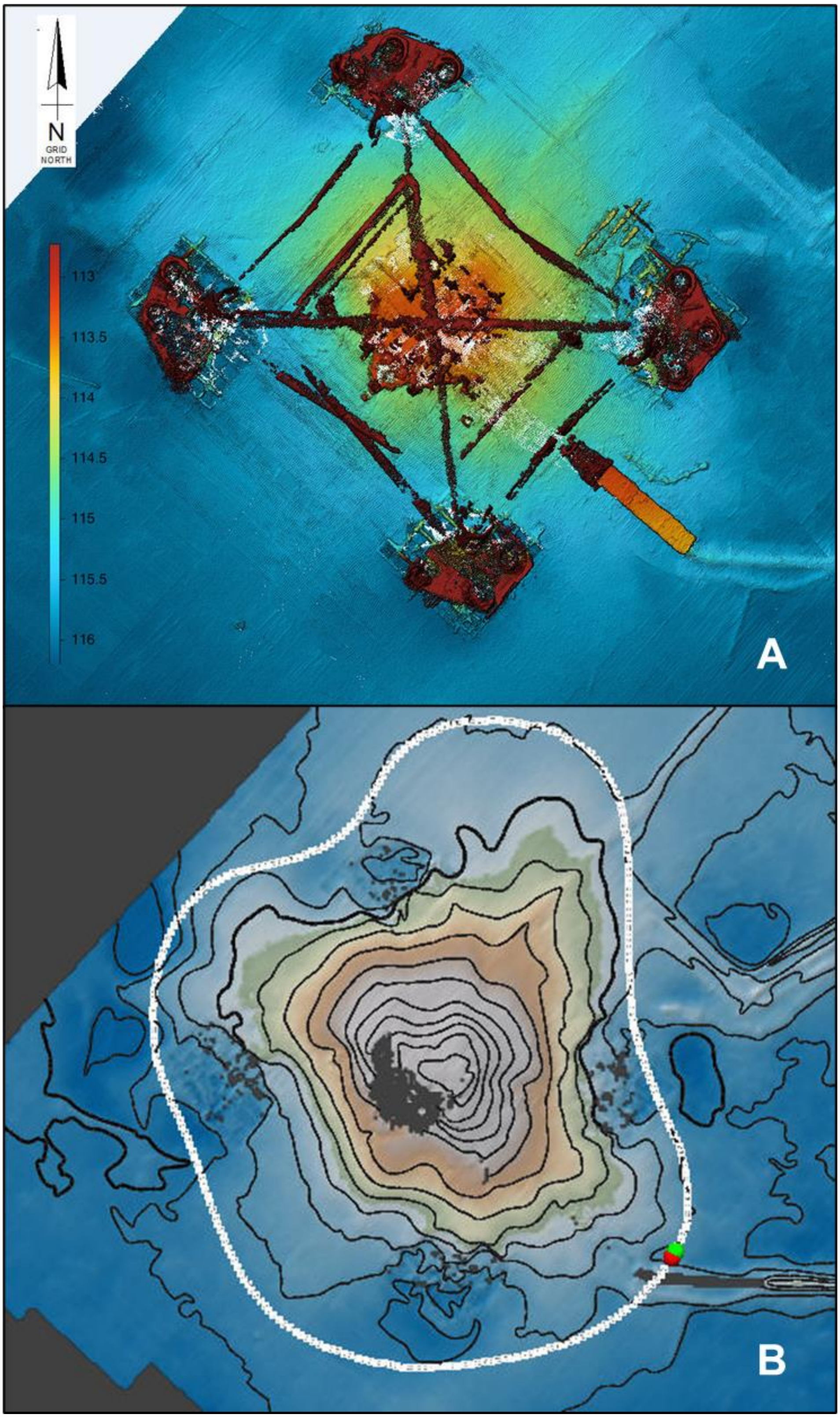
In line with OSPAR Decision 98/3 on the Disposal of Disused Offshore Installations (OSPAR, 1998) the Andrew topsides and jacket will be recovered to shore for management via the waste hierarchy.

2.1.1 Andrew Drill Cuttings

In total, 17 platform wells were drilled at Andrew from 1994 to 2017, 15 oil producing, one gas producing and one gas injection well. Some of the well sections associated with these wells were drilled using oil-based mud (OBM) and therefore, in addition to water-based mud (WBM), contaminated cuttings will have been discharged to the seabed prior to 2001. It is also possible that synthetic based muds may have been discharged. Note that after 2001 OBM could no longer be discharged to the seabed as a result of the prohibition of discharge to the marine environment of drill cuttings contaminated with more than 1% oil by weight of oil-based fluids on dry cuttings (*OSPAR Decision 2000/3 on the Use of Organic Phase Drilling Fluids* [OPF] and *the Discharge of OPF-Contaminated Cuttings*) came into force on 16 January 2001.

A bathymetric multi-beam echo sounder (MBES) survey and visual inspection of the Andrew cuttings pile was conducted and the Volume Calculation Utility in NaviModel reported the overall area of 5,280.89 m^2 and the calculated volume of 3,212.93 m^3 with an estimated maximum height of 2.34 m (Subsea7, 2019). The Andrew cuttings pile is considered to be a “small cuttings pile” (<5,000 m^3) according to the Norwegian Oil and Gas Association Guidance (NOREG, 2016).

Figure 2-2 shows the extent of the cuttings pile around the Andrew jacket and template based on the MBES survey (Subsea7, 2019).



Source: Subsea7, 2019.

Figure 2-2 A) Drill cuttings mound MBES image, B) Drill cuttings pile boundary

2.1.2 Drill Cuttings Disturbance During Decommissioning

Some disturbance of the drill cuttings pile located at the Andrew platform will be required to recover the jacket, drilling template and the pipeline and umbilical ends covered with cuttings. Genesis have previously modelled two disturbance scenarios to support the assessment of disturbing the cuttings pile (Genesis, 2026b):

- Scenario 1: The anticipated worst-case scenario of spreading 100% of the cuttings pile (3,212.93 m^3) to support the assessment of the option of spreading the whole pile to promote the natural breakdown of hydrocarbons; and
- Scenario 2: Relocation of 40% of the cuttings pile (1,285.17 m^3) to recover the jacket, drilling template and pipeline and umbilical ends covered with cuttings. A disturbance of 40% to the cuttings pile was estimated based on internal cuttings of the jacket piles. These modelling results will be used to support the assessment of the option to leave the cuttings pile *in situ* after the decommissioning activities are completed.

The results from these modelling studies have been used in the assessment of two of the cuttings pile management options considered in this report (referred later to as Option 1 and Option 4).

2.2 Legislative Context

Under OSPAR Decision 98/3 (OSPAR, 1998) the Andrew platform (jacket and topsides) and drilling template must be recovered. Decision 98/3 also includes principles for the restoration of the seabed following decommissioning, although it recognises that at the time there was little information on cuttings pile management.

Recommendation 2006/5 on a Management Regime for Offshore Cuttings Piles (OSPAR, 2006) was established on the basis of subsequent research. Recommendation 2006/5 established criteria for determining whether an existing cuttings pile gives rise to an insignificant level of pollution. If the rate of oil loss to the water column is less than 10 t/yr, and the persistence over the area of seabed contaminated is less the 500 km^2.yr, then the cuttings pile may be left *in situ* to degrade naturally. Cuttings piles which do not fall into this category require assessment for BAT and/or Best Environmental Practice (BEP).

The OSPAR report (OSPAR, 2009a) on the implementation of Recommendation 2006/5 concluded that there was no evidence of substantial loss of oil from historic cuttings piles in the North Sea, that immediate action was not required to reduce environmental impact of them, and that the management of cutting piles could be addressed as part of the decommissioning plan for the installations.

2.3 OSPAR Assessment of the Andrew Cuttings pile

In response to OSPAR Recommendation 2006/5, the UK commissioned ERT (Environmental Resources Technology) to evaluate all cuttings piles in the United Kingdom Continental Shelf (UKCS) against the criteria for establishing significance of pollution. ERT (2009) estimated that the Andrew cuttings pile had a leaching rate of 1.21-1.70 t/yr and a persistence of contaminated area <18 km^2.yr. The 2019 survey results estimate a rate of oil loss to the water column of 0.24 t/yr (Fugro, 2019a). Both metrics and sources are significantly below the OSPAR thresholds for leaching rate (10 t/yr) and persistence (500 km^2.yr).

2.4 Best Available Techniques

BAT is a term applied within environmental regulations on limiting pollutant discharges with regard to the abatement strategy.

BAT is defined as follows (EC, 2010)

'best available techniques' *means the most effective and advanced stage in the development of activities and their methods of operation which indicates the practical suitability of particular techniques for providing the basis for emission limit values and other permit conditions designed to prevent and, where that is not practicable, to reduce emissions and the impact on the environment as a whole:*

(a) ***'techniques'*** *includes both the technology used and the way in which the installation is designed, built, maintained, operated and decommissioned;*

(b) ***'available techniques'*** *means those developed on a scale which allows implementation in the relevant industrial sector, under economically and technically viable conditions, taking into consideration the costs and advantages, whether or not the techniques are used or produced inside the Member State in question, as long as they are reasonably accessible to the operator;*

(c) ***'best'*** *means most effective in achieving a high general level of protection of the environment as a whole;*

BEP is defined as "the application of the most appropriate combination of environmental control measures and strategies".

The essence of BAT/BEP is that the selection of techniques and control measures to protect the environment should achieve an appropriate balance between the environmental benefits they bring and the costs to implement them.

2.5 Objectives and Scope of BAT Assessment

The objective of the BAT assessment is to review the options available for the management of the Andrew drill cuttings pile, and identify one or more options that represents BAT.

The scope of the assessment is in keeping with OSPAR Decision 2006/5, and considers the following options:

- Natural degradation *in situ* following partial disturbance during the removal of the Andrew infrastructure[1];
- Offshore injection;
- Offshore treatment and disposal;
- Onshore treatment and reuse or disposal;
- Bioremediation *in situ*;
- Covering *in situ; and*
- Spreading.

[1] Natural degradation *in situ* without any disturbance is not applicable as recovery of the jacket, drilling template and line ends will cause initial disturbance of up to 40% of the cuttings pile.

The following aspects have been considered in the course of the assessment, focussing on those that give greatest differentiation between options:

- Safety;
- Technical feasibility;
- Regulatory uncertainty;
- Environmental impacts in relation to:
    - Cuttings release;
    - Emissions to air;
    - Aqueous discharges;
    - Chemical use;
    - Underwater noise;
    - Waste generated;
    - Unplanned events;
    - Legacy impacts;
- Cost.

Comparison of available onshore technologies for treatment of the cuttings was considered to be outwith the scope of this BAT assessment and therefore environmental impacts onshore, following the skip and ship option, have assumed a base case of thermal treatment and disposal of treated cuttings to landfill (with the reuse of recovered oil) as this is the most commonly used onshore treatment/disposal option for low toxicity oil based mud (LTOBM) contaminated cuttings used for current drilling operations.

3.0 CUTTINGS PILE CHARACTERISATION

A full description of the extent, dimensions and composition of the cuttings pile is provided in the Andrew Cuttings Pile Dispersion Modelling Report (Genesis, 2026b), with a brief summary of some salient points provided here.

The total volume of the Andrew cuttings pile was estimated to be 3,212.93 m^3 and the area of the seabed covered by the cuttings pile was estimated to be 5,280.89 m^2 (Subsea7, 2019). The volume and area estimates were calculated by Subsea7 based on MBES data using the Volume Calculation Utility in NaviModel.

Typically, cuttings piles are made up of three layers (UKOOA, 2002; Hayes & Galley, 2013):

- Top layer: an oxygenated surface layer;
- Middle layer: an oil contaminated core; and
- Bottom layer: a less contaminated base layer.

No deep cores were taken from the cuttings pile such that there was insufficient data to identify whether or not these layers are present in the Andrew cuttings piles, therefore, a single chemical composition was allocated to the full depth of the cuttings pile.

Further information on the distribution of metals and of specific hydrocarbon contaminants including Unresolved Complex Mixture (UCM), polycyclic aromatic hydrocarbons (PAH), polychlorinated biphenyls (PCB), naphthalenes, phenanthrenes and dibenzothiophenes (NPD), benzene, toluene, ethylbenzene and xylenes (BTEX) and alkylphenol ethoxylates is presented in the Andrew Drill Cuttings Dispersion Modelling Report (Genesis, 2026b).

4.0 ENVIRONMENTAL SETTING

A full description of the environmental baseline in the vicinity of the Andrew development is provided in the EA written to support the Andrew Jacket and Topsides Decommissioning Programme (Genesis, 2026a), with a small number of particular points of relevance for the comparison of the cuttings pile management options noted here.

The Andrew platform is located *c.* 198 km northeast of the Scottish coastline and *c.* 23 km from the UK/Norway median line The water depth at the field is *c.* 117 m LAT.

Typical current speeds in the Central North Sea (CNS) are 0.1 m/s and the maximum current speed during mean spring tide is between 0.4-0.5 m/s.

Table 4-1 Summary of the key receptors in the area

Receptor	Summary Description
Protected areas	The nearest protected areas to the Andrew Platform are the Norwegian Boundary Sediment Plain Nature Conservation Marine Protected Area (NCMPA), and Scanner Pockmark Special Area of Conservation (SAC), located *c.* 15 km east and *c.* 35 km northwest respectively. The Norwegian Boundary Sediment Plain NCMPA is protected for ocean quahog (*Arctica islandica*) and Offshore subtidal sands and gravels representing sediment types suitable for ocean quahog colonisation. Scanner Pockmark SAC is designated for submarine structures made by leaking gases.
Seabed	The sediments across the Andrew area are relatively uniform and typically comprises silty and or silty sand with scattered cobbles and gravels. A number of Priority habitats are known to occur in the vicinity of the Andrew Field. Evidence of juvenile *A. islandica* were present within the macrofaunal analysis conducted by Fugro (2019a,b). Elements of the OSPAR (2008) listed threatened and/or declining habitat 'sea pens and burrowing megafauna communities' habitat were present throughout the Andrew survey area, with sea pens (*Pennatula phosphorea* and *Virgularia mirabilis*), the Norway lobster (*Nephrops norvegicus*) and burrows observed.
Benthic communities	In relation to benthic communities, the results of the surveys taken in the area indicate a significant homogeneity in terms of diversity. The communities are all polychaete dominated with contributions from the echinoderm *Amphiura filiformis* and other ophiuroids (often as juveniles). Juvenile *A. islandica* were also present in a number of surveys. Survey results also suggested that the OSPAR (2008) listed threatened and/or declining habitat 'sea pens and burrowing megafauna community' is also present in the area.
Fish	Several fish species are known to spawn in the area including (but not limited to): cod, lemon sole, mackerel, Norway pout, *Nephrops*, and spotted ray. Group 0 fish for a number of species have been found in the area indicating it is used as a nursery ground for these species including (but not limited to): anglerfish, blue whiting, cod, hake, haddock, herring, lemon sole, ling, mackerel, plaice, Norway pout, *Nephrops,* sandeel, spotted ray, whiting and spurdog. Of the fish species identified in the area, mackerel, ling, Atlantic herring, sandeel, spurdog, cod, Norway pout, whiting, blue whiting and anglerfish have been assessed by NatureScot and the Joint Nature Conservation Committee (JNCC).

Marine mammals	Harbour seals are not likely to be present in the vicinity of the Andrew platform whilst grey seals possibly occur in low numbers with > 0 to 0.001% of the UK and Ireland at-sea grey seal population potentially present in the area. Cetacean species likely to occur within the area include Atlantic white-sided dolphin, white-beaked dolphin, minke whale, killer whale, harbour porpoise and beaked whale (Reid *et al*., 2003). When present, monthly densities range from high to low.
Birds	European Seabirds at Sea (ESAS) data collected over 30 years (Kober *et al*., 2010), indicates the presence of a number of bird species in the area including but not limited to the northern gannet, Manx shearwater, European storm-petrel, northern gannet, northern fulmar, black-legged kittiwake, lesser and great black-backed gull, razorbill, pomarine, great and Arctic skua, little auk, herring gull, common guillemot and Atlantic puffin. Of the species expected to occur in the area; European storm petrel is afforded protection by the European Commission (EC) Birds Directive (Annex I).
Fisheries	Andrew area occurs within International Council for Exploration of the Sea (ICES) rectangles 45F1. Fishing activity in the area can be considered moderate. A review of the Scottish Government landings data for 2019 to 2023 shows that trawls were the most dominant gear type used in ICES rectangle 45F1 amounting to a collective total of 4,058 days of fishing effort compared to seine nets where data were disclosive for each year through this time period (Scottish Government, 2023).

5.0 CUTTINGS PILE MANAGEMENT OPTIONS

The drill cuttings pile at Andrew falls below the thresholds of oil loss and area persistence as defined by OSPAR recommendation 2006/5. As such the recommended management for the cuttings pile is to leave it *in situ* to degrade naturally. This would be feasible but would require the lower parts of the Andrew jacket legs, drilling template and the pipeline and umbilical ends to be decommissioned *in situ* rather than be removed. BPEOC is not currently considering this option as it would not comply with OSPAR Decision 98/3 and hence not applicable.

Removal of the Andrew jacket and seabed structures beneath it would require disturbance of a portion of the cuttings pile. Table 5-1 presents the options considered for the management of the cuttings pile to enable decommissioning. As discussed in the Andrew Drill Cuttings Modelling study (Genesis, 2026b), recovery of the jacket, drilling template and line ends are expected to result in disturbance to a maximum of 40% of the cuttings pile.

Table 5-1 Cuttings management options

Option	Name	Description
Option 1	Leave *in situ* following removal of infrastructure	Natural degradation *in situ* following partial disturbance during the removal of the Andrew infrastructure.
Option 2	Offshore treatment	Recovery of the whole pile to the platform or a vessel; separation, treatment and offshore discharge of water; offshore treatment and disposal of solids.
Option 3	Onshore treatment	Recovery of the whole pile to a vessel; transportation to shore; treatment onshore and reuse or disposal of recovered material streams.
Option 4	Spreading	Redistribution of the whole pile primarily within the Andrew 500 m exclusion zone.

As a result of the drill cuttings re-injection investigation study (bp, 2025), it has been determined that cuttings re-injection is not feasible due to significant risks associated with its implementation. Injecting drill cuttings into the wells could block the natural flow pathways within the rock or require high injection pressures, which may compromise the integrity of the wells and the surrounding rock formations. Such damage could potentially result in oil or gas migrating into unintended underground layers. Additionally, the equipment required for cuttings reinjection has been removed from the platform, and reestablishing this process would involve substantial modifications that are neither practical nor safe (bp, 2025). Therefore, this option is not considered further as part of this assessment.

Options to cover all or part of the pile, either *in situ* or following spreading are also not considered as these provide limited environmental benefit over uncapped piles (UKOOA, 2002; OGUK 2011).

Opportunities for *in situ* bioremediation have also been rejected. Whereas research has suggested that this may prove to be technically feasible, with high levels of degradation of contaminants, there has been no field demonstration of the technology to date, and it is anticipated to be high cost to implement (UKOOA, 2002; OGUK 2011). At the present time this is not deemed to be an available technique.

The following sections provide further detail of each of the options listed in Table 5-1.

5.1 Option 1 – Leave in situ following removal of infrastructure

This option would involve some initial disturbance to the cuttings pile during the removal of the jacket, drilling template and the line ends (up to 40% of the cuttings pile). Following the removal of the Andrew infrastructure the remaining cuttings pile will be left undisturbed *in situ* to degrade naturally. The Andrew Drill Cuttings Modelling study (Genesis, 2026b) considered the disturbance to 40% of the drill cuttings pile during the removal of the Andrew infrastructure.

5.2 Option 2 – Offshore Treatment and Disposal

The cuttings pile would be recovered and dewatered, following which dewatered solids would be treated to remove remaining water and hydrocarbons using equipment imported to the platform or on a support vessel. Wastewater would be treated and, along with the treated cuttings, would be discharged offshore whilst the hydrocarbons would be returned to shore for management under the waste hierarchy.

5.2.1 Recovery of Cuttings

Recovery of the cuttings pile would be by suction dredging using Remotely Operated Vehicles (ROV) to mobilise the cuttings, combined with pumping to surface. The mobilisation of cuttings piles by suction dredging has been demonstrated, for example at Valhall (DNV, 2017) and the technique is widely used for excavation and trenching of seabed sediments. However, there are few examples where dredged material has been recovered rather than merely moved to an area of the nearby seabed. Field trials demonstrated the combined dredging and lifting technique could be successfully applied to cuttings piles removal at North West Hutton (UKOOA, 2002), although operational difficulties were noted. These included poor visibility due to resuspended material, the presence of dropped objects and other debris, hardened deposits of cement or grout, and dredging line blockages requiring back flushing. The technique achieved relatively low removal rates (10 m^3/hr) and required large quantities of water mixing with the excavated cuttings, resulting in a water to solids ratio in the range of 6:1 to 25:1.

The technique is considered to be feasible and available, and it is anticipated that further experience will improve efficiency of cuttings removal. Anticipated dredging rates of 360-1200 m^3/d were quoted in the Oil & Gas UK (OGUK) Cuttings Study (OGUK, 2011), and a refined estimate of 960-1280 m^3/d was identified by CNRI for the Murchison decommissioning programme. However, the cuttings pile at Andrew is relatively small and much of it lies in and around structures which may limit the potential for improved performance. Although the North West Hutton trials quoted design flow rates of 100 m^3/hr, these were not achieved during the trials. Lower expectations would also be supported by work done by BPEOC at Valhall (Norwegian Environment Agency, 2013) where pumping rates varied between 7-32 m^3/hr.

A rate of 50 m^3/hr (as used for the Andrew cuttings modelling study) and a water to cuttings ratio of 10:1 have been adopted for the BAT Assessment. On this basis it is estimated that it would require up to 29 days for moving the whole cuttings pile, and a total volume of 35,342 m^3 of cuttings slurry would be received topsides.

An alternative method of using a grab bucket to remove the cuttings into bags for recovery to surface has been previously considered (UKOG, 2011) and would result in a lower water/solids ratio of the recovered material. This method is better able to handle obstructions within the pile but is not able to be used inside the jacket structure and would also be unsuited to recovering cuttings from around the drilling template. It is consequently not deemed an available technique for the recovery of the Andrew drill cuttings pile.

Due to the volume of recovered slurry and the footprint of the treatment systems a support vessel would most likely be required to handle and process the recovered cuttings.

5.2.2 Treatment of Recovered Cuttings

Systems exist to treat cuttings offshore in order to reduce the oil on cuttings level to below 1%. These are mainly based on the thermal desorption process, using mechanically generated heat to volatilise contaminants and water from the solid matrix. Volatilised oil and water are condensed and recovered for use or disposal. The recovered condensed water can be typically of 10-15 ppm oil content and would be eligible for discharge overboard under permit.

The commercially available systems, such as Hammermill units, whilst being efficient in treating fresh cuttings, have not been designed to deal with the large volumes of water generated by recovery of cuttings material from the seabed. A preliminary dewatering stage would therefore be required.

5.2.3 Disposal

Dewatering would produce around 32,129 m^3 of water[2], which would be treated to remove fine suspended material and oil before being discharged overboard under permit from Offshore Petroleum Regulator for Environment and Decommissioning (OPRED). The oil in the dewatering effluent is likely to be associated predominantly with the fine particulate matter and tests would be required to identify an appropriate treatment process, potentially involving chemical flocculation.

The residual dry solid material remaining after the desorption process, approximately 4,948 t at typically 0.1-1% oil content, would be disposed of offshore as is standard practice for management of treated drill cuttings.

Recovered oil would be shipped to shore for management under the waste hierarchy.

5.3 Option 3 – Onshore Treatment and Disposal

The option involves the removal of the whole cuttings pile to a vessel, transportation of the cuttings and associated water to shore, treatment onshore and reuse or disposal of recovered material streams.

5.3.1 Recovery of Cuttings

The first stage of the option, to recover the cuttings pile to the vessel, would be the same as for Option 2.

5.3.2 Transportation of Cuttings to Shore

The cuttings could either be recovered into sealed containers and back loaded for transport to shore or into an appropriately rated tanker. The latter would require quayside offloading of the cuttings slurry into road tankers for land transport to the treatment facility whereas skipped cuttings could be loaded onto flat-bed vehicles. For the former option, between 650-750 standard sealed tankers would be required (based on 35,342 m^3 of recovered slurry) and so opportunities to minimise land transport, for example by contracting a port-based treatment facility, should be sought.

[2] Total volume of cuttings slurry (32,342 m^3) less volume of cuttings (3,212.9 m^3) = 32,129 m^3 of water.

5.3.3 Treatment of Recovered Cuttings

The cuttings slurry would undergo a similar treatment as described for Option 2 although with different opportunities for the ultimate use or disposal of the waste streams. Onshore thermal desorption technology is commonly used within the industry for treatment of fresh cuttings. The stages would include:

- Preliminary concentration of the slurry;
- Treatment of the separated water;
- Discharge of the treated water under permit from the relevant authority e.g. in Scotland it would be the Scottish Environment Protection Agency (SEPA) or the Environment Agency;
- Thermal desorption of the concentrated cuttings slurry including condensation of evaporated water and oil;
- Discharge of condensed water, potentially following further treatment to reduce oil content;
- Reuse of recovered oil; and
- Disposal of residual solids to a suitable licensed landfill site.

Final waste stream quantities would be similar to Option 2.

5.4 Option 4 – Cuttings Spreading

This option would involve dispersing the entire cuttings pile by water jetting.

Spreading would be by re-suspension of the whole cuttings pile from its current location and its subsequent re-deposition primarily within the Andrew 500 m exclusion zone.

The Andrew Drill Cuttings Modelling study (Genesis, 2026b) considered spreading of the whole cuttings pile by suction dredger. Given the size of the pile and that much of the material is entrained amongst the structures to be decommissioned, it is considered that jetting would be a more effective means of clearing the structures than suction dredging. This option therefore assumes jetting will be employed.

Water jetting is a method where pressurized water is applied to the drill cuttings suspending them into the water column, and therefore relocating the majority of the cuttings from their original position. It is fairly common practice for cuttings to be moved around the seabed to facilitate access to subsea structures (CER, 1999) with examples of 3,000-4,000 m^3 piles being moved by high pressure jetting at Magnus and Nelson, and the technique was used to remove an unknown volume (but possibly up to 20,000 m^3) of cuttings for the decommissioning of the Tension Leg Platform (TLP) and drilling template at Hutton (Kerr McGee, 2002 and ERT, 2004).

Jetting is considered to have high efficiency, good manoeuvrability and is less impacted by the presence of debris within the cuttings piles. Conversely, the technique has less control of sediment settling area (compared to dredging) and high particle dispersion.

Some reports have indicated that formation of surface oil sheens could be a risk, while others reported no sheen observed.

Jetting would be undertaken by ROV, powered and controlled from a support vessel following the removal of the jacket as it is not feasible for spreading to occur prior to the jacket removal.

6.0 BAT METHODOLOGY

The relative merits of each of the options has been considered under categories of safety, technical feasibility, regulatory certainty, cost and a series of environmental aspects. The assessment is generally qualitative, and where metrics (e.g. cost) have been provided these are high level indications only, but are developed in a consistent way to allow comparison between options.

6.1 Evaluation of Assessment Categories

This section describes the approach taken for each of the categories.

6.1.1 Safety

It is accepted as a prerequisite that whichever option is selected, all aspects of each operation will be fully assessed and safe procedures implemented. Nevertheless, it is acknowledged that all offshore activities entail a degree of safety risk, and this residual risk is higher for certain types of activities than others. The present assessment has given consideration to the scale of offshore activities and acknowledging where there is a requirement for higher risk activities such as diving, crane operation and high pressure operations.

6.1.2 Technical Feasibility

Where experience has shown that similar operations have been successfully conducted before, these are deemed feasible. Where there is limited experience, recognition has been given to operational constraints and difficulties observed. Where technologies have been postulated but have not been implemented the technical complexities that would require demonstration are considered. Experience is drawn from various reports from the OSPAR Commission on cuttings piles management (OSPAR, 2009a, b and c), the UKOOA Drill Cuttings Initiative (UKOOA, 2002), the Oil and Gas UK Cuttings Study (OGUK, 2011) and review of recent developments noted within decommissioning studies in the UKCS undertaken by Genesis or others.

6.1.3 Regulatory Uncertainty

Activities where the regulatory framework has yet to be tested have been identified.

6.1.4 Environmental Impact Potential

A number of environmental aspects have been included in the assessment as described below.

6.1.4.1 Cuttings release

Releases of cuttings material into the water column during disturbance can impact on marine organisms within the water column and, following re-deposition of contaminated cuttings, on benthic organisms. The results of the Drill Cuttings Dispersion Modelling study (Genesis, 2026b) are used to inform the impacts of each option.

6.1.4.2 Emissions to Air

The principal sources of pollutant emissions to air are identified for each option. These are generally related to energy consumption for equipment or transport which give rise to emissions of CO_2, NOx, SO_2, CO, particulates and unburnt hydrocarbons.

Emissions factors for all contaminants, with the exception of CO_2, vary greatly for each of these fuel uses and an overall estimate of emissions has not been generated. For the purposes of comparison of options, the quantity of CO_2e generated is used as an appropriate proxy for comparisons of pollutant emissions to air.

Emissions of CO_2 are based on energy use estimates from the UKOOA Drill Cuttings Initiative (UKOOA, 2002), supplemented as necessary with ship fuel use for additional shipments not included in the UKOOA estimates. Ship fuel usage is based on Institute of Petroleum Guidelines (IoP, 2000). Energy is converted to tonnes of fuel using net calorific values taken from the UK Greenhouse Gas National Inventory Report (2022 data as published in the National Inventory Report, published in 2024), and fuel mass is converted to CO_2e emissions using standard emissions factors.

6.1.4.3 Aqueous Discharges

Quantities of effluent from dewatering are estimated based on the assumption that suction dredging results in recovered cuttings slurry that is 10:1 water to cuttings. Effluent quality is assumed to be within the relevant regulatory discharge limits, and the assessment takes into account the relative sensitivity of the respective discharge locations.

6.1.4.4 Chemical Use

Chemical use is noted for each option, but environmental impacts only considered if there will be a discharge to the environment of those chemicals used.

6.1.4.5 Underwater Noise

Principal sources of noise are identified and their scale is put into context of other routine sources affecting relevant receptors.

6.1.4.6 Waste Generation

Quantities of each principal waste stream are estimated and their potential end point identified.

6.1.4.7 Unplanned Events / Accidents

Activities which present a risk of significant environmental impact from unplanned events are noted.

6.1.4.8 Legacy Impacts

The majority of the environmental impacts relate to effects contemporaneous with the decommissioning operations. The potential for longer term impacts are considered within this aspect. Impacts include the potential for residual contamination to affect marine biota, including implications for fish catch, and the potential for physical obstruction of fishing gear.

The need for ongoing monitoring requirements by BPEOC is also noted under this aspect.

6.1.5 Cost

High level costs were estimated based on those identified by the UKOOA Drill Cuttings Initiative (2002). Where available these are updated based on figures from the more recent OGUK Cuttings Study (2011). The estimates are supplemented as necessary with costs of ship use where these have not been included in the UKOOA estimates. Day rates for different vessel classes are taken from Genesis' cost estimation database.

Sources of cost estimates published before 2024 have been updated to 2025 costs using Gross Domestic Product (GDP) deflator figures from the Office of National Statistics (December 2024 tables).

It is noted that costs within the oil and gas industry vary greatly over time depending on levels of investment and activity across the sector. However, this has less of an influence on their use for comparison between options to establish relative rankings.

A post decommissioning survey is anticipated to be required irrespective of the cuttings pile management option adopted and this has consequently been omitted from the scope of the present assessment. However, it has been noted where some options will require multiple post decommissioning surveys.

6.2 Options Comparison

Two forms of ranking have been used for the assessment.

Firstly, a system of Red, Amber and Green has been applied to each aspect for each option to reflect where significant impacts are expected or likely.

Secondly, options are ranked for each aspect. The overall environmental ranking of options is established to identify best environmental option, and also combined with those for non-environmental aspects to identify BAT.

7.0 ASSESSMENT OF OPTIONS

7.1 Option 1 – Leave *in situ* following removal of infrastructure

7.1.1 Safety

The option requires little or no additional interventions and results in no added safety risks during decommissioning. Safety from the continued presence of the remaining pile is considered under Legacy Impacts.

7.1.2 Technical Feasibility

No additional technology required for leaving *in situ* following the removal of Andrew infrastructure.

7.1.3 Regulatory Uncertainty

The Andrew cuttings pile falls below the OSPAR thresholds for leaching rate (10 t/yr) and persistence (500 km^2.yr) (Section 2.3). It is therefore expected that the remnant cuttings pile that remains undisturbed will also fall below the OSPAR thresholds.

7.1.4 Environmental Aspects

7.1.4.1 Cuttings release

Disturbance, up to 40% of the whole the cuttings pile, will result in some cuttings entering the water column. The subsequent fate of the re-suspended material has been modelled and the scale of environmental impact predicted. This is documented in the Andrew Drill Cuttings Dispersion Modelling Report (Genesis, 2026b) and used to inform the impacts assessments (Genesis, 2026a).

The Modelling study identified that there is potential for impacts to marine biota in the following circumstances:

- Pelagic organisms are predicted to be exposed to a risk, primarily from the physical presence of particulate matter and hydrocarbon concentrations, over a maximum volume of water of 0.41 km^3 at any single point in time during the period of operations. This may manifest in a temporary reduction in local population of sensitive species.
- Organisms exposed during this period may retain chronic impacts from persistent contaminants over a longer period, potentially the life-time of the organism. This may manifest in a temporary local population reduction if reproduction success is affected.
- The area of seabed where hydrocarbon concentrations in sediments exceeds 50 mg/kg may be slightly increased above its present extent for a short period of no more than a year and a half. This is demonstrated in the modelling, which predicts a temporary expansion of sediment risk (driven by toxicity) immediately following disturbance. The affected area is projected to shrink rapidly, reducing to approximately 0.39 km^2 after one year and to around 0.06 km^2 after two years, as natural attenuation and sediment recovery processes restore hydrocarbon contamination levels to current conditions.

- Sediment dwelling organisms are predicted to be exposed to a risk of > 5% at the time of cuttings spreading, over an area of 14.5 km^2. The risk is primarily (77.5%) from the toxic effects of the hydrocarbon contamination. The extent of the affected area will reduce steadily due to biodegradation, and will be well within the currently affected area within 10 years.

7.1.4.2 Emissions to Air

There is very limited potential for direct emissions (i.e. evaporation) of hydrocarbons from the remobilised cuttings. There are no additional sources of atmospheric emissions outwith the general decommissioning activities arising from this option.

7.1.4.3 Aqueous Discharges

The operation results in no aqueous discharges.

7.1.4.4 Chemical Use

No chemical use has been identified for this option.

7.1.4.5 Underwater Noise

The operation results in no additional underwater noise outwith the noise from overall decommissioning vessel activity.

7.1.4.6 Waste Generation

No wastes are generated by the cuttings spreading option.

7.1.4.7 Unplanned Events / Accidents

n/a.

7.1.4.8 Legacy Impacts

The quantity of oil in the existing cuttings pile is estimated to be 14.7 t in total and, following disturbance, future losses of oil from the cuttings material to the water column will not exceed the OSPAR threshold of 10 t/yr. The overall contaminated footprint persistence of the resettled material will be significantly below the OSPAR threshold of 500 km^2/year (Genesis, 2026b).

The resettled cuttings will not present a snagging risk to fishing gear, it is theoretically feasible that there is the potential for contamination of catch as bottom dwelling bivalves could be exposed to contaminants from the disturbed material and the remaining pile which may result in tainted flavour or human exposure to contaminants.

As only 40% of the cuttings pile is disturbed in this option there will be a continued presence of an “undisturbed” cuttings pile on the seabed. This remnant pile could potentially present a snagging risk for fishing gear and therefore would be marked on Kingfish maps as a potential snagging hazard.

7.1.5 Cost

The option would result in no extra capital costs being incurred for decommissioning. There would however be a requirement to conduct additional post-decommissioning drill cuttings pile surveys. This is the lowest cost option.

7.2 Option 2 – Offshore Treatment and Disposal

7.2.1 Safety

Suction dredging is estimated to take up to 29 days with dewatering and treatment operations running concurrent with this and requiring additional operatives. There would be no anticipated requirement for diving.

7.2.2 Technical Feasibility

Each of the various steps are considered to be technically feasible although there are some residual uncertainties over achievable dredging rates and quantities of entrained water it produces. The combination of suction dredging with uplift to surface has been demonstrated in the field but is still a relatively novel technique.

Whereas thermomechanical cuttings cleaners (e.g. Hammermill) are established for treatment of freshly drilled OBM contaminated cuttings, application of the process for historical mixed cuttings types would require optimisation, and may not achieve the level of oil on cuttings typically seen in current drilling operations.

7.2.3 Regulatory Uncertainty

Treatment and discharge techniques are analogous with those typically used for fresh drill cuttings, for which regulatory aspects are well established.

7.2.4 Environmental Aspects

7.2.4.1 Cuttings Release

Re-suspension of cuttings material into the water column occurs during dredger shut-down and during back-flushing to clear blockages. During trials at North West Hutton for the UKOOA Drill Cuttings Initiative this was observed to lead to localised plumes of fine materials, with little discernible pollution beyond a distance of 100 m and no effects on the sea surface.

Cuttings discharged following treatment are fine grained and have typical oil contents of < 0.1% by weight. Topsides discharge is anticipated to result in rapid dispersal, and could result in physical stress to marine organisms, potentially over a wide area, for the duration that they are suspended in the water column.

7.2.4.2 Emissions to Air

Emissions of CO_2, NO_x, SO_2, CO and particulates from fuel use for offshore energy generation/pumps and vessel transport to support the following:

- Suction dredging and uplift (29 days);
- Dewatering and treatment of water (concurrent with uplift);

- Support vessels in the field (29 days); and
- Offshore thermal treatment.

Based on energy use estimates from UKOOA (2002) for suction dredging and for onshore treatment processes, used by analogy, Option 2 would use 109 TJ of energy and would generate approximately 1 TJ energy from recovered oil. The option would require a net energy demand of 108 TJ, resulting in the emission of 8,577 t CO_2e.

7.2.4.3 Aqueous Discharges

Offshore discharge of approximately 32,129 m^3 treated water to produced water discharge specification under Oil Pollution Prevention and Control (OPPC) permit. It is not uncommon for a large, mature installation in the UKCS to discharge this amount of produced water in a day.

7.2.4.4 Chemical Use

No chemical use has been identified for this option.

7.2.4.5 Underwater Noise

Sources of underwater noise for the offshore treatment option include vessels supporting the various operations over a period of around 1 to 2 months, and from subsea ROV equipment for the suction dredging. The impact of all vessel activity during decommissioning of the Andrew platform was assessed in the EA (Genesis, 2026a) and concluded to be of low significance. Underwater noise specifically related to the offshore cuttings management option is therefore considered to be insignificant.

Dewatering and Hammermill operations generate significant noise levels topsides. Topsides noise has low propagation to the water and is unlikely to affect marine species.

7.2.4.6 Waste Generation

Approximately 32,129 m^3 of wastewater in the vicinity of, Andrew. Approximately 14.6 t[3] of oil will be recovered for use.

7.2.4.7 Unplanned Events / Accidents

All offshore activities include risks for releases of material to the environment and are managed through mature processes. In addition to standard operations, such as waste water handling, Option 2 would also include less frequently encountered operations, such as dredging and recovery of cuttings solids. There is potential for accidental release of cuttings slurry to sea during uplift, for example through failure of the uplift hose. However, following completion of an appropriate risk assessment process, and implementation of risk management measures identified, undertaking these operations would not involve a significant risk to the environment.

7.2.4.8 Legacy Impacts

The offshore treatment option would remove the cuttings pile and enable removal of the jacket, drilling template and the pipeline and umbilical ends. There would be some residual

[3] Total estimated oil in the cuttings pile is 14.7 t. Treatment of the cuttings can achieve <1% oil on solids therefore 14.6 t has been calculated as recoverable oil.

contaminated sediments in the area around the platform, with hydrocarbon concentrations >50 mg/kg extending over an area of approximately 0.26 km^2. This is a result of discharges of LTOBM contaminated cuttings during the historic drilling campaigns prior to 2001.

These sediments are thought to be contaminated from historical drilling operations and as such the hydrocarbons would be expected to be highly weathered, strongly sorbed and have very low bioavailability. It is, however, possible that some commercially fished species growing within the area of residual sediment contamination could accumulate elevated levels of hydrocarbons, particularly UCM and PAH, in their flesh.

Post-decommissioning surveys would be required to determine whether this posed a risk to the catch and ultimately to food chain impacts. *In extremis*, a fisheries exclusion zone covering this area may need to be established until sediment contamination degrades to an appropriate level.

Following decommissioning, removal of the Andrew exclusion zone will provide a small increase in the area available for commercial fishing.

Solids treated in the Hammermill (or equivalent) process are in a fine powder form and, following discharge, are expected to be dispersed and settle out over a wide area. It is unlikely that resettlement would give rise to significant contamination of sediments and hence would not give rise to legacy impacts.

7.2.5 Cost

Option 2 is estimated to have the second highest cost, slightly behind Option 3 (See Section 7.3.5). These costs are based on estimates from OGUK (2011) and UKOOA (2002) for:

- Suction dredging and uplift (including support vessels);
- Offshore dewatering and treatment of wastewater discharge; and
- Offshore treatment of solids and disposal.[4]

7.3 Option 3 – Onshore Treatment and Disposal

7.3.1 Safety

Offshore activity for this option is limited to the suction dredging operation only. This is estimated to take up to 29 days to complete. There would be no anticipated requirement for diving. Assuming cuttings are received topsides directly to a vessel equipped with appropriately rated tanks for transporting the recovered slurry to shore, there would be no requirement for offshore transfers of material. The option would involve in port transfer of slurry to road tankers and onshore transport by public road network. Transportation of the slurry in containers rather than in a vessel tank would require significant craning and would be inherently less safe.

7.3.2 Technical Feasibility

Each of the various steps should be technically feasible although there are some residual uncertainties over achievable dredging rates and quantities of entrained water it produces.

[4] Note: As a result of a lack of information, the costs for the offshore dewatering and treatment along with the costs for offshore treatment of solids and disposal are assumed to be similar to that of the equivalent onshore activities.

The combination of suction dredging with uplift to surface has been demonstrated in the field but is still a relatively novel technique.

Should any technical difficulties be encountered with the treatment of the specific cuttings pile material, being onshore there is greater flexibility of space and holding time for alternatives to be identified. Accommodating change offshore, as would be necessary for Option 2, presents greater complications due to logistics and cost escalation.

7.3.3 Regulatory Uncertainty

Regulatory aspects of all steps are well established for the treatment of fresh drill cuttings and these are anticipated to be directly relevant to the onshore treatment of historic cuttings recovered during decommissioning.

7.3.4 Environmental Aspects

7.3.4.1 Cuttings Release

Re-suspension of cuttings material into the water column occurs during dredger shut-down and during back-flushing to clear blockages. During trials at North West Hutton for the UKOOA Drill Cuttings Initiative this was observed to lead to localised plumes of fine materials, with little discernible pollution beyond a distance of 100 m and no effects on the sea surface.

7.3.4.2 Emissions to Air

Limited potential for emissions of hydrocarbons (i.e. evaporation) from the remobilised cuttings, either from particles released into the water column, during dewatering or during the (closed) thermal treatment process.

Emissions of CO_2, NO_x, SO_2, CO and particulates from fuel use for onshore and offshore energy generation/pumps and vessel transport to support the following:

- Suction dredging and uplift (29 days);
- Support vessels in the field (29 days);
- Transportation of cuttings to shore (assumes 2 trailer dredgers required as volume of cuttings slurry of c. 35,342 m^3 with each vessel requiring two days loading; 4 days in transit plus 1 day unloading); and
- Onshore dewatering and thermal treatment (emissions for energy may be secondary if power sourced from the grid).

Based on energy use estimates from UKOOA (2002), supplemented as necessary with ship fuel use for additional shipments not included in the UKOOA estimates, Option 3 would use 119 TJ of energy and would generate approximately 1 TJ energy from recovered oil. The option would require a net energy demand of 118 TJ, resulting in the emission of 9,333 t CO_2e.

7.3.4.3 Aqueous Discharges

Coastal discharge of approximately 32,129 m^3 water treated to specifications of the Water Environment Water Services (Scotland) Act under a controlled water activities (CAR) licence.

This aspect assumes that the discharge will meet regulatory specifications. Concerns over treatment feasibility are captured under technical feasibility.

7.3.4.4 Chemical Use

No chemical use has been identified for this option.

7.3.4.5 Underwater Noise

Source of underwater noise for the onshore treatment option include vessels supporting the suction dredging operations over a period of around a month, including ROV equipment, and from the cuttings transport vessel. As with Option 2, the impact of vessels for these works is assessed to be a minor part of the overall decommissioning vessel activity, the impact of which has been assessed to have a low significance to marine biota.

7.3.4.6 Waste Generation

In addition to the dewatering effluent considered in Section 7.3.4.3, the option gives rise to approximately 4,948 t of dry solid waste[5]. If opportunities for reuse cannot be identified for this material, then it would be disposed of to landfill. This end point is the lowest point on the waste hierarchy of reduce, reuse, recycle, recover, disposal and contributes to the burden on a limited capacity of landfill sites.

Recovered oil will be available for use and so not deemed as waste.

7.3.4.7 Unplanned Events / Accidents

All offshore activities include risks for releases of material to the environment and are managed through mature processes. In addition to standard operations, Option 3 would also include less frequently encountered operations, such as dredging of cuttings solids and ship-to-ship and ship-to-port transfer of cuttings slurry. There is potential for accidental release of cuttings slurry to sea during these operations, for example through hose failure. However, following completion of an appropriate risk assessment process, and implementation of risk management measures identified, undertaking these operations would not involve a significant risk to the environment.

7.3.4.8 Legacy Impacts

As with Option 2, the onshore treatment option would remove the cuttings pile and enable removal of the jacket, drilling template and the pipeline and umbilical ends. There would be some residual contaminated sediments in the area around the platform, with hydrocarbon concentrations >50 mg/kg extending over an area of approximately 0.26 km^2. This is a result of discharges of LTOBM contaminated cuttings during the historic drilling campaigns prior to 2001.

Following decommissioning, removal of the Andrew exclusion zone will provide a small increase in the area available for commercial fishing, with the same provision for potential contamination of catch described in Section 7.2.4.8 also being relevant for Option 3.

7.3.5 Cost

Option 3 is estimated to have the highest cost of all the options, slightly greater than Option 2 due to the addition of transportation of material to shore. These costs are based on estimates from OGUK (2011) and UKOOA (2002) for:

[5] As calculated in the modelling report (Genesis, 2025b) from the cuttings pile volume, estimated moisture content and wet bulk density.

- Suction dredging and uplift;
- Transportation to shore, dewatering, treatment of discharge; and
- Onshore treatment of solids and disposal – including onshore transport.

7.4 Option 4 – Cuttings Spreading

7.4.1 Safety

The offshore activities for this option are limited to the jetting operations. By analogy with suction dredging rates, it is assumed that jetting operations will require up to 29 days to complete. However, this is seen as a worst case estimate, and feedback from suppliers suggests that jetting could be achieved in less than 5 days. There would be no anticipated requirement for diving, no crane use and no significant high pressure activities (jetting does not require significant high pressure).

7.4.2 Technical Feasibility

The cuttings spreading option involves a single operation which has been used frequently on small scales throughout the North Sea for clearing parts of cuttings piles for operational reasons, as well as some examples for decommissioning.

7.4.3 Regulatory Uncertainty

Regulatory aspects are tried and tested, for example for decommissioning of the Hutton TLP.

7.4.4 Environmental Aspects

7.4.4.1 Cuttings release

Spreading of the cuttings pile will force the cuttings into the water column. The subsequent fate of the re-suspended material has been modelled and the scale of environmental impact predicted. This is documented in the Andrew Drill Cuttings Dispersion Modelling Report (Genesis, 2026b) and used to inform the impacts assessments (Genesis, 2026a).

The Modelling study identified that there is potential for impacts to marine biota in the following circumstances:

- Pelagic organisms are predicted to be exposed to a risk, primarily from the physical presence of particulate matter and hydrocarbon concentrations, over a maximum volume of water of 0.47 km^3 at any single point in time during the period of operations. This may manifest in a temporary reduction in local population of sensitive species.
- Organisms exposed during this period may retain chronic impacts from persistent contaminants over a longer period, potentially the life-time of the organism. This may manifest in a temporary local population reduction if reproduction success is affected.
- The area of seabed where hydrocarbon concentrations in sediments exceeds 50 mg/kg is predicted to increase above its present extent for a short period of no more than a two years.
- Sediment dwelling organisms are predicted to be exposed to a risk of > 5% at the time of cuttings spreading, over an area of 24.3 km^2. The risk is primarily (77.5%) from the toxic effects of the hydrocarbon contamination. The extent of the affected area will

reduce steadily due to biodegradation, and will be well within the currently affected area within 10 years.

- The model predicted no risk of > 5% to sediment dwelling species in the Norwegian Boundary Sediment Plain NCMPA, located *c.* 15 km west of the Andrew platform. Very fine particles will spread over larger distances and any sediment that could settle in the Norwegian Boundary Sediment Plain NCMPA would result in a depth of burial of < 0.5 mm.

7.4.4.2 Emissions to Air

There is very limited potential for direct emissions (i.e evaporation) of hydrocarbons from the remobilised cuttings.

There would be emissions of CO_2, NO_x, SO_2, CO and particulates from fuel use for ROV jet lance and support vessel (29 days).

Based on energy use estimates from UKOOA (2002), assuming a similar demand to that required for suction dredging, Option 4 would use approximately 7 TJ of energy, resulting in the emission of 172 t CO_2e.

7.4.4.3 Aqueous Discharges

The operation results in no aqueous discharges.

7.4.4.4 Chemical Use

No chemical use has been identified for this option.

7.4.4.5 Underwater Noise

Source of underwater noise for spreading the cuttings pile option include vessels supporting the jet lance ROV and from the jet lance equipment itself. As with Options 2 and 3, the impact of vessels for these works is assessed to be a minor part of the overall decommissioning vessel activity, the impact of which has been assessed to have a low significance to marine biota.

7.4.4.6 Waste Generation

No wastes are generated by the cuttings spreading option.

7.4.4.7 Unplanned Events / Accidents

All offshore activities include risks for releases of material to the environment and are managed through mature processes. Use of a jet lance by ROV is a standard procedure and there are few untested or unusual risks to the environment presented by the option.

7.4.4.8 Legacy Impacts

The quantity of oil in the existing cuttings pile is estimated to be 14.7 t in total and, following resettlement, future losses of oil from the resettled cuttings material to the water column are not expected to exceed the OSPAR threshold of 10 t/yr. The act of spreading will encourage increased aeration of deposited material which will enable its further degradation by natural processes however this occurs at a slow rate. Given that the Total Hydrocarbon (THC) content of the cuttings is estimated at 14.71 t and that the current rate of oil loss to the water column is 0.24 t/yr it is unlikely that spreading the cuttings pile will increase the rate beyond the OSPAR threshold of 10 t/yr.. The overall contaminated footprint persistence of the resettled material will be significantly below the OSPAR threshold of 500 km^2.year (Genesis, 2026b).

The operation will result in the enhanced degradation of some of the cuttings pile oil, but the majority of the contaminants will resettle on the seabed in a dispersed, shallow layer of varying thickness.

The resettled cuttings will not present a snagging risk to fishing gear, it is theoretically feasible that bottom dwelling fish and shellfish could be exposed to contaminants from the dispersed material which may result in tainted flavour or human exposure to contaminants.

Studies summarised in Hartley *et al*., 2003, showed that the metals associated with cuttings piles on the sea floor are mostly in solid, poorly soluble forms. It is probable that some dissolved metals diffuse into the overlying water column and escape from the pile, but the efflux is not sufficient to raise the concentration of metals above natural background levels to an ecologically significant extent. There is some evidence of a limited bioavailability of a few metals, such as Pb and Zn, from cuttings piles, but it is doubtful that metals' bioaccumulation from cuttings piles, if it occurs, is sufficient to cause harmful effects in marine animals living on or near cuttings piles. This is consistent with the conclusions from the cuttings modelling (Genesis, 2026b) that risks due to metals in the redistributed cuttings are insignificant.

Chemical analysis of the hydrocarbons in the cuttings pile showed that the hydrocarbons content of the cuttings is dominated by UCM. UCM is a diverse range of hydrocarbon compounds that are the products of biodegradation of fresh oils, and the high proportion of UCM indicates that the cuttings hydrocarbons have previously been heavily weathered. There is little information to determine the extent to which UCM may be made bioavailable by the redistribution of the cuttings and taken up by shellfish. Their low solubility in water leads to their persistence in sediments (and cuttings piles) and would indicate a low bioavailability.

PAHs make up ~0.1% of THCs in the cuttings. However, they tend to be persistent in the marine environment and are toxic to marine organisms.

Hartley *et al.* (2003), concluded that, when left undisturbed, old cuttings piles most likely had no significant food chain effect and did not pose a risk to human health. However, they did not consider disturbance of cuttings piles and they also emphasized that very little direct information existed on contaminant accumulation in pile surface organisms. Evidence from more intense exposure to contamination, such as following large oil spills, has provided evidence of contamination and tainting of shellfish. Following the *Exxon Valdez* spill, crustaceans and molluscs were significantly contaminated and were unsafe to eat following exposure to crude oil, versus finfish which were found safe to eat. In the *Braer* spill, *Nephrops* and bivalve molluscs including mussels and scallops were severely affected and restrictions on *Nephrops* and mussels continued from 1993 until 2000. After the *Sea Empress* spill, fishing for crabs, lobsters and whelks was restricted for six months while fishing for other shellfish was restricted for over 18 months. These examples are following far larger releases of oil than would occur during or after spreading of the cuttings and recovery times, if required at all, would be far shorter.

Post decommissioning surveys will be required to monitor the state of the seabed, typically including bathymetric survey, the sampling and analysis of contaminants in sediments and shellfish from a suite of locations within and outside the present 500 m exclusion zone, and the sampling and analysis of benthic fauna at a separate suite of locations. Surveys are typically required immediately after decommissioning and at a time some years afterwards. It is possible that this option may require additional survey effort.

7.4.5 Cost

The estimated cost for Option 4 is based on estimates provided for suction dredging from UKOOA (2002) and if any additional surveys are required specifically for this option. Option 4 is the second lowest cost behind Option 1. The vessel usage and ROV equipment required for jetting is anticipated to be lower than for the suction dredging technique, and hence use of this indicative estimate of cost as a proxy for jetting is considered to be the worst possible case.

7.5 Comparison of Options

Based on the narrative and estimates provided in Section 7.1 to Section 7.4, and with regard to the impact levels identified for decommissioning activities in the Andrew Decommissioning EA (Genesis, 2026a), there are few aspects that provide differentiation between options due to step changes in the significance of impacts. This is summarised in Section 7.5.1. Nevertheless, some of the aspects do allow comparison between options based on lesser levels of difference, and this is described in Section 7.5.2.

7.5.1 Rating by Significance

The significance of aspects has been graded as insignificant (green), moderately significant (amber) or highly significant (red) in Table 7-1. These bandings indicate:

<u>Green</u>: no regulatory or technical issues, emission/discharges/wastes etc. considered to be insignificant and in line with BAT;

<u>Amber</u>: some regulatory requirements, potential technical issues that can be overcome with prior planning, emission/discharges/wastes etc. higher than what would normally be considered to represent BAT; and

<u>Red</u>: option has the potential to result in regulatory non-compliance, major technical issues which it may not be feasible to overcome, emissions/discharges/wastes etc. significantly higher that BAT.

The potential technical uncertainties over the feasibility of combined dredging and uplift, including whether it could be effective for recovery of cuttings lying in and amongst the subsea structures, give rise to amber ratings for options which include this technique. Resolution of these technical uncertainties could be explored with equipment providers.

The legacy impact of Option 1 and 4 relates to the potential for environmental impacts to fishing catches in the medium term, and the continued presence of cuttings piles in the long term.

The significance of the environmental impact from released cuttings during the spreading operation has been identified as moderate based on the modelling results. However, it is recognised that the impact is short term, and similar to routine activities undertaken under licence in the offshore oil and gas sector, such as disposal of WBM. Option 1 has also been rated moderate as although the environmental impacts are less than Option 4, they are not insignificant.

At several million pounds, the cost of all options, other than Option 1, are significant, especially Options 2 & 3, even though they are a relatively minor part of the whole cost of decommissioning.

Table 7-1 Assessment summary of impacts

OPTION ASPECT	OPTION 1 *In Situ* following infrastructure removal	OPTION 2 Treat Offshore	OPTION 3 Treat Onshore	OPTION 4 Spreading
Safety				
Technical feasibility				
Regulatory uncertainty				
Cuttings release				
Emissions to air				
Aqueous discharges				
Chemical use				
Underwater Noise				
Waste generated				
Unplanned events				
Legacy impacts				
Cost				

7.5.2 Rating by Comparison

Differentiation between options can be identified for many of the aspects considered, even if the overall impact of these aspects is not large. Table 7-2 provides a summary of these differences for each aspect, based on the lowest impact options being highlighted in light colour, middle ranking options in middle hue and higher impact options shown in dark blue.

The spread observable in Table 7-2 confirms the overall conclusion from Section 7.5.1 that there are no options that stand out as clearly best or least favourable. There are aspects of each option that are better than others and *vice versa*. This is especially the case when looking solely at the environmental aspects.

More detailed development of each option would refine the understanding of the impacts and this could have the potential to revise and even reverse the relative rankings of the options.

At the time of writing, the Andrew jacket is scheduled for removal between late 2028 to 2030 followed by the drilling template by 2035 and the exclusion zone will remain in place until full removal is completed. Whichever cuttings management option is adopted, there would be benefit in undertaking this element of the decommissioning of Andrew as early as technically feasible to allow maximum time for recovery of the seabed prior to removal of the exclusion zone and freeing access to other marine users.

Table 7-2 Summary of option differentiators

OPTION	OPTION 1	OPTION 2	OPTION 3	OPTION 4
ASPECT	***In Situ* following infrastructure removal**	**Treat Offshore**	**Treat Onshore**	**Spreading**
Safety				
Technical feasibility				
Regulatory uncertainty				
Cuttings release				
Emissions to air				
Aqueous discharges				
Chemical use				
Underwater Noise				
Waste generated				
Unplanned events				
Legacy impacts				
Cost				

Table Key: The shade of blue indicates the relative scale of impact among options: Dark > Medium > Light.

The assessment assumed that Options 2 - 4 would disturb the whole cuttings pile. Option 1 only disturbs 40% of the cuttings pile resulting in a small legacy impact, in that there will be a continued presence of a cuttings pile on the seabed. Whether this remnant pile would present a snagging risk for fishing gear would depend on the quantity and profile of the residual pile. Some degree of smoothing could be achieved, if necessary, using the suction dredger or water jet. This may result in some exposure of deeper, more contaminated cuttings, temporarily increasing hydrocarbon release before degradation of the newly exposed material occurs. Nevertheless, leaving *in situ* that part of the pile which does not need to be disturbed would be BAT given that both the hydrocarbon release and footprint persistence of the pile is below the respective thresholds under OSPAR Recommendation 2006/5.

8.0 CONCLUSION

Five options for management of the Andrew cuttings pile were considered:

- Option 1 – Leave *in situ* following removal of infrastructure;
- Option 2 – Remove and treat offshore;
- Option 3 – Remove and treat onshore; and
- Option 4 – Spread within 500 m safety zone.

Based on the rating by significance and comparison, Option 1 (leave *in situ* following removal of infrastructure) was consequently concluded to be BAT for the management of the Andrew drill cuttings pile given that both the hydrocarbon release and footprint persistence of the pile is below the respective thresholds under OSPAR Recommendation 2006/5.

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