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Dunlin Field Subsea Infrastructure Comparative Assessment

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Executive Summary

Fairfield has conducted a Comparative Assessment (CA) in support of the Dunlin Subsea Infrastructure Decommissioning Programme. The following steps from the Oil and Gas UK CA Guidelines have been completed:

This CA report presents the methodology, decisions which needed to be taken, the preparation works carried out, and the outcomes (recommendations) from the internal and external (with stakeholders) workshops.

The CA for the Dunlin Subsea Infrastructure Decommissioning Programme has focussed on eight groups (from Table 1, groups 2, 3, 5, 6, 7, 8, 9 and 10). All other groups of Dunlin subsea infrastructure were confirmed at the CA Scoping and Screening stage to be fully removed from the field. The outcome of the CA process has made the following recommendations:

Group	Infrastructure Type	Decommissioning Recommendation
1a	Deposits	Full Removal
1b	Structures	Full Removal
2	Buried Structures and Deposits	Deburial using mass flow excavator and full removal.
3	Rigid Risers	Leave in Situ – Minor Intervention (Outboard Cut and Recovery)
4	Surface Laid Rigid Spools	Full Removal
5	Trenched and Buried Pipelines	Leave in Situ – Minimal Intervention (Rock Placement)
6	Rock Dumped Surface Laid Rigid Spools	Full Removal – disconnect and recover
7	Rock Dumped Surface Laid Umbilicals	Full Removal – Reverse Reel
8	Riser Cable (Dunlin)	Leave in Situ – Minor Intervention (Outboard Cut and Recovery)
9	Trenched and Buried Cable	Leave in Situ - Minimal Intervention (Local Rock Placement)
10	Riser Cable (Third Party Infrastructure)	Leave in Situ – Minor Intervention (Outboard Cut and Recovery)

Table 1 Final Dunlin Recommendations

The eight decisions were reached on completion of an appropriate amount of preparatory study work, with clear decision outcomes. Sensitivities were performed where appropriate (e.g. relating to economics, or relating to uncertainty for some rankings) and found that these did not alter the overall decision outcomes. The only infrastructure remaining from the Dunlin field following decommissioning is proposed to be the already

trenched and buried pipelines, the trenched and buried cable, and the sections of all risers which are within the J-Tubes integral to the Dunlin Alpha CGB, and at Third Party Infrastructure. All other infrastructure will be fully removed.

Contents

1. Introduction

1.1. Overview

Fairfield Betula Limited (Fairfield) is the operator of the Dunlin, Osprey and Merlin fields, located in United Kingdom Continental Shelf (UKCS) Blocks 211/23 of the northern North Sea.

The Dunlin field was discovered by Shell UK in 1973 and the Dunlin Alpha platform subsequently installed in 1977; production from the field commenced in 1978. Prior to cessation of production, hydrocarbons from the Osprey and Merlin fields were transported to the Dunlin Alpha platform by pipeline for processing at a dedicated module.

Infrastructure associated with the Dunlin, Merlin and Osprey fields are currently being prepared for decommissioning. The Dunlin field lies approximately 137 km from the nearest landfall point, 196 km north east of Lerwick and 508 km north east of Aberdeen. The field sits 11 km from the UK/Norway median line and in a water depth of approximately 150 m (Figure 1.1). The Osprey field is a subsea tie-back located 6 km to the north-north-west of the Dunlin Alpha platform and the Merlin field is a subsea tie-back located 7 km to the west-north west of the Dunlin Alpha platform. Production at the fields ceased following cessation of production in 2015 and Fairfield now intend to decommission all three fields.

1.2. Purpose

The purpose of this document is to present a Comparative Assessment (CA) for the Dunlin subsea infrastructure in support of the decommissioning programme. The document describes the field infrastructure, the decommissioning options considered, the method used in the CA and the recommendations made during the CA process.

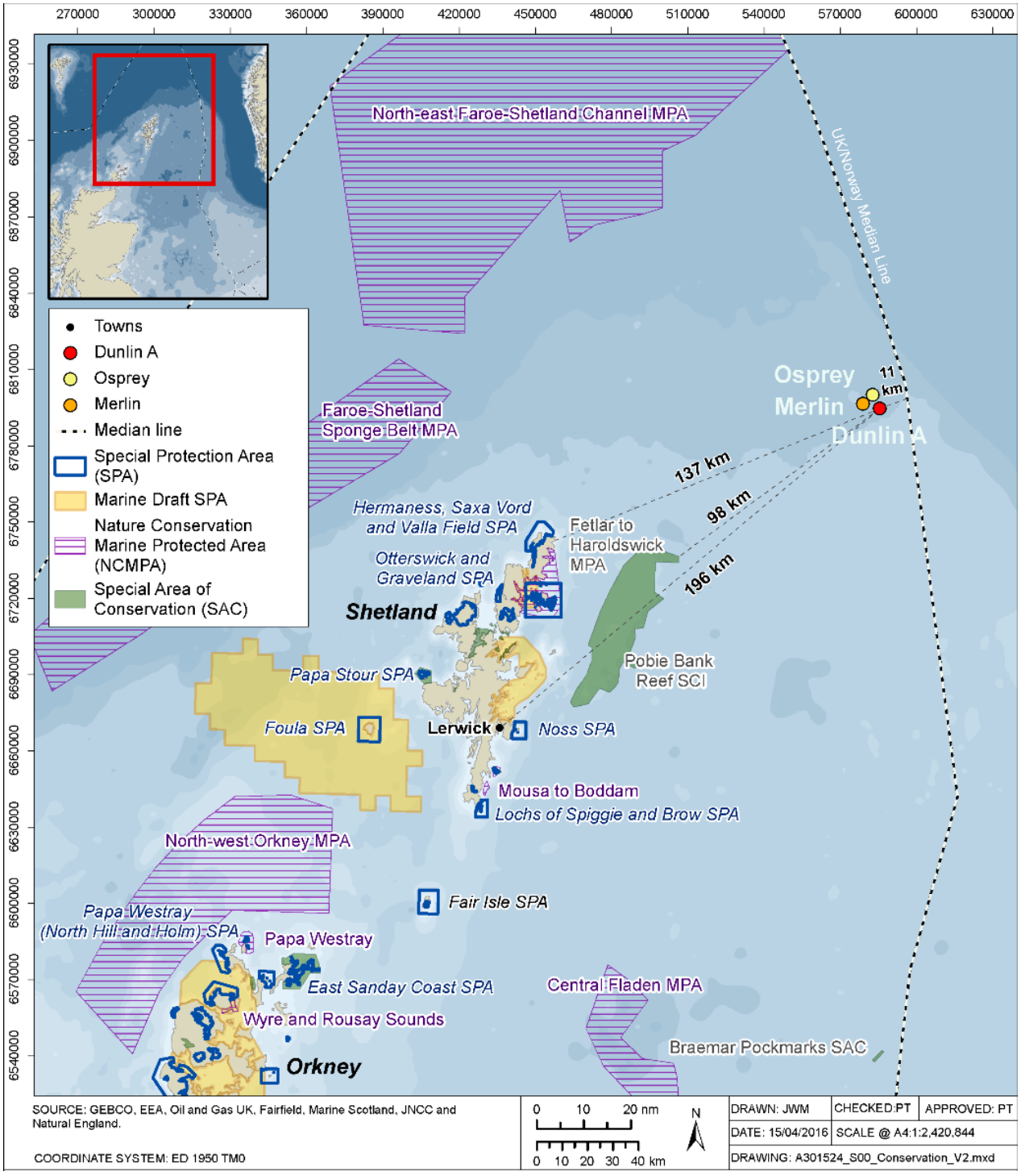


Figure 1.1 Location of Osprey, Merlin and Dunlin

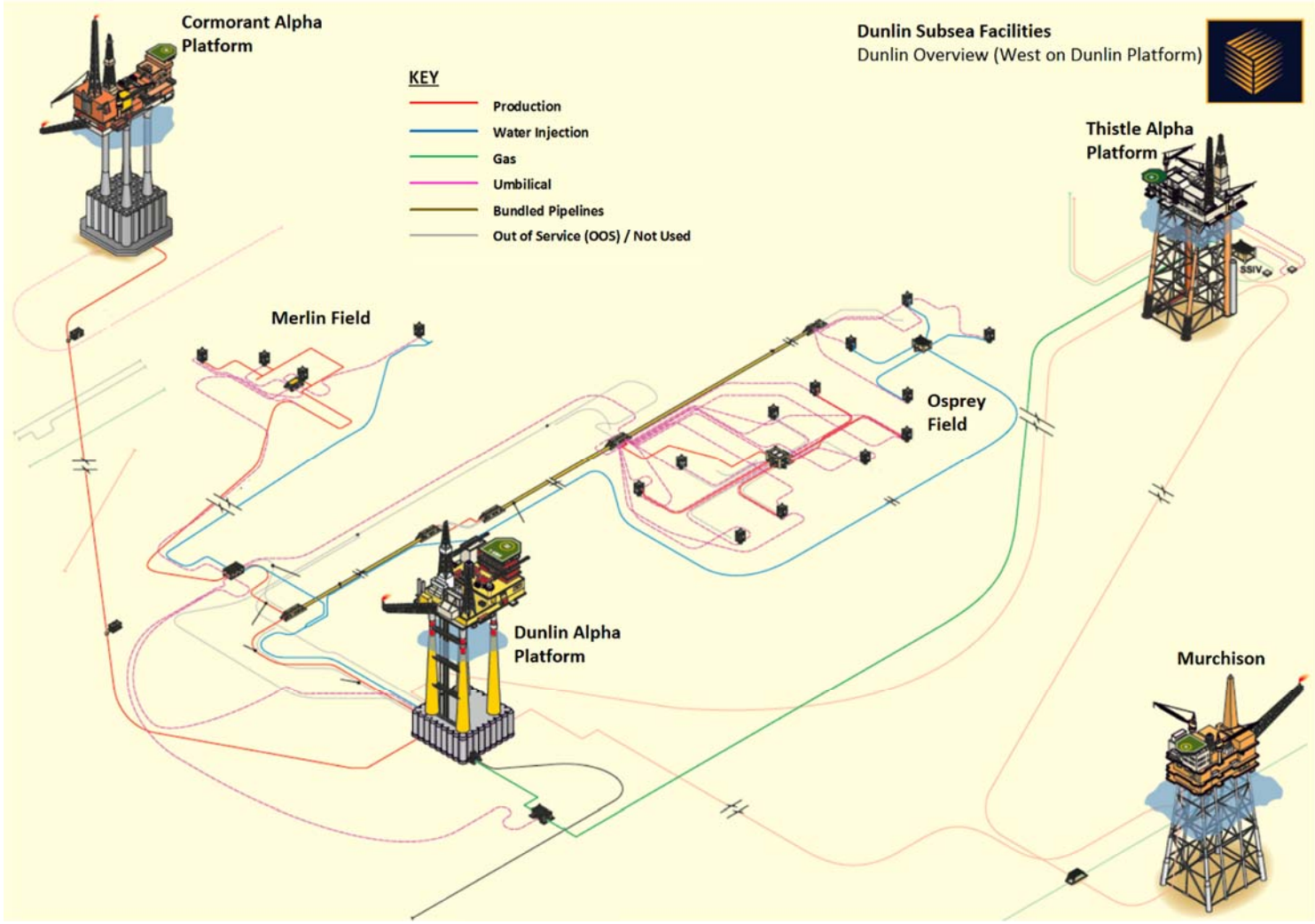


Figure 1.2 Dunlin Area Layout

1.3. Report Structure

This CA Report contains the following:

- Section 2 – An overview of the CA methodology;
- Section 3 – A description of each decision required to be made through the CA;
- Section 4 – A description of the study work undertaken to prepare for selecting a preferred option for each subsea infrastructure group;
- Section 5 – Presents the results of the CA process;
- Section 6 – Summary and recommendations;
- Section 7 – References
- Section 8 – Acronyms and glossary
- Appendix A – Pairwise Methodology Explanation
- Appendix B – CA Criteria
- Appendix C – Environment Criteria Assessment Methodologies
- Appendix D – Stakeholder CA Workshop Minutes
- Appendix E – Data Sheets (Exc. Costs)
- Appendix F – CA Attributes Tables & Pairwise Comparison (Exc. Costs)
- Appendix G – Decision Output Charts
- Appendix H – Data Sheets (Inc. Costs)
- Appendix I – CA Attributes Tables & Pairwise Comparison (Inc. Costs)

2. Comparative Assessment Methodology

2.1. Overview

CA is a process by which decisions are made on the most appropriate approach to decommissioning. As such it is a core part of the overall decommissioning planning process being undertaken by Fairfield for the subsea infrastructure at Osprey, Merlin and Dunlin.

Guidelines for CA were prepared in 2015 by Oil and Gas UK, where seven steps to the CA process were recommended. Table 2.1 provides commentary on each of these steps to demonstrate the Fairfield position.

Title	Scope	Status	Commentary
Scoping	Decide on appropriate CA method, confirm criteria, identify boundaries of CA (physical and phase), and identify and map stakeholders	✓	Scoping Reports prepared for Osprey, Merlin and Dunlin subsea infrastructure in advance of Screening (see below). Stakeholders identified and mapped and Stakeholder Engagement Plan prepared. CA methodology and criteria established for screening by early 2016.
Screening	Consider alternative uses and deselect unfeasible options.	✓	Screening workshops held Q1 2016 with external stakeholders for Osprey, Merlin and Dunlin. Specific studies identified and agreed that would help with the evaluation of options. CA methodology and criteria also revisited following screening to support option selection.
Preparation	Undertake technical, safety, environmental studies plus stakeholder engagement	✓	Studies undertaken alongside continued stakeholder engagement. Section 4 lists the relevant study reports.
Evaluation	Evaluate the options using the chosen CA methodology	✓	Fairfield conducted two internal CA workshops as part of the evaluation phase. The first, in August 2016, identified areas where further information was needed in order to make a recommendation (effectively recycling to the preparation phase). A second internal workshop was held in November where the results of recent study work were used to discuss and update the decision tool. An additional study (fisheries QRA) was commissioned to run in parallel and be used to either amend or validate the decision tool.
Recommendation	Create recommendation in the form of narrative supported by charts explaining key trade-offs.	✓	The two workshops described above under the Evaluation stage produced a set of emerging recommendations which Fairfield presented as emerging recommendations to external stakeholders. A Briefing

Title	Scope	Status	Commentary
			Session was held in December 2016 to review these and provide additional data to stakeholders.
Review	Review the recommendation with internal and/or external stakeholders	✓	Workshop held with external stakeholders (JNCC, SFF, Marine Scotland, BEIS, OGA) on Tuesday 10 January 2017.
Submit	Submit to BEIS as part of/alongside Decommissioning Programme	✓	This report is available alongside the Decommissioning Programme for the Dunlin subsea infrastructure.

Table 2.1 CA Process Overview

2.2. CA Methodology

Fairfield has selected a Multi Criteria Decision Analysis (MCDA) methodology for the evaluation phase of the CA. This methodology uses a pairwise comparison system based on the methodologies of the Analytical Hierarchy Process (AHP) by T.L. Saaty, described in various publications, such as Analytical Hierarchy Process ref. [9]. This allows the relative importance of each differentiating criteria to be judged against each other in a qualitative way, supported by quantification where appropriate. The key steps for the evaluation phase of the CA are as follows:

- Define Differentiating Criteria – this was completed in July 2016;
- Define Options – this was initially completed as part of CA Screening, but a trial run internal CA workshop validated or amended the options where appropriate;
- Pre-populate worksheets for internal CA workshops – based on all the studies undertaken the worksheets were pre-populated in advance of the internal CA workshops;
- Perform internal CA workshop:
    - Discuss attributes of each option against each differentiating criteria – the discussion was recorded 'live' during the workshop in order that informed opinion and experience is factored into the decision-making process;
    - Perform scoring (see Appendix A.3);
    - Perform sensitivity analyses to test the decision outcomes;
- Export CA worksheets as a formal record of the workshop attendees' combined opinion on the current preferred options, the 'Emerging Recommendations';
- Evaluate whether the CA needs to 'recycle' to the Preparation phase to obtain any further information to help inform decision making (this occurred following the first internal CA workshop in August 2016);
- Discuss Emerging Recommendations with stakeholders (January 2017); and
- Recycle process as required prior to decision on the selected options which will be presented in the Decommissioning Programme and assessed in the Environmental Impact Assessment.

The sections below describe how the MCDA methodology has been applied. Appendix A contains a more detailed explanation of the workings behind the MCDA tool.

2.3. Differentiating Criteria & Approach to Assessment

A key step in setting up the CA was agreeing and defining the appropriate criteria that differentiates between each of the tabled options. As a starting point, the criteria considered for this CA were taken from the DECC (now BEIS) Guidelines for Decommissioning of Offshore Oil and Gas Installations and Pipelines which are as follows (in no particular order):

- Safety
- Environmental
- Economic
- Technical
- Societal

These differentiating criteria were found to be appropriate for the decommissioning options tabled and were largely aligned with Fairfield's Guiding Principles, Ref [1] and were taken forward as the primary differentiating criteria for the CA. Additional sub-criteria and definitions were added for clarity and are shown in Table 2.2 alongside the approach used for assessment under each criteria or sub-criteria.

Appendix C provides some additional information on the calculations/assumptions used for assessing the environmental criteria.

Differentiating Criteria	Sub-Criteria	Description	Approach to Assessment
1. Safety	1.1 Personnel Offshore	This sub-criterion considers elements that impact risk to offshore personnel and includes, project team, project vessel crew, diving teams, supply boat crew, and survey vessel crew. It should be noted that crew changes are performed via port calls.	Summed PLL numbers allow a quantified direct comparison between options. See section 4.3 for information on study work undertaken. Assessment made based on summed PLL numbers and narrative around other factors such as high consequence events or residual risk where there was a differentiator.
	1.2 Personnel Onshore	This sub-criterion considers elements that impact risk to onshore personnel. Factors such as any requirement for dismantling, disposal operations, material transfer and onshore handling may impact onshore personnel.	
	1.3 Other Users	This sub-criterion covers the impact associated with the risk to other users. Considers elements such as collision impact whilst performing activities. Users such as fishing vessels, commercial transport vessels and military vessels are considered.	
	1.4 High Consequence Events	This sub-criterion relates to any inherent potential for high consequence events i.e. major accident hazard, major environmental hazard type events. It applies to all onshore and offshore personnel involved in the project. Considerations such as dropped object concerns, support vessel risks, are considered.	
	1.5 Residual Risk	This sub-criterion addresses and residual risk to other sea users i.e. fishermen, military vessel crews, commercial vessel crews and passengers, other sea users, that is provided by the option. Issues such as residual snag risk, collision risk, etc. may be considered.	
2. Environmental	2.1 Marine Impacts	This sub-criterion covers elements such as underwater noise generated by vessels, cutting operations, explosives etc. It also covers any damaging discharges to sea from vessels and / or activities performed.	Assessment based on quantifying underwater noise generated by decommissioning activities in the short term. Potential discharges to sea also

Differentiating Criteria	Sub-Criteria	Description	Approach to Assessment
			captured where appropriate, but assumed not to be a differentiating factor for flushed and cleaned pipelines.
	2.2 Emissions	This sub-criterion relates to the amount of damaging atmospheric emissions associated with a particular option.	A life-cycle emissions assessment has been carried out capturing: ● Transport emissions from vessels or trucks; ● Rock excavation; ● Reuse of materials; ● Production of new materials; ● Disposal of marine growth; and ● Material left *in situ.* The output CO2 figures allow a direct, quantitative comparison between options.
	2.3 Consumption	This sub-criterion relates to the amount of Energy / Resource consumption such as fuel use, recycling of materials, use of quarried rock, production of replacement materials.	Assessment based on quantifying the volume of fuel and new material used.
	2.4 Disturbance	This sub-criterion relates to both direct and indirect seabed disturbance. Both short and long term impacts are considered.	Assessment based on quantifying the area of disturbance by type of disturbance (dredging, rock dump, trenching, backfilling), in combination with an understanding of the baseline

Differentiating Criteria	Sub-Criteria	Description	Approach to Assessment
			environment in the area as shown by the outputs from the environmental surveys.
	2.5 Protections	This sub-criterion relates to the impact of the options on any protected sites and species.	The Dunlin Area does not overlap with any protected areas or zones. The habitat type is mud with sea pens and burrowing megafauna which is a priority marine feature, however impacts on this habitat type (and associated recovery) is via the mechanism of seabed disturbance which is covered in sub-criteria 2.4 above. Therefore, 'Protections' on its own is not considered to be a differentiator.
3. Technical	3.1 Technical Risk	This sub-criterion relates to the various technical risks that could result in a major project failure. Concepts such as: Technical Novelty and Potential for Showstoppers can be captured along with impact on the schedule due to overruns from technical issues such as operations being interrupted by the weather. Technical Feasibility and Technical Maturity is also considered.	Assessment based on engineering studies (see section 4.2) and captures: • Feasibility; • Concept Maturity; • Availability of Technology; • Track Record; • Risk of Failure; • Consequence of Failure; and • Emerging Technology.

Differentiating Criteria	Sub-Criteria	Description	Approach to Assessment
4. Societal	4.1 Fishing	This sub-criterion addresses the impact of the option on commercial fishing operations. It includes consideration of impacts from both the decommissioning activities any residual impacts post decommissioning such as reinstatement of access to area.	Commercial Fisheries Baseline Study provides a base level of understanding for the importance of the area for fisheries. This is combined with narrative (rather than quantification) regarding the influence of each decommissioning option on the availability of the area of seabed for fisheries. A fisheries QRA (see section 4.3) has been used to provide some context for the risk of loss of equipment due to snagging risk.
	4.2 Other Users	This sub-criterion addresses any socio-economic impacts on other users both onshore where the impact may be from dismantling, transporting, treating, recycling and land filling activities relating to the option and offshore. Issues such as impact on the health, well-being, standard of living, structure or coherence of communities or amenities are considered here e.g. business or jobs creation/retention, increase in noise, dust or odour pollution during the process which has a negative impact on communities, increased traffic disruption due to extra-large transport loads, etc. Includes the FEL Guiding Principle of 'Minimal business interruption to others'.	Assessment of impacts on other users is a qualitative narrative considering both positive and negative impacts on waste disposal, recycling, business interruption and general community impacts. Potential employment benefits have been considered but at the scale of any individual option and in context with the wider full removal scopes for each field area the potential employment benefits are not deemed to be a differentiator.

Differentiating Criteria	Sub-Criteria	Description	Approach to Assessment
5. Economic	5.1 Short-term Costs	This sub-criterion addresses the cost of delivering the option as described. No long-term cost element is considered here. Cost uncertainty (a function of activity maturity) is also recorded.	See engineering studies, section 4.2.
	5.2 Long-term Costs	This sub-criterion addresses the costs associated with any long-term liabilities such as on-going monitoring and any potential future remediation costs.	See engineering studies, section 4.2. Timeframe assumed for the purposes of the CA is 50 years.

Table 2.2 Differentiating Criteria and Sub-Criteria

2.4. Differentiator Weightings

The 5 differentiating criteria all carry a 20% weighting. That is, all criteria are neutral to each other. Figure 2.1 shows the pairwise comparison matrix. Fairfield decided that equal weightings offered the most transparency and a balanced view from all perspectives.

Differentiating Criteria	1. Safety	2. Environmental	3. Technical	4. Societal	5. Economic	Weighting
1. Safety	N	N	N	N	N	20%
2. Environmental	N	N	N	N	N	20%
3. Technical	N	N	N	N	N	20%
4. Societal	N	N	N	N	N	20%
5. Economic	N	N	N	N	N	20%

Figure 2.1 Example Pairwise Comparison Matrix (N = Neutral)

2.5. Option Attributes

The next step in the CA process was to describe and discuss the attributes of each option with respect to each of the differentiating criteria. In preparation, all relevant data and information developed during the preparation phase were pre-populated into the attributes table for each option. Appendix F contains the completed Attributes Tables.

Any additional discussion around the relative merits of the options was also recorded in the attributes matrix. A summary discussion of why options are considered more or less attractive with respect to each of the differentiating criteria was also recorded. An easy-to-read version of this matrix was supplied to stakeholders as part of the recommendation review process.

2.6. Option Pair-Wise Comparison

Once the option attributes were compiled and discussed, a pair-wise comparison was performed for each of the differentiating criteria where the proposed options were compared against each other. The pairwise comparison adopted in this case used phrases such as stronger, much stronger, weaker, much weaker, etc. to make qualitative judgements (often based on quantitative data) of the options against each other. Adopting these phrases rather than the more common numerical 'importance scale' from the Analytical Hierarchy Process (AHP) is often more intuitive and representative of the sentiment of a workshop.

One of the challenges of applying the numerical importance scale historically, is that often when scoring a pair of options against each other as a score of 3, delegates implied the comparison was 3 times better, etc. rather than 'slightly better' as the importance scale suggests.

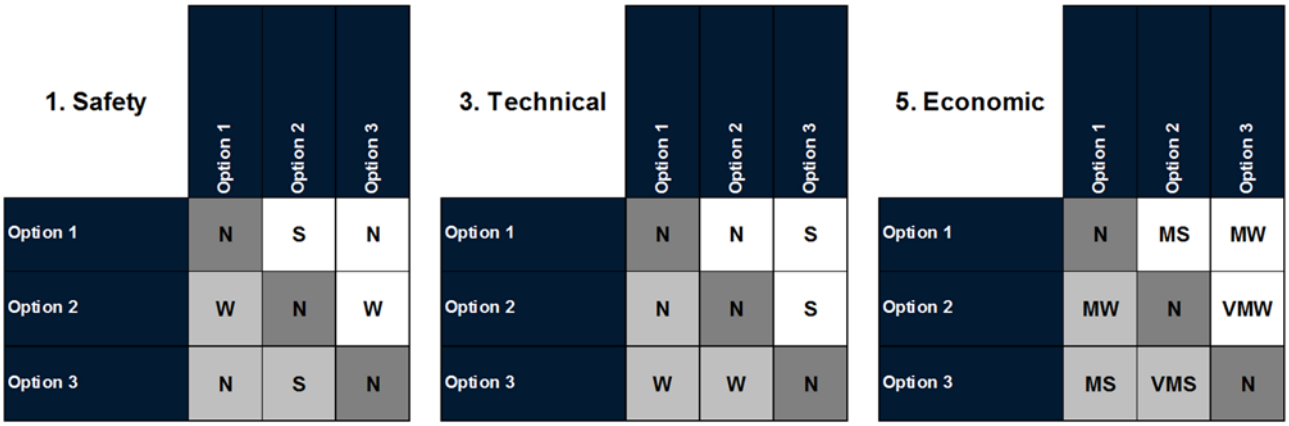
To manage this, Fairfield chose to apply the principles of the AHP by replacing numbers in the pairwise comparison matrix with a narrative or descriptive approach. This is already programmed into the AHP in the importance scale explanations (see Appendix A, Table A.1). It was agreed that three positions from equal (and their reciprocals) would be sufficient for this CA. These positions were:

Phrase	Meaning
Neutral	Equal Importance, equivalent to 1 in the importance scale from Table A.1.
Stronger (S) / Weaker (W)	Moderate importance of one criteria / option over the other, equivalent to 3 in the importance scale from Table A.1.
Much Stronger (MS) / Much Weaker (MW)	Essential / strong importance of one criteria / option over the other equivalent to 5 or 6 in the importance scale from Table A.1.
Very Much Stronger (VMS) / Very Much Weaker (VMW)	Extreme importance of one criteria / option over the other equivalent to 8 or 9 in the importance scale from Table A.1.

Table 2.3 Explanation of Phrasing Adopted for Pairwise Comparison

Using this transposed scoring system made it simpler and, more importantly, more effective at capturing the mind-set and feeling of the attendees at the workshops. Phrases such as 'what are the relative merits of pipeline removal on a project versus rock dumping from a safety perspective? Are these Neutral to each other? Are they stronger? If so, how much stronger? If you had to prioritise one over the other, which would it be?'. This promoted a collaborative dynamic in the workshop and enabled the collective mind-set of the attendees to be captured. Where there was quantitative data to provide back-up and evidence to support the collective assertions, so much the better.

Largely, these qualitative judgements were driven by the quantitative parameters captured in the previous step (as described in Table 2.2 in Section 2.3). This allowed qualitative and quantitative judgment criteria to be combined. A summary example of the completed pair-wise comparisons for differentiating criteria versus options are shown in Figure 2.2 with a full worked example in Appendix A.4.



1. Safety	Option 1	Option 2	Option 3
Option 1	N	S	N
Option 2	W	N	W
Option 3	N	S	N

3. Technical	Option 1	Option 2	Option 3
Option 1	N	N	S
Option 2	N	N	S
Option 3	W	W	N

5. Economic	Option 1	Option 2	Option 3
Option 1	N	MS	MW
Option 2	MW	N	VMW
Option 3	MS	VMS	N

Figure 2.2 Example Option Pair-Wise Comparison

2.7. Visual Output and Sensitivities

The decision-making tool used the above judgements to automatically generate a visual output indicating the highest scoring option i.e. the option which represents the most 'successful' solution in terms of its overall contribution to the set of differentiating criteria. At this stage, opportunity was provided to fine tune the judgements provided, to ensure that all attendees were happy to endorse the outcome. The visual outputs from each decision point are included in section 5.

The CA output could then easily be stress tested by the workshop attendees by undertaking a sensitivity analysis such as by modifying the pair-wise comparison of the options against each other within the differentiating criteria where appropriate. These sensitivities helped inform workshop attendees as to whether a particular aspect was driving a preferred option, or indeed if the preferred option remained the same when the sensitivities were applied, the preferred option was effectively reinforced. Where sensitivities were performed these are described in section 5.

3. Comparative Assessment Decisions

3.1. Overview

Table 3.1 lists all infrastructure groups from the Dunlin field. Early CA scoping and screening activities identified where full removal would be the immediately recommended approach, and where the remainder of the CA process needed to be undertaken in order to conclude on a recommended approach (groups 2, 3, 5, 6, 7, 8, 9 and 10). The options for these groups are provided in Table 3.2.

Group	Infrastructure Type	Decommissioning Recommendation
1a	Deposits	Full Removal
1b	Structures	Full Removal
2	Buried Structures and Deposits	Subject of Comparative Assessment
3	Rigid Risers	Subject of Comparative Assessment
4	Surface Laid Rigid Spools	Full Removal
5	Trenched and Buried Pipelines	Subject of Comparative Assessment
6	Rock Dumped Surface Laid Rigid Spools	Subject of Comparative Assessment
7	Rock Dumped Surface Laid Umbilicals	Subject of Comparative Assessment
8	Riser Cable (Dunlin)	Subject of Comparative Assessment
9	Trenched and Buried Cable	Subject of Comparative Assessment
10	Riser Cable (Third Party Infrastructure)	Subject of Comparative Assessment

Table 3.1 Dunlin Infrastructure Groups

3.2. Options Carried Forward to Full Comparative Assessment (Option Recommendation)

Screening was conducted in March 2016. Section 5 of this CA report demonstrates which options were screened in and screened out at that stage, and detailed information on the decisions made at screening are available in the Dunlin CA Screening Report Ref [2].

Table 3.2 identifies the options included within the CA process for the Dunlin subsea infrastructure. Table 3.3 identifies the battery limits for Dunlin subsea infrastructure. Figures 3.1, 3.2 and 3.3 show the locations of these infrastructure groups in relation to the remaining infrastructure which is proposed for full removal.

Decision	Group	Description	Option 1	Option 2	Option 3
1	2	Buried Structures and Deposits Note 1	Local rock dump over snag hazard, leave in-situ, periodic monitoring and remediation as required.	Deburial using mass flow excavator and full removal, no monitoring required.	
2	3	Rigid Risers	Cut outboard of j-tube subsea and recover, remainder to remain in-situ.	Cut outboard of j-tube subsea and recover, remainder to be removed by topside pull.	
3	5	Trenched and Buried Pipelines	End removal, local rock dump of cut ends and areas of low burial depth, periodic monitoring and remediation as required.	Full removal using reverse reeling technique including deburial, no monitoring required.	
4	6	Rock Dumped Surface Laid Rigid Spools	End removal, local rock dump of cut ends and areas of low burial depth, periodic monitoring and remediation as required.	Full removal, disconnect and recover, no monitoring required.	
5	7	Rock Dumped Surface Laid Umbilicals	End removal, local rock dump of cut ends and areas of low burial depth, periodic monitoring and remediation as required.	End removal, rock dump to 0.6M depth, periodic monitoring and remediation as required.	Full removal using reverse reeling technique, no monitoring required.
6	8	Riser Cable (Dunlin)	Cut outboard of j-tube subsea and recover, remainder to remain in-situ.	Cut outboard of j-tube subsea and recover, remainder to be removed by topside pull.	
7	9	Trenched and Buried Cable	End removal, local rock dump of cut ends and areas of low burial depth, periodic monitoring and remediation as required.	End, spans and exposure removal, local rock dump of cut ends, periodic monitoring and remediation as required.	Full removal using reverse reeling technique including deburial, no monitoring required.
8	10	Riser Cable (Third Party Infrastructure)	Cut outboard of j-tube subsea and recover, remainder to remain in-situ.	Cut outboard of j-tube subsea and recover, remainder to be removed by topside pull.	

Note 1: Removal of Buried Structures and Deposits shall be performed post decommissioning of any related live lines / infrastructure.

Table 3.2 Dunlin Decision Points & Options

Field	System	Battery Limits
Dunlin	Dunlin Power Import (DPI) – PL4334	From the Brent Charlie Switchgear to the Dunlin Alpha switchgear.
	Dunlin Fuel Gas Import (DFGI) – PL2852	From the Thistle SSIV Structure tie-in flange (Thistle end) to upstream flange of XV-27267. The valves themselves belong to the DAD programme and are beyond the scope of this document.

Table 3.3 Dunlin Battery Limits

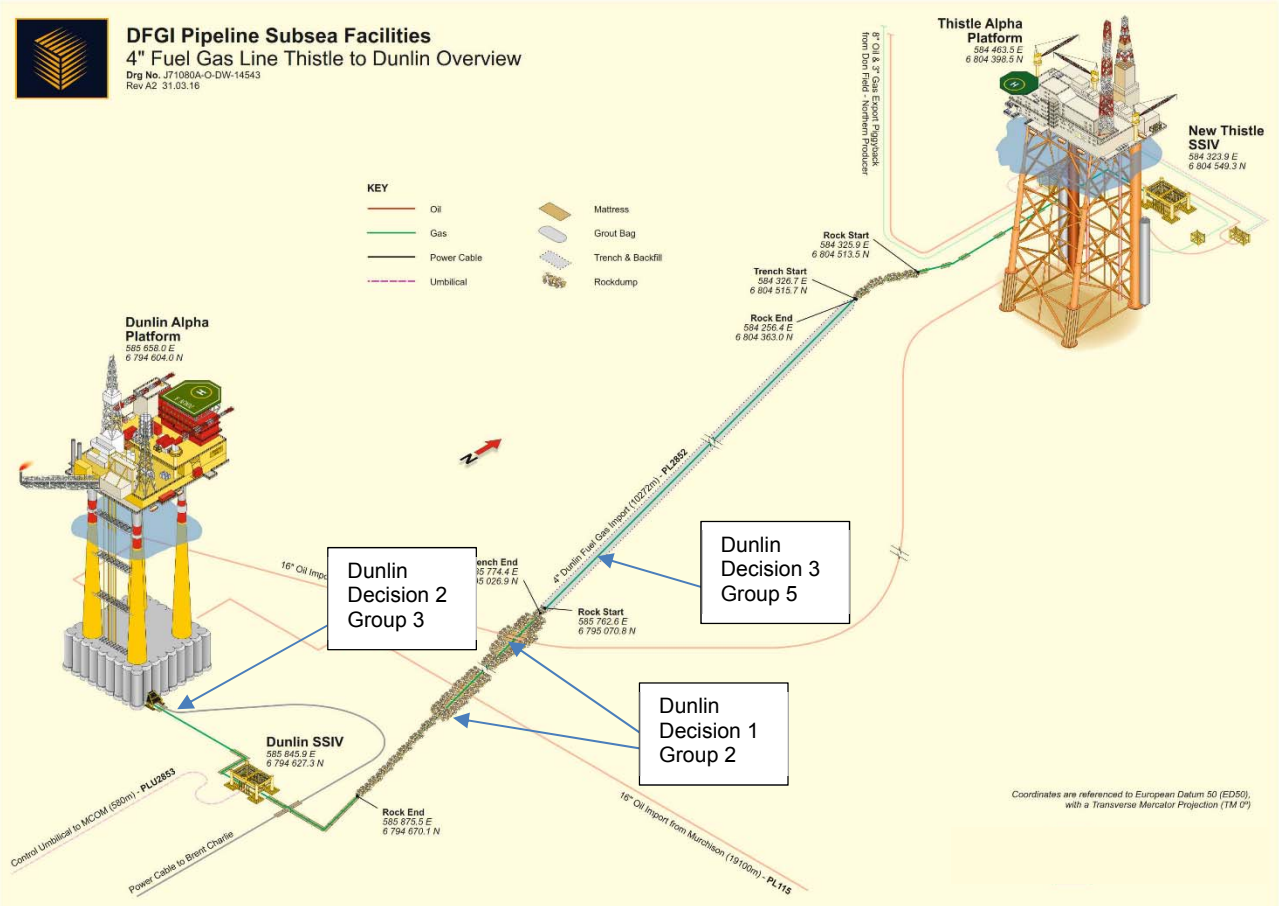


Figure 3.1 Dunlin Decision Points (1)

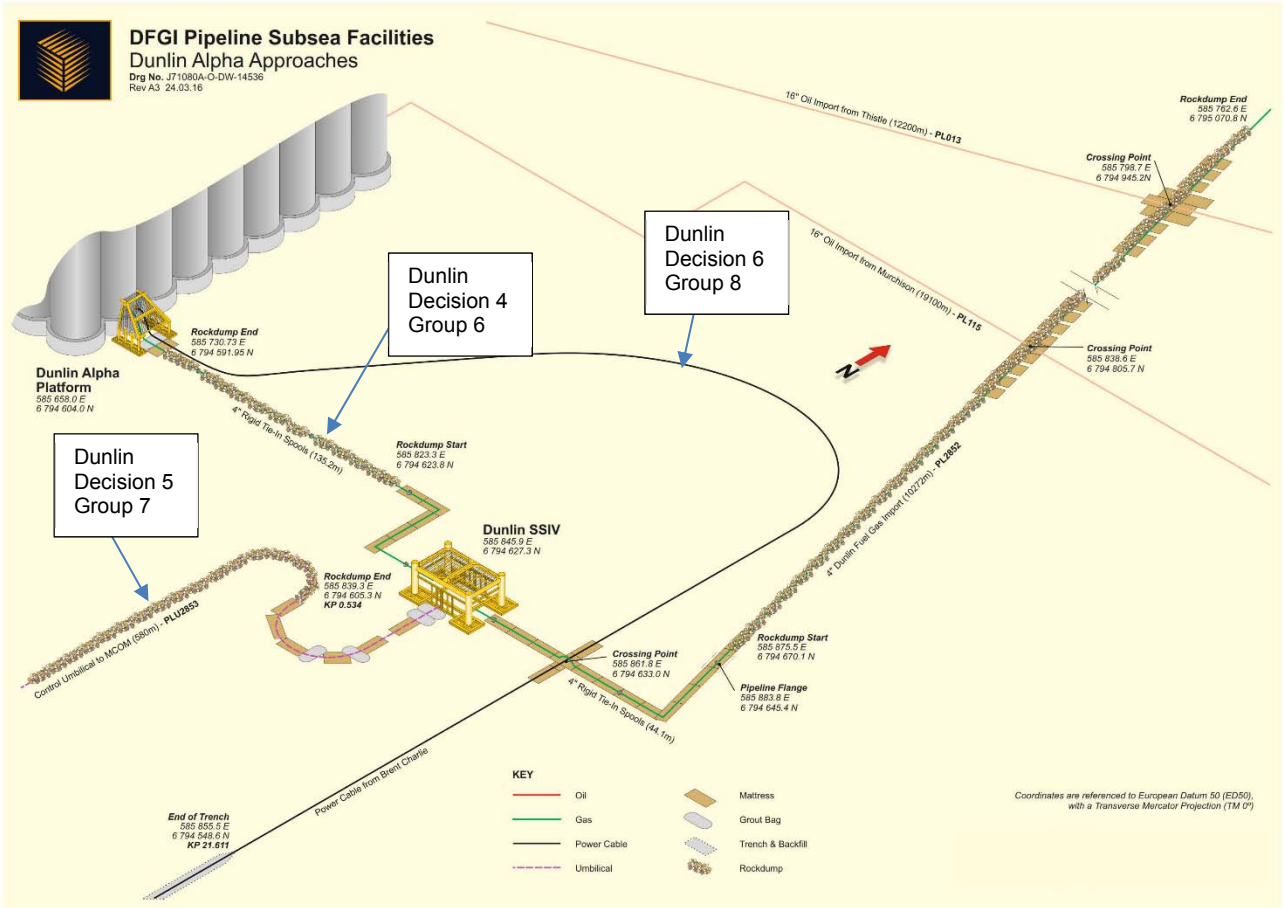


Figure 3.2 Dunlin Decision Points (2)

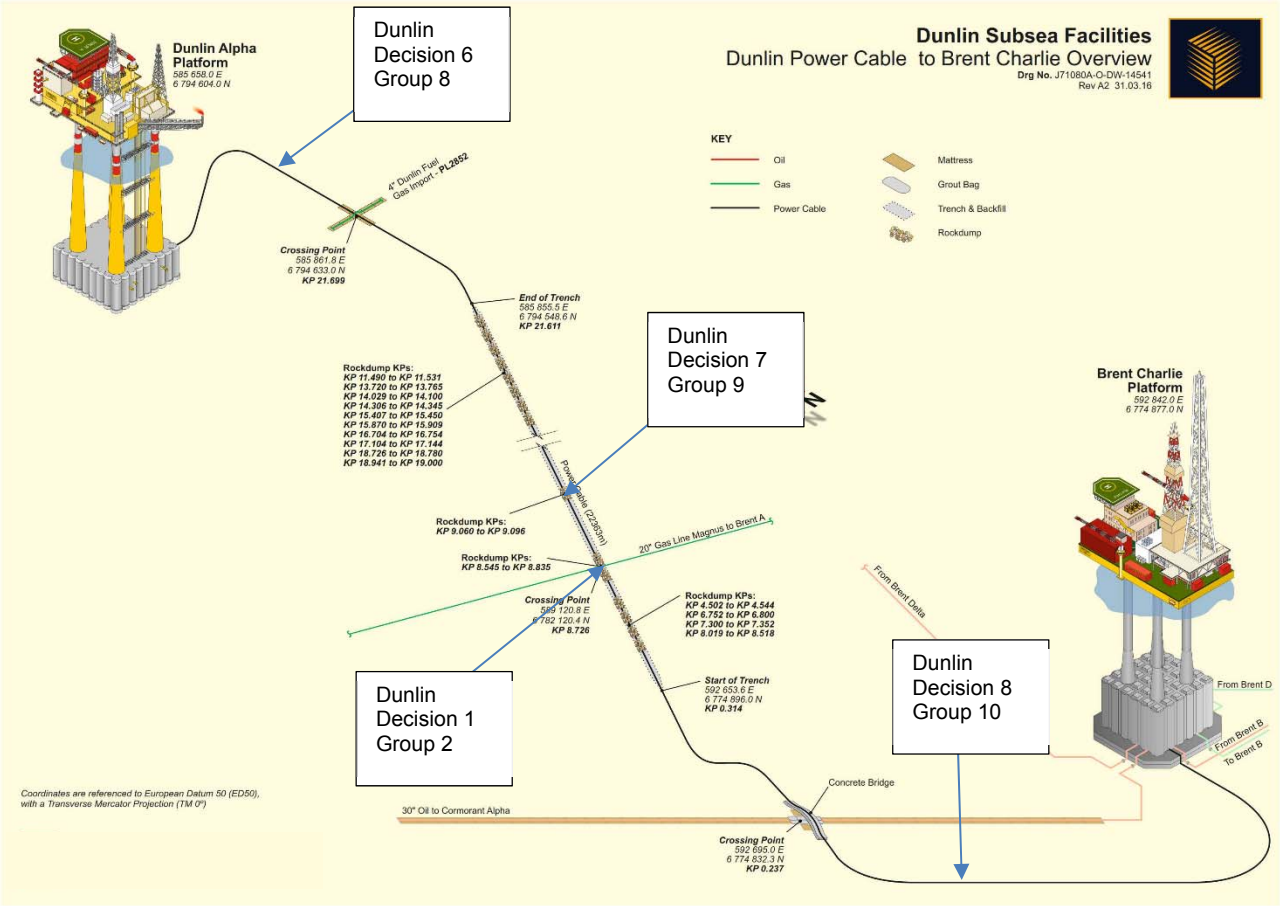


Figure 3.3 Dunlin Decision Points (3)

4. Comparative Assessment Preparation

4.1. Introduction

In advance of the internal CA workshops the preparation phase output was consolidated into a data sheet (Appendix E) for each option and the decision tool was pre-populated. Additional narrative was added during the internal CA workshops.

This section presents the work carried out following the CA Screening session held with stakeholders in Q1 2016. Note that the CA Scoping and Screening reports, and the reports of all other CA preparation activities, are available on request so information within them is not presented here.

For clarity of presentation, in advance of the external CA workshops, the decision tool and emerging recommendations were provided to stakeholders with a consolidated narrative and key data points only. A Briefing Session was held a month in advance of the external CA workshop where stakeholders were provided with an opportunity to discuss any supplementary information that they would like to receive.

Studies and activities during the Preparation phase were conducted under four broad themes:

- Engineering;
- Safety;
- Environmental and Societal; and
- Consultation / Engagement with Stakeholders and Supply Chain.

This work was conducted alongside regular continued engagement with the Regulator, BEIS.

4.2. Engineering Studies

Dunlin Common Scope Report ref. [3]. This report provided the following information on each option:

- Execution Method Statement, including:
    - Sequence of operations;
    - List of vessels and equipment specifications and durations;
    - Materials requirements;
    - Environmental impacts (i.e. area of disturbance, vessel emissions, noise outputs);
    - Onshore disposal requirements;
    - Execution Schedule;
    - Cost estimate;
    - Long term liability estimation (considering material remaining in situ, material degradation, seabed mobility);
    - Risk review (see section 4.3 below).

  This information was summarised into the datasheets made available during the CA workshop. Additionally, the following studies were also completed and informed the above report:

- Dunlin specific scopes:
    - Dunlin Long-term Materials Degradation Study ref. [4];

- Dunlin Trench and Backfill Feasibility Study ref. [5];
- Dunlin Removal / Recovery Feasibility Study ref. [6];
- Dunlin Effect of Riser Remaining ref. [7];
- Dunlin Risk Evaluation of Leaving Items In-situ ref. [19].

4.3. Safety Studies

Fairfield conducted two specific safety studies:

- Personnel risk review (contained within the Common Scope Report referenced in 4.2), which considered:
  - General working occupational risk for the suite of activities associated with each option. This included offshore exposure (e.g. diver activity, vessel based activity and topsides activity), onshore activities (up to the final disposal/recycling point) and legacy activities (e.g. future surveys and remediation activities). A set of Fatal Accident Rates (FAR) were used to provide a consistent approach to assessing Potential Loss of Life (PLL); and
  - Unique high consequence events from major accident hazards. Major accident hazards were defined as those events with the potential for serious injury or fatality to more than 4 personnel.
- Fisheries Quantified Risk Assessment (QRA) ref [20] which:
  - Determined fishing activity in the vicinity of the Dunlin, Merlin and Osprey pipelines, umbilicals and bundles;
  - Calculated frequency of interaction (probability of occurrence) of vessels fishing across the subsea infrastructure; and
  - Calculated PLL for the decommissioning options specified above.

The personnel risk review was based on the Risk Analysis of Decommissioning Activities ref. [8] which provided the PLL calculation methodology and FAR values. The CA outputs are quantitative PLL tables and are included in the relevant sections of the Common Scope Report.

4.4. Environmental Societal Studies

The following studies, surveys and activities were used to support the evaluation process:

- Environmental surveys:
  - Habitat Assessment Reports ref. [11];
  - Environmental Baseline Survey Reports ref. [12];
- Pipeline Cleanliness Study ref. [14];
- Lifecycle Emissions Assessment ref. [16];
- Noise Emissions Calculations (contained within the Common Scope Report ref. [3]);
- Drill Cuttings Screening (against OSPAR 2006/5) ref. [15];
- Commercial Fisheries Baseline (including SFF Services Limited questionnaire survey) ref. [17];
- Internal Environmental Issues Identification Workshop detailed in the ENVID Report ref. [18].

4.5. Consultation & Engagement

4.5.1. Engagement Strategy

Fairfield recognised that early and ongoing engagement with stakeholders is a critical part of the development of robust, respectful programmes for the decommissioning of North Sea installations. To ensure the efficacy of stakeholder engagement, Fairfield developed a Stakeholder Engagement Strategy and Action Plan. This Plan outlined how and why stakeholder engagement should occur. It assisted in driving engagement through the CA, and was supported by a continually updated Stakeholder Engagement Workbook and Stakeholder Alignment Plan / Matrix, through which stakeholder engagement could be tracked.

4.5.2. Consultation

As a demonstration of Fairfield's execution of its stakeholder strategy and the extent to which external stakeholders have had the opportunity to influence the decommissioning project, a summary of the key engagement activities is given in Table 4.1. As well as working with key regulatory and environmental stakeholders, Fairfield has sought to understand the lessons that other UKCS Operators have learned during their decommissioning activities to date. In addition, Fairfield makes information available to the general public via a dedicated decommissioning website at http://www.fairfield-energy.com/.

Activity	Date	Stakeholders
Introduction to the Greater Dunlin Area Decommissioning Project	January 2010	Aberdeenshire Council, BEIS, Cefas, Decom North Sea, HSE, JNCC, Marine Scotland, Maritime and Coastguard Agency, Greenpeace, Scottish Enterprise, SEPA (Radioactive waste), SEPA (Marine), SFF, University of Aberdeen
Between 2010 and 2015, Fairfield continued engagement with stakeholders, including OSPAR and those outlined above, to guide the development of Fairfield's decommissioning strategy for the Greater Dunlin Area.		
Meet with statutory stakeholders to discuss progress	December 2015/January 2016	JNCC, Marine Scotland, SFF
Subsea CA Screening Workshop	March 2016	BEIS, JNCC, Marine Scotland, SFF
Update on Greater Dunlin Area decommissioning	April 2016	BEIS
Fisheries update on Greater Dunlin Area decommissioning	May 2016	UK Fisheries Offshore Oil and Gas Legacy Trust Fund (FLTC) National Federation of Fishermen's Organisations (NFFO), Northern Ireland Fish Producers' Organisation Limited (NIFPO)
Issue of note to advise on progress	June 2016	BEIS, JNCC, OGA, SFF
Update on Greater Dunlin Area decommissioning	July 2016	OGA

Activity	Date	Stakeholders
Workshop on decommissioning of concrete mattresses	September 2016	SEPA, Decom North Sea
Update meetings on Greater Dunlin Area decommissioning	September 2016	SFF, JNCC
Update on Greater Dunlin Area decommissioning	October 2016	SEPA
Briefing session for Subsea CA	December 2016	BEIS, JNCC, Marine Scotland, OGA, SFF
Subsea CA workshop	January 2017	BEIS, JNCC, Marine Scotland, OGA, SFF

Table 4.1 Summary of Key Stakeholder Engagement Activities

4.5.3. Supply Chain Engagement

In addition to its stakeholders, Fairfield has also informed its decommissioning projects (including the CA) through discussions with supply chain. The following organisations have been met:

- Bibby Offshore
- Jee
- PDi
- ROVOP
- Zenocean
- Technip
- Ardent Global
- ASCO (disposal facilities)
- EMAS Chiyoda Subsea
- Halliburton
- Forth Ports
- CSub (GRP Subsea Protection Structures)
- Boskalis
- Subsea7

5. Comparative Assessment Results

5.1. Decision 1: Group 2 – Buried Structures and Deposits

5.1.1. Characteristics

Item	Characteristics
PL2852	Two X-ings (Over) PL013 16″ Oil from Thistle – Live / PL115 16″ Oil from Murchison - decommissioned Concrete mattresses and fully rock dumped (0.6m achieved)
PLU2853	One X-ing (Over) PL5 24″ DMT Oil Line – Live Concrete mattresses and fully rock dumped (0.6m not achieved)
PL4334	One X-ing (Over) PL164 20″ Magnus Gas Line - Live One concrete arch Grout bags, sand bags, concrete mattresses and fully rock dumped (0.6m not achieved)

Table 5.1 Decision 1 Characteristics

5.1.2. Options

Two options were presented at screening stage with both screened in. The two options assessed from the outset of the CA were:

- Option 1: Leave *in Situ* – Minimal Intervention (Local Rock Placement).
- Option 2: Full Removal.

The process undertaken for this decision point, the judgement made against each of the five criteria, and the chart which demonstrates which option is recommended to be taken forward from the CA are presented on the following pages.

5.1.3. Sensitivity Analysis

A sensitivity analysis was performed on this decision point relating to economics. Removing the economics criteria (shown in blue on the chart) from the decision making process had no impact on the preferred option.

No further sensitivity analysis was performed for this decision point.

5.1.4. Recommendation

The outcome of this decision point is to fully remove the buried structures and deposits. This shall be performed post decommissioning of any related live lines / infrastructure. Timing of this operation may be outside of the main project and will be subject to final agreement and arrangements placed with third party operators.

Group 2 – Buried Structures & Deposits

Option Screening

(for narrative see Dunlin Screening Report)

Leave in Situ – Minimal Intervention (Local Rock Placement)	Full Removal
Screened In	**Screened In**

Comparative Assessment

(for full attributes tables and pairwise comparisons see Appendix F)

Option 1 Leave in Situ – Minimal Intervention (Local Rock Placement)	**Option 2** Full Removal (De-burial)

Safety	Environment	Technical	Societal	Economic
Summed PLL figures for options 1 and 2 indicate that the risk exposure for option 1 is very slightly lower than option 2, but vessels on site less for option 2 than for option 1. Overall the workshop considered Option 1 to be **Neutral** with Option 2 from a safety perspective.	The differentiator in this case is the seabed disturbance. The rock dumping associated with Option 1 impacts a greater area and is considered a permanent impact compared to the smaller, temporary seabed disturbance associated with Option 2. Overall, option 1 is **Weaker** than option 2.	Options 1 and 2 are equal to each other technically and are therefore scored as **Neutral** to each other from a technical perspective.	Option 1 and 2 largely comparable, although option 1 does have some additional new material. Option 2 involves crossing third party lines however agreement in principle that operations will only be performed once line has been decommissioned. Overall option 1 **Neutral** to option 2.	Very little difference between the two options so Option 1 and Option 2 are considered **Neutral** to each other.

Summary

The workshops considered Option 1 to be **Neutral** with Option 2 in all areas apart from environmental. Due to the introduction of new material for Option 1, Option 2 (de-burial) was considered **Stronger** from an environmental perspective. Overall Option 2 was the preferred option and is therefore recommended to be taken forward from the CA process.

5.2. Decision 2: Group 3 – Rigid Risers

5.2.1. Characteristics

Item	Characteristics
PL2852	4″ Gas Rigid Riser (steel)

Table 5.2 Decision 2 Characteristics

5.2.2. Options

Three options were presented at screening stage with one of those screened out (full removal by reverse J-tube pull). The options assessed during the CA were:

- Option 1: Leave *in situ* – Minor Intervention (Outboard cut and seal)
- Option 2: Full Removal -Topside Pull

The process undertaken for this decision point, the judgement made against each of the five criteria, and the chart which demonstrates which option is recommended to be taken forward from the CA are presented on the following page.

5.2.3. Sensitivity Analysis

A sensitivity analysis was performed on this decision point relating to economics. Removing the economics criteria (shown in blue on the chart) from the decision making process had no impact on the preferred option nor the order of the remaining options.

The environmental and societal criteria were discussed in the workshops because there could be justification made to rank them differently. For the environmental criteria the workshop agreed to rank Option 1 as stronger than Option 2. In absolute terms the difference between the two is negligible, but Option 1 is still slightly better than Option 2. For societal, the workshop agreed to rank Options 1 and 2 as neutral to each other. Option 2 could be argued as slightly stronger due to more material being returned to shore (with positives such as recycling or employment) but the workshop felt the benefits were not enough to move away from Neutral. However, a sensitivity was undertaken for both environmental and societal in favour of Option 2, but the overall outcome with all five criteria combined did not change.

5.2.4. Recommendation

Option 1, removal of the outboard section and leaving the remainder in the J-Tube, was assessed as being the preferred option in all criteria apart from technical and societal (in which it was considered Neutral to option 2). The outcome of this decision point is therefore to decommission Group 3 *in situ* having recovered the surface laid section. The fate of the section within the J-Tube will ultimately be determined by the CA covering the fate of the Dunlin Alpha CGB. The Dunlin – Effect of Riser Remaining Study, Ref [7] has been conducted examining the effects of decommissioning the riser in the J-Tube and found the consequence on other activities to be negligible.

Group 3 – Rigid Riser

Option Screening

(for narrative see Dunlin Screening Report)

Leave in Situ – Minimal Intervention (Cut and Seal)	Full Removal - Reverse J-Tube Pull	Full Removal - Topside Pull	
Screened In	**Screened Out**	**Screened In**	

Comparative Assessment

(for full attributes tables and pairwise comparisons see Appendix F)

Option 1 Leave in Situ – Cut and Seal	**Option 2** Full Removal - Topside Pull

Safety	Environment	Technical	Societal	Economic
Summed PLL figures for options 1 and 2 indicate that the risk exposure for option 1 is slightly lower than option 2 driven by a higher exposure to offshore and topsides worker groups for option 2. Option 1 is also a slightly shorter duration and carries a lower risk of high consequence events. Overall, option 1 is **Much Stronger** than option 2 from a safety perspective.	Option 1 is either equal to or marginally better than option 2 in all areas. As such, option 1 is considered **Stronger** than option 2 from an environmental perspective. It is noted that the difference here in absolute terms is likely to be negligible, but given a choice on environmental grounds alone, option 1 would be preferred.	Initially option 2 appears to be more technically challenging, however this rigid riser has been successfully pulled-in recently (2010) and is therefore assessed as being highly deliverable. As such, option 1 and 2 are scored as **Neutral** to each other from a Technical Feasibility perspective.	Options 1 and 2 largely similar from a Societal perspective so scored **Neutral** against each other. Whilst there is more material returned to shore under option 2, the workshops did not consider this enough to warrant a change to the scoring from Neutral.	Option 1 has a lower cost and cost risk than option 2. Therefore option 1 is considered **Stronger** than option 2.

Summary

The workshops considered Option 1 to be **Stronger** than Option 2 in the areas of safety, environmental and Economic, but **Neutral** to each other in technical and societal. Option 1 was consistently the preferred option and is therefore recommended to be taken forward from the CA process.

5.3. Decision 3: Group 5 – Trenched and Buried Pipelines

5.3.1. Characteristics

Item	Characteristics
PL2852	4″ Gas Import Line (installed 2012) (steel) 10.272 km length, trenched and rock dumped

Table 5.3 Decision 3 Characteristics

Figures 5.1 shows the route and burial status of PL2852.

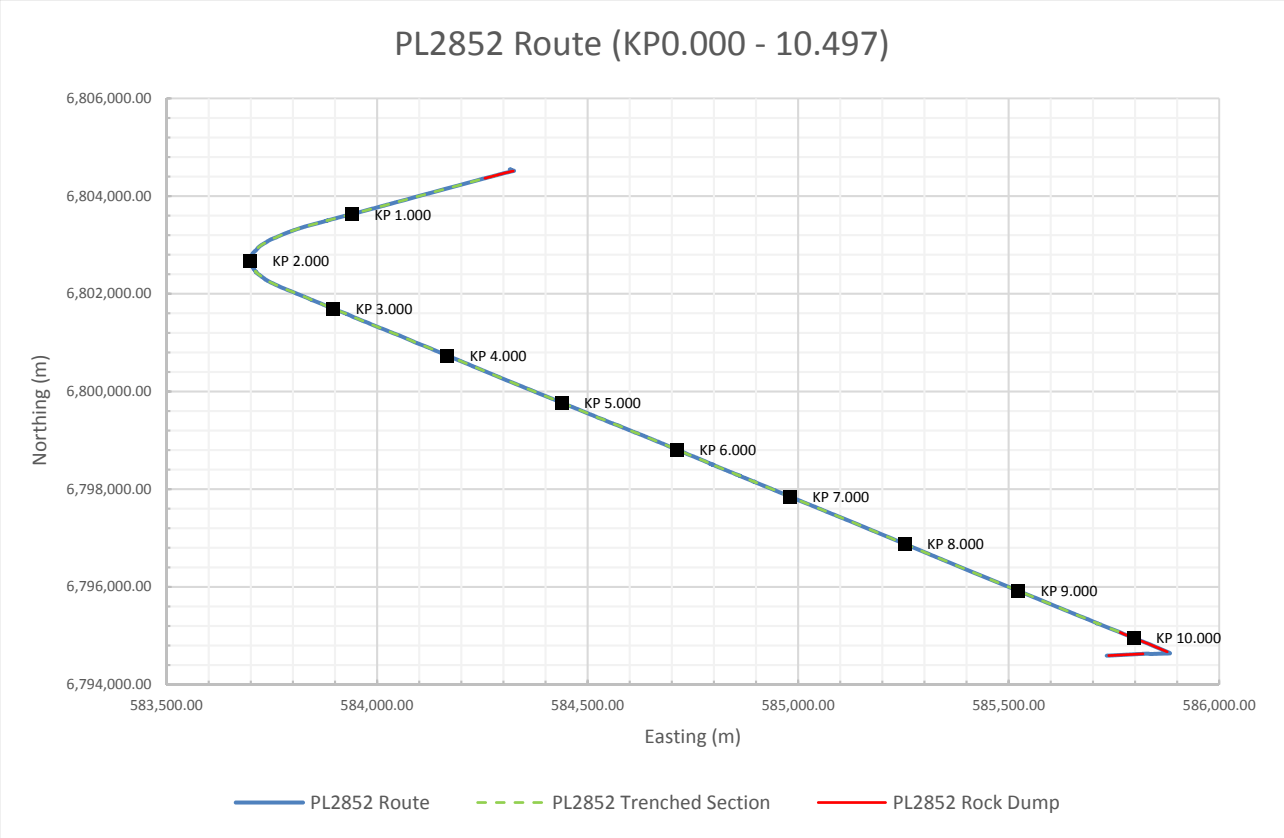


Figure 5.1 PL2852 Route Details

5.3.2. Options

Six options were presented at screening stage with three of those screened out. During the preparation phase it was found that the majority of the length of PL2852 achieved the desired burial depth of at least 0.6 m. This then ruled out the need to cut exposed sections/areas of low cover, so this option was also removed. The options assessed during the CA were:

- Option 1: Leave *in situ* – Minimal Intervention - Removal of exposed ends, rock placement over snag hazards and areas of low cover.
- Option 2: Full Removal – Reverse Reel.

The process undertaken for this decision point, the judgement made against each of the five criteria, and the chart which demonstrates which option is recommended to be taken forward from the CA are presented on the following page.

5.3.3. Sensitivity Analysis

A sensitivity analysis was performed on this decision point relating to economics. Removing the economics criteria (shown in blue on the chart) from the decision making process had no impact on the preferred option nor the order of the remaining options. No further sensitivity analysis was performed for this decision point.

5.3.4. Recommendation

The CA workshops found Option 1 to be preferred over Option 2 which was technically very challenging due to the burial status. Option 2 was marginally better than Option 1 for societal only, based on the return of material to shore having both a recycling and employment benefit. The recommendation taken forward from the CA is therefore to decommission this infrastructure by removing the ends of the pipeline and placing local rock dump at the cut ends and areas of low burial depth. Periodic monitoring and remediation will be carried out at this location as required.

Group 5 – Trenched & Buried Pipelines

Option Screening

(for narrative see Dunlin Screening Report)

Leave in Situ – Minimal Intervention (Local Rock Placement) **Screened In**	Leave in Situ – Minimal Intervention (End Trench & Rock Placement) **Screened Out**	Leave in Situ – Minor Intervention (Cut and Rock Placement) **Screened In**	Leave in Situ – Minor Intervention (Trenching and Rock Placement) **Screened In**
Full Removal – Reverse Reeling **Screened In**	Full Removal – Cut and Lift **Screened Out**		

Comparative Assessment

(for full attributes tables and pairwise comparisons see Appendix F) *Note – Minor intervention option screened in above was disregarded during the CA as sufficient cover is present along the length of the pipeline, therefore identical to Option 1 below.*

Option 1 Leave in Situ – Minimal Intervention (Local Rock Placement)	**Option 2** Full Removal – Reverse Reeling

Safety	Environment	Technical	Societal	Economic
Summed PLL figures for options 1 and 2 indicate that the risk exposure for option 2 is slightly lower than option 1. However, Option 1 carries a lower risk of high consequence events. Overall, option 1 is **Stronger** than option 2 from a safety perspective based on a preference to decrease risk of high consequence events.	Despite Option 2 being marginally preferable for most environment sub criteria, Option 2 has a substantially larger area of seabed disturbance (nearly 240 times larger). Overall, option 1 is **Stronger** than option 2 from an environmental perspective.	Option 1 less technically challenging than Option 2 due to uncertainty surrounding the ability to perform de-burial of the rigid pipeline. Overall Option 1 **Much Stronger** than Option 2 from a technical perspective.	Options 1 and 2 largely similar from a fishing perspective. Option 2 returns more material to shore thus having a benefit from recycling perspective. Overall Option 1 **Weaker** than Option 2.	Option 2 has a high cost risk due to potential for challenges during the de-burial operations which could lead to cost escalation. Overall, Option 1 is **Stronger** than Option 2 due to potential for cost escalation.

Summary

The workshops considered Option 1 to be at least **Stronger** than Option 2 in the areas of safety, environmental, technical and Economic, but **Weaker** than Option 2 in societal. Option 1 was therefore consistently the preferred option and is recommended to be taken forward from the CA process.

5.4. Decision 4: Group 6 – Rock Dumped Surface Laid Rigid Spools

5.4.1. Characteristics

Item	Characteristics
PL2852	4″ Gas Import Line Spool (steel), 127 m long, rock dumped

Table 5.4 Decision 4 Characteristics

5.4.2. Options

Two options were presented at screening stage with none screened out. The options assessed during the CA were:

- Option 1: Leave *in situ* – Minimal Intervention – End removal and local rock placement
- Option 2: Full Removal – Disconnect and Recover

The process undertaken for this decision point, the judgement made against each of the five criteria, and the chart which demonstrates which option is recommended to be taken forward from the CA are presented on the following page.

5.4.3. Sensitivity Analysis

A sensitivity analysis was performed on this decision point relating to economics. Removing the economics criteria (shown in blue on the chart) from the decision making process had no impact on the preferred option.

5.4.4. Recommendation

The workshops considered Option 2 to be Stronger than Option 1 in the areas of safety and economic, but Neutral to each other in all other areas. The recommended option being carried forward from the CA is therefore to decommission the infrastructure by fully removing it and recovering to shore for processing.

Group 6 – Rock Dumped Surface Laid & Rigid Spools

Option Screening

(for narrative see Dunlin Screening Report)

Leave in Situ – Minimal Intervention (Local Rock Placement)	Full Removal – Disconnect and Recover		
Screened In	**Screened In**		

Comparative Assessment

(for full attributes tables and pairwise comparisons see Appendix F)

Option 1 Leave in Situ – End Removal – Local Rock Placement	**Option 2** Full Removal - Disconnect and Recover

Safety	**Environment**	**Technical**	**Societal**	**Economic**
Summed PLL figures for options 1 and 2 indicate that the risk exposure for option 2 is slightly lower than option 1 driven by a lack of legacy component for Option 2. Risk of high consequence events is similar. Overall, option 1 is **Weaker** than option 2 from a safety perspective.	Option 1 and 2 are considered **Neutral** to each other due to Option 1 being slightly worse in noise, emissions and fuel being offset by Option 2 being slightly worse in seabed disturbance.	Options 1 and 2 are equal technically and are therefore scored as **Neutral** to each other from a technical perspective.	Options 1 and 2 are largely similar from a societal perspective and are therefore scored as **Neutral** to each other. It should be noted that these items are currently within the 500m zone of Dunlin Alpha. Even if this 500m zone was to reduce in size, these items are still likely to remain in that new, smaller exclusion zone.	Overall, option 1 is considered **Weaker** than Option 2 due to the higher overall cost and future monitoring component.

Summary

The workshops considered Option 2 to be **Stronger** than Option 1 in the areas of safety and economic, but **Neutral** to each other in all other areas. Although marginal, Option 2 was the preferred option and is therefore recommended to be taken forward from the CA process.

5.5. Decision 5: Group 7 – Rock Dumped Surface Laid Umbilicals

5.5.1. Characteristics

Item	Characteristics
PLU2853	2.5″ Umbilical (polymer / steel / copper), 580 m long, partially rock dumped (0.6 m not achieved)

Table 5.5 Decision 5 Characteristics

5.5.2. Options

Three options were presented at screening stage with none screened out. The options assessed during the CA were:

- Option 1: Leave *in situ* – Minimal Intervention – Removal of exposed ends, rock placement over snag hazards and areas of low cover.
- Option 2 – Leave *in Situ* – Minor Intervention – Removal of exposed ends, rock placement over entire length.
- Option 3: Full Removal – Reverse Reel

The process undertaken for this decision point, the judgement made against each of the five criteria, and the chart which demonstrates which option is recommended to be taken forward from the CA are presented on the following page.

5.5.3. Sensitivity Analysis

A sensitivity analysis was performed on this decision point relating to economics. Removing the economics criteria (shown in blue on the chart) from the decision making process had no impact on the preferred option.

5.5.4. Recommendation

The workshops considered Option 3 to be Stronger than both Options 1 and 2 in all areas apart from societal (in which it was Neutral) and technical feasibility (in which it was Weaker). Despite the technical feasibility being lower, any negative outcome of experiencing technical challenges will be limited. The recommended option being carried forward from the CA is therefore to decommission the infrastructure by fully removing it and recovering to shore for processing.

Group 7 – Rock Dumped Surface Laid Umbilicals

Option Screening

(for narrative see Osprey Screening Report)

Leave in Situ – Minimal Intervention (Rock Placement)	Leave in Situ – Major Intervention (Full Rock Placement)	Full Removal – Reverse Reeling	
Screened In	**Screened In**	**Screened In**	

Comparative Assessment

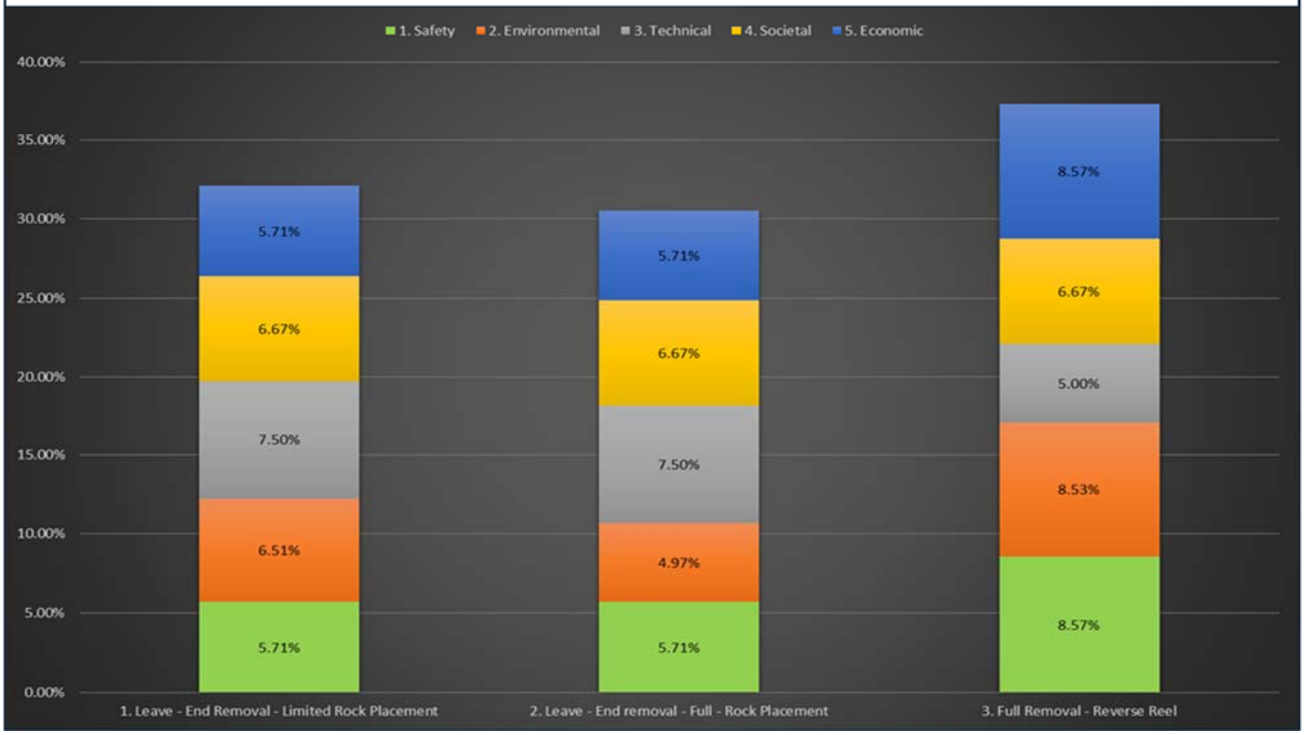
(for full attributes tables and pairwise comparisons see Appendix F)

Option 1 Leave in Situ – End Removal, Limited Rock Placement	**Option 2** Leave in Situ – End Removal, Full Rock Placement	**Option 3** Full Removal – Reverse Reeling

Safety	Environment	Technical	Societal	Economic
The summed PLL figures for options 1, 2 & 3 indicate that option 3 is the lowest risk for all worker groups due largely to the lower diver and offshore worker group exposure and the lack of a legacy risk component. Options 1 & 2 are very similar. Risk of high consequence events is also similar across the options. Options 1 & 2 are therefore **Neutral** and both **Weaker** than option 3.	Option 1 is **Stronger** than option 2 due to less seabed disturbance and less rock dump, but **Weaker** than option 3 due to being less attractive in all areas. Option 2 is Weaker than Option 3 for similar reasons.	Options 1 and 2 are equal to each other technically. They both carry less technical risk than Option 3. Overall, Options 1 and 2 are **Neutral** to each other and both **Stronger** than Option 3 from a technical perspective.	All Options **Neutral** to each other from a societal perspective.	Options 1 and 2 are **Neutral** to each other and both **Weaker** than Option 3 due to lower total cost and with the cost risk associated with Option 3 being insufficient to influence this. Option 3 also removes requirement for on-going monitoring.

Summary

The workshops considered Option 3 to be **Neutral** or better than Options 1 or 2 in safety, environment, societal and economic. Only in the technical criteria was Option 3 **Weaker**. Overall, Option 3 is consistently preferred and is therefore recommended to be taken forward from the CA process.



5.6. Decision 6: Group 8 – Riser Cable (Dunlin)

5.6.1. Characteristics

Item	Characteristics
PL4334	4.5″ Power Import Cable (riser) (polymer / steel / copper / fibre optic), 480 m length, surface laid and in Dunlin Alpha J-tube. Note, this is part of one long cable with limits between the topside switch gear and the start of the trench.

Table 5.6 Decision 6 Characteristics

5.6.2. Options

Four options were presented at screening stage with two of those screened out (local rock placement on surface laid section, and full removal by reverse J-tube pull). The options assessed during the CA were:

- Option 1: Leave *in situ* – Minor Intervention (Outboard cut and recover)
- Option 2: Full Removal -Topside Pull

The process undertaken for this decision point, the judgement made against each of the five criteria, and the chart which demonstrates which option is recommended to be taken forward from the CA are presented on the following page.

5.6.3. Sensitivity Analysis

A sensitivity analysis was performed on this decision point relating to economics. Removing the economics criteria (shown in blue on the chart) from the decision making process had no impact on the preferred option nor the order of the remaining options.

The environmental and societal criteria were discussed in the workshops because there could be justification made to rank them differently. For the environmental criteria the workshop agreed to rank Option 1 as stronger than Option 2. In absolute terms the difference between the two is negligible, but Option 1 is still slightly better than Option 2. For societal, the workshop agreed to rank Options 1 and 2 as neutral to each other. Option 2 could be argued as slightly stronger due to more material being returned to shore (with positives such as recycling or employment) but the workshop felt the benefits were not enough to move away from Neutral. However, a sensitivity was undertaken for both environmental and societal in favour of Option 2, but the overall outcome with all five criteria combined did not change.

5.6.4. Recommendation

Option 1, removal of the outboard section and leaving the remainder in the J-Tube, was assessed as being the preferred option in all criteria apart from societal (in which it was considered Neutral to option 2). The outcome of this decision point is therefore to decommission Group 8 *in situ* having recovered the surface laid section. The fate of the section within the J-Tube will ultimately be determined by the CA covering the fate of the Dunlin Alpha CGB. The Dunlin – Effect of Riser Remaining Study, Ref [7] has been conducted examining the effects of decommissioning the riser in the J-Tube and found the consequence on other activities to be negligible.

Group 8 – Riser Cable (Dunlin Alpha)

Option Screening

(for narrative see Dunlin Screening Report)

Leave in Situ – Minimal Intervention (Local Rock Placement)	Leave in Situ – Minor Intervention (Outboard Cut and Recovery)	Full Removal - Reverse J-Tube Pull	Full Removal - Topside Pull
Screened Out	**Screened In**	**Screened Out**	**Screened In**

Comparative Assessment

(for full attributes tables and pairwise comparisons see Appendix F)

Option 1 Leave in Situ – Minor Intervention (Outboard Cut and Recovery)	**Option 2** Full Removal - Topside Pull

Safety	Environment	Technical	Societal	Economic
Summed PLL figures for options 1 and 2 indicate that the risk exposure for option 1 is slightly lower than option 2 driven by a higher exposure to offshore and topsides worker groups for option 2. Option 1 is also a slightly shorter duration and carries a lower risk of high consequence events. Overall, option 1 is **Much Stronger** than option 2 from a safety perspective.	Option 1 is either equal to or marginally better than option 2 in all areas. As such, option 1 is considered **Stronger** than option 2 from an environmental perspective. It is noted that the difference here in absolute terms is likely to be negligible, but given a choice on environmental grounds alone, option 1 would be preferred.	Option 1 carries less technical risk than Option 2 due to the potential / consequence of failure associated with the uncertainty of the j-tube integrity. Overall option 1 is considered **Stronger** than option 2 from a Technical Feasibility perspective.	Options 1 and 2 largely similar from a Societal perspective so scored **Neutral** against each other. Whilst there is more material returned to shore under option 2, the workshops did not consider this enough to warrant a change to the scoring from Neutral.	Option 1 has a lower cost and cost risk than option 2. Therefore option 1 is considered **Stronger** than option 2.

Summary

The workshops considered Option 1 to be **Stronger** than Option 2 in the areas of safety, environmental, technical and economic, but **Neutral** to each other in societal. Option 1 was consistently the preferred option and is therefore recommended to be taken forward from the CA process. The workshop attendees also noted that altering the scoring for the environmental and societal criteria away from a stronger or neutral position, respectively, would not change the overall outcome.

5.7. Decision 7: Group 9 – Trenched and Buried Cable

5.7.1. Characteristics

Item	Characteristics
PL4334	4.5″ Power Import Cable (polymer / steel / copper / fibre optic) 21,403 m long, Trenched and buried, two exposures along trenched length. Note, this is part of one long cable with the limits considered are between the start of the trench and end of trench.

Table 5.7 Decision 7 Characteristics

The route of this line is shown in Figure 5.2.

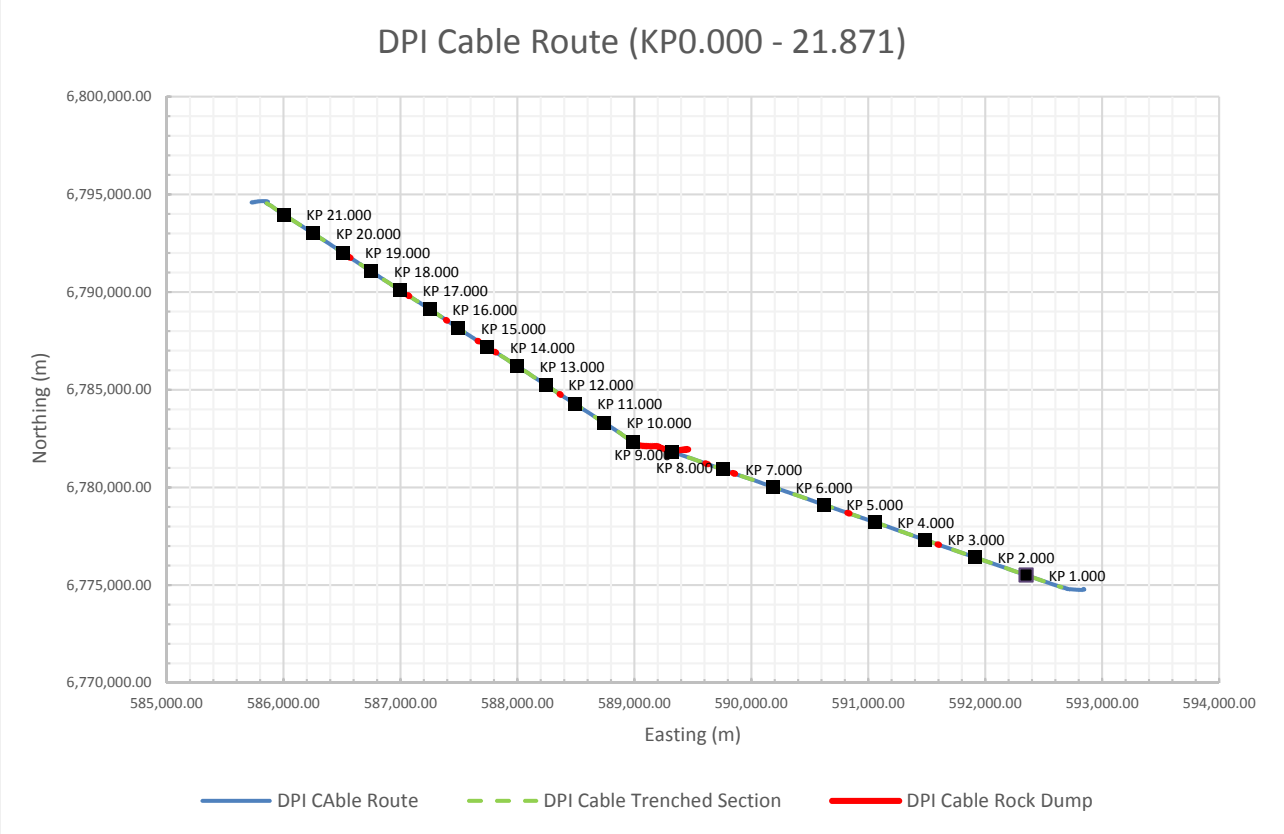


Figure 5.2 DPI Cable Route

5.7.2. Options

Seven options were presented at screening stage with four of those screened out. The options assessed during the CA were:

- Option 1: Leave *in situ* – Minimal Intervention – Removal of all cable transitions, rock placement over snag hazards and areas of low cover.
- Option 2: Leave *in situ* – Minor Intervention – Removal of all exposures, rock placement over snag hazards and areas of low cover.
- Option 3: Full Removal – Reverse Reel.

The process undertaken for this decision point, the judgement made against each of the five criteria, and the chart which demonstrates which option is recommended to be taken forward from the CA are presented on the following page.

5.7.3. Sensitivity Analysis

A sensitivity analysis was performed on this decision point relating to economics. Removing the economics criteria (shown in blue on the chart) from the decision making process had no impact on the preferred option nor the order of the remaining options. No further sensitivity analysis was performed for this decision point.

5.7.4. Recommendation

Although reverse reeling is a preferred option in terms of both safety and environment, undertaking such an activity will require use of a mass flow excavator prior to reverse reeling. Over such distances (>21 km) the technical feasibility was felt to be much lower than either Options 1 or 2. Option 1 was Stronger or Neutral to Option 2 across all areas. The outcome of this decision point is therefore to decommission this infrastructure by removing the ends and placing local rock dump at the cut ends and areas of low burial depth.

Group 9 – Trenched & Buried Cable

Option Screening

(for narrative see Osprey Screening Report)

Leave in Situ – Minimal Intervention (Rock Placement) **Screened In**	Leave in Situ – Minor Intervention (Cut & Rock Placement) **Screened In**	Leave in Situ – Minor Intervention (Local Trench) **Screened Out**	Leave in Situ – Major Intervention (Full Re-Trench) **Screened Out**
Leave in Situ – Major Intervention (Full Rock Placement) **Screened Out**	Full Removal – Reverse Reeling **Screened In**	Full Removal – Cut and Lift **Screened Out**	

Comparative Assessment

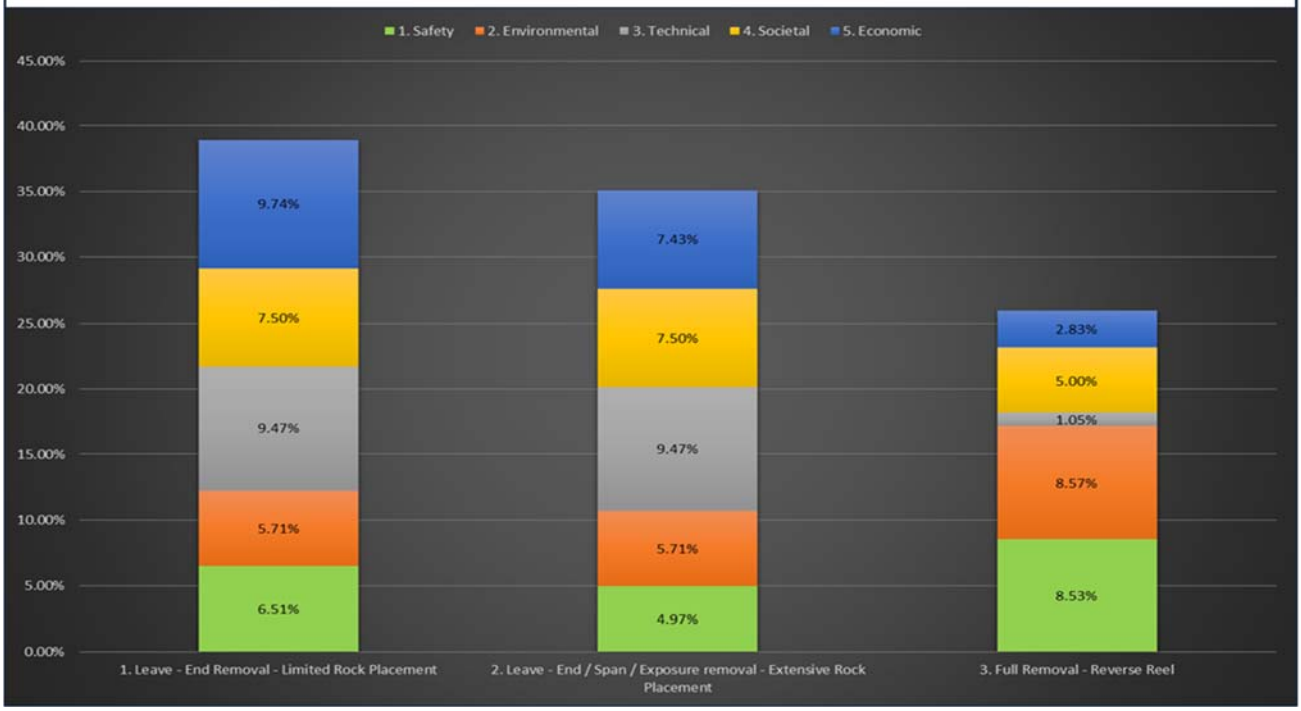
(for full attributes tables and pairwise comparisons see Appendix F)

Option 1	Option 2	Option 3
Leave in Situ – End Removal, Limited Rock Placement	Leave in Situ – End / Span / Exposure removal - Extensive Rock Placement	Full Removal – Reverse Reeling

Safety	Environment	Technical	Societal	Economic
Based on summed PLLs across all worker groups, Option 1 is **Stronger** than Option 2 as it has a lower overall risk exposure. Option 1 is **Weaker** than Option 3 as it has a higher risk exposure. Option 2 is also weaker than Option 3 as it has a higher risk exposure. All options carry a low risk of high consequence events.	Options 1 and 2 are **Neutral** to each other across the sub-criteria. Options 1 and 2 are considered **Weaker** than Option 3 due to the introduction of rock dump (and hence permanent seabed impact) and higher noise / emissions / fuel / rock use.	Option 1 and 2 are technically very similar and as such are scored **Neutral** against each other. Both option 1 & 2 are **Very Much Stronger** technically than option 3 due to the uncertainty surrounding the ability to successfully de-bury the cable, particularly in areas where soils / clays are not conducive to simple de-burial operations, and the length (>21 km).	There is a societal benefit associated with the copper that can be reclaimed under Option 3, however there is also a large amount of material that is not recyclable which offsets that benefit. Options 1 and 2 are identical so are scored **Neutral** to each other, and both **Stronger** than option 3 due to the amount of non-recyclable material returned.	Option 1 is **Stronger** than Option 2 due to lower cost, and **Much Stronger** than Option 3 due to potential overruns associated with Option 3. Option 2 is **Much Stronger** than Option 3 as, whilst Option 3 is slightly lower cost with no legacy component, the potential for significant cost overrun more than offsets that small benefit.

Summary

The workshops considered Option 1 to be **Neutral** with Option 2 in the areas of environmental, technical and societal, but **Stronger** than Option 2 in both safety and economic. Option 3 was preferable to both Options 1 and 2 in the safety and environmental criteria. However, Option 3 was significantly less preferred in both technical and economic. Overall, Option 1 is preferred and is therefore recommended to be taken forward from the CA process.



5.8. Decision 8: Group 10 – Riser Cable (Third Party Infrastructure)

5.8.1. Characteristics

Item	Characteristics
PL4334	4.5″ Power Import Cable (riser) (polymer / steel / copper / fibre optic), 480 m length, surface laid and in third party J-tube. Note, this is part of one long cable with the limits considered between the topside switch gear and start of the trench.

Table 5.8 Decision 8 Characteristics

5.8.2. Options

Four options were presented at screening stage with two of those screened out (local rock placement on surface laid section, and full removal by reverse J-tube pull). The options assessed during the CA were:

- Option 1: Leave *in situ* – Minor Intervention (Outboard cut and recover)
- Option 2: Full Removal -Topside Pull

The process undertaken for this decision point, the judgement made against each of the five criteria, and the chart which demonstrates which option is recommended to be taken forward from the CA are presented on the following page.

5.8.3. Sensitivity Analysis

A sensitivity analysis was performed on this decision point relating to economics. Removing the economics criteria (shown in blue on the chart) from the decision making process had no impact on the preferred option nor the order of the remaining options.

The environmental and societal criteria were discussed in the workshops because there could be justification made to rank them differently. For the environmental criteria the workshop agreed to rank Option 1 as stronger than Option 2. In absolute terms the difference between the two is negligible, but Option 1 is still slightly better than Option 2. For societal, the workshop agreed to rank Options 1 and 2 as neutral to each other. Option 2 could be argued as slightly stronger due to more material being returned to shore (with positives such as recycling or employment) but the workshop felt the benefits were not enough to move away from Neutral. However, a sensitivity was undertaken for both environmental and societal in favour of Option 2, but the overall outcome with all five criteria combined did not change.

5.8.4. Recommendation

Option 1, removal of the outboard section and leaving the remainder in the J-Tube, was assessed as being the preferred option in all criteria apart from societal (in which it was considered Neutral to option 2). The outcome of this decision point is therefore to decommission Group 10 *in situ* having recovered the surface laid section. The fate of the section within the J-Tube will ultimately be determined by the fate of the Third Party Infrastructure. The Dunlin – Effect of Riser Remaining Study, Ref [7] has been conducted examining the effects of decommissioning the riser in the J-Tube and found the consequence on other activities to be negligible, including the end within the J-Tube at third party infrastructure.

Group 10 – Riser Cable (Third Party Infrastructure)

Option Screening

(for narrative see Dunlin Screening Report)

Leave in Situ – Minimal Intervention (Local Rock Placement)	Leave in Situ – Minor Intervention (Outboard Cut and Recovery)	Full Removal - Reverse J-Tube Pull	Full Removal - Topside Pull
Screened Out	**Screened In**	**Screened Out**	**Screened In**

Comparative Assessment

(for full attributes tables and pairwise comparisons see Appendix F)

Option 1 Leave in Situ – Minor Intervention (Outboard Cut and Recovery)	**Option 2** Full Removal - Topside Pull

Safety	Environment	Technical	Societal	Economic
Summed PLL figures for options 1 and 2 indicate that the risk exposure for option 1 is slightly lower than option 2 driven by a higher exposure to offshore and topsides worker groups for option 2. Option 1 is also a slightly shorter duration and carries a lower risk of high consequence events. Overall, option 1 is **Much Stronger** than option 2 from a safety perspective.	Option 1 is either equal to or marginally better than option 2 in all areas. As such, option 1 is considered **Stronger** than option 2 from an environmental perspective. It is noted that the difference here in absolute terms is likely to be negligible, but given a choice on environmental grounds alone, option 1 would be preferred.	Option 1 carries less technical risk than Option 2 due to the potential / consequence of failure associated with the uncertainty of the j-tube integrity. Overall option 1 is considered **Stronger** than option 2 from a Technical Feasibility perspective.	Options 1 and 2 largely similar from a Societal perspective so scored **Neutral** against each other. Whilst there is more material returned to shore under option 2, the workshops did not consider this enough to warrant a change to the scoring from Neutral.	Option 1 has a lower cost and cost risk than option 2. Therefore option 1 is considered **Stronger** than option 2.

Summary

The workshops considered Option 1 to be **Stronger** than Option 2 in the areas of safety, environmental, technical and economic, but **Neutral** to each other in societal. Option 1 was consistently the preferred option and is therefore recommended to be taken forward from the CA process. The workshop attendees also noted that altering the scoring for the environmental and societal criteria away from a stronger or neutral position, respectively, would not change the overall outcome.

6. Summary of Final Recommendations

The CA for the Dunlin Subsea Infrastructure Decommissioning Programme has focussed on eight groups (from Table 6.1, groups 2, 3, 5, 6, 7, 8, 9 and 10). All other groups of Dunlin subsea infrastructure were confirmed at the CA Scoping and Screening stage to be fully removed from the field. The outcome of the CA process has made the following recommendations:

Group	Infrastructure Type	Decommissioning Recommendation
1a	Deposits	Full Removal
1b	Structures	Full Removal
2	Buried Structures and Deposits	Deburial using mass flow excavator and full removal.
3	Rigid Risers	Leave in Situ – Minor Intervention (Outboard Cut and Recovery)
4	Surface Laid Rigid Spools	Full Removal
5	Trenched and Buried Pipelines	Leave in Situ – Minimal Intervention (Rock Placement)
6	Rock Dumped Surface Laid Rigid Spools	Full Removal – disconnect and recover
7	Rock Dumped Surface Laid Umbilicals	Full Removal – Reverse Reel
8	Riser Cable (Dunlin)	Leave in Situ – Minor Intervention (Outboard Cut and Recovery)
9	Trenched and Buried Cable	Leave in Situ - Minimal Intervention (Local Rock Placement)
10	Riser Cable (Third Party Infrastructure)	Leave in Situ – Minor Intervention (Outboard Cut and Recovery)

Table 6.1 Final Dunlin Recommendations

The eight decisions were reached on completion of an appropriate amount of preparatory study work, with clear decision outcomes. Justifications are summarised below:

Group 2: The outcome of this decision point is to fully remove the buried structures and deposits. Whilst the options considered had a similar scoring, removal was scored higher from an environmental perspective.

Removal shall be performed post decommissioning of any related live lines / infrastructure. Timing of this operation may be outside of the main project and will be subject to final agreement and arrangements placed with third party operators.

Group 3: Partial removal of the riser, where the outboard and exposed section of the riser is removed, leaving the remainder in the J-tube, was assessed as being the preferred option in all criteria apart from technical and societal (in which it was considered neutral to the other CA options).

The outcome of this decision point is therefore to decommission Group 3 in situ by partial removal, having recovered the surface laid/exposed section. The fate of the section within the J-tube will ultimately be determined by the CA covering the fate of the Dunlin Alpha CGBS. The Dunlin – Effect of Riser Remaining Study has been conducted examining the effects of decommissioning the riser in the J-tube and found the consequence on other activities to be negligible.

Group 5: With the exception of the end sections, PL2852 is trenched and buried to 0.6m or greater along the majority of the route. 6,743t of rock has been used to provide protection at the north and south ends of the line and crossing locations. The line is stable and there is no significant seabed mobility within the vicinity of the line.

The CA workshop found partial removal to be the preferred option in all areas except societal where it was considered that there were some minor benefits related to the return of material to shore.

The outcome of this decision point is therefore to decommission Group 5 in situ by partial removal. This infrastructure will be decommissioned by removing exposures outside of the defined trench and placing local rock cover at the cut ends and areas of low burial depth.

Periodic monitoring and remediation will be carried out at this location as required.

Group 6: The outcome of this decision point is to fully remove the rock covered surface laid rigid spools. Whilst the options considered had a similar scoring, removal was scored higher from a long term economic and safety perspective.

Group 7: PLU2853 is a surface laid umbilical covered with 0.3m of rock totalling 2,717t.

The physical properties of the umbilical and its installed configuration are such that reverse reeling, according to desk-top engineering studies, is deemed to be feasible, although it still carries some technical risk.

The CA identified removal by reverse reeling to be the preferred option against all criteria apart from societal (in which it was Neutral) and technical feasibility (in which it was Weaker). Despite the technical feasibility being lower, any negative outcome of experiencing technical challenges will be limited.

The outcome of this decision point is therefore to decommission Group 7 by full removal using reverse reeling.

Group 8: Partial removal of the riser PL4334, where the outboard and exposed section of the riser is removed, leaving the remainder in the J-tube, was assessed as being the preferred option in all criteria apart from societal (in which it was considered Neutral to the other CA options).

The outcome of this decision point is therefore to decommission Group 8 in situ by partial removal, having recovered the surface laid/exposed section. The fate of the section within the J-tube will ultimately be determined by the CA covering the fate of the Dunlin Alpha CGBS. The Dunlin – Effect of Riser Remaining Study has been conducted examining the effects of

decommissioning the risers in the J-tube and found the consequence on other activities to be negligible.

Group 9: With the exception of the end sections and crossing location, the cable PL4334 is trenched and buried along the majority of the route. 11,612t of rock has been used to provide protection at areas of low cover and the crossing location. The line is stable and there is no significant seabed mobility within the vicinity of the line.

The CA workshop identified that partial removal was the preferred option. Whilst it was not the highest scoring for safety and environmental, it scored consistently similar to the other options in most criteria. It offered a less technically demanding solution and provided more economic certainty.

The outcome of this decision point is therefore to decommission Group 9 in situ by partial removal. This infrastructure will be decommissioned by removing exposures outside of the defined trench and placing local rock cover at the cut ends and areas of low burial depth.

Periodic monitoring and remediation will be carried out at this location as required.

Group 10: Partial removal of the riser PL4334 where the outboard and exposed section of the riser is removed, leaving the remainder within the J-tube, was assessed as being the preferred option in all criteria apart from ‘societal’ (in which it was considered Neutral to the other CA options).

The outcome of this decision point is therefore to decommission Group 10 in situ by partial removal, having recovered the surface laid/exposed section. The fate of the section within the Brent Charlie J-tube will ultimately be determined by the CA covering the fate of the Brent Charlie platform (as submitted by Shell).

Sensitivities were performed where appropriate (e.g. relating to economics, or relating to uncertainty for some rankings) and found that these did not alter the overall decision outcomes. The only infrastructure remaining from the Dunlin field following decommissioning is proposed to be the already trenched and buried pipelines, the trenched and buried cable, and the sections of all risers which are within the J-Tubes integral to the Dunlin Alpha CGB, and at Brent Charlie. All other infrastructure will be fully removed.

Figure 6.1 - Figure 6.3 show the Dunlin area post decommissioning.

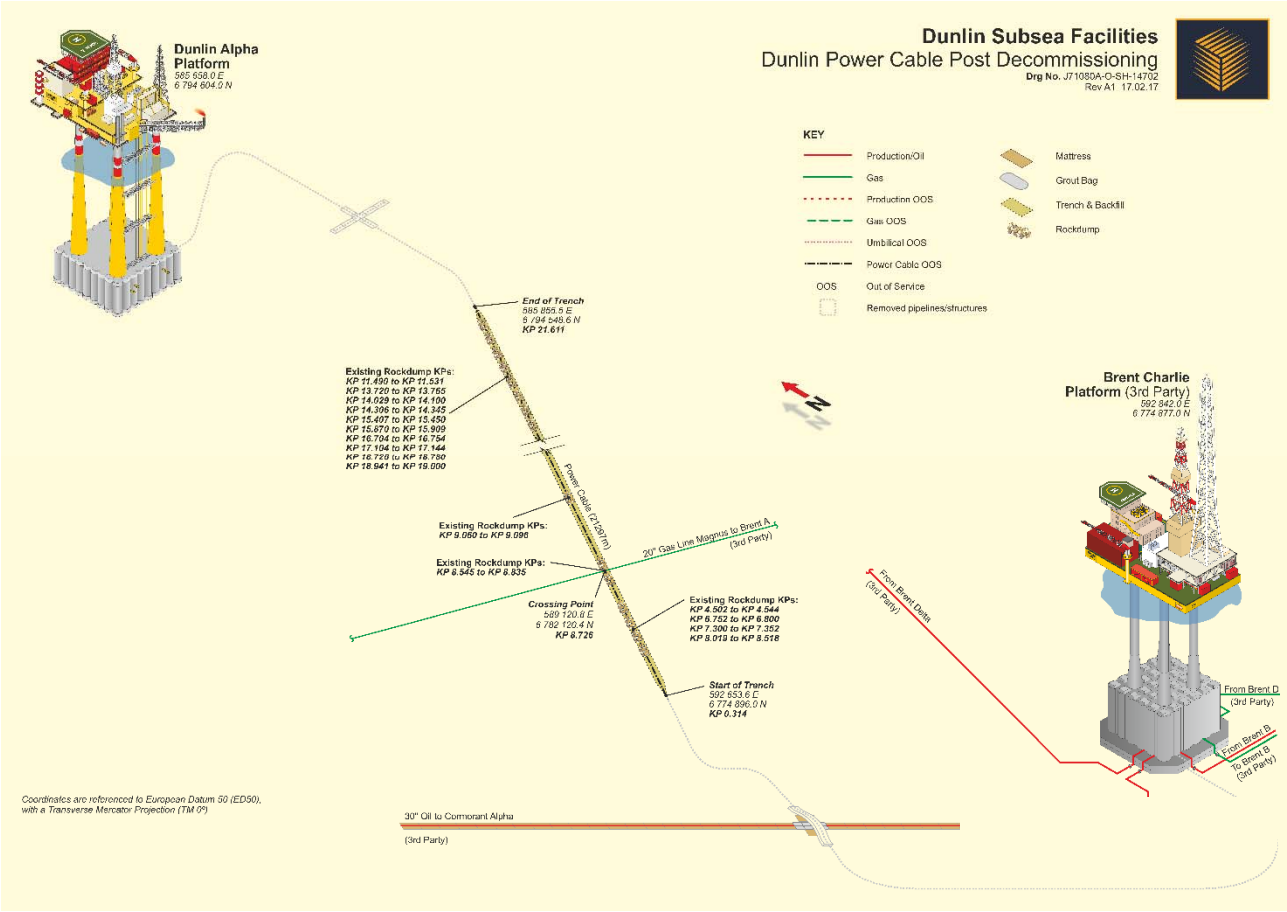


Figure 6.1 Dunlin Power Cable Post Decommissioning

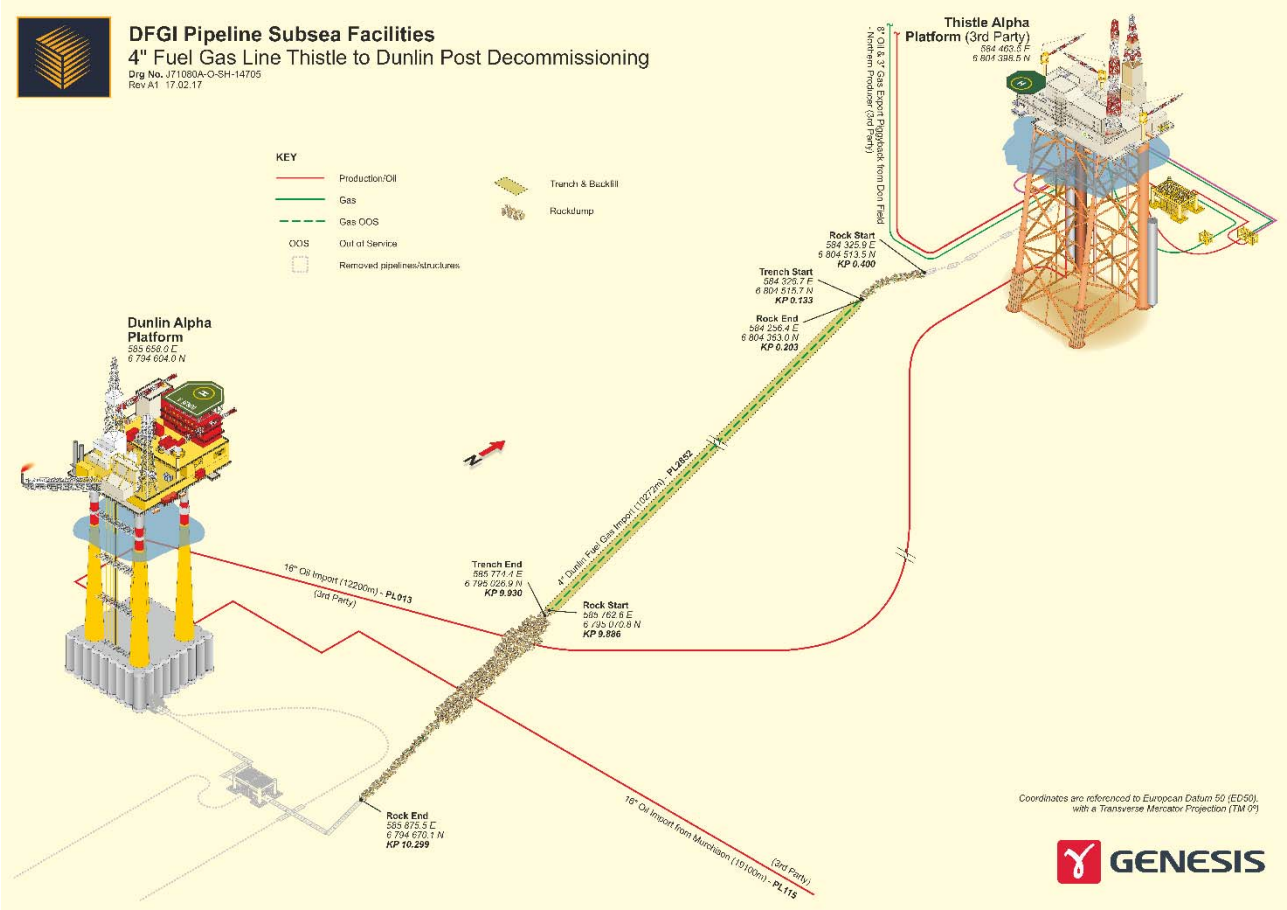


Figure 6.2 Dunlin Post Decommissioning

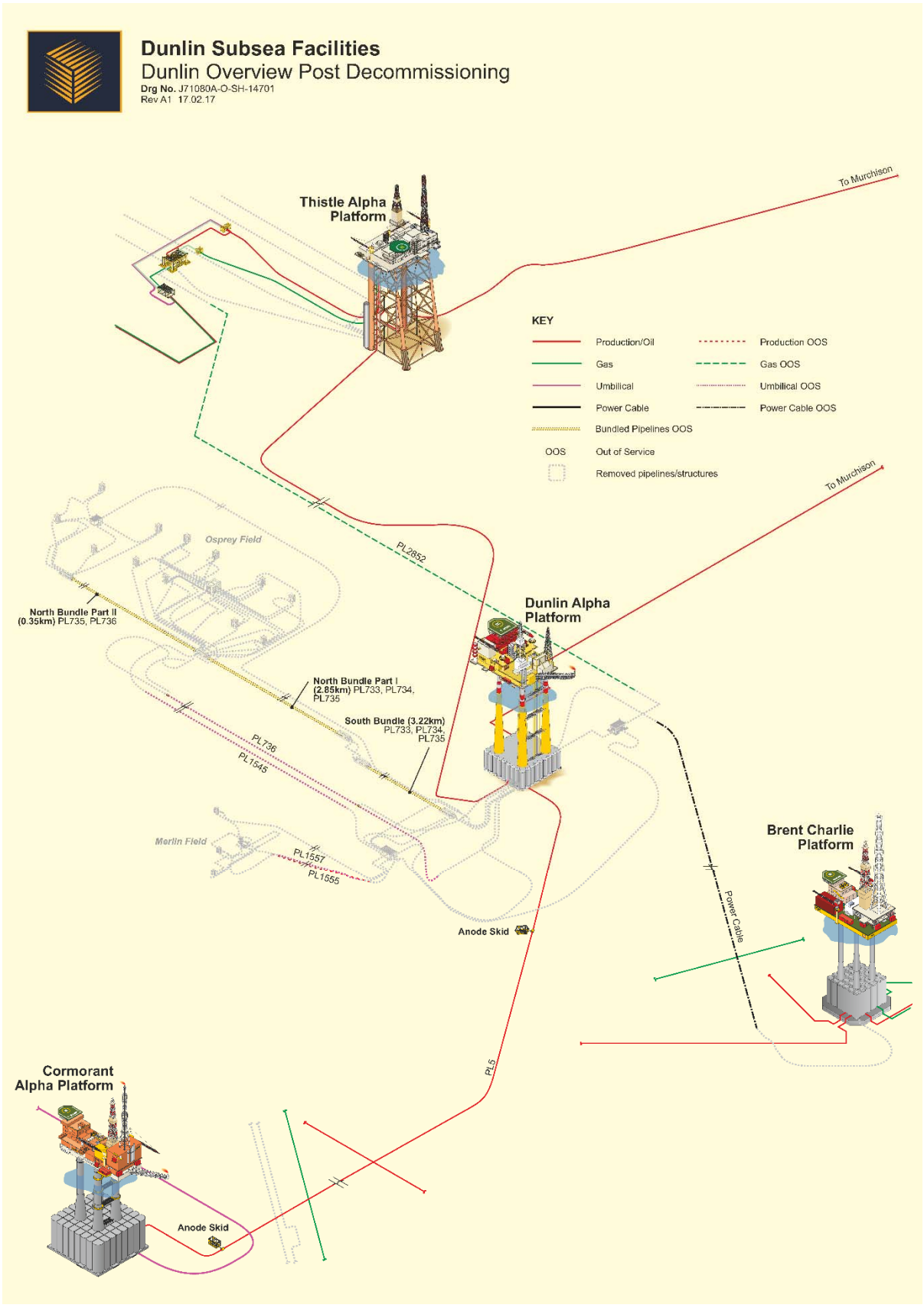


Figure 6.3 Overall Project Context

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13. Drill Cuttings Analysis	Dunlin Pre-decommissioning Cuttings Assessment Survey (Fugro Emu Limited, 2017)
14. Pipeline Cleanliness Study	A301524-S04-TECH-001, Pipelines Cleanliness Study – Dunlin Infield Oil Pipelines, Rev. A01, Dated 04/05/2016.
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19. Dunlin Risk Evaluation of Leaving Items In-situ	A301649-S01-TECH-012, Dunlin – Risk Evaluation of Leaving Items In-situ, Rev. A02, Dated 13/09/2016.
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8. Abbreviations and glossary

AHP	Analytical Hierarchy Process
BEIS	Business, Energy and Industrial Strategy
CA	Comparative Assessment
DAD	Dunlin Area Decommissioning
dB	Decibels
EIA	Environmental Impact Assessment
ESDVs	Emergency Shutdown Valves
FAR	Fatal Accident Rate
FEL	Fairfield Energy Limited
KP	Kilometre Post
MCDA	Multi-criteria Decision Analysis
MFE	Mass Flow Excavator
OSPAR	Oslo/Paris convention (for the Protection of the Marine Environment of the North-East Atlantic)
PLL	Potential for Loss of Life
QRA	Quantitative Risk Assessment
SCMs	Subsea Control Modules
SEL	Sound Energy Level
SFF	Scottish Fishermen's Federation
SID	Subsea Infrastructure Decommissioning
TPa^2S	Tera-pascal Squared Second – Total Noise Emission metric
TUTU	Topside Umbilical Termination Unit

Appendix A Pairwise Methodology Explanation

A1 Introduction

In order to support the decision making process for the remaining Subsea Infrastructure Decommissioning (SID) decision points, Fairfield has adopted the use of Xodus' Multiple Criteria Decision Analysis (MCDA) tool for delivering the required Comparative Assessment.

Whilst the key attributes and steps taken in the use of this tool are discussed in the main body of this report, an elaboration of the calculation methods used has been deemed appropriate.

A2 The Analytical Hierarchy Process (AHP)

The Analytical Hierarchy Process (AHP) is a general theory of measurement used to derive ratio scales or priorities which reflect the relative strength of comparisons. It was developed during the 1970s by Thomas L. Saaty, a mathematician at University of Pennsylvania and is considered a fundamental approach to multi-criteria decision making. It has been used extensively in a wide variety of applications and industries and is the subject of many books, papers and other publications.

Whilst a detailed discussion of the AHP is beyond the scope of this document it is however, worth discussing a number of the key mathematical elements of the process and how these are implemented.

A2.1 Initial Setup

One of the key concepts of AHP is the hierarchical nature of the decision making process. This is demonstrated by the need for any decision to have the following elements:

- Objective – the primary goal or objective for the decision.
- Decision criteria – the primary criteria by which the decision will be measured.
- Sub-criteria – the second tier (and potentially other tiers) of criteria that primary criteria may be split into
- The proposed alternatives (options) which may satisfy the objective.

In the context of the SID, the above elements are:

- Objective – to select the optimum decommissioning strategy, for each decision point, given the prevailing legislation and the Fairfield Guiding Principles.
- Criteria – Safety | Environment | Technical | Societal | Economic
- Sub-criteria:
  - Safety – Personnel Offshore | Personnel Onshore | Other Users | High Consequence Events | Residual Risk
  - Environmental – Marine Impacts | Emissions | Consumption | Disturbance | Protections
  - Societal – Fishing | Other Users
  - Economic – Short-term Costs | Long-term Costs

- Options (For this Worked Example - Osprey Group 3, Bundle)
  - 1a – Initial towhead removal and local rock dump with only minor remediation required in the future
  - 1b – Initial towhead removal and local rock dump with full rock dump in the future
  - 1c – Initial towhead removal and local rock dump with full removal in the future
  - 2 – Towhead removal and full rock dump
  - 3 – Towhead removal and trench and bury
  - 4 – Full removal

A2.2 Pairwise Comparison Matrix

The focal point of multi-criteria decision making and AHP is the construction of matrices by performing pairwise comparisons where the relative merits of pairs of criteria are considered against each other. AHP uses a hierarchical system of these matrices to allow the relative merits of options against the defined criteria and objective to be calculated.

These pairwise comparison matrices are constructed by listing the parameters being considered in rows and columns and considering what the relevant importance of each versus the others is. Most applications of the AHP use a 1 to 9 numeric scale as defined in Table A.1.

Importance Value	Definition	Explanation
1	Equal Importance	The criteria / options are considered equally important to each other.
3	Moderate importance	Experience and judgement moderately favour one criteria / option over the other.
5	Essential or strong importance	Experience and judgement strongly favour one criteria / option over the other.
7	Very Strong importance	A criteria / option is strongly favoured over the other and can be demonstrated in practice.
9	Extreme importance	The evidence favouring one criteria / option over the other is of the highest possible order.
2 / 4 / 6 / 8	Intermediate values between the two adjacent judgements	Can be used where compromise is needed.

Table A.1 Standard AHP Importance Scale

It should be noted that finer judgements can be made by applying further intermediate ranges such as 1.1, 1.2. etc. to add fidelity as required. Equally, the 1 to 9 numerical scale could be extended to say 1 to 100 as well if required. However, caution is advised in departing significantly from the widely accepted 1 to 9 numerical scale with the descriptions as detailed in Table A.1 as these have been shown over many applications to reflect the appropriate decision.

It should be further noted that only the upper triangle of the pairwise comparison matrix is completed as this represents the row versus column judgement, with the reciprocal being automatically inserted in the lower triangle of the pairwise comparison matrix.

An example is shown in Table A.2 of the standard AHP importance scale applied to decision relating to the relevant importance of criteria in the decision-making process of buying a personal vehicle. In this example the first pairwise comparison we make is Cost versus Style. Here, we make the decision that Cost is a much stronger consideration than Style, and so, from Table A.1 an importance metric of 7 may be selected (with a reciprocal of 1/7 automatically inserted in the corresponding Style versus Cost cell).

The next comparison is Cost versus Fuel Economy. In this case, the use of the personal vehicle could be over limited mileage and thus Cost could be considered vastly more important than Fuel Economy. Again, using the importance scale from Table A.1 a 9 is inserted with 1/9 as the reciprocal.

The remaining comparisons are made with the final pairwise comparison matrix shown in Table A.2.

	Cost	Style	Fuel Economy	Reliability
Cost	1	7	9	3
Style	1/7	1	1/3	1
Fuel Economy	1/9	3	1	1/3
Reliability	1/3	1	3	1

Table A.2 Example Pairwise Comparison

The scale of priorities or relative weighting of the criteria from Table A.2 has been shown by the AHP to be derived by calculating the primary eigenvector of the above matrix and normalising the result. Again, detailed discussion of how this calculation is performed and the associated priorities arrived at is beyond the scope of this discussion. In this example this derives the following priorities:

- Cost – 0.6445
- Style – 0.0812
- Fuel Economy – 0.1001
- Reliability – 0.1742

A3 Xodus Application of the AHP

Section Appendix A.2 details a standard application of the AHP and can be found described in many public domain papers and publications. Over the years, Xodus has applied these principles of the standard AHP in many applications, ranging from prioritising the order of competing work scopes by comparing their relative benefits, to identifying the most attractive option during the concept select phase of many projects.

In delivering these decision support activities, our consultants have gathered a breadth of experience that has enabled them to identify and implement improvements to the application of the standard AHP. In terms of Xodus' implementation of the AHP for this SID, on behalf of Fairfield, and as engineered into our tool, there are two departures from the standard AHP. These are:

- Using phrases rather than numbers in the importance scale.
- Tuning of the importance scale.

A3.1 Words v Numbers

One of the challenges that has faced Xodus when asking assembled audiences to apply the importance scale to a particular comparison, was to encourage them to apply the scale according to the descriptions and explanations (see Table A.1) rather than implying that adopting a 3 in the matrix meant the comparison was 3 times better, etc.

To manage this, Xodus changed the way we apply the principles of the AHP by replacing numbers in the pairwise comparison matrix with a narrative or descriptive approach. This is already programmed into the AHP in the importance scale explanations in Table A.1. Whilst implementing this change, Xodus also decided that three positions from equal (and their reciprocals) would be sufficient for most applications. These positions are:

Neutral	Equal Importance, equivalent to 1 in the importance scale from Table A.1
Stronger (S) / Weaker (W)	Moderate importance of one criteria / option over the other, equivalent to 3 in the importance scale from Table A.1.
Much Stronger (MS) / Much Weaker (MW)	Essential / strong importance of one criteria / option over the other equivalent to 5 or 6 in the importance scale from Table A.1.
Very Much Stronger (VMS) / Very Much Weaker (VMW)	Extreme importance of one criteria / option over the other equivalent to 8 or 9 in the importance scale from Table A.1.

Table A.3 Definitions of positions from equal

Using this transposed scoring system makes it, in our experience, simpler and more importantly, more effective at capturing the mind-set and feeling of the attendees at the workshops. Phrases such as 'what are the relative merits of pipeline removal on a project versus rock dumping from a safety perspective? Are these Neutral to each other? Are they stronger? If so, how much stronger? If you had to prioritise one over the

other, which would it be?'. This promotes a collaborative dynamic in the workshop and enables the collective mind-set of the attendees to be captured. Where there is quantitative data to provide back-up and evidence for the collective assertions, so much the better.

Once the matrix is complete, deriving the priority scale is performed in exactly the same manner as for the standard AHP i.e. the primary eigenvector of the matrix is solved (with Stronger replaced with 3, Much Stronger replaced with 6 and Very Much Stronger replaced with 9 (and similarly for the reciprocals)).

A3.2 Tuning Importance Scale

A further adjustment from the standard AHP has been implemented by Xodus in the last few years of applying AHP for decision making. This takes the form of tuning the importance scale to reflect the sentiment of the workshops. This is best illustrated by a 2 option decision matrix.

Let us take two options, option 1 and option 2 and apply the standard AHP importance scale to them with the Xodus Stronger / Much Stronger / Very Much Stronger wording relating to that standard scoring. This provides the derived priorities as shown in Table A.4.

Original AHP Importance Scale		**Derived Priority**	
Option 1	**Option 2**	**Option 1**	**Option 2**
1 (Neutral)	**1 (Neutral)**	**0.5000**	**0.5000**
2	1/2	0.6667	0.3333
3 (Stronger)	**1/3 (Weaker)**	**0.7500**	**0.2500**
4	1/4	0.8000	0.2000
5	1/5	0.8333	0.1667
6 (Much Stronger)	**1/6 (Much Weaker)**	**0.8571**	**0.1429**
7	1/7	0.8750	0.1250
8	1/8	0.8889	0.1111
9 (Very Much Stronger)	**1/9 (Very Much Weaker)**	**0.9000**	**0.1000**

Table A.3 Standard AHP Importance Scale and Derived Priorities

As can be seen, criteria / options that are scored as Neutral to each other have a relative priority of 0.500 each, which reflects what we would expect. If we then look at priority derived from considering criteria / options Stronger / Weaker to each other, we get a (0.7500, 0.2500) split. Following this through, for Much Stronger / Much Weaker we get priorities of (0.8571, 0.1429) and finally for Very Much Stronger / Very Much Weaker we get priorities of (0.9000, 0.1000).

When delivering comparison sessions, Xodus felt that the Stronger / Weaker sentiment in the room did not reflect a 75 / 25 split between the options and that this resulted in a contribution which was too dominant in these areas. It was felt that the Much Stronger / Much Weaker providing an 86 / 14 split was also more dominant than was intended by the workshop attendees. Finally, Very Much Stronger / Very Much Weaker with a 90 / 10 split seemed about right for the intentions of the workshops.

As such, Xodus decided to tune the relative importance scale to ensure that the sentiment of the workshop attended was reflected correctly when selecting the Stronger / Much Stronger / Very Much Stronger assessment. The outcome of that tuning process is shown in Table A.5.

Revised Xodus Importance Scale		Derived Priority	
Option 1	**Option 2**	**Option 1**	**Option 2**
1 (Neutral)	**1 (Neutral)**	**0.5000**	**0.5000**
1.5 (Stronger)	**1/1.5 (Weaker**	**0.6000**	**0.4000**
2	1/2	0.6667	0.3333
3 (Much Stronger)	**1/3 (Much Weaker)**	**0.7500**	**0.2500**
4	1/4	0.8000	0.2000
5	1/5	0.8333	0.1667
6	1/6	0.8571	0.1429
7	1/7	0.8750	0.1250
8	1/8	0.8889	0.1111
9 (Very Much Stronger)	**1/9 (Very Much Weaker)**	**0.9000**	**0.1000**

Table A.4 Xodus Tuned AHP Importance Scale and Derived Priorities

In this revised system the following splits are obtained:

- Stronger / Weaker provides a 60 / 40 split
- Much Stronger / Much Weaker provides a 75 / 25 split
- Very Much Stronger / Very Much Weaker provides a 90 / 10 split

Xodus believes this importance scale more accurately reflects what workshop attendees actually mean when they assess a criteria / option as stronger, much stronger or very much stronger than another.

A4 Worked Example

A key question when considering the Xodus application of AHP to our multi-criteria decision making activities is, what is the impact of Xodus modifications to the standard importance scale? Xodus believes the modifications to have been identified and implemented for valid reasons as described in Appendix A.3. To illustrate the impact of these changes, one of the SID decision points has been calculated using both the standard AHP importance scale and the tuned Xodus version and the derived priorities from these are illustrated in Figures A.1 to A.5.

1. Safety	1. Leave - End Removal - Limited Rock Placement	2. Leave - End Removal - Full Rock Placement	3. Full Removal - Reverse Reel	Standard AHP Priorities	Xodus AHP Priorities
1. Leave - End Removal - Limited Rock Placement	N	N	MS	46.15%	42.86%
2. Leave - End Removal - Full Rock Placement	N	N	MS	46.15%	42.86%
3. Full Removal - Reverse Reel	MW	MW	N	7.69%	14.29%

Figure A.1 Safety Pair-wise Comparison Matrix

2. Environmental	1. Leave - End Removal - Limited Rock Placement	2. Leave - End Removal - Full Rock Placement	3. Full Removal - Reverse Reel	Standard AHP Priorities	Xodus AHP Priorities
1. Leave - End Removal - Limited Rock Placement	N	S	S	58.42%	42.63%
2. Leave - End Removal - Full Rock Placement	W	N	W	13.50%	24.83%
3. Full Removal - Reverse Reel	W	S	N	28.08%	32.54%

Figure A.2 Environmental Pair-wise Comparison Matrix

3. Technical	1. Leave - End Removal - Limited Rock Placement	2. Leave - End Removal - Full Rock Placement	3. Full Removal - Reverse Reel	Standard AHP Priorities	Xodus AHP Priorities
1. Leave - End Removal - Limited Rock Placement	N	N	MS	46.15%	42.86%
2. Leave - End Removal - Full Rock Placement	N	N	MS	46.15%	42.86%
3. Full Removal - Reverse Reel	MW	MW	N	7.69%	14.29%

Figure A.3 Technical Pair-wise Comparison Matrix

4. Societal	1. Leave - End Removal - Limited Rock Placement	2. Leave - End Removal - Full Rock Placement	3. Full Removal - Reverse Reel	Standard AHP Priorities	Xodus AHP Priorities
1. Leave - End Removal - Limited Rock Placement	N	W	S	28.08%	32.54%
2. Leave - End Removal - Full Rock Placement	S	N	S	58.42%	42.63%
3. Full Removal - Reverse Reel	W	W	N	13.50%	24.83%

Figure A.4 Societal Pair-wise Comparison Matrix

5. Economic	1. Leave - End Removal - Limited Rock Placement	2. Leave - End Removal - Full Rock Placement	3. Full Removal - Reverse Reel	Standard AHP Priorities	Xodus AHP Priorities
1. Leave - End Removal - Limited Rock Placement	N	N	S	42.86%	37.50%
2. Leave - End Removal - Full Rock Placement	N	N	S	42.86%	37.50%
3. Full Removal - Reverse Reel	W	W	N	14.29%	25.00%

Figure A.5 Economic Pair-wise Comparison Matrix

A5 Final Priorities

As the name Analytical Hierarchical Process suggests, there is a strong hierarchical component to the process. This was introduced in Appendix A2.1 where the relationship between the objectives / goals, the success criteria, and associated sub-criteria and finally the proposed options was introduced.

The priorities derived for each of the proposed options, with respect to the identified criteria from the example detailed in Section Appendix A4 (using Xodus importance scale only) are summarised in Table A.6.

	Safety	Environment	Technical	Societal	Economic
Option 1	0.4286	0.4263	0.4286	0.3254	0.3750
Option 2	0.4286	0.2483	0.4286	0.4263	0.3750
Option 3	0.1429	0.3254	0.1429	0.2483	0.2500

Table A.5 Priority Matrix – Options w.r.t. Criteria

Similarly, the priorities derived by performing a pairwise comparison of the criteria themselves are summarised in Table A.7. At this stage, the criteria have been considered as having equal priority. As such the derived priorities are 0.2000 for all criteria.

	Priority
Safety	0.2000
Environment	0.2000
Technical	0.2000
Societal	0.2000
Economic	0.2000

Table A.6 Priority Matrix – Criteria

In order to obtain the final priorities, each row of the 3 x 5 matrix (i.e. a 1 x 5 matrix) is multiplied by the 5 x 1, which provides priority values which relate to the contributions of the benefits associated with each option for each criteria, weighted by that criteria.

In this example, the overall priorities derived are shown in Table A.8.

	Safety	Environment	Technical	Societal	Economic	Total
Option 1	0.0857	0.0853	0.0857	0.0651	0.0750	**0.3968**
Option 2	0.0857	0.0497	0.0857	0.0853	0.0750	**0.3814**
Option 3	0.0286	0.0651	0.0286	0.0497	0.0500	**0.2219**

Table A.7 Final Priorities

A6 Discussion

Combining the priorities derived in the example presented in Appendix A4 and the method for deriving the final priorities described in Appendix A5, we obtain the final priorities as shown in Table A.9 depicted graphically in Figure A.6.

Option	1. Saf.	2. Env.	3. Tech.	4. Soc.	5. Eco.	Total
1. Leave - End Removal - Limited Rock Placement	9.23%	11.68%	9.23%	5.62%	8.57%	**44.33%**
2. Leave - End Removal - Full Rock Placement	9.23%	2.70%	9.23%	11.68%	8.57%	**41.42%**
3. Full Removal - Reverse Reel	1.54%	5.62%	1.54%	2.70%	2.86%	**14.25%**

Table A.8 Outcome with Standard AHP Importance Scale

Option	1. Saf.	2. Env.	3. Tech.	4. Soc.	5. Eco.	Total
1. Leave - End Removal - Limited Rock Placement	8.57%	8.53%	8.57%	6.51%	7.50%	**39.68%**
2. Leave - End Removal - Full Rock Placement	8.57%	4.97%	8.57%	8.53%	7.50%	**38.14%**
3. Full Removal - Reverse Reel	2.86%	6.51%	2.86%	4.97%	5.00%	**22.19%**

Table A.9 Outcome with Xodus Tuned AHP Importance Scale

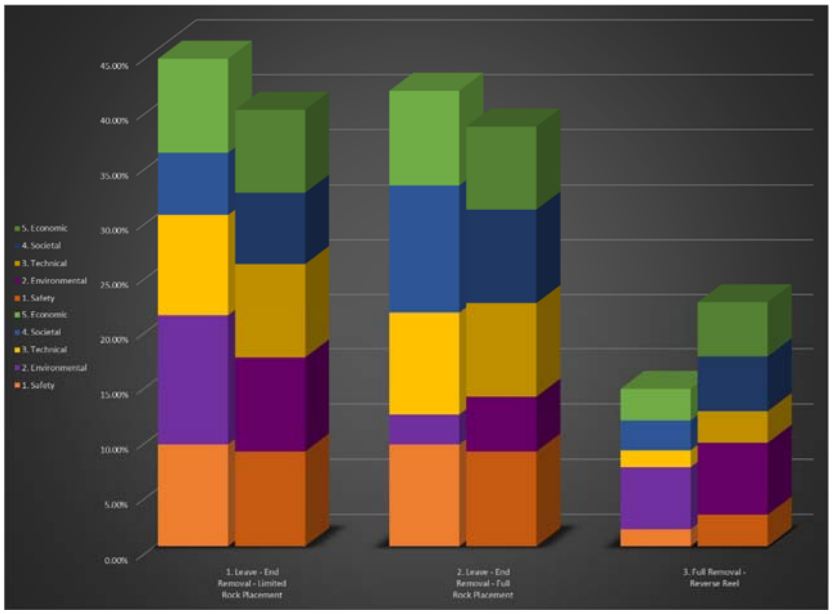

Figure A.6 CA Visual Output showing Standard v Xodus Tuned Importance Scale

In the graph shown in Figure A.6, the first column of each option shows the colour coded individual criteria priorities, whilst the stack-up shows the overall or final priority for the option under the standard AHP importance scale. The second column shows the equivalent using the Xodus tuned AHP importance scale.

As can be seen, and as would be expected given that Xodus tuning of the AHP importance scale reduces the impact of the Stronger and Much Stronger judgements (and their reciprocals), overall the priorities of the stronger options are a little lower and this has the associated impact of increasing the priority of the less attractive options. In effect, this Xodus tuning compresses priorities together – an outcome Xodus believes more accurately reflects the sentiment associated with comparisons of options that are considered close to each other.

Overall, the outcome for this example decision point is not altered by adopting standard versus Xodus tuned AHP importance scale.

Appendix B CA Criteria

Differentiator	Sub-Criteria	Description
1. Safety	1.1 Personnel Offshore	This sub-criterion considers elements that impact risk to offshore personnel and includes, project team, project vessel crew, diving teams, supply boat crew, and survey vessel crew. It should be noted that crew changes are performed via port calls.
	1.2 Personnel Onshore	This sub-criterion considers elements that impact risk to onshore personnel. Factors such as any requirement for dismantling, disposal operations, material transfer and onshore handling may impact onshore personnel.
	1.3 Other Users	This sub-criterion covers the impact associated with the risk to other users. Considers elements such as collision impact whilst performing activities. Users such as fishing vessels, commercial transport vessels and military vessels are considered.
	1.4 High Consequence Events	This sub-criterion relates to any inherent potential for high consequence events i.e. major accident hazard, major environmental hazard type events. It applies to all onshore and offshore personnel involved in the project. Considerations such as dropped object concerns, support vessel risks, are considered.
	1.5 Residual Risk	This sub-criterion addresses any residual risk to other sea users i.e. fishermen, military vessel crews, commercial vessel crews and passengers, other sea users, that is provided by the option. Issues such as residual snag risk, collision risk, etc. may be considered.
2. Environmental	2.1 Marine Impacts	This sub-criterion covers elements such as noise generated by vessels, cutting operations, explosives etc. It also covers any damaging discharges to sea from vessels and / or activities performed.
	2.2 Emissions	This sub-criterion relates to the amount of damaging atmospheric emissions associated with a particular option.
	2.3 Consumption	This sub-criterion relates to the amount of Energy / Resource consumption such as fuel use, recycling of materials, use of quarried rock, production of replacement materials.
	2.4 Disturbance	This sub-criterion relates to both direct and indirect seabed disturbance. Both short and long term impacts are considered.
	2.5 Protections	This sub-criterion relates to the impact of the options on any protected sites and species.
3. Technical	3.1 Technical Risk	This sub-criterion relates to the various technical risks that could result in a major project failure. Concepts such as: Technical Novelty and Potential for Showstoppers can be captured along with impact on the schedule due to overruns from technical issues such as operations being interrupted by the weather. Technical Feasibility and Technical Maturity is also considered.
4. Societal	4.1 Fishing	This sub-criterion addresses the impact of the option on commercial fishing operations. It includes consideration of impacts from both the decommissioning activities and residual impacts post decommissioning such as reinstatement of access to area.
	4.2 Other Users	This sub-criterion addresses any socio-economic impacts on other users both onshore where the impact may be from dismantling, transporting, treating, recycling and land filling activities relating to the option and offshore. Issues such as impact on the health, well-being, standard of living, structure or coherence of communities or amenities are considered here e.g. business or jobs creation, increase in noise, dust or odour pollution during the process which has a negative impact on communities, increased traffic disruption due to extra-large transport loads, etc. Includes the FEL Guiding Principle of 'Minimal business interruption to others'.
5. Economic	5.1 Short-term Costs	This sub-criterion addresses the cost of delivering the option as described. No long-term cost element is considered here. Cost uncertainty (a function of activity maturity) is also recorded.
	5.2 Long-term Costs	This sub-criterion addresses the costs associated with any long-term liabilities such as on-going monitoring and any potential future remediation costs.

Appendix C Environment Criteria Assessment Methodologies

C1 Introduction

This appendix provides further information on environment criteria assessment methodologies. Assessment methodologies for safety (e.g. Potential Loss of Life calculations), technical and economics are available within the Common Scope Report.

C2 Noise Emissions Assessment

A range of offshore activities generate airborne and underwater noise. Fish, whales and dolphins, and even diving seabirds, may be able to detect this noise and, if it is sufficiently loud, it can damage the hearing of these animals. Where noise is not loud enough to cause injury, it might still be loud enough to disturb the animals from normal behaviour. As part of this assessment, the activities that create noise in the marine environment have been identified and a representation of how loud the emissions are has been considered. It has been concluded that the possible noise emissions are either sufficiently quiet that injury isn't considered likely, or that mitigation measures could be adopted so that injury can be avoided. Examples of noise levels from decommissioning activities are given in the following table, alongside the levels required to cause injury:

Activity	Source Noise Level (dB re 1 mP @ 1 m rms)	Threshold of injury to marine mammals
Dive support vessel	178	233
Rock dumping	188	233
Mass flow excavation	162	233
Underwater cutting	195	233
Survey vessel	184	233

Table C.1 Comparison of Decommissioning Noise Sources and Injury Thresholds

On this basis, the activities are not likely to injure any marine animals. As such, it is the possibility of disturbing animals that required further consideration. Disturbance is not simply a function of cumulative noise exposure but also of absolute levels; habituation is important, where animals may become tolerant of a noise over time, but disturbance will also be related to the extent to which interference with communication and echolocation systems occurs. To investigate the measure of risk of disturbance posed by the decommissioning options, a risk score was developed that allowed Fairfield to compare the multi-activity events with each other in order to demonstrate the different total energy of each overall option. Taking the amount of noise emitted on each day and summing it for all days that the activities will occur on provided an estimate of the total noise from each decommissioning option. This number is not a measure of how loud the option is, but how much noise overall is emitted. If an option emits a lot of noise for a long time then it is, crudely for the purposes of comparison, considered as having a higher risk of disturbance to animals.

Calculations are given for two numbers:

- Total noise energy emitted in terms of cumulative SEL in decibels. The decibel scale is logarithmic (i.e. a 3 dB change represents a doubling or halving of acoustic energy and a 6 dB change represents a quadrupling or quartering of acoustic energy).

- Total noise energy emitted in TPa2s; this metric is a linear scale so comparing between two numbers is easier than using the decibel scale (i.e. a doubling of this metric means a doubling in noise emissions).

Note: Care must be taken in interpreting these abstract figures in terms of impact on marine wildlife because, as noted above, there is not necessarily a direct relationship between the cumulative sound exposure and marine mammal response. Nevertheless, this gave a relatively simple method of comparing the options in terms of acoustic emissions.

The two metrics were calculated to compare between the different decommissioning options. To set these values in context of existing offshore activities, a standby vessel on site for a year would result in the following values for the two metrics:

- Cumulative SEL = 263 dB re 1 P @ 1 m; and Total Noise Energy = 199 TeraPa2s.

C3 Disturbance Assessment

The disturbance assessment considered dredging, backfilling, trenching and rock dumping as the four key differentiating mechanisms for seabed disturbance. The seabed habitat in the region is mud with sea pens and burrowing megafauna. This is a priority marine feature and mud is relatively limited on the UK Continental Shelf compared to other sediment habitats. However, this habitat does have a reasonable recovery potential.

Whilst the area of disturbance is an important factor, the type of disturbance is also important. Dredging, backfilling and trenching are all activities which cause a temporary disturbance. Recovery from these, specifically for a pipeline or umbilical, will be via migration of species from bordering undisturbed areas, resulting in a community similar to what was there before. Rock dump, however, represents a permanent change and a new or different habitat type. In broad terms, the following hierarchy is applied:

Grading	**Best** →			**Worst**
Type of disturbance	**Dredge**	**Backfill**	**Trench**	**Rockdump**

When combining this with area of disturbance the general scale and context is also important:

- An area of approximately 1,000,000 m2 is effectively a large area equivalent to or larger than the largest habitat features thought to be of conservation significance.
- One tenth of this area, 100,000 m2 would be generally only be significant from a cumulative perspective (i.e. multiple areas of this size).
- Anything smaller is considered to be a relatively small area of disturbance.

When comparing options the project team in the workshop combined the quantified disturbance areas with this approximate hierarchy of disturbance types through discussion and narrative.

C4 Emissions

In order to provide a comparative assessment of the energy and emissions produced during each of the proposed decommissioning options being considered within this report, primarily the Institute of Petroleum (IP) guidelines for the calculations of estimates of energy use and gaseous emissions in the decommissioning of offshore structures (IP, 2000) methodology has been used. The IP document provides a standardised set of guidelines, allowing oil and gas operators to make predictions of the potential energy use and gaseous emissions during the process of decommissioning, when assessing the options for removal.

End points are defined as the final states of the materials following the decommissioning operations, i.e. secondary raw materials. If the end-point is a useful material then it is assumed that the material is recycled, with any consequent onshore reprocessing energy use and emissions also taken into account, including dismantling of materials and their subsequent transport to recycling yards. At this stage the recycling location has not as yet been identified, however, an assumption has been made in this assessment that the materials will be transported by lorry to a recycling plant 150 km from the quayside for dismantling and for recycling.

The weights for each material were extracted from the Materials Inventory, whilst the energy and emissions values were extracted from the IP guidelines values per tonne of new and recycled materials as well as the dismantling and onshore transportation data.

Xodus provided the anticipated vessel activity data for each of the proposed decommissioning methods (from the Common Scope Reports). This activity data (including the type of vessel(s) as well as the expected transit and field activity data) was used in the assessment in conjunction with the vessel operations energy and fuel consumption values (tonnes/day, based on fuel consumption figures provided by the IP Guidelines; IP, 2000). This assessment followed the internationally agreed principles for full life cycle assessments, as per DECC (2011) guidance notes for the Decommissioning of Offshore Oil and Gas Installations and Pipelines.

Energy consumption for both new materials manufactured or recycled uses the following calculation:

Tonnes of material to be processed x IP Factor for Energy used for processing (new manufacture or recycling) material(GJ/t) = Total energy consumption (GJ)

- Example: 450 tonnes of aluminium is designated to be recycled, requiring 6,750 GJ (450 t (to be processed) x 15 GJ/t (IP Factor for recycling Aluminium)) of energy to undergo the recycling process alone (this does not account for the energy requirement needed to dismantle the material and any transportation required onshore).

The gaseous emissions produced for both new material manufacturing and recycling uses the following calculation:

Tonnes of material to be processed x IP Emission factor (kg/t) = Gaseous emissions from the manufacture of new material (kg)

- Example: 450 tonnes of aluminium designated to be recycled is estimated to produce 486,000 kg (450 t x CO_2 emissions factor (1,080 of CO_2 kg emitted/t) of CO_2 gaseous emissions.

The Energy consumption from onshore transportation of materials from the quay side to a recycling facility have been calculated using IP guidelines (IP, 2000). The Energy consumption for both new materials manufactured or recycled uses the following calculation:

Total fuel use (t) x IP Emission factor (kg/t) = Gaseous emission from vessel activities (kg)

- Example: If 66.9 tonnes of fuel is need to complete the transfer of recycling materials to a designated recycling facility the vehicle(s) are estimated to produce 212,800 kg (66.9 x CO2 emissions factor (3180 of CO2 kg emitted/t)) of CO2 gaseous emissions.

C5 Scale and Context

The base case for all options, following the extensive preparation works to date, was that all options are tolerable in terms of safety, environmental impact, and societal impact. However, to understand whether one option is 'stronger', 'much stronger', or 'very much stronger' than another sometimes required an understanding of how close the options were on a given scale. For example, in terms of CO2 emissions whilst the numbers for two options may appear an order of magnitude different, in terms of percentage contribution to UK annual emissions both might still be relatively similar and could feasibly still be neutral or 'stronger' rather than 'very much stronger'.

Appendix D Stakeholder CA Workshop Agenda and Minutes

Fairfield Energy Limited
(Registered No. 5562373)

Minutes

Meeting Name:	Dunlin Area Subsea Infrastructure Removal – Comparative Assessment Workshop
Date:	10th January 2017
Venue:	Fairfield, Westhill

Present:	Louise Pell-Walpole	JNCC
	John Watt, Steven Alexander	Scottish Fishermen's Federation
	Dr Peter Hayes	Marine Scotland
	Debbie Taylor, Amy Stubbs	BEIS - ODU
	Ian Fozdar	Oil and Gas Authority
	Gary Farquhar, Peter Lee	FEL
	James Clarkson, Andrew Corse,	FEL
	Jonathan Bird, Harry Yorston	FEL
	Jiro Mukai	MCX
	Peter Tipler, John Foreman,	Xodus
	Kenneth Couston	Xodus

Actions

1. PURPOSE OF THE MEETING

The purpose of the workshop was to engage stakeholders in a comparative assessment (CA) workshop of the options to decommission subsea infrastructure associated with the Dunlin, Osprey and Merlin Fields. The outputs from the meeting were recommended methodologies for inclusion in the relevant Decommissioning Programmes for public consultation.

2. INTRODUCTIONS

FEL thanked stakeholders for taking time to attend the workshop and reading the CA recommendations and supporting analysis which had been issued in advance. Each participant was introduced.

3. COMPARATIVE ASSESSMENT PROCESS

Xodus described the CA process undertaken and confirmed that it is aligned to the CA guidelines issued by Oil and Gas UK. It was explained that six key CA recommendations would be made during the workshop. The recommendations will then also be applied to any analogous subsea infrastructure. The limits for the workshop were confirmed as subsea infrastructure only, the Dunlin CGBS will the subject of a separate CA.

The evaluation criteria are aligned to the BEIS ODU and OGUK Guidelines, namely Safety, Environmental, Technical, Societal and Economics. The criteria have been assessed using the Xodus "Pairwise" methodology and weighted equally.

For each decision a sensitivity analysis excluding the Economics criterion, has also been prepared. It was noted that removing Economics did not change the recommendation for any removal decision.

Xodus also advised that a Quantitative Risk Analysis (QRA) workshop in relation to the impact on fishing for each option is to be held week commencing 16th January 2017. Stakeholders will be advised of the QRA output and any impact on the CA recommendations.

3.1 Merlin Field

3.1.1 Merlin Trenched and Rock-Dumped Pipelines and Umbilicals

FEL described the scope and status of the Merlin Trenched and Rock-Dumped Pipeline (PL1555) and Umbilical (PL1557) and reminded attendees that full removal had previously been recommended for most of the other Merlin infrastructure groupings. FEL explained that three options were assessed for Merlin Trenched and Rock-Dumped Pipelines and Umbilicals which had not been not previously identified for full removal.

The options are:

> **Option 1** - Leave in situ, remove ends, rock placement over snag hazards and areas of low cover.
> **Option 2** - Leave in situ, remove all exposures, rock placement over snag hazards and areas of low cover.
> **Option 3**- Leave in situ, back-fill trench using existing berm.

Xodus presented the assessment of the options against the five criteria.

JNCC asked if the CA takes into consideration impacts of future monitoring requirements and impacts to future users of the sea if infrastructure is left in situ. Xodus confirmed that the assessments include future impacts for up to 50 years for the purposes of comparative assessment.

SFF stated that option 3 would improve future fishing risk exposure, whereas options 1 and 2 have a neutral effect. Xodus updated the assessment accordingly.

Marine Scotland (MS) observed that the Oil Pipeline contains around 5 tonnes of LSA scale. **FEL committed to verify any relevant regulatory requirements in relation to the LSA scale.** **FEL**

FEL explained that the trench berms have a typical gradient of 1 in 8 and a height of less than 0.6m which is within over-trawl parameters. **FEL committed to issuing the berm analysis data to stakeholders.** **FEL**

The overall result of the CA is that Option 1 is the recommended decision. Merlin Trenched and Rock-Dumped Pipeline and Umbilical (PL1555 and PL

1557) should be left in situ, ends removed, rock placed over snag hazards and areas of low burial followed by a sea-bed survey and trawl sweep.

3.1.2 Merlin Trenched and Buried Pipelines

FEL described the scope and status of the Merlin Trenched and Buried Pipeline (PL1665). FEL explained that three options were assessed for PL1665 which that had not been previously identified for full removal.

The options are:

> **Option 1** - Leave in situ, remove ends, rock placement over snag hazards and areas of low cover.
> **Option 2** - Leave in situ, remove all exposures, rock placement on snag hazards and areas of low cover.
> **Option 3** - Full removal, reverse reel.

Xodus presented the assessment of the options against the five criteria.

JNCC asked why there were free spans and areas of low burial, was it due to the target burial depth not being achieved during laying or due to subsequent sediment movement. FEL advised that it was not certain and that this had happened prior to FEL taking Operatorship and further confirmed there had been no change in the nine years since. MS observed that these pipelines had not had rock placement which may be a contributory factor.

In response to a question from MS, SFF and FEL confirmed that if the pipeline is removed then an over-trawl check will be required.

The overall result of the CA is that Option 3 is the recommended decision. Merlin Trenched and Buried Pipeline PL1665 should be removed by reverse reeling followed by a sea-bed survey.

3.2 Osprey Field

3.2.1 Osprey Bundles

FEL described the scope and status of the Osprey North and South Bundles and reminded attendees that full removal had previously been recommended for most other Osprey infrastructure groupings. FEL explained that six options were assessed for the Bundles which had not been previously identified for full removal.

The options are:

> **Option 1** - Leave in situ, remove towheads, rock placement over snag hazards and areas of potential span growth.
> **Option 1A** - Leave in situ, remove towheads, rock placement over snag hazards and areas of potential span growth. Return after 30 years and place rock over entire length.
> **Option 1B** - Leave in situ, remove towheads, rock placement over snag hazards and areas of potential span growth. Return after 30 years, cut bundle into 20m lengths and recover to shore.

Option 2 - Leave in situ, remove towheads, rock placement over entire length.
Option 3 - Leave in situ, remove towheads, cut bundle into 350m lengths, pull bundles into pre-cut trench and backfill with spoil.
Option 4 - Full removal, cut into 20m lengths and lift, recover to shore.

Xodus presented the assessment of the options against the five criteria.

FEL confirmed that for the options where the bundle remains in situ there will be regular future monitoring. FEL confirmed that their current understanding is that in around 30 years time the bundle would begin to lose structural integrity and therefore could become a safety risk for fishermen.

Xodus observed that safety exposure and technological feasibility and maturity were the key drivers impacting the CA. A discussion followed on the likelihood of safety exposure and technology changing over the next 30 years. FEL said that they would monitor industry progress.

SFF stated that they did not want option 1 to be the final outcome as it presents a future risk to fishermen. SFF asked if a removal trial could be undertaken on the smaller section of the North Bundle. FEL responded that such a trial would not prove the concept for the entirety of the two bundles and that research and development funds are not available, given the industry challenge of reducing decommissioning cost. SFF observed that the height of rock placement over the entire length would be substantial but still could be over-trawled. Xodus commented that the upcoming fishing impact QRA would provide a more detailed assessment.

SFF asked if the bundle could be refloated. FEL commented that refloating had been ruled out at the screening workshop in March 2016 due to the integrity of the bundle internals and lack of onshore landing facilities.

MS commented that there needs to be industry wide research into bundle removal and that technology would not improve unless there was a driver to do so.

JNCC also stated that industry leadership is required and that rock placement is a sub-optimal solution. JNCC further commented that leaving the bundle in situ, without significant rock placement allows more time for the Regulator and the wider industry to find better solutions. MS questioned how BEIS are considering the removal of old bundles across Operators.

OGA asked how long the bundle will last prior to decomposition commencing. FEL responded approximately 30 years based on the results of an Xodus material degradation study.

BEIS confirmed that subsequent to the Osprey Bundle installation, subsea bundles must be designed with a recovery methodology.

The overall result of the CA is that Option 1 is the recommended decision. The Osprey Bundles should be left in situ, towheads removed and rock placed over snag hazards and areas of potential span growth, followed by a sea-bed survey and trawl sweep.

3.2.2 Osprey Trenched and Rock Dumped Umbilicals

FEL described the scope and status of the Osprey Trenched and Rock-Dumped Umbilicals (PL736 and PL1545). FEL explained that three options were assessed for PL736 and PL1545 which had not been previously identified for full removal.

The options are:

> **Option 1** - Leave in situ, remove exposed ends, rock placement over snag hazards and areas of low cover.
> **Option 2** - Leave in situ, remove all exposed ends, rock placement over entire length.
> **Option 3** - Full removal, reverse reel.

Xodus presented the assessment of the options against the five criteria.

OGA asked if PL736 would have to be de-buried to allow for reverse reeling. FEL confirmed that de-burial would be required.

MS asked if BEIS Guidelines required pipelines to be buried. It was confirmed that BEIS Guidelines require pipelines to be trenched or buried to a depth of 0.6m below the sea-bed.

SFF asked about the profile of the PL1545 trench. FEL responded that the data is available and will be included in the fishing impact QRA.

The overall result of the CA is that Option 1 is the recommended decision. Osprey Trenched and Rock-Dumped Umbilicals (PL736 and PL1545) should be left in situ, the exposed ends removed and rock placed over snag hazards and areas of low cover followed by a sea-bed survey and trawl sweep.

3.3 Dunlin Field

3.3.1 Dunlin Rigid Risers

FEL described the scope and status of the Dunlin Rigid Risers. FEL explained that two options were assessed for the Risers.

The options are:

> **Option 1** - Leave in situ, riser cut at J-tube exit, outboard section recovered and J-tube sealed.
> **Option 2** - Full removal, outboard section cut and recovered, remaining section removed via topside.

Xodus presented the assessment of the options against the five criteria.

The overall result of the CA is that Option 1 is the recommended decision. The Dunlin Rigid Risers will be left in situ within the J-tube, the riser will be cut at the J-tube exit by a DSV, the J-tube will be sealed and the outboard section recovered to shore.

3.3.2 – Trenched and Buried Cable

FEL described the scope and status of the Dunlin Power Import Cable. FEL explained that three options were assessed for the Cable Risers.

The options are:

Option 1 - Leave in situ, remove all cable transitions, rock placement over snag hazards and areas of low cover.
Option 2 - Leave in situ, remove all cable transitions and exposures, rock placement over snag hazards and areas of low cover.
Option 3 - Full removal, reverse reel

Xodus presented the assessment of the options against the five criteria.

The overall result of the CA is that Option 1 is the recommended decision.
The Dunlin Power import Cable should be left in situ, cable transitions removed and rock placed over snag hazards and areas of low burial depth followed by a sea-bed survey and trawl sweep.

4 Next Steps

FEL thanked meeting attendees for their participation in the CA Workshop and reviewing the extensive pre-read materials. The fishing impact QRA will be undertaken week commencing 16th January and FEL will re-engage with the stakeholders should the QRA change the CA recommendations. Decommissioning Programmes will be updated with the CA recommendations in preparation for Public Consultation.

5 Post-Meeting Notes

On reviewing the minutes the SFF made three observations:

The SFF would like to highlight that for a number of the CAs considered, the overall option recommended was not the SFF's preference.

The SFF noted that removing the evaluation criteria of Economics did not change the recommendation for any removal decision, however the SFF also note that for the six separate Comparative Assessments reviewed, the chosen decommissioning option was the least expensive option on each occasion.

The SFF has concerns re the statement made in Section 3.2.2. (Osprey Trenched and Rock Dumped Umbilicals), that 'BEIS Guidelines require pipelines to be trenched or buried to a depth of 0.6m below the sea-bed' and will be seeking clarification with BEIS on this matter – it is felt that leaving pipelines or umbilicals uncovered in an open trench would pose a significant safety risk to fishermen.

Appendix E Data Sheets (Exc. Costs)

Subsea Infrastructure Decommissioning Comparative Assessment Data Sheet

Area	Dunlin	
Decision/Group	Decision 1 Group 2 – Buried Structures and Deposits	
Option	1 – Leave in Situ – Minimal Intervention (Rock Placement)	
Description	Rock placement over snag hazards and areas of low existing rock cover by DPFPV	
Ref. Documents	FBL-DUN-DAOM-SSP-01-RPT-00001 FBL-DUN-DAOM-SSP-01-RPT-00003 A-301649-S01-TECH-008 A-301649-S01-TECH-010 A-301649-S01-TECH-012 A-301649-S01-REPT-003	Subsea Decommissioning Inventory Subsea Decommissioning Screening – Dunlin Dunlin – Long Term Materials Degradation Study Dunlin – Removal/Recovery Feasibility Study Dunlin – Risk Evaluation of Leaving Items in Situ Dunlin – Common Scope Report

ID No.	Description	Material	Qty	Total Weight (Te)	Cover
PL4334 (Over PL164 20" Gas Line)	X-ing Arch	Concrete	1	15.0	Rock covered to 1.0m
	Mattress (5 X 2 X 0.15)	Concrete	2	7.2	
	Grout Bags	Grout	200 est.	5.0	
	Sand Bags	Sand	80 est.	2.0	
PL2852 (Over PL013 16" Oil Import)	Mattress (6 X 3 X 0.3 / 6 X 3 X 0.15)	Concrete	12/6	99.6/40.5	Rock covered to 0.6m
PL2852 (Over PL115 16" Oil Import)	Mattress (6 X 3 X 0.3 / 6 X 3 X 0.15)	Concrete	12/6	99.6/40.5	Rock covered to 0.6m
PLU2853 (Over PL5 24" Oil Export)	Mattress (6 X 3 X 0.3)	Concrete	7	58.1	Rock covered to 0.3m

SAFETY				
Offshore Personnel	Number	41	Man Hours	2559
Topsides Personnel	Number	N/A	Man Hours	N/A
Divers Required	Number	N/A	Man Hours	N/A
Onshore Personnel	Number	14	Man Hours	813
Legacy Personnel	Number	35	Man Hours	18900
Impact to Other Users of the Sea (Operational)	Number of Vessels Used	1	Duration of Operations	5.2
Impact to Other Users of the Sea (Legacy)	Number of Vessels Used	1	Duration of Operations	45

Potential for High Consequence Event	Low	Comments	Routine operations

Operational Risk Diver	PLL	N/A
Operational Risk Offshore	PLL	1.92E-04
Operational Risk Topsides	PLL	N/A
Operational Risk Onshore	PLL	1.00E-04
Legacy Risk (out to 50yrs)	PLL	1.04E-03
Fishing Risk	PLL	N/A (No increase in risk over and above what currently exists for fishing)
Overall Risk	∑PLL	1.33E-03

ENVIRONMENTAL								
Marine Impact (Vessels Operational)	Type	DSV	Number	N/A	Duration	N/A	Activity	N/A
	Type	CSV	Number	N/A	Duration	N/A	Activity	N/A
	Type	DPFPV	Number	1	Duration	5.2	Activity	Rock Dump
	Type	ROVSV	Number	N/A	Duration	N/A	Activity	N/A
	Type	PSV	Number	N/A	Duration	N/A	Activity	N/A
	Type	Trawler	Number	N/A	Duration	N/A	Activity	N/A
Marine Impact (Vessels Legacy)	Type	DPFPV	Number	N/A	Duration	N/A	Activity	N/A
	Type	ROVSV	Number	1	Duration	45	Activity	Survey
Noise (Total = Ops + Legacy)	Sound Exposure Level		251 dB re 1mP			12.6 TPa^2s		
Energy Use (Total = Ops + Legacy)	Fuel	113.5 Te	CO_2	359.9 Te	NOx	6.7 Te	SO_2	1.4 Te
Life Cycle Emissions (Total = Ops + Legacy)	CO_2		488.66 Te		CO_2 (Credit)		N/A	

Marine Impact (Seabed)	Activity	Dredging	Area	N/A	Resources	N/A
	Activity	Rock Dump	Area	1800 m^2	Resources	3800 Te (Rock)
	Activity	Trenching	Area	N/A	Resources	N/A
	Activity	Backfilling	Area	N/A	Resources	N/A

Materials	Recovered	N/A
	Remaining	1 x concrete arch; 45 x concrete mattress; 200 x grout bags; 80 x sand bags 23992 Te Rock (20192 Te Existing + 3800 Te New)
	Persistence	>100 years (fully covered)

Residuals	LSA Scale	In-Situ	N/A	Returned	N/A
	Hydrocarbon	In-Situ	N/A	Returned	N/A
	Control Fluids	In-Situ	N/A	Returned	N/A

Technical				
Technical Considerations	Feasibility	High	Concept Maturity	High
	Availability of Technology	High – Off the shelf		
	Track Record	High – Extensive history		
	Risk of Failure	Low		
	Consequence of Failure	Additional rock profiling / limited schedule impacts		
	Emerging Technology	N/A		

Societal		
Societal Factors	Commercial Fisheries Impact	Low – PL2852 & PLU2853 are within close proximity to DA CGB. If safety zone remains then there will be no return of grounds. DPI Cable is currently available for fishing.
	Socio Economic	Low – No materials returned

Economic		
Economic Considerations	Comparative Cost Operational	XX M
	Comparative Cost Legacy - Monitoring	XX M
	Comparative Cost Legacy - Remedial	XX M

Economic Risk	Cost Risk	Low	Factors	High degree of achievability; Low likelihood of future remediation required due to existing burial depth and low fishing activity within the area. Potential future requirement to remove the items after live pipelines are decommissioned.

Subsea Infrastructure Decommissioning Comparative Assessment Data Sheet

Area	Dunlin	
Decision/Group	Decision 1 Group 2 – Buried Structures and Deposits	
Option	2 – Full Removal	
Description	Deburial of buried deposits using mass flow excavator deployed from CSV Recovery of exposed deposits using a DSV	
Ref. Documents	FBL-DUN-DAOM-SSP-01-RPT-00001 FBL-DUN-DAOM-SSP-01-RPT-00003 A-301649-S01-TECH-008 A-301649-S01-TECH-010 A-301649-S01-TECH-012 A-301649-S01-REPT-003	Subsea Decommissioning Inventory Subsea Decommissioning Screening – Dunlin Dunlin – Long Term Materials Degradation Study Dunlin – Removal/Recovery Feasibility Study Dunlin – Risk Evaluation of Leaving Items in Situ Dunlin – Common Scope Report

ID No.	Description	Material	Qty	Total Weight (Te)	Cover
PL4334 (Over PL164 20" Gas Line)	X-ing Arch	Concrete	1	15.0	Rock covered to 1.0m
	Mattress (5 X 2 X 0.15)	Concrete	2	7.2	
	Grout Bags	Grout	200 est.	5.0	
	Sand Bags	Sand	80 est.	2.0	
PL2852 (Over PL013 16" Oil Import)	Mattress (6 X 3 X 0.3 / 6 X 3 X 0.15)	Concrete	12/6	99.6/40.5	Rock covered to 0.6m
PL2852 (Over PL115 16" Oil Import)	Mattress (6 X 3 X 0.3 / 6 X 3 X 0.15)	Concrete	12/6	99.6/40.5	Rock covered to 0.6m
PLU2853 (Over PL5 24" Oil Export)	Mattress (6 X 3 X 0.3)	Concrete	7	58.1	Rock covered to 0.3m

SAFETY				
Offshore Personnel	Number	116	Man Hours	10118
Topsides Personnel	Number	N/A	Man Hours	N/A
Divers Required	Number	9	Man Hours	800
Onshore Personnel	Number	20	Man Hours	2327
Legacy Personnel	Number	N/A	Man Hours	N/A
Impact to Other Users of the Sea (Operational)	Number of Vessels Used	2	Duration of Operations	13.7
Impact to Other Users of the Sea (Legacy)	Number of Vessels Used	N/A	Duration of Operations	N/A

Potential for High Consequence Event	Medium	Comments	Routine operations; Requires work over live lines (20" Gas and 16" Oil)

Operational Risk Diver	PLL	7.76E-04
Operational Risk Offshore	PLL	7.59E-04
Operational Risk Topsides	PLL	N/A
Operational Risk Onshore	PLL	2.86E-04
Legacy Risk (out to 50yrs)	PLL	N/A
Fishing Risk	PLL	N/A (No increase in risk over and above what currently exists for fishing)
Overall Risk	∑PLL	1.82E-03

ENVIRONMENTAL								
Marine Impact (Vessels Operational)	Type	DSV	Number	1	Duration	8.2	Activity	Recovery
	Type	CSV	Number	1	Duration	5.5	Activity	Deburial
	Type	DPFPV	Number	N/A	Duration	N/A	Activity	N/A
	Type	ROVSV	Number	N/A	Duration	N/A	Activity	N/A
	Type	PSV	Number	N/A	Duration	N/A	Activity	N/A
	Type	Trawler	Number	N/A	Duration	N/A	Activity	N/A
Marine Impact (Vessels Legacy)	Type	DPFPV	Number	N/A	Duration	N/A	Activity	N/A
	Type	ROVSV	Number	N/A	Duration	N/A	Activity	N/A
Noise (Total = Ops + Legacy)	Sound Exposure Level		245 dB re 1mP			3.5 TPa^2s		
Energy Use (Total = Ops + Legacy)	Fuel	302.3 Te	CO_2	958.2 Te	NOx	17.8 Te	SO_2	3.6 Te
Life Cycle Emissions (Total = Ops + Legacy)	CO_2		958.66 Te		CO_2 (Credit)		N/A	

Marine Impact (Seabed)	Activity	Dredging	Area	876 m^2	Resources	N/A
	Activity	Rock Dump	Area	N/A	Resources	N/A
	Activity	Trenching	Area	N/A	Resources	N/A
	Activity	Backfilling	Area	N/A	Resources	N/A

Materials	Recovered	1 x concrete arch; 45 x concrete mattress; 200 x grout bags; 80 x sand bags
	Remaining	20192 Te Rock (Existing)
	Persistence	N/A

Residuals	LSA Scale	In-Situ	N/A	Returned	N/A
	Hydrocarbon	In-Situ	N/A	Returned	N/A
	Control Fluids	In-Situ	N/A	Returned	N/A

Technical				
Technical Considerations	Feasibility	High	Concept Maturity	High
	Availability of Technology	High – Off the shelf		
	Track Record	High – Large history of MFE for local deburial		
	Risk of Failure	Low		
	Consequence of Failure	Additional dredging / additional rock profiling / limited schedule impacts		
	Emerging Technology	N/A		

Societal		
Societal Factors	Commercial Fisheries Impact	Low – Area will be available for fishing
	Socio Economic	Low – Limited materials of low value returned to shore

Economic				
Economic Considerations	Comparative Cost Operational	XX M		
	Comparative Cost Legacy - Monitoring	XX M		
	Comparative Cost Legacy - Remedial	XX M		
Economic Risk	Cost Risk	Low	Factors	High degree of achievability; Maybe some degree of business interruption to 3rd party line operators;

Area	Dunlin	
Decision/Group	Decision 2 Group 3 – Rigid Riser	
Option	1 – Leave in Situ – Minor Intervention (Outboard Cut and Recovery)	
Description	Disconnect and recover drop down spool utilising DSV Riser cut at J-tube exit by DSV Seal J-tube and recover outboard section of line back to the DSV Disconnect and gap riser on topsides.	
Ref. Documents	FBL-DUN-DAOM-SSP-01-RPT-00001 FBL-DUN-DAOM-SSP-01-RPT-00003 A-301649-S01-TECH-008 A-301649-S01-TECH-010 A-301649-S01-TECH-011 A-301649-S01-TECH-012 A-301649-S01-REPT-003	Subsea Decommissioning Inventory Subsea Decommissioning Screening – Dunlin Dunlin – Long Term Materials Degradation Study Dunlin – Removal/Recovery Feasibility Study Dunlin – Effect of Leaving Riser Section within J-Tube Dunlin – Risk Evaluation of Leaving Items in Situ Dunlin – Common Scope Report

ID No.	Type	Material	Length (m)	Trenched		Buried		Rock Dumped	
				Length (m)	Depth (m)	Length (m)	Depth (m)	Length (m)	Height (m)
PL2852 4" Gas Riser	Rigid	Steel	198	0	0	0	0	0	0

SAFETY				
Offshore Personnel	Number	76	Man Hours	5290
Topsides Personnel	Number	6	Man Hours	72
Divers Required	Number	9	Man Hours	324
Onshore Personnel	Number	20	Man Hours	1188
Legacy Personnel	Number	N/A	Man Hours	N/A
Impact to Other Users of the Sea (Operational)	Number of Vessels Used	1	Duration of Operations	5.8
Impact to Other Users of the Sea (Legacy)	Number of Vessels Used	N/A	Duration of Operations	N/A

Potential for High Consequence Event	Low	Comments	Routine operations

Operational Risk Diver	PLL	3.14E-04
Operational Risk Offshore	PLL	3.97E-04
Operational Risk Topsides	PLL	2.95E-06
Operational Risk Onshore	PLL	1.46E-04
Legacy Risk (out to 50yrs)	PLL	N/A (in line with CGB)
Fishing Risk	PLL	N/A
Overall Risk	∑PLL	8.60E-04

ENVIRONMENTAL								
Marine Impact (Vessels Operational)	Type	DSV	Number	1	Duration	5.8	Activity	Destruct
	Type	CSV	Number	N/A	Duration	N/A	Activity	N/A
	Type	DPFPV	Number	N/A	Duration	N/A	Activity	N/A
	Type	ROVSV	Number	N/A	Duration	N/A	Activity	N/A
	Type	PSV	Number	N/A	Duration	N/A	Activity	N/A
	Type	Trawler	Number	N/A	Duration	N/A	Activity	N/A
Marine Impact (Vessels Legacy)	Type	DPFPV	Number	N/A	Duration	N/A	Activity	N/A
	Type	ROVSV	Number	N/A	Duration	N/A	Activity	N/A
Noise (Total = Ops + Legacy)	Sound Exposure Level		237 dB re 1mP		0.5 TPa^2s			
Energy Use (Total = Ops + Legacy)	Fuel	128.3 Te	CO_2	406.6 Te	NOx	7.6 Te	SO_2	1.5 Te
Life Cycle Emissions (Total = Ops + Legacy)	CO_2		414.48 Te		CO_2 (Credit)		N/A	

Marine Impact (Seabed)	Activity	Dredging	Area	N/A	Resources	N/A
	Activity	Rock Dump	Area	N/A	Resources	N/A
	Activity	Trenching	Area	N/A	Resources	N/A
	Activity	Backfilling	Area	N/A	Resources	N/A

Materials	Recovered	1 m (0.05Te)			
	Remaining	197 m within J-tube			
	Persistence	In-line with CGB & J-tubes >250 years			
Residuals	LSA Scale	In-Situ	N/A	Returned	N/A
	Hydrocarbon	In-Situ	N/A	Returned	N/A
	Control Fluids	In-Situ	N/A	Returned	N/A

Technical				
Technical Considerations	Feasibility	High	Concept Maturity	High
	Availability of Technology	High – Off the shelf		
	Track Record	High – Extensive history of similar work		
	Risk of Failure	Low		
	Consequence of Failure	Limited schedule impacts		
	Emerging Technology	Diverless cutting maybe an option		

Societal		
Societal Factors	Commercial Fisheries Impact	Low – Remaining material will be within the CGB
	Socio Economic	Low – Limited material returned to shore

Economic				
Economic Considerations	Comparative Cost Operational		XX M	
	Comparative Cost Legacy - Monitoring		XX M – (Monitoring is assumed to be done as part of any CGB monitoring)	
	Comparative Cost Legacy - Remedial		XX M	
Economic Risk	Cost Risk	Low	Factors	High degree of achievability.

Area	Dunlin	
Decision/Group	Decision 2 Group 3 – Rigid Riser	
Option	2 – Full Removal – Topsides Pull	
Description	Mobilise winch spread to platform, install and test Remove topside hang-off and transfer riser to winch Disconnect and recover drop down spool utilising DSV Remove J-tube seal by DSV Remove centralisers (part reverse pull as required) by DSV Riser cut at J-tube exit by DSV Seal J-tube and recover outboard section of riser back to the DSV Pull-in riser using the topside winch (pull, secure, cut, repeat) Backload riser sections and winch equipment	
Ref. Documents	FBL-DUN-DAOM-SSP-01-RPT-00001 FBL-DUN-DAOM-SSP-01-RPT-00003 A-301649-S01-TECH-008 A-301649-S01-TECH-009 A-301649-S01-TECH-010 A-301649-S01-TECH-011 A-301649-S01-TECH-012 A-301649-S01-REPT-003	Subsea Decommissioning Inventory Subsea Decommissioning Screening – Dunlin Dunlin – Long Term Materials Degradation Study Dunlin – Trench Backfilling Feasibility Study Dunlin – Removal/Recovery Feasibility Study Dunlin – Effect of Leaving Riser Section within J-Tube Dunlin – Risk Evaluation of Leaving Items in Situ Dunlin – Common Scope Report

ID No.	Type	Material	Length (m)	Trenched		Buried		Rock Dumped	
				Length (m)	Depth (m)	Length (m)	Depth (m)	Length (m)	Height (m)
PL2852 4” Gas Riser	Rigid	Steel	198	0	0	0	0	0	0

SAFETY				
Offshore Personnel	Number	126	Man Hours	11837
Topsides Personnel	Number	6	Man Hours	2895
Divers Required	Number	9	Man Hours	432
Onshore Personnel	Number	20	Man Hours	3647
Legacy Personnel	Number	N/A	Man Hours	N/A
Impact to Other Users of the Sea (Operational)	Number of Vessels Used	2	Duration of Operations	16.4
Impact to Other Users of the Sea (Legacy)	Number of Vessels Used	N/A	Duration of Operations	N/A

Potential for High Consequence Event	Medium	Comments	Non-routine operations but not unusual. Limited SIMOPS.

Operational Risk Diver	PLL	4.19E-04
Operational Risk Offshore	PLL	8.88E-04
Operational Risk Topsides	PLL	1.19E-04
Operational Risk Onshore	PLL	4.49E-04
Legacy Risk (out to 50yrs)	PLL	N/A
Fishing Risk	PLL	N/A
Overall Risk	∑PLL	1.87E-03

ENVIRONMENTAL								
Marine Impact (Vessels Operational)	Type	DSV	Number	1	Duration	6.4	Activity	Destruct
	Type	CSV	Number	N/A	Duration	N/A	Activity	N/A
	Type	DPFPV	Number	N/A	Duration	N/A	Activity	N/A
	Type	ROVSV	Number	N/A	Duration	N/A	Activity	N/A
	Type	PSV	Number	1	Duration	10.0	Activity	Supply
	Type	Trawler	Number	N/A	Duration	N/A	Activity	N/A
Marine Impact (Vessels Legacy)	Type	DPFPV	Number	N/A	Duration	N/A	Activity	N/A
	Type	ROVSV	Number	N/A	Duration	N/A	Activity	N/A
Noise (Total = Ops + Legacy)	Sound Exposure Level		244 dB re 1mP			2.7 TPa^2s		
Energy Use (Total = Ops + Legacy)	Fuel	241.0 Te	CO_2	764.0 Te	NOx	14.2 Te	SO_2	2.9 Te
Life Cycle Emissions (Total = Ops + Legacy)	CO_2		768.23 Te		CO_2 (Credit)		3.89 Te	

Marine Impact (Seabed)	Activity	Dredging	Area	N/A	Resources	N/A
	Activity	Rock Dump	Area	N/A	Resources	N/A
	Activity	Trenching	Area	N/A	Resources	N/A
	Activity	Backfilling	Area	N/A	Resources	N/A

Materials	Recovered	198 m (4.2 Te)
	Remaining	0 m
	Persistence	N/A

Residuals	LSA Scale	In-Situ	N/A	Returned	N/A
	Hydrocarbon	In-Situ	N/A	Returned	N/A
	Control Fluids	In-Situ	N/A	Returned	N/A

Technical				
Technical Considerations	Feasibility	High	Concept Maturity	Medium
	Availability of Technology	High – Off the shelf		
	Track Record	High – Extensive history in North Sea and recent history on Dunlin.		
	Risk of Failure	Low – Riser is a recent installation and J-tube was inspected in 2010 as part of the riser install.		
	Consequence of Failure	Riser would remain within J-tube / schedule over runs		
	Emerging Technology	N/A		

Societal		
Societal Factors	Commercial Fisheries Impact	Low – Area will potentially remain within a safety zone
	Socio Economic	Low – Limited material returned to shore

Economic		
Economic Considerations	Comparative Cost Operational	XX M
	Comparative Cost Legacy - Monitoring	XX M
	Comparative Cost Legacy - Remedial	XX M

Economic Risk	Cost Risk	Medium	Factors	Topside engineering for winch locating, pull-in loads and handling of cut sections is not mature; Previous pull-in operations have suffered delays and cost over runs.

Subsea Infrastructure Decommissioning Comparative Assessment Data Sheet

Area	Dunlin	
Decision/Group	Decision 3 Group 5 – Trenched and Buried Pipelines	
Option	1 – Leave in Situ – Minimal Intervention (Rock Placement)	
Description	Pipeline end transitions removed by DSV Rock placement over snag hazards and areas of low burial depth by DPFPV Survey by ROVSV Trawl sweep using trawler	
Ref. Documents	FBL-DUN-DAOM-SSP-01-RPT-00001 FBL-DUN-DAOM-SSP-01-RPT-00003 A-301649-S01-TECH-008 A-301649-S01-TECH-009 A-301649-S01-TECH-010 A-301649-S01-TECH-011 A-301649-S01-TECH-012 A-301649-S01-REPT-003	Subsea Decommissioning Inventory Subsea Decommissioning Screening – Dunlin Dunlin – Long Term Materials Degradation Study Dunlin – Trench Backfilling Feasibility Study Dunlin – Removal/Recovery Feasibility Study Dunlin – Effect of Leaving Riser Section within J-Tube Dunlin – Risk Evaluation of Leaving Items in Situ Dunlin – Common Scope Report

ID No.	Type	Material	Length (m)	Trenched		Buried		Rock Dumped	
				Length (m)	Depth (m)	Length (m)	Depth (m)	Length (m)	Height (m)
PL2852 4" Gas	Rigid	Steel	10272	9795	1.0	9733	1.0	153 (Thistle) 393 (Dunlin)	0.6

SAFETY				
Offshore Personnel	Number	157	Man Hours	12162
Topsides Personnel	Number	N/A	Man Hours	N/A
Divers Required	Number	9	Man Hours	476
Onshore Personnel	Number	20	Man Hours	3020
Legacy Personnel	Number	35	Man Hours	23520
Impact to Other Users of the Sea (Operational)	Number of Vessels Used	4	Duration of Operations	23.1
Impact to Other Users of the Sea (Legacy)	Number of Vessels Used	1	Duration of Operations	55.9

Potential for High Consequence Event	Low	Comments	Routine operations

Operational Risk Diver	PLL	4.62E-04
Operational Risk Offshore	PLL	9.12E-04
Operational Risk Topsides	PLL	N/A
Operational Risk Onshore	PLL	3.71E-04
Legacy Risk (out to 50yrs)	PLL	1.29E-03
Fishing Risk	PLL	N/A (No increase in risk over and above what currently exists for fishing)
Overall Risk	∑PLL	3.04E-03

ENVIRONMENTAL								
Marine Impact (Vessels Operational)	Type	DSV	Number	1	Duration	8.0	Activity	Destruct
	Type	CSV	Number	N/A	Duration	N/A	Activity	N/A
	Type	DPFPV	Number	1	Duration	4.5	Activity	Rock Dump
	Type	ROVSV	Number	1	Duration	5.6	Activity	Survey
	Type	PSV	Number	N/A	Duration	N/A	Activity	N/A
	Type	Trawler	Number	1	Duration	5.0	Activity	Trawl Sweep
Marine Impact (Vessels Legacy)	Type	DPFPV	Number	N/A	Duration	N/A	Activity	N/A
	Type	ROVSV	Number	1	Duration	55.9	Activity	Survey
Noise (Total = Ops + Legacy)	Sound Exposure Level		252 dB re 1mP		17.2 TPa^2s			
Energy Use (Total = Ops + Legacy)	Fuel	892.5 Te	CO_2	2829.2 Te	NOx	52.7 Te	SO_2	10.7 Te
Life Cycle Emissions (Total = Ops + Legacy)	CO_2		3256.69 Te		CO_2 (Credit)		N/A	

Marine Impact (Seabed)	Activity	Dredging	Area	40 m^2	Resources	N/A
	Activity	Rock Dump	Area	206 m^2	Resources	200 Te (Rock)
	Activity	Trenching	Area	N/A	Resources	N/A
	Activity	Backfilling	Area	N/A	Resources	N/A

Materials	Recovered	30 m (0.65 Te)			
	Remaining	10242 m 6063 Te Rock (5863 Te Existing + 200 Te New)			
	Persistence	PL2852 >250 years where fully covered			
Residuals	LSA Scale	In-Situ	N/A	Returned	N/A
	Hydrocarbon	In-Situ	N/A	Returned	N/A
	Control Fluids	In-Situ	N/A	Returned	N/A

Technical				
Technical Considerations	Feasibility	High	Concept Maturity	High
	Availability of Technology	High – Off the shelf		
	Track Record	High – Extensive history		
	Risk of Failure	Low		
	Consequence of Failure	Alternate cutting technique / additional rock / limited schedule impacts		
	Emerging Technology	Diverless cutting maybe an option		

Societal		
Societal Factors	Commercial Fisheries Impact	Low – No change as area is currently available for fishing
	Socio Economic	Low – Limited material returned to shore

Economic				
Economic Considerations	Comparative Cost Operational	XX M		
	Comparative Cost Legacy - Monitoring	XX M		
	Comparative Cost Legacy - Remedial	XX M		
Economic Risk	Cost Risk	Low	Factors	High degree of achievability; Low likelihood of future remediation required due to existing burial depth.

Subsea Infrastructure Decommissioning Comparative Assessment Data Sheet

Area	Dunlin	
Decision/Group	Decision 3 Group 5 – Trenched and Buried Pipelines	
Option	2 – Full Removal – (Reverse Reel) [Originally listed as Option 3 however; after review Option 1 & 2 were found to be identical and as such the original Option 2 was removed and Option 3 was re-numbered]	
Description	Pipeline deburial using MFE deployed from CSV Pipeline disconnect and recovery head installation by DSV Recover pipeline and reverse reel by DSV with reel spread Survey by ROVSV	
Ref. Documents	FBL-DUN-DAOM-SSP-01-RPT-00001 FBL-DUN-DAOM-SSP-01-RPT-00003 A-301649-S01-TECH-008 A-301649-S01-TECH-009 A-301649-S01-TECH-010 A-301649-S01-TECH-011 A-301649-S01-TECH-012 A-301649-S01-REPT-003	Subsea Decommissioning Inventory Subsea Decommissioning Screening – Dunlin Dunlin – Long Term Materials Degradation Study Dunlin – Trench Backfilling Feasibility Study Dunlin – Removal/Recovery Feasibility Study Dunlin – Effect of Leaving Riser Section within J-Tube Dunlin – Risk Evaluation of Leaving Items in Situ Dunlin – Common Scope Report

ID No.	Type	Material	Length (m)	Trenched		Buried		Rock Dumped	
				Length (m)	Depth (m)	Length (m)	Depth (m)	Length (m)	Height (m)
PL2852 4" Gas	Rigid	Steel	10272	9795	1.0	9733	1.0	153 (Thistle) 393 (Dunlin)	0.6

SAFETY				
Offshore Personnel	Number	151	Man Hours	16916
Topsides Personnel	Number	N/A	Man Hours	N/A
Divers Required	Number	9	Man Hours	346
Onshore Personnel	Number	20	Man Hours	4940
Legacy Personnel	Number	N/A	Man Hours	N/A
Impact to Other Users of the Sea (Operational)	Number of Vessels Used	3	Duration of Operations	26.4
Impact to Other Users of the Sea (Legacy)	Number of Vessels Used	N/A	Duration of Operations	N/A

Potential for High Consequence Event	Medium	Comments	Non Routine Operation; Integrity assumed by engineering only.

Operational Risk Diver	PLL	3.36E-04
Operational Risk Offshore	PLL	1.27E-03
Operational Risk Topsides	PLL	N/A
Operational Risk Onshore	PLL	6.08E-04
Legacy Risk (out to 50yrs)	PLL	N/A
Fishing Risk	PLL	N/A (No increase in risk over and above what currently exists for fishing)
Overall Risk	∑PLL	2.21E-03

ENVIRONMENTAL								
Marine Impact (Vessels Operational)	Type	DSV	Number	1	Duration	10.6	Activity	Reverse Reel
	Type	CSV	Number	1	Duration	10.2	Activity	Deburial
	Type	DPFPV	Number	N/A	Duration	N/A	Activity	N/A
	Type	ROVSV	Number	1	Duration	5.6	Activity	Survey
	Type	PSV	Number	N/A	Duration	N/A	Activity	N/A
	Type	Trawler	Number	N/A	Duration	N/A	Activity	N/A
Marine Impact (Vessels Legacy)	Type	DPFPV	Number	N/A	Duration	N/A	Activity	N/A
	Type	ROVSV	Number	N/A	Duration	N/A	Activity	N/A
Noise (Total = Ops + Legacy)	Sound Exposure Level		249 dB re 1mP		7.4 TPa^2s			
Energy Use (Total = Ops + Legacy)	Fuel	513.3 Te	CO_2	1627.1 Te	NOx	30.3 Te	SO_2	6.2 Te
Life Cycle Emissions (Total = Ops + Legacy)	CO_2 Equivalent		1851.28 Te		CO_2 (Credit)		205.75 Te	

Marine Impact (Seabed)	Activity	Dredging	Area	48995 m^2	Resources	N/A
	Activity	Rock Dump	Area	N/A	Resources	N/A
	Activity	Trenching	Area	N/A	Resources	N/A
	Activity	Backfilling	Area	N/A	Resources	N/A

Materials	Recovered	10272 m (222.6 Te)			
	Remaining	0 m 5863 Te Rock (Existing)			
	Persistence	N/A			
Residuals	LSA Scale	In-Situ	N/A	Returned	N/A
	Hydrocarbon	In-Situ	N/A	Returned	N/A
	Control Fluids	In-Situ	N/A	Returned	N/A

Technical				
Technical Considerations	Feasibility	Medium	Concept Maturity	Low
	Availability of Technology	Medium – Limited number of existing techniques suitable for deburial		
	Track Record	Low – Limited experience of exposing pipelines over extended distances to enable re-reeling		
	Risk of Failure	High		
	Consequence of Failure	Alternate deburial techniques required / Alternate recovery techniques required/ rock required to remedy over trenched areas / large schedule overruns with limited ability to recover.		
	Emerging Technology	N/A		

Societal		
Societal Factors	Commercial Fisheries Impact	Low – No change as area is currently available for fishing
	Socio Economic	Low – Material returned to shore will generate a small amount of recycling work.

Economic				
Economic Considerations	Comparative Cost Operational	XX M		
	Comparative Cost Legacy - Monitoring	XX M		
	Comparative Cost Legacy - Remedial	XX M		
Economic Risk	Cost Risk	High	Factors	Medium degree of achievability; High likelihood of failure to expose the line fully without multiple deburial techniques and passes; High likelihood of over trenching in sandy areas leading to areas of disturbance that are larger than required.

Subsea Infrastructure Decommissioning Comparative Assessment Data Sheet

Area	Dunlin	
Decision/Group	Decision 4 Group 6 – Rock Dumped Surface Laid Rigid Spools	
Option	1 – Leave in Situ – Minimal Intervention (Rock Placement)	
Description	Pipeline end transitions removed by DSV Rock placement over snag hazards and areas of low burial depth by DPFPV	
Ref. Documents	FBL-DUN-DAOM-SSP-01-RPT-00001 FBL-DUN-DAOM-SSP-01-RPT-00003 A-301649-S01-TECH-008 A-301649-S01-TECH-010 A-301649-S01-REPT-003	Subsea Decommissioning Inventory Subsea Decommissioning Screening – Dunlin Dunlin – Long Term Materials Degradation Study Dunlin – Removal/Recovery Feasibility Study Dunlin – Common Scope Report

ID No.	Type	Material	Length (m)	Trenched		Buried		Rock Dumped	
				Length (m)	Depth (m)	Length (m)	Depth (m)	Length (m)	Height (m)
PL2852 4" Gas	Rigid	Steel	127	0	0	0	0	92	0.6

SAFETY				
Offshore Personnel	Number	152	Man Hours	9930
Topsides Personnel	Number	N/A	Man Hours	N/A
Divers Required	Number	9	Man Hours	497
Onshore Personnel	Number	20	Man Hours	2028
Legacy Personnel	Number	35	Man Hours	17220
Impact to Other Users of the Sea (Operational)	Number of Vessels Used	3	Duration of Operations	15.1
Impact to Other Users of the Sea (Legacy)	Number of Vessels Used	1	Duration of Operations	40.4

Potential for High Consequence Event	Low	Comments	Routine operations

Operational Risk Diver	PLL	4.82E-04
Operational Risk Offshore	PLL	7.45E-04
Operational Risk Topsides	PLL	N/A
Operational Risk Onshore	PLL	2.49E-04
Legacy Risk (out to 50yrs)	PLL	9.47E-04
Fishing Risk	PLL	N/A
Overall Risk	∑PLL	2.42E-03

ENVIRONMENTAL								
Marine Impact (Vessels Operational)	Type	DSV	Number	1	Duration	6.6	Activity	Destruct
	Type	CSV	Number	N/A	Duration	N/A	Activity	N/A
	Type	DPFPV	Number	1	Duration	4.5	Activity	Rock Dump
	Type	ROVSV	Number	1	Duration	4.0	Activity	Survey
	Type	PSV	Number	N/A	Duration	N/A	Activity	N/A
	Type	Trawler	Number	N/A	Duration	N/A	Activity	N/A
Marine Impact (Vessels Legacy)	Type	DPFPV	Number	N/A	Duration	N/A	Activity	N/A
	Type	ROVSV	Number	1	Duration	40.4	Activity	Survey
Noise (Total = Ops + Legacy)	Sound Exposure Level		251 dB re 1mP			13.4 TPa^2s		
Energy Use (Total = Ops + Legacy)	Fuel	688.4 Te	CO_2	2182.3 Te	NOx	40.6 Te	SO_2	8.3 Te
Life Cycle Emissions (Total = Ops + Legacy)	CO_2		2191.42 Te		CO_2 (Credit)		N/A	

Marine Impact (Seabed)	Activity	Dredging	Area	40 m^2	Resources	N/A
	Activity	Rock Dump	Area	100 m^2	Resources	100 Te (Rock)
	Activity	Trenching	Area	N/A	Resources	N/A
	Activity	Backfilling	Area	N/A	Resources	N/A

Materials	Recovered	35 m (0.6 Te)			
	Remaining	92 m 980 Te Rock (880 Te Existing + 100 Te New)			
	Persistence	PL2852 >250 years where fully covered			
Residuals	LSA Scale	In-Situ	N/A	Returned	N/A
	Hydrocarbon	In-Situ	N/A	Returned	N/A
	Control Fluids	In-Situ	N/A	Returned	N/A

Technical				
Technical Considerations	Feasibility	High	Concept Maturity	High
	Availability of Technology	High – Off the shelf		
	Track Record	High – Extensive history		
	Risk of Failure	Low		
	Consequence of Failure	Alternate cutting technique / additional rock / limited schedule impacts		
	Emerging Technology	N/A		

Societal		
Societal Factors	Commercial Fisheries Impact	Low – Area will potentially remain within the safety zone of the CGB
	Socio Economic	Low – Limited material returned to shore

Economic				
Economic Considerations	Comparative Cost Operational	XX M		
	Comparative Cost Legacy - Monitoring	XX M		
	Comparative Cost Legacy - Remedial	XX M		
Economic Risk	Cost Risk	Low	Factors	High degree of achievability; Low likelihood of future remediation required due to existing burial depth and proximity to CGB.

Subsea Infrastructure Decommissioning Comparative Assessment Data Sheet

Area	Dunlin	
Decision/Group	Decision 4 Group 6 – Rock Dumped Surface Laid Rigid Spools	
Option	2– Full Removal – (Disconnect and Recover)	
Description	Deburial of spools using a mass flow excavator deployed from a DSV Disconnection of spools by DSV Recovery of spools back to DSV Survey by DSV	
Ref. Documents	FBL-DUN-DAOM-SSP-01-RPT-00001 FBL-DUN-DAOM-SSP-01-RPT-00003 A-301649-S01-TECH-008 A-301649-S01-TECH-010 A-301649-S01-REPT-003	Subsea Decommissioning Inventory Subsea Decommissioning Screening – Dunlin Dunlin – Long Term Materials Degradation Study Dunlin – Removal/Recovery Feasibility Study Dunlin – Common Scope Report

ID No.	Type	Material	Length (m)	Trenched		Buried		Rock Dumped	
				Length (m)	Depth (m)	Length (m)	Depth (m)	Length (m)	Height (m)
PL2852 4" Gas	Rigid	Steel	127	0	0	0	0	92	0.6

SAFETY				
Offshore Personnel	Number	76	Man Hours	6840
Topsides Personnel	Number	N/A	Man Hours	N/A
Divers Required	Number	9	Man Hours	648
Onshore Personnel	Number	20	Man Hours	1311
Legacy Personnel	Number	N/A	Man Hours	N/A

Impact to Other Users of the Sea	Number of Vessels Used	1	Duration of Operations	7.5
Impact to Other Users of the Sea (Legacy)	Number of Vessels Used	N/A	Duration of Operations	N/A

Potential for High Consequence Event	Low	Comments	Routine operations

Operational Risk Diver	PLL	6.29E-04
Operational Risk Offshore	PLL	5.13E-04
Operational Risk Topsides	PLL	N/A
Operational Risk Onshore	PLL	1.61E-04
Legacy Risk (out to 50yrs)	PLL	N/A
Fishing Risk	PLL	N/A
Overall Risk	∑PLL	1.30E-03

ENVIRONMENTAL								
Marine Impact (Vessels Operational)	Type	DSV	Number	1	Duration	7.5	Activity	Destruct
	Type	CSV	Number	N/A	Duration	N/A	Activity	N/A
	Type	DPFPV	Number	N/A	Duration	N/A	Activity	N/A
	Type	ROVSV	Number	N/A	Duration	N/A	Activity	N/A
	Type	PSV	Number	N/A	Duration	N/A	Activity	N/A
	Type	Trawler	Number	N/A	Duration	N/A	Activity	N/A
Marine Impact (Vessels Legacy)	Type	DPFPV	Number	N/A	Duration	N/A	Activity	N/A
	Type	ROVSV	Number	N/A	Duration	N/A	Activity	N/A

Noise (Total = Ops + Legacy)	Sound Exposure Level	236 dB re 1mP	0.4 TPa^2s	

Energy Use (Total = Ops + Legacy)	Fuel	165.7 Te	CO_2	525.1 Te	NOx	9.8 Te	SO_2	2.0 Te
Life Cycle Emissions (Total = Ops + Legacy)	CO_2		528.66 Te		CO_2 (Credit)		2.35 Te	

Marine Impact (Seabed)	Activity	Dredging	Area	920 m^2	Resources	N/A
	Activity	Rock Dump	Area	N/A	Resources	N/A
	Activity	Trenching	Area	N/A	Resources	N/A
	Activity	Backfilling	Area	N/A	Resources	N/A

Materials	Recovered	127 m (4 Te)
	Remaining	880 Te Rock (Existing)
	Persistence	N/A

Residuals	LSA Scale	In-Situ	N/A	Returned	N/A
	Hydrocarbon	In-Situ	N/A	Returned	N/A
	Control Fluids	In-Situ	N/A	Returned	N/A

Technical				
Technical Considerations	Feasibility	High	Concept Maturity	High
	Availability of Technology	High – Off the shelf		
	Track Record	High – Extensive history		
	Risk of Failure	Low		
	Consequence of Failure	Alternate deburial technique / limited schedule impacts		
	Emerging Technology	N/A		

Societal		
Societal Factors	Commercial Fisheries Impact	Low – Area will potentially remain within the safety zone of the CGB
	Socio Economic	Low – Limited material returned to shore

Economic				
Economic Considerations	Comparative Cost Operational		XX M	
	Comparative Cost Legacy - Monitoring		XX M	
	Comparative Cost Legacy - Remedial		XX M	
Economic Risk	Cost Risk	Low	Factors	High degree of achievability; Future liability removed.

Area	Dunlin	
Decision/Group	Decision 5 Group 7 – Rock Dumped Surface Laid Umbilicals	
Option	1 – Leave in Situ – Minimal Intervention (Rock Placement)	
Description	Pipeline end transitions removed by DSV Rock placement over snag hazards and areas of low burial depth by DPFPV Trawl sweep by trawler	
Ref. Documents	FBL-DUN-DAOM-SSP-01-RPT-00001 FBL-DUN-DAOM-SSP-01-RPT-00003 A-301649-S01-TECH-008 A-301649-S01-TECH-010 A-301649-S01-REPT-003	Subsea Decommissioning Inventory Subsea Decommissioning Screening – Dunlin Dunlin – Long Term Materials Degradation Study Dunlin – Removal/Recovery Feasibility Study Dunlin – Common Scope Report

ID No.	Type	Material	Length (m)	Trenched		Buried		Rock Dumped	
				Length (m)	Depth (m)	Length (m)	Depth (m)	Length (m)	Height (m)
PLU2853 2.5" Umb.	Umbilical	Polymer / Steel / Copper	580	0	0	0	0	550	0.3

SAFETY				
Offshore Personnel	Number	157	Man Hours	9831
Topsides Personnel	Number	N/A	Man Hours	N/A
Divers Required	Number	9	Man Hours	497
Onshore Personnel	Number	20	Man Hours	2299
Legacy Personnel	Number	35	Man Hours	17220
Impact to Other Users of the Sea (Operational)	Number of Vessels Used	4	Duration of Operations	18.8
Impact to Other Users of the Sea (Legacy)	Number of Vessels Used	1	Duration of Operations	40.9

Potential for High Consequence Event	Low	Comments	Routine operations

Operational Risk Diver	PLL	4.82E-04
Operational Risk Offshore	PLL	7.37E-04
Operational Risk Topsides	PLL	N/A
Operational Risk Onshore	PLL	2.83E-04
Legacy Risk (out to 50yrs)	PLL	9.47E-04
Fishing Risk	PLL	N/A
Overall Risk	∑PLL	2.45E-03

ENVIRONMENTAL								
Marine Impact (Vessels Operational)	Type	DSV	Number	1	Duration	6.2	Activity	Destruct
	Type	CSV	Number	N/A	Duration	N/A	Activity	N/A
	Type	DPFPV	Number	1	Duration	4.5	Activity	Rock Dump
	Type	ROVSV	Number	1	Duration	4.1	Activity	Survey
	Type	PSV	Number	N/A	Duration	N/A	Activity	N/A
	Type	Trawler	Number	1	Duration	4	Activity	Trawl Sweep
Marine Impact (Vessels Legacy)	Type	DPFPV	Number	N/A	Duration	N/A	Activity	N/A
	Type	ROVSV	Number	1	Duration	40.9	Activity	Survey
Noise (Total = Ops + Legacy)	Sound Exposure Level		251 dB re 1mP		13.6 TPa^2s			
Energy Use (Total = Ops + Legacy)	Fuel	688.9 Te	CO_2	2183.7 Te	NOx	40.6 Te	SO_2	8.3 Te
Life Cycle Emissions (Total = Ops + Legacy)	CO_2		2198.22 Te		CO_2 (Credit)		N/A	

Marine Impact (Seabed)	Activity	Dredging	Area	20 m^2	Resources	N/A
	Activity	Rock Dump	Area	200 m^2	Resources	200 Te (Rock)
	Activity	Trenching	Area	N/A	Resources	N/A
	Activity	Backfilling	Area	N/A	Resources	N/A

Materials	Recovered	30 m Umbilical (polymer/steel/copper) (0.2 Te)			
	Remaining	550 m Umbilical (polymer/steel/copper) 2917 Te Rock (2717 Te Existing + 200 Te New)			
	Persistence	>100 years (no long term data/experience of polymers in seawater/buried)			
Residuals	LSA Scale	In-Situ	N/A	Returned	N/A
	Hydrocarbon	In-Situ	N/A	Returned	N/A
	Control Fluids	In-Situ	N/A	Returned	N/A

Technical				
Technical Considerations	Feasibility	High	Concept Maturity	High
	Availability of Technology	High – Off the shelf		
	Track Record	High – Extensive history		
	Risk of Failure	Low		
	Consequence of Failure	Additional rock requirement / limited schedule impacts		
	Emerging Technology	N/A		

Societal		
Societal Factors	Commercial Fisheries Impact	Low – Area will potentially remain within the safety zone of the CGB
	Socio Economic	Low – Limited material returned to shore

Economic				
Economic Considerations	Comparative Cost Operational	XX M		
	Comparative Cost Legacy - Monitoring	XX M		
	Comparative Cost Legacy - Remedial	XX M		
Economic Risk	Cost Risk	Low	Factors	High degree of achievability; Low likelihood of future remediation required due to proximity to CGB.

Area	Dunlin	
Decision/Group	Decision 5 Group 7 – Rock Dumped Surface Laid Umbilicals	
Option	2 – Leave in Situ – Major Intervention (Full Rock Placement)	
Description	Pipeline end transitions removed by DSV Rock placement over snag hazards and areas of low burial depth by DPFPV to 0.6m above ToP Survey by ROVSV Trawl sweep by trawler	
Ref. Documents	FBL-DUN-DAOM-SSP-01-RPT-00001 FBL-DUN-DAOM-SSP-01-RPT-00003 A-301649-S01-TECH-008 A-301649-S01-TECH-010 A-301649-S01-REPT-003	Subsea Decommissioning Inventory Subsea Decommissioning Screening – Dunlin Dunlin – Long Term Materials Degradation Study Dunlin – Removal/Recovery Feasibility Study Dunlin – Common Scope Report

ID No.	Type	Material	Length (m)	Trenched		Buried		Rock Dumped	
				Length (m)	Depth (m)	Length (m)	Depth (m)	Length (m)	Height (m)
PLU2853 2.5" Umb.	Umbilical	Polymer / Steel / Copper	580	0	0	0	0	550	0.3

SAFETY				
Offshore Personnel	Number	157	Man Hours	9831
Topsides Personnel	Number	N/A	Man Hours	N/A
Divers Required	Number	9	Man Hours	411
Onshore Personnel	Number	20	Man Hours	2299
Legacy Personnel	Number	35	Man Hours	17220
Impact to Other Users of the Sea (Operational)	Number of Vessels Used	4	Duration of Operations	18.8
Impact to Other Users of the Sea (Legacy)	Number of Vessels Used	1	Duration of Operations	40.9

Potential for High Consequence Event	Low	Comments	Routine operations

Operational Risk Diver	PLL	3.99E-04
Operational Risk Offshore	PLL	7.37E-04
Operational Risk Topsides	PLL	N/A
Operational Risk Onshore	PLL	2.83E-04
Legacy Risk (out to 50yrs)	PLL	9.47E-04
Fishing Risk	PLL	N/A
Overall Risk	∑PLL	2.37E-03

ENVIRONMENTAL								
Marine Impact (Vessels Operational)	Type	DSV	Number	1	Duration	6.2	Activity	Destruct
	Type	CSV	Number	N/A	Duration	N/A	Activity	N/A
	Type	DPFPV	Number	1	Duration	4.5	Activity	Rock Dump
	Type	ROVSV	Number	1	Duration	4.1	Activity	Survey
	Type	PSV	Number	N/A	Duration	N/A	Activity	N/A
	Type	Trawler	Number	1	Duration	4	Activity	Trawl Sweep
Marine Impact (Vessels Legacy)	Type	DPFPV	Number	N/A	Duration	N/A	Activity	N/A
	Type	ROVSV	Number	1	Duration	40.9	Activity	Survey
Noise (Total = Ops + Legacy)	Sound Exposure Level		251 dB re 1mP			13.6 TPa^2s		
Energy Use (Total = Ops + Legacy)	Fuel	689.5 Te	CO_2	2185.7 Te	NOx	40.7 Te	SO_2	8.3 Te
Life Cycle Emissions (Total = Ops + Legacy)	CO_2		2224.02 Te		CO_2 (Credit)		N/A	

Marine Impact (Seabed)	Activity	Dredging	Area	20 m^2	Resources	N/A
	Activity	Rock Dump	Area	1800 m^2	Resources	900 Te (Rock)
	Activity	Trenching	Area	N/A	Resources	N/A
	Activity	Backfilling	Area	N/A	Resources	N/A

Materials	Recovered	30 m Umbilical (polymer/steel/copper) (0.2Te)			
	Remaining	550 m Umbilical (polymer/steel/copper) 3617 Te Rock (2717 Te Existing + 900 Te New)			
	Persistence	>100 years (no long term data/experience of polymers in seawater/buried)			
Residuals	LSA Scale	In-Situ	N/A	Returned	N/A
	Hydrocarbon	In-Situ	N/A	Returned	N/A
	Control Fluids	In-Situ	N/A	Returned	N/A

Technical				
Technical Considerations	Feasibility	High	Concept Maturity	High
	Availability of Technology	High – Off the shelf		
	Track Record	High – Extensive history		
	Risk of Failure	Low		
	Consequence of Failure	Additional rock requirement / limited schedule impacts		
	Emerging Technology	N/A		

Societal		
Societal Factors	Commercial Fisheries Impact	Low – Area will potentially remain within the safety zone of the CGB
	Socio Economic	Low – Limited material returned to shore

Economic				
Economic Considerations	Comparative Cost Operational	XX M		
	Comparative Cost Legacy - Monitoring	XX M		
	Comparative Cost Legacy - Remedial	XX M		
Economic Risk	Cost Risk	Low	Factors	High degree of achievability; Low likelihood of future remediation required due to proximity to CGB.

Subsea Infrastructure Decommissioning Comparative Assessment Data Sheet

Area	Dunlin	
Decision/Group	Decision 5 Group 7 – Rock Dumped Surface Laid Umbilicals	
Option	3 – Full Removal – (Reverse Reel)	
Description	Umbilical disconnect and recovery head installation by DSV Recover umbilical and reverse reel by DSV with reel spread Survey by DSV	
Ref. Documents	FBL-DUN-DAOM-SSP-01-RPT-00001 FBL-DUN-DAOM-SSP-01-RPT-00003 A-301649-S01-TECH-010 A-301649-S01-REPT-003	Subsea Decommissioning Inventory Subsea Decommissioning Screening – Dunlin Dunlin – Removal/Recovery Feasibility Study Dunlin – Common Scope Report

ID No.	Type	Material	Length (m)	Trenched		Buried		Rock Dumped	
				Length (m)	Depth (m)	Length (m)	Depth (m)	Length (m)	Height (m)
PLU2853 2.5" Umb.	Umbilical	Polymer / Steel / Copper	580	0	0	0	0	550	0.3

SAFETY				
Offshore Personnel	Number	76	Man Hours	6111
Topsides Personnel	Number	N/A	Man Hours	N/A
Divers Required	Number	9	Man Hours	281
Onshore Personnel	Number	20	Man Hours	2253
Legacy Personnel	Number	N/A	Man Hours	N/A
Impact to Other Users of the Sea (Operations)	Number of Vessels Used	1	Duration of Operations	6.7
Impact to Other Users of the Sea (Legacy)	Number of Vessels Used	N/A	Duration of Operations	N/A

Potential for High Consequence Event	Medium	Comments	Non Routine Operation; Integrity assumed by engineering only.

Operational Risk Diver	PLL	2.73E-04
Operational Risk Offshore	PLL	4.58E-04
Operational Risk Topsides	PLL	N/A
Operational Risk Onshore	PLL	2.77E-04
Legacy Risk (out to 50yrs)	PLL	N/A
Fishing Risk	PLL	N/A
Overall Risk	∑PLL	1.01E-03

ENVIRONMENTAL								
Marine Impact (Vessels Operational)	Type	DSV	Number	1	Duration	6.7	Activity	Reverse Reel
	Type	CSV	Number	N/A	Duration	N/A	Activity	N/A
	Type	DPFPV	Number	N/A	Duration	N/A	Activity	N/A
	Type	ROVSV	Number	N/A	Duration	N/A	Activity	N/A
	Type	PSV	Number	N/A	Duration	N/A	Activity	N/A
	Type	Trawler	Number	N/A	Duration	N/A	Activity	N/A
Marine Impact (Vessels Legacy)	Type	DPFPV	Number	N/A	Duration	N/A	Activity	N/A
	Type	ROVSV	Number	N/A	Duration	N/A	Activity	N/A

Noise (Total = Ops + Legacy)	Sound Exposure Level	236 dB re 1mP	0.4 TPa^2s	

Energy Use (Total = Ops + Legacy)	Fuel	147.4 Te	CO_2	467.3 Te	NOx	8.7 Te	SO_2	1.8 Te
Life Cycle Emissions (Total = Ops + Legacy)	CO_2		471.18 Te		CO_2 (Credit)		3.37 Te	

Marine Impact (Seabed)	Activity	Dredging	Area	N/A	Resources	N/A
	Activity	Rock Dump	Area	N/A	Resources	N/A
	Activity	Trenching	Area	N/A	Resources	N/A
	Activity	Backfilling	Area	N/A	Resources	N/A

Materials	Recovered	580 m Umbilical (polymer/steel/copper) (4.6 Te)
	Remaining	0 m 2717 Te Rock (Existing)
	Persistence	N/A

Residuals	LSA Scale	In-Situ	N/A	Returned	N/A
	Hydrocarbon	In-Situ	N/A	Returned	N/A
	Control Fluids	In-Situ	N/A	Returned	N/A

Technical				
Technical Considerations	Feasibility	High	Concept Maturity	High
	Availability of Technology	High – Off the shelf		
	Track Record	Low – Limited experience of reverse reeling buried umbilicals		
	Risk of Failure	Low – Initial engineering shows low utilisation values during recovery		
	Consequence of Failure	Alternate recovery techniques required/ Deburial may be required/ Limited schedule impacts.		
	Emerging Technology	N/A		

Societal		
Societal Factors	Commercial Fisheries Impact	Low – Area will potentially remain within the CGB exclusion zone
	Socio Economic	Low – Material returned to shore will generate a small amount of recycling work.

Economic				
Economic Considerations	Comparative Cost Operational		XX M	
	Comparative Cost Legacy - Monitoring		XX M	
	Comparative Cost Legacy - Remedial		XX M	
Economic Risk	Cost Risk	Low	Factors	Whilst initial engineering indicates a high degree of achievability, deburial operations maybe required that could increase schedule and cost.

Subsea Infrastructure Decommissioning Comparative Assessment Data Sheet

Area	Dunlin	
Decision/Group	Decision 6 Group 8 – DPI Cable Riser (Dunlin)	
Option	1 – Leave in Situ – Minor Intervention (Outboard Cut and Recovery)	
Description	Cable riser cut at J-tube exit by DSV Cable cut at trench transition by DSV Bellmouth removal at the J-tube by DSV Seal J-tube and recover outboard section of cable, between J-tube and trench transition, back to the DSV Disconnect cable and gap at topside	
Ref. Documents	FBL-DUN-DAOM-SSP-01-RPT-00001 FBL-DUN-DAOM-SSP-01-RPT-00003 A-301649-S01-TECH-008 A-301649-S01-TECH-011 A-301649-S01-REPT-003	Subsea Decommissioning Inventory Subsea Decommissioning Screening – Dunlin Dunlin – Long Term Materials Degradation Study Dunlin – Effect of Leaving Riser Section within J-Tube Dunlin – Common Scope Report

ID No.	Type	Material	Length (m)	Trenched		Buried		Rock Dumped	
				Length (m)	Depth (m)	Length (m)	Depth (m)	Length (m)	Height (m)
PL4334 Riser	Cable (Untrenched section at Dunlin)	Polymer / Steel / Copper/ Fibre Optic	480	0	0	0	0	0	0

SAFETY				
Offshore Personnel	Number	76	Man Hours	5427
Topsides Personnel	Number	6	Man Hours	87
Divers Required	Number	9	Man Hours	346
Onshore Personnel	Number	20	Man Hours	1599
Legacy Personnel	Number	N/A	Man Hours	N/A
Impact to Other Users of the Sea (Operational)	Number of Vessels Used	1	Duration of Operations	6.0
Impact to Other Users of the Sea (Legacy)	Number of Vessels Used	N/A	Duration of Operations	N/A

Potential for High Consequence Event	Low	Comments	Routine operations

Operational Risk Diver	PLL	3.36E-04
Operational Risk Offshore	PLL	4.10E-04
Operational Risk Topsides	PLL	3.57E-06
Operational Risk Onshore	PLL	1.97E-04
Legacy Risk (out to 50yrs)	PLL	N/A (in line with CGB)
Fishing Risk	PLL	N/A
Overall Risk	∑PLL	9.46E-04

ENVIRONMENTAL								
Marine Impact (Vessels Operational)	Type	DSV	Number	1	Duration	6.0	Activity	Destruct
	Type	CSV	Number	N/A	Duration	N/A	Activity	N/A
	Type	DPFPV	Number	N/A	Duration	N/A	Activity	N/A
	Type	ROVSV	Number	N/A	Duration	N/A	Activity	N/A
	Type	PSV	Number	N/A	Duration	N/A	Activity	N/A
	Type	Trawler	Number	N/A	Duration	N/A	Activity	N/A
Marine Impact (Vessels Legacy)	Type	DPFPV	Number	N/A	Duration	N/A	Activity	N/A
	Type	ROVSV	Number	N/A	Duration	N/A	Activity	N/A
Noise (Total = Ops + Legacy)	Sound Exposure Level		239 dB re 1mP			0.8 TPa^2s		
Energy Use (Total = Ops + Legacy)	Fuel	130.9 Te	CO_2	415.0 Te	NOx	7.7 Te	SO_2	1.6 Te
Life Cycle Emissions (Total = Ops + Legacy)	CO_2		443.08 Te		CO_2 (Credit)		N/A	
Marine Impact (Seabed)	Activity	Dredging	Area	N/A	Resources	N/A		
	Activity	Rock Dump	Area	N/A	Resources	N/A		
	Activity	Trenching	Area	N/A	Resources	N/A		
	Activity	Backfilling	Area	N/A	Resources	N/A		

Materials	Recovered	300 m Cable (Polymer/ Copper/ Fibre Optics) (9.1 Te)			
	Remaining	180 m Cable within J-tube (Polymer/ Copper/ Fibre Optics)			
	Persistence	In-line with CGB & J-tubes >250 years			
Residuals	LSA Scale	In-Situ	N/A	Returned	N/A
	Hydrocarbon	In-Situ	N/A	Returned	N/A
	Control Fluids	In-Situ	N/A	Returned	N/A

Technical				
Technical Considerations	Feasibility	High	Concept Maturity	High
	Availability of Technology	High – Off the shelf		
	Track Record	High – Extensive history of similar work		
	Risk of Failure	Low		
	Consequence of Failure	Limited schedule impacts		
	Emerging Technology	N/A		

Societal		
Societal Factors	Commercial Fisheries Impact	Low – Area will potentially remain within a safety zone
	Socio Economic	Low – Limited material returned to shore

Economic				
Economic Considerations	Comparative Cost Operational		XX M	
	Comparative Cost Legacy - Monitoring		XX M – (Monitoring is assumed to be done as part of any CGB monitoring)	
	Comparative Cost Legacy - Remedial		XX M	
Economic Risk	Cost Risk	Low	Factors	High degree of achievability.

Subsea Infrastructure Decommissioning Comparative Assessment Data Sheet

Area	Dunlin	
Decision/Group	Decision 6 Group 8 – DPI Cable Riser (Dunlin)	
Option	2 – Full Removal – Topsides Pull	
Description	Mobilise winch spread to platform, install and test Remove topside hang-off and transfer cable to winch Cable cut at J-tube exit and trench transition by DSV Seal J-tube and recover outboard section of cable, between J-tube and trench transition, back to the DSV Pull-in cable using the topside winch (pull, secure, cut, repeat) Backload cable sections and winch equipment Survey by DSV	
Ref. Documents	FBL-DUN-DAOM-SSP-01-RPT-00001 FBL-DUN-DAOM-SSP-01-RPT-00003 A-301649-S01-TECH-010 A-301649-S01-REPT-003	Subsea Decommissioning Inventory Subsea Decommissioning Screening – Dunlin Dunlin – Removal/Recovery Feasibility Study Dunlin – Common Scope Report

ID No.	Type	Material	Length (m)	Trenched		Buried		Rock Dumped	
				Length (m)	Depth (m)	Length (m)	Depth (m)	Length (m)	Height (m)
PL4334 Riser	Cable (Untrenched section at Dunlin)	Polymer / Steel / Copper/ Fibre Optic	480	0	0	0	0	0	0

SAFETY				
Offshore Personnel	Number	126	Man Hours	11472
Topsides Personnel	Number	6	Man Hours	2823
Divers Required	Number	9	Man Hours	346
Onshore Personnel	Number	20	Man Hours	4225
Legacy Personnel	Number	N/A	Man Hours	N/A
Impact to Other Users of the Sea (Operational)	Number of Vessels Used	2	Duration of Operations	16
Impact to Other Users of the Sea (Legacy)	Number of Vessels Used	N/A	Duration of Operations	N/A

Potential for High Consequence Event	Medium	Comments	Non-routine operations but not unusual. Limited SIMOPS.

Operational Risk Diver	PLL	3.36E-04
Operational Risk Offshore	PLL	8.60E-04
Operational Risk Topsides	PLL	1.16E-04
Operational Risk Onshore	PLL	5.20E-04
Legacy Risk (out to 50yrs)	PLL	N/A
Fishing Risk	PLL	N/A
Overall Risk	∑PLL	1.83E-03

ENVIRONMENTAL								
Marine Impact (Vessels Operational)	Type	DSV	Number	1	Duration	6	Activity	Destruct
	Type	CSV	Number	N/A	Duration	N/A	Activity	N/A
	Type	DPFPV	Number	N/A	Duration	N/A	Activity	N/A
	Type	ROVSV	Number	N/A	Duration	N/A	Activity	N/A
	Type	PSV	Number	1	Duration	10	Activity	Supply
	Type	Trawler	Number	N/A	Duration	N/A	Activity	N/A
Marine Impact (Vessels Legacy)	Type	DPFPV	Number	N/A	Duration	N/A	Activity	N/A
	Type	ROVSV	Number	N/A	Duration	N/A	Activity	N/A
Noise (Total = Ops + Legacy)	Sound Exposure Level		245 dB re 1mP			3.0 TPa^2s		
Energy Use (Total = Ops + Legacy)	Fuel	230.9 Te	CO_2	732.0 Te	NOx	13.6 Te	SO_2	2.8 Te
Life Cycle Emissions (Total = Ops + Legacy)	CO_2		747.66 Te		CO_2 (Credit)		2.69 Te	

Marine Impact (Seabed)	Activity	Dredging	Area	N/A	Resources	N/A
	Activity	Rock Dump	Area	N/A	Resources	N/A
	Activity	Trenching	Area	N/A	Resources	N/A
	Activity	Backfilling	Area	N/A	Resources	N/A

Materials	Recovered	480 m Cable (Polymer/ Copper/ Fibre Optics) (15.6 Te)			
	Remaining	0 m			
	Persistence	N/A			
Residuals	LSA Scale	In-Situ	N/A	Returned	N/A
	Hydrocarbon	In-Situ	N/A	Returned	N/A
	Control Fluids	In-Situ	N/A	Returned	N/A

Technical				
Technical Considerations	Feasibility	High	Concept Maturity	Medium
	Availability of Technology	High – Off the shelf		
	Track Record	High – Extensive history in North Sea and recent history on Dunlin.		
	Risk of Failure	Medium – Unknown integrity of J-tube / cable and inability to inspect.		
	Consequence of Failure	Cable would remain within J-tube / schedule over runs		
	Emerging Technology	N/A		

Societal		
Societal Factors	Commercial Fisheries Impact	Low – Area where cable is removed will potentially remain within a safety zone
	Socio Economic	Low – Limited material returned to shore

Economic				
Economic Considerations	Comparative Cost Operational		XX M	
	Comparative Cost Legacy - Monitoring		XX M	
	Comparative Cost Legacy - Remedial		XX M	
Economic Risk	Cost Risk	Medium	Factors	Topside engineering for winch locating is not mature; Inspection to confirm integrity of J-tube and cable is not possible; Previous pull-in operations have suffered delays and cost over runs.

Subsea Infrastructure Decommissioning Comparative Assessment Data Sheet

Area	Dunlin	
Decision/Group	Decision 7 Group 9 – Trenched and Buried Cable	
Option	1 – Leave in Situ – Minimal Intervention (Rock Placement)	
Description	Cable end transitions removed by DSV Rock placement over snag hazards and areas of low burial depth by DPFPV Survey by ROVSV Trawl sweep using trawler	
Ref. Documents	FBL-DUN-DAOM-SSP-01-RPT-00001 FBL-DUN-DAOM-SSP-01-RPT-00003 A-301649-S01-TECH-008 A-301649-S01-REPT-003	Subsea Decommissioning Inventory Subsea Decommissioning Screening – Dunlin Dunlin – Long Term Materials Degradation Study Dunlin – Common Scope Report

ID No.	Type	Material	Length (m)	Trenched		Buried		Rock Dumped	
				Length (m)	Depth (m)	Length (m)	Depth (m)	Length (m)	Height (m)
PL4334	Cable (Trenched section DA-BC)	Polymer / Steel / Copper/ Fibre Optic	21403	21297	0.6	21297	0.6	1435 Total	0.6

SAFETY				
Offshore Personnel	Number	157	Man Hours	14870
Topsides Personnel	Number	N/A	Man Hours	N/A
Divers Required	Number	9	Man Hours	476
Onshore Personnel	Number	20	Man Hours	3425
Legacy Personnel	Number	35	Man Hours	30660
Impact to Other Users of the Sea (Operational)	Number of Vessels Used	4	Duration of Operations	27.4
Impact to Other Users of the Sea (Legacy)	Number of Vessels Used	1	Duration of Operations	73.0

Potential for High Consequence Event	Low	Comments	Routine operations

Operational Risk Diver	PLL	4.62E-04
Operational Risk Offshore	PLL	1.12E-03
Operational Risk Topsides	PLL	N/A
Operational Risk Onshore	PLL	4.21E-04
Legacy Risk (out to 50yrs)	PLL	1.69E-03
Fishing Risk	PLL	N/A (No increase in risk over and above what currently exists for fishing)
Overall Risk	∑PLL	3.68E-03

ENVIRONMENTAL								
Marine Impact (Vessels Operational)	Type	DSV	Number	1	Duration	9.7	Activity	Destruct
	Type	CSV	Number	N/A	Duration	N/A	Activity	N/A
	Type	DPFPV	Number	1	Duration	5.4	Activity	Rock Dump
	Type	ROVSV	Number	1	Duration	7.3	Activity	Survey
	Type	PSV	Number	N/A	Duration	N/A	Activity	N/A
	Type	Trawler	Number	1	Duration	5.0	Activity	Trawl Sweep
Marine Impact (Vessels Legacy)	Type	DPFPV	Number	N/A	Duration	N/A	Activity	N/A
	Type	ROVSV	Number	1	Duration	73.0	Activity	Survey
Noise (Total = Ops + Legacy)	Sound Exposure Level		253 dB re 1mP			21.9 TPa^2s		
Energy Use (Total = Ops + Legacy)	Fuel	1139.5 Te	CO_2	3612.2 Te	NOx	67.2 Te	SO_2	13.7 Te
Life Cycle Emissions (Total = Ops + Legacy)	CO_2		6539.58 Te		CO_2 (Credit)		N/A	

Marine Impact (Seabed)	Activity	Dredging	Area	40 m^2	Resources	N/A
	Activity	Rock Dump	Area	25800 m^2	Resources	22300 Te (Rock)
	Activity	Trenching	Area	N/A	Resources	N/A
	Activity	Backfilling	Area	N/A	Resources	N/A

Materials	Recovered	100 m Cable (Polymer/ Copper/ Fibre Optics) (3.2 Te)			
	Remaining	21303 m Cable (Polymer/ Copper/ Fibre Optics) 33912 Te Rock (11612 Te Existing + 22300 Te New)			
	Persistence	>100 years (no long term data/experience of polymers in seawater/buried)			
Residuals	LSA Scale	In-Situ	N/A	Returned	N/A
	Hydrocarbon	In-Situ	N/A	Returned	N/A
	Control Fluids	In-Situ	N/A	Returned	N/A

Technical				
Technical Considerations	Feasibility	High	Concept Maturity	High
	Availability of Technology	High – Off the shelf		
	Track Record	High – Extensive history		
	Risk of Failure	Low		
	Consequence of Failure	Alternate cutting technique / additional rock / limited schedule impacts		
	Emerging Technology	N/A		

Societal		
Societal Factors	Commercial Fisheries Impact	Low – No change as area is currently available for fishing
	Socio Economic	Low – Limited material returned to shore

Economic				
Economic Considerations	Comparative Cost Operational		XX M	
	Comparative Cost Legacy - Monitoring		XX M	
	Comparative Cost Legacy - Remedial		XX M	
Economic Risk	Cost Risk	Low	Factors	High degree of achievability; Low likelihood of future remediation required due to existing burial depth.

Subsea Infrastructure Decommissioning Comparative Assessment Data Sheet

Area	Dunlin	
Decision/Group	Decision 7 Group 9 – Trenched and Buried Cable	
Option	2 – Leave in Situ – Minor Intervention (Cut and Rock Placement)	
Description	Cable end transitions, spans and exposures removed by DSV Rock placement over snag hazards and areas of low burial depth by DPFPV Survey by ROVSV Trawl sweep using trawler	
Ref. Documents	FBL-DUN-DAOM-SSP-01-RPT-00001 FBL-DUN-DAOM-SSP-01-RPT-00003 A-301649-S01-TECH-008 A-301649-S01-REPT-003	Subsea Decommissioning Inventory Subsea Decommissioning Screening – Dunlin Dunlin – Long Term Materials Degradation Study Dunlin – Common Scope Report

ID No.	Type	Material	Length (m)	Trenched		Buried		Rock Dumped	
				Length (m)	Depth (m)	Length (m)	Depth (m)	Length (m)	Height (m)
PL4334	Cable (Trenched section DA-BC)	Polymer / Steel / Copper/ Fibre Optic	21403	21297	0.6	21297	0.6	1435 Total	0.6

SAFETY				
Offshore Personnel	Number	157	Man Hours	17423
Topsides Personnel	Number	N/A	Man Hours	N/A
Divers Required	Number	9	Man Hours	1080
Onshore Personnel	Number	20	Man Hours	4295
Legacy Personnel	Number	35	Man Hours	30660
Impact to Other Users of the Sea (Operational)	Number of Vessels Used	4	Duration of Operations	30.2
Impact to Other Users of the Sea (Legacy)	Number of Vessels Used	1	Duration of Operations	73.0

Potential for High Consequence Event	Low	Comments	Routine operations

Operational Risk Diver	PLL	1.05E-03
Operational Risk Offshore	PLL	1.31E-03
Operational Risk Topsides	PLL	N/A
Operational Risk Onshore	PLL	5.28E-04
Legacy Risk (out to 50yrs)	PLL	1.69E-03
Fishing Risk	PLL	N/A (No increase in risk over and above what currently exists for fishing)
Overall Risk	∑PLL	4.57E-03

ENVIRONMENTAL								
Marine Impact (Vessels Operational)	Type	DSV	Number	1	Duration	12.5	Activity	Destruct
	Type	CSV	Number	N/A	Duration	N/A	Activity	N/A
	Type	DPFPV	Number	1	Duration	5.4	Activity	Rock Dump
	Type	ROVSV	Number	1	Duration	7.3	Activity	Survey
	Type	PSV	Number	N/A	Duration	N/A	Activity	N/A
	Type	Trawler	Number	1	Duration	5.0	Activity	Trawl Sweep
Marine Impact (Vessels Legacy)	Type	DPFPV	Number	N/A	Duration	N/A	Activity	N/A
	Type	ROVSV	Number	1	Duration	73.0	Activity	Survey
Noise (Total = Ops + Legacy)	Sound Exposure Level		254 dB re 1mP		23.9 TPa²s			
Energy Use (Total = Ops + Legacy)	Fuel	1201.1 Te	CO_2	3807.5 Te	NOx	70.9 Te	SO_2	14.4 Te
Life Cycle Emissions (Total = Ops + Legacy)	CO_2		6700.05 Te		CO_2 (Credit)		N/A	

Marine Impact (Seabed)	Activity	Dredging	Area	120 m²	Resources	N/A
	Activity	Rock Dump	Area	25000 m²	Resources	21600 Te (Rock)
	Activity	Trenching	Area	N/A	Resources	N/A
	Activity	Backfilling	Area	N/A	Resources	N/A

Materials	Recovered	260m Cable (Polymer/ Copper/ Fibre Optics) (8.4 Te)			
	Remaining	21223 m Cable (Polymer/ Copper/ Fibre Optics) 33212 Te Rock (11612 Te Existing + 21600 Te New)			
	Persistence	>100 years (no long term data/experience of polymers in seawater/buried)			
Residuals	LSA Scale	In-Situ	N/A	Returned	N/A
	Hydrocarbon	In-Situ	N/A	Returned	N/A
	Control Fluids	In-Situ	N/A	Returned	N/A

Technical				
Technical Considerations	Feasibility	High	Concept Maturity	High
	Availability of Technology	High – Off the shelf		
	Track Record	High – Extensive history		
	Risk of Failure	Low		
	Consequence of Failure	Alternate cutting technique / additional rock / limited schedule impacts		
	Emerging Technology	N/A		

Societal		
Societal Factors	Commercial Fisheries Impact	Low – No change as area is currently available for fishing
	Socio Economic	Low – Limited material returned to shore

Economic				
Economic Considerations	Comparative Cost Operational	XX M		
	Comparative Cost Legacy - Monitoring	XX M		
	Comparative Cost Legacy - Remedial	XX M		
Economic Risk	Cost Risk	Low	Factors	High degree of achievability; Low likelihood of future remediation required due to existing burial depth.

Subsea Infrastructure Decommissioning Comparative Assessment Data Sheet

Area	Dunlin	
Decision/Group	Decision 7 Group 9 – Trenched and Buried Cable	
Option	3 – Full Removal – (Reverse Reel)	
Description	Cable deburial using MFE deployed from CSV Cable recovery head installation by DSV Recover cable and reverse reel by DSV with reel spread Survey by ROVSV	
Ref. Documents	FBL-DUN-DAOM-SSP-01-RPT-00001 FBL-DUN-DAOM-SSP-01-RPT-00003 A-301649-S01-TECH-009 A-301649-S01-TECH-010 A-301649-S01-REPT-003	Subsea Decommissioning Inventory Subsea Decommissioning Screening – Dunlin Dunlin – Trench Backfilling Feasibility Study Dunlin – Removal/Recovery Feasibility Study Dunlin – Common Scope Report

ID No.	Type	Material	Length (m)	Trenched		Buried		Rock Dumped	
				Length (m)	Depth (m)	Length (m)	Depth (m)	Length (m)	Height (m)
PL4334	Cable (Trenched section DA-BC)	Polymer / Steel / Copper/ Fibre Optic	21403	21297	0.6	21297	0.6	1435 Total	0.6

SAFETY				
Offshore Personnel	Number	151	Man Hours	25353
Topsides Personnel	Number	N/A	Man Hours	N/A
Divers Required	Number	9	Man Hours	346
Onshore Personnel	Number	20	Man Hours	15683
Legacy Personnel	Number	N/A	Man Hours	N/A
Impact to Other Users of the Sea (Operational)	Number of Vessels Used	3	Duration of Operations	39.6
Impact to Other Users of the Sea (Legacy)	Number of Vessels Used	N/A	Duration of Operations	N/A

Potential for High Consequence Event	Medium	Comments	Non-Routine operations; however not unusual to recovery umbilicals/cables. Deburial length is a factor.

Operational Risk Diver	PLL	3.36E-04
Operational Risk Offshore	PLL	1.90E-03
Operational Risk Topsides	PLL	N/A
Operational Risk Onshore	PLL	1.93E-03
Legacy Risk (out to 50yrs)	PLL	N/A
Fishing Risk	PLL	N/A (No increase in risk over and above what currently exists for fishing)
Overall Risk	∑PLL	4.17E-03

ENVIRONMENTAL								
Marine Impact (Vessels Operational)	Type	DSV	Number	1	Duration	15.7	Activity	Reeling
	Type	CSV	Number	1	Duration	16.6	Activity	Deburial
	Type	DPFPV	Number	N/A	Duration	N/A	Activity	N/A
	Type	ROVSV	Number	1	Duration	7.3	Activity	Survey
	Type	PSV	Number	N/A	Duration	N/A	Activity	N/A
	Type	Trawler	Number	N/A	Duration	N/A	Activity	N/A
Marine Impact (Vessels Legacy)	Type	DPFPV	Number	N/A	Duration	N/A	Activity	N/A
	Type	ROVSV	Number	N/A	Duration	N/A	Activity	N/A
Noise (Total = Ops + Legacy)	Sound Exposure Level		251 dB re 1mP			12.0 TPa^2s		
Energy Use (Total = Ops + Legacy)	Fuel	871.0 Te	CO_2	2761.0 Te	NOx	51.4 Te	SO_2	10.5 Te
Life Cycle Emissions (Total = Ops + Legacy)	CO_2		3127.53 Te		CO_2 (Credit)		318.05 Te	
Marine Impact (Seabed)	Activity	Dredging	Area	106485 m^2	Resources	N/A		
	Activity	Rock Dump	Area	N/A	Resources	N/A		
	Activity	Trenching	Area	N/A	Resources	N/A		
	Activity	Backfilling	Area	N/A	Resources	N/A		

Materials	Recovered	21403 m Cable (Polymer/ Copper/ Fibre Optics) (726.5 Te)			
	Remaining	11612 Te Rock (Existing)			
	Persistence	N/A			
Residuals	LSA Scale	In-Situ	N/A	Returned	N/A
	Hydrocarbon	In-Situ	N/A	Returned	N/A
	Control Fluids	In-Situ	N/A	Returned	N/A

Technical				
Technical Considerations	Feasibility	Medium	Concept Maturity	Low
	Availability of Technology	Medium – Limited number of existing techniques suitable for deburial		
	Track Record	Low – Limited experience of exposing cables over extended distances to enable re-reeling		
	Risk of Failure	High		
	Consequence of Failure	Alternate deburial techniques required / Alternate recovery techniques required/ rock required to remedy over dredged areas / large schedule overruns with limited ability to recover.		
	Emerging Technology	N/A		

Societal		
Societal Factors	Commercial Fisheries Impact	Low – No change as area is currently available for fishing
	Socio Economic	Low – Material returned to shore will generate a small amount of recycling work.

Economic				
Economic Considerations	Comparative Cost Operational	XX M		
	Comparative Cost Legacy - Monitoring	XX M		
	Comparative Cost Legacy - Remedial	XX M		
Economic Risk	Cost Risk	High	Factors	Medium degree of achievability; High likelihood of failure to expose the line fully without multiple deburial techniques and passes; High likelihood of over trenching in sandy areas leading to areas of disturbance that are larger than required with potential remediation required i.e. rock installation.

Subsea Infrastructure Decommissioning Comparative Assessment Data Sheet

Area	Dunlin	
Decision/Group	Decision 8 Group 10 – DPI Cable Riser (Brent Charlie)	
Option	1 – Leave in Situ – Minor Intervention (Outboard Cut and Recovery)	
Description	Cable riser cut at J-tube exit by DSV Cable cut at trench transition by DSV Bellmouth removal at the J-tube by DSV Seal J-tube and recover outboard section of cable, between J-tube and trench transition, back to the DSV Disconnect cable and gap at topside	
Ref. Documents	FBL-DUN-DAOM-SSP-01-RPT-00001 FBL-DUN-DAOM-SSP-01-RPT-00003 A-301649-S01-TECH-008 A-301649-S01-TECH-011 A-301649-S01-REPT-003	Subsea Decommissioning Inventory Subsea Decommissioning Screening – Dunlin Dunlin – Long Term Materials Degradation Study Dunlin – Effect of Leaving Riser Section within J-Tube Dunlin – Common Scope Report

ID No.	Type	Material	Length (m)	Trenched		Buried		Rock Dumped	
				Length (m)	Depth (m)	Length (m)	Depth (m)	Length (m)	Height (m)
PL4334 Riser	Cable (Untrenched section at Brent Charlie)	Polymer / Steel / Copper/ Fibre Optic	480	0	0	0	0	0	0

SAFETY				
Offshore Personnel	Number	76	Man Hours	5427
Topsides Personnel	Number	6	Man Hours	87
Divers Required	Number	9	Man Hours	346
Onshore Personnel	Number	20	Man Hours	1599
Legacy Personnel	Number	N/A	Man Hours	N/A
Impact to Other Users of the Sea(Operational)	Number of Vessels Used	1	Duration of Operations	6.0
Impact to Other Users of the Sea (Legacy)	Number of Vessels Used	N/A	Duration of Operations	N/A

Potential for High Consequence Event	Low	Comments	Routine operations

Operational Risk Diver	PLL	3.36E-04
Operational Risk Offshore	PLL	4.10E-04
Operational Risk Topsides	PLL	3.57E-06
Operational Risk Onshore	PLL	1.97E-04
Legacy Risk (out to 50yrs)	PLL	N/A (in line with CGB)
Fishing Risk	PLL	N/A
Overall Risk	∑PLL	9.46E-04

ENVIRONMENTAL								
Marine Impact (Vessels Operational)	Type	DSV	Number	1	Duration	6.0	Activity	Destruct
	Type	CSV	Number	N/A	Duration	N/A	Activity	N/A
	Type	DPFPV	Number	N/A	Duration	N/A	Activity	N/A
	Type	ROVSV	Number	N/A	Duration	N/A	Activity	N/A
	Type	PSV	Number	N/A	Duration	N/A	Activity	N/A
	Type	Trawler	Number	N/A	Duration	N/A	Activity	N/A
Marine Impact (Vessels Legacy)	Type	DPFPV	Number	N/A	Duration	N/A	Activity	N/A
	Type	ROVSV	Number	N/A	Duration	N/A	Activity	N/A
Noise (Total = Ops + Legacy)	Sound Exposure Level		239 dB re 1mP			0.8 TPa^2s		
Energy Use (Total = Ops + Legacy)	Fuel	130.9 Te	CO_2	415.0 Te	NOx	7.7 Te	SO_2	1.6 Te
Life Cycle Emissions (Total = Ops + Legacy)	CO_2		443.08 Te		CO_2 (Credit)		N/A	

Marine Impact (Seabed)	Activity	Dredging	Area	N/A	Resources	N/A
	Activity	Rock Dump	Area	N/A	Resources	N/A
	Activity	Trenching	Area	N/A	Resources	N/A
	Activity	Backfilling	Area	N/A	Resources	N/A

Materials	Recovered	300 m Cable (Polymer/ Copper/ Fibre Optics) (9.1 Te)			
	Remaining	180 m Cable within J-tube (Polymer/ Copper/ Fibre Optics)			
	Persistence	In-line with CGB & J-tubes >250 years			
Residuals	LSA Scale	In-Situ	N/A	Returned	N/A
	Hydrocarbon	In-Situ	N/A	Returned	N/A
	Control Fluids	In-Situ	N/A	Returned	N/A

Technical				
Technical Considerations	Feasibility	High	Concept Maturity	High
	Availability of Technology	High – Off the shelf		
	Track Record	High – Extensive history of similar work		
	Risk of Failure	Low		
	Consequence of Failure	Limited schedule impacts		
	Emerging Technology	N/A		

Societal		
Societal Factors	Commercial Fisheries Impact	Low – Area will potentially remain within a safety zone
	Socio Economic	Low – Limited material returned to shore

Economic				
Economic Considerations	Comparative Cost Operational		XX M	
	Comparative Cost Legacy - Monitoring		XX M – (Monitoring is assumed to be done as part of any CGB monitoring)	
	Comparative Cost Legacy - Remedial		XX M	
Economic Risk	Cost Risk	Low	Factors	High degree of achievability.

Subsea Infrastructure Decommissioning Comparative Assessment Data Sheet

Area	Dunlin	
Decision/Group	Decision 8 Group 10 – DPI Cable Riser (Brent Charlie)	
Option	2 – Full Removal – Topsides Pull	
Description	Mobilise winch spread to platform, install and test Remove topside hang-off and transfer cable to winch Cable cut at J-tube exit and trench transition by DSV Seal J-tube and recover outboard section of cable, between J-tube and trench transition, back to the DSV Pull-in cable using the topside winch (pull, secure, cut, repeat) Backload cable sections and winch equipment Survey by ROVSV	
Ref. Documents	FBL-DUN-DAOM-SSP-01-RPT-00001 FBL-DUN-DAOM-SSP-01-RPT-00003 A-301649-S01-TECH-010 A-301649-S01-REPT-003	Subsea Decommissioning Inventory Subsea Decommissioning Screening – Dunlin Dunlin – Removal/Recovery Feasibility Study Dunlin – Common Scope Report

ID No.	Type	Material	Length (m)	Trenched		Buried		Rock Dumped	
				Length (m)	Depth (m)	Length (m)	Depth (m)	Length (m)	Height (m)
PL4334 Riser	Cable (Untrenched section at Brent Charlie)	Polymer / Steel / Copper/ Fibre Optic	480	0	0	0	0	0	0

SAFETY				
Offshore Personnel	Number	126	Man Hours	11472
Topsides Personnel	Number	6	Man Hours	2823
Divers Required	Number	9	Man Hours	346
Onshore Personnel	Number	20	Man Hours	4225
Legacy Personnel	Number	N/A	Man Hours	N/A
Impact to Other Users of the Sea	Number of Vessels Used	2	Duration of Operations	16
Impact to Other Users of the Sea (Legacy)	Number of Vessels Used	N/A	Duration of Operations	N/A

Potential for High Consequence Event	High	Comments	Non-routine operations but not unusual. High SIMOPS between Fairfield and 3rd party operator.

Operational Risk Diver	PLL	3.36E-04
Operational Risk Offshore	PLL	8.60E-04
Operational Risk Topsides	PLL	1.16E-04
Operational Risk Onshore	PLL	5.20E-04
Legacy Risk (out to 50yrs)	PLL	N/A
Fishing Risk	PLL	N/A
Overall Risk	∑PLL	1.83E-03

ENVIRONMENTAL								
Marine Impact (Vessels Operational)	Type	DSV	Number	1	Duration	6	Activity	Destruct
	Type	CSV	Number	N/A	Duration	N/A	Activity	N/A
	Type	DPFPV	Number	N/A	Duration	N/A	Activity	N/A
	Type	ROVSV	Number	N/A	Duration	N/A	Activity	N/A
	Type	PSV	Number	1	Duration	10	Activity	Supply
	Type	Trawler	Number	N/A	Duration	N/A	Activity	N/A
Marine Impact (Vessels Legacy)	Type	DPFPV	Number	N/A	Duration	N/A	Activity	N/A
	Type	ROVSV	Number	N/A	Duration	N/A	Activity	N/A
Noise (Total = Ops + Legacy)	Sound Exposure Level		245 dB re 1mP			3.0 TPa^2s		
Energy Use (Total = Ops + Legacy)	Fuel	230.9 Te	CO_2	732.0 Te	NOx	13.6 Te	SO_2	2.8 Te
Life Cycle Emissions (Total = Ops + Legacy)	CO_2		747.66 Te		CO_2 (Credit)		2.69 Te	

Marine Impact (Seabed)	Activity	Dredging	Area	N/A	Resources	N/A
	Activity	Rock Dump	Area	N/A	Resources	N/A
	Activity	Trenching	Area	N/A	Resources	N/A
	Activity	Backfilling	Area	N/A	Resources	N/A
Materials	Recovered	480 m Cable (Polymer/ Copper/ Fibre Optics) (15.6 Te)				
	Remaining	0 m				
	Persistence	N/A				
Residuals	LSA Scale	In-Situ	N/A	Returned	N/A	
	Hydrocarbon	In-Situ	N/A	Returned	N/A	
	Control Fluids	In-Situ	N/A	Returned	N/A	

Technical				
Technical Considerations	Feasibility	High	Concept Maturity	Medium
	Availability of Technology	High – Off the shelf		
	Track Record	High – Extensive history in North Sea and recent history on Dunlin.		
	Risk of Failure	Medium – Unknown integrity of J-tube / cable and inability to inspect.		
	Consequence of Failure	Cable would remain within J-tube / schedule over runs		
	Emerging Technology	N/A		

Societal		
Societal Factors	Commercial Fisheries Impact	Low – Area where cable is removed will potentially remain within a safety zone
	Socio Economic	Low – Limited material returned to shore

Economic				
Economic Considerations	Comparative Cost Operational		XX M	
	Comparative Cost Legacy - Monitoring		XX M	
	Comparative Cost Legacy - Remedial		XX M	
Economic Risk	Cost Risk	Medium	Factors	Topside engineering for winch locating is not mature; Limited available information on 3rd party asset; delays due to 3rd party operations/restrictions would impact schedule and cost.

Appendix F CA Attributes Tables & Pairwise Comparison (Exc. Costs)

Project Differentiator Attributes

Differentiator	Sub-Criteria	Description	1. Leave - Rock Placement	2. Full Removal - Deburial
1. Safety	1.1 Personnel Offshore	This sub-criterion considers elements that impact risk to offshore personnel and includes, project team, project vessel crew, diving teams, supply boat crew, and survey vessel crew. It should be noted that crew changes are performed via port calls.	Total PLL: 1.33E-03 Vessels located on site for Operations: 5.2 days Legacy: 45 days	Total PLL: 1.82E-03 Vessels located on site for 13.7 days.
	1.2 Personnel Onshore	This sub-criterion considers elements that impact risk to onshore personnel. Factors such as any requirement for dismantling, disposal operations, material transfer and onshore handling may impact onshore personnel.		
	1.3 Other Users	This sub-criterion covers the impact associated with the risk to other users. Considers elements such as collision impact whilst performing activities. Users such as fishing vessels, commercial transport vessels and military vessels are considered.		
	1.4 High Consequence Events	This sub-criterion relates to any inherent potential for high consequence events i.e. major accident hazard, major environmental hazard type events. It applies to all onshore and offshore personnel involved in the project. Considerations such as dropped object concerns, support vessel risks, are considered.	Low risk of high consequence events - routine.	Low risk of high consequence events - only performed once the lines being crossed are no longer operational and have been flushed. Agreement in principle with 3rd parties has been reached at this stage.
	1.5 Residual Risk	This sub-criterion addresses and residual risk to other sea users i.e. fishermen, military vessel crews, commercial vessel crews and passengers, other sea users, that is provided by the option. Issues such as residual snag risk, collision risk, etc. may be considered.	Residual Risk Monitoring: 35 / 18900 / 1.04E-03 Fishing: Negligible additional risk presented to fisherman from spot rock dumped buried structures.	There is no residual legacy risk or risk to fishing operations associated with this option as it is a full removal option.
	Summary		The summed PLL figures for options 1 and 2 (all worker groups and including legacy component where present) are 1.33E-03 and 1.82E-03 respectively. This shows that option 1 carries a lower overall risk than option 2, however the difference is minimal. The durations that vessels are on site are higher for option 1 than option 2. Overall, option 1 is Stronger than option 2.	
2. Environmental	2.1 Marine Impacts	This sub-criterion covers elements such as noise generated by vessels, cutting operations, explosives etc. It also covers any damaging discharges to sea from vessels and / or activities performed.	Sound Exposure 251 dB re 1mP / 12.6 TPa2s	Sound Exposure 245 dB re 1mP / 3.5 TPa2s
	2.2 Emissions	This sub-criterion relates to the amount of damaging atmospheric emissions associated with a particular option.	CO2: 359.9 Te NOx: 6.7 Te SO2: 1.4 Te Lifecycle Emissions CO2: 488.86 Te CO2 Credit (for steel): N/A	CO2: 958.2 Te NOx: 17.8 Te SO2: 3.6 Te Lifecycle Emissions CO2: 958.66 CO2 Credit (for steel): N/A
	2.3 Consumption	This sub-criterion relates to the amount of Energy / Resource consumption such as fuel use, recycling of materials, use of quarried rock, production of replacement materials.	Fuel: 113.5 Te Rock: 3800 Te	Fuel: 302.3 Te Rock: N/A
	2.4 Disturbance	This sub-criterion relates to both direct and indirect seabed disturbance. Both short and long term impacts are considered.	Disturbance Rock Dump: 1800 m2	Disturbance Dredging: 876 m2
	2.5 Protections	This sub-criterion relates to the impact of the options on any protected sites and species.	This option has no impact on protected sites or species.	This option has no impact on protected sites or species.
	Summary		Option 1 is preferable to option 2 from an emissions and fuel use perspective. Option 2 is preferable to option 1 from a noise exposure and introduction of new material (rock) perspective. It should be noted that all these preferences are minimal and make the options equal. The differentiator in this case is the seabed disturbance. The rock dumping associated with Option 1 impacts a greater area and is considered a permanent impact compared to the smaller, temporary seabed disturbance associated with Option 2, although the difference is not particularly large. Overall, option 1 is Weaker than option 2.	

Project Differentiator Attributes

Differentiator	Sub-Criteria	Description	1. Leave - Rock Placement	2. Full Removal - Deburial
3. Technical	3.1 Technical Risk	This sub-criterion relates to the various technical risks that could result in a major project failure. Concepts such as: Technical Novelty and Potential for Showstoppers can be captured along with impact on the schedule due to overruns from technical issues such as operations being interrupted by the weather. Technical Feasibility and Technical Maturity is also considered.	Feasibility: High Concept Maturity: High Availability of Technology: High – Off the shelf Track Record: High – Extensive history Risk of Failure: Low Consequence of Failure: Additional rock profiling / limited schedule impacts Emerging Technology: N/A	Feasibility: High Concept Maturity: High Availability of Technology: High – Off the shelf Track Record: High – Large history of MFE for local deburial Risk of Failure: Low Consequence of Failure: Additional dredging / additional rock profiling / limited schedule impacts Emerging Technology: N/A
		Summary	Options 1 and 2 are equal to each other technically and are therefore scored as Neutral to each other from a technical perspective.	
4. Societal	4.1 Fishing	This sub-criterion addresses the impact of the option on commercial fishing operations. It includes consideration of impacts from both the decommissioning activities any residual impacts post decommissioning such as reinstatement of access to area.	PL2852, PLU2853 in 500m zone (within 200m of Dunlin Alpha CGB). All other equipment that this group applies to are currently overtrawlable so no change to current situation re: fishing.	Option does remove a crossing (over the DFGI line) but such a small area considered negligible from a fishing operations perspective.
	4.2 Other Users	This sub-criterion addresses any socio-economic impacts on other users both onshore where the impact may be from dismantling, transporting, treating, recycling and land filling activities relating to the option and offshore. Issues such as impact on the health, well-being, standard of living, structure or coherence of communities or amenities are considered here e.g. business or jobs creation, increase in noise, dust or odour pollution during the process which has a negative impact on communities, increased traffic disruption due to extra-large transport loads, etc. Includes the FEL Guiding Principle of 'Minimal business interruption to others'.	Material returned to shore Recovered: N/A Remaining: 1 x concrete arch 45 x concrete mattress 200 x grout bags 80 x sand bags 23992 Te Rock (20192 Te Existing + 3800 Te New). Persistence: >100 years (fully covered).	Material returned to shore Recovered: 1 x concrete arch 45 x concrete mattress 200 x grout bags 80 x sand bags Remaining: 20192 Te Rock (Existing). Persistence: N/A
		Summary	Option 1 and 2 largely comparable, although option 1 does have some additional new material. Option 2 involves crossing third party lines however agreement in principle that operations will only be performed once line has been decommissioned. Overall option 1 Neutral to option 2.	
5. Economic	5.1 Short-term Costs	This sub-criterion addresses the cost of delivering the option as described. No long-term cost element is considered here. Cost uncertainty (a function of activity maturity) is also recorded.	Cost: XX M Cost Risk: Low Risk Factors: High degree of achievability.	Cost: XX M Cost Risk: Low Risk Factors: High degree of achievability.
	5.2 Long-term Costs	This sub-criterion addresses the costs associated with any long-term liabilities such as on-going monitoring and any potential future remediation costs.	Monitoring Cost: XX M Remedial Cost: XX M Cost Risk: Low Risk Factors: Low likelihood of future remediation required due to existing burial depth and low fishing activity within the area. Potential future requirement to remove items after live pipelines are decommissioned.	There are no long-term cost liabilities associated with this full removal option.
		Summary	The total costs for options XX and XX are XX M, and XX M respectively. This is a relatively small differential and are assessed as Neutral to each other. It should be noted that DPI line has no section 29 associated with it.	

1. Safety

	1. Leave - Rock Placement	2. Full Removal - Deburial	Priorities
1. Leave - Rock Placement	N	N	50.00%
2. Full Removal - Deburial	N	N	50.00%

2. Environmental

	1. Leave - Rock Placement	2. Full Removal - Deburial	Priorities
1. Leave - Rock Placement	N	W	40.00%
2. Full Removal - Deburial	S	N	60.00%

3. Technical

	1. Leave - Rock Placement	2. Full Removal - Deburial	Priorities
1. Leave - Rock Placement	N	N	50.00%
2. Full Removal - Deburial	N	N	50.00%

4. Societal

	1. Leave - Rock Placement	2. Full Removal - Deburial	Priorities
1. Leave - Rock Placement	N	N	50.00%
2. Full Removal - Deburial	N	N	50.00%

5. Economic

	1. Leave - Rock Placement	2. Full Removal - Deburial	Priorities
1. Leave - Rock Placement	N	N	50.00%
2. Full Removal - Deburial	N	N	50.00%

Dunlin Decision 1 – Buried Structures and Deposits

Pairwise Comparison

xodus GROUP

Differentiator	Sub-Criteria	Description	1. Leave - Cut and Seal	2. Full Removal - Topsides Pull
1. Safety	1.1 Personnel Offshore	This sub-criterion considers elements that impact risk to offshore personnel and includes, project team, project vessel crew, diving teams, supply boat crew, and survey vessel crew. It should be noted that crew changes are performed via port calls.	Total PLL: 8.60E-04 Vessels located on site for 5.8 days.	Total PLL: 1.87E-03 Vessels located on site for 16.4 days.
	1.2 Personnel Onshore	This sub-criterion considers elements that impact risk to onshore personnel. Factors such as any requirement for dismantling, disposal operations, material transfer and onshore handling may impact onshore personnel.		
	1.3 Other Users	This sub-criterion covers the impact associated with the risk to other users. Considers elements such as collision impact whilst performing activities. Users such as fishing vessels, commercial transport vessels and military vessels are considered.		
	1.4 High Consequence Events	This sub-criterion relates to any inherent potential for high consequence events i.e. major accident hazard, major environmental hazard type events. It applies to all onshore and offshore personnel involved in the project. Considerations such as dropped object concerns, support vessel risks, are considered.	Low risk of high consequence events - routine.	Medium risk of high consequence events - non-routine operations, not considered unusual, possible limited SIMOPS.
	1.5 Residual Risk	This sub-criterion addresses and residual risk to other sea users i.e. fishermen, military vessel crews, commercial vessel crews and passengers, other sea users, that is provided by the option. Issues such as residual snag risk, collision risk, etc. may be considered.	There is no residual risk associated with this option as it is wholly within the 500m exclusion zone and all outboard elements are fully removed.	There is no residual risk associated with this full removal option.
		Summary	The summed PLL figures for options 1 and 2 (all worker groups and including legacy component where present) are 8.60E-04 and 1.87E-03 respectively. This indicates that option 1 is the lowest risk for all worker groups, due lower exposures for all groups. Vessel durations are lower for option 1 versus option 2 and risk of high consequence events is also lower. Overall, option 1 is Much Stronger than option 2.	
2. Environmental	2.1 Marine Impacts	This sub-criterion covers elements such as noise generated by vessels, cutting operations, explosives etc. It also covers any damaging discharges to sea from vessels and / or activities performed.	Sound Exposure 237 dB re 1mP / 0.5 TPa2s	Sound Exposure 244 dB re 1mP / 2.7 TPa2s
	2.2 Emissions	This sub-criterion relates to the amount of damaging atmospheric emissions associated with a particular option.	CO2: 406.6 Te NOx: 7.6 Te SO2: 1.5 Te Lifecycle Emissions CO2: 414.48 Te CO2 Credit (for steel): N/A	CO2: 764.0 Te NOx: 14.2 Te SO2: 2.9 Te Lifecycle Emissions CO2: 768.23 Te CO2 Credit (for steel): 3.89 Te
	2.3 Consumption	This sub-criterion relates to the amount of Energy / Resource consumption such as fuel use, recycling of materials, use of quarried rock, production of replacement materials.	Fuel: 128.3 Te Rock: None	Fuel: 241.0 Te Rock: None
	2.4 Disturbance	This sub-criterion relates to both direct and indirect seabed disturbance. Both short and long term impacts are considered.	This option has no associated seabed disturbance.	This option has no associated seabed disturbance.
	2.5 Protections	This sub-criterion relates to the impact of the options on any protected sites and species.	This option has no impact on protected sites or species.	This option has no impact on protected sites or species.
		Summary	Option 1 is either equal to or marginally better than option 2 in all areas. As such, option 1 is Stronger than option 2 from an environmental perspective due to the cumulative effect of these marginal improvements.	

Differentiator	Sub-Criteria	Description	1. Leave - Cut and Seal	2. Full Removal - Topsides Pull
3. Technical	3.1 Technical Risk	This sub-criterion relates to the various technical risks that could result in a major project failure. Concepts such as: Technical Novelty and Potential for Showstoppers can be captured along with impact on the schedule due to overruns from technical issues such as operations being interrupted by the weather. Technical Feasibility and Technical Maturity is also considered.	Feasibility: High. Concept Maturity: High. Availability of Technology: High – Off the shelf. Track Record: High – Extensive history of similar work. Risk of Failure: Low. Consequence of Failure: Limited schedule impacts. Emerging Technology: Diverless cutting may be an option.	Feasibility: High. Concept Maturity: Medium. Availability of Technology: High – Off the shelf. Track Record: High – Extensive history in North Sea and recent history on Dunlin. Risk of Failure: Low – Riser is a recent installation and J-tube was inspected in 2010 as part of the riser install. Consequence of Failure: Riser would remain within J-tube / schedule overruns Emerging Technology: N/A. Neutral - have pulled-in recently (2010) thus technically highly deliverable.
		Summary	Options 1 and 2 are considered equal to each other from a Technical Feasibility perspective. Initially option 2 appears to be more technically challenging, however this rigid riser has been successfully pulled-in recently (2010) and is therefore assessed as being highly deliverable. As such, option 1 and 2 are scored as Neutral to each other from a Technical Feasibility perspective.	
4. Societal	4.1 Fishing	This sub-criterion addresses the impact of the option on commercial fishing operations. It includes consideration of impacts from both the decommissioning activities any residual impacts post decommissioning such as reinstatement of access to area.	Will not remain on seabed - no long term exposure.	Will not remain on seabed - no long term exposure.
	4.2 Other Users	This sub-criterion addresses any socio-economic impacts on other users both onshore where the impact may be from dismantling, transporting, treating, recycling and land filling activities relating to the option and offshore. Issues such as impact on the health, well-being, standard of living, structure or coherence of communities or amenities are considered here e.g. business or jobs creation, increase in noise, dust or odour pollution during the process which has a negative impact on communities, increased traffic disruption due to extra-large transport loads, etc. Includes the FEL Guiding Principle of 'Minimal business interruption to others'.	Material returned to shore Recovered: 1 m Riser (0.05 Te) Remaining: 197 m Riser (within J-tube) Persistence: In-line with CGB & J-tubes >250 years.	Material returned to shore Recovered: 198 m (4.2 Te) Remaining: 0 m Persistence: N/A
		Summary	Options 1 and 2 are largely similar from a societal perspective. There is more material returned to shore under option 2, however this was not considered significant enough to change the scoring from Neutral.	
5. Economic	5.1 Short-term Costs	This sub-criterion addresses the cost of delivering the option as described. No long-term cost element is considered here. Cost uncertainty (a function of activity maturity) is also recorded.	Cost: XX M Cost Risk: Low Risk Factors: High degree of achievability.	Cost: XX M Cost Risk: Medium Risk Factors: Topside engineering for winch locating, pull-in loads and handling of cut sections is not mature / Previous pull-in operations have suffered delays and cost overruns. Historical overruns have been pull-in rather than removal operations.
	5.2 Long-term Costs	This sub-criterion addresses the costs associated with any long-term liabilities such as on-going monitoring and any potential future remediation costs.	No long-term costs, any Monitoring is assumed to be done as part of any CGB monitoring.	No long-term costs associated with this full removal option.
		Summary	Option 1 has a lower cost and cost risk than option 2. Therefore option 1 is Stronger than option 2.	

1. Safety	1. Leave - Cut and Seal	2. Full Removal - Topsides Pull	Priorities
1. Leave - Cut and Seal	N	MS	75.00%
2. Full Removal - Topsides Pull	MW	N	25.00%

2. Environmental	1. Leave - Cut and Seal	2. Full Removal - Topsides Pull	Priorities
1. Leave - Cut and Seal	N	S	60.00%
2. Full Removal - Topsides Pull	W	N	40.00%

3. Technical	1. Leave - Cut and Seal	2. Full Removal - Topsides Pull	Priorities
1. Leave - Cut and Seal	N	N	50.00%
2. Full Removal - Topsides Pull	N	N	50.00%

4. Societal	1. Leave - Cut and Seal	2. Full Removal - Topsides Pull	Priorities
1. Leave - Cut and Seal	N	N	50.00%
2. Full Removal - Topsides Pull	N	N	50.00%

5. Economic	1. Leave - Cut and Seal	2. Full Removal - Topsides Pull	Priorities
1. Leave - Cut and Seal	N	S	60.00%
2. Full Removal - Topsides Pull	W	N	40.00%

Dunlin Decision 2 – Rigid Risers

Pairwise Comparison

xodus GROUP

Project Differentiator Attributes

Differentiator	Sub-Criteria	Description	1. Leave - End Removal - Limited Rock Placement	2. Full removal - Reverse Reel
1. Safety	1.1 Personnel Offshore	This sub-criterion considers elements that impact risk to offshore personnel and includes, project team, project vessel crew, diving teams, supply boat crew, and survey vessel crew. It should be noted that crew changes are performed via port calls.	Total PLL: 3.04E-03 Vessels located on site for Operations: 23.1 days Legacy: 55.9 days	Total PLL: 2.21E-03 Vessels located on site for 26.4 days.
	1.2 Personnel Onshore	This sub-criterion considers elements that impact risk to onshore personnel. Factors such as any requirement for dismantling, disposal operations, material transfer and onshore handling may impact onshore personnel.		
	1.3 Other Users	This sub-criterion covers the impact associated with the risk to other users. Considers elements such as collision impact whilst performing activities. Users such as fishing vessels, commercial transport vessels and military vessels are considered.		
	1.4 High Consequence Events	This sub-criterion relates to any inherent potential for high consequence events i.e. major accident hazard, major environmental hazard type events. It applies to all onshore and offshore personnel involved in the project. Considerations such as dropped object concerns, support vessel risks, are considered.	Low risk of high consequence events - routine.	Medium risk of high consequence events - non-routine. The integrity of the pipeline is assumed by engineering only. Potential for pipeline integrity failure during these operations.
	1.5 Residual Risk	This sub-criterion addresses and residual risk to other sea users i.e. fishermen, military vessel crews, commercial vessel crews and passengers, other sea users, that is provided by the option. Issues such as residual snag risk, collision risk, etc. may be considered.	Residual Risk Legacy: 35 / 23520 / 1.29E-03 Fishing: Negligible additional risk presented to fisherman from spot rock dumped trenched and buried pipeline.	There is no residual legacy risk or risk to fishing operations associated with this option as it is a full removal option.
	Summary		The summed PLL figures for options 1 and 2 (all worker groups and including legacy component where present) are 3.04E-03 and 2.21E-03 respectively. This indicates that option 2 carries a lower risk exposure due to there being no legacy risk component. Vessel durations are higher for option 1 versus option 2 but the risk of high consequence events is higher for option 2 due to non-routine reverse reel and deburial activities. Overall, option 1 is Stronger than option 2 due as the risk for high consequence events associated with option 2 outweighs the lower risk exposure associated with option 1.	
2. Environmental	2.1 Marine Impacts	This sub-criterion covers elements such as noise generated by vessels, cutting operations, explosives etc. It also covers any damaging discharges to sea from vessels and / or activities performed.	Sound Exposure 252 dB re 1mP / 17.2 TPa2s Higher noise from cutting operations.	Sound Exposure 249 dB re 1mP / 7.4 TPa2s
	2.2 Emissions	This sub-criterion relates to the amount of damaging atmospheric emissions associated with a particular option.	CO2: 2829.2 Te NOx: 52.7 Te SO2: 10.7 Te Lifecycle Emissions CO2: 3256.75 Te CO2 Credit (for steel): N/A	CO2: 1627.1 Te NOx: 30.3 Te SO2: 6.2 Te Lifecycle Emissions CO2: 1851.28 Te CO2 Credit (for steel): 205.75 Te
	2.3 Consumption	This sub-criterion relates to the amount of Energy / Resource consumption such as fuel use, recycling of materials, use of quarried rock, production of replacement materials.	Fuel: 892.5 Te Rock: 200 Te	Fuel: 513.3 Te Rock: N/A
	2.4 Disturbance	This sub-criterion relates to both direct and indirect seabed disturbance. Both short and long term impacts are considered.	Disturbance Dredging: 40 m2 Rock Dump: 206 m2	Disturbance Dredging: 48995 m2
	2.5 Protections	This sub-criterion relates to the impact of the options on any protected sites and species.	This option has no impact on protected sites or species.	This option has no impact on protected sites or species.
	Summary		Option 1 is marginally less preferable than option 2 from a noise exposure, emissions and fuel use perspective, although the differences are minimal. There is little to choose between the option from a rock use perspective, especially given that the rock use associated with option 1 is to spot rock dump the exposed ends of the pipeline. Whilst it is noted that the seabed disturbance impact from the dredging operations associated with option 2 is transient in nature compared to the permanent impact of the rock dump associated with option 1, it is over a much larger area than option 1. Overall, option 1 is Stronger than option 2, driven by the substantially larger area of seabed disturbance.	

Project Differentiator Attributes

Differentiator	Sub-Criteria	Description	1. Leave - End Removal - Limited Rock Placement	2. Full removal - Reverse Reel
3. Technical	3.1 Technical Risk	This sub-criterion relates to the various technical risks that could result in a major project failure. Concepts such as: Technical Novelty and Potential for Showstoppers can be captured along with impact on the schedule due to overruns from technical issues such as operations being interrupted by the weather. Technical Feasibility and Technical Maturity is also considered.	Feasibility: High Concept Maturity: High Availability of Technology: High – Off the shelf Track Record: High – Extensive history Risk of Failure: Low Consequence of Failure: Alternate cutting technique / additional rock / limited schedule impacts Emerging Technology: Diverless cutting may be an option.	Feasibility: Medium Concept Maturity: Low Availability of Technology: Medium – Limited number of existing techniques suitable for deburial Track Record: Low – Limited experience of exposing pipelines over extended distances to enable re-reeling Risk of Failure: High Consequence of Failure: Alternate deburial techniques required / Alternate recovery techniques required/ rock required to remedy over trenched areas / large schedule overruns with limited ability to recover. Emerging Technology: N/A
		Summary	Option 1 less technically challenging than option 2 due to uncertainty surrounding the ability to perform deburial of the rigid pipeline. Overall option 1 Much Stronger than option 2 from a technical perspective.	
4. Societal	4.1 Fishing	This sub-criterion addresses the impact of the option on commercial fishing operations. It includes consideration of impacts from both the decommissioning activities any residual impacts post decommissioning such as reinstatement of access to area.	Introduction of small amount of additional rock at ends, alongside existing rock placement. Still overtrawlable in long term, negligible short term impact - no additional exclusions so as is.	Removal of pipeline, still overtrawlable in long term. Negligible short term impact.
	4.2 Other Users	This sub-criterion addresses any socio-economic impacts on other users both onshore where the impact may be from dismantling, transporting, treating, recycling and land filling activities relating to the option and offshore. Issues such as impact on the health, well-being, standard of living, structure or coherence of communities or amenities are considered here e.g. business or jobs creation, increase in noise, dust or odour pollution during the process which has a negative impact on communities, increased traffic disruption due to extra-large transport loads, etc. Includes the FEL Guiding Principle of 'Minimal business interruption to others'.	Material returned to shore Recovered: 30 m pipe (0.65 Te) Remaining: 10242 m pipe 6063 Te Rock (5863 Te Existing + 200 Te new). Persistence: PL2852 >250 years where fully covered.	Material returned to shore Recovered: 10272 m pipe Remaining: 0 m 5863 Te Rock (Existing). Persistence: N/A This option relates to a trenched gas import line so unlikely to be any significant onshore cleaning / treatment required - no LSA. Pipeline is rigid but expected to be in good condition, plastic strain is likely to be such that it would be unusable as an operational pipeline after recovery (may be possible for derated use). Ability to install may be very low so no credit given for re-use.
		Summary	Options 1 and 2 largely similar from a fishing perspective. Option 2 returns more material to shore thus having a benefit from recycling perspective. Overall option 1 Weaker than option 2.	

Project Differentiator Attributes

Differentiator	Sub-Criteria	Description	1. Leave - End Removal - Limited Rock Placement	2. Full removal - Reverse Reel
5. Economic	5.1 Short-term Costs	This sub-criterion addresses the cost of delivering the option as described. No long-term cost element is considered here. Cost uncertainty (a function of activity maturity) is also recorded.	Cost: XX M Cost Risk: Low Risk Factors: High degree of achievability.	Cost: XX M Cost Risk: High Risk Factors: Medium degree of achievability / High likelihood of failure to expose the line fully without multiple deburial techniques and passes / High likelihood of over trenching in sandy areas leading to areas of disturbance that are larger than required.
	5.2 Long-term Costs	This sub-criterion addresses the costs associated with any long-term liabilities such as on-going monitoring and any potential future remediation costs.	Monitoring Cost: XXM Remedial Cost: XXM Cost Risk: Low Risk Factors: Low likelihood of future remediation required due to existing burial depth.	There are no long-term cost liabilities associated with this full removal option.
		Summary	The total costs for options 1 and 2 are XX M, and XX M respectively, which are Neutral. However, option 2 has a high cost risk due to potential for challenges during the deburial operations which could lead to cost escalation. Overall, option 1 is Stronger than option 2 due to potential for cost escalation.	

1. Safety	1. Leave - End Removal - Limited Rock Placement	2. Full removal - Reverse Reel	Priorities
1. Leave - End Removal - Limited Rock Placement	N	S	60.00%
2. Full removal - Reverse Reel	W	N	40.00%

2. Environmental	1. Leave - End Removal - Limited Rock Placement	2. Full removal - Reverse Reel	Priorities
1. Leave - End Removal - Limited Rock Placement	N	S	60.00%
2. Full removal - Reverse Reel	W	N	40.00%

3. Technical	1. Leave - End Removal - Limited Rock Placement	2. Full removal - Reverse Reel	Priorities
1. Leave - End Removal - Limited Rock Placement	N	MS	75.00%
2. Full removal - Reverse Reel	MW	N	25.00%

4. Societal	1. Leave - End Removal - Limited Rock Placement	2. Full removal - Reverse Reel	Priorities
1. Leave - End Removal - Limited Rock Placement	N	W	40.00%
2. Full removal - Reverse Reel	S	N	60.00%

5. Economic	1. Leave - End Removal - Limited Rock Placement	2. Full removal - Reverse Reel	Priorities
1. Leave - End Removal - Limited Rock Placement	N	S	60.00%
2. Full removal - Reverse Reel	W	N	40.00%

Dunlin Decision 3 – Trenched and Buried Pipelines

Pairwise Comparison

xodus GROUP

Project Differentiator Attributes

Differentiator	Sub-Criteria	Description	1. Leave - End Removal - Rock Placement	2. Full Removal - Disconnect and recover
1. Safety	1.1 Personnel Offshore	This sub-criterion considers elements that impact risk to offshore personnel and includes, project team, project vessel crew, diving teams, supply boat crew, and survey vessel crew. It should be noted that crew changes are performed via port calls.	Total PLL: 2.42E-03 Vessels located on site for Operations: 15.1 days Legacy: 40.4 days	Total PLL: 1.30E-03 Vessels located on site for 7.5 days.
	1.2 Personnel Onshore	This sub-criterion considers elements that impact risk to onshore personnel. Factors such as any requirement for dismantling, disposal operations, material transfer and onshore handling may impact onshore personnel.	Low risk of high consequence events - routine.	Low risk of high consequence events - routine.
	1.3 Other Users	This sub-criterion covers the impact associated with the risk to other users. Considers elements such as collision impact whilst performing activities. Users such as fishing vessels, commercial transport vessels and military vessels are considered.	Residual Risk Legacy: 35 / 17220 / 9.47E-04 Fishing: Negligible additional risk presented to fisherman from spot rock dumped surface laid spools.	There is no residual legacy risk or risk to fishing operations associated with this option as it is a full removal option.
	1.4 High Consequence Events	This sub-criterion relates to any inherent potential for high consequence events i.e. major accident hazard, major environmental hazard type events. It applies to all onshore and offshore personnel involved in the project. Considerations such as dropped object concerns, support vessel risks, are considered.	The summed PLL figures for options 1 and 2 (all worker groups and including legacy component where present) are 2.42E-03 and 1.30E-03 respectively. This indicates that option 2 carries lower overall risk, with the main influence being the lack of a legacy risk component. Vessel durations are higher for option 1 versus option 2 whilst risk of high consequence events are similar. Overall, as the differentials are relatively small, option 1 is Weaker than option 2.	
	1.5 Residual Risk	This sub-criterion addresses and residual risk to other sea users i.e. fishermen, military vessel crews, commercial vessel crews and passengers, other sea users, that is provided by the option. Issues such as residual snag risk, collision risk, etc. may be considered.		
	Summary			
2. Environmental	2.1 Marine Impacts	This sub-criterion covers elements such as noise generated by vessels, cutting operations, explosives etc. It also covers any damaging discharges to sea from vessels and / or activities performed.	Sound Exposure 251 dB re 1mP / 13.4 TPa2s Higher noise from cutting operations.	Sound Exposure 236 dB re 1mP / 0.4 TPa2s
	2.2 Emissions	This sub-criterion relates to the amount of damaging atmospheric emissions associated with a particular option.	CO2: 2182.3 Te NOx: 40.6 Te SO2: 8.3 Te Lifecycle Emissions CO2: 2191.42 Te CO2 Credit (for steel): N/A	CO2: 525.1 Te NOx: 9.8 Te SO2: 2.0 Te Lifecycle Emissions CO2: 528.66 Te CO2 Credit (for steel): 2.35 Te
	2.3 Consumption	This sub-criterion relates to the amount of Energy / Resource consumption such as fuel use, recycling of materials, use of quarried rock, production of replacement materials.	Fuel: 688.4 Te Rock: 100 Te	Fuel: 165.7 Te Rock: N/A
	2.4 Disturbance	This sub-criterion relates to both direct and indirect seabed disturbance. Both short and long term impacts are considered.	Disturbance Dredging: 40 m2 Rock Dump: 100 m2	Disturbance Dredging: 920 m2
	2.5 Protections	This sub-criterion relates to the impact of the options on any protected sites and species.	This option has no impact on protected sites or species.	This option has no impact on protected sites or species.
	Summary		Option 2 is preferable to option 1 from a noise exposure, emissions and fuel use perspective albeit the differentials are small. It is difficult to differentiate between the options in terms of seabed disturbance as, whilst there is rock being introduced with option 1, the impacted area is very limited. Whilst option 2 impacts a wider area, it is dredging operations only, the impact of which is considered transient in nature. Option 1 is slightly more appealing. Overall, option 1 and 2 are largely Neutral to each other due to option 1 being slightly worse in nosie / emissons / fuel being offset by option 2 being slighlty worse in seabed disturbance.	

3. Technical	3.1 Technical Risk	This sub-criterion relates to the various technical risks that could result in a major project failure. Concepts such as: Technical Novelty and Potential for Showstoppers can be captured along with impact on the schedule due to overruns from technical issues such as operations being interrupted by the weather. Technical Feasibility and Technical Maturity is also considered.	Feasibility: High Concept Maturity: High Availability of Technology: High – Off the shelf Track Record: High – Extensive history Risk of Failure: Low Consequence of Failure: Alternate cutting technique / additional rock / limited schedule impacts Emerging Technology: N/A	Feasibility: High Concept Maturity: High Availability of Technology: High – Off the shelf Track Record: High – Extensive history Risk of Failure: Low Consequence of Failure: Alternate deburial technique / limited schedule impacts Emerging Technology: N/A
		Summary	Options 1 and 2 are equal technically and are therefore scored as Neutral to each other from a technical perspective.	
4. Societal	4.1 Fishing	This sub-criterion addresses the impact of the option on commercial fishing operations. It includes consideration of impacts from both the decommissioning activities any residual impacts post decommissioning such as reinstatement of access to area.	Negligible change in terms of condition of seabed for fishing operations as area is currently overtrawlable.	Negligible change in terms of condition of seabed for fishing operations as area is currently overtrawlable.
	4.2 Other Users	This sub-criterion addresses any socio-economic impacts on other users both onshore where the impact may be from dismantling, transporting, treating, recycling and land filling activities relating to the option and offshore. Issues such as impact on the health, well-being, standard of living, structure or coherence of communities or amenities are considered here e.g. business or jobs creation, increase in noise, dust or odour pollution during the process which has a negative impact on communities, increased traffic disruption due to extra-large transport loads, etc. Includes the FEL Guiding Principle of 'Minimal business interruption to others'.	Material returned to shore Recovered: 35 m (0.6 Te) Remaining: 92 m 980 Te Rock (880 Te Existing + 100 Te New). Persistence: PL2852 >250 years where fully covered.	Material returned to shore Recovered: 127 m (4 Te) Remaining: 880 Te Rock (Existing). Persistence: N/A.
		Summary	Options 1 and 2 are largely similar from a societal perspective and are therefore scored as Neutral to each other. It should be noted that these items are currently within the 500m zone of Dunlin Alpha. If this 500m zone was to reduce in size, these items are still likely to remain in that new, smaller exclusion zone.	
5. Economic	5.1 Short-term Costs	This sub-criterion addresses the cost of delivering the option as described. No long-term cost element is considered here. Cost uncertainty (a function of activity maturity) is also recorded.	Cost: XX M Cost Risk: Low Risk Factors: High degree of achievability.	Cost: XX M Cost Risk: Low Risk Factors: High degree of achievability / Future liability removed.
	5.2 Long-term Costs	This sub-criterion addresses the costs associated with any long-term liabilities such as on-going monitoring and any potential future remediation costs.	Monitoring Cost: XX M Remedial Cost: XX M Cost Risk: Low Risk Factors: Low likelihood of future remediation required due to existing burial depth and proximity to CGB.	There are no long-term cost liabilities associated with this full removal option.
		Summary	The total costs for options 1 and 2 are XX M, and XX M respectively however option 2 does remove any requirement for future monitoring. Overall, option 1 is considered Weaker than option 2 due to the higher overall cost and future monitoring component.	

1. Safety

	1. Leave - End Removal - Rock Placement	2. Full Removal - Disconnect and recover	Priorities
1. Leave - End Removal - Rock Placement	N	W	40.00%
2. Full Removal - Disconnect and recover	S	N	60.00%

2. Environmental

	1. Leave - End Removal - Rock Placement	2. Full Removal - Disconnect and recover	Priorities
1. Leave - End Removal - Rock Placement	N	N	50.00%
2. Full Removal - Disconnect and recover	N	N	50.00%

3. Technical

	1. Leave - End Removal - Rock Placement	2. Full Removal - Disconnect and recover	Priorities
1. Leave - End Removal - Rock Placement	N	N	50.00%
2. Full Removal - Disconnect and recover	N	N	50.00%

4. Societal

	1. Leave - End Removal - Rock Placement	2. Full Removal - Disconnect and recover	Priorities
1. Leave - End Removal - Rock Placement	N	N	50.00%
2. Full Removal - Disconnect and recover	N	N	50.00%

5. Economic

	1. Leave - End Removal - Rock Placement	2. Full Removal - Disconnect and recover	Priorities
1. Leave - End Removal - Rock Placement	N	W	40.00%
2. Full Removal - Disconnect and recover	S	N	60.00%

Dunlin Decision 4 – Rock Dumped Surface Laid Rigid Spools

Pairwise Comparison

xodus GROUP

Project Differentiator Attributes

Differentiator	Sub-Criteria	Description	1. Leave - End Removal - Limited Rock Placement	2. Leave - End removal - Full - Rock Placement	3. Full Removal - Reverse Reel
1. Safety	1.1 Personnel Offshore	This sub-criterion considers elements that impact risk to offshore personnel and includes, project team, project vessel crew, diving teams, supply boat crew, and survey vessel crew. It should be noted that crew changes are performed via port calls.	Total PLL: 2.45E-03 Vessels located on site for Operations: 18.8 days Legacy: 40.9 days	Total PLL: 2.37E-03 Vessels located on site for Operations: 18.8 days Legacy: 40.9 days	Total PLL: 1.01E-03 Vessels located on site for 6.7 days.
	1.2 Personnel Onshore	This sub-criterion considers elements that impact risk to onshore personnel. Factors such as any requirement for dismantling, disposal operations, material transfer and onshore handling may impact onshore personnel.	Low risk of high consequence events - routine.	Low risk of high consequence events - routine.	Low risk of high consequence events - non-routine due to presence of rock dump, it is not unusual to recover umbilicals. Integrity assumed by engineering, high degree of confidence.
	1.3 Other Users	This sub-criterion covers the impact associated with the risk to other users. Considers elements such as collision impact whilst performing activities. Users such as fishing vessels, commercial transport vessels and military vessels are considered.	Residual Risk Legacy: 35 / 17220 / 9.47E-04 Fishing: Negligible additional risk presented to fisherman from spot rock dumped surface laid umbilicals.	Residual Risk Legacy: 35 / 17220 / 9.47E-04 Fishing: Negligible additional risk presented to fisherman from fully rock dumped surface laid umbilicals.	There is no residual legacy risk or risk to fishing operations associated with this option as it is a full removal option.
	1.4 High Consequence Events	This sub-criterion relates to any inherent potential for high consequence events i.e. major accident hazard, major environmental hazard type events. It applies to all onshore and offshore personnel involved in the project. Considerations such as dropped object concerns, support vessel risks, are considered.			
	1.5 Residual Risk	This sub-criterion addresses and residual risk to other sea users i.e. fishermen, military vessel crews, commercial vessel crews and passengers, other sea users, that is provided by the option. Issues such as residual snag risk, collision risk, etc. may be considered.			
		Summary	The summed PLL figures for options 1, 2 and 3 (all worker groups and including legacy component where present) are 2.45E-03, 2.37E-03 and 1.01E-03 respectively. This indicates that option 3 is the lowest risk for all worker groups, due largely to the lower diver and offshore worker group exposure and the lack of a legacy risk componenet. Options 1 and 2 are very similar in terms of risk exposure. Vessel durations are higher for options 1 and 2 versus option 3 and risk of high consequence events are largely similar accross the options. Overall, options 1 and 2 are Neutral to each other. Both options 1 and 2 are Weaker than option 3 due to them having a higher risk exposure.		
2. Environmental	2.1 Marine Impacts	This sub-criterion covers elements such as noise generated by vessels, cutting operations, explosives etc. It also covers any damaging discharges to sea from vessels and / or activities performed.	Sound Exposure 251 dB re 1mP / 13.6 TPa2s	Sound Exposure 251 dB re 1mP / 13.6 TPa2s	Sound Exposure 236 dB re 1mP / 0.4 TPa2s
	2.2 Emissions	This sub-criterion relates to the amount of damaging atmospheric emissions associated with a particular option.	CO2: 2183.7 Te NOx: 40.6 Te SO2: 8.3 Te Lifecycle CO2: 2198.22 Te CO2 Credit for Steel: N/A	CO2: 2185.7 Te NOx: 40.7 Te SO2: 8.3 Te Lifecycle CO2: 2224.02 Te CO2 Credit for Steel: N/A	CO2: 467.3 Te NOx: 8.7 Te SO2: 1.8 Te Lifecycle CO2: 471.18 Te CO2 Credit for Steel: 3.37 Te
	2.3 Consumption	This sub-criterion relates to the amount of Energy / Resource consumption such as fuel use, recycling of materials, use of quarried rock, production of replacement materials.	Fuel: 688.9 Te Rock: 200 Te	Fuel: 689.5 Te Rock: 900 Te	Fuel: 147.4 Te Rock: N/A
	2.4 Disturbance	This sub-criterion relates to both direct and indirect seabed disturbance. Both short and long term impacts are considered.	Disturbance Dredging: 20 m2 Rock Dump: 200 m2	Disturbance Dredging: 20 m2 Rock Dump: 1800 m2	This option has no associated seabed disturbance.
	2.5 Protections	This sub-criterion relates to the impact of the options on any protected sites and species.	This option has no impact on protected sites or species.	This option has no impact on protected sites or species.	This option has no impact on protected sites or species.
		Summary	Options 1 and 2 are largely comparable in terms of noise exposure, emissions, fuel and rock use. Option 3 is an improvement in each area. There is no seabed disturbance associated with option 3 and whilst still a small area for option 1 and 2, has a requirement for permanent rock dump. Overall, option 1 is Stronger than option 2 due to less seabed disturbance and less rock dump, but Weaker than option 3 due to being less attactive in all areas. Option 2 is Weaker than option 3 for similar reasons.		

Project Differentiator Attributes

Differentiator	Sub-Criteria	Description	1. Leave - End Removal - Limited Rock Placement	2. Leave - End removal - Full - Rock Placement	3. Full Removal - Reverse Reel
3. Technical	3.1 Technical Risk	This sub-criterion relates to the various technical risks that could result in a major project failure. Concepts such as: Technical Novelty and Potential for Showstoppers can be captured along with impact on the schedule due to overruns from technical issues such as operations being interrupted by the weather. Technical Feasibility and Technical Maturity is also considered.	Feasibility: High Concept Maturity: High Availability of Technology: High – Off the shelf Track Record: High – Extensive history Risk of Failure: Low Consequence of Failure: Additional rock requirement / limited schedule impacts Emerging Technology: N/A	Feasibility: High Concept Maturity: High Availability of Technology: High – Off the shelf Track Record: High – Extensive history Risk of Failure: Low Consequence of Failure: Additional rock requirement / limited schedule impacts Emerging Technology: N/A	Feasibility: High Concept Maturity: Medium Availability of Technology: High – Off the shelf Track Record: Low – Limited experience of reverse reeling buried umbilicals Risk of Failure: Low – Initial engineering shows low utilisation values during recovery Consequence of Failure: Alternate recovery techniques required / deburial may be required / limited schedule impacts Emerging Technology: N/A Have reverse reeled this umbilical prior to being rock dumped in the recent past.
		Summary	Options 1 and 2 are equal to each other technically. They both carry less technical risk than option 3. Overall, options 1 and 2 are Neutral to each other and both Stronger than option 3 from a technical perspective.		
4. Societal	4.1 Fishing	This sub-criterion addresses the impact of the option on commercial fishing operations. It includes consideration of impacts from both the decommissioning activities any residual impacts post decommissioning such as reinstatement of access to area.	Negligible change in terms of condition of seabed for fishing operations as area is currently overtrawlable.	Negligible change in terms of condition of seabed for fishing operations as area is currently overtrawlable.	Negligible change in terms of condition of seabed for fishing operations as area is currently overtrawlable.
	4.2 Other Users	This sub-criterion addresses any socio-economic impacts on other users both onshore where the impact may be from dismantling, transporting, treating, recycling and land filling activities relating to the option and offshore. Issues such as impact on the health, well-being, standard of living, structure or coherence of communities or amenities are considered here e.g. business or jobs creation, increase in noise, dust or odour pollution during the process which has a negative impact on communities, increased traffic disruption due to extra-large transport loads, etc. Includes the FEL Guiding Principle of 'Minimal business interruption to others'.	Material returned to shore Recovered: 30 m Umbilical (0.2Te) Remaining: 550 m Umbilical 2917 Te Rock (2717 Te Existing + 200 Te New). Persistence: >100 years (no long term data / experience of polymers in seawater / buried).	Material returned to shore Recovered: 30 m Umbilical (0.2 Te) Remaining: 550 m Umbilical 3617 Te Rock (2717 Te Existing + 900 Te New). Persistence: >100 years (no long term data / experience of polymers in seawater/buried).	Material returned to shore Recovered: 580 m Umbilical (4.6Te) Remaining: 0 m 2717 Te Rock (existing). Persistence: N/A
		Summary	All options see negligible change in terms of fishing conditions (in all cases any existing snags / spans will be removed). All options Neutral to each other from a societal perspective.		
5. Economic	5.1 Short-term Costs	This sub-criterion addresses the cost of delivering the option as described. No long-term cost element is considered here. Cost uncertainty (a function of activity maturity) is also recorded.	Cost: XX M Cost Risk: Low Risk Factors: High degree of achievability.	Cost: XX M Cost Risk: Low Risk Factors: High degree of achievability.	Cost: XX M Cost Risk: Low Risk Factors: Whilst initial engineering indicates a high degree of achievability, potential for deburial operations to increase schedule and cost, although the impact of these overruns is considered low.
	5.2 Long-term Costs	This sub-criterion addresses the costs associated with any long-term liabilities such as on-going monitoring and any potential future remediation costs.	Monitoring Cost: XX M Remedial Cost: XX M Cost Risk: Low Risk Factors: Low likelihood of future remediation required due to proximity to CGB.	Monitoring Cost: XX M Remedial Cost: XX M Cost Risk: Low Risk Factors: Low likelihood of future remediation required due to proximity to CGB.	There are no long-term cost liabilities associated with this full removal option.
		Summary	The total costs for options 1, 2 and 3 are XX M, XX M and XX M respectively. Both options 1 and 2 have lower cost risk with option 3 having a higher potential for cost overruns relating to possible requirement to debury the umbillical. Overall, option 1 and 2 are Neutral to each other. Options 1 and 2 are both Weaker than option 3 due to lower total cost with the cost risk associated with option 3 being insufficient to influence this. Option 3 also removes requirement for on-going monitoring.		

1. Safety	1. Leave - End Removal - Limited Rock Placement	2. Leave - End removal - Full - Rock Placement	3. Full Removal - Reverse Reel	Priorities
1. Leave - End Removal - Limited Rock Placement	N	N	W	28.57%
2. Leave - End removal - Full - Rock Placement	N	N	W	28.57%
3. Full Removal - Reverse Reel	S	S	N	42.86%

2. Environmental	1. Leave - End Removal - Limited Rock Placement	2. Leave - End removal - Full - Rock Placement	3. Full Removal - Reverse Reel	Priorities
1. Leave - End Removal - Limited Rock Placement	N	S	W	32.54%
2. Leave - End removal - Full - Rock Placement	W	N	W	24.83%
3. Full Removal - Reverse Reel	S	S	N	42.63%

3. Technical	1. Leave - End Removal - Limited Rock Placement	2. Leave - End removal - Full - Rock Placement	3. Full Removal - Reverse Reel	Priorities
1. Leave - End Removal - Limited Rock Placement	N	N	S	37.50%
2. Leave - End removal - Full - Rock Placement	N	N	S	37.50%
3. Full Removal - Reverse Reel	W	W	N	25.00%

4. Societal	1. Leave - End Removal - Limited Rock Placement	2. Leave - End removal - Full - Rock Placement	3. Full Removal - Reverse Reel	Priorities
1. Leave - End Removal - Limited Rock Placement	N	N	N	33.33%
2. Leave - End removal - Full - Rock Placement	N	N	N	33.33%
3. Full Removal - Reverse Reel	N	N	N	33.33%

5. Economic	1. Leave - End Removal - Limited Rock Placement	2. Leave - End removal - Full - Rock Placement	3. Full Removal - Reverse Reel	Priorities
1. Leave - End Removal - Limited Rock Placement	N	N	W	28.57%
2. Leave - End removal - Full - Rock Placement	N	N	W	28.57%
3. Full Removal - Reverse Reel	S	S	N	42.86%

Dunlin Decision 5 – Rock Dumped Surface Laid Umbilicals

Pairwise Comparison

xodus GROUP

Project Differentiator Attributes

Differentiator	Sub-Criteria	Description	1. Leave - Outboard Cut and Recover	2. Full Removal - Topsides Pull
1. Safety	1.1 Personnel Offshore	This sub-criterion considers elements that impact risk to offshore personnel and includes, project team, project vessel crew, diving teams, supply boat crew, and survey vessel crew. It should be noted that crew changes are performed via port calls.	Total PLL: 9.46E-04 Vessels located on site for 6 days.	Total PLL: 1.83E-03 Vessels located on site for 16 days.
	1.2 Personnel Onshore	This sub-criterion considers elements that impact risk to onshore personnel. Factors such as any requirement for dismantling, disposal operations, material transfer and onshore handling may impact onshore personnel.	Low risk of high consequence events - routine.	Medium risk of high consequence events - non-routine, not unusual.
	1.3 Other Users	This sub-criterion covers the impact associated with the risk to other users. Considers elements such as collision impact whilst performing activities. Users such as fishing vessels, commercial transport vessels and military vessels are considered.	There is no residual risk associated with this option as it is wholly within the 500m exclusion zone and all outboard elements are fully removed.	There is no residual risk associated with this full removal option.
	1.4 High Consequence Events	This sub-criterion relates to any inherent potential for high consequence events i.e. major accident hazard, major environmental hazard type events. It applies to all onshore and offshore personnel involved in the project. Considerations such as dropped object concerns, support vessel risks, are considered.		
	1.5 Residual Risk	This sub-criterion addresses and residual risk to other sea users i.e. fishermen, military vessel crews, commercial vessel crews and passengers, other sea users, that is provided by the option. Issues such as residual snag risk, collision risk, etc. may be considered.		
		Summary	The summed PLL figures for options 1 and 2 (all worker groups and including legacy component where present) are 9.46E-04 and 1.83E-03 respectively. This indicates that option 1 is lower than option 2, driven by the marginally higher exposure associated with the offshore, topsides and onshore worker groups for option 2. Option 1 is also slightly shorter duration. Overall, option 1 is Much Stronger than option 2 from a safety perspective.	
2. Environmental	2.1 Marine Impacts	This sub-criterion covers elements such as noise generated by vessels, cutting operations, explosives etc. It also covers any damaging discharges to sea from vessels and / or activities performed.	Sound Exposure 239 dB re 1mP / 0.8 TPa2s	Sound Exposure 245 dB re 1mP / 3.0 TPa2s
	2.2 Emissions	This sub-criterion relates to the amount of damaging atmospheric emissions associated with a particular option.	CO2: 415.0 Te NOx: 7.7 Te SO2: 1.6 Te Lifecycle CO2: 443.08 Te CO2 Credit for Steel: N/A	CO2: 732.0 Te NOx: 13.6 Te SO2: 2.8 Te Lifecycle CO2: 747.66 Te CO2 Credit for Steel: 2.69 Te
	2.3 Consumption	This sub-criterion relates to the amount of Energy / Resource consumption such as fuel use, recycling of materials, use of quarried rock, production of replacement materials.	Fuel: 130.9 Te Rock: None	Fuel: 230.9 Te Rock: None
	2.4 Disturbance	This sub-criterion relates to both direct and indirect seabed disturbance. Both short and long term impacts are considered.	This option has no associated seabed disturbance.	This option has no associated seabed disturbance.
	2.5 Protections	This sub-criterion relates to the impact of the options on any protected sites and species.	This option has no impact on protected sites or species.	This option has no impact on protected sites or species.
		Summary	Option 1 is either equal to or marginally better than option 2 in all areas. As such, option 1 is Stronger than option 2 from an environmental perspective due to the cumulative effect of these marginal improvements.	

Project Differentiator Attributes

Differentiator	Sub-Criteria	Description	1. Leave - Outboard Cut and Recover	2. Full Removal - Topsides Pull
3. Technical	3.1 Technical Risk	This sub-criterion relates to the various technical risks that could result in a major project failure. Concepts such as: Technical Novelty and Potential for Showstoppers can be captured along with impact on the schedule due to overruns from technical issues such as operations being interrupted by the weather. Technical Feasibility and Technical Maturity is also considered.	Feasibility: High. Concept Maturity: High. Availability of Technology: High – Off the shelf. Track Record: High – Extensive history of similar work. Risk of Failure: Low. Consequence of Failure: Limited schedule impacts. Emerging Technology: Diverless cutting may be an option.	Feasibility: High Concept Maturity: Medium - final details for performing task are yet to be defined, platform crane, winch placement and operations, etc. Availability of Technology: High – Off the shelf Track Record: High – Extensive history in North Sea and recent history on Dunlin. Risk of Failure: Medium – Unknown integrity of J-tube / cable and inability to inspect. Consequence of Failure: Cable would remain within J-tube / schedule overruns Emerging Technology: N/A.
		Summary	Option 1 carries significantly less technical risk than option 2 due largely to the potential / consequence of failure related to j-tube integrity uncertainty. Overall option 1 considered Stronger than option 2 from a Technical Feasibility perspective.	
4. Societal	4.1 Fishing	This sub-criterion addresses the impact of the option on commercial fishing operations. It includes consideration of impacts from both the decommissioning activities any residual impacts post decommissioning such as reinstatement of access to area.	Will not remain on seabed - no long term exposure.	Will not remain on seabed - no long term exposure.
	4.2 Other Users	This sub-criterion addresses any socio-economic impacts on other users both onshore where the impact may be from dismantling, transporting, treating, recycling and land filling activities relating to the option and offshore. Issues such as impact on the health, well-being, standard of living, structure or coherence of communities or amenities are considered here e.g. business or jobs creation, increase in noise, dust or odour pollution during the process which has a negative impact on communities, increased traffic disruption due to extra-large transport loads, etc. Includes the FEL Guiding Principle of 'Minimal business interruption to others'.	Material returned to shore Recovered: 300 m Cable Remaining: 180 m Cable (within J-tube) Persistence: In-line with CGB & J-tubes >250 years.	Material returned to shore Recovered: 480 m Cable Remaining: 0 m Persistence: N/A
		Summary	Options 1 and 2 are largely similar from a societal perspective. There is more material returned to shore under option 2, however this was not considered significant enough to change the scoring from Neutral.	
5. Economic	5.1 Short-term Costs	This sub-criterion addresses the cost of delivering the option as described. No long-term cost element is considered here. Cost uncertainty (a function of activity maturity) is also recorded.	Cost: XX M Cost Risk: Low Risk Factors: High degree of achievability.	Cost: XX M Cost Risk: Medium Risk Factors: Topside engineering for winch locating is not mature / inspection to confirm integrity of J-tube and cable is not possible / previous pull-in operations have suffered delays and cost overruns. Historical overruns have been pull-in rather than removal operations.
	5.2 Long-term Costs	This sub-criterion addresses the costs associated with any long-term liabilities such as on-going monitoring and any potential future remediation costs.	No long-term costs, any Monitoring is assumed to be done as part of any CGB monitoring.	No long-term costs associated with this full removal option.
		Summary	Option 1 has a lower cost and cost risk than option 2. Therefore option 1 is Stronger than option 2.	

1. Safety

	1. Leave - Outboard Cut and Recover	2. Full Removal - Topsides Pull	Priorities
1. Leave - Outboard Cut and Recover	N	MS	75.00%
2. Full Removal - Topsides Pull	MW	N	25.00%

2. Environmental

	1. Leave - Outboard Cut and Recover	2. Full Removal - Topsides Pull	Priorities
1. Leave - Outboard Cut and Recover	N	S	60.00%
2. Full Removal - Topsides Pull	W	N	40.00%

3. Technical

	1. Leave - Outboard Cut and Recover	2. Full Removal - Topsides Pull	Priorities
1. Leave - Outboard Cut and Recover	N	S	60.00%
2. Full Removal - Topsides Pull	W	N	40.00%

4. Societal

	1. Leave - Outboard Cut and Recover	2. Full Removal - Topsides Pull	Priorities
1. Leave - Outboard Cut and Recover	N	N	50.00%
2. Full Removal - Topsides Pull	N	N	50.00%

5. Economic

	1. Leave - Outboard Cut and Recover	2. Full Removal - Topsides Pull	Priorities
1. Leave - Outboard Cut and Recover	N	S	60.00%
2. Full Removal - Topsides Pull	W	N	40.00%

Dunlin Decision 6 – Riser Cable (Dunlin)

Pairwise Comparison

xodus GROUP

Project Differentiator Attributes

Differentiator	Sub-Criteria	Description	1. Leave - End Removal - Limited Rock Placement	2. Leave - End / Span / Exposure removal - Extensive Rock Placement	3. Full Removal - Reverse Reel
1. Safety	1.1 Personnel Offshore	This sub-criterion considers elements that impact risk to offshore personnel and includes, project team, project vessel crew, diving teams, supply boat crew, and survey vessel crew. It should be noted that crew changes are performed via port calls.	Total PLL: 3.68E-03 Vessels located on site for Operations: 27.4 days Legacy: 73 days	Total PLL: 4.57E-03 Vessels located on site for Operations: 30.2 days Legacy: 73 days	Total PLL: 4.17E-03 Vessels located on site for 39.6 days.
	1.2 Personnel Onshore	This sub-criterion considers elements that impact risk to onshore personnel. Factors such as any requirement for dismantling, disposal operations, material transfer and onshore handling may impact onshore personnel.			
	1.3 Other Users	This sub-criterion covers the impact associated with the risk to other users. Considers elements such as collision impact whilst performing activities. Users such as fishing vessels, commercial transport vessels and military vessels are considered.			
	1.4 High Consequence Events	This sub-criterion relates to any inherent potential for high consequence events i.e. major accident hazard, major environmental hazard type events. It applies to all onshore and offshore personnel involved in the project. Considerations such as dropped object concerns, support vessel risks, are considered.	Low risk of high consequence events - routine.	Low risk of high consequence events - routine.	Low risk of high consequence events - non-routine but not unusual to recover umbilicals / cables. Length is a factor, as is diameter and requirement to de-bury cable prior to reverse reeling.
	1.5 Residual Risk	This sub-criterion addresses and residual risk to other sea users i.e. fishermen, military vessel crews, commercial vessel crews and passengers, other sea users, that is provided by the option. Issues such as residual snag risk, collision risk, etc. may be considered.	Residual Risk Legacy: 35 / 30660 / 1.69E-03 Fishing: Negligible additional risk presented to fisherman from spot rock dumped cable.	Residual Risk Legacy: 35 / 30660 / 1.69E-03 Fishing: Negligible additional risk presented to fisherman from fully rock dumped cable.	There is no legacy or additional fishing risk associated with this full removal option.
	Summary		The summed PLL figures for options 1, 2 and 3 (all worker groups and including legacy component where present) are 3.68E-03, 4.57E-03 and 4.17E-03 respectively. This indicates that option 1 is the lowest risk for all worker groups, due to low diver exposure and much lower onshore exposure. Option 3 carries the next lowest exposure with low diver hours and no legacy risk component being offset by the higher number of onshore hours. Finally, option 2 has the highest risk profile due to the much higher number of divers hours in comparison with the other options. Vessel durations and risk of high consequence events are similar between options 1 and 2 with option 3 being a lower due to no legacy component. The options are equal in terms of risk of high consequence events. Overall, option 1 is Stronger than option 2 as it has a lower risk exposure. Option 1 is Weaker than option 3 as it has a higher risk exposure. Option 2 is also weaker than option 3 as it has a higher risk exposure.		
2. Environmental	2.1 Marine Impacts	This sub-criterion covers elements such as noise generated by vessels, cutting operations, explosives etc. It also covers any damaging discharges to sea from vessels and / or activities performed.	Sound Exposure 253 dB re 1mP / 21.9 TPa2s	Sound Exposure 254 dB re 1mP / 23.9 TPa2s	Sound Exposure 251 dB re 1mP / 12.0 TPa2s
	2.2 Emissions	This sub-criterion relates to the amount of damaging atmospheric emissions associated with a particular option.	CO2: 3612.2 Te NOx: 67.2 Te SO2: 13.7 Te Lifecycle CO2: 6539.58 Te CO2 Credit for Steel: N/A	CO2: 3807.5 Te NOx: 70.9 Te SO2: 14.4 Te Lifecycle CO2: 6700.05 Te CO2 Credit for Steel: N/A	CO2: 2761.0 Te NOx: 51.4 Te SO2: 10.5 Te Lifecycle CO2: 3127.53 Te CO2 Credit for Steel: 318.05 Te
	2.3 Consumption	This sub-criterion relates to the amount of Energy / Resource consumption such as fuel use, recycling of materials, use of quarried rock, production of replacement materials.	Fuel: 1139.5 Te Rock: 22300 Te	Fuel: 1201.1 Te Rock: 21600 Te	Fuel: 871.0 Te Rock: N/A
	2.4 Disturbance	This sub-criterion relates to both direct and indirect seabed disturbance. Both short and long term impacts are considered.	Disturbance Dredging: 40 m2 Rock Dump: 25800 m2	Disturbance Dredging: 120 m2 Rock Dump: 25000 m2	Disturbance Dredging: 106485 m2
	2.5 Protections	This sub-criterion relates to the impact of the options on any protected sites and species.	This option has no impact on protected sites or species.	This option has no impact on protected sites or species.	This option has no impact on protected sites or species.
	Summary		Option 1 and 2 are largely comparable in terms of noise exposure, emissions, fuel and rock use, with option 3 being an improvement in each area. Both options 1 and 2 do introduce a significant amount of (largely comparable) new material and permanent seabed impact when compared to the option 3. The transient seabed disturbance (dredging) is largely similar for options 1 and 2. Option 3 has a much greater transient seabed disturbance area however the temporary nature of this impact offsets the larger area. Overall, option 1 and 2 are Neutral to each other. Option 1 and 2 are considered Weaker than option 3 due to the introduction of rock dump (and hence permanent seabed impact) and higher noise / emissions / fuel / rock use.		

Project Differentiator Attributes

Differentiator	Sub-Criteria	Description	1. Leave - End Removal - Limited Rock Placement	2. Leave - End / Span / Exposure removal - Extensive Rock Placement	3. Full Removal - Reverse Reel
3. Technical	3.1 Technical Risk	This sub-criterion relates to the various technical risks that could result in a major project failure. Concepts such as: Technical Novelty and Potential for Showstoppers can be captured along with impact on the schedule due to overruns from technical issues such as operations being interrupted by the weather. Technical Feasibility and Technical Maturity is also considered.	Feasibility: High Concept Maturity: High Availability of Technology: High – Off the shelf Track Record: High – Extensive history Risk of Failure: Low Consequence of Failure: Alternate cutting technique / additional rock / limited schedule impacts Emerging Technology: Diverless cutting may be an option.	Feasibility: High Concept Maturity: High Availability of Technology: High – Off the shelf Track Record: High – Extensive history Risk of Failure: Low Consequence of Failure: Alternate cutting technique / additional rock / limited schedule impacts Emerging Technology: Diverless cutting may be an option.	Feasibility: Medium Concept Maturity: Low Availability of Technology: Medium – Limited number of existing techniques suitable for deburial - soils / clays in area not conducive to deburial Track Record: Low – Limited experience of exposing cables over extended distances to enable re-reeling Risk of Failure: High Consequence of Failure: Alternate deburial techniques required / Alternate recovery techniques required/ rock required to remedy over dredged areas / large schedule overruns with limited ability to recover. Emerging Technology: N/A The length of challenging operations pushes the assessment to VMW than alternatives.
	Summary		Options 1 and 2 are equal to each other technically. They both carry much less technical risk than option 3 due to the uncertainty surrounding the ability to successfully debury the cable, particularly in areas where soils / clays are not conducive to simple deburial operations and the length (21 km) over which these operations need to be performed. Overall, options 1 and 2 are Neutral to each other and both Very Much Stronger than option 3 from a technical perspective.		
4. Societal	4.1 Fishing	This sub-criterion addresses the impact of the option on commercial fishing operations. It includes consideration of impacts from both the decommissioning activities any residual impacts post decommissioning such as reinstatement of access to area.	Exposures (not spans) so no material change to fishing.	No material change to fishing.	No material change to fishing.
	4.2 Other Users	This sub-criterion addresses any socio-economic impacts on other users both onshore where the impact may be from dismantling, transporting, treating, recycling and land filling activities relating to the option and offshore. Issues such as impact on the health, well-being, standard of living, structure or coherence of communities or amenities are considered here e.g. business or jobs creation, increase in noise, dust or odour pollution during the process which has a negative impact on communities, increased traffic disruption due to extra-large transport loads, etc. Includes the FEL Guiding Principle of 'Minimal business interruption to others'.	Material returned to shore Recovered: 100 m Cable Remaining: 21303 m Cable 33912 Te Rock (11612 Te Existing + 22300 Te New). Persistence: >100 years (no long term data / experience of polymers in seawater / buried). Requires minor excursion into Brent 500m zone but not sufficient disruption to influence assessment.	Material returned to shore Recovered: 260m Cable Remaining: 21223 m Cable 33212 Te Rock (11612 Te Existing + 21600 Te New). Persistence: >100 years (no long term data/experience of polymers in seawater/buried). Requires minor excursion into Brent 500m zone but not sufficient disruption to influence assessment.	Material returned to shore Recovered: 21403 m Cable (726.5 Te) Remaining: 11612 Te Rock (Existing). Persistence: N/A Some societal benefits from retrieval of copper including value. There are challenges associated with disposal routes for returned umbilical.
	Summary		There is a societal benefit associated with the copper that can be reclaimed under option 3, however there is also a large amount of material that is not recyclable which offsets that benefit. Overall options 1 and 2 are identical so are scored Neutral to each other. Options 1 and 2 are Stronger than option 3 due to the amount of non-recyclable material returned.		
5. Economic	5.1 Short-term Costs	This sub-criterion addresses the cost of delivering the option as described. No long-term cost element is considered here. Cost uncertainty (a function of activity maturity) is also recorded.	Cost: XX M Cost Risk: Low Risk Factors: High degree of achievability.	Cost: XX M Cost Risk: Low Risk Factors: High degree of achievability.	Cost: XX M Cost Risk: Very High Risk Factors: Medium degree of achievability / High likelihood of failure to expose the line fully without multiple deburial techniques and passes / High likelihood of over trenching in sandy areas leading to areas of disturbance that are larger than required with potential remediation required.
	5.2 Long-term Costs	This sub-criterion addresses the costs associated with any long-term liabilities such as on-going monitoring and any potential future remediation costs.	Monitoring Cost: XXM Remedial Cost: XXM Cost Risk: Low Risk Factors: Low likelihood of future remediation required due to existing burial depth.	Monitoring Cost: XXM Remedial Cost: XXM Cost Risk: Low Risk Factors: Low likelihood of future remediation required due to existing burial depth.	No long-term costs associated with this full removal option.
	Summary		The total costs for options 1, 2 and 3 are XX M, XX M and XX M respectively. Both options 1 and 2 have lower cost risk than option 3 which has higher potential for cost overruns relating to deburial of 21km of umbilical in challenging soils and clays. Overall, option 1 is Stronger than option 2 due to lower cost, and Much Stronger than option 3 due to potential overruns associated with option 3. Option 2 is Much Stronger than option 3 as, whilst option 3 is slightly lower cost with no legacy component, the potential for significant cost overrun more than offsets that small benefit.		

1. Safety

	1. Leave - End Removal - Limited Rock Placement	2. Leave - End / Span / Exposure removal - Extensive Rock Placement	3. Full Removal - Reverse Reel	Priorities
1. Leave - End Removal - Limited Rock Placement	N	S	W	32.54%
2. Leave - End / Span / Exposure removal - Extensive Rock Placement	W	N	W	24.83%
3. Full Removal - Reverse Reel	S	S	N	42.63%

2. Environmental

	1. Leave - End Removal - Limited Rock Placement	2. Leave - End / Span / Exposure removal - Extensive Rock Placement	3. Full Removal - Reverse Reel	Priorities
1. Leave - End Removal - Limited Rock Placement	N	N	W	28.57%
2. Leave - End / Span / Exposure removal - Extensive Rock Placement	N	N	W	28.57%
3. Full Removal - Reverse Reel	S	S	N	42.86%

3. Technical

	1. Leave - End Removal - Limited Rock Placement	2. Leave - End / Span / Exposure removal - Extensive Rock Placement	3. Full Removal - Reverse Reel	Priorities
1. Leave - End Removal - Limited Rock Placement	N	N	VMS	47.37%
2. Leave - End / Span / Exposure removal - Extensive Rock Placement	N	N	VMS	47.37%
3. Full Removal - Reverse Reel	VMW	VMW	N	5.26%

4. Societal

	1. Leave - End Removal - Limited Rock Placement	2. Leave - End / Span / Exposure removal - Extensive Rock Placement	3. Full Removal - Reverse Reel	Priorities
1. Leave - End Removal - Limited Rock Placement	N	N	S	37.50%
2. Leave - End / Span / Exposure removal - Extensive Rock Placement	N	N	S	37.50%
3. Full Removal - Reverse Reel	W	W	N	25.00%

5. Economic

	1. Leave - End Removal - Limited Rock Placement	2. Leave - End / Span / Exposure removal - Extensive Rock Placement	3. Full Removal - Reverse Reel	Priorities
1. Leave - End Removal - Limited Rock Placement	N	S	MS	48.68%
2. Leave - End / Span / Exposure removal - Extensive Rock Placement	W	N	MS	37.15%
3. Full Removal - Reverse Reel	MW	MW	N	14.17%

Dunlin Decision 7 – Trenched and Buried Cable

Pairwise Comparison

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Project Differentiator Attributes

Differentiator	Sub-Criteria	Description	1. Leave - Outboard Cut and Recover	2. Full Removal - Topsides Pull	
1. Safety	1.1 Personnel Offshore	This sub-criterion considers elements that impact risk to offshore personnel and includes, project team, project vessel crew, diving teams, supply boat crew, and survey vessel crew. It should be noted that crew changes are performed via port calls.	Total PLL: 9.46E-04 Vessels located on site for 6 days.	Total PLL: 1.83E-03 Vessels located on site for 16 days.	
	1.2 Personnel Onshore	This sub-criterion considers elements that impact risk to onshore personnel. Factors such as any requirement for dismantling, disposal operations, material transfer and onshore handling may impact onshore personnel.	Low risk of high consequence events - routine.	Medium risk of high consequence events - non-routine, not unusual.	
	1.3 Other Users	This sub-criterion covers the impact associated with the risk to other users. Considers elements such as collision impact whilst performing activities. Users such as fishing vessels, commercial transport vessels and military vessels are considered.	There is no residual risk associated with this option as it is wholly within the 500m exclusion zone and all outboard elements are fully removed.	There is no residual risk associated with this full removal option.	
	1.4 High Consequence Events	This sub-criterion relates to any inherent potential for high consequence events i.e. major accident hazard, major environmental hazard type events. It applies to all onshore and offshore personnel involved in the project. Considerations such as dropped object concerns, support vessel risks, are considered.			
	1.5 Residual Risk	This sub-criterion addresses and residual risk to other sea users i.e. fishermen, military vessel crews, commercial vessel crews and passengers, other sea users, that is provided by the option. Issues such as residual snag risk, collision risk, etc. may be considered.			
		Summary	The summed PLL figures for options 1 and 2 (all worker groups and including legacy component where present) are 9.46E-04 and 1.83E-03 respectively. This indicates that option 1 is lower than option 2, driven by the marginally higher exposure associated with the offshore, topsides and onshore worker groups for option 2. Option 1 is also slightly shorter duration. Overall, option 1 is Much Stronger than option 2 from a safety perspective.		The summed PLL figures for options 1 and 2 (all worker groups and including legacy component where present) are 9.46E-04 and 1.83E-03 respectively. This indicates that option 1 is lower than option 2, driven by the marginally higher exposure associated with the offshore, topsides and onshore worker groups for option 2. Option 1 is also slightly shorter duration. Overall, option 1 is Much Stronger than option 2 from a safety perspective.
2. Environmental	2.1 Marine Impacts	This sub-criterion covers elements such as noise generated by vessels, cutting operations, explosives etc. It also covers any damaging discharges to sea from vessels and / or activities performed.	Sound Exposure 239 dB re 1mP / 0.8 TPa2s Lower than option 2 but very similar.	Sound Exposure 245 dB re 1mP / 3.0 TPa2s	
	2.2 Emissions	This sub-criterion relates to the amount of damaging atmospheric emissions associated with a particular option.	CO2: 415 Te NOx: 7.7 Te SO2: 1.6 Te Lifecycle CO2: 443.08 Te CO2 Credit for Steel: N/A	CO2: 732.0 Te NOx: 13.6 Te SO2: 2.8 Te Lifecycle CO2: 747.66 Te CO2 Credit for Steel: 2.69 Te	
	2.3 Consumption	This sub-criterion relates to the amount of Energy / Resource consumption such as fuel use, recycling of materials, use of quarried rock, production of replacement materials.	Fuel: 130.9 Te Rock: None	Fuel: 230.9 Te Rock: None	
	2.4 Disturbance	This sub-criterion relates to both direct and indirect seabed disturbance. Both short and long term impacts are considered.	This option has no associated seabed disturbance.	This option has no associated seabed disturbance.	
	2.5 Protections	This sub-criterion relates to the impact of the options on any protected sites and species.	This option has no impact on protected sites or species.	This option has no impact on protected sites or species.	
		Summary	Option 1 is either equal to or marginally better than option 2 in all areas. As such, option 1 is Stronger than option 2 from an environmental perspective due to the cumulative effect of these marginal improvements.		Option 1 is either equal to or marginally better than option 2 in all areas. As such, option 1 is Stronger than option 2 from an environmental perspective due to the cumulative effect of these marginal improvements.
3. Technical	3.1 Technical Risk	This sub-criterion relates to the various technical risks that could result in a major project failure. Concepts such as: Technical Novelty and Potential for Showstoppers can be captured along with impact on the schedule due to overruns from technical issues such as operations being interrupted by the weather. Technical Feasibility and Technical Maturity is also considered.	Feasibility: High. Concept Maturity: High. Availability of Technology: High – Off the shelf. Track Record: High – Extensive history of similar work. Risk of Failure: Low. Consequence of Failure: Limited schedule impacts. Emerging Technology: Diverless cutting may be an option.	Feasibility: High Concept Maturity: Medium - final details for performing task are yet to be defined, platform crane, winch placement and operations, etc. Availability of Technology: High – Off the shelf Track Record: High – Extensive history in North Sea and recent history on Dunlin. Risk of Failure: Medium – Unknown integrity of J-tube / cable and inability to inspect. Consequence of Failure: Cable would remain within J-tube / schedule over runs Emerging Technology: N/A.	
		Summary	Option 1 carries significantly less technical risk than option 2 due largely to the potential / consequence of failure related to j-tube integrity uncertainty. Overall option 1 considered Stronger than option 2 from a Technical Feasibility perspective.		Option 1 carries significantly less technical risk than option 2 due largely to the potential / consequence of failure related to j-tube integrity uncertainty. Overall option 1 considered Stronger than option 2 from a Technical Feasibility perspective.
4. Societal	4.1 Fishing	This sub-criterion addresses the impact of the option on commercial fishing operations. It includes consideration of impacts from both the decommissioning activities any residual impacts post decommissioning such as reinstatement of access to area.	Will not remain on seabed - no long term exposure.	Will not remain on seabed - no long term exposure.	
	4.2 Other Users	This sub-criterion addresses any socio-economic impacts on other users both onshore where the impact may be from dismantling, transporting, treating, recycling and land filling activities relating to the option and offshore. Issues such as impact on the health, well-being, standard of living, structure or coherence of communities or amenities are considered here e.g. business or jobs creation, increase in noise, dust or odour pollution during the process which has a negative impact on communities, increased traffic disruption due to extra-large transport loads, etc. Includes the FEL Guiding Principle of 'Minimal business interruption to others'.	Material returned to shore Recovered: 300 m Cable Remaining: 180 m Cable (within J-tube) Persistence: In-line with CGB & J-tubes >250 years.	Material returned to shore Recovered: 480 m Cable Remaining: 0m Persistence: N/A	
		Summary	Options 1 and 2 are largely similar from a societal perspective. There is more material returned to shore under option 2, however this was not considered significant enough to change the scoring from Neutral.		Options 1 and 2 are largely similar from a societal perspective. There is more material returned to shore under option 2, however this was not considered significant enough to change the scoring from Neutral.
5. Economic	5.1 Short-term Costs	This sub-criterion addresses the cost of delivering the option as described. No long-term cost element is considered here. Cost uncertainty (a function of activity maturity) is also recorded.	Cost: XX M Cost Risk: Low Risk Factors: High degree of achievability.	Cost: XX M Cost Risk: Medium Risk Factors: Topside engineering for winch locating is not mature / inspection to confirm integrity of J-tube and cable is not possible / previous pull-in operations have suffered delays and cost overruns. Historical overruns have been pull-in rather than removal operations.	

Project Differentiator Attributes

Differentiator	Sub-Criteria	Description	1. Leave - Outboard Cut and Recover	2. Full Removal - Topsides Pull
	5.2 Long-term Costs	This sub-criterion addresses the costs associated with any long-term liabilities such as on-going monitoring and any potential future remediation costs.	No long-term costs, any Monitoring is assumed to be done as part of any CGB monitoring.	No long-term costs associated with this full removal option.
		Summary	Option 1 has a lower cost and cost risk than option 2. Therefore option 1 is Stronger than option 2.	

Option 1 has a lower cost and cost risk than option 2. Therefore option 1 is Stronger than option 2.

Notes:

All project differentiators and project options defined on the 'Define' sheet will be repeated here. In this sheet, the description of what each of the project differentiators are should be provided in the indicated section. Additionally, all differentiators for each of the project options should be detailed.

1. Safety

	1. Leave - Outboard Cut and Recover	2. Full Removal - Topsides Pull	Priorities
1. Leave - Outboard Cut and Recover	N	MS	75.00%
2. Full Removal - Topsides Pull	MW	N	25.00%

2. Environmental

	1. Leave - Outboard Cut and Recover	2. Full Removal - Topsides Pull	Priorities
1. Leave - Outboard Cut and Recover	N	S	60.00%
2. Full Removal - Topsides Pull	W	N	40.00%

3. Technical

	1. Leave - Outboard Cut and Recover	2. Full Removal - Topsides Pull	Priorities
1. Leave - Outboard Cut and Recover	N	S	60.00%
2. Full Removal - Topsides Pull	W	N	40.00%

4. Societal

	1. Leave - Outboard Cut and Recover	2. Full Removal - Topsides Pull	Priorities
1. Leave - Outboard Cut and Recover	N	N	50.00%
2. Full Removal - Topsides Pull	N	N	50.00%

5. Economic

	1. Leave - Outboard Cut and Recover	2. Full Removal - Topsides Pull	Priorities
1. Leave - Outboard Cut and Recover	N	S	60.00%
2. Full Removal - Topsides Pull	W	N	40.00%

Dunlin Decision 8 – Riser Cable (Third Party)

Pairwise Comparison

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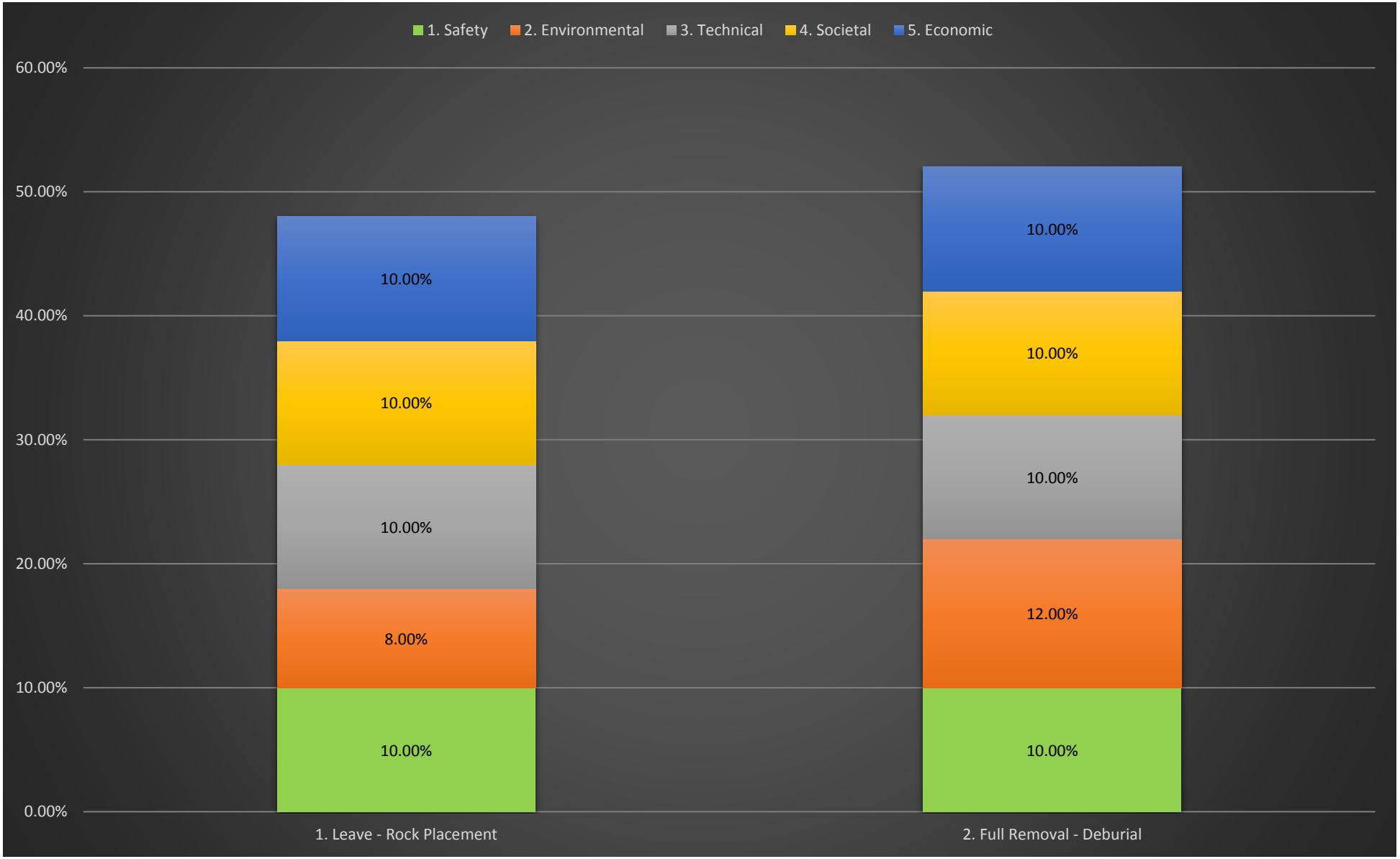
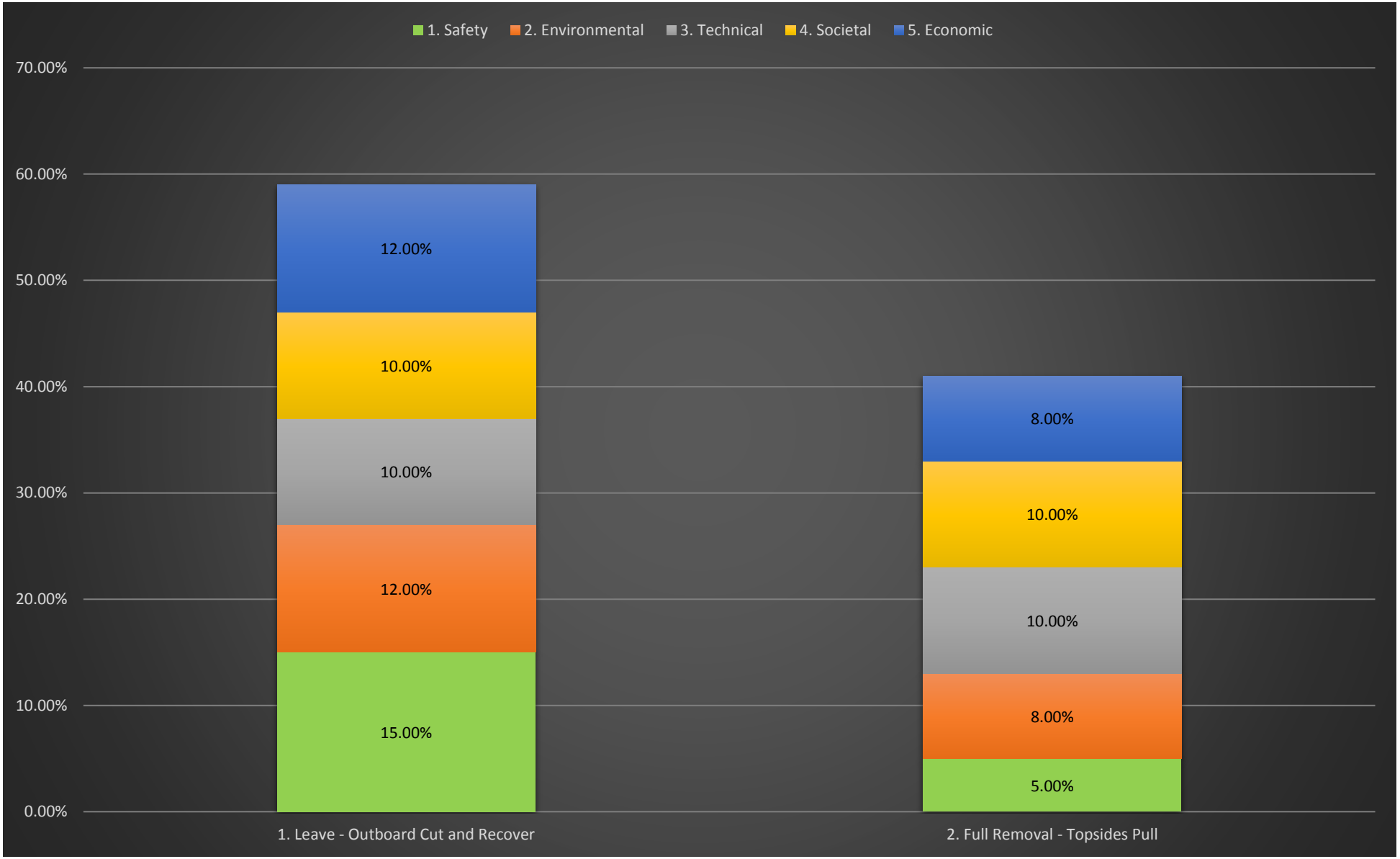
Appendix G Output Charts

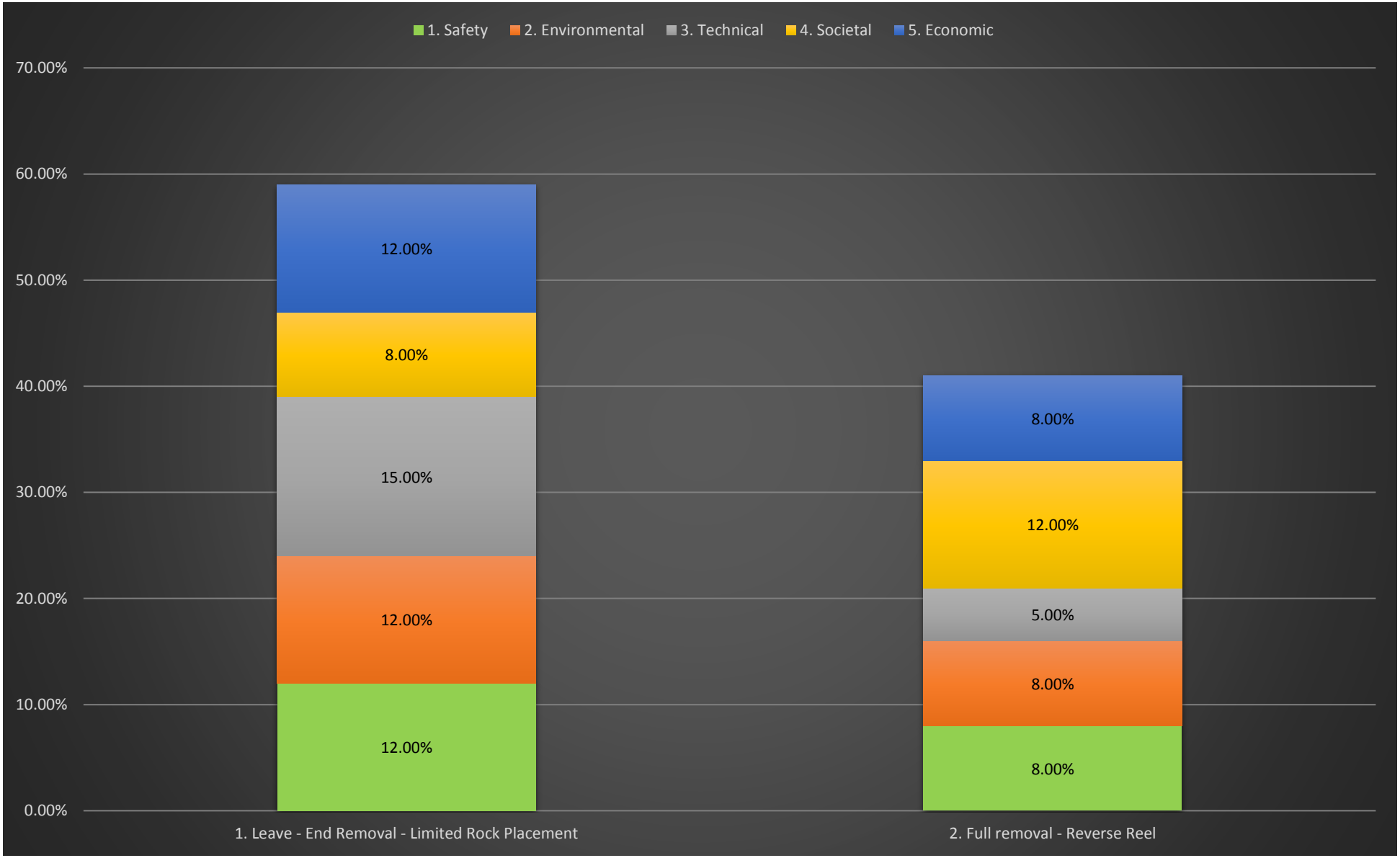
Dunlin Group 2 - Buried Structures and Deposits - Results (5 Criteria)



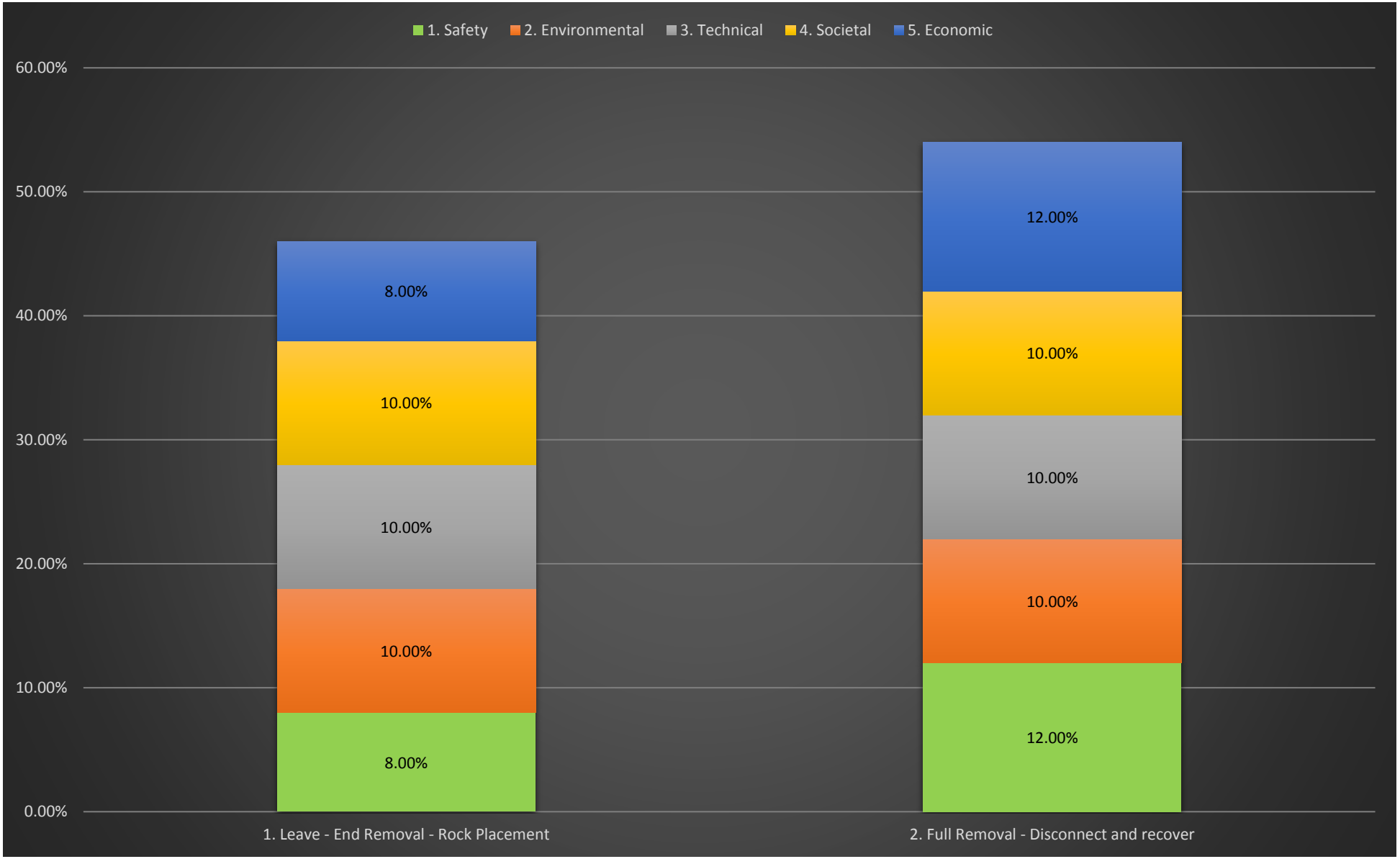
Dunlin Group 3 - Rigid Riser - Results (5 Criteria)



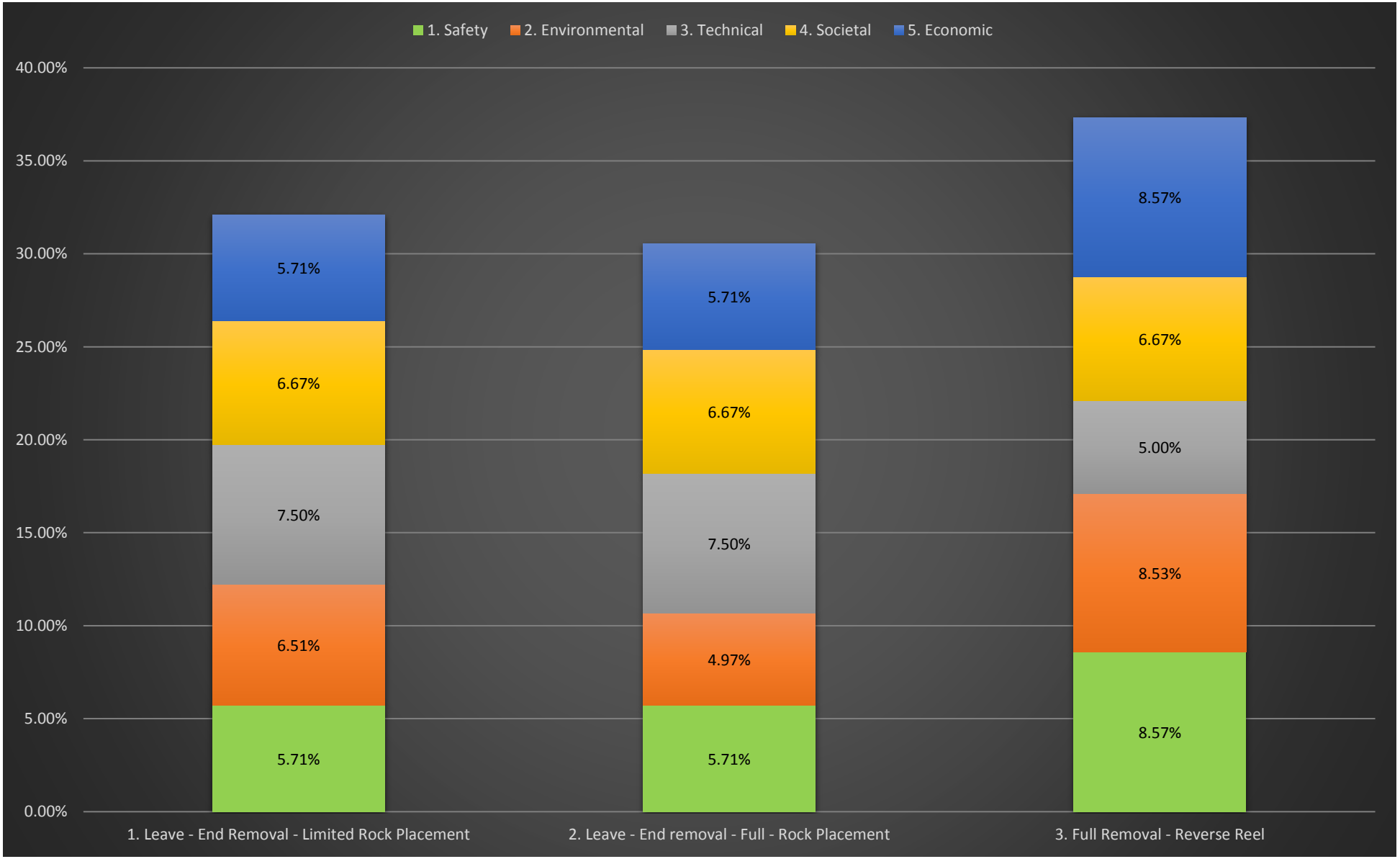
Dunlin Group 5 - Trenched and Buried Pipelines - Results (5 Criteria)



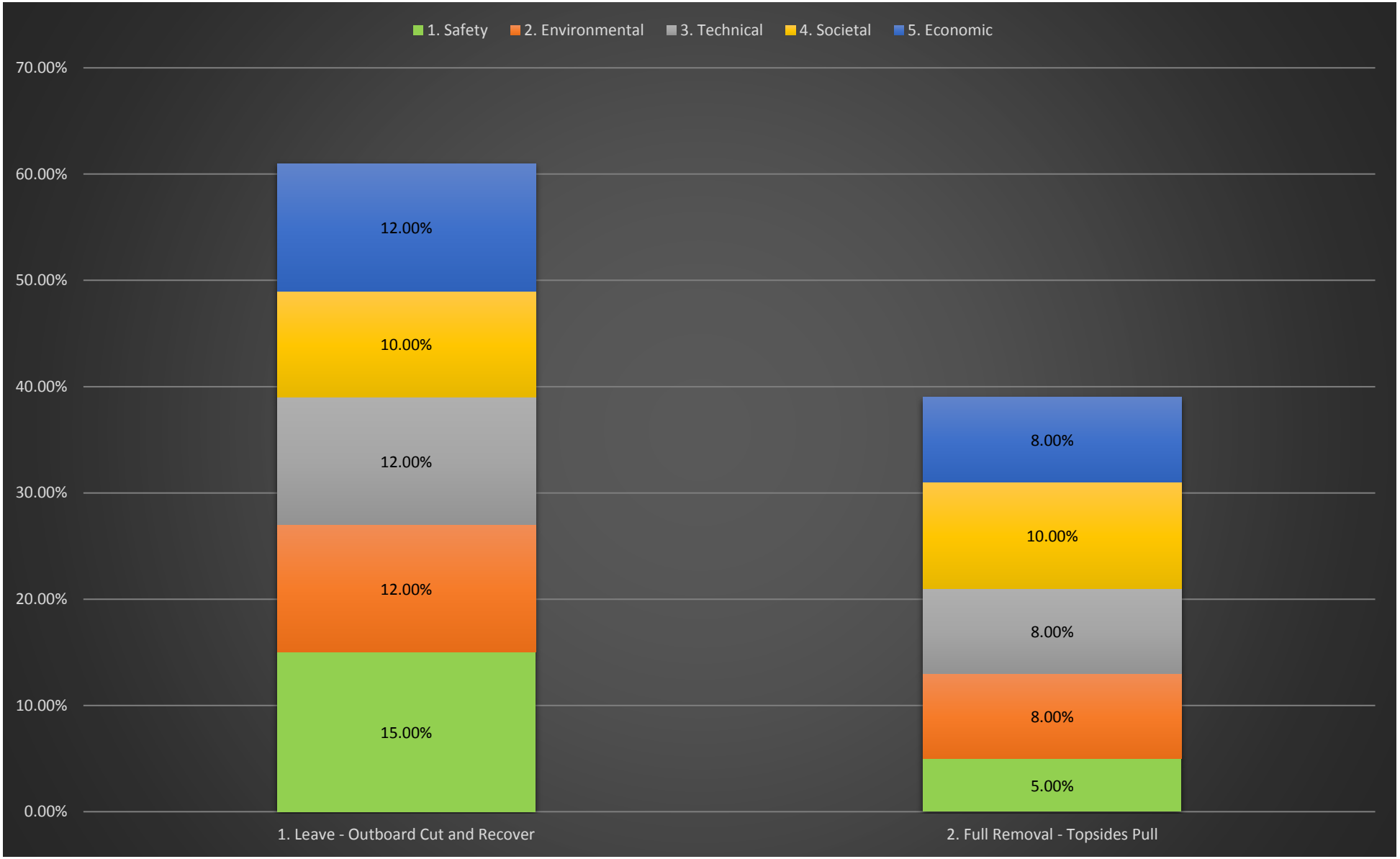
Dunlin Group 6 - Rock Dumped Surface Laid Rigid Spools - Results (5 Criteria)



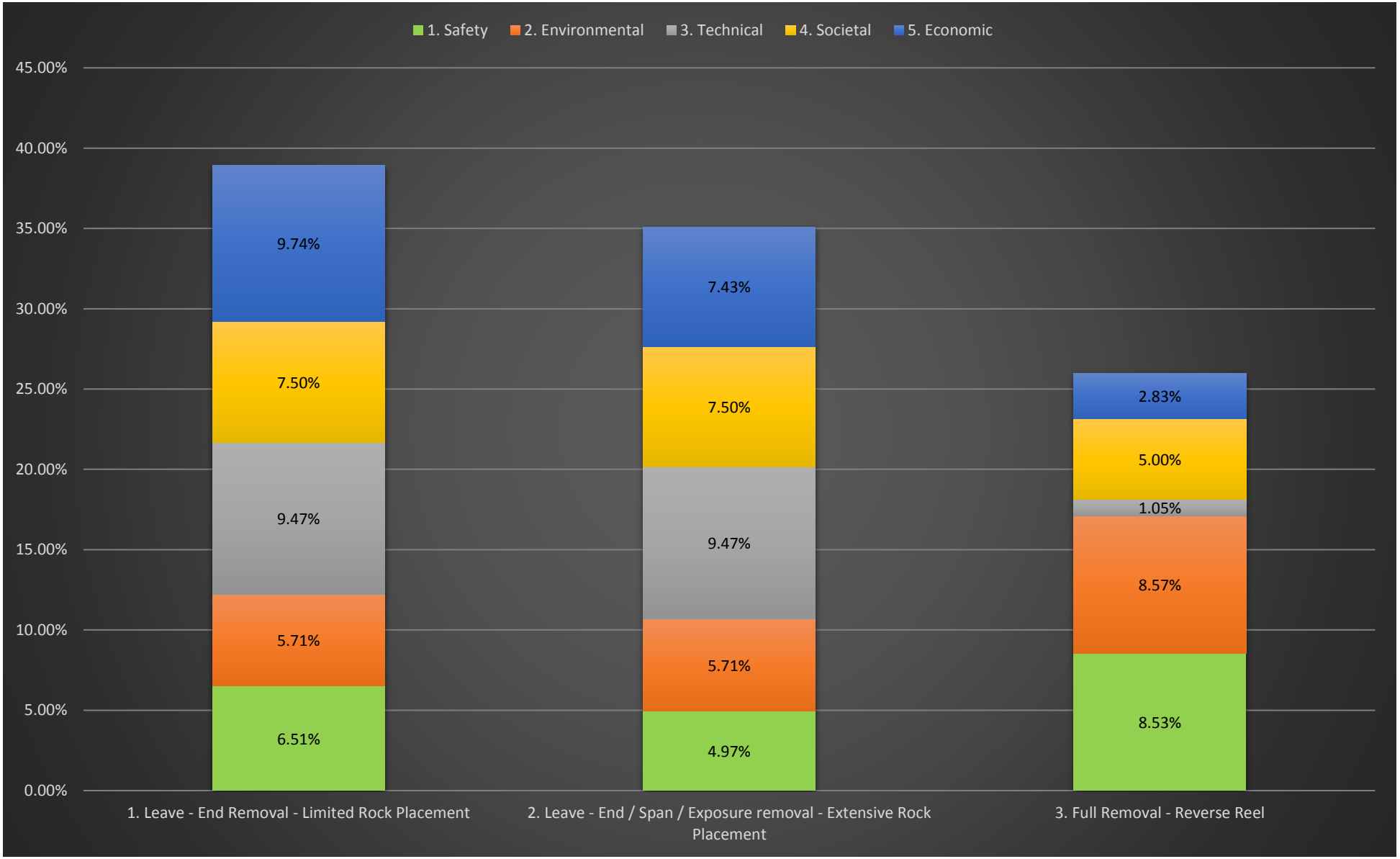
Dunlin Group 7 - Rock Dumped Surface Laid Umbilicals - Results (5 Criteria)



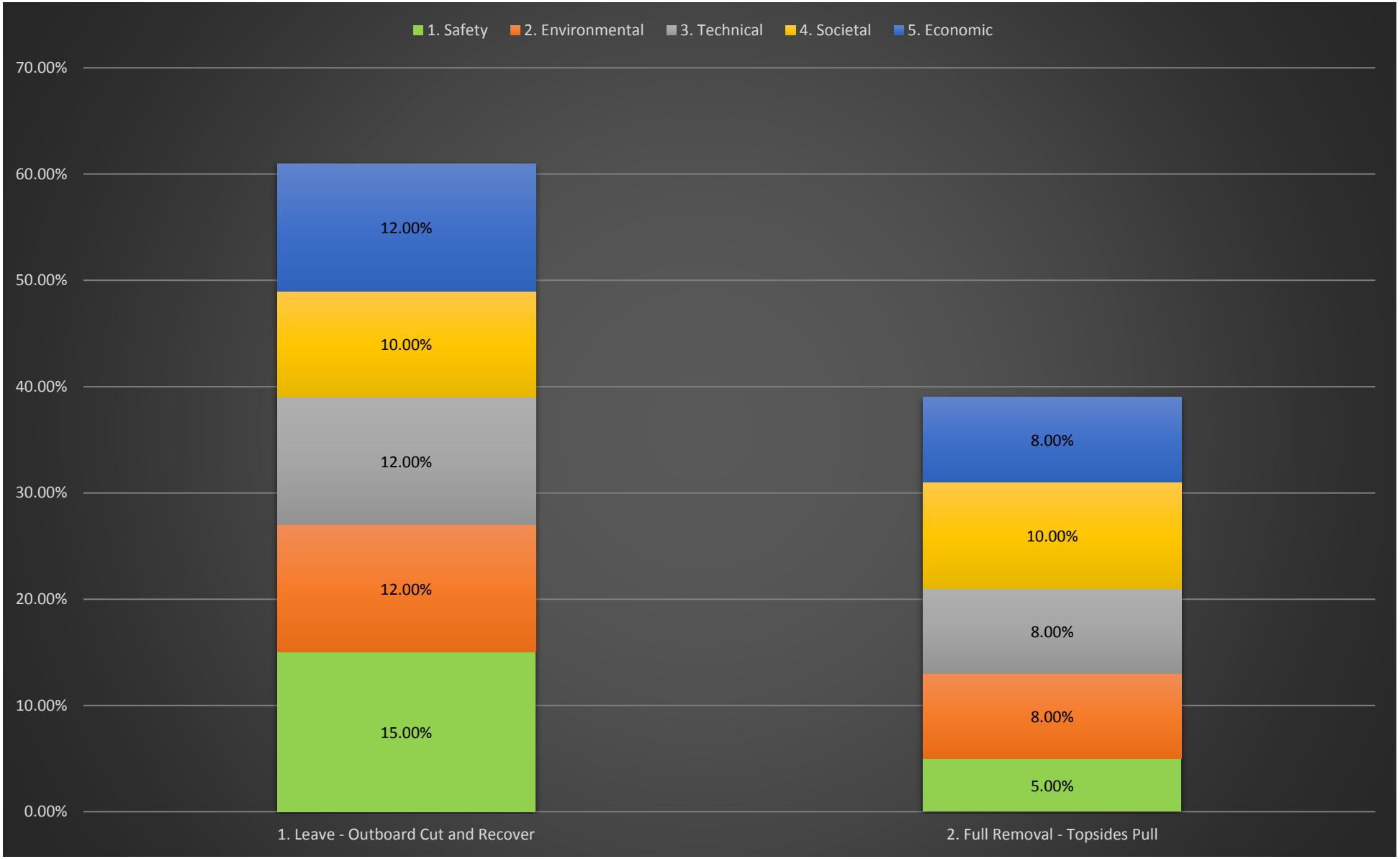
Dunlin Group 8 - Riser Cable (Dunlin) - Results (5 Criteria)



Dunlin Group 9 - Trenched and Buried Cable - Results (5 Criteria)



Dunlin Group 10 - Riser Cable (Brent) - Results (5 Criteria)



Appendix H Data Sheets (Inc. Costs)

Subsea Infrastructure Decommissioning Comparative Assessment Data Sheet

Area	Dunlin	
Decision/Group	Decision 1 Group 2 – Buried Structures and Deposits	
Option	1 – Leave in Situ – Minimal Intervention (Rock Placement)	
Description	Rock placement over snag hazards and areas of low existing rock cover by DPFPV	
Ref. Documents	FBL-DUN-DAOM-SSP-01-RPT-00001 FBL-DUN-DAOM-SSP-01-RPT-00003 A-301649-S01-TECH-008 A-301649-S01-TECH-010 A-301649-S01-TECH-012 A-301649-S01-REPT-003	Subsea Decommissioning Inventory Subsea Decommissioning Screening – Dunlin Dunlin – Long Term Materials Degradation Study Dunlin – Removal/Recovery Feasibility Study Dunlin – Risk Evaluation of Leaving Items in Situ Dunlin – Common Scope Report

ID No.	Description	Material	Qty	Total Weight (Te)	Cover
PL4334 (Over PL164 20" Gas Line)	X-ing Arch	Concrete	1	15.0	Rock covered to 1.0m
	Mattress (5 X 2 X 0.15)	Concrete	2	7.2	
	Grout Bags	Grout	200 est.	5.0	
	Sand Bags	Sand	80 est.	2.0	
PL2852 (Over PL013 16" Oil Import)	Mattress (6 X 3 X 0.3 / 6 X 3 X 0.15)	Concrete	12/6	99.6/40.5	Rock covered to 0.6m
PL2852 (Over PL115 16" Oil Import)	Mattress (6 X 3 X 0.3 / 6 X 3 X 0.15)	Concrete	12/6	99.6/40.5	Rock covered to 0.6m
PLU2853 (Over PL5 24" Oil Export)	Mattress (6 X 3 X 0.3)	Concrete	7	58.1	Rock covered to 0.3m

SAFETY				
Offshore Personnel	Number	41	Man Hours	2559
Topsides Personnel	Number	N/A	Man Hours	N/A
Divers Required	Number	N/A	Man Hours	N/A
Onshore Personnel	Number	14	Man Hours	813
Legacy Personnel	Number	35	Man Hours	18900
Impact to Other Users of the Sea (Operational)	Number of Vessels Used	1	Duration of Operations	5.2
Impact to Other Users of the Sea (Legacy)	Number of Vessels Used	1	Duration of Operations	45

Potential for High Consequence Event	Low	Comments	Routine operations

Operational Risk Diver	PLL	N/A
Operational Risk Offshore	PLL	1.92E-04
Operational Risk Topsides	PLL	N/A
Operational Risk Onshore	PLL	1.00E-04
Legacy Risk (out to 50yrs)	PLL	1.04E-03
Fishing Risk	PLL	N/A (No increase in risk over and above what currently exists for fishing)
Overall Risk	∑PLL	1.33E-03

ENVIRONMENTAL								
Marine Impact (Vessels Operational)	Type	DSV	Number	N/A	Duration	N/A	Activity	N/A
	Type	CSV	Number	N/A	Duration	N/A	Activity	N/A
	Type	DPFPV	Number	1	Duration	5.2	Activity	Rock Dump
	Type	ROVSV	Number	N/A	Duration	N/A	Activity	N/A
	Type	PSV	Number	N/A	Duration	N/A	Activity	N/A
	Type	Trawler	Number	N/A	Duration	N/A	Activity	N/A
Marine Impact (Vessels Legacy)	Type	DPFPV	Number	N/A	Duration	N/A	Activity	N/A
	Type	ROVSV	Number	1	Duration	45	Activity	Survey
Noise (Total = Ops + Legacy)	Sound Exposure Level		251 dB re 1mP			12.6 TPa^2s		
Energy Use (Total = Ops + Legacy)	Fuel	113.5 Te	CO_2	359.9 Te	NOx	6.7 Te	SO_2	1.4 Te
Life Cycle Emissions (Total = Ops + Legacy)	CO_2		488.66 Te		CO_2 (Credit)		N/A	

Marine Impact (Seabed)	Activity	Dredging	Area	N/A	Resources	N/A
	Activity	Rock Dump	Area	1800 m^2	Resources	3800 Te (Rock)
	Activity	Trenching	Area	N/A	Resources	N/A
	Activity	Backfilling	Area	N/A	Resources	N/A

Materials	Recovered	N/A
	Remaining	1 x concrete arch; 45 x concrete mattress; 200 x grout bags; 80 x sand bags 23992 Te Rock (20192 Te Existing + 3800 Te New)
	Persistence	>100 years (fully covered)

Residuals	LSA Scale	In-Situ	N/A	Returned	N/A
	Hydrocarbon	In-Situ	N/A	Returned	N/A
	Control Fluids	In-Situ	N/A	Returned	N/A

Technical				
Technical Considerations	Feasibility	High	Concept Maturity	High
	Availability of Technology	High – Off the shelf		
	Track Record	High – Extensive history		
	Risk of Failure	Low		
	Consequence of Failure	Additional rock profiling / limited schedule impacts		
	Emerging Technology	N/A		

Societal		
Societal Factors	Commercial Fisheries Impact	Low – PL2852 & PLU2853 are within close proximity to DA CGB. If safety zone remains then there will be no return of grounds. DPI Cable is currently available for fishing.
	Socio Economic	Low – No materials returned

Economic		
Economic Considerations	Comparative Cost Operational	0.6M
	Comparative Cost Legacy - Monitoring	1.8M
	Comparative Cost Legacy - Remedial	0.0M

Economic Risk	Cost Risk	Low	Factors	High degree of achievability; Low likelihood of future remediation required due to existing burial depth and low fishing activity within the area. Potential future requirement to remove the items after live pipelines are decommissioned.

Subsea Infrastructure Decommissioning Comparative Assessment Data Sheet

Area	Dunlin	
Decision/Group	Decision 1 Group 2 – Buried Structures and Deposits	
Option	2 – Full Removal	
Description	Deburial of buried deposits using mass flow excavator deployed from CSV Recovery of exposed deposits using a DSV	
Ref. Documents	FBL-DUN-DAOM-SSP-01-RPT-00001 FBL-DUN-DAOM-SSP-01-RPT-00003 A-301649-S01-TECH-008 A-301649-S01-TECH-010 A-301649-S01-TECH-012 A-301649-S01-REPT-003	Subsea Decommissioning Inventory Subsea Decommissioning Screening – Dunlin Dunlin – Long Term Materials Degradation Study Dunlin – Removal/Recovery Feasibility Study Dunlin – Risk Evaluation of Leaving Items in Situ Dunlin – Common Scope Report

ID No.	Description	Material	Qty	Total Weight (Te)	Cover
PL4334 (Over PL164 20" Gas Line)	X-ing Arch	Concrete	1	15.0	Rock covered to 1.0m
	Mattress (5 X 2 X 0.15)	Concrete	2	7.2	
	Grout Bags	Grout	200 est.	5.0	
	Sand Bags	Sand	80 est.	2.0	
PL2852 (Over PL013 16" Oil Import)	Mattress (6 X 3 X 0.3 / 6 X 3 X 0.15)	Concrete	12/6	99.6/40.5	Rock covered to 0.6m
PL2852 (Over PL115 16" Oil Import)	Mattress (6 X 3 X 0.3 / 6 X 3 X 0.15)	Concrete	12/6	99.6/40.5	Rock covered to 0.6m
PLU2853 (Over PL5 24" Oil Export)	Mattress (6 X 3 X 0.3)	Concrete	7	58.1	Rock covered to 0.3m

SAFETY				
Offshore Personnel	Number	116	Man Hours	10118
Topsides Personnel	Number	N/A	Man Hours	N/A
Divers Required	Number	9	Man Hours	800
Onshore Personnel	Number	20	Man Hours	2327
Legacy Personnel	Number	N/A	Man Hours	N/A
Impact to Other Users of the Sea (Operational)	Number of Vessels Used	2	Duration of Operations	13.7
Impact to Other Users of the Sea (Legacy)	Number of Vessels Used	N/A	Duration of Operations	N/A

Potential for High Consequence Event	Medium	Comments	Routine operations; Requires work over live lines (20" Gas and 16" Oil)

Operational Risk Diver	PLL	7.76E-04
Operational Risk Offshore	PLL	7.59E-04
Operational Risk Topsides	PLL	N/A
Operational Risk Onshore	PLL	2.86E-04
Legacy Risk (out to 50yrs)	PLL	N/A
Fishing Risk	PLL	N/A (No increase in risk over and above what currently exists for fishing)
Overall Risk	∑PLL	1.82E-03

ENVIRONMENTAL								
Marine Impact (Vessels Operational)	Type	DSV	Number	1	Duration	8.2	Activity	Recovery
	Type	CSV	Number	1	Duration	5.5	Activity	Deburial
	Type	DPFPV	Number	N/A	Duration	N/A	Activity	N/A
	Type	ROVSV	Number	N/A	Duration	N/A	Activity	N/A
	Type	PSV	Number	N/A	Duration	N/A	Activity	N/A
	Type	Trawler	Number	N/A	Duration	N/A	Activity	N/A
Marine Impact (Vessels Legacy)	Type	DPFPV	Number	N/A	Duration	N/A	Activity	N/A
	Type	ROVSV	Number	N/A	Duration	N/A	Activity	N/A
Noise (Total = Ops + Legacy)	Sound Exposure Level		245 dB re 1mP			3.5 TPa^2s		
Energy Use (Total = Ops + Legacy)	Fuel	302.3 Te	CO_2	958.2 Te	NOx	17.8 Te	SO_2	3.6 Te
Life Cycle Emissions (Total = Ops + Legacy)	CO_2		958.66 Te		CO_2 (Credit)		N/A	

Marine Impact (Seabed)	Activity	Dredging	Area	876 m^2	Resources	N/A
	Activity	Rock Dump	Area	N/A	Resources	N/A
	Activity	Trenching	Area	N/A	Resources	N/A
	Activity	Backfilling	Area	N/A	Resources	N/A

Materials	Recovered	1 x concrete arch; 45 x concrete mattress; 200 x grout bags; 80 x sand bags
	Remaining	20192 Te Rock (Existing)
	Persistence	N/A

Residuals	LSA Scale	In-Situ	N/A	Returned	N/A
	Hydrocarbon	In-Situ	N/A	Returned	N/A
	Control Fluids	In-Situ	N/A	Returned	N/A

Technical				
Technical Considerations	Feasibility	High	Concept Maturity	High
	Availability of Technology	High – Off the shelf		
	Track Record	High – Large history of MFE for local deburial		
	Risk of Failure	Low		
	Consequence of Failure	Additional dredging / additional rock profiling / limited schedule impacts		
	Emerging Technology	N/A		

Societal		
Societal Factors	Commercial Fisheries Impact	Low – Area will be available for fishing
	Socio Economic	Low – Limited materials of low value returned to shore

Economic		
Economic Considerations	Comparative Cost Operational	3.1M
	Comparative Cost Legacy - Monitoring	0.0M
	Comparative Cost Legacy - Remedial	0.0M

Economic Risk	Cost Risk	Low	Factors	High degree of achievability; Maybe some degree of business interruption to 3rd party line operators;

Subsea Infrastructure Decommissioning Comparative Assessment Data Sheet

Area	Dunlin	
Decision/Group	Decision 2 Group 3 – Rigid Riser	
Option	1 – Leave in Situ – Minor Intervention (Outboard Cut and Recovery)	
Description	Disconnect and recover drop down spool utilising DSV Riser cut at J-tube exit by DSV Seal J-tube and recover outboard section of line back to the DSV Disconnect and gap riser on topsides.	
Ref. Documents	FBL-DUN-DAOM-SSP-01-RPT-00001 FBL-DUN-DAOM-SSP-01-RPT-00003 A-301649-S01-TECH-008 A-301649-S01-TECH-010 A-301649-S01-TECH-011 A-301649-S01-TECH-012 A-301649-S01-REPT-003	Subsea Decommissioning Inventory Subsea Decommissioning Screening – Dunlin Dunlin – Long Term Materials Degradation Study Dunlin – Removal/Recovery Feasibility Study Dunlin – Effect of Leaving Riser Section within J-Tube Dunlin – Risk Evaluation of Leaving Items in Situ Dunlin – Common Scope Report

ID No.	Type	Material	Length (m)	Trenched		Buried		Rock Dumped	
				Length (m)	Depth (m)	Length (m)	Depth (m)	Length (m)	Height (m)
PL2852 4" Gas Riser	Rigid	Steel	198	0	0	0	0	0	0

SAFETY				
Offshore Personnel	Number	76	Man Hours	5290
Topsides Personnel	Number	6	Man Hours	72
Divers Required	Number	9	Man Hours	324
Onshore Personnel	Number	20	Man Hours	1188
Legacy Personnel	Number	N/A	Man Hours	N/A
Impact to Other Users of the Sea (Operational)	Number of Vessels Used	1	Duration of Operations	5.8
Impact to Other Users of the Sea (Legacy)	Number of Vessels Used	N/A	Duration of Operations	N/A

Potential for High Consequence Event	Low	Comments	Routine operations

Operational Risk Diver	PLL	3.14E-04
Operational Risk Offshore	PLL	3.97E-04
Operational Risk Topsides	PLL	2.95E-06
Operational Risk Onshore	PLL	1.46E-04
Legacy Risk (out to 50yrs)	PLL	N/A (in line with CGB)
Fishing Risk	PLL	N/A
Overall Risk	∑PLL	8.60E-04

ENVIRONMENTAL								
Marine Impact (Vessels Operational)	Type	DSV	Number	1	Duration	5.8	Activity	Destruct
	Type	CSV	Number	N/A	Duration	N/A	Activity	N/A
	Type	DPFPV	Number	N/A	Duration	N/A	Activity	N/A
	Type	ROVSV	Number	N/A	Duration	N/A	Activity	N/A
	Type	PSV	Number	N/A	Duration	N/A	Activity	N/A
	Type	Trawler	Number	N/A	Duration	N/A	Activity	N/A
Marine Impact (Vessels Legacy)	Type	DPFPV	Number	N/A	Duration	N/A	Activity	N/A
	Type	ROVSV	Number	N/A	Duration	N/A	Activity	N/A
Noise (Total = Ops + Legacy)	Sound Exposure Level		237 dB re 1mP		0.5 TPa^2s			
Energy Use (Total = Ops + Legacy)	Fuel	128.3 Te	CO_2	406.6 Te	NOx	7.6 Te	SO_2	1.5 Te
Life Cycle Emissions (Total = Ops + Legacy)	CO_2		414.48 Te		CO_2 (Credit)		N/A	

Marine Impact (Seabed)	Activity	Dredging	Area	N/A	Resources	N/A
	Activity	Rock Dump	Area	N/A	Resources	N/A
	Activity	Trenching	Area	N/A	Resources	N/A
	Activity	Backfilling	Area	N/A	Resources	N/A

Materials	Recovered	1 m (0.05Te)			
	Remaining	197 m within J-tube			
	Persistence	In-line with CGB & J-tubes >250 years			
Residuals	LSA Scale	In-Situ	N/A	Returned	N/A
	Hydrocarbon	In-Situ	N/A	Returned	N/A
	Control Fluids	In-Situ	N/A	Returned	N/A

Technical				
Technical Considerations	Feasibility	High	Concept Maturity	High
	Availability of Technology	High – Off the shelf		
	Track Record	High – Extensive history of similar work		
	Risk of Failure	Low		
	Consequence of Failure	Limited schedule impacts		
	Emerging Technology	Diverless cutting maybe an option		

Societal		
Societal Factors	Commercial Fisheries Impact	Low – Remaining material will be within the CGB
	Socio Economic	Low – Limited material returned to shore

Economic				
Economic Considerations	Comparative Cost Operational		1.8M	
	Comparative Cost Legacy - Monitoring		0.0M – (Monitoring is assumed to be done as part of any CGB monitoring)	
	Comparative Cost Legacy - Remedial		0.0M	
Economic Risk	Cost Risk	Low	Factors	High degree of achievability.

Area	Dunlin	
Decision/Group	Decision 2 Group 3 – Rigid Riser	
Option	2 – Full Removal – Topsides Pull	
Description	Mobilise winch spread to platform, install and test Remove topside hang-off and transfer riser to winch Disconnect and recover drop down spool utilising DSV Remove J-tube seal by DSV Remove centralisers (part reverse pull as required) by DSV Riser cut at J-tube exit by DSV Seal J-tube and recover outboard section of riser back to the DSV Pull-in riser using the topside winch (pull, secure, cut, repeat) Backload riser sections and winch equipment	
Ref. Documents	FBL-DUN-DAOM-SSP-01-RPT-00001 FBL-DUN-DAOM-SSP-01-RPT-00003 A-301649-S01-TECH-008 A-301649-S01-TECH-009 A-301649-S01-TECH-010 A-301649-S01-TECH-011 A-301649-S01-TECH-012 A-301649-S01-REPT-003	Subsea Decommissioning Inventory Subsea Decommissioning Screening – Dunlin Dunlin – Long Term Materials Degradation Study Dunlin – Trench Backfilling Feasibility Study Dunlin – Removal/Recovery Feasibility Study Dunlin – Effect of Leaving Riser Section within J-Tube Dunlin – Risk Evaluation of Leaving Items in Situ Dunlin – Common Scope Report

ID No.	Type	Material	Length (m)	Trenched		Buried		Rock Dumped	
				Length (m)	Depth (m)	Length (m)	Depth (m)	Length (m)	Height (m)
PL2852 4” Gas Riser	Rigid	Steel	198	0	0	0	0	0	0

SAFETY				
Offshore Personnel	Number	126	Man Hours	11837
Topsides Personnel	Number	6	Man Hours	2895
Divers Required	Number	9	Man Hours	432
Onshore Personnel	Number	20	Man Hours	3647
Legacy Personnel	Number	N/A	Man Hours	N/A
Impact to Other Users of the Sea (Operational)	Number of Vessels Used	2	Duration of Operations	16.4
Impact to Other Users of the Sea (Legacy)	Number of Vessels Used	N/A	Duration of Operations	N/A
Potential for High Consequence Event	Medium	Comments	Non-routine operations but not unusual. Limited SIMOPS.	
Operational Risk Diver	PLL	4.19E-04		
Operational Risk Offshore	PLL	8.88E-04		
Operational Risk Topsides	PLL	1.19E-04		
Operational Risk Onshore	PLL	4.49E-04		
Legacy Risk (out to 50yrs)	PLL	N/A		
Fishing Risk	PLL	N/A		
Overall Risk	∑PLL	1.87E-03		

ENVIRONMENTAL								
Marine Impact (Vessels Operational)	Type	DSV	Number	1	Duration	6.4	Activity	Destruct
	Type	CSV	Number	N/A	Duration	N/A	Activity	N/A
	Type	DPFPV	Number	N/A	Duration	N/A	Activity	N/A
	Type	ROVSV	Number	N/A	Duration	N/A	Activity	N/A
	Type	PSV	Number	1	Duration	10.0	Activity	Supply
	Type	Trawler	Number	N/A	Duration	N/A	Activity	N/A
Marine Impact (Vessels Legacy)	Type	DPFPV	Number	N/A	Duration	N/A	Activity	N/A
	Type	ROVSV	Number	N/A	Duration	N/A	Activity	N/A
Noise (Total = Ops + Legacy)	Sound Exposure Level		244 dB re 1mP			2.7 TPa^2s		
Energy Use (Total = Ops + Legacy)	Fuel	241.0 Te	CO_2	764.0 Te	NOx	14.2 Te	SO_2	2.9 Te
Life Cycle Emissions (Total = Ops + Legacy)	CO_2		768.23 Te		CO_2 (Credit)		3.89 Te	

Marine Impact (Seabed)	Activity	Dredging	Area	N/A	Resources	N/A
	Activity	Rock Dump	Area	N/A	Resources	N/A
	Activity	Trenching	Area	N/A	Resources	N/A
	Activity	Backfilling	Area	N/A	Resources	N/A

Materials	Recovered	198 m (4.2 Te)
	Remaining	0 m
	Persistence	N/A

Residuals	LSA Scale	In-Situ	N/A	Returned	N/A
	Hydrocarbon	In-Situ	N/A	Returned	N/A
	Control Fluids	In-Situ	N/A	Returned	N/A

Technical				
Technical Considerations	Feasibility	High	Concept Maturity	Medium
	Availability of Technology	High – Off the shelf		
	Track Record	High – Extensive history in North Sea and recent history on Dunlin.		
	Risk of Failure	Low – Riser is a recent installation and J-tube was inspected in 2010 as part of the riser install.		
	Consequence of Failure	Riser would remain within J-tube / schedule over runs		
	Emerging Technology	N/A		

Societal		
Societal Factors	Commercial Fisheries Impact	Low – Area will potentially remain within a safety zone
	Socio Economic	Low – Limited material returned to shore

Economic		
Economic Considerations	Comparative Cost Operational	3.3M
	Comparative Cost Legacy - Monitoring	0.0M
	Comparative Cost Legacy - Remedial	0.0M

Economic Risk	Cost Risk	Medium	Factors	Topside engineering for winch locating, pull-in loads and handling of cut sections is not mature; Previous pull-in operations have suffered delays and cost over runs.

Subsea Infrastructure Decommissioning Comparative Assessment Data Sheet

Area	Dunlin	
Decision/Group	Decision 3 Group 5 – Trenched and Buried Pipelines	
Option	1 – Leave in Situ – Minimal Intervention (Rock Placement)	
Description	Pipeline end transitions removed by DSV Rock placement over snag hazards and areas of low burial depth by DPFPV Survey by ROVSV Trawl sweep using trawler	
Ref. Documents	FBL-DUN-DAOM-SSP-01-RPT-00001 FBL-DUN-DAOM-SSP-01-RPT-00003 A-301649-S01-TECH-008 A-301649-S01-TECH-009 A-301649-S01-TECH-010 A-301649-S01-TECH-011 A-301649-S01-TECH-012 A-301649-S01-REPT-003	Subsea Decommissioning Inventory Subsea Decommissioning Screening – Dunlin Dunlin – Long Term Materials Degradation Study Dunlin – Trench Backfilling Feasibility Study Dunlin – Removal/Recovery Feasibility Study Dunlin – Effect of Leaving Riser Section within J-Tube Dunlin – Risk Evaluation of Leaving Items in Situ Dunlin – Common Scope Report

ID No.	Type	Material	Length (m)	Trenched		Buried		Rock Dumped	
				Length (m)	Depth (m)	Length (m)	Depth (m)	Length (m)	Height (m)
PL2852 4" Gas	Rigid	Steel	10272	9795	1.0	9733	1.0	153 (Thistle) 393 (Dunlin)	0.6

SAFETY				
Offshore Personnel	Number	157	Man Hours	12162
Topsides Personnel	Number	N/A	Man Hours	N/A
Divers Required	Number	9	Man Hours	476
Onshore Personnel	Number	20	Man Hours	3020
Legacy Personnel	Number	35	Man Hours	23520
Impact to Other Users of the Sea (Operational)	Number of Vessels Used	4	Duration of Operations	23.1
Impact to Other Users of the Sea (Legacy)	Number of Vessels Used	1	Duration of Operations	55.9

Potential for High Consequence Event	Low	Comments	Routine operations

Operational Risk Diver	PLL	4.62E-04
Operational Risk Offshore	PLL	9.12E-04
Operational Risk Topsides	PLL	N/A
Operational Risk Onshore	PLL	3.71E-04
Legacy Risk (out to 50yrs)	PLL	1.29E-03
Fishing Risk	PLL	N/A (No increase in risk over and above what currently exists for fishing)
Overall Risk	∑PLL	3.04E-03

ENVIRONMENTAL								
Marine Impact (Vessels Operational)	Type	DSV	Number	1	Duration	8.0	Activity	Destruct
	Type	CSV	Number	N/A	Duration	N/A	Activity	N/A
	Type	DPFPV	Number	1	Duration	4.5	Activity	Rock Dump
	Type	ROVSV	Number	1	Duration	5.6	Activity	Survey
	Type	PSV	Number	N/A	Duration	N/A	Activity	N/A
	Type	Trawler	Number	1	Duration	5.0	Activity	Trawl Sweep
Marine Impact (Vessels Legacy)	Type	DPFPV	Number	N/A	Duration	N/A	Activity	N/A
	Type	ROVSV	Number	1	Duration	55.9	Activity	Survey
Noise (Total = Ops + Legacy)	Sound Exposure Level		252 dB re 1mP		17.2 TPa^2s			
Energy Use (Total = Ops + Legacy)	Fuel	892.5 Te	CO_2	2829.2 Te	NOx	52.7 Te	SO_2	10.7 Te
Life Cycle Emissions (Total = Ops + Legacy)	CO_2		3256.69 Te		CO_2 (Credit)		N/A	

Marine Impact (Seabed)	Activity	Dredging	Area	40 m^2	Resources	N/A
	Activity	Rock Dump	Area	206 m^2	Resources	200 Te (Rock)
	Activity	Trenching	Area	N/A	Resources	N/A
	Activity	Backfilling	Area	N/A	Resources	N/A

Materials	Recovered	30 m (0.65 Te)			
	Remaining	10242 m 6063 Te Rock (5863 Te Existing + 200 Te New)			
	Persistence	PL2852 >250 years where fully covered			
Residuals	LSA Scale	In-Situ	N/A	Returned	N/A
	Hydrocarbon	In-Situ	N/A	Returned	N/A
	Control Fluids	In-Situ	N/A	Returned	N/A

Technical				
Technical Considerations	Feasibility	High	Concept Maturity	High
	Availability of Technology	High – Off the shelf		
	Track Record	High – Extensive history		
	Risk of Failure	Low		
	Consequence of Failure	Alternate cutting technique / additional rock / limited schedule impacts		
	Emerging Technology	Diverless cutting maybe an option		

Societal		
Societal Factors	Commercial Fisheries Impact	Low – No change as area is currently available for fishing
	Socio Economic	Low – Limited material returned to shore

Economic				
Economic Considerations	Comparative Cost Operational	3.1M		
	Comparative Cost Legacy - Monitoring	2.2M		
	Comparative Cost Legacy - Remedial	0.0M		
Economic Risk	Cost Risk	Low	Factors	High degree of achievability; Low likelihood of future remediation required due to existing burial depth.

Subsea Infrastructure Decommissioning Comparative Assessment Data Sheet

Area	Dunlin	
Decision/Group	Decision 3 Group 5 – Trenched and Buried Pipelines	
Option	2 – Full Removal – (Reverse Reel) [Originally listed as Option 3 however; after review Option 1 & 2 were found to be identical and as such the original Option 2 was removed and Option 3 was re-numbered]	
Description	Pipeline deburial using MFE deployed from CSV Pipeline disconnect and recovery head installation by DSV Recover pipeline and reverse reel by DSV with reel spread Survey by ROVSV	
Ref. Documents	FBL-DUN-DAOM-SSP-01-RPT-00001 FBL-DUN-DAOM-SSP-01-RPT-00003 A-301649-S01-TECH-008 A-301649-S01-TECH-009 A-301649-S01-TECH-010 A-301649-S01-TECH-011 A-301649-S01-TECH-012 A-301649-S01-REPT-003	Subsea Decommissioning Inventory Subsea Decommissioning Screening – Dunlin Dunlin – Long Term Materials Degradation Study Dunlin – Trench Backfilling Feasibility Study Dunlin – Removal/Recovery Feasibility Study Dunlin – Effect of Leaving Riser Section within J-Tube Dunlin – Risk Evaluation of Leaving Items in Situ Dunlin – Common Scope Report

ID No.	Type	Material	Length (m)	Trenched		Buried		Rock Dumped	
				Length (m)	Depth (m)	Length (m)	Depth (m)	Length (m)	Height (m)
PL2852 4" Gas	Rigid	Steel	10272	9795	1.0	9733	1.0	153 (Thistle) 393 (Dunlin)	0.6

SAFETY				
Offshore Personnel	Number	151	Man Hours	16916
Topsides Personnel	Number	N/A	Man Hours	N/A
Divers Required	Number	9	Man Hours	346
Onshore Personnel	Number	20	Man Hours	4940
Legacy Personnel	Number	N/A	Man Hours	N/A
Impact to Other Users of the Sea (Operational)	Number of Vessels Used	3	Duration of Operations	26.4
Impact to Other Users of the Sea (Legacy)	Number of Vessels Used	N/A	Duration of Operations	N/A

Potential for High Consequence Event	Medium	Comments	Non Routine Operation; Integrity assumed by engineering only.

Operational Risk Diver	PLL	3.36E-04
Operational Risk Offshore	PLL	1.27E-03
Operational Risk Topsides	PLL	N/A
Operational Risk Onshore	PLL	6.08E-04
Legacy Risk (out to 50yrs)	PLL	N/A
Fishing Risk	PLL	N/A (No increase in risk over and above what currently exists for fishing)
Overall Risk	∑PLL	2.21E-03

ENVIRONMENTAL								
Marine Impact (Vessels Operational)	Type	DSV	Number	1	Duration	10.6	Activity	Reverse Reel
	Type	CSV	Number	1	Duration	10.2	Activity	Deburial
	Type	DPFPV	Number	N/A	Duration	N/A	Activity	N/A
	Type	ROVSV	Number	1	Duration	5.6	Activity	Survey
	Type	PSV	Number	N/A	Duration	N/A	Activity	N/A
	Type	Trawler	Number	N/A	Duration	N/A	Activity	N/A
Marine Impact (Vessels Legacy)	Type	DPFPV	Number	N/A	Duration	N/A	Activity	N/A
	Type	ROVSV	Number	N/A	Duration	N/A	Activity	N/A
Noise (Total = Ops + Legacy)	Sound Exposure Level		249 dB re 1mP		7.4 TPa^2s			
Energy Use (Total = Ops + Legacy)	Fuel	513.3 Te	CO_2	1627.1 Te	NOx	30.3 Te	SO_2	6.2 Te
Life Cycle Emissions (Total = Ops + Legacy)	CO_2 Equivalent		1851.28 Te		CO_2 (Credit)		205.75 Te	
Marine Impact (Seabed)	Activity	Dredging	Area	48995 m^2	Resources	N/A		
	Activity	Rock Dump	Area	N/A	Resources	N/A		
	Activity	Trenching	Area	N/A	Resources	N/A		
	Activity	Backfilling	Area	N/A	Resources	N/A		

Materials	Recovered	10272 m (222.6 Te)			
	Remaining	0 m 5863 Te Rock (Existing)			
	Persistence	N/A			
Residuals	LSA Scale	In-Situ	N/A	Returned	N/A
	Hydrocarbon	In-Situ	N/A	Returned	N/A
	Control Fluids	In-Situ	N/A	Returned	N/A

Technical				
Technical Considerations	Feasibility	Medium	Concept Maturity	Low
	Availability of Technology	Medium – Limited number of existing techniques suitable for deburial		
	Track Record	Low – Limited experience of exposing pipelines over extended distances to enable re-reeling		
	Risk of Failure	High		
	Consequence of Failure	Alternate deburial techniques required / Alternate recovery techniques required/ rock required to remedy over trenched areas / large schedule overruns with limited ability to recover.		
	Emerging Technology	N/A		

Societal		
Societal Factors	Commercial Fisheries Impact	Low – No change as area is currently available for fishing
	Socio Economic	Low – Material returned to shore will generate a small amount of recycling work.

Economic				
Economic Considerations	Comparative Cost Operational	4.9M		
	Comparative Cost Legacy - Monitoring	0.0M		
	Comparative Cost Legacy - Remedial	0.0M		
Economic Risk	Cost Risk	High	Factors	Medium degree of achievability; High likelihood of failure to expose the line fully without multiple deburial techniques and passes; High likelihood of over trenching in sandy areas leading to areas of disturbance that are larger than required.

Subsea Infrastructure Decommissioning Comparative Assessment Data Sheet

Area	Dunlin	
Decision/Group	Decision 4 Group 6 – Rock Dumped Surface Laid Rigid Spools	
Option	1 – Leave in Situ – Minimal Intervention (Rock Placement)	
Description	Pipeline end transitions removed by DSV Rock placement over snag hazards and areas of low burial depth by DPFPV	
Ref. Documents	FBL-DUN-DAOM-SSP-01-RPT-00001 FBL-DUN-DAOM-SSP-01-RPT-00003 A-301649-S01-TECH-008 A-301649-S01-TECH-010 A-301649-S01-REPT-003	Subsea Decommissioning Inventory Subsea Decommissioning Screening – Dunlin Dunlin – Long Term Materials Degradation Study Dunlin – Removal/Recovery Feasibility Study Dunlin – Common Scope Report

ID No.	Type	Material	Length (m)	Trenched		Buried		Rock Dumped	
				Length (m)	Depth (m)	Length (m)	Depth (m)	Length (m)	Height (m)
PL2852 4" Gas	Rigid	Steel	127	0	0	0	0	92	0.6

SAFETY				
Offshore Personnel	Number	152	Man Hours	9930
Topsides Personnel	Number	N/A	Man Hours	N/A
Divers Required	Number	9	Man Hours	497
Onshore Personnel	Number	20	Man Hours	2028
Legacy Personnel	Number	35	Man Hours	17220
Impact to Other Users of the Sea (Operational)	Number of Vessels Used	3	Duration of Operations	15.1
Impact to Other Users of the Sea (Legacy)	Number of Vessels Used	1	Duration of Operations	40.4

Potential for High Consequence Event	Low	Comments	Routine operations

Operational Risk Diver	PLL	4.82E-04
Operational Risk Offshore	PLL	7.45E-04
Operational Risk Topsides	PLL	N/A
Operational Risk Onshore	PLL	2.49E-04
Legacy Risk (out to 50yrs)	PLL	9.47E-04
Fishing Risk	PLL	N/A
Overall Risk	∑PLL	2.42E-03

ENVIRONMENTAL								
Marine Impact (Vessels Operational)	Type	DSV	Number	1	Duration	6.6	Activity	Destruct
	Type	CSV	Number	N/A	Duration	N/A	Activity	N/A
	Type	DPFPV	Number	1	Duration	4.5	Activity	Rock Dump
	Type	ROVSV	Number	1	Duration	4.0	Activity	Survey
	Type	PSV	Number	N/A	Duration	N/A	Activity	N/A
	Type	Trawler	Number	N/A	Duration	N/A	Activity	N/A
Marine Impact (Vessels Legacy)	Type	DPFPV	Number	N/A	Duration	N/A	Activity	N/A
	Type	ROVSV	Number	1	Duration	40.4	Activity	Survey
Noise (Total = Ops + Legacy)	Sound Exposure Level		251 dB re 1mP			13.4 TPa^2s		
Energy Use (Total = Ops + Legacy)	Fuel	688.4 Te	CO_2	2182.3 Te	NOx	40.6 Te	SO_2	8.3 Te
Life Cycle Emissions (Total = Ops + Legacy)	CO_2		2191.42 Te		CO_2 (Credit)		N/A	

Marine Impact (Seabed)	Activity	Dredging	Area	40 m^2	Resources	N/A
	Activity	Rock Dump	Area	100 m^2	Resources	100 Te (Rock)
	Activity	Trenching	Area	N/A	Resources	N/A
	Activity	Backfilling	Area	N/A	Resources	N/A

Materials	Recovered	35 m (0.6 Te)			
	Remaining	92 m 980 Te Rock (880 Te Existing + 100 Te New)			
	Persistence	PL2852 >250 years where fully covered			
Residuals	LSA Scale	In-Situ	N/A	Returned	N/A
	Hydrocarbon	In-Situ	N/A	Returned	N/A
	Control Fluids	In-Situ	N/A	Returned	N/A

Technical				
Technical Considerations	Feasibility	High	Concept Maturity	High
	Availability of Technology	High – Off the shelf		
	Track Record	High – Extensive history		
	Risk of Failure	Low		
	Consequence of Failure	Alternate cutting technique / additional rock / limited schedule impacts		
	Emerging Technology	N/A		

Societal		
Societal Factors	Commercial Fisheries Impact	Low – Area will potentially remain within the safety zone of the CGB
	Socio Economic	Low – Limited material returned to shore

Economic				
Economic Considerations	Comparative Cost Operational	2.0M		
	Comparative Cost Legacy - Monitoring	1.6M		
	Comparative Cost Legacy - Remedial	0.0M		
Economic Risk	Cost Risk	Low	Factors	High degree of achievability; Low likelihood of future remediation required due to existing burial depth and proximity to CGB.

Area	Dunlin	
Decision/Group	Decision 4 Group 6 – Rock Dumped Surface Laid Rigid Spools	
Option	2– Full Removal – (Disconnect and Recover)	
Description	Deburial of spools using a mass flow excavator deployed from a DSV Disconnection of spools by DSV Recovery of spools back to DSV Survey by DSV	
Ref. Documents	FBL-DUN-DAOM-SSP-01-RPT-00001 FBL-DUN-DAOM-SSP-01-RPT-00003 A-301649-S01-TECH-008 A-301649-S01-TECH-010 A-301649-S01-REPT-003	Subsea Decommissioning Inventory Subsea Decommissioning Screening – Dunlin Dunlin – Long Term Materials Degradation Study Dunlin – Removal/Recovery Feasibility Study Dunlin – Common Scope Report

ID No.	Type	Material	Length (m)	Trenched		Buried		Rock Dumped	
				Length (m)	Depth (m)	Length (m)	Depth (m)	Length (m)	Height (m)
PL2852 4" Gas	Rigid	Steel	127	0	0	0	0	92	0.6

SAFETY				
Offshore Personnel	Number	76	Man Hours	6840
Topsides Personnel	Number	N/A	Man Hours	N/A
Divers Required	Number	9	Man Hours	648
Onshore Personnel	Number	20	Man Hours	1311
Legacy Personnel	Number	N/A	Man Hours	N/A

Impact to Other Users of the Sea	Number of Vessels Used	1	Duration of Operations	7.5
Impact to Other Users of the Sea (Legacy)	Number of Vessels Used	N/A	Duration of Operations	N/A

Potential for High Consequence Event	Low	Comments	Routine operations

Operational Risk Diver	PLL	6.29E-04
Operational Risk Offshore	PLL	5.13E-04
Operational Risk Topsides	PLL	N/A
Operational Risk Onshore	PLL	1.61E-04
Legacy Risk (out to 50yrs)	PLL	N/A
Fishing Risk	PLL	N/A
Overall Risk	∑PLL	1.30E-03

ENVIRONMENTAL								
Marine Impact (Vessels Operational)	Type	DSV	Number	1	Duration	7.5	Activity	Destruct
	Type	CSV	Number	N/A	Duration	N/A	Activity	N/A
	Type	DPFPV	Number	N/A	Duration	N/A	Activity	N/A
	Type	ROVSV	Number	N/A	Duration	N/A	Activity	N/A
	Type	PSV	Number	N/A	Duration	N/A	Activity	N/A
	Type	Trawler	Number	N/A	Duration	N/A	Activity	N/A
Marine Impact (Vessels Legacy)	Type	DPFPV	Number	N/A	Duration	N/A	Activity	N/A
	Type	ROVSV	Number	N/A	Duration	N/A	Activity	N/A

Noise (Total = Ops + Legacy)	Sound Exposure Level	236 dB re 1mP	0.4 TPa^2s	

Energy Use (Total = Ops + Legacy)	Fuel	165.7 Te	CO_2	525.1 Te	NOx	9.8 Te	SO_2	2.0 Te
Life Cycle Emissions (Total = Ops + Legacy)	CO_2		528.66 Te		CO_2 (Credit)		2.35 Te	

Marine Impact (Seabed)	Activity	Dredging	Area	920 m^2	Resources	N/A
	Activity	Rock Dump	Area	N/A	Resources	N/A
	Activity	Trenching	Area	N/A	Resources	N/A
	Activity	Backfilling	Area	N/A	Resources	N/A

Materials	Recovered	127 m (4 Te)
	Remaining	880 Te Rock (Existing)
	Persistence	N/A

Residuals	LSA Scale	In-Situ	N/A	Returned	N/A
	Hydrocarbon	In-Situ	N/A	Returned	N/A
	Control Fluids	In-Situ	N/A	Returned	N/A

Technical				
Technical Considerations	Feasibility	High	Concept Maturity	High
	Availability of Technology	High – Off the shelf		
	Track Record	High – Extensive history		
	Risk of Failure	Low		
	Consequence of Failure	Alternate deburial technique / limited schedule impacts		
	Emerging Technology	N/A		

Societal		
Societal Factors	Commercial Fisheries Impact	Low – Area will potentially remain within the safety zone of the CGB
	Socio Economic	Low – Limited material returned to shore

Economic				
Economic Considerations	Comparative Cost Operational		2.3M	
	Comparative Cost Legacy - Monitoring		0.0M	
	Comparative Cost Legacy - Remedial		0.0M	
Economic Risk	Cost Risk	Low	Factors	High degree of achievability; Future liability removed.

Subsea Infrastructure Decommissioning Comparative Assessment Data Sheet

Area	Dunlin	
Decision/Group	Decision 5 Group 7 – Rock Dumped Surface Laid Umbilicals	
Option	1 – Leave in Situ – Minimal Intervention (Rock Placement)	
Description	Pipeline end transitions removed by DSV Rock placement over snag hazards and areas of low burial depth by DPFPV Trawl sweep by trawler	
Ref. Documents	FBL-DUN-DAOM-SSP-01-RPT-00001 FBL-DUN-DAOM-SSP-01-RPT-00003 A-301649-S01-TECH-008 A-301649-S01-TECH-010 A-301649-S01-REPT-003	Subsea Decommissioning Inventory Subsea Decommissioning Screening – Dunlin Dunlin – Long Term Materials Degradation Study Dunlin – Removal/Recovery Feasibility Study Dunlin – Common Scope Report

ID No.	Type	Material	Length (m)	Trenched		Buried		Rock Dumped	
				Length (m)	Depth (m)	Length (m)	Depth (m)	Length (m)	Height (m)
PLU2853 2.5" Umb.	Umbilical	Polymer / Steel / Copper	580	0	0	0	0	550	0.3

SAFETY				
Offshore Personnel	Number	157	Man Hours	9831
Topsides Personnel	Number	N/A	Man Hours	N/A
Divers Required	Number	9	Man Hours	497
Onshore Personnel	Number	20	Man Hours	2299
Legacy Personnel	Number	35	Man Hours	17220
Impact to Other Users of the Sea (Operational)	Number of Vessels Used	4	Duration of Operations	18.8
Impact to Other Users of the Sea (Legacy)	Number of Vessels Used	1	Duration of Operations	40.9

Potential for High Consequence Event	Low	Comments	Routine operations

Operational Risk Diver	PLL	4.82E-04
Operational Risk Offshore	PLL	7.37E-04
Operational Risk Topsides	PLL	N/A
Operational Risk Onshore	PLL	2.83E-04
Legacy Risk (out to 50yrs)	PLL	9.47E-04
Fishing Risk	PLL	N/A
Overall Risk	∑PLL	2.45E-03

ENVIRONMENTAL								
Marine Impact (Vessels Operational)	Type	DSV	Number	1	Duration	6.2	Activity	Destruct
	Type	CSV	Number	N/A	Duration	N/A	Activity	N/A
	Type	DPFPV	Number	1	Duration	4.5	Activity	Rock Dump
	Type	ROVSV	Number	1	Duration	4.1	Activity	Survey
	Type	PSV	Number	N/A	Duration	N/A	Activity	N/A
	Type	Trawler	Number	1	Duration	4	Activity	Trawl Sweep
Marine Impact (Vessels Legacy)	Type	DPFPV	Number	N/A	Duration	N/A	Activity	N/A
	Type	ROVSV	Number	1	Duration	40.9	Activity	Survey
Noise (Total = Ops + Legacy)	Sound Exposure Level		251 dB re 1mP		13.6 TPa^2s			
Energy Use (Total = Ops + Legacy)	Fuel	688.9 Te	CO_2	2183.7 Te	NOx	40.6 Te	SO_2	8.3 Te
Life Cycle Emissions (Total = Ops + Legacy)	CO_2		2198.22 Te		CO_2 (Credit)		N/A	

Marine Impact (Seabed)	Activity	Dredging	Area	20 m^2	Resources	N/A
	Activity	Rock Dump	Area	200 m^2	Resources	200 Te (Rock)
	Activity	Trenching	Area	N/A	Resources	N/A
	Activity	Backfilling	Area	N/A	Resources	N/A

Materials	Recovered	30 m Umbilical (polymer/steel/copper) (0.2 Te)			
	Remaining	550 m Umbilical (polymer/steel/copper) 2917 Te Rock (2717 Te Existing + 200 Te New)			
	Persistence	>100 years (no long term data/experience of polymers in seawater/buried)			
Residuals	LSA Scale	In-Situ	N/A	Returned	N/A
	Hydrocarbon	In-Situ	N/A	Returned	N/A
	Control Fluids	In-Situ	N/A	Returned	N/A

Technical				
Technical Considerations	Feasibility	High	Concept Maturity	High
	Availability of Technology	High – Off the shelf		
	Track Record	High – Extensive history		
	Risk of Failure	Low		
	Consequence of Failure	Additional rock requirement / limited schedule impacts		
	Emerging Technology	N/A		

Societal		
Societal Factors	Commercial Fisheries Impact	Low – Area will potentially remain within the safety zone of the CGB
	Socio Economic	Low – Limited material returned to shore

Economic				
Economic Considerations	Comparative Cost Operational	2.4M		
	Comparative Cost Legacy - Monitoring	1.6M		
	Comparative Cost Legacy - Remedial	0.0M		
Economic Risk	Cost Risk	Low	Factors	High degree of achievability; Low likelihood of future remediation required due to proximity to CGB.

Subsea Infrastructure Decommissioning Comparative Assessment Data Sheet

Area	Dunlin	
Decision/Group	Decision 5 Group 7 – Rock Dumped Surface Laid Umbilicals	
Option	2 – Leave in Situ – Major Intervention (Full Rock Placement)	
Description	Pipeline end transitions removed by DSV Rock placement over snag hazards and areas of low burial depth by DPFPV to 0.6m above ToP Survey by ROVSV Trawl sweep by trawler	
Ref. Documents	FBL-DUN-DAOM-SSP-01-RPT-00001 FBL-DUN-DAOM-SSP-01-RPT-00003 A-301649-S01-TECH-008 A-301649-S01-TECH-010 A-301649-S01-REPT-003	Subsea Decommissioning Inventory Subsea Decommissioning Screening – Dunlin Dunlin – Long Term Materials Degradation Study Dunlin – Removal/Recovery Feasibility Study Dunlin – Common Scope Report

ID No.	Type	Material	Length (m)	Trenched		Buried		Rock Dumped	
				Length (m)	Depth (m)	Length (m)	Depth (m)	Length (m)	Height (m)
PLU2853 2.5" Umb.	Umbilical	Polymer / Steel / Copper	580	0	0	0	0	550	0.3

SAFETY				
Offshore Personnel	Number	157	Man Hours	9831
Topsides Personnel	Number	N/A	Man Hours	N/A
Divers Required	Number	9	Man Hours	411
Onshore Personnel	Number	20	Man Hours	2299
Legacy Personnel	Number	35	Man Hours	17220
Impact to Other Users of the Sea (Operational)	Number of Vessels Used	4	Duration of Operations	18.8
Impact to Other Users of the Sea (Legacy)	Number of Vessels Used	1	Duration of Operations	40.9

Potential for High Consequence Event	Low	Comments	Routine operations

Operational Risk Diver	PLL	3.99E-04
Operational Risk Offshore	PLL	7.37E-04
Operational Risk Topsides	PLL	N/A
Operational Risk Onshore	PLL	2.83E-04
Legacy Risk (out to 50yrs)	PLL	9.47E-04
Fishing Risk	PLL	N/A
Overall Risk	∑PLL	2.37E-03

ENVIRONMENTAL								
Marine Impact (Vessels Operational)	Type	DSV	Number	1	Duration	6.2	Activity	Destruct
	Type	CSV	Number	N/A	Duration	N/A	Activity	N/A
	Type	DPFPV	Number	1	Duration	4.5	Activity	Rock Dump
	Type	ROVSV	Number	1	Duration	4.1	Activity	Survey
	Type	PSV	Number	N/A	Duration	N/A	Activity	N/A
	Type	Trawler	Number	1	Duration	4	Activity	Trawl Sweep
Marine Impact (Vessels Legacy)	Type	DPFPV	Number	N/A	Duration	N/A	Activity	N/A
	Type	ROVSV	Number	1	Duration	40.9	Activity	Survey

Noise (Total = Ops + Legacy)	Sound Exposure Level	251 dB re 1mP	13.6 TPa^2s	

Energy Use (Total = Ops + Legacy)	Fuel	689.5 Te	CO_2	2185.7 Te	NOx	40.7 Te	SO_2	8.3 Te
Life Cycle Emissions (Total = Ops + Legacy)	CO_2		2224.02 Te		CO_2 (Credit)		N/A	

Marine Impact (Seabed)	Activity	Dredging	Area	20 m^2	Resources	N/A
	Activity	Rock Dump	Area	1800 m^2	Resources	900 Te (Rock)
	Activity	Trenching	Area	N/A	Resources	N/A
	Activity	Backfilling	Area	N/A	Resources	N/A

Materials	Recovered	30 m Umbilical (polymer/steel/copper) (0.2Te)			
	Remaining	550 m Umbilical (polymer/steel/copper) 3617 Te Rock (2717 Te Existing + 900 Te New)			
	Persistence	>100 years (no long term data/experience of polymers in seawater/buried)			
Residuals	LSA Scale	In-Situ	N/A	Returned	N/A
	Hydrocarbon	In-Situ	N/A	Returned	N/A
	Control Fluids	In-Situ	N/A	Returned	N/A

Technical				
Technical Considerations	Feasibility	High	Concept Maturity	High
	Availability of Technology	High – Off the shelf		
	Track Record	High – Extensive history		
	Risk of Failure	Low		
	Consequence of Failure	Additional rock requirement / limited schedule impacts		
	Emerging Technology	N/A		

Societal		
Societal Factors	Commercial Fisheries Impact	Low – Area will potentially remain within the safety zone of the CGB
	Socio Economic	Low – Limited material returned to shore

Economic				
Economic Considerations	Comparative Cost Operational	2.4M		
	Comparative Cost Legacy - Monitoring	1.6M		
	Comparative Cost Legacy - Remedial	0.0M		
Economic Risk	Cost Risk	Low	Factors	High degree of achievability; Low likelihood of future remediation required due to proximity to CGB.

Subsea Infrastructure Decommissioning Comparative Assessment Data Sheet

Area	Dunlin	
Decision/Group	Decision 5 Group 7 – Rock Dumped Surface Laid Umbilicals	
Option	3 – Full Removal – (Reverse Reel)	
Description	Umbilical disconnect and recovery head installation by DSV Recover umbilical and reverse reel by DSV with reel spread Survey by DSV	
Ref. Documents	FBL-DUN-DAOM-SSP-01-RPT-00001 FBL-DUN-DAOM-SSP-01-RPT-00003 A-301649-S01-TECH-010 A-301649-S01-REPT-003	Subsea Decommissioning Inventory Subsea Decommissioning Screening – Dunlin Dunlin – Removal/Recovery Feasibility Study Dunlin – Common Scope Report

ID No.	Type	Material	Length (m)	Trenched		Buried		Rock Dumped	
				Length (m)	Depth (m)	Length (m)	Depth (m)	Length (m)	Height (m)
PLU2853 2.5" Umb.	Umbilical	Polymer / Steel / Copper	580	0	0	0	0	550	0.3

SAFETY				
Offshore Personnel	Number	76	Man Hours	6111
Topsides Personnel	Number	N/A	Man Hours	N/A
Divers Required	Number	9	Man Hours	281
Onshore Personnel	Number	20	Man Hours	2253
Legacy Personnel	Number	N/A	Man Hours	N/A
Impact to Other Users of the Sea (Operations)	Number of Vessels Used	1	Duration of Operations	6.7
Impact to Other Users of the Sea (Legacy)	Number of Vessels Used	N/A	Duration of Operations	N/A

Potential for High Consequence Event	Medium	Comments	Non Routine Operation; Integrity assumed by engineering only.

Operational Risk Diver	PLL	2.73E-04
Operational Risk Offshore	PLL	4.58E-04
Operational Risk Topsides	PLL	N/A
Operational Risk Onshore	PLL	2.77E-04
Legacy Risk (out to 50yrs)	PLL	N/A
Fishing Risk	PLL	N/A
Overall Risk	∑PLL	1.01E-03

ENVIRONMENTAL								
Marine Impact (Vessels Operational)	Type	DSV	Number	1	Duration	6.7	Activity	Reverse Reel
	Type	CSV	Number	N/A	Duration	N/A	Activity	N/A
	Type	DPFPV	Number	N/A	Duration	N/A	Activity	N/A
	Type	ROVSV	Number	N/A	Duration	N/A	Activity	N/A
	Type	PSV	Number	N/A	Duration	N/A	Activity	N/A
	Type	Trawler	Number	N/A	Duration	N/A	Activity	N/A
Marine Impact (Vessels Legacy)	Type	DPFPV	Number	N/A	Duration	N/A	Activity	N/A
	Type	ROVSV	Number	N/A	Duration	N/A	Activity	N/A

Noise (Total = Ops + Legacy)	Sound Exposure Level	236 dB re 1mP	0.4 TPa^2s	

Energy Use (Total = Ops + Legacy)	Fuel	147.4 Te	CO_2	467.3 Te	NOx	8.7 Te	SO_2	1.8 Te
Life Cycle Emissions (Total = Ops + Legacy)	CO_2		471.18 Te		CO_2 (Credit)		3.37 Te	

Marine Impact (Seabed)	Activity	Dredging	Area	N/A	Resources	N/A
	Activity	Rock Dump	Area	N/A	Resources	N/A
	Activity	Trenching	Area	N/A	Resources	N/A
	Activity	Backfilling	Area	N/A	Resources	N/A

Materials	Recovered	580 m Umbilical (polymer/steel/copper) (4.6 Te)
	Remaining	0 m 2717 Te Rock (Existing)
	Persistence	N/A

Residuals	LSA Scale	In-Situ	N/A	Returned	N/A
	Hydrocarbon	In-Situ	N/A	Returned	N/A
	Control Fluids	In-Situ	N/A	Returned	N/A

Technical				
Technical Considerations	Feasibility	High	Concept Maturity	High
	Availability of Technology	High – Off the shelf		
	Track Record	Low – Limited experience of reverse reeling buried umbilicals		
	Risk of Failure	Low – Initial engineering shows low utilisation values during recovery		
	Consequence of Failure	Alternate recovery techniques required/ Deburial may be required/ Limited schedule impacts.		
	Emerging Technology	N/A		

Societal		
Societal Factors	Commercial Fisheries Impact	Low – Area will potentially remain within the CGB exclusion zone
	Socio Economic	Low – Material returned to shore will generate a small amount of recycling work.

Economic				
Economic Considerations	Comparative Cost Operational		2.2M	
	Comparative Cost Legacy - Monitoring		0.0M	
	Comparative Cost Legacy - Remedial		0.0M	
Economic Risk	Cost Risk	Low	Factors	Whilst initial engineering indicates a high degree of achievability, deburial operations maybe required that could increase schedule and cost.

Subsea Infrastructure Decommissioning Comparative Assessment Data Sheet

Area	Dunlin	
Decision/Group	Decision 6 Group 8 – DPI Cable Riser (Dunlin)	
Option	1 – Leave in Situ – Minor Intervention (Outboard Cut and Recovery)	
Description	Cable riser cut at J-tube exit by DSV Cable cut at trench transition by DSV Bellmouth removal at the J-tube by DSV Seal J-tube and recover outboard section of cable, between J-tube and trench transition, back to the DSV Disconnect cable and gap at topside	
Ref. Documents	FBL-DUN-DAOM-SSP-01-RPT-00001 FBL-DUN-DAOM-SSP-01-RPT-00003 A-301649-S01-TECH-008 A-301649-S01-TECH-011 A-301649-S01-REPT-003	Subsea Decommissioning Inventory Subsea Decommissioning Screening – Dunlin Dunlin – Long Term Materials Degradation Study Dunlin – Effect of Leaving Riser Section within J-Tube Dunlin – Common Scope Report

ID No.	Type	Material	Length (m)	Trenched		Buried		Rock Dumped	
				Length (m)	Depth (m)	Length (m)	Depth (m)	Length (m)	Height (m)
PL4334 Riser	Cable (Untrenched section at Dunlin)	Polymer / Steel / Copper/ Fibre Optic	480	0	0	0	0	0	0

SAFETY				
Offshore Personnel	Number	76	Man Hours	5427
Topsides Personnel	Number	6	Man Hours	87
Divers Required	Number	9	Man Hours	346
Onshore Personnel	Number	20	Man Hours	1599
Legacy Personnel	Number	N/A	Man Hours	N/A
Impact to Other Users of the Sea (Operational)	Number of Vessels Used	1	Duration of Operations	6.0
Impact to Other Users of the Sea (Legacy)	Number of Vessels Used	N/A	Duration of Operations	N/A

Potential for High Consequence Event	Low	Comments	Routine operations

Operational Risk Diver	PLL	3.36E-04
Operational Risk Offshore	PLL	4.10E-04
Operational Risk Topsides	PLL	3.57E-06
Operational Risk Onshore	PLL	1.97E-04
Legacy Risk (out to 50yrs)	PLL	N/A (in line with CGB)
Fishing Risk	PLL	N/A
Overall Risk	∑PLL	9.46E-04

ENVIRONMENTAL								
Marine Impact (Vessels Operational)	Type	DSV	Number	1	Duration	6.0	Activity	Destruct
	Type	CSV	Number	N/A	Duration	N/A	Activity	N/A
	Type	DPFPV	Number	N/A	Duration	N/A	Activity	N/A
	Type	ROVSV	Number	N/A	Duration	N/A	Activity	N/A
	Type	PSV	Number	N/A	Duration	N/A	Activity	N/A
	Type	Trawler	Number	N/A	Duration	N/A	Activity	N/A
Marine Impact (Vessels Legacy)	Type	DPFPV	Number	N/A	Duration	N/A	Activity	N/A
	Type	ROVSV	Number	N/A	Duration	N/A	Activity	N/A
Noise (Total = Ops + Legacy)	Sound Exposure Level		239 dB re 1mP			0.8 TPa^2s		
Energy Use (Total = Ops + Legacy)	Fuel	130.9 Te	CO_2	415.0 Te	NOx	7.7 Te	SO_2	1.6 Te
Life Cycle Emissions (Total = Ops + Legacy)	CO_2		443.08 Te		CO_2 (Credit)		N/A	
Marine Impact (Seabed)	Activity	Dredging	Area	N/A	Resources	N/A		
	Activity	Rock Dump	Area	N/A	Resources	N/A		
	Activity	Trenching	Area	N/A	Resources	N/A		
	Activity	Backfilling	Area	N/A	Resources	N/A		

Materials	Recovered	300 m Cable (Polymer/ Copper/ Fibre Optics) (9.1 Te)			
	Remaining	180 m Cable within J-tube (Polymer/ Copper/ Fibre Optics)			
	Persistence	In-line with CGB & J-tubes >250 years			
Residuals	LSA Scale	In-Situ	N/A	Returned	N/A
	Hydrocarbon	In-Situ	N/A	Returned	N/A
	Control Fluids	In-Situ	N/A	Returned	N/A

Technical				
Technical Considerations	Feasibility	High	Concept Maturity	High
	Availability of Technology	High – Off the shelf		
	Track Record	High – Extensive history of similar work		
	Risk of Failure	Low		
	Consequence of Failure	Limited schedule impacts		
	Emerging Technology	N/A		

Societal		
Societal Factors	Commercial Fisheries Impact	Low – Area will potentially remain within a safety zone
	Socio Economic	Low – Limited material returned to shore

Economic				
Economic Considerations	Comparative Cost Operational		1.9M	
	Comparative Cost Legacy - Monitoring		0.0M – (Monitoring is assumed to be done as part of any CGB monitoring)	
	Comparative Cost Legacy - Remedial		0.0M	
Economic Risk	Cost Risk	Low	Factors	High degree of achievability.

Subsea Infrastructure Decommissioning Comparative Assessment Data Sheet

Area	Dunlin	
Decision/Group	Decision 6 Group 8 – DPI Cable Riser (Dunlin)	
Option	2 – Full Removal – Topsides Pull	
Description	Mobilise winch spread to platform, install and test Remove topside hang-off and transfer cable to winch Cable cut at J-tube exit and trench transition by DSV Seal J-tube and recover outboard section of cable, between J-tube and trench transition, back to the DSV Pull-in cable using the topside winch (pull, secure, cut, repeat) Backload cable sections and winch equipment Survey by DSV	
Ref. Documents	FBL-DUN-DAOM-SSP-01-RPT-00001 FBL-DUN-DAOM-SSP-01-RPT-00003 A-301649-S01-TECH-010 A-301649-S01-REPT-003	Subsea Decommissioning Inventory Subsea Decommissioning Screening – Dunlin Dunlin – Removal/Recovery Feasibility Study Dunlin – Common Scope Report

ID No.	Type	Material	Length (m)	Trenched		Buried		Rock Dumped	
				Length (m)	Depth (m)	Length (m)	Depth (m)	Length (m)	Height (m)
PL4334 Riser	Cable (Untrenched section at Dunlin)	Polymer / Steel / Copper/ Fibre Optic	480	0	0	0	0	0	0

SAFETY				
Offshore Personnel	Number	126	Man Hours	11472
Topsides Personnel	Number	6	Man Hours	2823
Divers Required	Number	9	Man Hours	346
Onshore Personnel	Number	20	Man Hours	4225
Legacy Personnel	Number	N/A	Man Hours	N/A
Impact to Other Users of the Sea (Operational)	Number of Vessels Used	2	Duration of Operations	16
Impact to Other Users of the Sea (Legacy)	Number of Vessels Used	N/A	Duration of Operations	N/A

Potential for High Consequence Event	Medium	Comments	Non-routine operations but not unusual. Limited SIMOPS.

Operational Risk Diver	PLL	3.36E-04
Operational Risk Offshore	PLL	8.60E-04
Operational Risk Topsides	PLL	1.16E-04
Operational Risk Onshore	PLL	5.20E-04
Legacy Risk (out to 50yrs)	PLL	N/A
Fishing Risk	PLL	N/A
Overall Risk	∑PLL	1.83E-03

ENVIRONMENTAL								
Marine Impact (Vessels Operational)	Type	DSV	Number	1	Duration	6	Activity	Destruct
	Type	CSV	Number	N/A	Duration	N/A	Activity	N/A
	Type	DPFPV	Number	N/A	Duration	N/A	Activity	N/A
	Type	ROVSV	Number	N/A	Duration	N/A	Activity	N/A
	Type	PSV	Number	1	Duration	10	Activity	Supply
	Type	Trawler	Number	N/A	Duration	N/A	Activity	N/A
Marine Impact (Vessels Legacy)	Type	DPFPV	Number	N/A	Duration	N/A	Activity	N/A
	Type	ROVSV	Number	N/A	Duration	N/A	Activity	N/A
Noise (Total = Ops + Legacy)	Sound Exposure Level		245 dB re 1mP			3.0 TPa^2s		
Energy Use (Total = Ops + Legacy)	Fuel	230.9 Te	CO_2	732.0 Te	NOx	13.6 Te	SO_2	2.8 Te
Life Cycle Emissions (Total = Ops + Legacy)	CO_2		747.66 Te		CO_2 (Credit)		2.69 Te	

Marine Impact (Seabed)	Activity	Dredging	Area	N/A	Resources	N/A
	Activity	Rock Dump	Area	N/A	Resources	N/A
	Activity	Trenching	Area	N/A	Resources	N/A
	Activity	Backfilling	Area	N/A	Resources	N/A

Materials	Recovered	480 m Cable (Polymer/ Copper/ Fibre Optics) (15.6 Te)			
	Remaining	0 m			
	Persistence	N/A			
Residuals	LSA Scale	In-Situ	N/A	Returned	N/A
	Hydrocarbon	In-Situ	N/A	Returned	N/A
	Control Fluids	In-Situ	N/A	Returned	N/A

Technical				
Technical Considerations	Feasibility	High	Concept Maturity	Medium
	Availability of Technology	High – Off the shelf		
	Track Record	High – Extensive history in North Sea and recent history on Dunlin.		
	Risk of Failure	Medium – Unknown integrity of J-tube / cable and inability to inspect.		
	Consequence of Failure	Cable would remain within J-tube / schedule over runs		
	Emerging Technology	N/A		

Societal		
Societal Factors	Commercial Fisheries Impact	Low – Area where cable is removed will potentially remain within a safety zone
	Socio Economic	Low – Limited material returned to shore

Economic				
Economic Considerations	Comparative Cost Operational		3.2M	
	Comparative Cost Legacy - Monitoring		0.0M	
	Comparative Cost Legacy - Remedial		0.0M	
Economic Risk	Cost Risk	Medium	Factors	Topside engineering for winch locating is not mature; Inspection to confirm integrity of J-tube and cable is not possible; Previous pull-in operations have suffered delays and cost over runs.

Subsea Infrastructure Decommissioning Comparative Assessment Data Sheet

Area	Dunlin	
Decision/Group	Decision 7 Group 9 – Trenched and Buried Cable	
Option	1 – Leave in Situ – Minimal Intervention (Rock Placement)	
Description	Cable end transitions removed by DSV Rock placement over snag hazards and areas of low burial depth by DPFPV Survey by ROVSV Trawl sweep using trawler	
Ref. Documents	FBL-DUN-DAOM-SSP-01-RPT-00001 FBL-DUN-DAOM-SSP-01-RPT-00003 A-301649-S01-TECH-008 A-301649-S01-REPT-003	Subsea Decommissioning Inventory Subsea Decommissioning Screening – Dunlin Dunlin – Long Term Materials Degradation Study Dunlin – Common Scope Report

ID No.	Type	Material	Length (m)	Trenched		Buried		Rock Dumped	
				Length (m)	Depth (m)	Length (m)	Depth (m)	Length (m)	Height (m)
PL4334	Cable (Trenched section DA-BC)	Polymer / Steel / Copper/ Fibre Optic	21403	21297	0.6	21297	0.6	1435 Total	0.6

SAFETY				
Offshore Personnel	Number	157	Man Hours	14870
Topsides Personnel	Number	N/A	Man Hours	N/A
Divers Required	Number	9	Man Hours	476
Onshore Personnel	Number	20	Man Hours	3425
Legacy Personnel	Number	35	Man Hours	30660
Impact to Other Users of the Sea (Operational)	Number of Vessels Used	4	Duration of Operations	27.4
Impact to Other Users of the Sea (Legacy)	Number of Vessels Used	1	Duration of Operations	73.0

Potential for High Consequence Event	Low	Comments	Routine operations

Operational Risk Diver	PLL	4.62E-04
Operational Risk Offshore	PLL	1.12E-03
Operational Risk Topsides	PLL	N/A
Operational Risk Onshore	PLL	4.21E-04
Legacy Risk (out to 50yrs)	PLL	1.69E-03
Fishing Risk	PLL	N/A (No increase in risk over and above what currently exists for fishing)
Overall Risk	∑PLL	3.68E-03

ENVIRONMENTAL								
Marine Impact (Vessels Operational)	Type	DSV	Number	1	Duration	9.7	Activity	Destruct
	Type	CSV	Number	N/A	Duration	N/A	Activity	N/A
	Type	DPFPV	Number	1	Duration	5.4	Activity	Rock Dump
	Type	ROVSV	Number	1	Duration	7.3	Activity	Survey
	Type	PSV	Number	N/A	Duration	N/A	Activity	N/A
	Type	Trawler	Number	1	Duration	5.0	Activity	Trawl Sweep
Marine Impact (Vessels Legacy)	Type	DPFPV	Number	N/A	Duration	N/A	Activity	N/A
	Type	ROVSV	Number	1	Duration	73.0	Activity	Survey
Noise (Total = Ops + Legacy)	Sound Exposure Level		253 dB re 1mP			21.9 TPa^2s		
Energy Use (Total = Ops + Legacy)	Fuel	1139.5 Te	CO_2	3612.2 Te	NOx	67.2 Te	SO_2	13.7 Te
Life Cycle Emissions (Total = Ops + Legacy)	CO_2		6539.58 Te		CO_2 (Credit)		N/A	

Marine Impact (Seabed)	Activity	Dredging	Area	40 m^2	Resources	N/A
	Activity	Rock Dump	Area	25800 m^2	Resources	22300 Te (Rock)
	Activity	Trenching	Area	N/A	Resources	N/A
	Activity	Backfilling	Area	N/A	Resources	N/A

Materials	Recovered	100 m Cable (Polymer/ Copper/ Fibre Optics) (3.2 Te)			
	Remaining	21303 m Cable (Polymer/ Copper/ Fibre Optics) 33912 Te Rock (11612 Te Existing + 22300 Te New)			
	Persistence	>100 years (no long term data/experience of polymers in seawater/buried)			
Residuals	LSA Scale	In-Situ	N/A	Returned	N/A
	Hydrocarbon	In-Situ	N/A	Returned	N/A
	Control Fluids	In-Situ	N/A	Returned	N/A

Technical				
Technical Considerations	Feasibility	High	Concept Maturity	High
	Availability of Technology	High – Off the shelf		
	Track Record	High – Extensive history		
	Risk of Failure	Low		
	Consequence of Failure	Alternate cutting technique / additional rock / limited schedule impacts		
	Emerging Technology	N/A		

Societal		
Societal Factors	Commercial Fisheries Impact	Low – No change as area is currently available for fishing
	Socio Economic	Low – Limited material returned to shore

Economic				
Economic Considerations	Comparative Cost Operational	4.8M		
	Comparative Cost Legacy - Monitoring	2.9M		
	Comparative Cost Legacy - Remedial	0.0M		
Economic Risk	Cost Risk	Low	Factors	High degree of achievability; Low likelihood of future remediation required due to existing burial depth.

Subsea Infrastructure Decommissioning Comparative Assessment Data Sheet

Area	Dunlin	
Decision/Group	Decision 7 Group 9 – Trenched and Buried Cable	
Option	2 – Leave in Situ – Minor Intervention (Cut and Rock Placement)	
Description	Cable end transitions, spans and exposures removed by DSV Rock placement over snag hazards and areas of low burial depth by DPFPV Survey by ROVSV Trawl sweep using trawler	
Ref. Documents	FBL-DUN-DAOM-SSP-01-RPT-00001 FBL-DUN-DAOM-SSP-01-RPT-00003 A-301649-S01-TECH-008 A-301649-S01-REPT-003	Subsea Decommissioning Inventory Subsea Decommissioning Screening – Dunlin Dunlin – Long Term Materials Degradation Study Dunlin – Common Scope Report

ID No.	Type	Material	Length (m)	Trenched		Buried		Rock Dumped	
				Length (m)	Depth (m)	Length (m)	Depth (m)	Length (m)	Height (m)
PL4334	Cable (Trenched section DA-BC)	Polymer / Steel / Copper/ Fibre Optic	21403	21297	0.6	21297	0.6	1435 Total	0.6

SAFETY				
Offshore Personnel	Number	157	Man Hours	17423
Topsides Personnel	Number	N/A	Man Hours	N/A
Divers Required	Number	9	Man Hours	1080
Onshore Personnel	Number	20	Man Hours	4295
Legacy Personnel	Number	35	Man Hours	30660
Impact to Other Users of the Sea (Operational)	Number of Vessels Used	4	Duration of Operations	30.2
Impact to Other Users of the Sea (Legacy)	Number of Vessels Used	1	Duration of Operations	73.0

Potential for High Consequence Event	Low	Comments	Routine operations

Operational Risk Diver	PLL	1.05E-03
Operational Risk Offshore	PLL	1.31E-03
Operational Risk Topsides	PLL	N/A
Operational Risk Onshore	PLL	5.28E-04
Legacy Risk (out to 50yrs)	PLL	1.69E-03
Fishing Risk	PLL	N/A (No increase in risk over and above what currently exists for fishing)
Overall Risk	∑PLL	4.57E-03

ENVIRONMENTAL								
Marine Impact (Vessels Operational)	Type	DSV	Number	1	Duration	12.5	Activity	Destruct
	Type	CSV	Number	N/A	Duration	N/A	Activity	N/A
	Type	DPFPV	Number	1	Duration	5.4	Activity	Rock Dump
	Type	ROVSV	Number	1	Duration	7.3	Activity	Survey
	Type	PSV	Number	N/A	Duration	N/A	Activity	N/A
	Type	Trawler	Number	1	Duration	5.0	Activity	Trawl Sweep
Marine Impact (Vessels Legacy)	Type	DPFPV	Number	N/A	Duration	N/A	Activity	N/A
	Type	ROVSV	Number	1	Duration	73.0	Activity	Survey
Noise (Total = Ops + Legacy)	Sound Exposure Level		254 dB re 1mP			23.9 TPa²s		
Energy Use (Total = Ops + Legacy)	Fuel	1201.1 Te	CO_2	3807.5 Te	NOx	70.9 Te	SO_2	14.4 Te
Life Cycle Emissions (Total = Ops + Legacy)	CO_2		6700.05 Te		CO_2 (Credit)		N/A	
Marine Impact (Seabed)	Activity	Dredging	Area	120 m²	Resources	N/A		
	Activity	Rock Dump	Area	25000 m²	Resources	21600 Te (Rock)		
	Activity	Trenching	Area	N/A	Resources	N/A		
	Activity	Backfilling	Area	N/A	Resources	N/A		

Materials	Recovered	260m Cable (Polymer/ Copper/ Fibre Optics) (8.4 Te)			
	Remaining	21223 m Cable (Polymer/ Copper/ Fibre Optics) 33212 Te Rock (11612 Te Existing + 21600 Te New)			
	Persistence	>100 years (no long term data/experience of polymers in seawater/buried)			
Residuals	LSA Scale	In-Situ	N/A	Returned	N/A
	Hydrocarbon	In-Situ	N/A	Returned	N/A
	Control Fluids	In-Situ	N/A	Returned	N/A

Technical				
Technical Considerations	Feasibility	High	Concept Maturity	High
	Availability of Technology	High – Off the shelf		
	Track Record	High – Extensive history		
	Risk of Failure	Low		
	Consequence of Failure	Alternate cutting technique / additional rock / limited schedule impacts		
	Emerging Technology	N/A		

Societal		
Societal Factors	Commercial Fisheries Impact	Low – No change as area is currently available for fishing
	Socio Economic	Low – Limited material returned to shore

Economic				
Economic Considerations	Comparative Cost Operational	5.7M		
	Comparative Cost Legacy - Monitoring	2.9M		
	Comparative Cost Legacy - Remedial	0.0M		
Economic Risk	Cost Risk	Low	Factors	High degree of achievability; Low likelihood of future remediation required due to existing burial depth.

Subsea Infrastructure Decommissioning Comparative Assessment Data Sheet

Area	Dunlin	
Decision/Group	Decision 7 Group 9 – Trenched and Buried Cable	
Option	3 – Full Removal – (Reverse Reel)	
Description	Cable deburial using MFE deployed from CSV Cable recovery head installation by DSV Recover cable and reverse reel by DSV with reel spread Survey by ROVSV	
Ref. Documents	FBL-DUN-DAOM-SSP-01-RPT-00001 FBL-DUN-DAOM-SSP-01-RPT-00003 A-301649-S01-TECH-009 A-301649-S01-TECH-010 A-301649-S01-REPT-003	Subsea Decommissioning Inventory Subsea Decommissioning Screening – Dunlin Dunlin – Trench Backfilling Feasibility Study Dunlin – Removal/Recovery Feasibility Study Dunlin – Common Scope Report

ID No.	Type	Material	Length (m)	Trenched		Buried		Rock Dumped	
				Length (m)	Depth (m)	Length (m)	Depth (m)	Length (m)	Height (m)
PL4334	Cable (Trenched section DA-BC)	Polymer / Steel / Copper/ Fibre Optic	21403	21297	0.6	21297	0.6	1435 Total	0.6

SAFETY				
Offshore Personnel	Number	151	Man Hours	25353
Topsides Personnel	Number	N/A	Man Hours	N/A
Divers Required	Number	9	Man Hours	346
Onshore Personnel	Number	20	Man Hours	15683
Legacy Personnel	Number	N/A	Man Hours	N/A
Impact to Other Users of the Sea (Operational)	Number of Vessels Used	3	Duration of Operations	39.6
Impact to Other Users of the Sea (Legacy)	Number of Vessels Used	N/A	Duration of Operations	N/A

Potential for High Consequence Event	Medium	Comments	Non-Routine operations; however not unusual to recovery umbilicals/cables. Deburial length is a factor.

Operational Risk Diver	PLL	3.36E-04
Operational Risk Offshore	PLL	1.90E-03
Operational Risk Topsides	PLL	N/A
Operational Risk Onshore	PLL	1.93E-03
Legacy Risk (out to 50yrs)	PLL	N/A
Fishing Risk	PLL	N/A (No increase in risk over and above what currently exists for fishing)
Overall Risk	∑PLL	4.17E-03

ENVIRONMENTAL								
Marine Impact (Vessels Operational)	Type	DSV	Number	1	Duration	15.7	Activity	Reeling
	Type	CSV	Number	1	Duration	16.6	Activity	Deburial
	Type	DPFPV	Number	N/A	Duration	N/A	Activity	N/A
	Type	ROVSV	Number	1	Duration	7.3	Activity	Survey
	Type	PSV	Number	N/A	Duration	N/A	Activity	N/A
	Type	Trawler	Number	N/A	Duration	N/A	Activity	N/A
Marine Impact (Vessels Legacy)	Type	DPFPV	Number	N/A	Duration	N/A	Activity	N/A
	Type	ROVSV	Number	N/A	Duration	N/A	Activity	N/A
Noise (Total = Ops + Legacy)	Sound Exposure Level		251 dB re 1mP			12.0 TPa^2s		
Energy Use (Total = Ops + Legacy)	Fuel	871.0 Te	CO_2	2761.0 Te	NOx	51.4 Te	SO_2	10.5 Te
Life Cycle Emissions (Total = Ops + Legacy)	CO_2		3127.53 Te		CO_2 (Credit)		318.05 Te	
Marine Impact (Seabed)	Activity	Dredging	Area	106485 m^2	Resources	N/A		
	Activity	Rock Dump	Area	N/A	Resources	N/A		
	Activity	Trenching	Area	N/A	Resources	N/A		
	Activity	Backfilling	Area	N/A	Resources	N/A		

Materials	Recovered	21403 m Cable (Polymer/ Copper/ Fibre Optics) (726.5 Te)			
	Remaining	11612 Te Rock (Existing)			
	Persistence	N/A			
Residuals	LSA Scale	In-Situ	N/A	Returned	N/A
	Hydrocarbon	In-Situ	N/A	Returned	N/A
	Control Fluids	In-Situ	N/A	Returned	N/A

Technical				
Technical Considerations	Feasibility	Medium	Concept Maturity	Low
	Availability of Technology	Medium – Limited number of existing techniques suitable for deburial		
	Track Record	Low – Limited experience of exposing cables over extended distances to enable re-reeling		
	Risk of Failure	High		
	Consequence of Failure	Alternate deburial techniques required / Alternate recovery techniques required/ rock required to remedy over dredged areas / large schedule overruns with limited ability to recover.		
	Emerging Technology	N/A		

Societal		
Societal Factors	Commercial Fisheries Impact	Low – No change as area is currently available for fishing
	Socio Economic	Low – Material returned to shore will generate a small amount of recycling work.

Economic				
Economic Considerations	Comparative Cost Operational	8.0M		
	Comparative Cost Legacy - Monitoring	0.0M		
	Comparative Cost Legacy - Remedial	0.0M		
Economic Risk	Cost Risk	High	Factors	Medium degree of achievability; High likelihood of failure to expose the line fully without multiple deburial techniques and passes; High likelihood of over trenching in sandy areas leading to areas of disturbance that are larger than required with potential remediation required i.e. rock installation.

Subsea Infrastructure Decommissioning Comparative Assessment Data Sheet

Area	Dunlin	
Decision/Group	Decision 8 Group 10 – DPI Cable Riser (Brent Charlie)	
Option	1 – Leave in Situ – Minor Intervention (Outboard Cut and Recovery)	
Description	Cable riser cut at J-tube exit by DSV Cable cut at trench transition by DSV Bellmouth removal at the J-tube by DSV Seal J-tube and recover outboard section of cable, between J-tube and trench transition, back to the DSV Disconnect cable and gap at topside	
Ref. Documents	FBL-DUN-DAOM-SSP-01-RPT-00001 FBL-DUN-DAOM-SSP-01-RPT-00003 A-301649-S01-TECH-008 A-301649-S01-TECH-011 A-301649-S01-REPT-003	Subsea Decommissioning Inventory Subsea Decommissioning Screening – Dunlin Dunlin – Long Term Materials Degradation Study Dunlin – Effect of Leaving Riser Section within J-Tube Dunlin – Common Scope Report

ID No.	Type	Material	Length (m)	Trenched		Buried		Rock Dumped	
				Length (m)	Depth (m)	Length (m)	Depth (m)	Length (m)	Height (m)
PL4334 Riser	Cable (Untrenched section at Brent Charlie)	Polymer / Steel / Copper/ Fibre Optic	480	0	0	0	0	0	0

SAFETY				
Offshore Personnel	Number	76	Man Hours	5427
Topsides Personnel	Number	6	Man Hours	87
Divers Required	Number	9	Man Hours	346
Onshore Personnel	Number	20	Man Hours	1599
Legacy Personnel	Number	N/A	Man Hours	N/A
Impact to Other Users of the Sea(Operational)	Number of Vessels Used	1	Duration of Operations	6.0
Impact to Other Users of the Sea (Legacy)	Number of Vessels Used	N/A	Duration of Operations	N/A

Potential for High Consequence Event	Low	Comments	Routine operations

Operational Risk Diver	PLL	3.36E-04
Operational Risk Offshore	PLL	4.10E-04
Operational Risk Topsides	PLL	3.57E-06
Operational Risk Onshore	PLL	1.97E-04
Legacy Risk (out to 50yrs)	PLL	N/A (in line with CGB)
Fishing Risk	PLL	N/A
Overall Risk	∑PLL	9.46E-04

ENVIRONMENTAL								
Marine Impact (Vessels Operational)	Type	DSV	Number	1	Duration	6.0	Activity	Destruct
	Type	CSV	Number	N/A	Duration	N/A	Activity	N/A
	Type	DPFPV	Number	N/A	Duration	N/A	Activity	N/A
	Type	ROVSV	Number	N/A	Duration	N/A	Activity	N/A
	Type	PSV	Number	N/A	Duration	N/A	Activity	N/A
	Type	Trawler	Number	N/A	Duration	N/A	Activity	N/A
Marine Impact (Vessels Legacy)	Type	DPFPV	Number	N/A	Duration	N/A	Activity	N/A
	Type	ROVSV	Number	N/A	Duration	N/A	Activity	N/A
Noise (Total = Ops + Legacy)	Sound Exposure Level		239 dB re 1mP			0.8 TPa^2s		
Energy Use (Total = Ops + Legacy)	Fuel	130.9 Te	CO_2	415.0 Te	NOx	7.7 Te	SO_2	1.6 Te
Life Cycle Emissions (Total = Ops + Legacy)	CO_2		443.08 Te		CO_2 (Credit)		N/A	

Marine Impact (Seabed)	Activity	Dredging	Area	N/A	Resources	N/A
	Activity	Rock Dump	Area	N/A	Resources	N/A
	Activity	Trenching	Area	N/A	Resources	N/A
	Activity	Backfilling	Area	N/A	Resources	N/A

Materials	Recovered	300 m Cable (Polymer/ Copper/ Fibre Optics) (9.1 Te)			
	Remaining	180 m Cable within J-tube (Polymer/ Copper/ Fibre Optics)			
	Persistence	In-line with CGB & J-tubes >250 years			
Residuals	LSA Scale	In-Situ	N/A	Returned	N/A
	Hydrocarbon	In-Situ	N/A	Returned	N/A
	Control Fluids	In-Situ	N/A	Returned	N/A

Technical				
Technical Considerations	Feasibility	High	Concept Maturity	High
	Availability of Technology	High – Off the shelf		
	Track Record	High – Extensive history of similar work		
	Risk of Failure	Low		
	Consequence of Failure	Limited schedule impacts		
	Emerging Technology	N/A		

Societal		
Societal Factors	Commercial Fisheries Impact	Low – Area will potentially remain within a safety zone
	Socio Economic	Low – Limited material returned to shore

Economic				
Economic Considerations	Comparative Cost Operational		1.9M	
	Comparative Cost Legacy - Monitoring		0.0M – (Monitoring is assumed to be done as part of any CGB monitoring)	
	Comparative Cost Legacy - Remedial		0.0M	
Economic Risk	Cost Risk	Low	Factors	High degree of achievability.

Subsea Infrastructure Decommissioning Comparative Assessment Data Sheet

Area	Dunlin	
Decision/Group	Decision 8 Group 10 – DPI Cable Riser (Brent Charlie)	
Option	2 – Full Removal – Topsides Pull	
Description	Mobilise winch spread to platform, install and test Remove topside hang-off and transfer cable to winch Cable cut at J-tube exit and trench transition by DSV Seal J-tube and recover outboard section of cable, between J-tube and trench transition, back to the DSV Pull-in cable using the topside winch (pull, secure, cut, repeat) Backload cable sections and winch equipment Survey by ROVSV	
Ref. Documents	FBL-DUN-DAOM-SSP-01-RPT-00001 FBL-DUN-DAOM-SSP-01-RPT-00003 A-301649-S01-TECH-010 A-301649-S01-REPT-003	Subsea Decommissioning Inventory Subsea Decommissioning Screening – Dunlin Dunlin – Removal/Recovery Feasibility Study Dunlin – Common Scope Report

ID No.	Type	Material	Length (m)	Trenched		Buried		Rock Dumped	
				Length (m)	Depth (m)	Length (m)	Depth (m)	Length (m)	Height (m)
PL4334 Riser	Cable (Untrenched section at Brent Charlie)	Polymer / Steel / Copper/ Fibre Optic	480	0	0	0	0	0	0

SAFETY				
Offshore Personnel	Number	126	Man Hours	11472
Topsides Personnel	Number	6	Man Hours	2823
Divers Required	Number	9	Man Hours	346
Onshore Personnel	Number	20	Man Hours	4225
Legacy Personnel	Number	N/A	Man Hours	N/A
Impact to Other Users of the Sea	Number of Vessels Used	2	Duration of Operations	16
Impact to Other Users of the Sea (Legacy)	Number of Vessels Used	N/A	Duration of Operations	N/A

Potential for High Consequence Event	High	Comments	Non-routine operations but not unusual. High SIMOPS between Fairfield and 3rd party operator.

Operational Risk Diver	PLL	3.36E-04
Operational Risk Offshore	PLL	8.60E-04
Operational Risk Topsides	PLL	1.16E-04
Operational Risk Onshore	PLL	5.20E-04
Legacy Risk (out to 50yrs)	PLL	N/A
Fishing Risk	PLL	N/A
Overall Risk	∑PLL	1.83E-03

ENVIRONMENTAL								
Marine Impact (Vessels Operational)	Type	DSV	Number	1	Duration	6	Activity	Destruct
	Type	CSV	Number	N/A	Duration	N/A	Activity	N/A
	Type	DPFPV	Number	N/A	Duration	N/A	Activity	N/A
	Type	ROVSV	Number	N/A	Duration	N/A	Activity	N/A
	Type	PSV	Number	1	Duration	10	Activity	Supply
	Type	Trawler	Number	N/A	Duration	N/A	Activity	N/A
Marine Impact (Vessels Legacy)	Type	DPFPV	Number	N/A	Duration	N/A	Activity	N/A
	Type	ROVSV	Number	N/A	Duration	N/A	Activity	N/A
Noise (Total = Ops + Legacy)	Sound Exposure Level		245 dB re 1mP			3.0 TPa^2s		
Energy Use (Total = Ops + Legacy)	Fuel	230.9 Te	CO_2	732.0 Te	NOx	13.6 Te	SO_2	2.8 Te
Life Cycle Emissions (Total = Ops + Legacy)	CO_2		747.66 Te		CO_2 (Credit)		2.69 Te	

Marine Impact (Seabed)	Activity	Dredging	Area	N/A	Resources	N/A
	Activity	Rock Dump	Area	N/A	Resources	N/A
	Activity	Trenching	Area	N/A	Resources	N/A
	Activity	Backfilling	Area	N/A	Resources	N/A

Materials	Recovered	480 m Cable (Polymer/ Copper/ Fibre Optics) (15.6 Te)
	Remaining	0 m
	Persistence	N/A

Residuals	LSA Scale	In-Situ	N/A	Returned	N/A
	Hydrocarbon	In-Situ	N/A	Returned	N/A
	Control Fluids	In-Situ	N/A	Returned	N/A

Technical				
Technical Considerations	Feasibility	High	Concept Maturity	Medium
	Availability of Technology	High – Off the shelf		
	Track Record	High – Extensive history in North Sea and recent history on Dunlin.		
	Risk of Failure	Medium – Unknown integrity of J-tube / cable and inability to inspect.		
	Consequence of Failure	Cable would remain within J-tube / schedule over runs		
	Emerging Technology	N/A		

Societal		
Societal Factors	Commercial Fisheries Impact	Low – Area where cable is removed will potentially remain within a safety zone
	Socio Economic	Low – Limited material returned to shore

Economic		
Economic Considerations	Comparative Cost Operational	3.2M
	Comparative Cost Legacy - Monitoring	0.0M
	Comparative Cost Legacy - Remedial	0.0M

Economic Risk	Cost Risk	Medium	Factors	Topside engineering for winch locating is not mature; Limited available information on 3rd party asset; delays due to 3rd party operations/restrictions would impact schedule and cost.

Appendix I CA Attributes Tables & Pairwise Comparison (Inc. Costs)

Project Differentiator Attributes

Differentiator	Sub-Criteria	Description	1. Leave - Rock Placement	2. Full Removal - Deburial
1. Safety	1.1 Personnel Offshore	This sub-criterion considers elements that impact risk to offshore personnel and includes, project team, project vessel crew, diving teams, supply boat crew, and survey vessel crew. It should be noted that crew changes are performed via port calls.	Total PLL: 1.33E-03 Vessels located on site for Operations: 5.2 days Legacy: 45 days	Total PLL: 1.82E-03 Vessels located on site for 13.7 days.
	1.2 Personnel Onshore	This sub-criterion considers elements that impact risk to onshore personnel. Factors such as any requirement for dismantling, disposal operations, material transfer and onshore handling may impact onshore personnel.		
	1.3 Other Users	This sub-criterion covers the impact associated with the risk to other users. Considers elements such as collision impact whilst performing activities. Users such as fishing vessels, commercial transport vessels and military vessels are considered.		
	1.4 High Consequence Events	This sub-criterion relates to any inherent potential for high consequence events i.e. major accident hazard, major environmental hazard type events. It applies to all onshore and offshore personnel involved in the project. Considerations such as dropped object concerns, support vessel risks, are considered.	Low risk of high consequence events - routine.	Low risk of high consequence events - only performed once the lines being crossed are no longer operational and have been flushed. Agreement in principle with 3rd parties has been reached at this stage.
	1.5 Residual Risk	This sub-criterion addresses and residual risk to other sea users i.e. fishermen, military vessel crews, commercial vessel crews and passengers, other sea users, that is provided by the option. Issues such as residual snag risk, collision risk, etc. may be considered.	Residual Risk Monitoring: 35 / 18900 / 1.04E-03 Fishing: Negligible additional risk presented to fisherman from spot rock dumped buried structures.	There is no residual legacy risk or risk to fishing operations associated with this option as it is a full removal option.
	Summary		The summed PLL figures for options 1 and 2 (all worker groups and including legacy component where present) are 1.33E-03 and 1.82E-03 respectively. This shows that option 1 carries a lower overall risk than option 2, however the difference is minimal. The durations that vessels are on site are higher for option 1 than option 2. Overall, option 1 is Stronger than option 2.	
2. Environmental	2.1 Marine Impacts	This sub-criterion covers elements such as noise generated by vessels, cutting operations, explosives etc. It also covers any damaging discharges to sea from vessels and / or activities performed.	Sound Exposure 251 dB re 1mP / 12.6 TPa2s	Sound Exposure 245 dB re 1mP / 3.5 TPa2s
	2.2 Emissions	This sub-criterion relates to the amount of damaging atmospheric emissions associated with a particular option.	CO2: 359.9 Te NOx: 6.7 Te SO2: 1.4 Te Lifecycle Emissions CO2: 488.86 Te CO2 Credit (for steel): N/A	CO2: 958.2 Te NOx: 17.8 Te SO2: 3.6 Te Lifecycle Emissions CO2: 958.66 CO2 Credit (for steel): N/A
	2.3 Consumption	This sub-criterion relates to the amount of Energy / Resource consumption such as fuel use, recycling of materials, use of quarried rock, production of replacement materials.	Fuel: 113.5 Te Rock: 3800 Te	Fuel: 302.3 Te Rock: N/A
	2.4 Disturbance	This sub-criterion relates to both direct and indirect seabed disturbance. Both short and long term impacts are considered.	Disturbance Rock Dump: 1800 m2	Disturbance Dredging: 876 m2
	2.5 Protections	This sub-criterion relates to the impact of the options on any protected sites and species.	This option has no impact on protected sites or species.	This option has no impact on protected sites or species.
	Summary		Option 1 is preferable to option 2 from an emissions and fuel use perspective. Option 2 is preferable to option 1 from a noise exposure and introduction of new material (rock) perspective. It should be noted that all these preferences are minimal and make the options equal. The differentiator in this case is the seabed disturbance. The rock dumping associated with Option 1 impacts a greater area and is considered a permanent impact compared to the smaller, temporary seabed disturbance associated with Option 2, although the difference is not particularly large. Overall, option 1 is Weaker than option 2.	

Project Differentiator Attributes

Differentiator	Sub-Criteria	Description	1. Leave - Rock Placement	2. Full Removal - Deburial
3. Technical	3.1 Technical Risk	This sub-criterion relates to the various technical risks that could result in a major project failure. Concepts such as: Technical Novelty and Potential for Showstoppers can be captured along with impact on the schedule due to overruns from technical issues such as operations being interrupted by the weather. Technical Feasibility and Technical Maturity is also considered.	Feasibility: High Concept Maturity: High Availability of Technology: High – Off the shelf Track Record: High – Extensive history Risk of Failure: Low Consequence of Failure: Additional rock profiling / limited schedule impacts Emerging Technology: N/A	Feasibility: High Concept Maturity: High Availability of Technology: High – Off the shelf Track Record: High – Large history of MFE for local deburial Risk of Failure: Low Consequence of Failure: Additional dredging / additional rock profiling / limited schedule impacts Emerging Technology: N/A
		Summary	Options 1 and 2 are equal to each other technically and are therefore scored as Neutral to each other from a technical perspective.	
4. Societal	4.1 Fishing	This sub-criterion addresses the impact of the option on commercial fishing operations. It includes consideration of impacts from both the decommissioning activities any residual impacts post decommissioning such as reinstatement of access to area.	PL2852, PLU2853 in 500m zone (within 200m of Dunlin Alpha CGB). All other equipment that this group applies to are currently overtrawlable so no change to current situation re: fishing.	Option does remove a crossing (over the DFGI line) but such a small area considered negligible from a fishing operations perspective.
	4.2 Other Users	This sub-criterion addresses any socio-economic impacts on other users both onshore where the impact may be from dismantling, transporting, treating, recycling and land filling activities relating to the option and offshore. Issues such as impact on the health, well-being, standard of living, structure or coherence of communities or amenities are considered here e.g. business or jobs creation, increase in noise, dust or odour pollution during the process which has a negative impact on communities, increased traffic disruption due to extra-large transport loads, etc. Includes the FEL Guiding Principle of 'Minimal business interruption to others'.	Material returned to shore Recovered: N/A Remaining: 1 x concrete arch 45 x concrete mattress 200 x grout bags 80 x sand bags 23992 Te Rock (20192 Te Existing + 3800 Te New). Persistence: >100 years (fully covered).	Material returned to shore Recovered: 1 x concrete arch 45 x concrete mattress 200 x grout bags 80 x sand bags Remaining: 20192 Te Rock (Existing). Persistence: N/A
		Summary	Option 1 and 2 largely comparable, although option 1 does have some additional new material. Option 2 involves crossing third party lines however agreement in principle that operations will only be performed once line has been decommissioned. Overall option 1 Neutral to option 2.	
5. Economic	5.1 Short-term Costs	This sub-criterion addresses the cost of delivering the option as described. No long-term cost element is considered here. Cost uncertainty (a function of activity maturity) is also recorded.	Cost: 0.6 M Cost Risk: Low Risk Factors: High degree of achievability.	Cost: 3.1 M Cost Risk: Low Risk Factors: High degree of achievability.
	5.2 Long-term Costs	This sub-criterion addresses the costs associated with any long-term liabilities such as on-going monitoring and any potential future remediation costs.	Monitoring Cost: 1.8 M Remedial Cost: 0.0 M Cost Risk: Low Risk Factors: Low likelihood of future remediation required due to existing burial depth and low fishing activity within the area. Potential future requirement to remove items after live pipelines are decommissioned.	There are no long-term cost liabilities associated with this full removal option.
		Summary	The total costs for options 1 and 2 are 2.4 M, and 3.1 M respectively. This is a relatively small differential and are assessed as Neutral to each other. It should be noted that DPI line has no section 29 associated with it.	

1. Safety

	1. Leave - Rock Placement	2. Full Removal - Deburial	Priorities
1. Leave - Rock Placement	N	N	50.00%
2. Full Removal - Deburial	N	N	50.00%

2. Environmental

	1. Leave - Rock Placement	2. Full Removal - Deburial	Priorities
1. Leave - Rock Placement	N	W	40.00%
2. Full Removal - Deburial	S	N	60.00%

3. Technical

	1. Leave - Rock Placement	2. Full Removal - Deburial	Priorities
1. Leave - Rock Placement	N	N	50.00%
2. Full Removal - Deburial	N	N	50.00%

4. Societal

	1. Leave - Rock Placement	2. Full Removal - Deburial	Priorities
1. Leave - Rock Placement	N	N	50.00%
2. Full Removal - Deburial	N	N	50.00%

5. Economic

	1. Leave - Rock Placement	2. Full Removal - Deburial	Priorities
1. Leave - Rock Placement	N	N	50.00%
2. Full Removal - Deburial	N	N	50.00%

Dunlin Decision 1 – Buried Structures and Deposits

Pairwise Comparison

xodus GROUP

Differentiator	Sub-Criteria	Description	1. Leave - Cut and Seal	2. Full Removal - Topsides Pull
1. Safety	1.1 Personnel Offshore	This sub-criterion considers elements that impact risk to offshore personnel and includes, project team, project vessel crew, diving teams, supply boat crew, and survey vessel crew. It should be noted that crew changes are performed via port calls.	Total PLL: 8.60E-04 Vessels located on site for 5.8 days.	Total PLL: 1.87E-03 Vessels located on site for 16.4 days.
	1.2 Personnel Onshore	This sub-criterion considers elements that impact risk to onshore personnel. Factors such as any requirement for dismantling, disposal operations, material transfer and onshore handling may impact onshore personnel.	Low risk of high consequence events - routine.	Medium risk of high consequence events - non-routine operations, not considered unusual, possible limited SIMOPS.
	1.3 Other Users	This sub-criterion covers the impact associated with the risk to other users. Considers elements such as collision impact whilst performing activities. Users such as fishing vessels, commercial transport vessels and military vessels are considered.	There is no residual risk associated with this option as it is wholly within the 500m exclusion zone and all outboard elements are fully removed.	There is no residual risk associated with this full removal option.
	1.4 High Consequence Events	This sub-criterion relates to any inherent potential for high consequence events i.e. major accident hazard, major environmental hazard type events. It applies to all onshore and offshore personnel involved in the project. Considerations such as dropped object concerns, support vessel risks, are considered.		
	1.5 Residual Risk	This sub-criterion addresses and residual risk to other sea users i.e. fishermen, military vessel crews, commercial vessel crews and passengers, other sea users, that is provided by the option. Issues such as residual snag risk, collision risk, etc. may be considered.		
		Summary	The summed PLL figures for options 1 and 2 (all worker groups and including legacy component where present) are 8.60E-04 and 1.87E-03 respectively. This indicates that option 1 is the lowest risk for all worker groups, due lower exposures for all groups. Vessel durations are lower for option 1 versus option 2 and risk of high consequence events is also lower. Overall, option 1 is Much Stronger than option 2.	
2. Environmental	2.1 Marine Impacts	This sub-criterion covers elements such as noise generated by vessels, cutting operations, explosives etc. It also covers any damaging discharges to sea from vessels and / or activities performed.	Sound Exposure 237 dB re 1mP / 0.5 TPa2s	Sound Exposure 244 dB re 1mP / 2.7 TPa2s
	2.2 Emissions	This sub-criterion relates to the amount of damaging atmospheric emissions associated with a particular option.	CO2: 406.6 Te NOx: 7.6 Te SO2: 1.5 Te Lifecycle Emissions CO2: 414.48 Te CO2 Credit (for steel): N/A	CO2: 764.0 Te NOx: 14.2 Te SO2: 2.9 Te Lifecycle Emissions CO2: 768.23 Te CO2 Credit (for steel): 3.89 Te
	2.3 Consumption	This sub-criterion relates to the amount of Energy / Resource consumption such as fuel use, recycling of materials, use of quarried rock, production of replacement materials.	Fuel: 128.3 Te Rock: None	Fuel: 241.0 Te Rock: None
	2.4 Disturbance	This sub-criterion relates to both direct and indirect seabed disturbance. Both short and long term impacts are considered.	This option has no associated seabed disturbance.	This option has no associated seabed disturbance.
	2.5 Protections	This sub-criterion relates to the impact of the options on any protected sites and species.	This option has no impact on protected sites or species.	This option has no impact on protected sites or species.
		Summary	Option 1 is either equal to or marginally better than option 2 in all areas. As such, option 1 is Stronger than option 2 from an environmental perspective due to the cumulative effect of these marginal improvements.	
3. Technical	3.1 Technical Risk	This sub-criterion relates to the various technical risks that could result in a major project failure. Concepts such as: Technical Novelty and Potential for Showstoppers can be captured along with impact on the schedule due to overruns from technical issues such as operations being interrupted by the weather. Technical Feasibility and Technical Maturity is also considered.	Feasibility: High. Concept Maturity: High. Availability of Technology: High – Off the shelf. Track Record: High – Extensive history of similar work. Risk of Failure: Low. Consequence of Failure: Limited schedule impacts. Emerging Technology: Diverless cutting may be an option.	Feasibility: High. Concept Maturity: Medium. Availability of Technology: High – Off the shelf. Track Record: High – Extensive history in North Sea and recent history on Dunlin. Risk of Failure: Low – Riser is a recent installation and J-tube was inspected in 2010 as part of the riser install. Consequence of Failure: Riser would remain within J-tube / schedule overruns Emerging Technology: N/A. Neutral - have pulled-in recently (2010) thus technically highly deliverable.
		Summary	Options 1 and 2 are considered equal to each other from a Technical Feasibility perspective. Initially option 2 appears to be more technically challenging, however this rigid riser has been successfully pulled-in recently (2010) and is therefore assessed as being highly deliverable. As such, option 1 and 2 are scored as Neutral to each other from a Technical Feasibility perspective.	

Differentiator	Sub-Criteria	Description	1. Leave - Cut and Seal	2. Full Removal - Topsides Pull
4. Societal	4.1 Fishing	This sub-criterion addresses the impact of the option on commercial fishing operations. It includes consideration of impacts from both the decommissioning activities any residual impacts post decommissioning such as reinstatement of access to area.	Will not remain on seabed - no long term exposure.	Will not remain on seabed - no long term exposure.
	4.2 Other Users	This sub-criterion addresses any socio-economic impacts on other users both onshore where the impact may be from dismantling, transporting, treating, recycling and land filling activities relating to the option and offshore. Issues such as impact on the health, well-being, standard of living, structure or coherence of communities or amenities are considered here e.g. business or jobs creation, increase in noise, dust or odour pollution during the process which has a negative impact on communities, increased traffic disruption due to extra-large transport loads, etc. Includes the FEL Guiding Principle of 'Minimal business interruption to others'.	Material returned to shore Recovered: 1 m Riser (0.05 Te) Remaining: 197 m Riser (within J-tube) Persistence: In-line with CGB & J-tubes >250 years.	Material returned to shore Recovered: 198 m (4.2 Te) Remaining: 0 m Persistence: N/A
		Summary	Options 1 and 2 are largely similar from a societal perspective. There is more material returned to shore under option 2, however this was not considered significant enough to change the scoring from Neutral.	
5. Economic	5.1 Short-term Costs	This sub-criterion addresses the cost of delivering the option as described. No long-term cost element is considered here. Cost uncertainty (a function of activity maturity) is also recorded.	Cost: 1.8 M Cost Risk: Low Risk Factors: High degree of achievability.	Cost: 3.3 M Cost Risk: Medium Risk Factors: Topside engineering for winch locating, pull-in loads and handling of cut sections is not mature / Previous pull-in operations have suffered delays and cost overruns. Historical overruns have been pull-in rather than removal operations.
	5.2 Long-term Costs	This sub-criterion addresses the costs associated with any long-term liabilities such as on-going monitoring and any potential future remediation costs.	No long-term costs, any Monitoring is assumed to be done as part of any CGB monitoring.	No long-term costs associated with this full removal option.
		Summary	Option 1 has a lower cost and cost risk than option 2. Therefore option 1 is Stronger than option 2.	

1. Safety	1. Leave - Cut and Seal	2. Full Removal - Topsides Pull	Priorities
1. Leave - Cut and Seal	N	MS	75.00%
2. Full Removal - Topsides Pull	MW	N	25.00%

2. Environmental	1. Leave - Cut and Seal	2. Full Removal - Topsides Pull	Priorities
1. Leave - Cut and Seal	N	S	60.00%
2. Full Removal - Topsides Pull	W	N	40.00%

3. Technical	1. Leave - Cut and Seal	2. Full Removal - Topsides Pull	Priorities
1. Leave - Cut and Seal	N	N	50.00%
2. Full Removal - Topsides Pull	N	N	50.00%

4. Societal	1. Leave - Cut and Seal	2. Full Removal - Topsides Pull	Priorities
1. Leave - Cut and Seal	N	N	50.00%
2. Full Removal - Topsides Pull	N	N	50.00%

5. Economic	1. Leave - Cut and Seal	2. Full Removal - Topsides Pull	Priorities
1. Leave - Cut and Seal	N	S	60.00%
2. Full Removal - Topsides Pull	W	N	40.00%

Dunlin Decision 2 – Rigid Risers

Pairwise Comparison

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Project Differentiator Attributes

Differentiator	Sub-Criteria	Description	1. Leave - End Removal - Limited Rock Placement	2. Full removal - Reverse Reel
1. Safety	1.1 Personnel Offshore	This sub-criterion considers elements that impact risk to offshore personnel and includes, project team, project vessel crew, diving teams, supply boat crew, and survey vessel crew. It should be noted that crew changes are performed via port calls.	Total PLL: 3.04E-03 Vessels located on site for Operations: 23.1 days Legacy: 55.9 days	Total PLL: 2.21E-03 Vessels located on site for 26.4 days.
	1.2 Personnel Onshore	This sub-criterion considers elements that impact risk to onshore personnel. Factors such as any requirement for dismantling, disposal operations, material transfer and onshore handling may impact onshore personnel.	Low risk of high consequence events - routine.	Medium risk of high consequence events - non-routine. The integrity of the pipeline is assumed by engineering only. Potential for pipeline integrity failure during these operations.
	1.3 Other Users	This sub-criterion covers the impact associated with the risk to other users. Considers elements such as collision impact whilst performing activities. Users such as fishing vessels, commercial transport vessels and military vessels are considered.	Residual Risk Legacy: 35 / 23520 / 1.29E-03 Fishing: Negligible additional risk presented to fisherman from spot rock dumped trenched and buried pipeline.	There is no residual legacy risk or risk to fishing operations associated with this option as it is a full removal option.
	1.4 High Consequence Events	This sub-criterion relates to any inherent potential for high consequence events i.e. major accident hazard, major environmental hazard type events. It applies to all onshore and offshore personnel involved in the project. Considerations such as dropped object concerns, support vessel risks, are considered.		
	1.5 Residual Risk	This sub-criterion addresses and residual risk to other sea users i.e. fishermen, military vessel crews, commercial vessel crews and passengers, other sea users, that is provided by the option. Issues such as residual snag risk, collision risk, etc. may be considered.		
	Summary		The summed PLL figures for options 1 and 2 (all worker groups and including legacy component where present) are 3.04E-03 and 2.21E-03 respectively. This indicates that option 2 carries a lower risk exposure due to there being no legacy risk component. Vessel durations are higher for option 1 versus option 2 but the risk of high consequence events is higher for option 2 due to non-routine reverse reel and deburial activities. Overall, option 1 is Stronger than option 2 due as the risk for high consequence events associated with option 2 outweighs the lower risk exposure associated with option 1.	
2. Environmental	2.1 Marine Impacts	This sub-criterion covers elements such as noise generated by vessels, cutting operations, explosives etc. It also covers any damaging discharges to sea from vessels and / or activities performed.	Sound Exposure 252 dB re 1mP / 17.2 TPa2s Higher noise from cutting operations.	Sound Exposure 249 dB re 1mP / 7.4 TPa2s
	2.2 Emissions	This sub-criterion relates to the amount of damaging atmospheric emissions associated with a particular option.	CO2: 2829.2 Te NOx: 52.7 Te SO2: 10.7 Te Lifecycle Emissions CO2: 3256.75 Te CO2 Credit (for steel): N/A	CO2: 1627.1 Te NOx: 30.3 Te SO2: 6.2 Te Lifecycle Emissions CO2: 1851.28 Te CO2 Credit (for steel): 205.75 Te
	2.3 Consumption	This sub-criterion relates to the amount of Energy / Resource consumption such as fuel use, recycling of materials, use of quarried rock, production of replacement materials.	Fuel: 892.5 Te Rock: 200 Te	Fuel: 513.3 Te Rock: N/A
	2.4 Disturbance	This sub-criterion relates to both direct and indirect seabed disturbance. Both short and long term impacts are considered.	Disturbance Dredging: 40 m2 Rock Dump: 206 m2	Disturbance Dredging: 48995 m2
	2.5 Protections	This sub-criterion relates to the impact of the options on any protected sites and species.	This option has no impact on protected sites or species.	This option has no impact on protected sites or species.
	Summary		Option 1 is marginally less preferable than option 2 from a noise exposure, emissions and fuel use perspective, although the differences are minimal. There is little to choose between the option from a rock use perspective, especially given that the rock use associated with option 1 is to spot rock dump the exposed ends of the pipeline. Whilst it is noted that the seabed disturbance impact from the dredging operations associated with option 2 is transient in nature compared to the permanent impact of the rock dump associated with option 1, it is over a much larger area than option 1. Overall, option 1 is Stronger than option 2, driven by the substantially larger area of seabed disturbance.	

Project Differentiator Attributes

Differentiator	Sub-Criteria	Description	1. Leave - End Removal - Limited Rock Placement	2. Full removal - Reverse Reel
3. Technical	3.1 Technical Risk	This sub-criterion relates to the various technical risks that could result in a major project failure. Concepts such as: Technical Novelty and Potential for Showstoppers can be captured along with impact on the schedule due to overruns from technical issues such as operations being interrupted by the weather. Technical Feasibility and Technical Maturity is also considered.	Feasibility: High Concept Maturity: High Availability of Technology: High – Off the shelf Track Record: High – Extensive history Risk of Failure: Low Consequence of Failure: Alternate cutting technique / additional rock / limited schedule impacts Emerging Technology: Diverless cutting may be an option.	Feasibility: Medium Concept Maturity: Low Availability of Technology: Medium – Limited number of existing techniques suitable for deburial Track Record: Low – Limited experience of exposing pipelines over extended distances to enable re-reeling Risk of Failure: High Consequence of Failure: Alternate deburial techniques required / Alternate recovery techniques required/ rock required to remedy over trenched areas / large schedule overruns with limited ability to recover. Emerging Technology: N/A
		Summary	Option 1 less technically challenging than option 2 due to uncertainty surrounding the ability to perform deburial of the rigid pipeline. Overall option 1 Much Stronger than option 2 from a technical perspective.	
4. Societal	4.1 Fishing	This sub-criterion addresses the impact of the option on commercial fishing operations. It includes consideration of impacts from both the decommissioning activities any residual impacts post decommissioning such as reinstatement of access to area.	Introduction of small amount of additional rock at ends, alongside existing rock placement. Still overtrawlable in long term, negligible short term impact - no additional exclusions so as is.	Removal of pipeline, still overtrawlable in long term. Negligible short term impact.
	4.2 Other Users	This sub-criterion addresses any socio-economic impacts on other users both onshore where the impact may be from dismantling, transporting, treating, recycling and land filling activities relating to the option and offshore. Issues such as impact on the health, well-being, standard of living, structure or coherence of communities or amenities are considered here e.g. business or jobs creation, increase in noise, dust or odour pollution during the process which has a negative impact on communities, increased traffic disruption due to extra-large transport loads, etc. Includes the FEL Guiding Principle of 'Minimal business interruption to others'.	Material returned to shore Recovered: 30 m pipe (0.65 Te) Remaining: 10242 m pipe 6063 Te Rock (5863 Te Existing + 200 Te new). Persistence: PL2852 >250 years where fully covered.	Material returned to shore Recovered: 10272 m pipe Remaining: 0 m 5863 Te Rock (Existing). Persistence: N/A This option relates to a trenched gas import line so unlikely to be any significant onshore cleaning / treatment required - no LSA. Pipeline is rigid but expected to be in good condition, plastic strain is likely to be such that it would be unusable as an operational pipeline after recovery (may be possible for derated use). Ability to install may be very low so no credit given for re-use.
		Summary	Options 1 and 2 largely similar from a fishing perspective. Option 2 returns more material to shore thus having a benefit from recycling perspective. Overall option 1 Weaker than option 2.	
5. Economic	5.1 Short-term Costs	This sub-criterion addresses the cost of delivering the option as described. No long-term cost element is considered here. Cost uncertainty (a function of activity maturity) is also recorded.	Cost: 3.1 M Cost Risk: Low Risk Factors: High degree of achievability.	Cost: 4.9 M Cost Risk: High Risk Factors: Medium degree of achievability / High likelihood of failure to expose the line fully without multiple deburial techniques and passes / High likelihood of over trenching in sandy areas leading to areas of disturbance that are larger than required.
	5.2 Long-term Costs	This sub-criterion addresses the costs associated with any long-term liabilities such as on-going monitoring and any potential future remediation costs.	Monitoring Cost: 2.2M Remedial Cost: 0.0M Cost Risk: Low Risk Factors: Low likelihood of future remediation required due to existing burial depth.	There are no long-term cost liabilities associated with this full removal option.
		Summary	The total costs for options 1 and 2 are 5.2 M, and 4.9 M respectively, which are Neutral. However, option 2 has a high cost risk due to potential for challenges during the deburial operations which could lead to cost escalation. Overall, option 1 is Stronger than option 2 due to potential for cost escalation.	

1. Safety	1. Leave - End Removal - Limited Rock Placement	2. Full removal - Reverse Reel	Priorities
1. Leave - End Removal - Limited Rock Placement	N	S	60.00%
2. Full removal - Reverse Reel	W	N	40.00%

2. Environmental	1. Leave - End Removal - Limited Rock Placement	2. Full removal - Reverse Reel	Priorities
1. Leave - End Removal - Limited Rock Placement	N	S	60.00%
2. Full removal - Reverse Reel	W	N	40.00%

3. Technical	1. Leave - End Removal - Limited Rock Placement	2. Full removal - Reverse Reel	Priorities
1. Leave - End Removal - Limited Rock Placement	N	MS	75.00%
2. Full removal - Reverse Reel	MW	N	25.00%

4. Societal	1. Leave - End Removal - Limited Rock Placement	2. Full removal - Reverse Reel	Priorities
1. Leave - End Removal - Limited Rock Placement	N	W	40.00%
2. Full removal - Reverse Reel	S	N	60.00%

5. Economic	1. Leave - End Removal - Limited Rock Placement	2. Full removal - Reverse Reel	Priorities
1. Leave - End Removal - Limited Rock Placement	N	S	60.00%
2. Full removal - Reverse Reel	W	N	40.00%

Dunlin Decision 3 – Trenched and Buried Pipelines

Pairwise Comparison

xodus GROUP

Project Differentiator Attributes

Differentiator	Sub-Criteria	Description	1. Leave - End Removal - Rock Placement	2. Full Removal - Disconnect and recover
1. Safety	1.1 Personnel Offshore	This sub-criterion considers elements that impact risk to offshore personnel and includes, project team, project vessel crew, diving teams, supply boat crew, and survey vessel crew. It should be noted that crew changes are performed via port calls.	Total PLL: 2.42E-03 Vessels located on site for Operations: 15.1 days Legacy: 40.4 days	Total PLL: 1.30E-03 Vessels located on site for 7.5 days.
	1.2 Personnel Onshore	This sub-criterion considers elements that impact risk to onshore personnel. Factors such as any requirement for dismantling, disposal operations, material transfer and onshore handling may impact onshore personnel.	Low risk of high consequence events - routine.	Low risk of high consequence events - routine.
	1.3 Other Users	This sub-criterion covers the impact associated with the risk to other users. Considers elements such as collision impact whilst performing activities. Users such as fishing vessels, commercial transport vessels and military vessels are considered.	Residual Risk Legacy: 35 / 17220 / 9.47E-04 Fishing: Negligible additional risk presented to fisherman from spot rock dumped surface laid spools.	There is no residual legacy risk or risk to fishing operations associated with this option as it is a full removal option.
	1.4 High Consequence Events	This sub-criterion relates to any inherent potential for high consequence events i.e. major accident hazard, major environmental hazard type events. It applies to all onshore and offshore personnel involved in the project. Considerations such as dropped object concerns, support vessel risks, are considered.		
	1.5 Residual Risk	This sub-criterion addresses and residual risk to other sea users i.e. fishermen, military vessel crews, commercial vessel crews and passengers, other sea users, that is provided by the option. Issues such as residual snag risk, collision risk, etc. may be considered.		
	Summary		The summed PLL figures for options 1 and 2 (all worker groups and including legacy component where present) are 2.42E-03 and 1.30E-03 respectively. This indicates that option 2 carries lower overall risk, with the main influence being the lack of a legacy risk component. Vessel durations are higher for option 1 versus option 2 whilst risk of high consequence events are similar. Overall, as the differentials are relatively small, option 1 is Weaker than option 2.	
2. Environmental	2.1 Marine Impacts	This sub-criterion covers elements such as noise generated by vessels, cutting operations, explosives etc. It also covers any damaging discharges to sea from vessels and / or activities performed.	Sound Exposure 251 dB re 1mP / 13.4 TPa2s Higher noise from cutting operations.	Sound Exposure 236 dB re 1mP / 0.4 TPa2s
	2.2 Emissions	This sub-criterion relates to the amount of damaging atmospheric emissions associated with a particular option.	CO2: 2182.3 Te NOx: 40.6 Te SO2: 8.3 Te Lifecycle Emissions CO2: 2191.42 Te CO2 Credit (for steel): N/A	CO2: 525.1 Te NOx: 9.8 Te SO2: 2.0 Te Lifecycle Emissions CO2: 528.66 Te CO2 Credit (for steel): 2.35 Te
	2.3 Consumption	This sub-criterion relates to the amount of Energy / Resource consumption such as fuel use, recycling of materials, use of quarried rock, production of replacement materials.	Fuel: 688.4 Te Rock: 100 Te	Fuel: 165.7 Te Rock: N/A
	2.4 Disturbance	This sub-criterion relates to both direct and indirect seabed disturbance. Both short and long term impacts are considered.	Disturbance Dredging: 40 m2 Rock Dump: 100 m2	Disturbance Dredging: 920 m2
	2.5 Protections	This sub-criterion relates to the impact of the options on any protected sites and species.	This option has no impact on protected sites or species.	This option has no impact on protected sites or species.
	Summary		Option 2 is preferable to option 1 from a noise exposure, emissions and fuel use perspective albeit the differentials are small. It is difficult to differentiate between the options in terms of seabed disturbance as, whilst there is rock being introduced with option 1, the impacted area is very limited. Whilst option 2 impacts a wider area, it is dredging operations only, the impact of which is considered transient in nature. Option 1 is slightly more appealing. Overall, option 1 and 2 are largely Neutral to each other due to option 1 being slightly worse in nosie / emissons / fuel being offset by option 2 being slighlty worse in seabed disturbance.	

3. Technical	3.1 Technical Risk	This sub-criterion relates to the various technical risks that could result in a major project failure. Concepts such as: Technical Novelty and Potential for Showstoppers can be captured along with impact on the schedule due to overruns from technical issues such as operations being interrupted by the weather. Technical Feasibility and Technical Maturity is also considered.	Feasibility: High Concept Maturity: High Availability of Technology: High – Off the shelf Track Record: High – Extensive history Risk of Failure: Low Consequence of Failure: Alternate cutting technique / additional rock / limited schedule impacts Emerging Technology: N/A	Feasibility: High Concept Maturity: High Availability of Technology: High – Off the shelf Track Record: High – Extensive history Risk of Failure: Low Consequence of Failure: Alternate deburial technique / limited schedule impacts Emerging Technology: N/A
		Summary	Options 1 and 2 are equal technically and are therefore scored as Neutral to each other from a technical perspective.	
4. Societal	4.1 Fishing	This sub-criterion addresses the impact of the option on commercial fishing operations. It includes consideration of impacts from both the decommissioning activities any residual impacts post decommissioning such as reinstatement of access to area.	Negligible change in terms of condition of seabed for fishing operations as area is currently overtrawlable.	Negligible change in terms of condition of seabed for fishing operations as area is currently overtrawlable.
	4.2 Other Users	This sub-criterion addresses any socio-economic impacts on other users both onshore where the impact may be from dismantling, transporting, treating, recycling and land filling activities relating to the option and offshore. Issues such as impact on the health, well-being, standard of living, structure or coherence of communities or amenities are considered here e.g. business or jobs creation, increase in noise, dust or odour pollution during the process which has a negative impact on communities, increased traffic disruption due to extra-large transport loads, etc. Includes the FEL Guiding Principle of 'Minimal business interruption to others'.	Material returned to shore Recovered: 35 m (0.6 Te) Remaining: 92 m 980 Te Rock (880 Te Existing + 100 Te New). Persistence: PL2852 >250 years where fully covered.	Material returned to shore Recovered: 127 m (4 Te) Remaining: 880 Te Rock (Existing). Persistence: N/A.
		Summary	Options 1 and 2 are largely similar from a societal perspective and are therefore scored as Neutral to each other. It should be noted that these items are currently within the 500m zone of Dunlin Alpha. If this 500m zone was to reduce in size, these items are still likely to remain in that new, smaller exclusion zone.	
5. Economic	5.1 Short-term Costs	This sub-criterion addresses the cost of delivering the option as described. No long-term cost element is considered here. Cost uncertainty (a function of activity maturity) is also recorded.	Cost: 2.0 M Cost Risk: Low Risk Factors: High degree of achievability.	Cost: 2.3 M Cost Risk: Low Risk Factors: High degree of achievability / Future liability removed.
	5.2 Long-term Costs	This sub-criterion addresses the costs associated with any long-term liabilities such as on-going monitoring and any potential future remediation costs.	Monitoring Cost: 1.6 M Remedial Cost: 0.0 M Cost Risk: Low Risk Factors: Low likelihood of future remediation required due to existing burial depth and proximity to CGB.	There are no long-term cost liabilities associated with this full removal option.
		Summary	The total costs for options 1 and 2 are 3.6 M, and 2.3 M respectively however option 2 does remove any requirement for future monitoring. Overall, option 1 is considered Weaker than option 2 due to the higher overall cost and future monitoring component.	

1. Safety

	1. Leave - End Removal - Rock Placement	2. Full Removal - Disconnect and recover	Priorities
1. Leave - End Removal - Rock Placement	N	W	40.00%
2. Full Removal - Disconnect and recover	S	N	60.00%

2. Environmental

	1. Leave - End Removal - Rock Placement	2. Full Removal - Disconnect and recover	Priorities
1. Leave - End Removal - Rock Placement	N	N	50.00%
2. Full Removal - Disconnect and recover	N	N	50.00%

3. Technical

	1. Leave - End Removal - Rock Placement	2. Full Removal - Disconnect and recover	Priorities
1. Leave - End Removal - Rock Placement	N	N	50.00%
2. Full Removal - Disconnect and recover	N	N	50.00%

4. Societal

	1. Leave - End Removal - Rock Placement	2. Full Removal - Disconnect and recover	Priorities
1. Leave - End Removal - Rock Placement	N	N	50.00%
2. Full Removal - Disconnect and recover	N	N	50.00%

5. Economic

	1. Leave - End Removal - Rock Placement	2. Full Removal - Disconnect and recover	Priorities
1. Leave - End Removal - Rock Placement	N	W	40.00%
2. Full Removal - Disconnect and recover	S	N	60.00%

Dunlin Decision 4 – Rock Dumped Surface Laid Rigid Spools

Pairwise Comparison

xodus GROUP

Project Differentiator Attributes

Differentiator	Sub-Criteria	Description	1. Leave - End Removal - Limited Rock Placement	2. Leave - End removal - Full - Rock Placement	3. Full Removal - Reverse Reel
1. Safety	1.1 Personnel Offshore	This sub-criterion considers elements that impact risk to offshore personnel and includes, project team, project vessel crew, diving teams, supply boat crew, and survey vessel crew. It should be noted that crew changes are performed via port calls.	Total PLL: 2.45E-03 Vessels located on site for Operations: 18.8 days Legacy: 40.9 days	Total PLL: 2.37E-03 Vessels located on site for Operations: 18.8 days Legacy: 40.9 days	Total PLL: 1.01E-03 Vessels located on site for 6.7 days.
	1.2 Personnel Onshore	This sub-criterion considers elements that impact risk to onshore personnel. Factors such as any requirement for dismantling, disposal operations, material transfer and onshore handling may impact onshore personnel.	Low risk of high consequence events - routine.	Low risk of high consequence events - routine.	Low risk of high consequence events - non-routine due to presence of rock dump, it is not unusual to recover umbilicals. Integrity assumed by engineering, high degree of confidence.
	1.3 Other Users	This sub-criterion covers the impact associated with the risk to other users. Considers elements such as collision impact whilst performing activities. Users such as fishing vessels, commercial transport vessels and military vessels are considered.	Residual Risk Legacy: 35 / 17220 / 9.47E-04 Fishing: Negligible additional risk presented to fisherman from spot rock dumped surface laid umbilicals.	Residual Risk Legacy: 35 / 17220 / 9.47E-04 Fishing: Negligible additional risk presented to fisherman from fully rock dumped surface laid umbilicals.	There is no residual legacy risk or risk to fishing operations associated with this option as it is a full removal option.
	1.4 High Consequence Events	This sub-criterion relates to any inherent potential for high consequence events i.e. major accident hazard, major environmental hazard type events. It applies to all onshore and offshore personnel involved in the project. Considerations such as dropped object concerns, support vessel risks, are considered.			
	1.5 Residual Risk	This sub-criterion addresses and residual risk to other sea users i.e. fishermen, military vessel crews, commercial vessel crews and passengers, other sea users, that is provided by the option. Issues such as residual snag risk, collision risk, etc. may be considered.			
		Summary	The summed PLL figures for options 1, 2 and 3 (all worker groups and including legacy component where present) are 2.45E-03, 2.37E-03 and 1.01E-03 respectively. This indicates that option 3 is the lowest risk for all worker groups, due largely to the lower diver and offshore worker group exposure and the lack of a legacy risk componenet. Options 1 and 2 are very similar in terms of risk exposure. Vessel durations are higher for options 1 and 2 versus option 3 and risk of high consequence events are largely similar accross the options. Overall, options 1 and 2 are Neutral to each other. Both options 1 and 2 are Weaker than option 3 due to them having a higher risk exposure.		
2. Environmental	2.1 Marine Impacts	This sub-criterion covers elements such as noise generated by vessels, cutting operations, explosives etc. It also covers any damaging discharges to sea from vessels and / or activities performed.	Sound Exposure 251 dB re 1mP / 13.6 TPa2s	Sound Exposure 251 dB re 1mP / 13.6 TPa2s	Sound Exposure 236 dB re 1mP / 0.4 TPa2s
	2.2 Emissions	This sub-criterion relates to the amount of damaging atmospheric emissions associated with a particular option.	CO2: 2183.7 Te NOx: 40.6 Te SO2: 8.3 Te Lifecycle CO2: 2198.22 Te CO2 Credit for Steel: N/A	CO2: 2185.7 Te NOx: 40.7 Te SO2: 8.3 Te Lifecycle CO2: 2224.02 Te CO2 Credit for Steel: N/A	CO2: 467.3 Te NOx: 8.7 Te SO2: 1.8 Te Lifecycle CO2: 471.18 Te CO2 Credit for Steel: 3.37 Te
	2.3 Consumption	This sub-criterion relates to the amount of Energy / Resource consumption such as fuel use, recycling of materials, use of quarried rock, production of replacement materials.	Fuel: 688.9 Te Rock: 200 Te	Fuel: 689.5 Te Rock: 900 Te	Fuel: 147.4 Te Rock: N/A
	2.4 Disturbance	This sub-criterion relates to both direct and indirect seabed disturbance. Both short and long term impacts are considered.	Disturbance Dredging: 20 m2 Rock Dump: 200 m2	Disturbance Dredging: 20 m2 Rock Dump: 1800 m2	This option has no associated seabed disturbance.
	2.5 Protections	This sub-criterion relates to the impact of the options on any protected sites and species.	This option has no impact on protected sites or species.	This option has no impact on protected sites or species.	This option has no impact on protected sites or species.
		Summary	Options 1 and 2 are largely comparable in terms of noise exposure, emissions, fuel and rock use. Option 3 is an improvement in each area. There is no seabed disturbance associated with option 3 and whilst still a small area for option 1 and 2, has a requirement for permanent rock dump. Overall, option 1 is Stronger than option 2 due to less seabed disturbance and less rock dump, but Weaker than option 3 due to being less attactive in all areas. Option 2 is Weaker than option 3 for similar reasons.		

Project Differentiator Attributes

Differentiator	Sub-Criteria	Description	1. Leave - End Removal - Limited Rock Placement	2. Leave - End removal - Full - Rock Placement	3. Full Removal - Reverse Reel
3. Technical	3.1 Technical Risk	This sub-criterion relates to the various technical risks that could result in a major project failure. Concepts such as: Technical Novelty and Potential for Showstoppers can be captured along with impact on the schedule due to overruns from technical issues such as operations being interrupted by the weather. Technical Feasibility and Technical Maturity is also considered.	Feasibility: High Concept Maturity: High Availability of Technology: High – Off the shelf Track Record: High – Extensive history Risk of Failure: Low Consequence of Failure: Additional rock requirement / limited schedule impacts Emerging Technology: N/A	Feasibility: High Concept Maturity: High Availability of Technology: High – Off the shelf Track Record: High – Extensive history Risk of Failure: Low Consequence of Failure: Additional rock requirement / limited schedule impacts Emerging Technology: N/A	Feasibility: High Concept Maturity: Medium Availability of Technology: High – Off the shelf Track Record: Low – Limited experience of reverse reeling buried umbilicals Risk of Failure: Low – Initial engineering shows low utilisation values during recovery Consequence of Failure: Alternate recovery techniques required / deburial may be required / limited schedule impacts Emerging Technology: N/A Have reverse reeled this umbilical prior to being rock dumped in the recent past.
		Summary	Options 1 and 2 are equal to each other technically. They both carry less technical risk than option 3. Overall, options 1 and 2 are Neutral to each other and both Stronger than option 3 from a technical perspective.		
4. Societal	4.1 Fishing	This sub-criterion addresses the impact of the option on commercial fishing operations. It includes consideration of impacts from both the decommissioning activities any residual impacts post decommissioning such as reinstatement of access to area.	Negligible change in terms of condition of seabed for fishing operations as area is currently overtrawlable.	Negligible change in terms of condition of seabed for fishing operations as area is currently overtrawlable.	Negligible change in terms of condition of seabed for fishing operations as area is currently overtrawlable.
	4.2 Other Users	This sub-criterion addresses any socio-economic impacts on other users both onshore where the impact may be from dismantling, transporting, treating, recycling and land filling activities relating to the option and offshore. Issues such as impact on the health, well-being, standard of living, structure or coherence of communities or amenities are considered here e.g. business or jobs creation, increase in noise, dust or odour pollution during the process which has a negative impact on communities, increased traffic disruption due to extra-large transport loads, etc. Includes the FEL Guiding Principle of 'Minimal business interruption to others'.	Material returned to shore Recovered: 30 m Umbilical (0.2Te) Remaining: 550 m Umbilical 2917 Te Rock (2717 Te Existing + 200 Te New). Persistence: >100 years (no long term data / experience of polymers in seawater / buried).	Material returned to shore Recovered: 30 m Umbilical (0.2 Te) Remaining: 550 m Umbilical 3617 Te Rock (2717 Te Existing + 900 Te New). Persistence: >100 years (no long term data / experience of polymers in seawater/buried).	Material returned to shore Recovered: 580 m Umbilical (4.6Te) Remaining: 0 m 2717 Te Rock (existing). Persistence: N/A
		Summary	All options see negligible change in terms of fishing conditions (in all cases any existing snags / spans will be removed). All options Neutral to each other from a societal perspective.		
5. Economic	5.1 Short-term Costs	This sub-criterion addresses the cost of delivering the option as described. No long-term cost element is considered here. Cost uncertainty (a function of activity maturity) is also recorded.	Cost: 2.4 M Cost Risk: Low Risk Factors: High degree of achievability.	Cost: 2.4 M Cost Risk: Low Risk Factors: High degree of achievability.	Cost: 2.2 M Cost Risk: Low Risk Factors: Whilst initial engineering indicates a high degree of achievability, potential for deburial operations to increase schedule and cost, although the impact of these overruns is considered low.
	5.2 Long-term Costs	This sub-criterion addresses the costs associated with any long-term liabilities such as on-going monitoring and any potential future remediation costs.	Monitoring Cost: 1.6 M Remedial Cost: 0.0 M Cost Risk: Low Risk Factors: Low likelihood of future remediation required due to proximity to CGB.	Monitoring Cost: 1.6 M Remedial Cost: 0.0 M Cost Risk: Low Risk Factors: Low likelihood of future remediation required due to proximity to CGB.	There are no long-term cost liabilities associated with this full removal option.
		Summary	The total costs for options 1, 2 and 3 are 4.0 M, 4.0 M and 2.2 M respectively. Both options 1 and 2 have lower cost risk with option 3 having a higher potential for cost overruns relating to possible requirement to debury the umbillical. Overall, option 1 and 2 are Neutral to each other. Options 1 and 2 are both Weaker than option 3 due to lower total cost with the cost risk associated with option 3 being insufficient to influence this. Option 3 also removes requirement for on-going monitoring.		

1. Safety	1. Leave - End Removal - Limited Rock Placement	2. Leave - End removal - Full - Rock Placement	3. Full Removal - Reverse Reel	Priorities
1. Leave - End Removal - Limited Rock Placement	N	N	W	28.57%
2. Leave - End removal - Full - Rock Placement	N	N	W	28.57%
3. Full Removal - Reverse Reel	S	S	N	42.86%

2. Environmental	1. Leave - End Removal - Limited Rock Placement	2. Leave - End removal - Full - Rock Placement	3. Full Removal - Reverse Reel	Priorities
1. Leave - End Removal - Limited Rock Placement	N	S	W	32.54%
2. Leave - End removal - Full - Rock Placement	W	N	W	24.83%
3. Full Removal - Reverse Reel	S	S	N	42.63%

3. Technical	1. Leave - End Removal - Limited Rock Placement	2. Leave - End removal - Full - Rock Placement	3. Full Removal - Reverse Reel	Priorities
1. Leave - End Removal - Limited Rock Placement	N	N	S	37.50%
2. Leave - End removal - Full - Rock Placement	N	N	S	37.50%
3. Full Removal - Reverse Reel	W	W	N	25.00%

4. Societal	1. Leave - End Removal - Limited Rock Placement	2. Leave - End removal - Full - Rock Placement	3. Full Removal - Reverse Reel	Priorities
1. Leave - End Removal - Limited Rock Placement	N	N	N	33.33%
2. Leave - End removal - Full - Rock Placement	N	N	N	33.33%
3. Full Removal - Reverse Reel	N	N	N	33.33%

5. Economic	1. Leave - End Removal - Limited Rock Placement	2. Leave - End removal - Full - Rock Placement	3. Full Removal - Reverse Reel	Priorities
1. Leave - End Removal - Limited Rock Placement	N	N	W	28.57%
2. Leave - End removal - Full - Rock Placement	N	N	W	28.57%
3. Full Removal - Reverse Reel	S	S	N	42.86%

Dunlin Decision 5 – Rock Dumped Surface Laid Umbilicals

Pairwise Comparison

xodus GROUP

Project Differentiator Attributes

Differentiator	Sub-Criteria	Description	1. Leave - Outboard Cut and Recover	2. Full Removal - Topsides Pull
1. Safety	1.1 Personnel Offshore	This sub-criterion considers elements that impact risk to offshore personnel and includes, project team, project vessel crew, diving teams, supply boat crew, and survey vessel crew. It should be noted that crew changes are performed via port calls.	Total PLL: 9.46E-04 Vessels located on site for 6 days.	Total PLL: 1.83E-03 Vessels located on site for 16 days.
	1.2 Personnel Onshore	This sub-criterion considers elements that impact risk to onshore personnel. Factors such as any requirement for dismantling, disposal operations, material transfer and onshore handling may impact onshore personnel.	Low risk of high consequence events - routine.	Medium risk of high consequence events - non-routine, not unusual.
	1.3 Other Users	This sub-criterion covers the impact associated with the risk to other users. Considers elements such as collision impact whilst performing activities. Users such as fishing vessels, commercial transport vessels and military vessels are considered.	There is no residual risk associated with this option as it is wholly within the 500m exclusion zone and all outboard elements are fully removed.	There is no residual risk associated with this full removal option.
	1.4 High Consequence Events	This sub-criterion relates to any inherent potential for high consequence events i.e. major accident hazard, major environmental hazard type events. It applies to all onshore and offshore personnel involved in the project. Considerations such as dropped object concerns, support vessel risks, are considered.	The summed PLL figures for options 1 and 2 (all worker groups and including legacy component where present) are 9.46E-04 and 1.83E-03 respectively. This indicates that option 1 is lower than option 2, driven by the marginally higher exposure associated with the offshore, topsides and onshore worker groups for option 2. Option 1 is also slightly shorter duration. Overall, option 1 is Much Stronger than option 2 from a safety perspective.	
	1.5 Residual Risk	This sub-criterion addresses and residual risk to other sea users i.e. fishermen, military vessel crews, commercial vessel crews and passengers, other sea users, that is provided by the option. Issues such as residual snag risk, collision risk, etc. may be considered.		
	Summary			
2. Environmental	2.1 Marine Impacts	This sub-criterion covers elements such as noise generated by vessels, cutting operations, explosives etc. It also covers any damaging discharges to sea from vessels and / or activities performed.	Sound Exposure 239 dB re 1mP / 0.8 TPa2s	Sound Exposure 245 dB re 1mP / 3.0 TPa2s
	2.2 Emissions	This sub-criterion relates to the amount of damaging atmospheric emissions associated with a particular option.	CO2: 415.0 Te NOx: 7.7 Te SO2: 1.6 Te Lifecycle CO2: 443.08 Te CO2 Credit for Steel: N/A	CO2: 732.0 Te NOx: 13.6 Te SO2: 2.8 Te Lifecycle CO2: 747.66 Te CO2 Credit for Steel: 2.69 Te
	2.3 Consumption	This sub-criterion relates to the amount of Energy / Resource consumption such as fuel use, recycling of materials, use of quarried rock, production of replacement materials.	Fuel: 130.9 Te Rock: None	Fuel: 230.9 Te Rock: None
	2.4 Disturbance	This sub-criterion relates to both direct and indirect seabed disturbance. Both short and long term impacts are considered.	This option has no associated seabed disturbance.	This option has no associated seabed disturbance.
	2.5 Protections	This sub-criterion relates to the impact of the options on any protected sites and species.	This option has no impact on protected sites or species.	This option has no impact on protected sites or species.
	Summary		Option 1 is either equal to or marginally better than option 2 in all areas. As such, option 1 is Stronger than option 2 from an environmental perspective due to the cumulative effect of these marginal improvements.	

Project Differentiator Attributes

Differentiator	Sub-Criteria	Description	1. Leave - Outboard Cut and Recover	2. Full Removal - Topsides Pull
3. Technical	3.1 Technical Risk	This sub-criterion relates to the various technical risks that could result in a major project failure. Concepts such as: Technical Novelty and Potential for Showstoppers can be captured along with impact on the schedule due to overruns from technical issues such as operations being interrupted by the weather. Technical Feasibility and Technical Maturity is also considered.	Feasibility: High. Concept Maturity: High. Availability of Technology: High – Off the shelf. Track Record: High – Extensive history of similar work. Risk of Failure: Low. Consequence of Failure: Limited schedule impacts. Emerging Technology: Diverless cutting may be an option.	Feasibility: High Concept Maturity: Medium - final details for performing task are yet to be defined, platform crane, winch placement and operations, etc. Availability of Technology: High – Off the shelf Track Record: High – Extensive history in North Sea and recent history on Dunlin. Risk of Failure: Medium – Unknown integrity of J-tube / cable and inability to inspect. Consequence of Failure: Cable would remain within J-tube / schedule overruns Emerging Technology: N/A.
		Summary	Option 1 carries significantly less technical risk than option 2 due largely to the potential / consequence of failure related to j-tube integrity uncertainty. Overall option 1 considered Stronger than option 2 from a Technical Feasibility perspective.	
4. Societal	4.1 Fishing	This sub-criterion addresses the impact of the option on commercial fishing operations. It includes consideration of impacts from both the decommissioning activities any residual impacts post decommissioning such as reinstatement of access to area.	Will not remain on seabed - no long term exposure.	Will not remain on seabed - no long term exposure.
	4.2 Other Users	This sub-criterion addresses any socio-economic impacts on other users both onshore where the impact may be from dismantling, transporting, treating, recycling and land filling activities relating to the option and offshore. Issues such as impact on the health, well-being, standard of living, structure or coherence of communities or amenities are considered here e.g. business or jobs creation, increase in noise, dust or odour pollution during the process which has a negative impact on communities, increased traffic disruption due to extra-large transport loads, etc. Includes the FEL Guiding Principle of 'Minimal business interruption to others'.	Material returned to shore Recovered: 300 m Cable Remaining: 180 m Cable (within J-tube) Persistence: In-line with CGB & J-tubes >250 years.	Material returned to shore Recovered: 480 m Cable Remaining: 0 m Persistence: N/A
		Summary	Options 1 and 2 are largely similar from a societal perspective. There is more material returned to shore under option 2, however this was not considered significant enough to change the scoring from Neutral.	
5. Economic	5.1 Short-term Costs	This sub-criterion addresses the cost of delivering the option as described. No long-term cost element is considered here. Cost uncertainty (a function of activity maturity) is also recorded.	Cost: 1.9 M Cost Risk: Low Risk Factors: High degree of achievability.	Cost: 3.2 M Cost Risk: Medium Risk Factors: Topside engineering for winch locating is not mature / inspection to confirm integrity of J-tube and cable is not possible / previous pull-in operations have suffered delays and cost overruns. Historical overruns have been pull-in rather than removal operations.
	5.2 Long-term Costs	This sub-criterion addresses the costs associated with any long-term liabilities such as on-going monitoring and any potential future remediation costs.	No long-term costs, any Monitoring is assumed to be done as part of any CGB monitoring.	No long-term costs associated with this full removal option.
		Summary	Option 1 has a lower cost and cost risk than option 2. Therefore option 1 is Stronger than option 2.	

1. Safety

	1. Leave - Outboard Cut and Recover	2. Full Removal - Topsides Pull	Priorities
1. Leave - Outboard Cut and Recover	N	MS	75.00%
2. Full Removal - Topsides Pull	MW	N	25.00%

2. Environmental

	1. Leave - Outboard Cut and Recover	2. Full Removal - Topsides Pull	Priorities
1. Leave - Outboard Cut and Recover	N	S	60.00%
2. Full Removal - Topsides Pull	W	N	40.00%

3. Technical

	1. Leave - Outboard Cut and Recover	2. Full Removal - Topsides Pull	Priorities
1. Leave - Outboard Cut and Recover	N	S	60.00%
2. Full Removal - Topsides Pull	W	N	40.00%

4. Societal

	1. Leave - Outboard Cut and Recover	2. Full Removal - Topsides Pull	Priorities
1. Leave - Outboard Cut and Recover	N	N	50.00%
2. Full Removal - Topsides Pull	N	N	50.00%

5. Economic

	1. Leave - Outboard Cut and Recover	2. Full Removal - Topsides Pull	Priorities
1. Leave - Outboard Cut and Recover	N	S	60.00%
2. Full Removal - Topsides Pull	W	N	40.00%

Dunlin Decision 6 – Riser Cable (Dunlin)

Pairwise Comparison

xodus GROUP

Project Differentiator Attributes

Differentiator	Sub-Criteria	Description	1. Leave - End Removal - Limited Rock Placement	2. Leave - End / Span / Exposure removal - Extensive Rock Placement	3. Full Removal - Reverse Reel
1. Safety	1.1 Personnel Offshore	This sub-criterion considers elements that impact risk to offshore personnel and includes, project team, project vessel crew, diving teams, supply boat crew, and survey vessel crew. It should be noted that crew changes are performed via port calls.	Total PLL: 3.68E-03 Vessels located on site for Operations: 27.4 days Legacy: 73 days	Total PLL: 4.57E-03 Vessels located on site for Operations: 30.2 days Legacy: 73 days	Total PLL: 4.17E-03 Vessels located on site for 39.6 days.
	1.2 Personnel Onshore	This sub-criterion considers elements that impact risk to onshore personnel. Factors such as any requirement for dismantling, disposal operations, material transfer and onshore handling may impact onshore personnel.	Low risk of high consequence events - routine.	Low risk of high consequence events - routine.	Low risk of high consequence events - non-routine but not unusual to recover umbilicals / cables. Length is a factor, as is diameter and requirement to de-bury cable prior to reverse reeling.
	1.3 Other Users	This sub-criterion covers the impact associated with the risk to other users. Considers elements such as collision impact whilst performing activities. Users such as fishing vessels, commercial transport vessels and military vessels are considered.	Residual Risk Legacy: 35 / 30660 / 1.69E-03 Fishing: Negligible additional risk presented to fisherman from spot rock dumped cable.	Residual Risk Legacy: 35 / 30660 / 1.69E-03 Fishing: Negligible additional risk presented to fisherman from fully rock dumped cable.	There is no legacy or additional fishing risk associated with this full removal option.
	1.4 High Consequence Events	This sub-criterion relates to any inherent potential for high consequence events i.e. major accident hazard, major environmental hazard type events. It applies to all onshore and offshore personnel involved in the project. Considerations such as dropped object concerns, support vessel risks, are considered.			
	1.5 Residual Risk	This sub-criterion addresses and residual risk to other sea users i.e. fishermen, military vessel crews, commercial vessel crews and passengers, other sea users, that is provided by the option. Issues such as residual snag risk, collision risk, etc. may be considered.			
		Summary	The summed PLL figures for options 1, 2 and 3 (all worker groups and including legacy component where present) are 3.68E-03, 4.57E-03 and 4.17E-03 respectively. This indicates that option 1 is the lowest risk for all worker groups, due to low diver exposure and much lower onshore exposure. Option 3 carries the next lowest exposure with low diver hours and no legacy risk component being offset by the higher number of onshore hours. Finally, option 2 has the highest risk profile due to the much higher number of divers hours in comparison with the other options. Vessel durations and risk of high consequence events are similar between options 1 and 2 with option 3 being a lower due to no legacy component. The options are equal in terms of risk of high consequence events. Overall, option 1 is Stronger than option 2 as it has a lower risk exposure. Option 1 is Weaker than option 3 as it has a higher risk exposure. Option 2 is also weaker than option 3 as it has a higher risk exposure.		
2. Environmental	2.1 Marine Impacts	This sub-criterion covers elements such as noise generated by vessels, cutting operations, explosives etc. It also covers any damaging discharges to sea from vessels and / or activities performed.	Sound Exposure 253 dB re 1mP / 21.9 TPa2s	Sound Exposure 254 dB re 1mP / 23.9 TPa2s	Sound Exposure 251 dB re 1mP / 12.0 TPa2s
	2.2 Emissions	This sub-criterion relates to the amount of damaging atmospheric emissions associated with a particular option.	CO2: 3612.2 Te NOx: 67.2 Te SO2: 13.7 Te Lifecycle CO2: 6539.58 Te CO2 Credit for Steel: N/A	CO2: 3807.5 Te NOx: 70.9 Te SO2: 14.4 Te Lifecycle CO2: 6700.05 Te CO2 Credit for Steel: N/A	CO2: 2761.0 Te NOx: 51.4 Te SO2: 10.5 Te Lifecycle CO2: 3127.53 Te CO2 Credit for Steel: 318.05 Te
	2.3 Consumption	This sub-criterion relates to the amount of Energy / Resource consumption such as fuel use, recycling of materials, use of quarried rock, production of replacement materials.	Fuel: 1139.5 Te Rock: 22300 Te	Fuel: 1201.1 Te Rock: 21600 Te	Fuel: 871.0 Te Rock: N/A
	2.4 Disturbance	This sub-criterion relates to both direct and indirect seabed disturbance. Both short and long term impacts are considered.	Disturbance Dredging: 40 m2 Rock Dump: 25800 m2	Disturbance Dredging: 120 m2 Rock Dump: 25000 m2	Disturbance Dredging: 106485 m2
	2.5 Protections	This sub-criterion relates to the impact of the options on any protected sites and species.	This option has no impact on protected sites or species.	This option has no impact on protected sites or species.	This option has no impact on protected sites or species.
		Summary	Option 1 and 2 are largely comparable in terms of noise exposure, emissions, fuel and rock use, with option 3 being an improvement in each area. Both options 1 and 2 do introduce a significant amount of (largely comparable) new material and permanent seabed impact when compared to the option 3. The transient seabed disturbance (dredging) is largely similar for options 1 and 2. Option 3 has a much greater transient seabed disturbance area however the temporary nature of this impact offsets the larger area. Overall, option 1 and 2 are Neutral to each other. Option 1 and 2 are considered Weaker than option 3 due to the introduction of rock dump (and hence permanent seabed impact) and higher noise / emissions / fuel / rock use.		
3. Technical	3.1 Technical Risk	This sub-criterion relates to the various technical risks that could result in a major project failure. Concepts such as: Technical Novelty and Potential for Showstoppers can be captured along with impact on the schedule due to overruns from technical issues such as operations being interrupted by the weather. Technical Feasibility and Technical Maturity is also considered.	Feasibility: High Concept Maturity: High Availability of Technology: High – Off the shelf Track Record: High – Extensive history Risk of Failure: Low Consequence of Failure: Alternate cutting technique / additional rock / limited schedule impacts Emerging Technology: Diverless cutting may be an option.	Feasibility: High Concept Maturity: High Availability of Technology: High – Off the shelf Track Record: High – Extensive history Risk of Failure: Low Consequence of Failure: Alternate cutting technique / additional rock / limited schedule impacts Emerging Technology: Diverless cutting may be an option.	Feasibility: Medium Concept Maturity: Low Availability of Technology: Medium – Limited number of existing techniques suitable for deburial - soils / clays in area not conducive to deburial Track Record: Low – Limited experience of exposing cables over extended distances to enable re-reeling Risk of Failure: High Consequence of Failure: Alternate deburial techniques required / Alternate recovery techniques required/ rock required to remedy over dredged areas / large schedule overruns with limited ability to recover. Emerging Technology: N/A The length of challenging operations pushes the assessment to VMW than alternatives.
		Summary	Options 1 and 2 are equal to each other technically. They both carry much less technical risk than option 3 due to the uncertainty surrounding the ability to successfully debury the cable, particularly in areas where soils / clays are not conducive to simple deburial operations and the length (21 km) over which these operations need to be performed. Overall, options 1 and 2 are Neutral to each other and both Very Much Stronger than option 3 from a technical perspective.		

Project Differentiator Attributes

Differentiator	Sub-Criteria	Description	1. Leave - End Removal - Limited Rock Placement	2. Leave - End / Span / Exposure removal - Extensive Rock Placement	3. Full Removal - Reverse Reel
4. Societal	4.1 Fishing	This sub-criterion addresses the impact of the option on commercial fishing operations. It includes consideration of impacts from both the decommissioning activities any residual impacts post decommissioning such as reinstatement of access to area.	Exposures (not spans) so no material change to fishing.	No material change to fishing.	No material change to fishing.
	4.2 Other Users	This sub-criterion addresses any socio-economic impacts on other users both onshore where the impact may be from dismantling, transporting, treating, recycling and land filling activities relating to the option and offshore. Issues such as impact on the health, well-being, standard of living, structure or coherence of communities or amenities are considered here e.g. business or jobs creation, increase in noise, dust or odour pollution during the process which has a negative impact on communities, increased traffic disruption due to extra-large transport loads, etc. Includes the FEL Guiding Principle of 'Minimal business interruption to others'.	Material returned to shore Recovered: 100 m Cable Remaining: 21303 m Cable 33912 Te Rock (11612 Te Existing + 22300 Te New). Persistence: >100 years (no long term data / experience of polymers in seawater / buried). Requires minor excursion into Brent 500m zone but not sufficient disruption to influence assessment.	Material returned to shore Recovered: 260m Cable Remaining: 21223 m Cable 33212 Te Rock (11612 Te Existing + 21600 Te New). Persistence: >100 years (no long term data/experience of polymers in seawater/buried). Requires minor excursion into Brent 500m zone but not sufficient disruption to influence assessment.	Material returned to shore Recovered: 21403 m Cable (726.5 Te) Remaining: 11612 Te Rock (Existing). Persistence: N/A Some societal benefits from retrieval of copper including value. There are challenges associated with disposal routes for returned umbilical.
	Summary		There is a societal benefit associated with the copper that can be reclaimed under option 3, however there is also a large amount of material that is not recyclable which offsets that benefit. Overall options 1 and 2 are identical so are scored Neutral to each other. Options 1 and 2 are Stronger than option 3 due to the amount of non-recyclable material returned.		
5. Economic	5.1 Short-term Costs	This sub-criterion addresses the cost of delivering the option as described. No long-term cost element is considered here. Cost uncertainty (a function of activity maturity) is also recorded.	Cost: 4.8 M Cost Risk: Low Risk Factors: High degree of achievability.	Cost: 5.7 M Cost Risk: Low Risk Factors: High degree of achievability.	Cost: 8.0 M Cost Risk: Very High Risk Factors: Medium degree of achievability / High likelihood of failure to expose the line fully without multiple deburial techniques and passes / High likelihood of over trenching in sandy areas leading to areas of disturbance that are larger than required with potential remediation required.
	5.2 Long-term Costs	This sub-criterion addresses the costs associated with any long-term liabilities such as on-going monitoring and any potential future remediation costs.	Monitoring Cost: 2.9M Remedial Cost: 0.0M Cost Risk: Low Risk Factors: Low likelihood of future remediation required due to existing burial depth.	Monitoring Cost: 2.9M Remedial Cost: 0.0M Cost Risk: Low Risk Factors: Low likelihood of future remediation required due to existing burial depth.	No long-term costs associated with this full removal option.
	Summary		The total costs for options 1, 2 and 3 are 7.7 M, 8.6 M and 8.0 M respectively. Both options 1 and 2 have lower cost risk than option 3 which has higher potential for cost overruns relating to deburial of 21km of umbilical in challenging soils and clays. Overall, option 1 is Stronger than option 2 due to lower cost, and Much Stronger than option 3 due to potential overruns associated with option 3. Option 2 is Much Stronger than option 3 as, whilst option 3 is slightly lower cost with no legacy component, the potential for significant cost overrun more than offsets that small benefit.		

1. Safety

	1. Leave - End Removal - Limited Rock Placement	2. Leave - End / Span / Exposure removal - Extensive Rock Placement	3. Full Removal - Reverse Reel	Priorities
1. Leave - End Removal - Limited Rock Placement	N	S	W	32.54%
2. Leave - End / Span / Exposure removal - Extensive Rock Placement	W	N	W	24.83%
3. Full Removal - Reverse Reel	S	S	N	42.63%

2. Environmental

	1. Leave - End Removal - Limited Rock Placement	2. Leave - End / Span / Exposure removal - Extensive Rock Placement	3. Full Removal - Reverse Reel	Priorities
1. Leave - End Removal - Limited Rock Placement	N	N	W	28.57%
2. Leave - End / Span / Exposure removal - Extensive Rock Placement	N	N	W	28.57%
3. Full Removal - Reverse Reel	S	S	N	42.86%

3. Technical

	1. Leave - End Removal - Limited Rock Placement	2. Leave - End / Span / Exposure removal - Extensive Rock Placement	3. Full Removal - Reverse Reel	Priorities
1. Leave - End Removal - Limited Rock Placement	N	N	VMS	47.37%
2. Leave - End / Span / Exposure removal - Extensive Rock Placement	N	N	VMS	47.37%
3. Full Removal - Reverse Reel	VMW	VMW	N	5.26%

4. Societal

	1. Leave - End Removal - Limited Rock Placement	2. Leave - End / Span / Exposure removal - Extensive Rock Placement	3. Full Removal - Reverse Reel	Priorities
1. Leave - End Removal - Limited Rock Placement	N	N	S	37.50%
2. Leave - End / Span / Exposure removal - Extensive Rock Placement	N	N	S	37.50%
3. Full Removal - Reverse Reel	W	W	N	25.00%

5. Economic

	1. Leave - End Removal - Limited Rock Placement	2. Leave - End / Span / Exposure removal - Extensive Rock Placement	3. Full Removal - Reverse Reel	Priorities
1. Leave - End Removal - Limited Rock Placement	N	S	MS	48.68%
2. Leave - End / Span / Exposure removal - Extensive Rock Placement	W	N	MS	37.15%
3. Full Removal - Reverse Reel	MW	MW	N	14.17%

Dunlin Decision 7 – Trenched and Buried Cable

Pairwise Comparison

xodus GROUP

Project Differentiator Attributes

Differentiator	Sub-Criteria	Description	1. Leave - Outboard Cut and Recover	2. Full Removal - Topsides Pull
1. Safety	1.1 Personnel Offshore	This sub-criterion considers elements that impact risk to offshore personnel and includes, project team, project vessel crew, diving teams, supply boat crew, and survey vessel crew. It should be noted that crew changes are performed via port calls.	Total PLL: 9.46E-04 Vessels located on site for 6 days.	Total PLL: 1.83E-03 Vessels located on site for 16 days.
	1.2 Personnel Onshore	This sub-criterion considers elements that impact risk to onshore personnel. Factors such as any requirement for dismantling, disposal operations, material transfer and onshore handling may impact onshore personnel.		
	1.3 Other Users	This sub-criterion covers the impact associated with the risk to other users. Considers elements such as collision impact whilst performing activities. Users such as fishing vessels, commercial transport vessels and military vessels are considered.		
	1.4 High Consequence Events	This sub-criterion relates to any inherent potential for high consequence events i.e. major accident hazard, major environmental hazard type events. It applies to all onshore and offshore personnel involved in the project. Considerations such as dropped object concerns, support vessel risks, are considered.	Low risk of high consequence events - routine.	Medium risk of high consequence events - non-routine, not unusual.
	1.5 Residual Risk	This sub-criterion addresses and residual risk to other sea users i.e. fishermen, military vessel crews, commercial vessel crews and passengers, other sea users, that is provided by the option. Issues such as residual snag risk, collision risk, etc. may be considered.	There is no residual risk associated with this option as it is wholly within the 500m exclusion zone and all outboard elements are fully removed.	There is no residual risk associated with this full removal option.
	Summary		The summed PLL figures for options 1 and 2 (all worker groups and including legacy component where present) are 9.46E-04 and 1.83E-03 respectively. This indicates that option 1 is lower than option 2, driven by the marginally higher exposure associated with the offshore, topsides and onshore worker groups for option 2. Option 1 is also slightly shorter duration. Overall, option 1 is Much Stronger than option 2 from a safety perspective.	
2. Environmental	2.1 Marine Impacts	This sub-criterion covers elements such as noise generated by vessels, cutting operations, explosives etc. It also covers any damaging discharges to sea from vessels and / or activities performed.	Sound Exposure 239 dB re 1mP / 0.8 TPa2s Lower than option 2 but very similar.	Sound Exposure 245 dB re 1mP / 3.0 TPa2s
	2.2 Emissions	This sub-criterion relates to the amount of damaging atmospheric emissions associated with a particular option.	CO2: 415 Te NOx: 7.7 Te SO2: 1.6 Te Lifecycle CO2: 443.08 Te CO2 Credit for Steel: N/A	CO2: 732.0 Te NOx: 13.6 Te SO2: 2.8 Te Lifecycle CO2: 747.66 Te CO2 Credit for Steel: 2.69 Te
	2.3 Consumption	This sub-criterion relates to the amount of Energy / Resource consumption such as fuel use, recycling of materials, use of quarried rock, production of replacement materials.	Fuel: 130.9 Te Rock: None	Fuel: 230.9 Te Rock: None
	2.4 Disturbance	This sub-criterion relates to both direct and indirect seabed disturbance. Both short and long term impacts are considered.	This option has no associated seabed disturbance.	This option has no associated seabed disturbance.
	2.5 Protections	This sub-criterion relates to the impact of the options on any protected sites and species.	This option has no impact on protected sites or species.	This option has no impact on protected sites or species.
	Summary		Option 1 is either equal to or marginally better than option 2 in all areas. As such, option 1 is Stronger than option 2 from an environmental perspective due to the cumulative effect of these marginal improvements.	

Project Differentiator Attributes

Differentiator	Sub-Criteria	Description	1. Leave - Outboard Cut and Recover	2. Full Removal - Topsides Pull
3. Technical	3.1 Technical Risk	This sub-criterion relates to the various technical risks that could result in a major project failure. Concepts such as: Technical Novelty and Potential for Showstoppers can be captured along with impact on the schedule due to overruns from technical issues such as operations being interrupted by the weather. Technical Feasibility and Technical Maturity is also considered.	Feasibility: High. Concept Maturity: High. Availability of Technology: High – Off the shelf. Track Record: High – Extensive history of similar work. Risk of Failure: Low. Consequence of Failure: Limited schedule impacts. Emerging Technology: Diverless cutting may be an option.	Feasibility: High Concept Maturity: Medium - final details for performing task are yet to be defined, platform crane, winch placement and operations, etc. Availability of Technology: High – Off the shelf Track Record: High – Extensive history in North Sea and recent history on Dunlin. Risk of Failure: Medium – Unknown integrity of J-tube / cable and inability to inspect. Consequence of Failure: Cable would remain within J-tube / schedule over runs Emerging Technology: N/A.
		Summary	Option 1 carries significantly less technical risk than option 2 due largely to the potential / consequence of failure related to j-tube integrity uncertainty. Overall option 1 considered Stronger than option 2 from a Technical Feasibility perspective.	
4. Societal	4.1 Fishing	This sub-criterion addresses the impact of the option on commercial fishing operations. It includes consideration of impacts from both the decommissioning activities any residual impacts post decommissioning such as reinstatement of access to area.	Will not remain on seabed - no long term exposure.	Will not remain on seabed - no long term exposure.
	4.2 Other Users	This sub-criterion addresses any socio-economic impacts on other users both onshore where the impact may be from dismantling, transporting, treating, recycling and land filling activities relating to the option and offshore. Issues such as impact on the health, well-being, standard of living, structure or coherence of communities or amenities are considered here e.g. business or jobs creation, increase in noise, dust or odour pollution during the process which has a negative impact on communities, increased traffic disruption due to extra-large transport loads, etc. Includes the FEL Guiding Principle of 'Minimal business interruption to others'.	Material returned to shore Recovered: 300 m Cable Remaining: 180 m Cable (within J-tube) Persistence: In-line with CGB & J-tubes >250 years.	Material returned to shore Recovered: 480 m Cable Remaining: 0m Persistence: N/A
		Summary	Options 1 and 2 are largely similar from a societal perspective. There is more material returned to shore under option 2, however this was not considered significant enough to change the scoring from Neutral.	
5. Economic	5.1 Short-term Costs	This sub-criterion addresses the cost of delivering the option as described. No long-term cost element is considered here. Cost uncertainty (a function of activity maturity) is also recorded.	Cost: 1.9 M Cost Risk: Low Risk Factors: High degree of achievability.	Cost: 3.2 M Cost Risk: Medium Risk Factors: Topside engineering for winch locating is not mature / inspection to confirm integrity of J-tube and cable is not possible / previous pull-in operations have suffered delays and cost overruns. Historical overruns have been pull-in rather than removal operations.
	5.2 Long-term Costs	This sub-criterion addresses the costs associated with any long-term liabilities such as on-going monitoring and any potential future remediation costs.	No long-term costs, any Monitoring is assumed to be done as part of any CGB monitoring.	No long-term costs associated with this full removal option.
		Summary	Option 1 has a lower cost and cost risk than option 2. Therefore option 1 is Stronger than option 2.	

1. Safety

	1. Leave - Outboard Cut and Recover	2. Full Removal - Topsides Pull	Priorities
1. Leave - Outboard Cut and Recover	N	MS	75.00%
2. Full Removal - Topsides Pull	MW	N	25.00%

2. Environmental

	1. Leave - Outboard Cut and Recover	2. Full Removal - Topsides Pull	Priorities
1. Leave - Outboard Cut and Recover	N	S	60.00%
2. Full Removal - Topsides Pull	W	N	40.00%

3. Technical

	1. Leave - Outboard Cut and Recover	2. Full Removal - Topsides Pull	Priorities
1. Leave - Outboard Cut and Recover	N	S	60.00%
2. Full Removal - Topsides Pull	W	N	40.00%

4. Societal

	1. Leave - Outboard Cut and Recover	2. Full Removal - Topsides Pull	Priorities
1. Leave - Outboard Cut and Recover	N	N	50.00%
2. Full Removal - Topsides Pull	N	N	50.00%

5. Economic

	1. Leave - Outboard Cut and Recover	2. Full Removal - Topsides Pull	Priorities
1. Leave - Outboard Cut and Recover	N	S	60.00%
2. Full Removal - Topsides Pull	W	N	40.00%

Dunlin Decision 8 – Riser Cable (Third Party)

Pairwise Comparison

xodus GROUP